# Design Research Communication: Guidance for Researchers, Authors, and Students

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**Marcel Cahenzli**
from
Sternenberg (Zurich)

Approved on the application of

**Prof. Dr. Robert Winter**
and
**Prof. Dr. Jannis Beese**

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St. Gallen, May 24, 2022

The President:

Prof. Dr. Bernhard Ehrenzeller

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# List of Abbreviations

| | |
|---|---|
| ADR | Action Design Research (research approach) |
| CE | Content elements, codes to identify structure in research articles |
| DESRIST | International Conference on Design Science Research in Information Systems and Technology |
| DP | Design Principle |
| DR | Design Research (i.e., research applying the DSR methodology) |
| DS | Design Science (i.e., meta-research about design research) |
| DSR | Design Science Research (research paradigm in IS) |
| DSRM | Design Science Research Methodology (see: Peffers et a., 2007) |
| IS | Information Systems (field of research) |
| IT | Information Technology |
| PDF | Portable Document Format (standardised file format) |
| RQ | Research question |
| SciCom | Science Communication (stream of literature) |

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# Abstract

Design Science Research (DSR) is a pragmatic, utility-oriented, scientific approach to solving relevant Information Technology (IT) and Information Systems (IS) related organisational problems. It represents one of two essential paradigms in IS research, and its research output is not descriptive but prescriptive. It instructs about how general problems of the same class can be solved. Research projects in DSR (i.e., design research projects) involve many stakeholders from research and practice. They are iterative, lengthy, and complex, combining the roams of theory (ensuring rigour by using existing knowledge) and practice (ensuring relevance by actively integrating the stakeholders of the problem in the research process). At the same time, such research contributes both to research (through the identification of prescriptive means-end relationships) and to practice (providing instructions to solve practical organisational problems).

This very brief summary of DSR already makes one thing evident: Design research project communication is essential for this kind of research. Poor communication leads to inefficient exchange with practice, rejected research articles, slow accumulation of knowledge, or low practical impact of IS research. Another aspect that is revealed is that these projects are likely to be complicated to communicate (causes include, e.g., lengthiness, multi-stakeholder involvement, practitioner and academic audiences, addressing problem classes rather than problem instances). This problem has been recognised in various instances (e.g., writing of design research articles for academic journals), but existing support on how to communicate is ineffective, as many perceive the communication of design research projects to be a problem. This dissertation addresses that.

Employing DSR as the overarching research methodology, the presented research in this dissertation provides a solution that guides design researchers in general communication of their projects (DSR communication framework), in writing design research articles (a process with prescriptive instructions for each step), and in presenting DSR research designs (a checklist for effective DSR research design presentation, e.g., in the context of a research methods course). These artefacts (DSR contributions) are both built and evaluated based on empirical studies. This research thus offers a solution to the research problem. It furthermore puts a new topic of research on the map: DSR communication.

*Keywords: Design Science Research; Science Communication; Academic Writing; DSR Communication Framework*

# Kurzfassung

Design Science Research (DSR) ist ein pragmatischer, nutzenorientierter, wissenschaftlicher Ansatz zur Lösung relevanter organisationaler Probleme in Bezug auf Informationstechnologie (IT) und Informationssysteme (IS). DSR ist eines der beiden wesentlichen Paradigmen in der IS-Forschung. Das Forschungsergebnis eines DSR Projekts ist nicht deskriptiv, sondern präskriptiv. Es gibt Anweisungen, wie allgemeine Probleme der gleichen Klasse gelöst werden können. An DSR-Forschungsprojekten sind viele Akteure aus Forschung und Praxis beteiligt. Solche Projekte sind iterativ, langwierig und komplex und vereinen Theorie (sichern von Rigorosität durch Nutzung des vorhandenen Wissens) und Praxis (sichern von Relevanz durch aktive Einbindung der am Problem Beteiligten). Gleichzeitig trägt DSR zu Forschung (durch präskriptiven Mittel-Zweck-Beziehungen) und Praxis (Lösung praktischer organisatorischer Probleme) bei.

Diese sehr kurze Zusammenfassung von DSR macht deutlich: Kommunikation ist für diese Art von Forschung unerlässlich. Schlechte Kommunikation führt zu einem ineffizienten Austausch mit der Praxis, zu abgelehnten Forschungsartikeln, zu langsamer Wissensakkumulation oder zu geringer praktischer Wirkung der IS-Forschung. Weiter wird daraus klar: Kommunikation dieser Projekte ist kompliziert (Gründe beinhalten: lange Dauer, Einbezug von Praxis und Akademia, Problemklassen statt -einzelfälle). Dass Kommunikation für DSR-Forschende ein Problem ist wurde erkannt (z.B. beim Schreiben von DSR Artikeln), aber es fehlt an überzeugenden Lösungsansätzen.

Unter Verwendung von DSR als übergreifende Forschungsmethodik bietet die in dieser Dissertation vorgestellte Forschung Lösungen an, welche Designforscher bei der allgemeinen Kommunikation ihrer Projekte (DSR-Kommunikations-Framework), beim Schreiben von Designforschungsartikeln (ein Prozess mit präskriptiven Anweisungen für jeden Schritt) und bei der Präsentation von DSR-Forschungsdesigns (eine Checkliste für die effektive Präsentation von DSR-Forschungsdesigns, z. B. im Rahmen eines Forschungsmethodenkurses) anleitet. Diese Artefakte (DSR-Beiträge) werden auf der Grundlage von empirischen Studien erstellt und bewertet. Darüber hinaus wird ein neues Forschungsthema auf den Plan gerufen: DSR-Kommunikation.

*Keywords: Design Science Research; Science Communication; Academic Writing; DSR Communication Framework*

# 1 Introduction

This dissertation is the culmination of eighteen months of dedicated research about the communication of design research projects. During this time, three specific research questions were addressed, yielding about a dozen intermediary and four final Design Science Research (DSR) artefacts (Hevner, March, Park, & Ram, 2004). These are collectively informed by a literature review, an interview study, a mixed-methods document analysis, a multi-method study, two surveys, a field experiment, and many discussions with design researchers—from novices to renowned authorities. The central goal of these efforts is to provide guidance on how design research projects can be communicated effectively across their various communication situations. An example follows to illustrate what this research is about before diving into the research problem and research questions (Section 1.1), the research approach and the structure of the dissertation (Section 1.2), and a short presentation of the main results (1.3).

A DSR project like the one presented in this dissertation typically involves many stakeholders, a variety of descriptive studies, any number of intermediate results, much time (Gregor & Hevner, 2013), and some good fortune for it to end successfully (Peffers, Tuunanen, & Niehaves, 2018; Venable, Vom Brocke, & Winter, 2019). During this dissertation project's lifespan, it needed to be communicated to many stakeholders, such as the design researchers, contributors, evaluators, reviewers, the research community (Cahenzli, Beese, & Winter, 2021b) and in the case of this document: a thesis committee. Each stakeholder group is different across various factors (e.g., expectations, background knowledge, interests, terminology). At the same time, the project and its outcomes constantly evolved over time, amassing evermore documentation and learnings to discuss. Thereby, selecting a focus, re-packaging the content, and effectively communicating the project to these audiences while neither overwhelming, nor boring them, and accomplishing the goals of communication is a challenge—not only for the author, but for design researchers in general (Tremblay, VanderMeer, & Beck, 2018; vom Brocke & Maedche, 2019). In the example of this dissertation, the author needs to combinedly present two stories: the iterative design processes for several artefacts, and the descriptive studies that informed these processes. Thereby a major challenge is to concisely present these intertwined stories such that a clear understanding of what has been done, how, why, based on which evidence, and yielding which contributions is achieved.

## 1.1 Research Problem and Research Questions

Communicating design research projects is a challenge that differs from the mere communication of a descriptive research project because a design research project does not comply with established normative scripts for communicating research. Design research is not based on a waterfall-like development of a research model and providing evidence (Hevner, 2007; Peffers, Tuunanen, Rothenberger, & Chatterjee, 2007; Sein, Henfridsson, Purao, Rossi, & Lindgren, 2011). It does not yield results based on finding 'truth-like' descriptions (Niiniluoto, 2018) but artefacts that are useful for solving problems (Iivari, 2007; Simon, 1996; Winter, 2008). It combines both design research as an overarching methodology and descriptive research projects that collectively inform the outcomes of design research (Hevner et al., 2004). Design research also differs from many common philosophies of science (e.g., positivist, interpretivist, critical) in that it includes design, development, and building activities (Deng & Ji, 2018; Iivari, 2007; Venable, Pries-Heje, & Baskerville, 2016). This makes DSR subscribe more to pragmatism (Deng & Ji, 2018; Goldkuhl, 2012; Hevner, 2007; van der Merwe, Gerber, & Smuts, 2020), albeit it may have a distinct philosophy altogether (Vaishnavi & Kuechler, 2004). Thereby, the activity of communicating design research projects is a challenge because of their complexity (based on, e.g., the lengthy timeline, paralleled design- and description-related activities, a multitude of stakeholders, iterative nature), their otherness (and the resulting unfamiliarity in audiences including reviewers, Deng & Ji, 2018), their continually changing problem understanding and solution propositions (vom Brocke, Winter, Hevner, & Maedche, 2020) and the various ways in which they may contribute to research and practice (vom Brocke & Maedche, 2019). This motivates the over-arching research question (RQ) for this dissertation:

**RQ 1:** How can design research projects be effectively communicated in their various communication situations and to their various stakeholders?

This research question is relevant for various reasons. These include notably the fact that effective communication of research projects is important. By communicating more effectively, "important and relevant work will reach a wider audience, dissemination of which contributes to both research and professional practice" (Gregor & Hevner, 2013). Given that the purpose of IS research includes the production of knowledge on how to design information technology (IT) artefacts, information systems (IS), and methods to manage and support IT in organisations (Benbasat & Zmud, 2003; Iivari, 2007), it becomes evident that dissemination of such knowledge is crucial. Indeed, while academics

scorn management fads, these tend to have much more practical impact than research (e.g., a former president of the American Academy of Management noticed that management research might have mattered to the world of organisations and business, but that it did not; in van Aken, 2004). This is also the case for IS research (e.g., Agarwal & Lucas, 2005; Benbasat & Zmud, 2003; Straub & Ang, 2008). In the case of DSR, this is particularly interesting since it is the purpose of DSR to create usefulness (Winter, 2008). Because of this focus on utility and solving practical problems, there is an implicit assumption that DSR is highly relevant for practitioners (Morana et al., 2018). However, unless the research contributions are made available to practitioners and unless they are communicated adequately, it is unlikely that IS research (and DSR in particular) can develop its full potential (Benbasat & Zmud, 1999; Kuechler & Vaishnavi, 2011; Mirkovski, Doyle, & Liu, 2020). Because DSR plays a central role in IS research (see Section 2.1), effective communication of DSR projects is especially relevant.

Beyond the relevance of disseminating the knowledge created through DSR, the design researchers themselves have a pronounced need to communicate their projects effectively. After all, this is what enables them to gain access to funding, practice partners, or—most crucially to them—credit for their work (Liang et al., 2014; Tremblay et al., 2018). The latter refers specifically to the academia-facing communication of their projects in the form of articles in academic journals. Tremblay et al. (2018) specifically investigated the effects of the contemporary practice of quantifying academic productivity on design researchers. Their report underlines the centrality of academic journal articles for design researchers, the much greater difficulty of getting DSR articles published compared to non-DSR articles, and general frustration among design researchers with their difficulties in publishing design research articles. Their projects hardly fit the generally accepted structure in which research articles are expected to be presented (Gregor & Hevner, 2013). Despite an increasing number of design research articles being published, researchers in DSR still perceive serious difficulties in publishing them (Engel, Leicht, & Ebel, 2019). Herewith, the general research question (concerning all DSR communication situations) can be appended by a more focused sub-question:

**RQ 2:** How can design researchers present their completed design research projects in high-quality research articles?

Upon reading a few design research articles, it becomes apparent that these are indeed different from traditional descriptive articles. This is consistent with the fact that they follow a different research paradigm (Hevner et al., 2004). For the next generation of IS researchers, it is not only important that students (e.g., at the master or doctoral level)

learn about the two science paradigms in IS (van Aken, 2004; Winter & vom Brocke, 2021), but also that they communicate their research projects and project plans effectively. This may be helpful for their careers (see the introduction of RQ 2, above), but it is also crucial to evaluate their understanding of the methodology and thus, their ability to adopt DSR. Given that the author has been a teaching assistant in a research methods course at master level at the University of Saint Gallen, he has direct contact and the opportunity to both observe and instruct students. Applying the knowledge gained from investigating the problem of communicating DSR projects in general (i.e., RQ 1), this third research question as a sub-question of RQ 1 is raised:

**RQ 3:** How can students present their DSR research designs in the context of a research methods course?

## 1.2 Research Approach and Structure of the Dissertation

These three research questions address the general problem of communicating design research projects at three levels of abstraction. First, the overarching topic of communicating design research projects (RQ 1). Second, a sub-class of communication situations that is of utmost relevance to design researchers (i.e., writing design research articles, RQ 2). This question addresses a more specific set of communication instances (i.e., only the ones that yield a research article) and is therefore less abstract. The third question is more specific still, focusing on a more narrowly specified set of communication instances (i.e., presentations of only the research designs of DSR studies in the context of a research methods course, RQ 3). Each question indicates that a solution is sought ("how can X be achieved?"), rather than a description ("what is X? Or even: How is X currently achieved?"). The questions represent specific problems people perceive in their daily practices (researchers as 'practitioners' of DSR). These solution-seeking questions are adequate for design research endeavours (rather than behavioural science, van Aken, 2004). Therefore, and because the main problems cannot be solved by mere description, the research efforts presented in this dissertation subscribe to the design science paradigm. A science paradigm is characterised by the kind of questions that are asked, the methodologies used to investigate them, and the nature of the research output pursued (van Aken, 2004). In this case, the methodology is the DSR methodology, and the outputs are 'artefacts' (see also: Section 2.1.2.3). The answers to the research questions in this dissertation are therefore not merely explaining statements, but designed solutions: A DSR communication framework (RQ 1), a reference guide for writing DSR articles (RQ 2), and a checklist that helps prepare research design presentations (RQ 3).

The reference approach used for this dissertation is the DSR methodology presented in Peffers et al. (2007), in conjunction with the three-cycle view of Design Science Research (Hevner, 2007). These articles are seminal papers in DSR (Engel et al., 2019), and they have a slightly different focus. This is the reason for joining them in this dissertation. Doing so helps benefit from the strength of each of these two models, which allows for ensuring rigour and relevance of the approach. (Both articles are discussed conceptually in Section 2.1.3, and the application to this dissertation is presented in Section 3).

Peffers et al. (2007) provide a process model based on six sequential steps. Design researchers can use it to ensure that no relevant step is omitted. Furthermore, it is built to help structure how people think about and discuss DSR projects. This process model does indicate that there are iterations based on the results that emerge. The model is depicted in light colours in Figure 1. Hevner (2007) provides a more abstract view on DSR in that it describes how design research ensures rigour and relevance (integrated into Figure 1 in black). This model consists of three cycles: (1) The relevance cycle depicts interactions between the problem environment and the research project. These interactions are bi-directional. While the problem environment is fostered to obtain more profound knowledge about the problem, it is also the environment where the artefacts are deployed. Therewith, the research project (yielding the artefacts) returns information to the problem environment. During the evaluation of such artefacts, new data is created that feeds back into the research project. This indicates a cyclicality in the interactions between the project and the problem environment. (2) The rigour cycle features similar exchanges, but not with the problem environment. In the rigour cycle, information is taken from and contributed to the 'knowledgebase.' The knowledgebase contains, for example, the relevant methodological or background literature used in this dissertation. The design project thus draws from existing knowledge. At the same time, many findings emerge from a design research project, which may contribute to the knowledge base in the form of, e.g., a research article (for this dissertation: Cahenzli et al., 2021b). (3) The third cycle describes the iterative sequences between designing and evaluating artefacts. This is also explicitly part of the DSR process model (light colours in Figure 1), albeit the process model is more specific about the procedures. For this reason, the third cycle is replaced by the DSR process model in the research approach.

Merging the more process-oriented model and the rigour and relevance-oriented model illustrates this general research approach (Figure 1), which is described in further detail and transformed into a research framework in Section 3.2.

The approach is not discussed in further detail here. However, it remains to be stated that the operationalisation of the DSR methodology for this dissertation includes a three-way split of the design-specific activities. In other words, research questions 1-3 are combinedly discussed up to the point when the first design activity starts (Section 1-5). After that, the DSR process is split into design and evaluation cycles for RQ1 (Section 6), RQ 2 (Section 7) and RQ 3 (Section 8). Finally, having designed and evaluated an artefact for each research question, the discussion (Section 9) summarises the findings across these design and development activities before the dissertation is concluded.

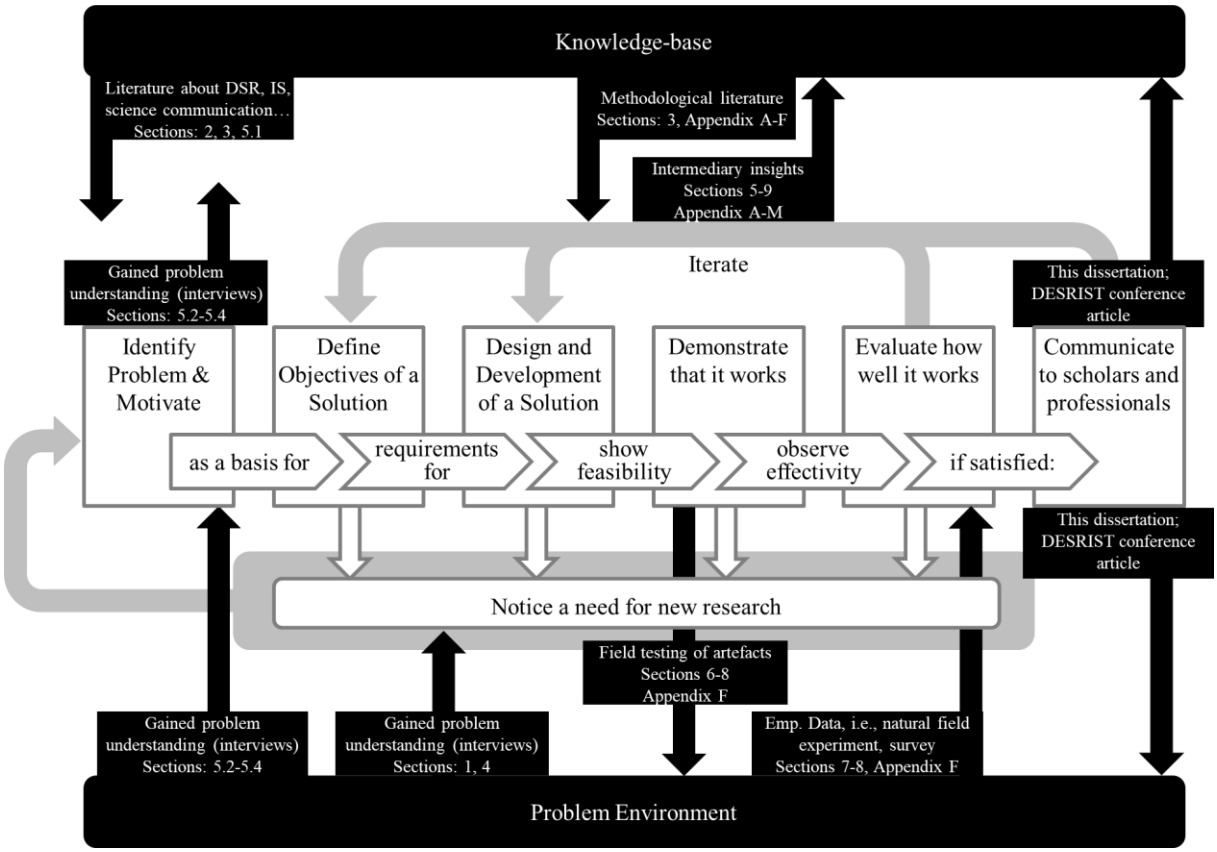


*Figure 1: Research Approach, Based on Peffers et al. (2007) in Conjunction with Hevner (2007)*

As can be perceived in Figure 1, this dissertation contains a variety of appendices. The appendices are split into appendices that provide the empirical study reports (Appendix A-Appendix F) and appendices that provide supplemental material for various aspects of the dissertation (Appendix G-Appendix M). Using appendices like this gives this dissertation an unorthodox structure, which might deserve some additional commentary. As indicated in the introductory example, the writing of this dissertation is one of the challenging tasks that this research endeavour should address. Furthermore, there are

two main stories that need to be told in this document: a design story explaining the application and results of the DSR project and a story about empirical, descriptive research. These stories are inherently intertwined (see also the black arrows in Figure 1), but they can hardly be told together. After all, a reader interested in the design research endeavour may not be interested in operational specificities of how a related empirical study was conducted (or at least not for every one of these studies), but rather what the contributions of these studies are to the design project. However, considering that this is a dissertation, the rigour and relevance of the work need to be proven. Whereas the design story may help prove relevance, the rigour can only be proven by providing insights into the empirical work. The compromising solution applied to this dissertation is that the design story (i.e., the manuscript excluding the appendices) is written such that it can be read from the beginning to the end, and the reader should be fully informed about the research project, its methodology, what was done and why (conceptual specificity), while omitting operational details (how) and only featuring the results from the empirical studies which were relevant to the creation of the artefacts. At the same time, there are ample references to the appendix, such that readers may easily find additional details about the empirical work (including operational details, insights into the data analyses, and limitations of the individual studies).

## 1.3 Main Results and How they Answer the Questions

Three individual design studies are used to answer the three research questions. Each of these studies relies on the foundational literature outlined in Sections 2 and 5.1. RQ 2 and RQ 3 furthermore use the artefact that answers RQ 1. In the following, these artefacts are very briefly presented. This should help clarify the text leading up to each of the artefacts and thereby contribute to the overall clarity of this dissertation.

**Artefact 1: A DSR Communication Framework** (Figure 2). This artefact features (1) a communication design process, which yields an explicated communication instance (e.g., this dissertation, a research article, or a student presentation), and (2) a set of characteristics of communication situations that affect this process. These characteristics are interesting insofar that there are implications of these individual characteristics for communication situations that share them. Furthermore, this knowledge about implications can be stored (knowledge containers) and re-used in any communication situation.

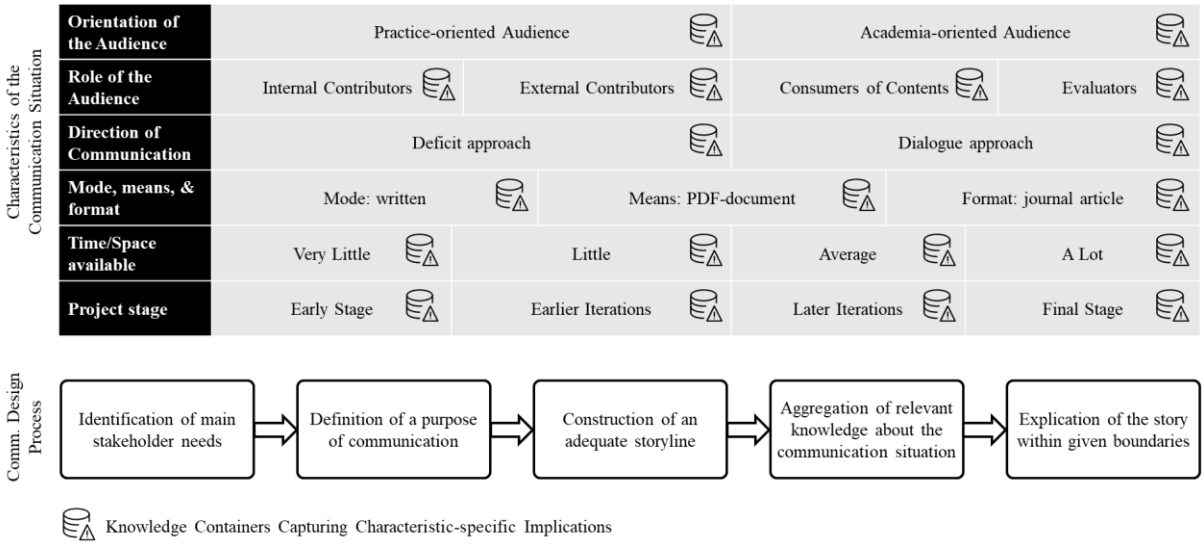


*Figure 2: A DSR Communication Framework*

**Artefact 2.1: A Set of Prescriptive Statements.** The second artefact answers RQ 2 by providing prescriptive knowledge about how to write design research articles. This prescriptive knowledge takes the form of statements that are either generally applicable to writing DSR articles or that apply to writing DSR articles with specific communication goals (e.g., convincing readers about the relevance of the research problem). This set of prescriptive statements is built upon empirical evidence and the contextualisation of the DSR communication framework. It implements the knowledge gained in these empirical studies (i.e., the content of the relevant knowledge containers). Therewith, it specifies the communication design process so that design researchers using the statements are guided step-by-step from identifying stakeholder needs to the explicated research article. Because the format of this artefact is cumbersome to use and share (as it is a set of statements that collaboratively holds the relevant information), another artefact that answers RQ 2 in a more pragmatically applicable way is created (artefact 2.2).

**Artefact 2.2: A Quick-Guide on how to Write Design Research Articles.** This artefact is a short summary of the insights that also underlie artefact 2.1. It takes the shape of a two pages long quick-guide. Design researchers are therein informed about the goals their design article should achieve, its contents, how these content elements should be presented, and a guide that helps them select one of four pre-defined structures for DSR research articles. Artefact 2.2 is much more concise and more clearly structured than artefact 2.1, making it more sharable and thus, increasing its chances of adoption. However, these qualities come at the expense of losing informational granularity compared to artefact 2.1.

**Artefact 3: A Checklist for Student Presentations.** The last artefact answers RQ 3. It is a checklist-like compilation of sentences and questions that clarify what students should discuss (supports selecting content elements), in which order to do so (supports structuring), and it indicates the level of detail that may be necessary (supports explicating).

# 2 Research Background

The following background section provides the conceptual understanding and status quo of research that lays the foundation for this dissertation. It focuses mainly on Design Science Research (DSR) since this is both the methodology used and part of the phenomenon investigated in this dissertation. Thereafter, some literature on the communication of research projects in general, as the parent phenomenon to the communication of design science research projects, is summarized. Since this is not the first attempt at addressing the challenges in communicating design research projects, the status quo on these efforts is presented as well (Section 2.3).

## 2.1 Design Science Research

This dissertation focuses on a phenomenon in Information Systems (IS) research that concerns researchers conducting Design Science Research (DSR). Before elaborating in more detail on what DSR is and how it is used, a short excursus on its necessity and role for IS research is provided.

### 2.1.1 Information Systems Research and DSR

> *"Brooks (1987, p. 12) observes, 'Einstein argued that there must be simplified explanations of nature because God is not capricious or arbitrary,' but concludes that, 'No such faith comforts the software engineer' because the objects of study 'were designed by different people, rather than by God. The phenomena studied in IT-research are artefacts that are designed and built by man to accomplish the purposes of man." (March & Smith, 1995, p. 262)*

In the field of information systems (IS) research, researchers are primarily concerned with information technology (IT) systems related phenomena, and therefore with various aspects of system designs (Walls, Widmeyer, & El Sawy, 1992). The term 'system' refers to interrelated components (and sub-systems), while the design of a system is the design of its components and their relationships (Churchman, 1971, cit. in Walls et al., 1992). As per the citation above, IS researchers are concerned with phenomena not directly governed by laws of nature but rather by the artefacts people built—objects, resulting relationships between objects, and interaction behaviours—and how these accomplish human purposes. In its earlier years, systems development approaches were the main focus of research in the field of IS, yielding for example the socio-technical approach (Bostrom & Heinen, 1977). Even though the methodological literature and

landmark articles on research methodologies that focus on design (e.g., Hevner et al., 2004; Nunamaker Jr, Chen, & Purdin, 1991; Peffers et al., 2007; Walls et al., 1992) emerged later, some claim that design-based research has its place in IS since the inception of the field (Iivari, 2007). According to Iivari (2007) and Benbasat and Zmud (2003), IS researchers should produce knowledge on how to design IT artefacts, information systems, and methods to manage and support IT or IT-enabled endeavours. Thus, IS research ought to be concerned with the design and management of IT artefacts and systems, as well as the application of IT to human organizations (Zmud, 1997), with a special focus on the use of artefacts that bridge social systems and technological systems (Gregor & Jones, 2007). Thereby, the term artefact describes something constructed by humans and thus, does not occur naturally (Simon, 1996).

The construction of such artefacts can follow constructive research methods and thus, be a disciplined, rigorous, and transparently reported process, or it can be merely pragmatic problem-solving. The construction process makes it possible to distinguish between Information Systems as a design science and the practice of developing IT artefacts (Iivari, 2007). This dissertation is concerned with the scientific approach to artefact construction.

In the 1970s and 1980s, IS researchers focused on how to best design IT artefacts and information systems to improve practice outcomes (e.g., decision support systems literature). Therefrom, theory emerged from within the field of IS. However, the subsequent era of adoption and application of theories from other disciplines to explain IS phenomena halted the creation of theories that are proper to IS (Benbasat & Zmud, 2003). This change of focus can be interpreted as a perceived need to improve the rigour of the (highly relevant and practice-driven) IS research activities. Even today, the most prestigious outlets in IS lay a very high value upon the application and development of explanatory theories, and some researchers argue that they do not value practice-oriented research enough (Baskerville, Lyytinen, Sambamurthy, & Straub, 2011; Lyytinen, Baskerville, Iivari, & Te'eni, 2007; Tremblay et al., 2018). This may lead to difficulties in getting this practice-oriented type of research published (Tremblay et al., 2018) and, thus, communicating it within the research community (Engel et al., 2019). Hence, it appears to be easier to publish and thus communicate explanations on phenomena that relate to social systems, technical systems, and the interaction between the two, rather than new designs and solutions that create, specify or improve such systems or their constituents.

However, IS research is about both the use of theories to explain phenomena and to design solutions. There is, in fact, a need for two types of scientific inquiry in IS: Hevner et al. (2004) argue in their seminal paper on the nature of IS research that the acquisition of knowledge about IT management and the application of IT in human organizations involves two complementary paradigms: Behavioural science and design science (Hevner et al., 2004; March & Smith, 1995). This aligns with the five classes of theory relevant for IS: theory for analysing, explaining, predicting, explaining and predicting, and for design and action (Gregor & Jones, 2007). The first four classes can be addressed with research techniques from the natural and behavioural sciences (e.g., experiments, surveys, interviews, observations). They can be summarized as explanation-oriented research outcomes: Research that adds to the explanation of phenomena by seeking to formulate true or rather 'truthlike' statements on what things are and how they behave (behavioural science paradigm) (Iivari, 2007; Niiniluoto, 2018). The last class of theory, theories for design & action, can be supported by using these same research techniques for gathering and analysing data, but there is a further need for a fundamentally different kind of research activity that informs not about what is or can be, but about how something should be built or done to achieve specific outcomes (Gregor, 2006). This type of theory emerges from activities based on the design science paradigm, and it is about principles of form and function, methods, and explanations that justify such prescriptive claims (Gregor, 2002; Walls et al., 1992).

This idea of two distinct but complementary research paradigms in IS research is fundamental for understanding IS research and the need for DSR. A 'research paradigm' describes the combination of *research questions* asked, *methodologies* used to investigate them, and the *nature of the research output* pursued (van Aken, 2004). Most researchers in management use a paradigm that targets the creation of understanding by describing, explaining, and eventually even predicting. They tend to ask why-questions and answer them by employing a variety of data gathering and data analysis techniques. Such research is based on the natural and behavioural science paradigms. However, a perfect understanding of organizational IT-related problems (e.g., a lack or an overwhelming amount of decision-relevant information) is not sufficient to overcome them. Considering that overcoming organizational IT-related problems and creating utility in socio-technical systems is a central purpose of IS research, there is a remaining need to develop, implement, and evaluate new or alternative approaches and solutions (van Aken, 2004). When, therefore, how-questions are asked, different methodological

approaches become necessary to achieve this different research output goal of creating utility, thereby positing its own research paradigm (the design science paradigm).

#### 2.1.1.1 Behavioural science paradigm

The behavioural science paradigm has its roots in the natural science research methods (Hevner et al., 2004). It seeks to describe and explain observable human phenomena (analysis, design, implementation, management, and use of IS, Hevner et al., 2004), thereby striving to identify causal relations as theory (Österle et al., 2011). In the tradition of natural sciences and behavioural sciences, philosophers of science conceptualize theory that arises from scientific inquiry as providing testable explanations and predictions (Gregor, 2006). Hence, if the object of a study is IS "design" under this paradigm, such research may focus on formulating true statements about design products (e.g., what types of designs exist?) or design processes (e.g., how do people design such IS?), rather than using the activity of designing something new as part of a research effort (Walls et al., 1992). This implies that phenomena of interest within this paradigm largely depend on already made design decisions that went into creating IT and information systems (Hevner et al., 2004) or on already established practices.

*Research questions* in this paradigm of IS are geared toward the goals of describing (e.g., what is?), analysing (e.g., how does something behave?), understanding (e.g., why does it behave as such?), and predicting (e.g., how will something behave under specific conditions?) behaviour in organizations. Such questions focus on IS in organizations as phenomena and seek to show factual characteristics (Österle et al., 2011). These goals or *research outputs* thus comply with the notion that 'explanation by law is the essence of science' (Seth & Zinkhan, 1991), and most academic research in management subscribes to this view (van Aken, 2004).

*Methodologically,* these questions can be answered by whatever techniques allow for exploring phenomena or confirming hypotheses. The exploratory and confirmatory research logics (Cahenzli, Aier, & Haki, 2021a, p. 3) pursued in this paradigm have also been described as inductive versus deductive (Gupta, Kannan, & Sanyal, 2018, p. 604), applied versus fundamental (Bitektine, Lucas, & Schilke, 2018, p. 151), or empirically-driven versus theory-driven (Thye, 2014, p. 73). The exploratory research logic describes a systematic enquiry for developing hypotheses or revealing yet undescribed phenomena to eventually develop new theories (Gupta et al., 2018). The confirmatory research logic seeks to reject (or find support for) hypotheses. These research logics translate to study designs that rely on one of many possible techniques useful to gather

data and techniques suitable for analysing gathered data. Such data may be quantitative or qualitative, and a technique's suitability may depend on the type of data that can be accessed or empirically gathered. Some researchers see superiority in quantitative data for its numerical objectivity and mathematical precision in assessing whether some hypotheses hold or not. Others prefer qualitative data, which enables researchers to capture phenomena on which no reasonable hypotheses have formed yet, and unanticipated findings can be captured and interpreted. Whereas many researchers identify as members of either the quantitative or the qualitative camp, there are some researchers that combine the two kinds of data (i.e., mixed methods research, see: Creswell, 2008). The selection of data type has strong implications on the kinds of questions and therefore the results one can expect. Furthermore, certain techniques are most suitable for gathering qualitative data (e.g., interviews), while others are most suitable for gathering quantitative data (e.g., survey), and the techniques to analyse data must comply with the type of data. More on quantitative, qualitative, and mixed methods research in IS: Venkatesh, Brown, and Bala (2013).

To summarize, studies in the behavioural science paradigm combine data gathering techniques such as case studies, surveys (Riedl & Rueckel, 2011), or experiments (Cahenzli et al., 2021a; Webster & Sell, 2014) with techniques of data analysis (e.g., structural equation modelling or factor analysis for quantitative data, and coding methods for qualitative data, Bortz & Döring, 2006). Therewith, they describe, analyse, create understanding and make predictions.

#### 2.1.1.2 Design science paradigm

The behavioural science paradigm on its own is not sufficient for what IS research is supposed to achieve. Of course, explaining real-world phenomena is desirable, but solving real-world problems requires such knowledge to be put into action (Winter, 2008). This is where the design science paradigm comes into play.

While behavioural science focuses on creating and testing theories that foster understanding of the world, design science is about creating technology-oriented things that serve human purposes (March & Smith, 1995). It "aims to develop and provide instructions for action (i.e., normative, practically applicable means-end conclusions) that allow for the design and operation of IS and innovative concepts within IS" (Österle et al., 2011, p. 8). Accordingly, the *kind of questions* one may ask in this paradigm is not really 'what is it?' or even 'how does it work?' but rather 'how can it be done?'. Hence, instead of asking: How **do** managers gather decision-relevant information? (requiring

an explanation as an answer), one may ask, 'how **can** managers be supplied with decision-relevant information?' (requesting a solution as an answer). The *outcomes of design science research* show how explanatory, predictive, or normative theories can be used to solve problems (Hevner et al., 2004; Walls et al., 1992).

*Methodologically*, the design science paradigm is rooted in engineering and the sciences of the artificial (Simon, 1996). Instead of merely observing the world to make truth-statements, design science researchers use knowledge about the world (such truth-statements) to create a useful artefact that solves a relevant problem. Hence, the design science research methodology cannot stop at gathering and analysing data about a phenomenon, but it must go beyond explanations and create artefacts that should actively change the world. (How design science research is conducted is specified in Section 2.1.3). These "artefacts" can take many different shapes (see discussion of artefacts in Section 2.1.2.3) and serve various purposes. They include "a wide range of socio-technical artefacts such as decision support systems, modelling tools, governance strategies, methods for IS evaluation and IS change interventions." (Gregor & Hevner, 2013, p. 337).

In conjunction with the behavioural science paradigm, the design science paradigm is necessary to respond to the dual mission of IS research: to make theoretical contributions that help understand IS phenomena and to help solve current and anticipated IT-related (organizational) problems of practitioners (Benbasat & Zmud, 1999; Sein et al., 2011). In other words: Without a design science, IS researchers would only understand the world as it is. While such an understanding may be valuable, it does not serve the practitioners that seek to use IT to solve problems. Therefore, IS research should be both concerned with the development and utility of IT-artefacts such as software, algorithms, user interfaces, process models, and methodologies (design science paradigm) and with gaining an in-depth understanding of IT-related phenomena, including theories of human and organizational behaviour (behavioural science paradigm; Hevner et al., 2004; Keith, Demirkan, & Goul, 2013; March & Smith, 1995).

### 2.1.2 About Design Science Research

IS research is thus pursuing a dual mission of creating explanatory theories on the one hand and of designing useful solutions on the other. In this sub-section, the focus lies on the design science paradigm (What is Design Science Research? What is its terminology?), before delving into more detail on how research in the design science paradigm is conducted, focussing on reference approaches and notably the Peffers et al. (2007) summarizing Design Science Research Methodology (DSRM, Section 2.1.3).

#### 2.1.2.1 Design Science Research, Design Science, and Design Research

Research associated with the design science paradigm used to appear under a variety of labels, such as (Gregor, 2006):

- Software engineering research (Morrison and George, 1995)
- Constructive type of research (Iivari, 1991; Iivari et al., 1998)
- Prototyping (Baskerville and Wood-Harper, 1998)
- System development approach (Burstein and Gregor, 1999; Lau, 1997; Nunamaker et al., 1990-1991)
- Design Science (Hevner et al, 2004; March and Smith, 1995; Simon, 1996)
- Sciences of the artificial (Simon, 1969)
- Systemeering (Iivari, 1983)
- A constructive approach (Iivari, 2007)

The fact that many terms have been used to refer to design-related activities in IS research has been noticed by many researchers, and a variety of attempts have been made to differentiate related concepts clearly and therefore to provide terminological guidance (e.g., Deng & Ji, 2018; Gregor & Hevner, 2013; Winter, 2008). However, beyond the fact that DSR has become an umbrella term to represent scientific research involving design activities, conceptualizations of related terminologies are poorly accepted (Alturki, Gable, & Bandara, 2011; Deng & Ji, 2018). For this reason, and because many researchers use related terms interchangeably, a few central terms used consistently across this dissertation are defined next.

Among the various definitions of Design Science Research and related terminologies, the author opted for the conceptually clear and terminologically consistent delineation provided in a guest editorial of the European Journal of Information Systems by Robert Winter (2008). Therein, (IS) Design Science Research is specified as being a literature stream that is concerned with two types of research contributions. First, DSR contains contributions that reflect on artefact construction and artefact evaluation methods on a generic level to establish standards for its rigour. This meta-research is what he terms Design Science (DS). DS is a term used to refer to literature and research about design science research in general and about design research activities in particular. Second, DSR contains the construction and evaluation of specific artefacts that aim at solving relevant problems. This is termed Design Research (DR) (Winter, 2008, p. 471) and thus, refers to research activities that use the DSR methodology to create artefacts as DSR outcomes.

This terminology is chosen because it is clear and intuitive. Research is the activity of applying (rigorous) methods to (relevant) problems, be it design problems or others. In contrast, science is "a system of knowledge (…) (that) can be divided into different branches," and that comes with historical, cultural, philosophical, and methodological backgrounds (Gregersen, 2021). Therewith, reflecting on how (design) research is being conducted adds to (design) science, whereas applying methods according to the (design) science paradigm equates to doing (design) research. This terminology is not consistently used in DSR literature. However, it would be desirable to use precise terms across the IS community to refer to the same things. Despite various attempts at unifying the terminology used in DSR, this has not been achieved yet. For an overview of competing and potentially conflicting conceptualizations of these terms, see Deng and Ji (2018, p. 5).

Thus far, the duality of IS research and the two types of research contributions in DSR are described. However, since this dissertation is concerned with design research projects (and therein, the communication sub-process), the background section continues with a focus on DR projects.

#### 2.1.2.2 Defining 'Design Research Projects'

DR projects are research endeavours that pursue the goal of DSR, which is "to generate prescriptive knowledge about the design of Information Systems (IS) artefacts like software, methods, models, and concepts" (vom Brocke & Maedche, 2019, p. 379). The understanding of 'project' used in this dissertation is drawn from the Merriam-Webster dictionary and situated following Gregor and Hevner (2013) and vom Brocke et al. (2020). According to the dictionary, a project is: "A **planned** piece of **work** that has a **specific purpose** (such as to find information or to make something new) and that usually requires a **lot of time**." (Merriam-Webster, n.d.-b). The dictionary lists a few examples of such planned undertakings, including "a definitely formulated piece of research" (Merriam-Webster, n.d.-b). In the context of DR, a project is, therefore, a piece of research that is planned and has a specific purpose. This may apply to any research activity, including, e.g., an interview study with the purpose of understanding which informational needs managers have (behavioural research paradigm), or developing a new kind of management information system (design research paradigm). This definition is therefore not specific enough for this dissertation. In fact, the communication of DR projects is the research problem and not the communication of (research) projects in general. DR projects are projects that "seek to produce knowledge about how to solve

important problems in a defined application domain" (vom Brocke et al., 2020). Thereby, these projects can also be part of more extensive research programs (Gregor & Hevner, 2013). Based on this, the term 'DR project' is used in this dissertation to refer to **a planned piece of research that seeks to produce knowledge about how to solve relevant problems in IS**.

#### 2.1.2.3 Research Outcomes: Theory, Artefacts, and Design Theory

Knowledge created in a DR project takes on various forms. In general, one may call the produced solution an artefact (Simon, 1996). IS researchers refer to various types of artefacts to categorize their contributions. However, the DSR community has not quite agreed on whether the established selection of four artefact types by (construct, model, method, and instantiation, March & Smith, 1995) is good as it is (Winter, 2008), and whether theory (namely: design theory) is an outcome of DR and if so, whether it is to be considered to be an artefact (Venable, 2006; Walls et al., 1992) or not (March & Smith, 1995). The fact that the nature of abstract knowledge created during a DR project has been considered to be theory or an artefact in the past is cause for confusion among IS researchers (Gregor & Hevner, 2013).

So, what kind of knowledge is created in a DR project? The three concepts of theory, artefacts, and design theory are introduced to answer this question. According to the Merriam-Webster dictionary, a **theory** is "a scientifically acceptable general principle or body of principles offered to explain phenomena" (Merriam-Webster, n.d.-c). With that, the behavioural science paradigm's ideal outcomes for research activities may come to mind ('explanation by law is the essence of science' Seth & Zinkhan, 1991), in that law-based explanations are these acceptable general principles. In scientific reasoning, more so than in non-scientific discourse, a theory is understood as a principle that is already supported by data. Its counterpart is the hypothesis, which is an assumption made before completing the research that ought to test possible principles (Merriam-Webster, n.d.-d).

In order to express a theory, one may first need to clarify the basic terms used for concepts that characterize a phenomenon. If the objects related to a phenomenon cannot be discerned and recognized by name or other conclusive means, then the phenomenon cannot be discussed in a meaningful way. Only once such concepts are clearly identified can hypotheses be formulated and tested to ultimately formulate theories. In DSR, the individual objects used to describe a phenomenon (e.g., entities and relationships) are referred to as '**constructs**' (March & Smith, 1995). These provide the "vocabulary and

symbols used to define and understand problems and solutions" (Gregor & Hevner, 2013, p. A3). Getting the constructs right is highly relevant to how problems are conceived, and therefore, the kinds of solutions one may create. In some sense, they form the foundations based on which a DSR-based solution for a relevant problem can be built.

When combining these constructs, more complex and abstract representations can be built. As an example, these may describe tasks or situations. If such higher-order constructions are used to describe things or phenomena, they are often called '**models**.' If they are used to provide instruction on how to perform a goal-directed activity, then such constructions are referred to as '**methods**' (March & Smith, 1995, p. 256 f.).

The creation of constructs, models and methods all require something more than mere observation. Observations need to be conceptualized, put into relation with each other, and translated from an explanatory view on things to a functional view, from cause-effect thinking to means-end thinking. With that, constructs, models, and methods comply with the targeted research outcomes in the design science paradigm. Indeed, these somewhat abstract research products are "artificial, or constructed by humans, as opposed to something that occurs naturally" (Simon, 1996). Human construction can, of course, take other forms as well. In particular, these constructs, models, and methods are abstract constructions. They are not suitable to directly solve organizational problems in the sense of a functional piece of software (a means to an organizational end). One may rather think of an abstract algorithm (method) containing a handful of steps to solve a particular problem. Such a research outcome can be taken from its intermediate level of abstraction (knowledge as operational principles) to specific (organizational) situations by operationalizing (or 'contextualizing') this knowledge as situated solutions (such as a piece of software that uses the steps of a methods but takes into account the intricacies and local requirements of the organization in which it is deployed). Such concrete implementations are also referred to as '**instantiations**.'

Terminologically, design science researchers agreed on using the word '**artefact**' to refer to these four types of artificially made objects or processes (Deng & Ji, 2018; Gregor & Hevner, 2013; Markus, Majchrzak, & Gasser, 2002). However, the debate on whether constructs, models, methods, and instantiations are the only acceptable artefact types in DSR or whether there should be others, too, is not settled yet (Deng & Ji, 2018; Gregor & Jones, 2007; Winter, 2008). That discussion comes with conceptual reflections on what can be outcomes of DSR (is it only these four artefact types?), as well as reflections on whether some outcomes of DSR can be things that are not to be considered artefacts

(can DSR yield non-artefact design knowledge? Is design theory an 'artefact'?). Furthermore, the question of whether DR projects (should) yield theories has split researchers into two camps:

March and Smith (1995) and Nunamaker Jr et al. (1991), representatives of the **pragmatic design camp**, claim that the core outcomes of DSR are the four types of artefacts described above (Deng & Ji, 2018). In particular, they support the idea that "IT research builds and evaluates constructs, models, methods, and instantiations. It also theorizes about these artefacts and attempts to justify these theories. Building and evaluating IT-artefacts have design science intent. Theorizing and justifying have natural science intent" (March & Smith, 1995, p. 256). This is described similarly in Hevner et al. (2004), where theory development and problem-solving are expressed as activities related to behavioural science and design science, respectively. These articles, therefore, portray the idea that design research yields these four artefact types and IS research may, in addition, provide theory through behavioural science.

At the same time, there is a **design theory camp** of researchers (Gregor & Jones, 2007; Markus et al., 2002; Walls et al., 1992) that emphasizes design (as) theory. To them, the core product of DSR is what they call "**design theory**", whereas they see instantiations as the material artefact (Deng & Ji, 2018). Indeed, one may argue that the knowledge produced in a design research project may be equated to theory or components of theory, given the definition of 'theory' provided above. The phenomenon explained would not be a cause-effect relationship but rather a means-end relationship, but the principles that emerge from a DR project can explain how one thing (implementing the principle) may lead to another (solving the problem). Gregor and Jones (2007) view constructs, models, and methods as one type of thing (theories or 'abstract artefacts'), whereas instantiations are a different thing altogether (a material artefact). To the researchers of the design theory camp, knowledge created through design research is design theory.

According to Gregor and Hevner (2013), these opposing and possibly inconsistent views on the research contributions that make a DR project 'true DSR' can be reconciled if one considers various **levels of abstraction**. While the instantiation (e.g., operational software) is situated and not abstract, an algorithm can be understood as an abstraction of this instance. An algorithm on its own may be unable to explain more complex, systemic solutions (e.g., a decision support system). Hence, there may be more abstract design knowledge assembling pieces of design knowledge. Going 'up' that ladder of abstraction, one may find that an organization requires not merely one complex information system (e.g., a decision support system) but a network of interlinked systems.

Design knowledge that guides practitioners in implementing such a system of systems might be created in a DR project or a set of projects. At this level of abstraction, the body of knowledge may be much more mature and complete in the sense of having a broader empirical and literary basis than the instance level. Based on this view on artefacts at various levels of abstraction, Gregor and Hevner (2013) propose an inclusive Design Science Research Contribution typology that summarizes this idea of levels of abstraction (Table 1). It is split into three levels of abstraction: Unique solutions developed in the situational problem environment (Level 1 contributions) apply to only few problem situations and do not generalise well. They do, however, solve a specific problem of a specific practitioner. At the same time, grand theory-type design theories may apply to many, most, or even all organizations. However, using such knowledge to solve concrete organizational problems requires extensive contextualisation and, while being highly projectible and thus applicable to many situations, it is not actionable (Gregor & Hevner, 2013; Winter, 2008). Thus, finer granularity leads to sharper, more clearly applicable knowledge at the expense of a more narrow scope of application (Maedche, Gregor, Morana, & Feine, 2019).

*Table 1: Design Science Research Contribution Types (Gregor and Hevner, 2013)*

| | Contribution Types | Example Artifacts |
|---|---|---|
| More abstract, complete, and mature knowledge | Level 3. Well-developed design theory about embedded phenomena | Design theories (mid-range and grand theories) |
| ↕ ↕ ↕ ↕ | Level 2. Nascent design theory—knowledge as operational principles/architecture | Constructs, methods, models, design principles, technological rules. |
| More specific, limited, and less mature knowledge | Level 1. Situated implementation of artifact | Instantiations (software products or implemented processes) |

For the purposes of this dissertation, the author's interpretation of the artefact type and DR outcome discussion is that whatever has been created through a DR project (Simon, 1996) **and** serves a specific purpose (March & Smith, 1995) is to be considered a DSR artefact. No dogmatic view on the typology of artefacts is adopted. If an artefact is a model, it seems reasonable to call it for what it is. However, forms of design knowledge (such as principles that support the construction of a solution but are not technically a method) are possible, and it seems adequate to leave the categories of possible artefacts open. Thereby, the author follows the somewhat cautious view on artefacts expressed in Venable and Baskerville (2012):

> *"A purposefully created artefact can be a technology, a tool, a methodology, a technique, a procedure, a combination of any of these, or any other means for achieving some purpose" (p. 142).*

At this point of the manuscript, it should have become apparent that DSR summarizes a constructive and scientific approach to solving relevant problems and that the knowledge that emerges from design research projects may take various forms and be at various levels of analysis. However, the production of such artefacts has not been addressed thus far. Therefore, the following sub-section discusses the central methodological aspects of DSR.

### 2.1.3 The Design Science Research Methodology

As with the terminology and the understanding of the outcomes of DSR, there are various descriptions in design science that elaborate on how one may conduct such research. This is unsurprising, as DSR is not a research technique (as opposed to, e.g., experimental research, Cahenzli et al., 2021a), but a scientific paradigm. Within this paradigm, the acceptable methodologies have evolved over time, such that sub-types of design research have emerged (e.g., action design research, Sein et al., 2011). In this sub-section, the central methodological guidance that defines how design research, in general, may be operationalized is presented. This includes three main contributions: March and Smith (1995), Hevner (2007), and Peffers et al. (2007).

#### 2.1.3.1 March and Smith (1995)

Apart from specifying the above-described four artefact types, March and Smith (1995, p. 258) described the research activities in design research: Build and evaluate. They parallel these two activities with discovering and justifying in the natural sciences.

**Build** refers to the construction of artefacts in such a way that the solutions can, at least conceptually, accomplish their intended task. Upon construction, the resulting artefacts can be compared to a discovery in natural science or a hypothesis in behavioural science: It becomes the object of study.

**Evaluate** refers to developing suitable criteria and assessing the constructed solution, probing how well it works. After all, utility is achieved if the built artefact achieves its task more efficiently or more effectively than existing solutions.

According to March and Smith (1995), 'build' demonstrates the feasibility of an artefact (i.e., it can be constructed). This activity is not sufficient to describe a creative process as design research. They specify that each artefact, "once built, <u>must</u> be evaluated scientifically." Hence, both build and evaluate are essential parts of conducting design research. There is broad acceptance of this understanding of design as science in the sense

that methodological guidance in DSR generally includes both building (design) and evaluation activities (Peffers et al., 2007).

#### 2.1.3.2 Hevner (2007)

Building on the ideas outlined in March and Smith (1995) and the understanding of IS research as pursuing a dual mission (e.g., van Aken, 2004), Hevner et al. (2004) wrote a seminal paper that, among other contributions, summarizes Information Systems Research in a conceptual framework. This conceptual framework has been developed further and yielded **The Three Cycle View of Design Science Research** (Hevner, 2007). This is one of two preeminent frameworks for conducting design research. The other framework was developed by Peffers et al. (2007) and is described below.

The 'three cycles' in Hevner's (2007) framework (see Figure 3) refer to the design cycle, the rigour cycle, and the relevance cycle. The **design cycle** iterates between design and evaluation activities. Hence, while evaluation must follow a design activity (March & Smith, 1995), the evaluation may also be the starting point for further design activities. This is notably the case if the evaluation indicates that the design is not satisfying its goal (see requirements in the relevance cycle, below), and hence, if the evaluation criteria are not satisfied. Knowledge gained throughout the evaluation is fed back to the design activities, and therewith, a new design alternative can be created. This cyclicality is broken if a satisfactory design emerges (Simon, 1996).

The **relevance cycle** "bridges the contextual environment of the research project with the design science activities" (Hevner, 2007, p. 2). Whether a design is satisfactory or not depends on the purposes it is supposed to fulfil. Since DSR seeks to solve problems in an application domain (where people, organizational systems, and technical systems interact), projects often start by identifying real problems in an actual application environment. From that problem environment, requirements for a potential solution can be drawn. Research activities related to gathering such requirements ensure that a relevant issue is being addressed, and it informs the design cycle as to what the evaluation of the final artefact should measure. This interaction of the environment with the core activities of designing and evaluating is bidirectional as well. Requirements and knowledge from the specific application domain are used as input to the design cycle, whereas the designed artefacts can be evaluated in the application domain (field testing). Information from such field tests may then be used to improve the researchers' understanding of the requirements and, thus, feed back into a new design cycle.

The **rigour cycle** connects these activities with the knowledgebase. The latter consists of conceptual scientific foundations (such as theoretical or methodological input), experience and expertise of the researchers, and existing knowledge on designs (e.g., meta-artefacts, such as design principles that inform researchers about how to create a particular type of artefact). The knowledgebase grounds a DR project in existing knowledge. However, each new project may generate new knowledge that appends to the knowledgebase, thereby closing the rigour cycle.

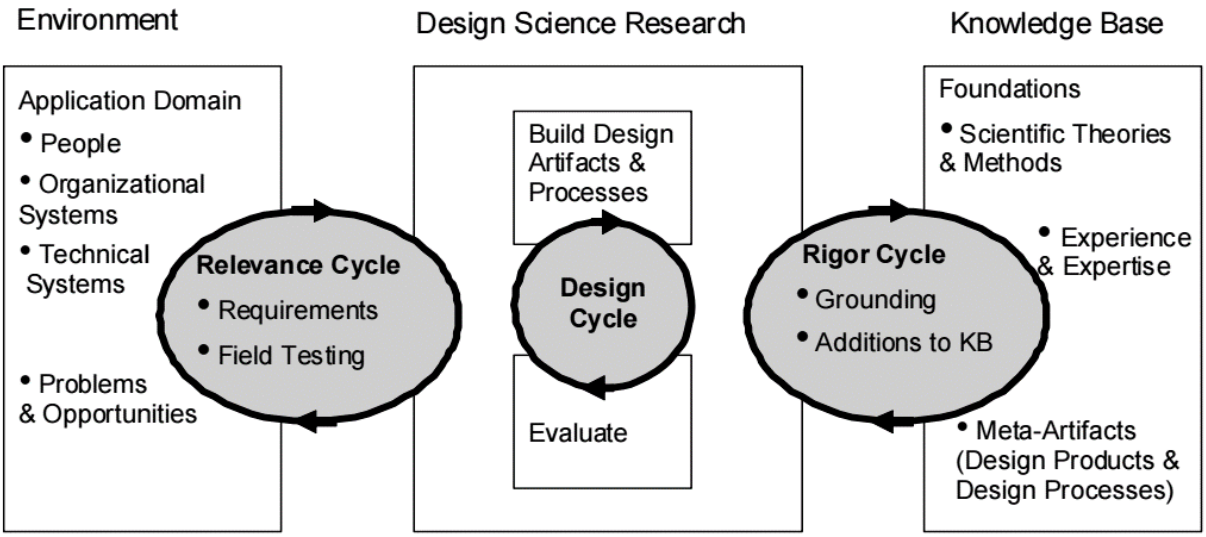


*Figure 3: Design Science Research Cycles (Hevner, 2007)*

#### 2.1.3.3 Peffers et al. (2007)

Despite the elaboration on how design and DSR are central to IS research (Section 2.1.1), there has been an underwhelming amount of DR articles published in IS literature (Peffers et al., 2007). To this day it seems more difficult to publish DSR articles in top IS journals than it is to publish non-DSR articles (Tremblay et al., 2018). Among the DSR articles published, only about one out of two is reporting on a design research project, with the rest featuring reflections on DSR (i.e., Design Science, Engel et al., 2019). Peffers et al. (2007) attributed this perceived lack of DR to the absence of a commonly accepted framework that serves as concrete methodological guidance for design researchers. Indeed, the above-described conceptualisations of DSR are not highly actionable. In their seminal paper, Peffers et al. (2007) created the Design Science Research Methodology (DSRM, Figure 4) which is based on prior literature, provides a nominal process model for conducting DR, and serves as a mental model for presenting and evaluating DSR. With this model, clear procedural guidance was presented, informing design researchers about the general steps to be taken in a DR project. Since this

dissertation is strongly oriented by the DSRM, its central steps and related ideas are presented here:

**Possible research entry points:** First of all, an opportunity for research should be identified. This opportunity may present itself during a DR project, practitioners may voice that they face a problem, or researchers may themselves identify a problem or opportunity for improvement. What is special about this step in the DSRM is that the identification of a problem does not provide researchers with sufficient knowledge about the problem to start building a solution. Indeed, the perceived problem may, in fact, already have been solved and therefore not require further research. This needs to be investigated first.

**1. Identify Problem and Motivate:** At the outset of a DR project, the problem should be defined (identify) and the value of a solution should be clarified (motivate). The problem definition should be precise enough to recognize the specific mechanisms that lead to or uphold the problem. One may for example atomize the problem conceptually to provide a basis that helps create a solution that captures the complexity of the problem. Whether such a problem is important, relevant, and thus worth solving, should be clarified in this step as well. Therewith, researchers, an audience, as well as participants that may partake in the endeavour are motivated to pursue the solution, and the scope of a solution and its acceptance in the problem domain increases (Peffers et al., 2007, p. 54 f.).

**2. Define Objectives of a Solution:** Some researchers explicitly separate this step from the problem definition (development of meta-requirements in Walls et al. (1992) or requirements in Eekels and Roozenburg (1991)), whereas others imply it within the problem definition. The definition of objectives can yield qualitative and quantitative specifications of desirable solution characteristics or performance. These characteristics may be drawn from the analysis of the problem and knowledge about currently employed solutions. They should be derived rationally, rather than set by e.g., researchers' preferences. For example: If users complain about not having the opportunity to ask questions or interact with system administrators, then a requirement may be that the solution should allow users to do so. However, even if a chat-bot may be a suitable tool for solving this problem, such a conclusion cannot be derived rationally and chat-bot functionality may therefore not be a requirement based on the problem definition.

**3. Design and Development:** This is the phase, during which the artefacts are created. As in this dissertation, Peffers et al. (2007) conceptualise artefacts as any designed

object in which a research contribution is embedded. The activities of this phase are determining the desired functionality and architecture of the artefact and building it thereafter. At this stage, additional knowledge from the knowledge bases (such as theoretical foundations, Hevner, 2007) are to be included.

**4. Demonstration:** This step consists of proving that the artefact can indeed solve one or more instances of the problem. It has been included in literature as part of the design and development step (Hevner, 2007), part of a more formal evaluation (Rossi & Sein, 2003), or as its distinct step aside from construction and evaluation (Eekels & Roozenburg, 1991; Nunamaker Jr et al., 1991). Any appropriate activity to provide this proof is acceptable (Peffers et al., 2007).

**5. Evaluation:** While the demonstration step merely proofs that the artefact solves a problem, the evaluation step's purpose is to measure how well it solves the problem. In other words: the evaluation should provide evidence of the efficiency and effectiveness of the artefact in accomplishing its intended task. This activity can take many forms, such as the comparison of requirements (step 2) with measured or observed outcome of the artefact in use, quantitative measures of performance, logical proof, or other forms of empirical evidence. If the artefact is satisfactory, the next step is initiated. Otherwise, the learnings from the evaluation should be formalized and re-introduced into the DR process. Maybe requirements need to be adapted, maybe the design is not up to the task.

**6. Communication:** Based on the identified need for communication of DR projects' resulting knowledge (Hevner et al., 2004), the final step is introduced into the framework. During this step, Peffers et al. (2007, p. 56) propose to communicate "the problem and its importance, the artefact, its utility and novelty, the rigour of its design, and its effectiveness" to the communities of research, communities of practice, and other relevant audiences.

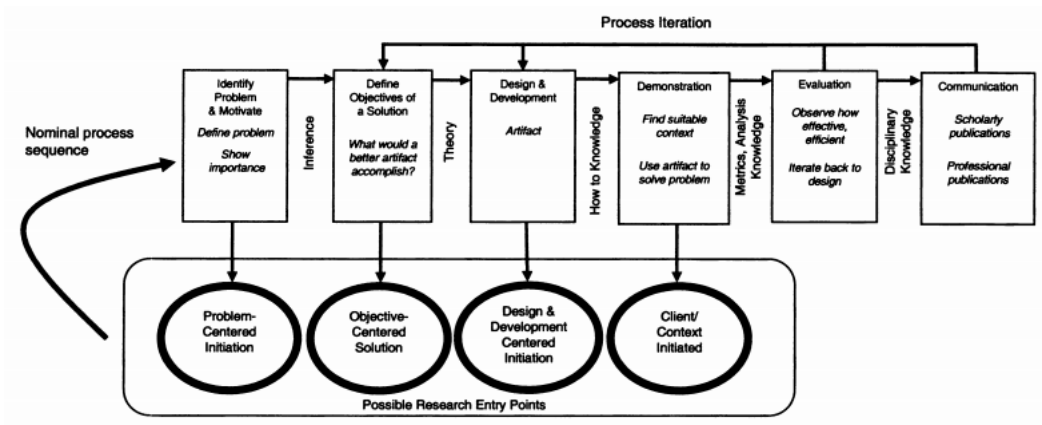


*Figure 4: DSRM Process Model (Peffers et al., 2007)*

As commented on in the introduction, communication (summative, in the case of the DSRM process model, but it might just as well be concurrent communication) poses problems to design researchers. Recognizing that there is a need for an effective solution is, of course, a potential research entry point. The methodology section elaborates on how this process model is operationalised for the specific research problem of communicating design research projects. In the upcoming sub-section, some of the status quo on the topic of communication of research projects in general (Section 2.2) and existing guidance for design research communication in particular (Section 2.3) are presented.

## 2.2 Communication of Research Projects

Considering that the issue raised in the introduction and detailed further in Sections 4 and 5 is not communication per se (e.g. message production and processing, persuasion, emotion expression, cf. Berger, Roloff, & Ewoldsen, 2010), but the communication of research projects and their outcomes (i.e., science, including results, procedures, rationales, cf. Burns, O'Connor, & Stocklmayer, 2003), the background literature also does not focus on pure communication (as in "communication science"), but on the communication of science (as in "science communication"). About communicating research projects, or 'science' in broad terms, a literature base called science communication (SciCom) exists. Even though it does not focus on DSR or design-oriented projects per se, it provides an initial foundation to build upon.

Over time, many definitions for science communication have been provided. While the underlying idea of science communication is the "exchange of scientific information with target audiences" (Wilson, Ramey, Donaldson, Germain, & Perkin, 2016, p. 127), definitions differ in many aspects from each other, e.g. in "their perspective (expert-expert communication vs expert-laymen communication), in their scope (internal vs external communication), in their focus (e.g., on target groups, on functions, or means), and their underlying assumptions and aims" (Mauelshagen & Jakobs, 2016, p. 2). For this dissertation, the summarizing and relatively high-level definition by Burns et al. (2003, p. 191) is used:

> *SCIENCE COMMUNICATION (SciCom) may be defined as the use of appropriate skills, media, activities, and dialogue to produce one or more of the following personal responses to science:*
>
> *Awareness, including familiarity with new aspects of science*

> ***E**njoyment or other affective responses, e.g. appreciating science as entertainment or art*
> ***I**nterest, as evidenced by voluntary involvement with science or its communication.*
> ***O**pinions, the forming, reforming, or conforming of science-related issues*
> ***U**nderstanding of science, its content, processes, and social factors.*

*Science communication may involve science practitioners, mediators, and other members of the general public, either peer-to-peer or between groups.*

This definition is rich in that it provides some idea of means for communication (skills, media, activities, dialogue), possible target outcomes (regarding awareness, enjoyment, interest, opinions, and understanding), as well as stakeholder groups (scientists, mediators, general public) and their relations (peer-to-peer vs between group communication). About all these aspects, additional literature exists, which can provide an initial knowledgebase to build upon. After all, the research problem focused on in this dissertation can be seen as a task that belongs to a sub-class of SciCom activities, where the communicating stakeholder is known (design researcher), and the 'science' is limited to a design research project.

### 2.2.1 Role and Relevance of Science Communication

Although traditional communication outlets for researchers (e.g. peer-reviewed journal articles, academic conferences) are effective for reaching a peer-to-peer audience, they may be unfitting for reaching broader, non-scientist audiences (Wilson et al., 2016). After all, science communication is not only about the exchange between researchers, but it is also largely responsible for informing the general public. As competition for publication space, funding, and support(ers) increases, effective communication of scientific findings, projects, or even plans for investigations becomes more relevant for scientists (Mauelshagen & Jakobs, 2016, p. 1; Van Eperen, Marincola, & Strohm, 2010). Thereby, they are required to and increasingly interested in communicating not only to other experts in the field but also to non-scientists and people who lack much of the research background, such as policymakers, (natural) resource managers, the general public, funding agencies, or practice partners (Putortì, Sciara, Larocca, Crippa, & Pantaleo, 2020; Wilson et al., 2016).

At the same time, communicating research projects is not straightforward. One reason for this is that popular formats in modern media and news coverage tend to get shorter (e.g., some seconds in an evening program news story, some hundreds of words in brief newspaper articles, or a handful of lines in a social media post) and effectively do not allow for detailed reporting, requiring communicators to cut the content of their communication short. Another reason is that complex stories take time and effort to understand while competing for attention with the daily flood of information people are exposed to (Van Eperen et al., 2010). Human attention is a fixed resource for which companies compete. After all, attention can be turned into money, for example, through subscriptions and advertisements (Stroud, 2017). In that competition for attention, a highly complex and lengthy research project presentation might be a weak horse to bet on, considering that humans subconsciously "monitor the environment for novel and threatening stimuli" (Marcus, Neuman, & MacKuen, 2000, p. 53, in Stroud, 2017) and that their attention is most easily triggered by "motion, colour, critters of every kind, sexualized men and women, babies and monsters" (Wu, 2016, p. 21). Regarding the attractiveness of the communication products created by researchers, Mirkovski et al. (2020) nicely put it:

> *"Our short attention spans (Barnes & Jones, 2000), limited processing capability (Paas, Renkl, & Sweller, 2004), built-in visual internalization (Levy, 2002), and natural empathy for storytelling (Schank, 1990) call into question the prevailing practice of communicating knowledge in the academic community in lengthy, text-driven articles, which are often (though not always) devoid of a clear and compelling storyline—not appealing to practitioners." (p. 4)*

Thus, science communication is a relevant but complicated activity for researchers. While many researchers lack formal training or even understanding of their role in science communication (Kuehne et al., 2014; Treise & Weigold, 2002), many researchers started to seek input and guidance (Cooke et al., 2017). One essential aspect of improving one's communication efforts is to use appropriate channels and techniques for specific communication use cases (Putortì et al., 2020; Van Eperen et al., 2010). In these use cases, communicators should account consider that "audiences differ with respect to demography, background knowledge, personality, worldview, cultural norms, and preferences" (Cooke et al., 2017, p. 235; Wilson et al., 2016).

### 2.2.2 Describing Science Communication Use Cases

A communication use case describes a typical science communication setting. It can be conceptualized as a partial input-process-output (IPO) model. Thereby, many variables may help describe the outset of a specific communication endeavour (input). At the same time, communicators tend to pursue some clear goals (output). Effective communication thus refers to the goal-oriented transformation of the input such that the targeted output is reached at low expense of resources. This transformation of inputs is the process part of an IPO model and refers to the communication-related activities. These are not part of the use case, but apply to specific use cases. This model is used here to structure the phenomenon.

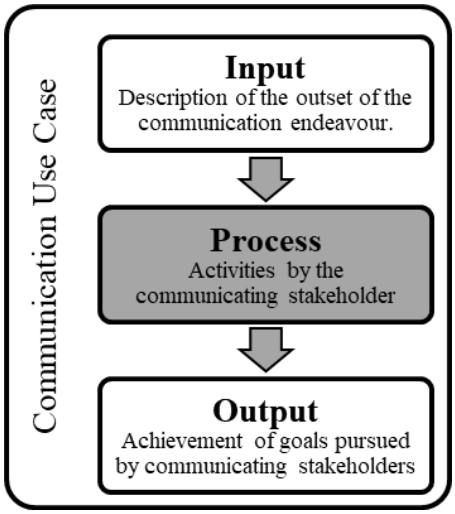


*Figure 5: Partial Input-Process-Output Model for Science Communication Use*

In the following paragraphs, some of the prominent aspects relevant to the input, process, and output of communication activities are described. While these accounts are not conclusive, they help understand this IPO model's different parts. Thereby, an underlying assumption is that design researchers come across similar communication use cases and that they may therefore be able to profit from knowledge on general science communication use cases.

**Input:** There is a lot of literature describing aspects that affect the choice of a communication strategy. While it may not be necessary to discuss this literature in detail here, a broad overview of the following intensely discussed elements ensues: specificities regarding the audience, direction of communication, channels, formats, and project-related aspects.

Regarding the *audience*, the literature suggests that communication efforts need to be customized with the target group in mind (Burns et al., 2003). How exactly that target audience is analysed and subsequently described varies. Some descriptions are categorical: Politicians, journalists, experts or scientific colleagues from the same/other disciplines, non-scientists or general audiences with little or no scientific background, interested laypeople, non-interested laypeople, engaged stakeholders, mediators, or general decision-makers (Burns et al., 2003; Cooke et al., 2017; Mauelshagen & Jakobs, 2016; Putortì et al., 2020; Wilson et al., 2016). Other descriptions of the audience are more

fine-grained, focussing on key characteristics such as the state of knowledge, interests, information needs, expected level of granularity (Burns et al., 2003; Mauelshagen & Jakobs, 2016), demography, background knowledge, personality, world view, cultural norms, and preferences (Cooke et al., 2017), or the terminologies they use (Morana et al., 2018). Before engaging in communication activities, it is important to know about the specific audience in one's use case.

Another relevant input information is the *direction of communication*. There are two general approaches (Mauelshagen & Jakobs, 2016): The communication can be unilateral, aiming to overcome a lack of knowledge in the audience compared to the communicator. This approach is called the 'deficit approach.' The underlying assumption is that the audience lacks knowledge about relevant scientific concepts. The opposite approach is called the 'dialogue approach' or the 'engagement model of science communication.' Therein, public knowledge about science is generated "much more as a dialogue in which, while the scientists may have scientific facts at their disposal, the members of the public concerned have local knowledge and an understanding of, and personal interest in, the problems to be solved" (Miller, 2001, p. 117).

While selecting an adequate communication *means* may sometimes be part of the process of designing the communication, it may also be a given circumstance, such as in written grant proposal papers, slide-show presentations at conferences, or a TV interview. Such means may include, but not be limited to: Website, daily newspaper, (guest) lectures, radio, TV, flyer, social media platforms, specialist literature, journals, personal interaction (e.g., guided tour, info events, workshops) (Mauelshagen & Jakobs, 2016), video, visual or performance art, or popular media (Cooke et al., 2017). Furthermore, the *format* of communication can also vary, such as the selection of accepted submission types at conferences or journals. For the MIS Quarterly, this would be research article, research note, research essay, issues and opinions paper, and the MISQ review paper (Lee, 2001). There are other formats, of course, the acceptability and content requirements for which are usually prescribed by the more traditional outlet types (e.g., journals, conferences, funding agencies).

Last in this overview on input aspects are the *project-related aspects*. The nature of a research project may also influence the process of devising ones' communication. One obvious example for this would be any kind of non-disclosure agreement, which may effectively forbid the sharing of project related information or restrict it such that, e.g., a participating stakeholder cannot be identified or is not explicitly mentioned. Another project-related aspect is the project timeline. The latter places varying demands on

communicating a project's activities and results (Mauelshagen & Jakobs, 2016). While researchers may not be able to provide any results in earlier *stages* of a research project, the addressed stakeholders may be interested in other information, such as, e.g., contact persons, aims of the project, understanding the research design, project governance or controls used (Mauelshagen & Jakobs, 2016). Furthermore, quantitative or qualitative results may place different requirements upon presenting results.

**Process:** The process itself is not really part of the use case description, as indicated above. However, there is some literature on what is important for the production of the communication (incl. content and presentation). Such literature can be understood as guidance for science communicators in general and researchers in particular.

There are usually descriptions of what the result should look like and how it should be produced for scholarly outlets. For example, this can be observed on conference websites, where researchers may find descriptions of submission types, author guides, document templates, formatting checklists, referencing guides, or presentation guidelines (see, e.g., icis2020.aisconferences.org/submissions; accessed on 28th of July 2020). For journals, this is similar (see, e.g., misq.org/instructions, accessed on 28th of July 2020). The latter also tend to inform authors about 'good practice' in editorials (e.g., Lee, 2000; Rai, 2018; Straub, 2009) or, conversely, what one may not submit (Zmud, 1995). Such guidance is also provided by funding agencies, which tend to have rigid expectations about what information shall be provided and what procedure must be followed (e.g., Swiss National Science Foundation: http://www.snf.ch/en/funding/how-to/, accessed on 28th of July 2020). Such guidance can be summarized as descriptions of what *content* should be selected and the *order* in which the content is to be presented.

Concerning non-scholarly communication use cases, literature provides some insights as to what the audience may be interested in regarding the content of the communication (e.g., intentions of the research project, milestones, overall and intermediate results, possible implementations of the results in practice, costs, involved stakeholders, and technical, economic, ecologic, and social impact) (Mauelshagen & Jakobs, 2016). Furthermore, there is some guidance on how one may convey such content. For example, communicators may show the actual data to the audience, as the latter might wish to understand it without glossing over important details. Furthermore, communication should be framed to provide the unique science-based perspective that researchers can provide. It may be less critical whether this goes hand in hand with high ranking publications, but the story used to package this view and insights must be compelling (Cooke et al., 2017). Mauelshagen and Jakobs (2016) investigated what may be important to target audiences

when it comes to communicating such stories. They found that the most frequently mentioned properties for high-quality SciCom are honest, reliable, transparent, clearly structured, and strongly stakeholder-oriented. The latter may include that researchers should not only focus on answering interesting questions but that they must also tell an interesting story (Mirkovski et al., 2020; Sauer, Neuroth, Chu, & Ma, 2016). A good read on the role of storytelling can be found in Pollock and Bono's (2013) "Being Scheherazade: The importance of storytelling in academic writing." The insights above underline the relevance of the *selection of content*, the *storytelling techniques*, the *tools* used, as well as the *involvement and engagement of the audience*.

While there are high-quality journals such as Public Understanding of Science or Science Communication to offer conceptual and empirical insights into the effectiveness of various communication techniques (Cooke et al., 2017), there is still a lot to be learned about how to communicate science effectively. This is particularly relevant for new and social media, as called for in Brossard and Scheufele (2013) and Liang et al. (2014). In addition, it is relevant to know more about the creation process of communication, as the latter should build the bridge between the input aspects and the goals or the output aspects.

**Output:** The output describes the goals pursued in a particular communication scenario. From the perspective of the scientist or communicator, these goals may be manifold, e.g., simply educating, informing, or entertaining audiences, or maybe even changing human behaviour (Cooke et al., 2017). They may also include developing and furthering one's career in science (Liang et al., 2014; Tremblay et al., 2018), recruiting the next generation of scientists, gaining acceptance of science, or supporting sound and effective decision-making (Stocklmayer, 2013, p. 21). Science communication is thereby never an end in itself (Davies, 2019). In a broader perspective, science communication also helps secure ongoing political and financial support for science, promotes science in general and science organizations (e.g., universities) as well as individual scientists in particular, while accounting for public expenditure on science (for an extensive overview of science communication motives, see: Weingart & Joubert, 2019).

While this overview of science communication is not complete, it may still provide a basis for discussing the communication of DR projects. After all, it provides an idea of what to look for with regard to the communication instance (a term I use for the specific opportunity to communicate, as described by non-project-related input factors) and project-related aspects (input), communication instance-related goals (output), and communication activity-related sub-processes (process). Knowledge on processes is focal for this dissertation project, as this should allow communicators to bridge the known input (a research project and the communication instance) with the self-defined outputs (desired goals).

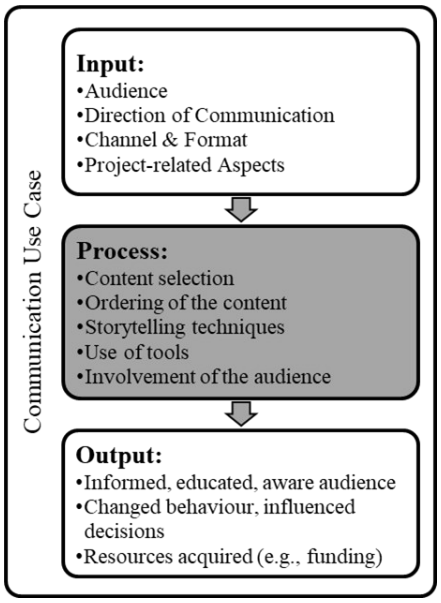


*Figure 6:* Extended IPO model for science communication

The following sub-section investigates the existing knowledge specifically on the communication of DR projects.

## 2.3 Communication of Design Research Projects

In the sections above, the literature outlines why DSR is central to IS research (Section 2.1.1), what DSR is, and how DR is conducted (Section 2.1.2), along with a conceptualisation of knowledge about communication of science as an IPO model (Section 2.2). In this sub-section, peculiarities of DR projects that seem to complicate the communication are discussed before providing an overview of some existing guidance on how design researchers may communicate their projects.

### 2.3.1 Peculiarities of Design Research Projects

DSR literature provides insights into how design research projects differ from non-design research projects. Considering that the research problem for this dissertation is about the specific problems encountered when communicating design research projects, it is important to understand what sets the latter apart from other communication situations. Five themes of these differences are described as peculiarities of design research:

#### 2.3.1.1 The Nature of Design Research Problems

Design researchers address wicked problems (Avdiji & Winter, 2019; Hevner et al., 2004; Rittel & Webber, 1984). Thereby, these problems have the following characteristics (Hevner et al., 2004, p. 81):

- Unstable requirements and constraints
- Ill-defined environmental contexts
- Complex interactions among subcomponents of the problem and its solution
- Inherent flexibility to change (malleability of design processes and artefacts)
- Critical dependence on human cognitive abilities (e.g., creativity) to produce effective solutions

With such a starting point to a research project, certain implications become apparent that affect the research process and the communication of such research projects. For example: To address a research problem within a changing and ill-defined environment, one may first need to **conceptualise the problem** in a meaningful way (Hevner et al., 2004). This includes specifying the type of problem (rather than the specific instance) that should be solved. Indeed, research outcomes of DR should not provide a solution for one specific problem but rather develop solutions that apply to a **class of problems** (Maedche et al., 2019; March & Smith, 1995; Walls et al., 1992). This is usually tied to the activity of identifying the problem. The latter includes determining the **scope of the research project**, along with the role and scope of practitioner involvement. Practitioners may be interested in partaking in DR projects, so long as their local problems are solved. This, however, is not the primary goal for a design researcher. Design researchers use the instance (local problem within an organization) to inform their activities, test their solutions, and keep the practitioners engaged. However, scholarly knowledge creation happens on a more abstract level though. Hence, design researchers must navigate multiple levels of abstraction and knowledge. This applies not only to the contributions (see: Section 2.1.2.3: Research Outcomes; and Gregor & Hevner, 2013: Design Science Research Contribution Types) but the entire DSR process.

Communicators of DR projects must thus not only make sure that they *adequately conceptualize the problem* despite its wickedness, but they also need to be *sensitive toward the agendas of their audiences*, as practitioners and research communities are interested in different scopes of solutions. Furthermore, based on the inherent flexibility to change in design research projects and the need for human abilities such as creativity, design researchers face many *(arbitrary) design decisions* which are often hard to justify.

#### 2.3.1.2 Navigating Several Levels of Abstraction

How such decisions could be justified and how the levels of abstraction that come with any DR project can be navigated is beautifully outlined in Avdiji and Winter (2019), where DSR is conceptualized as having three levels of abstraction: The causality level, the prescription level, and the instantiation level (Figure 7).

On the **causality level**, theoretical cause-effect relations (kernel theory) support the assumptions as to why suggested means-end relations may help solve a problem. These are descriptive theories. One can think of such theory as the foundation leading to hypotheses—in the case of design research: design hypotheses. They originate from disciplines outside of IS (Gregor & Hevner, 2013) and, while a kernel theory is currently understood as a 'reference theory,' it was initially a term to refer to "theories from natural science, social sciences, and mathematics" (Walls et al., 1992, p. 41) that are encompassed in design theory. Kernel theories exist without the need for or presence of an intervention in the real world. However, the design of such an intervention can be informed by the kernel theories.

On the **prescription level**, designs for problem classes are formulated as means-end relations. As such, these abstract prescriptive statements (e.g., "implement these means to reach these ends") bridge the real world in which instances of the problem can be observed (instantiation level) and the descriptive theory (causality level).

The 'translation' of prescriptive statements may be referred to as instantiating since the abstract solution is being specified such that an instance design emerges. This requires researchers to leave the theoretical domain and design solutions at the **instantiation level**. In some sense, this activity is similar to the translation of explanatory knowledge to design hypotheses, as the design hypotheses (abstract, claiming to address the problem class) inform the design of a concrete solution at a lower level of abstraction.

This navigation of multiple levels of abstraction is inherent and paramount in DR. It is much less focal in explanatory research, which focuses only on cause-effect relations. Cause-effect and means-end relations has also been referred to as descriptive and prescriptive knowledge (Gregor & Hevner, 2013).

Regarding communication, this peculiarity of DR projects indicates that the *story told* in a communication effort may be more complicated to follow because of the additional levels of abstraction. Each move up or down the abstraction levels needs addressing and justifying. Therewith, an adequate explanation may also use up more *space*. This is

problematic for DR communication, as many communication *formats* are strongly limited in the volume allowed (e.g., number of pages, minutes, words).

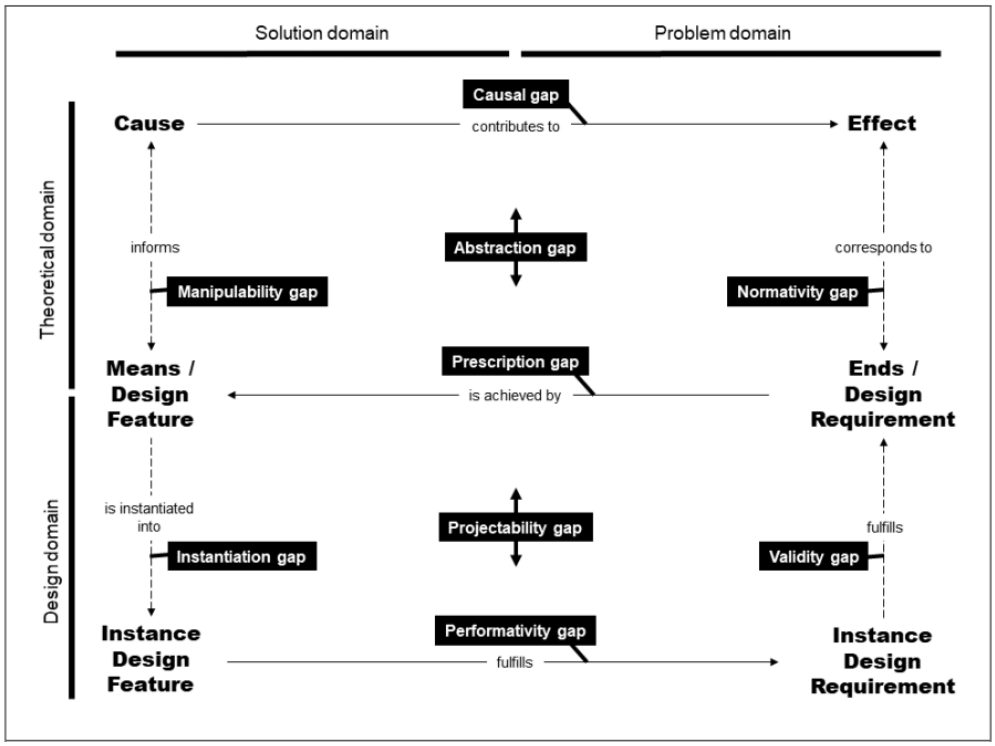


*Figure 7: Knowledge Gaps in Design Science Research (Avdiji & Winter, 2019)*

#### 2.3.1.3 The Predictability of a Design Research Project

A design research project has many "**degrees of freedom**" (limited number of ways in which a dynamic system may change, Merriam-Webster, n.d.-a)—starting at the design research problem, which is not entirely clear at the outset. From there on, a DR project might take a significant turn in yet unanticipated directions at various times throughout the process. This is made clear in both Hevner (2007) and Peffers et al. (2007) by their underlining of the cyclicality of DR. New knowledge gained during a project is introduced into the research process before finishing the design research study. Thereby, a fundamental difference in the predictability of DR projects and descriptive research projects exists:

In **descriptive** studies, the outcome is an explanation of some (aspect of a) phenomenon. Such an explanation can (and should) be reached by a well-justified process (methodology). That process is highly predictable in terms of activities to be performed and outcomes that can be achieved. By limiting the scope of a descriptive study (specifying a research problem and focussing on aspects of the research problem by, e.g., formulating hypotheses or research questions), a set of research techniques, including data collection

and data analysis, can be specified upfront. Given a selection of techniques, the related activities and the kinds of results an analysis might bring forth can be foreseen. Upon following through with such a process, the study is over. In the case of a confirmatory study, a hypothesis or several hypotheses are rejected or not, and in the case of an exploratory study, new behaviours are described. The completion of such a study may offer new research opportunities. However, if done well, there is usually no ex-post iteration necessary, and the degrees of freedom of such studies are limited compared to design studies. This implies that researchers may know early on what their research problem is, what they want to focus on, and how they will proceed. There is no procedural emergence to be expected for such a study. Thus, independently of the progress of the data collection, analysis, and interpretation, researchers can clearly (though maybe somewhat abstractly) communicate what they investigate, how they do it, and what possible outcomes of such a study are (the latter being only halfway valid for grounded theory method based investigations). Thereby, studies in the behavioural science paradigm tend to follow a normative script that is predictable: Definition of the problem, literature review, hypothesis development, data collection, data analysis, presentation of results, discussion of results, conclusion (Peffers et al., 2007). This script does not generally fit design studies (Gregor & Hevner, 2013).

In **design research** studies, a project should produce applicable and useful solutions to relevant problems (Peffers et al., 2007). Even if one thinks to have clearly understood the problem by using both literature and practitioner statements as a starting point, it remains unclear what the specific requirements for a solution are, what shape such a solution might take (in the sense of an artefact 'type'), whether the solution provides higher efficiency, effectiveness, or both, and whether practitioners can use it, and so forth. A DR study can be considered terminated only once the artefact has been evaluated and reached satisfying results. An iteration may be started if an artefact does not satisfy the requirements or project-relevant new knowledge has been gained throughout the DR process. Thus, the problem analysis, the elicitation of requirements for a solution, the creation of an artefact, and its evaluation all materialise during the DR process, and each step depends on the outputs of the former steps (Hevner, 2007; Markus et al., 2002; Parnas & Clements, 1986; Peffers et al., 2007). Furthermore, even if a design researcher is reasonably certain about an already finished step of the process, they may still find themselves questioning and updating the scope of their projects as they progress (vom Brocke & Maedche, 2019). DR projects, therefore, come with a higher level of complexity, and they lack this predictability of activities and outcomes compared to

studies that do not focus on creation (Deng & Ji, 2018). This can also be perceived when summarising research projects: While one would likely use the research model in descriptive research (left side of Figure 8), a research project requires more complexity to portray its central ideas, e.g., because of iterations (right side of Figure 8, based on Peffers et al., 2007, and Hevner, 2007). While there have been attempts at formulating normative scripts for design researchers (Gregor & Hevner, 2013; Peffers et al., 2007; Tremblay et al., 2018), these tend to be hard to apply to the high diversity of DR projects.

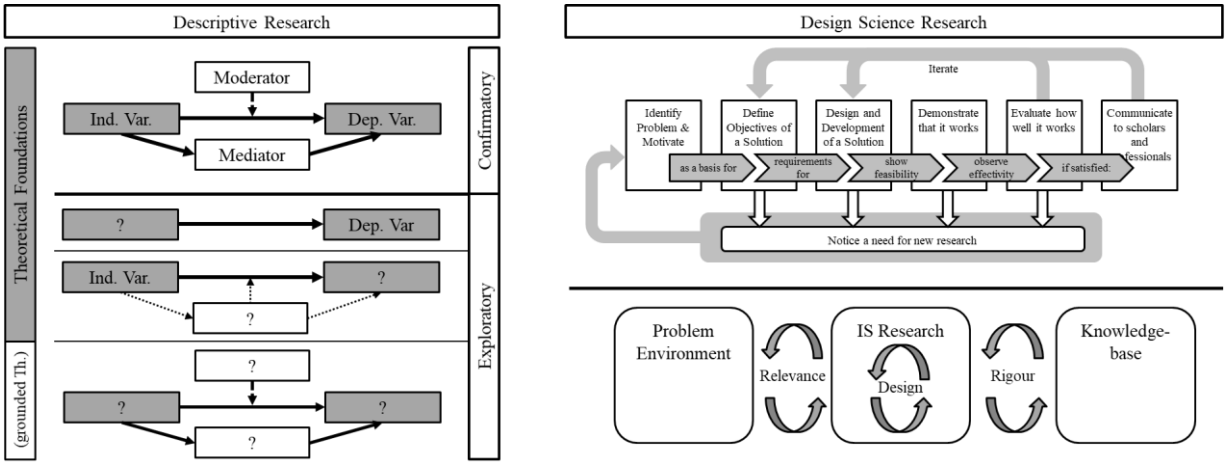


*Figure 8: Complexity in Descriptive research vs Design Research*

This iterative and emergent nature of the DR process, from problem understanding to evaluation, affects the process of communication in many ways: *Selecting the content* for communication may be troublesome, as many aspects remain somewhat unclear over much of the DR project, including fundamental questions such as: What is the goal of the study? What is the exact nature of the problem? That these questions cannot be conclusively answered, especially in earlier stages of the research project, strongly affects how one *tells a story, selects and orders the contents*.

#### 2.3.1.4 The Timeline of a Design Research

Another peculiarity of DR is that it comes with activities that are difficult to report on, including creative design decisions (e.g., why not using another legitimate approach?), or a multitude of small-change iterations that make earlier iterations hard to justify (e.g., why did one think the first iteration was a sensible approach, given strong evidence gathered from testing it afterwards?). An interesting account on why this is a relevant peculiarity that affects how researchers report on their activities can be found in Parnas and Clements (1986), who argue that there is no ideal (fully predictable) design process and that design projects, even at a very small scale, are mostly presented in a way that

can be described as an ex-post rationalization: The development process of an artefact tends to be "revised and polished until the author has shown us what he wishes he had done, not what actually did happen" (Parnas & Clements, 1986, p. 252). After all, it would be highly unsatisfactory for audiences to listen to or read the story of how design researchers took a long sequence of design decisions while changing both problem definition and solution requirements along the way. Unlike in explanatory research, where the research problem is clearly defined first, then questions and hypotheses are derived before investigating their answers, the DR process is iterative and not sequential. On the one hand, this creates a need for a different, less direct, and not waterfall-like storyline, while on the other hand, the chronological description of design processes may be unnecessarily long, confusing, and boring (Pollock & Bono, 2013).

Different *storytelling techniques* such as an idealized, rational design process may therefore be required to present DR projects (Parnas & Clements, 1986). This is not only necessary for completed projects (retrospective communication of DR projects), but also or even more so for early-stage projects (prospective communication of DR projects), when clarity about the problem, the process, and the outcome is very low. Early-stage DR project communication must be convincing to acquire the necessary funds, partners, and support. Thus, the effective communication of early-stage DR projects may significantly affect its likelihood of success (vom Brocke & Maedche, 2019).

#### 2.3.1.5 Research Outcomes

In the early stages, it may even be unclear or falsely and prematurely specified what kind of outcome one may expect from a DR project. Compared to traditional explanatory research, the outcomes of DR projects can take many forms ("artefacts"), which are conceptually much more diverse than the description of relations between variables (i.e., antecedents, IV, DV, moderators, mediators). This outcome diversity, concerning the level of abstraction versus specificity (Gregor & Hevner, 2013), and the conceptual type (Hevner & Chatterjee, 2010) is high, making a one-size-fits-all solution for SciCom including DR projects difficult. For a discussion on artefact types in literature, see above or Deng and Ji (2018) and Alturki et al. (2011).

Furthermore, dominant philosophical assumptions which underlie IS research may be inadequate for DR. In particular, the positivist/postpositivist and the interpretative/constructivist worldviews do not address the unique requirements of DR, which focuses on creation (Deng & Ji, 2018; Gregg, Kulkarni, & Vinzé, 2001). Design researchers are pragmatists who create knowledge by making and who value creative manipulation and

control of their environment while not necessarily pursuing truth but improvement and utility (Deng & Ji, 2018; Simon, 1996). This has implications on the communication of DS projects as well. Notably, the object of investigation is not finding a truthful answer to a justified question but a useful improvement regarding some relevant problem (Deng & Ji, 2018). Thereby, the *content one selects* for communication may be much less focused on deriving hypotheses, justifying them, and testing them for their truthfulness, but on creating something new and demonstrating its usefulness (Gregor & Hevner, 2013).

These peculiarities simultaneously underline that general-purpose SciCom may not necessarily fit DR projects and that DR project communication itself is indeed no simple task. (More on the research problem addressed in this dissertation in Section 5.) In the following sub-section, existing attempts at providing some guidance for design researchers are presented.

### 2.3.2 Existing Guidance for Design Researchers

This section is split into two parts: First, the role and state of guidance in DSR are investigated. Second, a selection of specific publications aimed at providing guidance to design researchers to communicate their projects is presented.

#### 2.3.2.1 A Short Overview on Guidance in DSR

The DSR should allow actors to "develop and provide instructions for action" (Österle et al., 2011, p. 8). This statement was meant to apply to the design and operation of IS. However, it also stands for a way of creating solutions used by design researchers for design researchers: Guidance in DSR has a long history, during which design researchers have themselves addressed locally bothering problems in their research activities such that solutions that can be used as instructions for the entire DSR community emerged. In other words: Design researchers develop and provide instructions for their own line of work, too. In doing so, over the last three decades, more and more guidance on how to conduct DR has been accumulating. For example, researchers have tried to respond to the difficulties of conducting rigorous and relevant DR and publishing it in respected outlets by publishing guidance (Engel et al., 2019; Gregor & Hevner, 2013; Hevner, 2007; Peffers et al., 2007). The fact that guidance and best practices are important to design researchers might also be observed when comparing the nearly equal number of basket journal publications about DSR (i.e., DS) with the number of publications that apply DSR to organizational problems (i.e., DR, see Engel et al., 2019).

The multitude and specificity of guidelines on how to conduct DR may risk of them being interpreted too strictly. This, in turn, can make DSR unattractive. Taking procedural guidelines and objectives published in journals and at conferences seriously makes it difficult and costly to carry out DR projects (Österle et al., 2011) and poses problems not only for researchers but also reviewers who attempt to ensure that an ever longer checklist of criteria and process steps are being adequately addressed (Engel et al., 2019; Peffers et al., 2007). Having more guidance on how to conduct DSR has thus led to many more activities to do and report on. Such reporting is particularly relevant when communicating research projects within the scientific community, of course, especially when preparing peer-reviewed articles (Tremblay et al., 2018). This observation, in turn, has led to some guidance on how to present DSR knowledge.

Some of that guidance is quite specific, focussing only on individual aspects of DR projects, such as how to represent design knowledge. This includes, for example, configurative models or methods (e.g., vom Brocke & Buddendick, 2006; Winter, 2012); formulating design principles (Chandra Kruse, Seidel, & Gregor, 2015; Gregor, Chandra Kruse, & Seidel, 2020), specifying design theories (Gregor & Jones, 2007), or a design knowledge map that represents a journey of design knowledge creation (vom Brocke et al., 2020).

Other guidance on presenting DR projects is more conceptually addressing the communication of DR projects, such as Hevner (2007), Peffers et al. (2007), or Parnas and Clements (1986). However, according to Gregor and Hevner (2013), such guidance is not detailed enough and therefore does not provide nearly as much clarity and depth on how to structure and write a DR publication as the guidance that exists in the behavioural science literature. For this reason, they wrote an interesting paper on "Positioning and Presenting Design Science Research for Maximum Impact" (Gregor & Hevner, 2013).

In general, most guidance focuses on one specific use case: Summative presentation of a DR project to IS researchers. However, this is not the only relevant use case. Design researchers need to present their projects throughout the entire DSR project and to various audiences (Cahenzli et al., 2021b; vom Brocke & Maedche, 2019).

#### 2.3.2.2 Approaches to Communicating DR Projects

Existing literature that discusses the communication of DR at the project level is scarce. In the following, the four approaches identified in an extensive literature search are presented in more detail. These publications feature a useful approach to deal with the high complexity of projects (Parnas & Clements, 1986), a structural reference process to

orient one's communication (Peffers et al., 2007), a ready-to-use solution for paper writing (Gregor & Hevner, 2013), and a solution focussing on communication with non-academic audiences (vom Brocke & Maedche, 2019).

**Parnas and Clements (1986):** In their thought-provoking paper, Parnas and Clements argue that it is impossible to follow a rational design process (here: in creating software). However, even if a design project relies on information that only surfaces during the design and evaluation processes, even if human error and bounded rationality tamper with an 'ideal' order of events, it may be desirable to have a notion of what a rational design process might look like. A design project can then be oriented towards that ideal process, rather than be fully emergent in its development, and – more curiously – researchers should create documentation (i.e., communicate their projects) as if they had followed the ideal process. Their rational design process suggestion is geared toward software development. However, its underlying ideas regarding project communication also apply to DR projects. It consists of the following steps:

- Establish and Document Requirements
- Design and Document the Module Structure
- Design and Document the Module Interfaces
- Design and Document Uses Hierarchy
- Design and Document the Module Internal Structures
- Write Programs
- Maintain

While this process is rationally sound and useful to describe how a final program may have been produced, this process is generally impossible to achieve. However, as Parnas and Clements argue, it provides guidance for effective communication that is concise and easy to follow.

**Peffers et al. (2007):** Peffers et al. set out to create a general-purpose DSR methodology, which includes conceptual principles to define what DSR is, practice rules, and a process for carrying out and presenting the research. They argue that the lack of a consensus-based DR process model has led to publications in IS journals that have required ad hoc arguments to support their validity (Peffers et al., 2007). Their process model (see Figure 4) should thus not only help planning and executing DR, but also presenting DR projects. Peffers et al. (2007) argue that "researchers might use the structure of this process to structure the paper, just as the nominal structure of an empirical research process is a common structure for empirical research papers" (p. 56).

While it is a valuable reference model for structuring and discussing DR activities, it may be (1) an idealistic process, such as the one suggested in Parnas and Clements (1986). (2) It also does not address how one may deal with most DR peculiarities that cause difficulties in communicating DR, as presented above. Even if the 'faking' approach proposed in Parnas and Clements (1986) is combined with the DSR process model by Peffers et al. (2007), (3) it remains unclear how the communication phase should account for, e.g., the iterative nature of DR or the low level of clarity and predictability regarding the problem definition, the set of requirements, the design process (i.e. the design phase), and therefore the outcome and its demonstration and evaluation.

**Gregor and Hevner (2013):** Focusing more on writing DR papers, Gregor and Hevner propose a reference structure or "publication schema for a DSR study." They recognize that the potential of DSR in IS is far from exhausted. One of the reasons for this is the difficulty in conveying DR projects such that both rigour and relevance become apparent, the paradigm and the methodology used becomes clear, and the contents are selected and presented convincingly. Following a similar line of argumentation as in Peffers et al. (2007), they proposed a set of headlines and some commentary on what may be presented in each section of a DR paper. This may seem to be the guidance a design researcher wishes for to solve a large part of the research problem outlined in this dissertation proposal. However, the descriptions and the rigid structure are not satisfactory either. In particular, it is very closely related to the nominal structure of an empirical research process, as referred to in Peffers et al. (2007). While this may appeal to reviewers or funding agents, for they can recognize more easily the structure, it does not adequately instruct design researchers on how to overcome the difficulties outlined in the peculiarities of DR (see Section 2.3.1). Notably, one of the key peculiarities – the iterative and emergent nature in which DR projects evolve – is not addressed. It provides an idealized reference, albeit an incomplete and procedurally unsatisfying one, into which most DR projects hardly fit.

A striking difficulty with implementing in their schema is caused by the fact that the iterations and emerging knowledge are only conceptually addressed (in the description of the chosen approach in the method section). Thereby, the research problem (introduction section), the solution requirements (introduction), the generic approach (method), and the artefact (artefact description), all of which iteratively develops during the project, are merely described retrospectively and in aggregated form. This may lead to highly unsatisfactory lines of argumentation, in particular when considering that the iterations of artefact development are not intended to be described. The latter can be

deduced from their schema, in which the fifth section is the evaluation of the artefact. However, in an iterative design search process, the (demonstration and) evaluation should be done once per iteration.

| Section | Contents |
|---|---|
| 1. Introduction | *Problem definition, problem significance/motivation, introduction to key concepts, research questions/objectives, scope of study, overview of methods and findings, theoretical and practical significance, structure of remainder of paper.*<br>For DSR, the contents are similar, but the problem definition and research objectives should specify the ***goals*** that are required of the artifact to be developed. |
| 2. Literature Review | *Prior work that is relevant to the study, including theories, empirical research studies and findings/reports from practice.*<br>For DSR work, the prior literature surveyed should include any prior design theory/knowledge relating to the class of problems to be addressed, including artifacts that have already been developed to solve similar problems. |
| 3. Method | *The research approach that was employed.*<br>For DSR work, the specific DSR approach adopted should be explained with reference to existing authorities. |
| 4. Artifact Description | A concise description of the artifact at the appropriate level of abstraction to make a new contribution to the knowledge base.<br>This section (or sections) should occupy the major part of the paper. The format is likely to be variable but should include at least the description of the designed artifact and, perhaps, the design search process. |
| 5. Evaluation | Evidence that the artifact is useful.<br>The artifact is evaluated to demonstrate its worth with evidence addressing criteria such as validity, utility, quality, and efficacy. |
| 6. Discussion | *Interpretation of the results: what the results mean and how they relate back to the objectives stated in the Introduction section. Can include: summary of what was learned, comparison with prior work, limitations, theoretical significance, practical significance,* and *areas requiring further work.*<br>Research contributions are highlighted and the broad implications of the paper's results to research and practice are discussed. |
| 7. Conclusions | *Concluding paragraphs that restate the important findings of the work.*<br>Restates the main ideas in the contribution and why they are important. |

*Table 2:* Publication Schema for a Design Science Research Study (Gregor & Hevner, 2013)

**vom Brocke and Maedche (2019):** Using a different approach altogether, vom Brocke and Maedche presented essential core dimensions that describe DR projects to help coordinate and communicate DR projects. They see the need for a quick and straightforward representation of DR projects to improve the interaction between its various stakeholders. For this reason, they conceptualised a high-level representation of DR projects that makes it possible to capture the essence of it on one page. Hence, compared to the other three attempts presented above, it does not promise to communicate the entire project but to capture essential 'cornerstones.' They acknowledge that a rigid template may not be most useful, as adaptations to such a structure may be necessary depending on the purpose for and context of each communication situation.

They have demonstrated the "DSR Grid," consisting of the six dimensions shown below (Figure 9), by filling it out based on various DR projects. While this is certainly an interesting approach, it is only a partial solution for a specific high-level representation use case. However, as with the other approaches, its fundamental ideas may be useful to inform the development of further guidance (e.g., by providing information about which possible contents might be relevant for a communication situation).

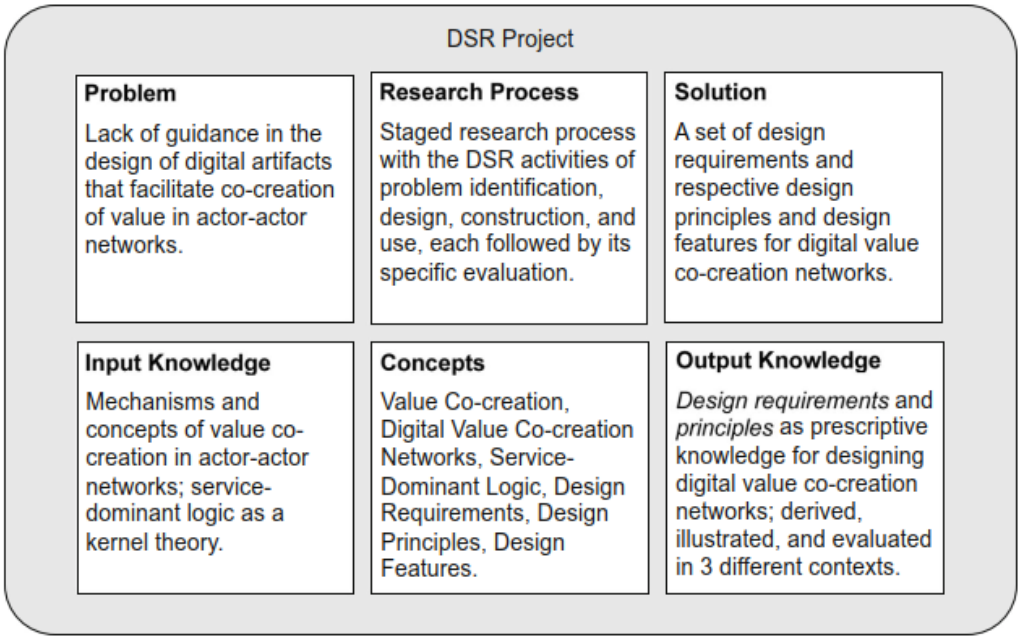


*Figure 9:* The DSR Grid (vom Brocke and Maedche, 2019)

With this outline of the DR-specific approaches to guide researchers in communicating their projects, it becomes apparent that (1) the issue is a relevant concern in the IS DSR community and that (2) these approaches are not satisfactorily addressing the peculiarities of DR projects. Therefore, it is still necessary to use ad hoc explanations and structures to communicate DR projects, which leads to poor communication effectiveness and is desirable—especially so when it comes to scholarly communication (Gregor & Hevner, 2013; Peffers et al., 2007). This may help explain the curious fact that there is about as much research about DR (i.e. DS) published in the Senior Scholars' basket of eight as there is research applying DR (Engel et al., 2019). If DSR is to express its full potential in IS research and practice, communication processes must improve (Gregor & Hevner, 2013).

# 3 Methodological Approach

Following the presentation and motivation of the general research problem in the introduction, along with the existing literature surrounding the research problem and indicating the research gap in the research background section, the preparatory stages of the original research presented in this dissertation are concluded. In this section, the research design, including the methods (quantitative, qualitative, mixed methods), techniques employed (survey, document analysis, field experiment, coding), the activities related to design, rigour, and relevance cycles, along with explanatory justifications for the research design decisions are outlined. Some argue that this section contains the most important part of a research project, as the quality of a study's results mainly depends on the adequacy of the research design (Bortz & Döring, 2006). Having extensively reviewed the research design of research articles (Cahenzli et al., 2021a) and having evaluated hundreds of research design proposals as a teaching assistant, the author acknowledges the relevance of a well-clarified methodology. For this reason, this methodology section features not only the research activities but also the associated reflections that should reveal the adequacy of the research design decisions. It starts with an explanation about the suitability of the design science methodology for this dissertation (Section 3.1) before presenting the overarching research framework (Section 3.2) and an overview of the empirical studies that inform this dissertation (Section 3.3).

## 3.1 Using DSR to Address the Research Problem

The research problem and the associated research questions in this dissertation are based on phenomena in IS research. Within IS research, the two complementary paradigms of behavioural science and design science provide some frame of reference to researchers as to what questions one may answer, what methodology is acceptable, and what research outputs can be expected (see Section 2.1.1 or March & Smith, 1995; van Aken, 2004). In the following, the research problem is conceptualised as a design problem (Section 3.1.1) before reframing both the research endeavour (Section 3.1.2) and the levels of abstraction associated with the research problem (and solution, Section 3.1.3), such that the applicability of design research becomes evident.

### 3.1.1 Conceptualising the Research Problem as a Design Problem

As introduced, design researchers face a relevant problem: the unsatisfied need for guidance on how to communicate their research projects in the many communication

situations they face. Given this starting point and the desire to address this issue through research, two main understandings of science can be used as a lens.

First, one may try to find out more about the problem—using the problem as a phenomenon that needs studying. Knowledge that explains the situation, its origins, and maybe even its future can be devised. This, of course, refers to the questions and outcomes accepted in the behavioural science paradigm (van Aken, 2004). Applied to the research problem in this dissertation, the behavioural science paradigm is useful in that it helps reveal how the problem materialises (e.g., which situations and aspects of communication are problematic, how does this affect researchers, how do communicators cope with the problem, and how effective are such strategies?). Without a proper understanding of the research problem, communicators can hardly be helped. While there is some limited discussion of the problem in existing literature, further investigation is needed. This is particularly the case for communication situations that are neither summative nor concerned with academic paper writing since summative paper writing is the primary aspect of the problem discussed in the DSR literature.

Second, one may use scientific methods and knowledge brought forth by scientific enquiry to solve the research problem or at least sub-problems. While problem-solving or achieving ends in the real world is meaningless to behavioural science, the design science paradigm aims explicitly to provide utility by constructing and evaluating generic means-end relations to solve problems (Simon, 1996). The main stakeholders affected by the problem raised in the introduction (i.e., design researchers) face their problem in pursuit of a goal (i.e., effective communication of their projects). To reach this end, they require adequate means. They are therefore not helped by mere explanations of cause-effect relations. A research-based approach to solving their problem includes the design of means, which complies with the ideas of design science research.

While the research problem could be investigated without providing any useful solutions to design researchers (behavioural science), a solution (design science) without further investigation of the problem is not possible. The design decision that needs to be taken is thus, whether to only work on creating a deeper understanding of the problem or whether to additionally work on a solution.

In this case, the research problem can be conceptualised as a practical problem. Even if provided with the explanatory theories that conceptualise the constituents of DR project communication, or relations between concepts, the problem would remain unsolved. An additional design step is necessary to help solve the real-world problem they experience.

Indeed, the focal stakeholders are helped when explanatory, predictive, or normative theories are put to practical use (Walls et al., 1992). The main stakeholders' concern is not strictly about a lack of understanding of a phenomenon (cause-effect relations) but rather about a need for a solution to a real-world problem (means-end relations). Since explanatory research of the behavioural science type would be inadequate on its own to help design researchers solve the problem outlined in the introduction, the research problem is addressed from a design science point of view. Thus, the relevance of the research outcome to the focal stakeholder is ensured by upholding the research purpose of creating utility (over seeking truth).

### 3.1.2 Rigour and Relevance in this Design Research Project

It is not enough to strive for relevance, even though this is a strength of DSR. Design researchers should also strive for high rigour, as illustrated in the three-cycle view on IS design research (Hevner, 2007). From a design researcher's point of view, this has several implications: (1) The research must be adequately founded on an existing knowledgebase. (2) In direct exchange with representatives from the application domain, this foundational knowledge should be extended to better understand the research problem and obtain requirements for a solution. (3) The primary knowledge contribution arises from a design-and-evaluate process (see respective numbers in Figure 10).

*Figure 10: Three-Cycle View, based on Hevner (2007)*

Based on the primary research objective, the solution that needs to be designed should provide guidance for design researchers for communicating their DR projects in various communication situations and at various stages of the project. Based on the research background, 'communication' can be conceptualised as an input-process-output model. The input (i.e., the starting conditions) and the targeted outputs (i.e., the purpose or goal of communication) should be known to design researchers, whereas the process that

leads from the starting conditions to the output is unclear. Hence, the **design cycles** should result in some guidance that helps take a communication situation's starting condition as input and guide users toward effectively achieving their communication goals.

The **rigour cycles** should feed the research with existing knowledge that helps to understand the status quo (including the above-presented literature on DSR and its peculiarities, communication science, and existing knowledge on communicating DR projects), and provide the methodological tools and guidance that allow for rigorous research (including behavioural science research methods and design science research methods). The methodological knowledge gathered from the knowledge base is outlined in Sections 3.2, 3.3, and the appendices that elaborate on the various empirical studies that contribute to the design of this dissertation's artefacts. At the same time, the design cycle contributes new knowledge to the knowledge base. These contributions are reflected upon in the discussion section (Section 9).

To ensure the relevance of the designed artefacts, the **relevance cycle** parallels the design cycles. From the problem identification to the problem specification, the definition of requirements, and inspiration for the designs (e.g., by harnessing knowledge about existing coping strategies), until the evaluation of concrete artefacts, the problem environment is constantly searched and thus involved in the design and evaluation activities. Hence, not only does precise knowledge about the problem, such as it arises in its natural environment, inform the design process, but the artefact is also tested in that environment to clarify whether it is indeed providing a relevant contribution. With that, the research endeavour can be illustrated in the Hevner et al. (2004) framework as follows:

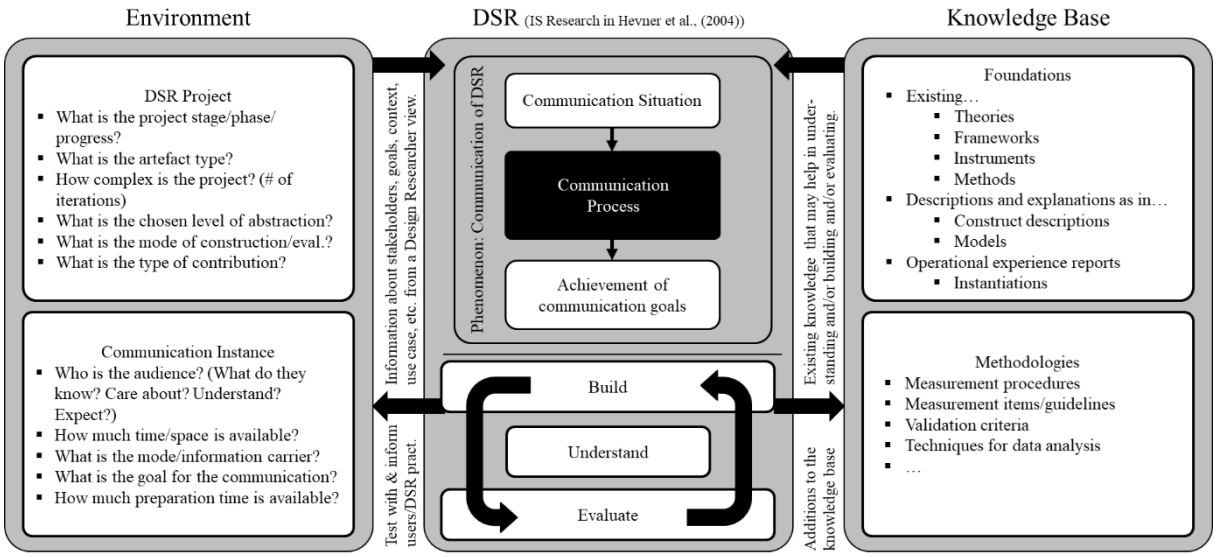


*Figure 11: Derived Research Framework, based on Hevner (2007)*

### 3.1.3 Levels of Analysis of Problems and Solutions

As established above, there is some guidance for some specific communication use cases (see: Section 2.3), but the problem affects many more situations. To conceptualise this, a discussion of levels of analysis might be necessary. On one extreme, explicit instructions prescribe how to formulate the communication for a specific situation (e.g., a preformulated text that merely needs keywords to be entered). Such guidance is, of course, highly contextualised. This means it is directly applicable within its specific context, but it is unlikely to generalise to other use cases (Lee & Baskerville, 2003). It would be on a low level of analysis, which for some design science researchers does not contribute to design theory, as the knowledge created is not transferrable (see the discussion on instances and design theory in Section 2.1.2.3). On the other end of the DSR contribution spectrum (Gregor & Hevner, 2013), there is design knowledge that is highly abstract and transferrable to many situations. Such knowledge is at a very high level of analysis. For such knowledge to be applied, it needs to be contextualised (i.e., it needs information from lower levels of analysis). A general-purpose instruction on how to communicate design research projects and what to consider for any design research project in any communication situation would thus be at a high level of analysis. Such knowledge is instructive for all kinds of situations, but additional effort needs to be invested to apply it. After all, practical problems present themselves as unique and specific (van Aken, 2004). Between specific instances and highly abstract design theories, a continuum of 'nascent design theory' covers the range between highly applicable but not generalisable to only indirectly applicable but highly generalisable.

This discussion of levels of analysis is relevant at this point, as it affects how a problem is specified (at what level of abstraction is it investigated?), and it influences the design of solutions. Furthermore, the level of analysis affects how learnings from a solution's application can be used to inform other solution designs. For example, a use case agnostic solution (highly generalised, but only applicable with considerable situating) must be effortfully contextualised before 'applying' it; and evaluation results from an instantiation may yield detailed information about the low level of analysis at which the contextualised version of the solution is deployed, but learnings may thin out when going up the levels of analysis. Hence, learnings from an implementation are absolutely relevant to the specific operationalisation of the abstract solution. However, these same learnings can hardly justify changes to the use case agnostic solution. After all, the learnings emerge from a derivative, not from the solution itself.

A highly generalised solution can be understood as a solution to a problem at the summarising class level of analysis. DSR is generally interested in classes of problems (Maedche et al., 2019; van Aken, 2004; Walls et al., 1992). However, among problem classes, there may still be a hierarchy. For example, in the case of the communication of design research projects, one may think of the overarching class of analysis as the communication of design research projects in the various communication situations one encounters along the design research process. This encompasses all problems related to communicating a design research project. In the following, this highest level of abstraction will be referred to as the **class level** (of analysis).

A lower level of abstraction that addresses a significant number of more specific problem types might be the writing of a research article. There can be a great variety of different DR projects, with different kinds of artefacts, at different stages of maturity, with different operationalisations of the design science research methodology, and different requirements imposed by the authorities at an outlet. There are also different kinds of research articles. A solution that provides utility to the communication problem of writing a design research article thus needs to be somewhat generalised to accommodate these various sub-types of articles and situations. However, it can exclude many irrelevant communication situations (e.g., acquisition talks or practitioner-oriented communication in general). This level of analysis is hereafter referred to as **sub-class** level.

Such differentiation between levels of analysis can be drawn arbitrarily. One might, for example, consider the class level (described above) as a sub-class of communication of research, which is a sub-class of general communication. For the purpose of having a meaningful frame of reference within this dissertation, however, the levels of analysis are set to three. The low level of analysis also addresses a problem sub-class (not an instance, e.g., a specific presentation, but a group of highly similar instances). The instance-level does not qualify as an adequate level of analysis for DSR (as this would be a problem of design practice, Venable, 2006). Instead, there might be an **instance type** that summarises a more specific and more situated group of design research communication situations. For example, one may think of the writing of a grant proposal to a specific type of grant agency or student presentations of early-stage research designs. A solution would apply to various distinct instances; however, the generalisability of such a solution (i.e., mapping knowledge to a sub-class) is strongly limited. At the same time, a solution at the instance-type level is highly applicable to its instances (see Figure 12).

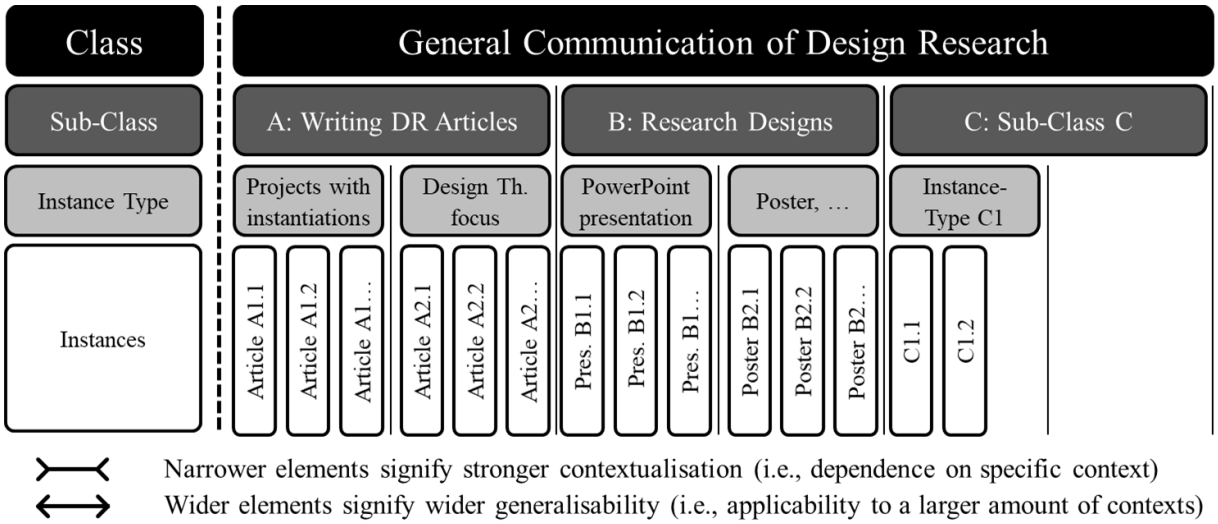


*Figure 12: Conceptualisation of Levels of Analysis with Examples*

Inspired by the literature gap, the research efforts in this dissertation include the creation of a solution for the class level (going beyond specific use cases, addressing how design researchers may communicate their projects in general, Section 6). That solution is thereafter used as a basis for designing further solutions. One such solution addresses a narrower and highly relevant sub-class of the problem (writing research articles, Section 7). To investigate whether the class-level solution can effectively be used to design solutions at the instance-type level, a third solution is designed: Guidance for students presenting early research design proposals of design research projects for obtaining feedback (Section 8). The following sub-section introduces the overarching research framework that ties these three design efforts together.

## 3.2 The Overarching Research Framework

The overarching research framework that helps discuss the methodology used in this dissertation is based on the DSR process model by Peffers et al. (2007). The use of this reference approach is motivated in the following sub-section. Thereafter, its adaptation that yields the research framework is presented. Finally, to round off the discussion on the methodology, Section 3.3 will introduce the individual empirical studies used throughout this design research endeavour.

### 3.2.1 Reference Approach: The DSRM

The DSR process model, illustrating the DSR methodology as presented in Peffers et al. (2007), serves as the overarching reference approach for addressing the overall research question in this dissertation. (For further details on the approach, see Section 2.1.3.3.).

The reasons for selecting this process model include the fact that it is accepted within the DSR community, it helps structure the research activities into process phases, it comes with high clarity regarding the sequential order in which activities may occur (see Figure 13. As such, this research process model is a good starting point to discuss the methodology for this dissertation. However, this approach of designing three artefacts at various levels of analysis is not directly perceptible based on the research process model. For the purpose of writing this dissertation, the author has created a derivative version of this process model (i.e., the overarching research framework, see: Figure 14).

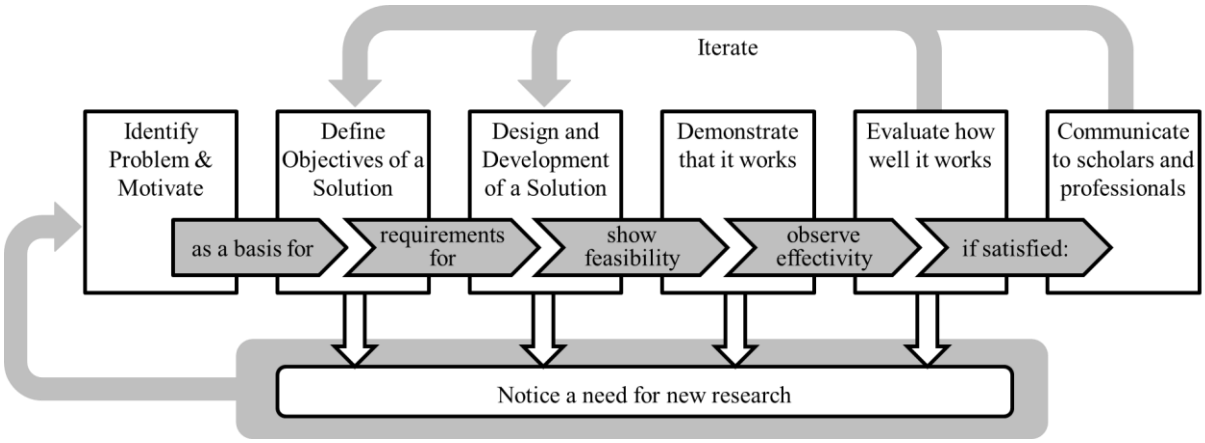


*Figure 13: The DSR Process Model (based on Peffers et al., 2007)*

### 3.2.2 Operationalisation of the DSR process model

The overarching research framework contains the following information:

- The sequence of addressed activities of the DSR methodology
- Added detail on what is contained in these activities
- The order and section where these activities are discussed in this dissertation

Compared to the DSR process model, the author has (1) made explicit the steps of identifying the research opportunity and investigating the knowledgebase; (2) integrated a split of the design and evaluation activities to accommodate for artefacts at three levels of analysis and merged the demonstration and evaluation phases into one. The rationales behind these adaptations are the following:

The DSR process model launches the research process with the identification of a research opportunity. There may be many entry points that lead to the project launch, and realistically, there needs to be some idea for a research opportunity to start a research endeavour. However, that research opportunity will become much clearer and more focused once some initial investigation of the existing knowledgebase is conducted. Indeed, a research gap may need to be first delimited by indicating what has been

researched in the past. While this may or may not have been included in the DSR process model, the investigation of existing knowledge is of particular importance to both DSR in general (Gaß, Koppenhagen, Biegel, Maedche, & Müller, 2012; Hevner, 2007), and this dissertation project in particular. These two early-stage processes (identification of a research opportunity and investigation of the knowledge base) have not enjoyed much presence in the Peffers et al. (2007) manuscript. Since they are essential to a dissertation (motivation and research background), the author has made the change (1) to the process model.

In addition to making these two changes, the idea of levels of analysis of both contributions and research problems are introduced to the DSR process model. While investigating several levels of abstraction is not in conflict with the DSR process model (one could conduct several DR projects at once), the communication of the methodology in this dissertation manuscript may be helped considerably by not splitting the work into three individual operationalisations of the entire DSR process model. Hence, this research framework ties together three DR studies into one overarching research endeavour. This is suitable for this dissertation, as all three studies share the same background literature and, to some extent, the same explanatory research conducted to inform the projects.

Lastly, for simplicity, the author has combined the demonstration and evaluation phases into one. This is not problematic, as Peffers et al. (2007) found that existing processes and guidance on conducting DSR sometimes includes only one of the two activities and sometimes both.

The resulting research framework can be seen below (Figure 14). It includes the activities and associated section numbers in this dissertation, where these activities are discussed. Notice that this manuscript's section on the methodological approach is not part of the DSR process model but is required to communicate a research endeavour to fellow researchers anyhow. Furthermore, as indicated by the horizontal line atop "Design and Development" and "Demonstration and Evaluation," these activities are reported combinedly in one section per level of analysis. Doing so should simplify the understanding for readers. Whereas the first five sections are relevant to all three levels of analysis, the design and development and the demonstration and evaluation activities are distinct for each level. Hence, Sections 6-8 build upon the same foundational information (Sections 1-5), which is thus provided only once, rather than repeating it several times.

The information that underlies the problem understanding, as well as the design and evaluation of the artefacts, has been obtained in various ways. Some information was gathered from reviewing existing literature, whereas other information has been obtained through empirical research and document analysis. In the following section, each information producing activity that supported this research is presented. Thereby, the focus is on the methodology and the research design. These studies and their results are presented in the appendices, whereas the key contributing findings are also integrated in this manuscript.

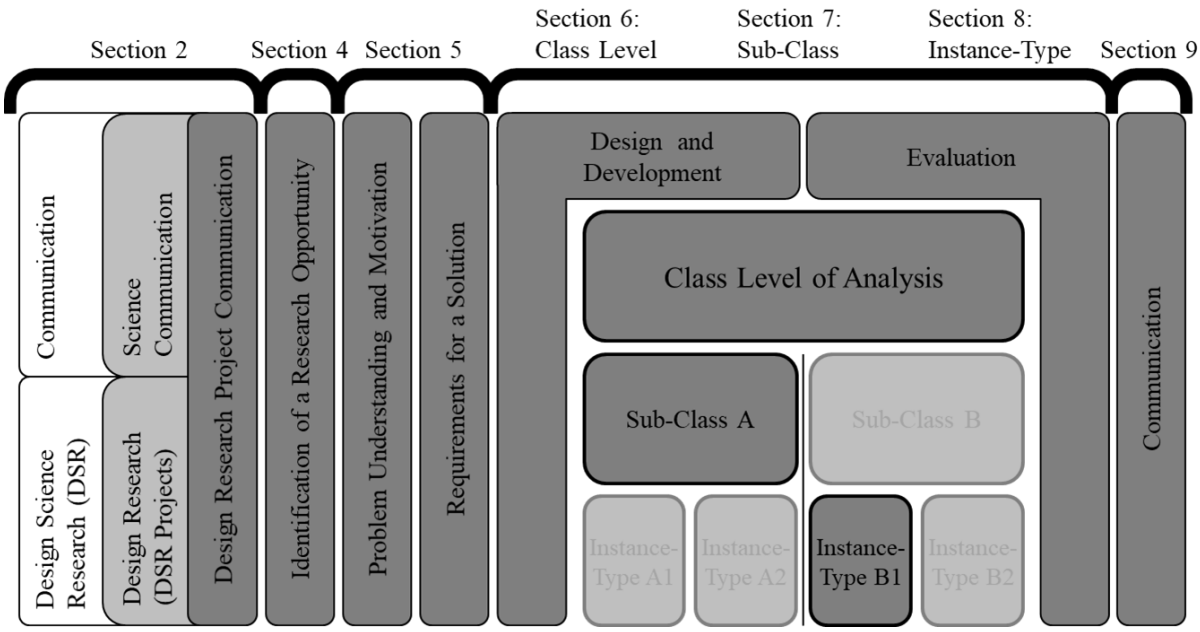


*Figure 14: The Research Framework for this dissertation (insp. by Peffers et al., 2007)*

## 3.3 Supporting Studies

The supporting knowledge used throughout the research activities presented in the research framework was gathered in various studies. The rationales behind these studies and a summary of their methodological approaches are presented here. In addition, for each supporting study, an overview is given on where additional information can be found in this dissertation.

### 3.3.1 Synthesis of the Knowledgebases (Selective Literature Review)

As explained in Section 3.2.2, the activity of searching the knowledge base is made more explicit in this dissertation's adoption of the DSR process model (Peffers et al., 2007). Indeed, among the first activities in this dissertation project was the study of existing literature. This is an essential part of the rigour cycle in Hevner's conceptualisation of

DSR (Hevner, 2007). The purpose of this step is manifold, but it is not to obtain a holistic view on any of the investigated topics. For this reason, the literature search conducted here is 'selective', and the review of the existing knowledgebase is therefore not a systematic literature review (Okoli & Schabram, 2010; Webster & Watson, 2002). Instead, the author relied upon summarising literature (including literature reviews) and used the snowball method from there. Hence, the references of such publications were used to reveal further publications to read. This process stopped once a consistent understanding of central concepts emerged.

The topics studied in this fashion are 'Communication' and 'Design Science Research.' The communication literature turned out to be split into a variety of areas, of which the area of interest for this dissertation is Science Communication (see Section 2.2). Within the DSR literature, both design science (understanding the constructs, methodology, standards and practices) and design research (identification of the problem and how it is expressed, existing solution designs) are of interest (see Section 2.1).

This literature search and analysis has fulfilled the following purposes and therewith covered several elements of the research framework (darkened based on contribution intensity in Figure 15):

- Creation of a fundamental understanding of related literature (Sections 1 and 2)
- Identification of descriptions of the research problem (Sections 1, 2, and 5)
- Identification of existing approaches to solving the problem (Sections 2 and 6-9)
- Initial delineation of the research gap (limits of literature) (Section 2, 4, and 5)

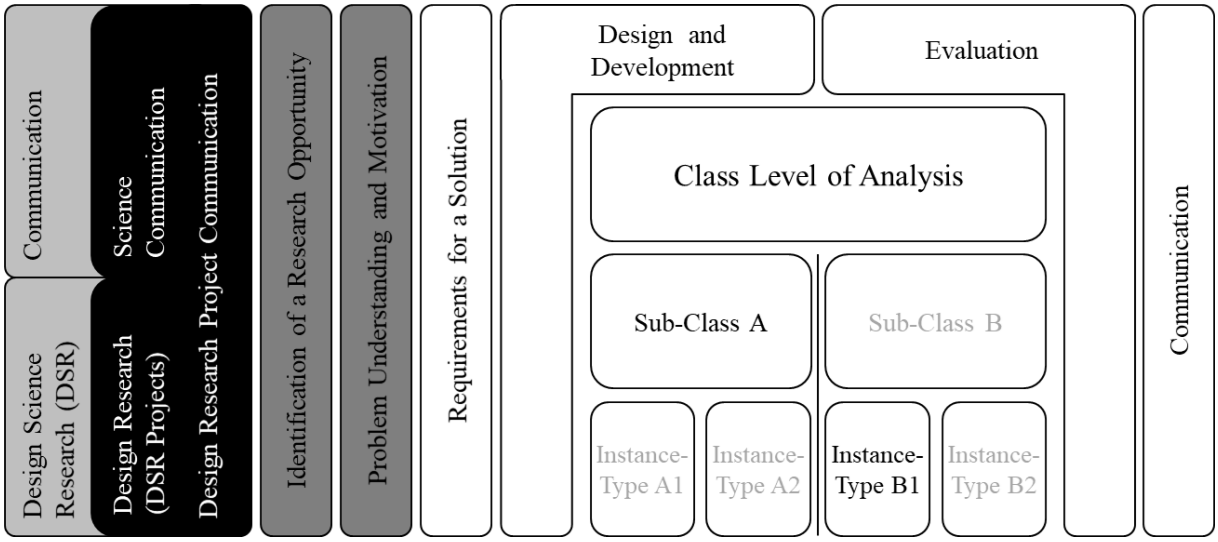


*Figure 15: Synthesis of the Knowledgebases (Selective Literature Search)*

The main contribution of the initial synthesis of the knowledgebases revealed some conceptual fundaments that are used in the design of the research framework as well. These include some conceptualisations (e.g., SciCom, DSR terminology, DSR process model), the Input-Process-Output model for communication, and a selection of assumptions about the relevant aspects of communication and DSR. The contributions of this phase directly informed an expert interview study (Section 3.3.2) and thus, indirectly informed the construction of the initial artefact at the class level (Section 6). The findings are summarised in a reflective framework, as shown in Figure 16, which splits the communication of research projects into descriptive input ('communication instance'), normative output ('targeted communication impact' which may take on various levels across the five communication impact measures, see: Burns et al., 2003), and a process ('crafting process'). The communication instance section summarises some of the seemingly important aspects of communication. The targeted communication impact features the possible effects SciCom may trigger in its audience, and the crafting process shows a tentative interpretation for a process that could bridge the two.

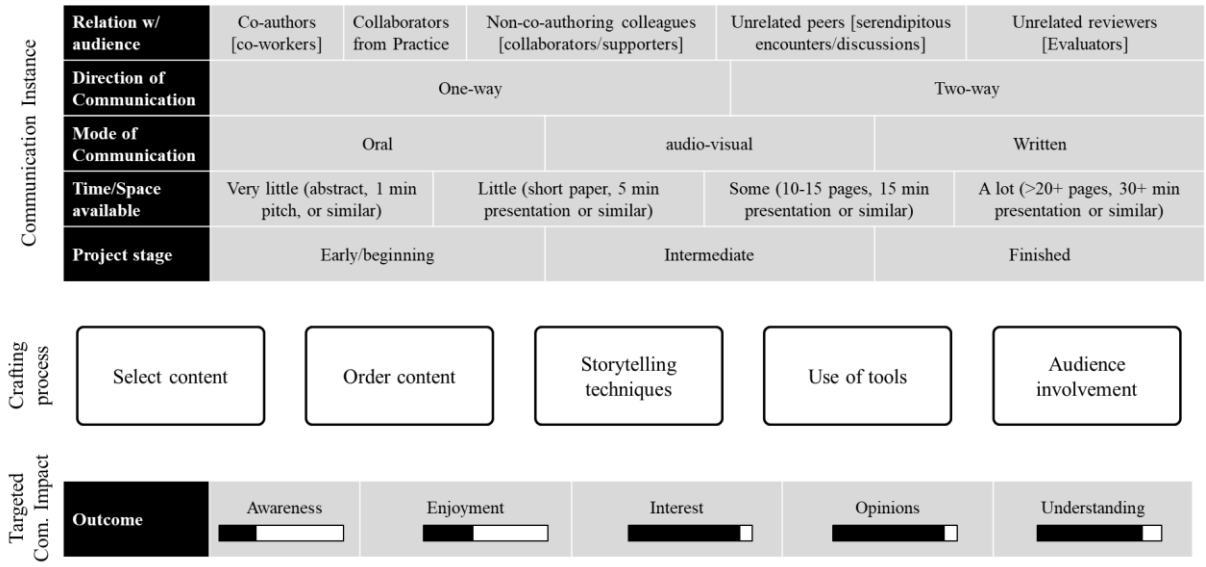


*Figure 16: Literature-based Reflective Framework (cf. Section 2)*

### 3.3.2 Expert Interview Study

The literature-based reflective framework contains three sections: (1) Descriptive characteristics of a communication instance; (2) the crafting process (i.e., activities that lead to and include the communication); and (3) impact measures of the communication (i.e., the audience-facing outcome created by the communication instance). The framework in Figure 16 is not meant to be conclusive. Hence, the format (IPO-model), the dimensions, and the characteristics within each dimension are to be understood as an initial

hint about aspects that are central to communicating design research projects. Since the framework's constituents were gathered based on existing literature, own experience, and reflections, some additional evidence was necessary to ensure its validity in general and the adequacy and relevance of its constituents. The expert interview study presented in this sub-section is used to do that. More specifically, the expert interviews should help make sense of the information gathered in the literature (the contents of the framework) in the specific context of the individuals that face the communication problem. For doing so, direct contact with design researchers promises to be most insightful. For this reason, new empirical evidence from this focal stakeholder group is gathered.

A relatively loosely executed semi-structured qualitative interview is adequate for this task (Dicicco-Bloom & Crabtree, 2006; cit in Ebel, Bretschneider, & Leimeister, 2016). It enables an evaluation of the existing framework for completeness, to add new aspects (through open, narrative response questions) and to understand the relative relevance of dimensions and their characteristics (through ad-hoc inquiries). The interview guideline is furthermore structured such that the perceived problem and experiences with dealing with the problem could be observed at various levels of abstraction and throughout the DSR process. To achieve this, some questions are formulated openly and geared toward an overall perception of DR project communication (class level), whereas others were specifically inquiring about one communication instance (instance level).

Addressing the issue of communication with practitioners helps understand the expressions of the problem in the real world. A deeper understanding of the problem and its occurrence increases the probability of creating an artefact that is actually useful to the focal stakeholders and addresses the core issues they face (primary purpose of DSR, Simon, 1996). These insights primarily added to the first two activities in the Design Science Research Methodology framework (i.e., problem understanding and requirements, Peffers et al., 2007). Accordingly, Section 5 is largely informed by this study.

Further effects of directly discussing with design researchers include a clearer understanding of the research opportunity (Section 4) and insights into coping mechanisms that were tried in the past. Coping mechanisms and the perceived effectiveness of these strategies can help inform the design and development activities (Sections 6-8). After all, fruitless strategies can be avoided, and successful practices can be integrated into a solution to increase its effectiveness and efficiency. Among the three design projects presented in this dissertation, the interview most substantially contributes to the class and the sub-class artefacts.

For further details on the methodology, the operationalisation of the research design (e.g., sampling, coding), and additional results that are not explicitly presented within the manuscript, please consider Appendix A.

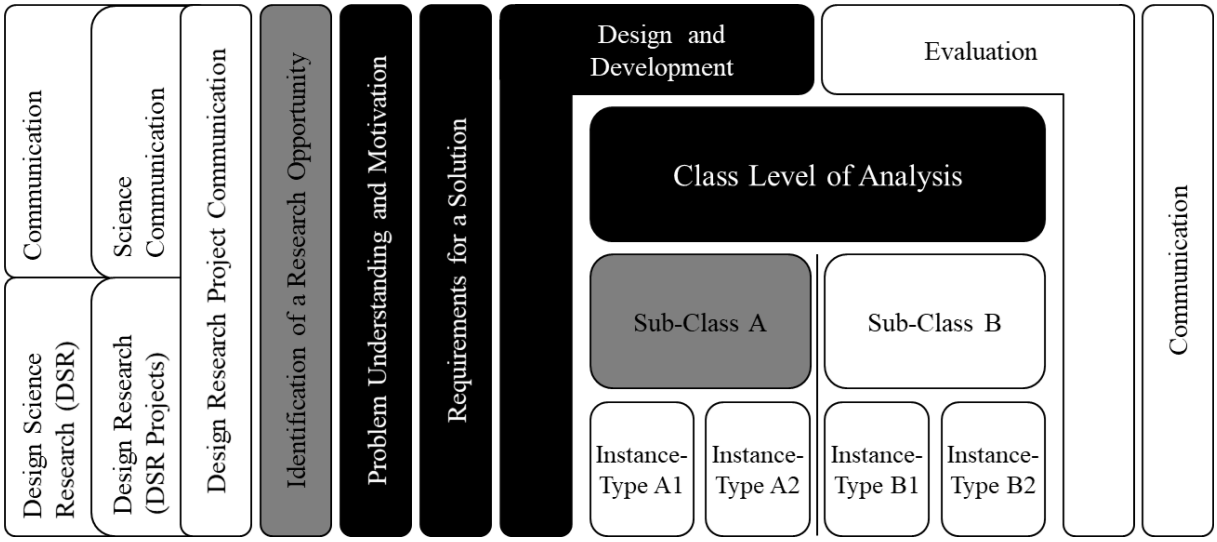


*Figure 17: Contributions of the Expert Interview Study to the Dissertation*

### 3.3.3 Artefact Creation at the Problem Class Level

After the literature review and the interview study, a good understanding of the problem and the requirements for a solution at the class level is established. Therewith, the first design cycle can be entered. Considering that the research problem of communicating design research projects appears in a wide variety of instance types and that there are no solutions for most of these types (solutions address primarily one type of the summative paper writing use case), the authors chose to build a solution that addresses the problem at the most abstract level of analysis first. With that, a successful artefact would be highly transferrable and therefore help design researchers in the multitude of communication situations they face. Based on the insights from the problem analysis (Section 5), design researchers face many communication situations in which guidance would be appreciated. With that in mind and considering that past attempts were quite narrowly scoped and therefore not only hard to generalise to other communication use cases but also to apply them to specific design research projects (Cahenzli et al., 2021b), addressing the research problem at the problem class level seems to be most useful for creating utility for the focal stakeholder.

While the methodological guidance related to conducting DSR has developed plentifully over the last few decades, its primary focus lies on identifying design requirements and evaluating a designed artefact. In other words: The design and development activity has

been largely treated as a methodological black box. Having made clear, however, that knowledge from the problem environment and the knowledge base must be used to inform the design in the Three Cycle View, Hevner (2007) provides some guidance as to how one may start the design and development activity. For this dissertation project and this specific iteration of the design cycle, that starting point includes the knowledge outlined in Section 2 (knowledgebase in the sense of the rigour cycle) and Section 5 (understanding of the problem and requirements for a solution). Furthermore, the expert interview study (Section 3.3.2) provides additional information from the problem environment. That information is introduced directly in the respective sections presenting the design and development activities at the class and sub-class levels (i.e., Sections 6 and 7).

As outlined in Section 2.1.3, a created artefact must be evaluated (March & Smith, 1995). After creating an artefact for the class level based on the knowledge outlined above and using imagination, creativity, experience, and problem-solving capabilities (Markus et al., 2002; van Aken, 2004; Venable, 2006; Walls et al., 1992), it thus needs evaluating. This evaluation can be operationalised in various ways: Sometimes, this evaluation takes the shape of a multi-study field test in the real world, whereas other times, researchers evaluate their designs conceptually, or they investigate existing solutions and compare whether these could have been created with one's artefact (Peffers et al., 2007; Pries-Heje, Baskerville, & Venable, 2008). Evaluating artefacts at a very high level of abstraction in real-world environments comes with its difficulties. In particular, the applicability of solutions at the class level to an instance is very low (see Section 3.1.3). This means that evaluating an abstract solution at an instance level is more likely to evaluate the implementation or specification of the abstract, class level solution to the situated, specific instance. Learnings from such an evaluation might inform the local solution design rather than the abstract solution design. For this reason, the class level artefact is evaluated in several ways, combinedly testing its effectiveness.

The author has evaluated the ideas and conceptualisations in various iterations. First, the author presented the fundamental understanding of the research problem and a first idea for a solution approach (i.e., conceptualising the problem as an IPO-Model and introducing a tentative draft of a possible process, see Figure 16) at the Swiss Chapter of the AIS doctoral consortium (CHAIS DC) in the summer of 2020. Second, these same ideas and a concrete plan to develop the artefact was discussed in September 2020 during the colloquium on the research proposal. After that, three further evaluative discussion series ensued as part of three semestrial doctoral courses. Each course contained two one-

on-one discussions (one with a doctoral student and one with a professor) and two plenary discussion sessions with fellow doctoral students and professors. Between each of these evaluation opportunities, the design was developed further. Lastly, together with two co-authors, the author has submitted a research article to the International Conference on Design Science Research in Information Systems and Technology (DESRIST 2021), which contained a mature version of the artefact. The reviewing process and the discussions at the conference served as yet other opportunities for evaluation.

Leaving the abstract level of discussing its effectiveness, the author has used the artefact to create the sub-class and the instance-type artefacts. In other words, the class level solution is the basis for creating the sub-class and the instance-type solutions (Sections 8 and 9, respectively).

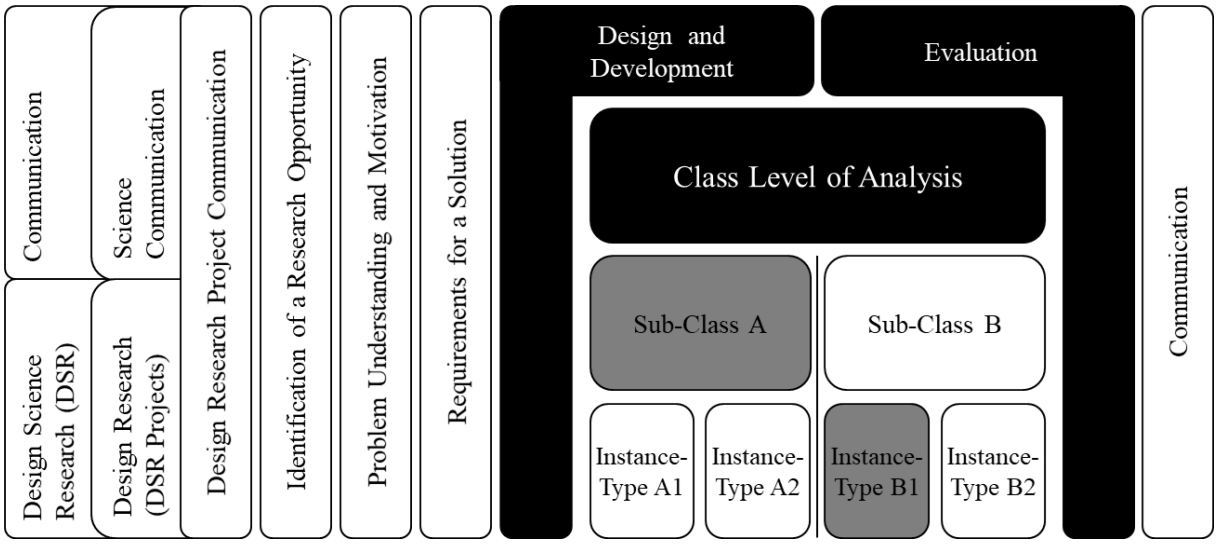


*Figure 18: Contributions of the Class Level Artefact Design Study to the Dissertation*

After creating an artefact for the class level, it can be contextualised. This contextualisation can be done for individual instances (i.e., applying it to one's communication situation), or it can be done for sub-classes or instance-types (i.e., specifying it to situations with shared characteristics). Contextualising means that context-specific information is added to the design such that its knowledge becomes more readily applicable (at the expense of generalisability to other sub-classes or instance-types). Hence, by virtue of addressing the problem class level, this initial artefact does not have direct utility to the stakeholders, but the stakeholders need to work with the artefact first. The utility that can be achieved with the research done throughout this dissertation project is undoubtedly much higher if further communication support at lower levels of abstraction is provided.

### 3.3.4 Artefact Creation at the Sub-Class Level

For design researchers, one of the most important sub-problem classes of design research project communication is the summative publication in high-end journals (Gregor & Hevner, 2013; Tremblay et al., 2018; Appendix A). While there is some existing guidance for writing high impact DSR articles, most notably Gregor and Hevner (2013), such guidance addresses the writing of articles as an instance type (low level of abstraction). Therewith, many DR projects hardly fit one or another solution (e.g., because of the variability among DR projects, Tremblay et al., 2018; Appendix A), and a more abstract, generalised solution at an intermediate level of abstraction might be much more helpful. Hence, knowledge from the design research communication sub-class of paper writing can be used to specify the class level artefact, while keeping a certain generalisability, accounting for the methodological and contribution diversity within DSR. Creating such guidance is the purpose of the artefact creation at the sub-class level.

To design and develop a solution at the sub-problem class level, additional knowledge must be gathered first, because descending levels of abstraction requires increasing specificity. The latter implies adding information that is closer to the instance. Such knowledge should be about the problem sub-class (i.e., the writing of journal papers). This knowledge, in turn, can emerge from investigating instances, such as specific communication artefacts (the articles themselves).

The fact is that there are successfully published design research. With that, some instances have been designed successfully. These instances can be used to identify good practices. After all, they have achieved the goal of the researchers. Observing successful instances can help inform the sub-class level of analysis through abstraction—by aggregating, clustering, and simplifying. This can be seen as a bottom-up approach to reaching the intermediate level of abstraction. At the same time, its counterpart is the specification of a solution at a higher level of abstraction (here: the class level), which achieves the same end of reaching the sub-class level of analysis. That can be seen as a top-down approach. In this dissertation, both approaches are used.

#### 3.3.4.1 Bottom-up Approach

The bottom-up approach investigates a selection of 19 design research project articles from the Senior Scholars' Basket of Journals. The articles were selected from a list of design research articles that emerged from a literature review (Engel et al., 2019) in such a way that all eight journals are present, but without ex-ante consideration of their

contents. Therewith prestigious and, thus, successful publications can be analysed with the goal of extracting prescriptive knowledge on how to communicate one's design research projects. That inductive investigation contains several studies, focussing on the structure of the articles, the effects the articles have on their audiences, and the combination of structure and effects:

The **analysis of the structure** of these articles was conducted to identify structural patterns. Finding established patterns that successfully get published can be one starting point to formulate how one may structure one's own publication. A mixed-methods study was used to reach this goal. Hence, the articles are analysed quantitatively and qualitatively. The quantitative research design consists of a coding exercise based on an initial coding framework (creation of a coding framework that quantitatively captures the structure and characteristics of the article, which thereafter can be described through statistics). In contrast, the qualitative research design consists of a coding exercise without an initial framework (independent coding of the contents and the order in which these contents are presented to identify groups of similarly designed articles). The research methodology, coding framework, analyses and further information on these two studies can be found in Appendix B and Appendix C. The key insights are presented and used in Section 7, where the design of the sub-class solution is developed.

The **analysis of the effects** these articles have on their audiences aims to identify the kinds of outcomes one might achieve through such publications. Such knowledge may be best extracted by no individual perceptions of these articles' effects. An analysis of these effects based on the author's perceptions might be inadequate, as he might be biased and identify aspects that individuals that are not involved or even aware of this research would not. Hence, collecting and aggregating the perceptions of many different people may provide a more neutral and independent overview of the audience's perceptions. For this reason, the data on effects are gathered from design researchers, whom each read a subset of two articles out of the same 18 articles from the structure analysis. Thereafter, they answered a survey designed to capture an articles' effects on readers. The methodological considerations, the survey, and further information about this study's sampling and operational implementation can be found in Appendix D. The key insights from this study are presented and used in Section 7.

After gathering information about the structure and the effects of these articles, the **structure and effects** are analysed combinedly. This fourth study maps the insights from both the structural analyses and the effect analysis to identify patterns. Such patterns can provide insights into the effects of certain structural design decisions on an

audience's perception and deduce prescriptions on how one ought to structure an article. Further information on the structure-effect-analysis can be found in Appendix E. The key results from that analysis are presented and used in Section 7 as well.

#### 3.3.4.2 Top-Down Approach

Using the class level solution as a starting point and specifying it by integrating knowledge gained from the four studies described above, the communication framework (class level) can be adapted in a top-down approach. Hence, the sub-class level artefact emerges from integrating the generalised knowledge contained in the class level artefact and the generalised knowledge gained from the observed instances. This top-down approach is presented in Section 7.3.2 Contextualisation of the Class Level Artefact.

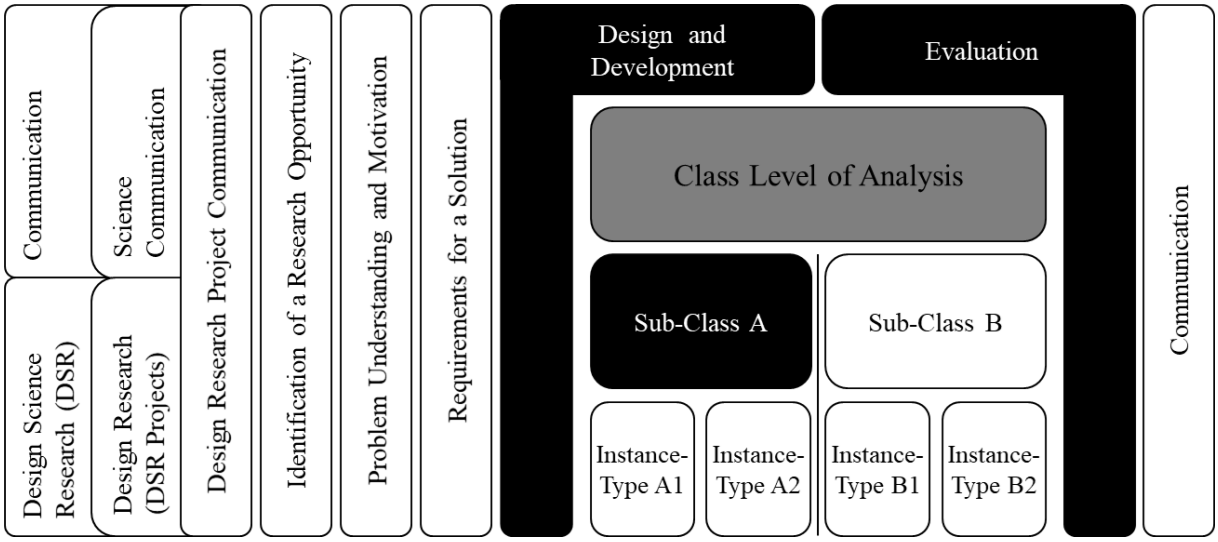


*Figure 19: Contributions of the Sub-Class Level Artefact Design Study to the Dissertation*

### 3.3.5 Artefact Creation at the Instance Type Level

As argued above (e.g., 3.1.3 Levels of Analysis of Problems and Solutions, or 3.3.4 Artefact Creation at the Sub-Class Level), the usefulness of an artefact that provides guidance increases for users with increasing applicability of it to their specific use cases, which is at a trade-off with the solution's generalisability. Therewith, guidance that features more direct applicability is closer to the instance and should use more specific knowledge about the local context. In contrast to research paper writing, which the author understands as a sub-class level issue, an artefact at the instance-type level provides guidance for a narrower set of communication instances. While providing such guidance is not strictly necessary within this dissertation project (considering that the contribution of such guidance in terms of its significance is low), the exercise of designing it,

evaluating it, and learning from the process may prove helpful in various ways: First, such guidance may solve a local problem, providing a solution and thus, utility. Second, since the primary artefact in this dissertation is concerned with the problem class level and must therefore be 'translated' first to yield more specific guidance for design researchers, something can be learned on how such a contextualisation process may look. Third, using the problem class level solution can provide evidence for its usefulness and usability, essentially evaluating it. For these reasons, the author adds another artefact to this dissertation, one that is located on the instance-type level.

Having had first-hand exposure to one specific instance-type over the last few years, the author has had the opportunity to observe the problem and implement and test solutions. This problem type is the presentation of design research projects (focus on research designs) in the context of a university course, with the goal of convincingly the lecturers about the students' understanding of how good research designs are created. The stakeholders facing the communication problem are the students participating in this course. In his role as a teaching assistant, the author has had the opportunity to observe the students' attempts at convincingly presenting their research designs, and to provide them with suggestions and guidance.

Similar to the top-down approach used above, this design study started with the class level solution and specified this solution by adding local knowledge about the communication use case. This time, however, the solution was to be more strongly contextualised. Hence, the solution ought to be highly applicable, with the consequence of losing much of the original artefact's transferability. The artefact, which emerged in collaboration with Robert Winter and Jannis Beese in the context of a research methods course taught by them, is a sort of checklist students can use to select relevant contents and to guide them in structuring their presentations (a visual impression of the artefact is provided below Figure 20).

*Figure 20: Checklist-like Artefact at the Instance-Type-Level*

A natural field experiment was conducted to evaluate the final artefact on the instance-type level. During this experiment, some student groups were provided with the artefact, whereas others were not. Independent researchers with experience in DSR evaluated their presentations. This experiment was conducted as a triple-blinded study (double-blinded with three parties): The students were unaware of their participation in the experiment and, thus, of their condition or the fact that their presentations were being used in an experiment. The assessors were unaware of the specificities of the conditions, and they did not know how many of the presentations they evaluated were assigned to which condition. Finally, the author and experimenter was not in direct contact with the student participants, and he made himself unaware of the distribution of conditions before instructing the assessors. The assessment of the presentations is based on 7-point Likert scales, and the analysis is therefore quantitative.

A description of the design process that yielded the artefact, the artefact itself, and the results and implications of the evaluation are presented in Section 8. Further information about the field experiment, including more details on the methodology and the operationalisation of the research design, can be found in Appendix F.

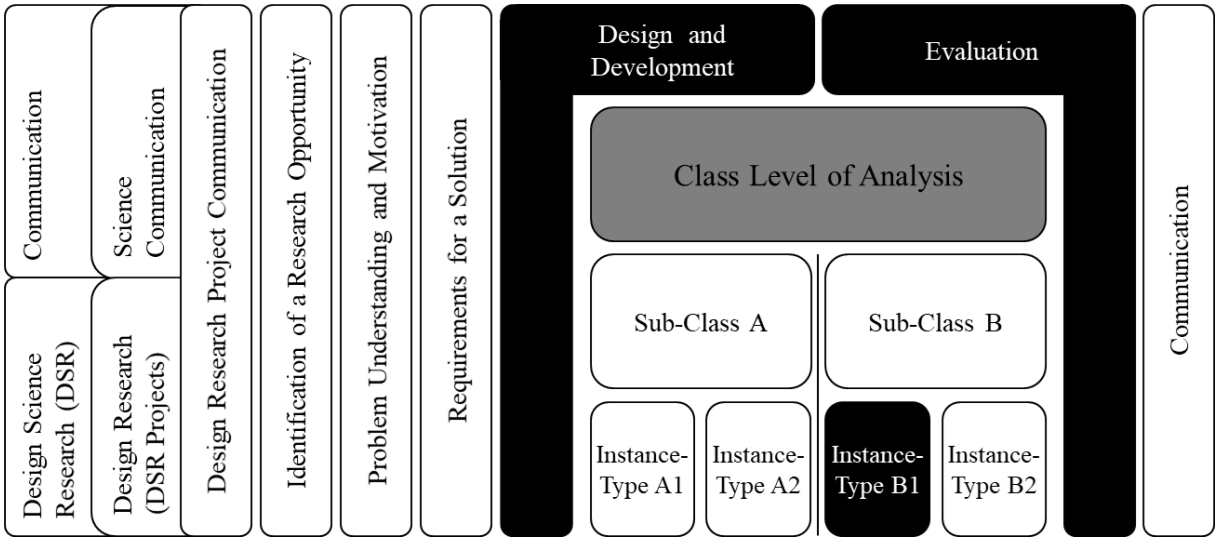


*Figure 21: Contributions of the Sub-class Level Artefact Design Study to the Dissertation*

Thus far, a general introduction to the research problem and the associated research endeavour was given in the introduction before elaborating on the research background and this section's explanation of the methodological considerations. However, the identification of the research endeavour, the research problem and requirements for a solution were only touched upon slightly. For this reason, the following sections provide more information on how the research opportunity was identified (Section 4) and how

the nature, relevance, and necessity for a solution (problem understanding and motivation) and the requirements for a solution (both in Section 5) are established.

# 4 Identification of the Research Opportunity

A design research endeavour starts with identifying a research opportunity (Sein et al., 2011). There can be many "research entry points" to a design research project (Peffers et al., 2007). In three sub-sections, insights on the identification of the research opportunity for this dissertation are presented. First, various experiences that lead to recognising the difficulty of communicating design research projects are outlined (Section 4.1). Starting a design research project based on recognising a perceived difficulty equates to a problem-centred initiation of a design research project (Peffers et al., 2007). However, recognizing difficulties with a particular activity anecdotally may not reasonably justify the effort of launching a research project. The problem might be trivial and not require DSR to be solved. Alternatively, it might indeed be solved already. Hence, second, evidence of non-triviality of the problem (Section 4.2) and third, some evidence of the research gap (i.e., the absence of a satisfactory solution) is summarized (Section 4.3).

## 4.1 Anecdotal and Experiential Problem Identification

As usual with research endeavours, the researchers must first become aware of some research problem worth investigating. The author of this dissertation has experienced this difficulty several times, and he has heard and read about many anecdotes that led him to believe that communication of DR projects is somehow problematic. Some of these anecdotal and experiential insights are outlined in the following few paragraphs.

First, the author attended a doctoral seminar on design science research in the spring of 2019. The students were asked to develop and present a design research project plan. In this project communication use case, the research is not conducted yet. It became evident that discussing a design research project plan is not nearly as straightforward as presenting a behavioural research study. What made this particularly complicated from the author's perspective was that such a project plan relies on emergence and iterations without knowing about intermediary results yet. This was the first time that the author was facing difficulties in communicating a design research project himself.

Second, since Summer 2018, the author has been involved in a research methods course for master students. In this course's curriculum, the students are presented with IS research methods, including information about the behavioural science and the design science paradigms. The students need to learn how to develop good research designs, and they present them either in the form of group presentations (see also Section 9) or written

take-home exams. Consistent with the author's experience, these students struggled to provide a clear storyline for presenting their research designs. This was primarily an issue for DR research designs and not for explanatory research designs. The evidence of the author's and his fellow doctoral students' experience was thus consistent with the master students' experiences.

Beyond this use case of presenting early-stage research designs, the author found that it may not be much easier to create communication artefacts for other use cases. He has, for example, participated in a DR project during which he prepared and led several communication situations with practitioners. They showed quite different views, essentially caring about the instance level, uninterested in methodological considerations or transferability of a solution; they seem to prefer pragmatism and established solutions over theoretical work and emergence. Furthermore, they use different terminology. This context for communicating the project posed difficulties because of the audience's different frames of reference and because the design research project so highly depended on the stakeholders' willingness to participate and to dedicate their time and resources.

Lastly, the author found that published design research articles are structured in creative ways. Understandably, many structures of DR articles the author has read have not matched the normative script he was familiar with from behavioural research (introduction, background knowledge, methodology, results, discussion, and conclusion, Peffers et al., 2007; Tremblay et al., 2018). However, they do not seem to follow an alternative shared structure either. Instead, some articles very closely match the normative script of behavioural research articles, essentially presenting the evaluation of an artefact; others primarily present the requirements elicitation and the evaluation. Yet others follow methodological literature such as the three cycles by Hevner (2007) to structure their articles. Thus, while DR projects tend to contain the same activities (qualifying them as DSR), the communication of these activities, their motivation, and their results are not being presented in a standardized way. Instead, design researchers seem to frame each project individually. This led the author to believe that a lot of thought goes into writing such articles, making an otherwise straightforward paper-planning process into a work-intensive process. Based on this observation, the author supposed that existing guidance for writing design research papers (including Gregor & Hevner, 2013; Peffers et al., 2007) might thus not be applicable enough or not effective enough.

Hence, the author became aware of a problem that arises at various stages of a design research project, facing diverse stakeholders with strongly varying needs (e.g., early-

stage research design presentations to teachers, intermediate-stage communication with practitioners, late-stage writing of articles for the research community). This anecdotal evidence suggests that the problems associated with communicating design research projects emerge in various instance types. There may consequentially be a need for addressing the problem at a more abstract level, and it may be useful to come up with a transferrable solution that addresses sub-classes of the problem. However, this is only relevant if the problem is not a trivial one to solve and if there is no adequate solution yet (that might simply not have been applied in the above-described experiences).

## 4.2 Non-triviality of the Identified Problem

Thus far, the identified problem is presented as being common to communication situations in which DR projects are being communicated. However, as per the background section, DR projects come with various peculiarities (Section 2.3.1) that differ from research projects in the behavioural science paradigm (Deng & Ji, 2018). Not necessarily claiming that behavioural science projects are easy to communicate, it is the DR projects that are found to be problematic. For this reason, it may be beneficial to reflect upon the peculiarities of DR projects to investigate whether these provide support statements for the non-triviality of the problem.

**Support statement 1:** DR projects are lengthy and can take several years to complete if they get to the end of the process at all (Gregor & Hevner, 2013; Peffers et al., 2018; Venable et al., 2019). With such a lengthy process, and many different activities, iterations, and various degrees of maturity of the artefacts, the number of steps and results to report is large and increases over time. This is a given while there usually is only limited space or time to communicate a project (e.g., a pitch meeting with a project partner, a twelve-page conference article, or an interview for the public media). The task of communicating ever-more information in a constant amount of time or space requires communicators to summarize contents. More importantly, they eventually face trade-offs between providing so little information that the respective activities or results can hardly be understood or omitting them entirely to provide adequate information on specific activities. Of course, non-DR projects are also affected by space restrictions. However, the number of activities tends to be more limited. The selection of which activities to focus on or how to solve the conflict of increasing load of information at constant space or time to convey that information is not trivial.

**Support statement 2:** DR project's evolutionary and emerging characteristics lead to continual changes in the problem understanding and solution designs (vom Brocke et

al., 2020). This leads to DR project states that might have little to do with the initial problem understanding, initial solution requirements, or the initial artefact design. Instead, the final problem understanding and the final solution emerge during the process. This, in turn, complicates the communication of the design and development activities (e.g., where does the intermediary artefact that led to the final artefact come from?), the problem (how was that final problem identified?), or the solution requirements (where do, e.g., intermediary requirements come from?). This leads to the non-trivial task of communicating a research project based on emergence, where intermediary results may be highly relevant to the final results but not different enough to avoid repetition.

**Support statement 3:** DR projects hardly fit a 'box' in the sense that methodological diversity is high, both regarding the operationalisation of DSR and the descriptive studies that are used within a DR project (Gregor & Hevner, 2013; Kuechler & Vaishnavi, 2008). Within the ways in which DR is being conducted, many genres can be identified with respect to, e.g., problems, artefact types, types of evaluation, artefact creation process, and knowledge contributions (Rai, 2017). With that, the problem of communicating one's research project may be different for each project genre and therein with each operationalization of a research design. In other words, the problem is expressed in many different instance types, but a solution would probably have to cater to all of them—or at least to a sub-class, making this problem require an abstract solution and therewith non-trivial to solve effectively.

## 4.3 Absence of Guidance

If the problem exists, as observed anecdotally (Section 4.1), and if the problem is not trivial to solve, as suggested above, one might have to check if the problem has not been solved yet. If it turns out that there are working solutions but that these merely have not been used, then building a new solution may not be the sensible thing to do. Hence, the follow-up question is whether there is existing guidance for solving the general communication problem design researchers encounter when facing a communication situation during their design research projects.

To reach an answer to this question, calls for research or references from peer-reviewed publications might be indicative. Hence, the author fostered research articles to identify pointers to solutions or indications as to whether there is a need for further guidance. The following few findings emerged from that activity:

*"The challenge becomes communicating the new ideas to the stakeholder communities. The design community lags the behavioural community in having useful templates for communicating knowledge contributions. (...) Some basic guidance on presenting DSR knowledge exists" (Gregor & Hevner, 2013)*

*"DSR scholars need to communicate and critically reflect on design knowledge—novice researchers, in particular, require guidance on how to identify, summarize, and communicate their findings (...). DSR researchers might benefit from more specific guidelines and best practices on how to communicate the impact of their research." (Morana et al., 2018)*

*"DSR researchers appeared to be compelled to (diffuse knowledge on how to conform to implicit normative scripts, giving keynotes, sponsoring panels, having public small-group sessions, and participating in private conversations at their meetings about how to create a broader script of what was 'good IS research') because, absent publications that appear in journals on the Senior Scholars' Basket, they felt it was substantially more difficult to earn recognition in the field or tenure at their home institutions." (Tremblay et al., 2018)*

*"The conversations and questions asked (at DESRIST 2013) by junior faculty of the panellists appeared to concentrate on how to publish DSR in the Senior Scholars' Basket." (Tremblay et al., 2018)*

*"Our own experience has shown how both students and more experienced researchers struggle with the problem of expressing design knowledge in an acceptable form in theses and journal articles" (Gregor & Jones, 2007)*

That effective communication of design research projects is complicated and yet unsolved might also be recognizable by the indirect effects on practice. Indeed, some researchers claim that the impact of IS design research on practice is low because of ineffective communication mechanisms (Mirkovski et al., 2020), inadequate use of language, or low focus of applicability (Gregor & Hevner, 2013; van Aken, 2004). As discussed in the background section, however, some guidance does exist (Section 2.3.2). This guidance seems to be insufficiently effective or situated too firmly to solve the problem at the problem class or sub-class level. With this rudimentary analysis of the identified research problem, it seems reasonable to address the identified research opportunity with a DR project.

# 5 Investigation of the Research Problem

In the last section, practical and reflective evidence about the existence of a research opportunity for design research was presented. Therewith, the first activities of the DSR process model can be launched. This section reports on the first two activities of the DSR process model (Peffers et al., 2007), namely the problem identification and the definition of objectives for a solution. These activities and the respective approaches used in this dissertation are summarised in Table 3 (based on Peffers et al., 2007). It is worth mentioning that this part of the overall DR endeavour relies on two supporting studies (see Section 3.3). First, a selective literature review is used to gain a deeper understanding of the constructs and the existing knowledge about the topics of communication, science communication, design science research, and communication of design science research. It is also used to obtain a general idea of the problem's characteristics, such as the levels of abstraction, the IPO conceptualisation, literature that laments the problem or specifies the needs of the stakeholders, and to identify existing solutions. Second, an expert interview study (see Section 3.3.2) is used after completing the literature search phase. Hence, an initial basic understanding of the problem was already established before talking to design researchers. This is beneficial in the sense that the questions (and therefore the discussions) could focus on reaching more depth, and the literature-heavy understanding of the problem could thus be challenged with a variety of different people's practical viewpoints.

*Table 3: Operationalisation of Activities 1 and 2 of the DSR Methodology (based on Peffers et al., 2007)*

| | **Activity 1** | **Activity 2** |
|---|---|---|
| **Activity** | Problem identification and motivation | Definition the objectives for a solution |
| **Outcome** | The specific problem that should be solved is defined (e.g., through conceptual atomisation), and the value of creating a solution is justified. | A set of objectives for a solution, rationally derived from the problem definition and the knowledge-base (e.g., knowledge on what is feasible). |
| **Purpose** | Stakeholders involved in the project gain motivation to pursue the solution and the acceptance of a solution is higher | Objectives specify which aspect(s) of the problem are to be focal (limiting the scope of a DR project) and provide a basis for evaluating artefacts' effectiveness. |

| | | |
|---|---|---|
| **Approach** | Selective literature review (see Section 3.3.1) to identify constructs, definitions, existing problem descriptions, existing solutions, and calls for research.<br><br>Expert interview study (see Section 3.3.2) to identify when and how the problem materialises, existing coping strategies, and their effectiveness. A multi-perspective, in-depth elicitation of this information should allow for a deep understanding of the problem. | Selective literature review to identify known approaches and knowledge on their generalisability (i.e., in which instance-types or classes do they apply?).<br><br>Expert interview study to identify specific needs toward a useful artefact based on the insights gathered directly from the focal stakeholders and experts on DSR. |

In the following, the findings from these supporting studies and how they helped reach the anticipated outcomes for the first two activities of the DSR process model are outlined. The illustrations below repeat how these studies are situated in the overall research framework (Figure 22 and Figure 23), as discussed in Section 3.3. Appendix A contains further details on the research design and the operationalisation of the interview study.

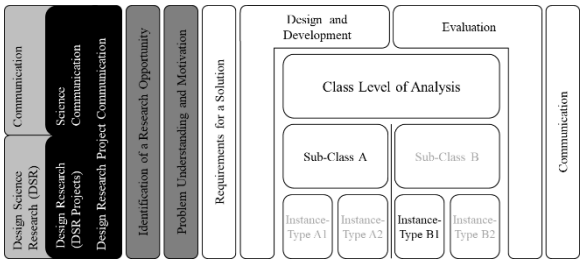


*Figure 22: Selective Literature Search in the Research Framework*

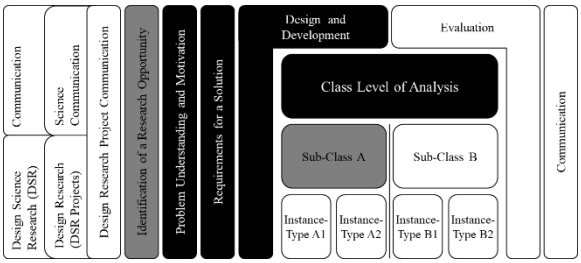


*Figure 23: Expert Interview Study in the Research Framework*

The conceptualisation of the problem space in DSR based on Maedche, Gregor, Morana, and Feine (2019) was used to ensure that the research problem is adequately investigated and defined. In their DESRIST article, Maedche et al. (2019) clarify that a design problem can be specified based on a **need** (i.e., the lack of something, given the problem situation), a **goal** (i.e., a representation of the desired to-be state that would fulfil the need), a set of **requirements** (i.e., things that need to be considered in the achievement of the goal), and the **stakeholders** (i.e., individuals involved in or affected by a DR project). Furthermore, the relatively detailed investigation of the problem situation contains some key insights that are illustrated with further information provided by the

interviewees. To better guide the reader through this section, the key insights are highlighted as separated sentences and marked as **"Insight:"**. They can be found among the results of the expert interview study (and not in the section on the literature review) because the latter evaluated and extended the problem understanding based on the literature search. A synthesis of the problem understanding summarises the key insights and rounds off the investigation of the research problem (5.4 Summary of the Problem Analysis).

## 5.1 Findings from the Selective Literature Review

The background literature was presented in Section 2, split into communication-related and DSR-related literature, as well as findings on the combined topics of DSR projects and science communication. Insights from these bodies of literature are used to conceptualise the research problem so that it can thereafter be studied in more depth by consulting the people who face the problem (i.e., design researchers).

Hence, the selective literature review serves a dual purpose of scanning the knowledgebase for relevant information in the sense of the rigour cycle (Hevner, 2007) and of conceptualising the research problem. Since the knowledgebase is mostly covered in sections above (constructs, definitions, existing approaches, calls for research; primarily in Section 2 and partially in Section 3), this section focuses only on the conceptualisation of the research problem. The latter contributes in a major way toward defining the problem and justifying the value a solution would create (the expected outcomes of activity 1, see Table 3). This initial conceptualisation of the research problem that informs the expert interview study emerged in three iterations. Even though the first two iterations are foundational for the final iteration, they are not elaborated on here for clarity. However, an account of the history of the following conceptualisation can be found in Appendix G.

The literature-derived understanding of the research problem is summarised in the following list:

- A design research project comes with many and diverse communication situations.
- Each of these communication situations presents itself with various characteristics, including goals and descriptions of the situation.
- These characteristics affect the communication of design research projects.
- "Communication" is the set of activities that bridges the communication situation's characteristics with its goals.

- Difficulties in communicating design research projects refer to problems that relate to these activities.
- These difficulties are at least partially due to implications of the characteristics of the communication situations and the uncertainty as to how one can communicate one's project effectively in a situationally adapted fashion.

From this summary of the literature-derived research problem follows that there are probably three distinct aspects to focus on when further specifying the research problem (see expert interview study, below). First, some communication instance-describing dimensions and characteristics may clarify relevant insights about the activities related to a communication situation. Information about a communication situation exists before communicating, and it can be understood as the input to the communication process. Second, there are targeted communication impact measures or goals of communication. Communication of research projects does not happen without any goal. Such goals can be conceptualised as communication impact measures (awareness, enjoyment, interest, opinions, and understanding, see: Burns et al., 2003, p. 191). Third, communication is the set of activities that lead from an initial state to another state. It is, thus, a process. The various steps within this process seem to be the source of the problem since the communication situation is mostly given, and the communicator can define communication goals (to-be state).

This understanding of the communication of design research projects as an IPO model and the problem being related to the process part has been outlined above. However, the problem analysis based on the initial literature review helped atomise the problem into a specific set of process steps, dimensions, and characteristics within these dimensions that appear to be of relevance and possible goals. This further specification is useful, as this provides specific pointers on what to look for in the expert interviews. For example, the latter can indicate that some activities or dimensions are still missing or that some characteristics are less relevant than others.

To ensure that the problem understanding is adequate, such that the requirements for a solution can be formulated without missing crucial aspects, this reflective conceptualisation (Figure 24) should be evaluated and refined. For this reason, the subsequently presented conceptualisation is used as a starting point for the expert interview study. The latter should validate the literature-derived problem understanding and yield requirements directly from the primary stakeholder.

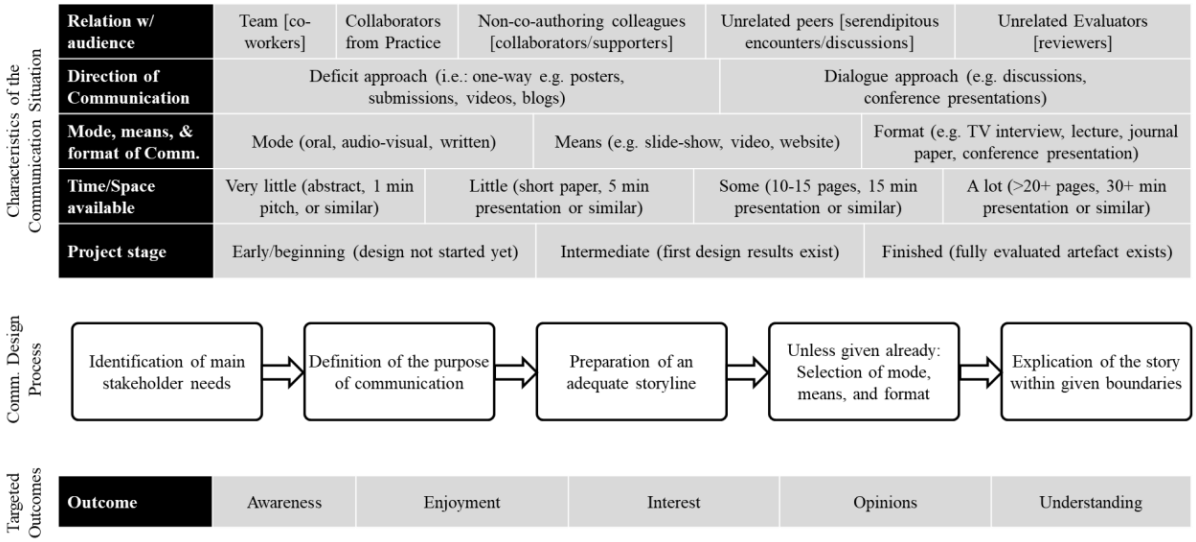


*Figure 24: Conceptualisation of the Research Problem's Constituents*

## 5.2 Findings from the Expert Interview Study

The interview study, as introduced in Section 3.3.2, consists of discussions on (1) communication instances throughout an entire design research project and (2) deep dives on specific communication instances. Therewith, the problem perceived by the focal stakeholder can be analysed on various levels of abstraction. This contributes to the problem understanding, and it should reveal the pain points that motivate further design research. This section focuses on the core findings from the interviews that contributed to activities 1 and 2 of the DSR process model (Table 3). A more detailed account of the methodology and operational details (such as descriptions of the sample or more insights from the qualitative data analysis) can be found in Appendix A. In this section, the interviews are used to identify, confirm, reject or append to the initial conceptualisation of the research problem and its constituents (bullet-point list and Figure 24 in Section 5.1), and to reveal further intricacies on how the problem materialises (illustrating the pains and concretising the value of a solution, Activity 1). The findings from the interview study, combined with the analysis of the knowledgebase, build the foundation for the specification of requirements for a solution (Activity 2).

### 5.2.1 Improved Understanding of DR Project Communication

The experts described an entire research project's journey during the interviews, focussing on communication-related aspects. These accounts allowed the author to learn about many individual communication instances and better understand the more abstract view on communication. In other words, the conceptualisation of DR project

communication (Figure 22) could be compared and iterated with the perceptions of the main stakeholders. This is important because improving the understanding of the phenomenon allows for more clarity when discussing specific challenges and formulating requirements for a solution.

Accounts of the various communication situations along the design research endeavour reveal many communication situations in each design research project. Not only are there many communication instances, but there is also diversity in the formats, goals, audiences, and so forth. In each interview, at least ten communication instances and four different settings with different starting situations and goals were discussed. Furthermore, various variables about the communication setting and the targeted outcomes of communication were mentioned as being distinctly influential on the communication process. Hence, this confirms that communication is an inherently important sub-process of DSR that appears throughout the research project (as opposed to summative communication only), and that the communication situations are indeed diverse, and that this diversity affects the communication process. This diversity was similarly captured in the literature-based problem conceptualisation above, where many input variables and several output variables are presented, which a communication process should bridge. With that, some general statements about the research problem can be made:

**Insight 1:** DR project communication is a prominent sub-process of DSR.

**Insight 2:** There is diversity in the communication settings.

**Insight 3:** There is diversity in the targeted communication outcomes.

**Insight 4:** Diversity of settings and targeted outcomes affect the communication process.

The diversity in communication settings and targeted outcomes was outlined in the interviews by short descriptions of the communication instances. By virtue of using a semi-structured questionnaire, all interviewees elaborated on the various dimensions and characteristics relevant to the communication situations they identified—either naturally emerging or upon specific follow-up questions from the author. This allows the author to inductively identify new or different dimensions and characteristics that describe the communication settings and outcomes as well as to test these aspects in the conceptualisation of the research problem. Therefrom the dimensions and characteristics that are perceived as being relevant for the communication of DR projects are the following:

Different **audiences:** Typical audiences include grant agencies, fellow researchers, practice and evaluation partners, peers, professors, students, a person familiar with both practice and research, developers that implement artefacts, mentors, reviewers, specific communities (audiences of outlets), and users. They differ most strongly in their proximity to academic work. The interviewees consistently differentiated between practice-facing and academia-facing audiences. These differ in their terminology, background knowledge, expected contents, interests, or the value they attribute to discussions at various levels of abstraction. The audience is perceived as being the primary source of variance in the communication, and hence, in transforming the input into communication outputs.

Different **interactivity:** Depending on the possibility of interacting with the audience, communicators have to prepare their communication as one non-changeable object (such as a manuscript), or they may prepare a flexible communication object (such as a presentation with various fallback-slides and encouraging the audience to ask questions). This affects the crafting process of communication in various ways. In non-interactive settings, the interviewees described that one has to include the entirety of explanations on the provided contents, and thus, poorly or non-explained aspects need to be avoided. This is troublesome for communicators since the intuitive strategy of just providing all the relevant information in a communication situation is usually not possible. For example, research papers or grant proposals have page limitations, reports that are too long may not be read, and a very high level of detail can spread confusion rather than clarity. At the same time, using this highly explained approach to communicating is often inadequate for communication situations with the possibility of directly interacting with the audience. After all, experts on a particular topic may get bored and lose interest if there is too much information about basic concepts, whereas non-experts may need further information to follow along. In an interactive setting, communicators can identify such situations and spontaneously adapt their communication accordingly.

Different **modes:** Somewhat related to interactivity is the mode of communication. The interviewees identified situations where the communication was operationalised orally, audio-visually, or in writing. The mode is perceived as both a limiting and an enabling factor in communicating projects. For example, oral presentations are perceived as being useful to motivate others to join the project or to gather opinions, whereas visual support is particularly beneficial for showing the artefact or indicating relationships between constructs. Written communication benefits the provision of more detailed information such as numeric data. The interviewees have not elaborated on specificities of the trade-

offs that come with these modes. Instead, these seem to be the same for DR and non-DR projects. Hence, while the mode is important for the communication process, its implications can be addressed with experience or general communication literature.

Different **means:** The interviewees have not only communicated with many different audiences, but they have also used a variety of means via which they reached these audiences. These means, similar to the interactivity and the modes, come with specific characteristics that have implications for communication. Indeed, the means of communication might prescribe the level of interactivity or the mode of communication (e.g., a research article vs an interview) while also providing some information about the kind of audience one might find. Among the means (or 'outlet types') of communication identified by the interviewees are website, newspaper, lecture, news media, social media, specialist practitioner literature, scientific journal, personal, popular media (see also: Mauelshagen & Jakobs, 2016; Cooke et al., 2017; in Section 2.2).

Different **formats:** The interviewees noticed that the format of communication helps structure one's communication. This may include prescribed formats based on the outlets (e.g., research articles may be accepted at conferences in the format of a research-in-progress article, a completed research article, an opinion paper, or the proposal for a workshop). Such formats tend to come with normative scripts, which are more or less explicit. Information about academia-facing formats tends to be shared in editorials, on websites of conferences or journals. The practice-facing formats are less evident, as these situations are usually less standardised. However, complying with formal expectations is less important in practice-facing communication.

Different **project stages:** There are many communication situations throughout a design research project. Thereby, the current status of the research project is perceived as another contributor to the diversity between these communication situations. This confirms the claim that design research communication is not a primarily summative activity. Each interviewee addressed the project phases as being important, with various implications. For example, a project can be structured by using phases to describe the anticipated steps that are yet to come (e.g., by using Peffers et al., 2007); or they were used to help clarify how rigour and relevance are ensured, to illustrate the emergence, to inspire competence, or to guide the audience through the contents of a presentation. Thereby, the existence of an initial prototype impacts the focus and content selection for a communication situation, as from this point forward, the prototype replaces a research plan as the central point of reference. This seems to be especially relevant in practice-facing communication.

Different **goals:** Another aspect that can be used to differentiate among certain communication situations is the goal pursued by the researchers or the audience. These goals include: gaining access to resources (e.g., time, data, money), acquiring practice partners for various tasks (e.g., problem analysis, co-creation of an artefact, implementation and evaluation of instantiations), informing an audience such that it can give constructive feedback, building trust between the practice partners and the researchers, making a contribution to the field, convincing the audience of the quality of the work, creating awareness for the problem or the solution, capturing the attention of the audience, improve career chances, influencing the wider community, gaining new ideas, reaching alignment of involved parties, fostering understanding for the usefulness of the artefact, or providing utility to others. The interviewees noted that while their particular goals influence the communication process, it is only one of many variables that shape it.

With that, many dimensions and their characteristics that affect the communication process are identified. Interestingly these dimensions—audience, interactivity, mode, means, formats, project stages, goal—do not include the methodology used, the type of artefact created, or the design decisions taken in the creation of an artefact. These aspects also vary between DR projects, and they could have been expected to play a role. However, they were not mentioned as being relevant influencers of the communication. Furthermore, there are some aspects the interviewees claimed to cause or accentuate their difficulties in communicating their DR projects, irrespective of the specificities of these various communication situations. Unlike the diverse project characteristics outlined above, these are shared across DR projects.

**Insight 5:** There are shared characteristics of DR projects that negatively affect project communicability.

The primary shared features of DR projects that accentuate the problem can be summarised as follows:

DR projects come with **unpredictability:** Wicked problems, emergent knowledge, an iterative and non-linear satisficing-oriented research process, or the dependence on human cognitive abilities are characteristics of DR projects that inherently cause a research project to be unpredictable. Such unpredictability causes a variety of issues when it comes to effective communication. For example: At early stages, it is unclear what the subsequent intermediary results are and therefore, providing a convincing research plan is difficult if the latter is supposed to be accurate. At intermediate stages of a project, one might have created a prototype already, but it is unclear whether that prototype will

be satisfactory. At later stages, one may have iterated several times. At this point, unpredictability is low. However, it may have affected a project in several ways, including the pursuit of failed solution paths, marginal improvements, and generations of artefact propositions that were necessary to come up with the satisfying solution. Since the final solution and the initial problem might therefore be relatively far apart from each other and providing an account of all phases of a project may be more confusing than informative, unpredictability might be even problematic in ex-post communication.

DR projects produce vast **amounts of documentation:** With the long time it takes to go through all the steps of a DR project until a working solution exists, a lot of information about the project builds up. Usually, there are many empirical studies included in just one DR project (e.g., this dissertation features one interview study, three document analyses, two survey studies, and a field experiment), and with every iteration, the volume of documentation increases. Furthermore, DR projects involve various stakeholders (e.g., people who face a problem, implementation partners, evaluation partners, developers, reviewers, collaborators). Contact with these stakeholders tends to unearth new information relevant to a DR project and therefore adds to a DR project's documentation, need for iterations, or in other ways. With that, DR projects consistently create vast amounts of information—much more so than descriptive studies on their own. Wealth of documentation is a general concern in SciCom, because most communication situations are not suitable for transmitting such extensive information. In DR, this problem is accentuated to an extent where merely summarising activities may not be sufficient and large parts of the DR project need to be omitted for the included content to be sufficiently elaborate for audiences to understand. Hence, communicators of DR projects must be very selective in the contents they include, and they need to ensure that the contents can 'stand on their own legs.'

DR projects span several **levels of abstraction:** DR projects should include some causal and some prescriptive knowledge. The causal knowledge, or kernel theory, informs the prescriptive knowledge, which in turn is instantiated in the demonstration and evaluation activities. Hence, several levels of abstraction need to be navigated (e.g., causality vs prescription vs instantiation, see Section 2.3.1.2). This is perceived as being problematic because audiences need to be guided not only through an evolving project (timeline) but also up and down the levels of abstraction.

DR projects come with **normative design decisions:** Even though artefact construction might be theory-informed, the problem selection and the design decisions are largely normative—based on the researchers' judgments—which seems unscientific to non-

DSR communities and arbitrary to practice communities. Why solve it this way or that way? Such a question is hardly answerable in objective terms. While explanatory research also contains such decisions (namely in the operationalisation of constructs), this is a much more prominent feature in DSR.

While these shared characteristics—unpredictability, extensive documentation, abstraction levels, and normative decisions—are part of the causes and accentuating factors that make DR project communication challenging, they are merely characteristics. Hence, situational characteristics may be the cause of problems. However, it is not in a state (description) but in a process (action) that a problem can be observed. Therefore, the following section focuses on communicators' activities in which the problem situations materialises as a problem.

### 5.2.2 Main Challenges Perceived by the Design Researchers

The interviews revealed that the variability of communication situations is a major source of difficulty in communicating a design research project. In particular, no two communication situations are the same, as the project itself (containing aspects such as the problem understanding, the requirements for a solution, or the intermediary artefact) constantly evolves, the formalities surrounding the communication situation vary (e.g., time or space available, the means one may use, the mode of communication, or the format), and completely different interests and needs must be catered to depending on the audience.

**Insight 6:** Integrating knowledge about a communication situation's diversity into the communication process is a major challenge.

Having initially reflected on entire DR projects, the many communication situations that exist, and how their characteristics differ from one another, the interview guide turned to focus on specific communication instances. The goal of this change of focus was to identify and discuss the specific challenges that emerge during the process of preparing and carrying out the communication (i.e., the P in the IPO-Model). The author also asked the interviewees to help differentiate their experience in a given instance from other instances. This enables a differentiated understanding of the challenges. In the following, the main challenges identified during the coding of the interview transcripts are listed. These challenges are formulated as activities since the characteristics of a communication situation (e.g., the iterative nature of a DR project or the large amount of information created during a DR project) materialise in activities.

#### 5.2.2.1 Structuring contents

According to the interviewees, the primary challenge in communicating DR projects is structuring the content. This activity includes selecting the contents (setting a focus and specifying which information is relevant), specifying the order in which the content is to be presented, and the level of detail with which aspects of the content are described.

**Insight 7:** Structuring the DR communication is a major challenge.

The difficulties that surface while structuring the contents are manifold, starting with (1) an **absence of a proven template** for this process. While all interviewees perceived the structuring of the contents as being problematic, they did not indicate a generally applicable reference approach. Instead, they all seem to have developed their individual coping strategies for various communication situation types. The interviewees argued for these strategies (e.g., using a prototype and the instance level to discuss the project with practitioners, effectively excluding design theory, explanatory theory, methodological considerations, and abstractions as possible contents) based on experience and reflection, rather than by reference. A related aspect of the challenge of structuring contents is (2) the **diversity of communication situations**. As indicated above, communication situations are diverse and finding an approach to structure contents for one use case does not necessarily help inform another. Many interviewees indicated more confidence in some communication situations while feeling more challenged in other situations. (3) **Limitations of space and time**, beyond being a characteristic of a communication situation, significantly contribute to the fact that the structuring of the content is problematic. This is more problematic in the communication with academic audiences than with practitioner audiences. For example, academic outlets require many checkboxes to be ticked off before an article gets published. DR articles not only need to comply with the standard quality requirements for descriptive research articles, but they must also provide information about additional DR-specificities. Lack of space thereby forces communicators to select a focus, summarise contents and pragmatically omit non-essential content aspects. However, it is not always evident (4) **which content to omit**. Intuitively, one might think that the design processes, intermediary design artefacts or even the final design artefact are important content aspects of DR project communication. However, in many DR projects, the interviewees admitted having moved those aspects to an appendix because various audiences perceived other aspects as even more important. (5) However, **an appendix is not always a legitimate solution**. In oral communication settings or at conferences in the Information Systems discipline, there is no such vessel to add information. This adds to the frustration of some of the interviewees,

asking themselves why IS researchers do not have electronic appendices ("it's like in the 1980s", interviewee 11). The interviewees are unsatisfied with this situation, and they voiced that merely summarising is usually not enough, as, at some point, there is so little information about process steps or findings that one might as well omit them. This is particularly unsatisfying in DR projects, as one has so many steps to do, and one needs to go an extra mile compared to descriptive research projects, on which one can barely touch. Of course, as pointed out by one of the interviewees, one should be able to communicate more in less time by using abstraction. However, depending on the volume of work and work results associated with a DR project, merely using abstraction might lead to incomprehensible content because of lacking specificity.

#### 5.2.2.2 Setting the level of abstraction

Using abstraction is not only a suitable technique to summarise contents. Instead, it is also a means to help portray ideas. The interviewees use it to help simplify complexity and increase the perceived relevance of the content they present. However, finding out which level of abstraction is most suitable for a specific communication situation is perceived as challenging.

**Insight 8:** Setting the level of abstraction is a major challenge.

Regarding the perceived desirability of abstraction, **practitioners and academics differ**. Practitioners are claimed to be unsatisfied with abstraction. They are interested in highly situated solutions, and they are generally more interested in situated content. Researchers, and especially reviewers at prestigious journals, are mostly interested in abstract concepts and design theory that generalises. A DR project's reality lies between these two. A DR project comes with more or less abstraction, and it is the communicators' task to **set an abstraction level for the story** they want to tell. This, however, is not straightforward. Abstracting removes granularity and therewith satisfies the desire for generalizability. However, the more one tries to abstract from evidence gathered throughout a project, the less actionable or useful become ones' claims. As one interviewee stated: "Often it is challenging to generalise your design knowledge in a way that it is really seen as theory, and at the same time it is not trivial" (interviewee 6). This difficulty also materialises in the other direction, where design knowledge is illustrated at the instance level. Such situating requires operationalising abstract ideas and formulating examples that tend to be one of many possible ways to operationalise it. The audience might, in these cases, miss fundamental ideas that allow for the solution to be

generalisable. Thus, the challenge is to satisfy the audience's needs and safeguard the contribution by not abstracting away valuable insights or **specifying away utility**.

#### 5.2.2.3 Publishing Design Research Articles

In all interviews, the aspect of publishing a research article out of or about the DR project was mentioned as being a highly relevant use case and as being particularly difficult to achieve. Thereby, as with non-DSR projects, the better-ranked outlets are more difficult to write an article for than lesser ranked ones, and publication takes longer in journal publication than in conference proceedings. This is unsurprising. However, compared to behavioural science research articles, DR articles seem to have a set of particular challenges to overcome, making publishing DR articles more challenging. This is a relevant aspect of the research problem because of the popularity of evaluating potential candidates for professorships or tenure tracks based on the number of high-end journal publications (on the impact of quantification of faculty productivity: Tremblay et al., 2018). In IS, there are not many outlets that qualify as high-end research outlets, and these are primarily about explanatory research (behavioural science). Assuming that many design researchers wish to further their careers, this aspect of the problem is to be underlined.

**Insight 9:** Publishing Design Research articles is a major challenge.

This challenge materialises in a variety of ways. One way in which it surfaces is in the (1) **lack of familiarity with DSR** they face. Several of the more senior interviewees indicated that DSR is rather known these days but that they used to omit DSR terminology. However, despite the progress they see in the popularity of DSR, their experiences in publication attempts are still marked by misunderstanding of the methodology and the design science paradigm as such. This also leads to (2) **content expectations that are hard to fulfil**. In particular, reviewers tend to expect clarity and certainty about the path forward in research-in-progress articles (which is somewhat incompatible with the unpredictability of DR projects), contributions to explanatory theory (which is incompatible with the purpose of DR projects, truth vs utility), and a rational or fully justified process (which is only partially feasible for normative design activities).

Furthermore, (3) **the role of theory is ambiguous** still. "Theory" is used as input to the design, but that does not mean that the design itself contributes to the theory. However, IS journals require a contribution to theory, whereas "theory" is often understood in the sense of behavioural science. Hence, one ought to show an impact on explanatory theory, which is not necessary per se for a DR project. Based on these insights, IS journals

are not particularly friendly toward DR projects. A DR project may thus need to be bent toward providing an explanatory theory rather than a design theory. Moreover, even if design theory was fully acceptable, one interviewee said that it is not self-evident what the theoretical contribution of a DR project is and how to frame it. "Upon completion of a DSR project, it has to be clarified what other researchers can build upon. What is the theory contribution of the overall thing?" (interviewee 2)

This may also refer to (4) **the level of abstraction** already addressed above (insight 8). In several interviews, the current practice of publishing design principles was critically discussed as being either so specific that it comes closer to a description of an instance than to a solution for a problem class, or they are so abstract that they are trivial. Beyond the concerns regarding the framing of a theoretical contribution, the interviewees reflected upon rigour and relevance. In DR and non-DR articles, these are both important. However, as one interviewee noted, they are operationalised differently in DR and in descriptive research (interviewee 4). In DR, rigour may imply that one follows the DSR methodology. However, when it comes to methodology, there is (5) **a lot of guidance to comply with**. This accentuates the problem issue raised above regarding space availability. As one interviewee put it: "If I go to journals like Decision Support Systems, then I have much better luck. They tend to understand the work, and I don't even have to mention design science. I don't need to. I feel like in IS, with all good intentions, we continue to put out these frameworks. But they just make it harder because now you have all these boxes to check. Like doing design guidelines. Do you have a kernel theory? Did you do two cycles of evaluation? Well, that's like a 100-page paper!" (interviewee 11). And 100 pages is generally not what is available in IS outlets. Something has got to drop out. For example, reviewers ask for several evaluations, but authors are (6) **not granted more space** just because it is a DR article. Since there rarely is a request for more information about the artefact or the artefact creation process, these aspects are moved to an appendix or omitted. This is perceived as a harsh reality by some of the interviewees since they put much effort into developing their artefacts, but what makes it into a journal paper is, in their experience, mainly the evaluation rounds.

#### 5.2.2.4 Effectively Communicating with Practitioners

Communication with practitioners is perceived as being different from communicating with academics in many regards. Most of the aspects that make publishing DR projects challenging, as outlined above, simply do not matter to practitioners. This, in turn,

creates an entirely different communication experience that researchers (and their audiences) are less familiar with.

**Insight 10:** Effectively communicating with practitioners is challenging.

Compared to academic audiences, practitioners tend to (1) **use different terminology**, (2) **have different frames of reference** and different existing knowledge. The terminology and different frames of reference cause problems that materialise in the following ways: Either practitioners share terms with the communicator but attach a different meaning to them, share the same conceptual understanding but use different terms for it, or share neither terms nor understanding. Compared to academic communication, the mere reference to (established) terminology or reference publications is ineffective in communication with practitioners. Therefore, it is important to ensure that inconsistencies in understanding are identified and cleared up. This is a task that may need repeating in the (3) **various sub-groups** that can be found when interacting with practitioners. For example, one might communicate with managers, human relations employees, developers, users, or customers, all of whom may have slightly different frames of reference and may or may not use different terminology. For researchers, this is a challenge, as the communication needs to be tailored to specific sub-groups outside of the academic community. Another challenge with practice partners is to (4) **overcome resistance against change**. Even with a certain buy-in of the practice partners, practitioners often have residual unwillingness to do the necessary work. Sometimes underlining the contribution of such work toward their (5) **primary interest of solving their local problems** helps. However, design researchers have different goals from practice partners. Indeed, they may need additional effort to be exerted to gather evaluation data and to reach some generalizability. Convincing practice partners to commit in general is perceived as being somewhat challenging.

#### 5.2.2.5 Addressing these Challenges

The interviewees presented the challenges outlined above as being non-trivial, and their exposure to them caused them to seek coping strategies. Upon request, they elaborated on their experiences with the coping strategies they developed. The fact that they created their own coping strategies indicates (1) a **need for coping mechanisms** that design researchers can use to address the challenges they perceive in communicating their projects. Such coping mechanisms are currently developed by the design researchers individually and situationally. There seems to be little or even no exchange of such strategies among researchers, and thus, (2) there is **no readily available, commonly used**

**guidance** that satisfies this need. As opposed to coping mechanisms that individuals create and use for themselves, effective guidance would be instructive for many design researchers to help them overcome the challenges in many communication situations. Such an artefact is currently missing.

**Insight 11:** There is a need for coping mechanisms to address the communication-related challenges faced by design researchers.

**Insight 12:** There is a lack of guidance for design researchers to address the communication-related challenges they face.

## 5.3 Goal and Requirements for a Solution

The results of the problem analysis outlined above yields an understanding of the problem situation and not only clarifies that there is an unsatisfied need for coping strategies that help design researchers communicate effectively, but also what the situation is within which this need is embedded and what the specific challenges are that design researchers struggle with. This primarily covers the 'need' concept in conceptualising a design research problem (Maedche et al., 2019). The following aspects to address are the goal and the requirements for a solution.

The goal should satisfy the need of a stakeholder. Therefore, it is based on the vantage point of a stakeholder and describes the 'to-be' state, which should be reached with an artefact. Given the same problem situation, different stakeholders might have different goals. "Goals represent desired results or a desired state of affairs. They describe intentions of stakeholders. Goals may conflict with one another" (Maedche et al., 2019). The goal is also normative because various to-be states may satisfy the need. In their examples, Maedche et al. (2019) illustrate this idea with a house in danger of flooding (problem situation), where the homeowner (stakeholder) desires to avoid flooding (need). The designers can define goals representing a to-be state, such as: The building should be raised by two meters, or there should be drainage pipes to evacuate excess water quickly. In this dissertation, the problem situation outlined above revealed that design researchers (**stakeholders**) have a need for coping mechanisms that help overcome the challenges in communicating design research projects (**need**). To start addressing and eventually satisfying this need, a goal for a to-be state needs to be set. Because the challenges are manifold and arise in various communication situations, and because the current approach of devising one's own coping mechanisms is not satisfactory, the author envisions an artefact that is helpful for (m)any communication situations, rather than devising situated coping mechanisms. With that, the target state would be:

**Goal:** Design researchers have access to guidance that supports them in communicating their design research projects in a way that is adequate for the specific communication situations they face.

This goal is formulated at an abstract level. It specifies that the artefact should be guiding design researchers and that it should be helpful during the communication process. This leaves room for further specification. For example, the goal could be refined to satisfy the need in one narrowly specified group of situations (e.g., presenting a research design to evaluators in the setting of a research methods course), or a more loosely specified but clearly delimited group of situations (e.g., presenting design research projects in research articles). At this point, the generically formulated goal accommodates all design research project communication situations. As the author not only creates an artefact at a class level (Section 6) but also at the sub-class level (Section 7) and the instance-type level of analysis (Section 8), the goal will need further specification for the respective levels (i.e., the research questions for the respective sections). However, for this dissertation project's overall goal and requirements (below), only the abstract level is formulated in this section, with further specifications introduced in the respective Sections 7 and 8.

Beyond formulating a to-be state, requirements that need to be met for the goal to be satisfactorily reached need to be specified. This equates to Activity 2 in Table 3. These requirements should be derived from the problem understanding (Maedche et al., 2019), and they should be abstract enough to not pre-emptively restrict the design of a solution. Based on the author's experience reviewing DR research designs and articles, failure to derive the requirements from the problem leads to auto-suggestion of solution paths (e.g., *the blockchain-based contracts* must ensure that relevant information about the current location of goods is provided to the buyer). While choosing one's preferred technology upfront may not necessarily be bad (at some point, design researchers must take normative decisions, such as operationalising a solution with a particular technology), such decisions are better located in the design and development phase, as they would otherwise unnecessarily restrict the solution space.

Since the goal specifies that available guidance should accommodate the various communication situations faced by design researchers and because the problem analysis revealed a plethora of different application settings for such guidance, the following requirement can be derived:

**Requirement 1:** The artefact must accommodate different application situations along the design research process.

Furthermore, communication does not happen without a purpose, and that purpose is naturally tied to the stakeholders' needs. Without a need to be satisfied, there is no communication. For example, if the purpose of communication is to satisfy a researcher's need to acquire a project partner (practitioner), that project partner is a central stakeholder of the communication and has needs. An artefact that effectively guides design researchers through the communication process should address the challenges in communicating with specific audiences (e.g., based on different vocabulary, interest in a different level of abstraction, or different informational needs). Thus, identifying stakeholders' needs and eventually selecting the ones one tries to satisfy appears to be central in the communication of design research projects. This has been nicely summarised in the fourth interview: "(The audience) should be taken through the messages and taken through the arguments – whether it is with slides or just talking. The big difference lies in the purpose (of communicating), and the purpose is based on stakeholder needs." Therefore, a goal achieving artefact needs to ensure that these needs are recognised and that they inform the purpose of communication.

**Requirement 2:** The artefact must support the definition of a stakeholder needs-based purpose.

Beyond the stakeholder-related challenges, many issues in communicating design research lie in the volume of content created throughout a design research project. This conflicts with the limited time or space available in most communication situations. Design researchers are thus forced to cut contents short or omit parts entirely. This creates the non-trivial problem of having to select, organise, and sensibly present the fragmented contents. Since the interviewees identified these activities as challenging, a compelling artefact would need to support them in these tasks. This, however, is not useful without taking into account the purpose of communication (and, therewith, the stakeholders and their needs). Hence:

**Requirement 3:** The artefact must support the selection, organising, and presentation of contents based on the purpose of communication.

Since requirements 2 and 3 are based on knowledge about the stakeholder needs, a basic understanding of these needs should be given. However, as per the problem description above, different audiences have peculiar characteristics. Hence, if an exemplary need of the audience is to comprehend the mechanisms based on which a solution works, the

artefact should help inform researchers about what is important to audiences and, thus, which contents to prepare. However, audiences consisting of software developers, academics, users, or others, may use different vocabularies and have different frames of reference. Therefore, it is not sufficient to align the selection and ordering of contents with the stakeholder-needs-based purpose. In addition, knowledge about the specific stakeholders (particularly about the audience) needs to be operationalised during the communication process.

**Requirement 4:** The artefact must support the operationalisation of knowledge about specific stakeholder needs.

## 5.4 Summary of the Problem Analysis

Having thus analysed the nature of the research problem and specified the stakeholder, a need, the goal and the requirements, the design research problem definition is complete (Maedche et al., 2019). Finally, a synthesising statement of the central insights of the investigation of the research problem (Table 4) rounds off this section:

Design Research project communication is a prominent **sub-process of DSR**. It occurs throughout a project, and the **communication settings** and the **targeted outcomes** of communication are diverse. This diversity of **settings and targeted outcomes affects the communication** process. Hence, communication is an adaptive process that is both influenced by an initial condition (the communication setting) and a purpose of communication (targeted outcome). This **adaptation is a major challenge** for design researchers.

Furthermore, this process is **hindered by some shared characteristics of DR projects** that are not conducive to communication. Beyond integrating knowledge about the setting and targeted outcomes and overcoming these characteristics, the related activities of **structuring the contents** and of **setting an adequate level of abstraction** complicate the communication process, as do the strongly diverging needs and interests of **practitioner** and **academic audiences**, which are often not aligned with the purposes of DSR. These problems are relevant for design researchers because their individual careers, the collective progress of the domain, and even societal problems that may be solved through **DSR depend on effective communication** between them and other academics and practitioners. However, since **design researchers do not have adequate guidance** that informs them about how to deal with these difficulties, they resort to individually creating coping strategies with limited success.

*Table 4: Extract of the Insights from the Problem Analysis*

| **Extract of the Insights from the Expert Interview Study** |
|---|
| **Insight 1:** DR project communication is a prominent sub-process of DSR. |
| **Insight 2:** There is diversity in the communication settings. |
| **Insight 3:** There is diversity in the targeted communication outcomes. |
| **Insight 4:** Diversity of settings and targeted outcomes affect the communication process. |
| **Insight 5:** There are shared characteristics of DR projects that negatively affect project communicability. |
| **Insight 6:** Integrating knowledge about a communication situation's diversity into the communication process is a major challenge. |
| **Insight 7:** Structuring the DR communication is a major challenge. |
| **Insight 8:** Setting the level of abstraction is a major challenge. |
| **Insight 9:** Publishing Design Research articles is a major challenge. |
| **Insight 10:** Effectively communicating with practitioners is challenging. |
| **Insight 11:** There is a need for coping mechanisms to address the communication-related challenges faced by design researchers. |
| **Insight 12:** There is a lack of guidance for design researchers to address the communication-related challenges they face. |
| **Insight 13:** Effectively communicating with practitioners is challenging. |

*Table 5: Overview of the Requirements based on the Problem Analysis*

| **Overview of the Requirements** |
|---|
| **Requirement 1:** The artefact must accommodate different application situations along the design research process. |
| **Requirement 2:** The artefact must support the definition of a stakeholder needs-based purpose. |
| **Requirement 3:** The artefact must support the selection, organising, and presentation of contents based on the purpose of communication. |
| **Requirement 4:** The artefact must support the operationalisation of knowledge about specific stakeholder needs. |

# 6 Artefact Creation for the Class Level

As outlined in Section 3.2.2, the activities Design and Development (Activity 3), Demonstration (Activity 4), and Evaluation (Activity 5, see Table 6) are presented in one section per artefact. Starting with the problem class level, Section 6 thus presents the design and development, along with the combined demonstration and evaluation of the most abstract (i.e., de-contextualised) artefact. Sections 6-8 are all structured in the same way:

**Starting point:** The starting point specifies the already discussed knowledge that informs the design and development phase of the respective artefact creation. It thus indicates on which foundations each individual design study is built. The starting points differ slightly between the three artefact creation sections. For example, the artefact creation for the sub-class and the instance-type level took place after the class level artefact was created. They could therefore use the class level artefact as a starting point.

**Design-specific additional knowledge:** In this manuscript, knowledge about related topics, phenomena, and the research problem, as well as requirements, have been discussed already (Sections 1-5). To design the three artefacts, gathering some additional knowledge is useful or even necessary. This design-specific knowledge (i.e., geared toward the targeted artefact) is introduced before presenting the design and evolution of the respective artefact. Design-specific additional knowledge provides the context necessary to adequately specify the respective artefact.

**Artefact design and its evolution:** The design process and the artefacts are presented in this sub-section. Thereby, any intermediary artefacts and their evolution precede the final artefact design proposition.

**Demonstration and evaluation:** The artefact that emerges from the design process needs to be evaluated in some way. How the respective artefact is tested and what resulted from this activity is presented last and rounds off each of the Sections 6 to 8.

*Table 6: Activities 3-5 of the Design Research Methodology (Peffers et al., 2007)*

| | Activity 3 | Activity 4 and 5 |
|---|---|---|
| **Activity** | Design and Development | Demonstration and Evaluation |
| **Outcome** | A design research artefact, i.e., a designed object in which a research contribution is embedded in the design. | Evidence for how well and/or that the artefact fulfils its purpose |
| **Purpose** | Creation of an artefact under consideration of existing knowledge | Proving the suitability of the artefact for its intended purpose. |
| **Approach** | This activity includes determining the desired functionality of the artefact, its architecture, and the creation of the actual artefact. It was informed partly by the problem understanding and the requirements, along with further information from the interview study describing existing approaches and their effectiveness. | Conceptual demonstration (i.e., explaining how it works for an exemplary case) and using the artefact as a basis to build the sub-PC and problem type instance. Therewith, the artefact's general suitability can be compared with the requirements for a solution. |

## 6.1 Starting Point

The research problem at the problem class level (as per the discussion on abstraction, see: Section 3.1.3) is abstract, and the summarising problem statement in Section 5.4 can be used as an adequate definition of the research problem. After all, it was formulated to conceptualise the overarching research problem (i.e., the problem class). Many intricacies of the research problem are outlined in Section 5.2.2 (Main Challenges Perceived by the Design Researchers). Together with the problem statement, these specific challenges form a large part of the knowledge base used to inform the design and development of the artefact. Furthermore, the design requirements for the artefact can also be adopted as presented in Section 5.3, since these requirements were formulated as abstract common denominators for the overarching research problem, which is, incidentally, the level of analysis for the artefact in this section. The problem definition and the design requirements can thus be understood as the starting point for the artefact design phase. However, beyond providing the initial problem understanding for the design activities, further knowledge about potential solutions may be useful. Such knowledge was also gathered during the interviews, as outlined below.

## 6.2 Design-specific Additional Knowledge

The expert interview study is not only used to investigate the research problem and to derive requirements for a solution. In addition, the interviewees were asked about their coping strategies and their experiences with working on solving their challenges in communicating their design research projects (for a detailed presentation of the study and its findings, see: Appendix A). These inquiries result in insights into how design researchers construct storylines (Section 6.2.1) and specific techniques they use to overcome specific challenges (Section 6.2.2). Furthermore, the analysis of the interview transcripts also reveals a variety of communication situation characteristics that affect the communication of design research projects (as already discussed in Section 5.2). These can be summarised into dimensions (analogous to the input section of the problem conceptualisation in Section 5.1, see 'Communication Situation' in Figure 24). Such dimensions and characteristics may need to be considered when preparing one's communication (Section 6.2.3). Lastly, the interviewees provided insights about the goals they pursued in the various communication situations they presented (Section 6.2.4). In this additional knowledge section, some of the insights related to these dimensions and characteristics are presented (and possibly repeated from Section 5.2) in a way that allows for combinedly transforming the knowledge to a higher level of abstraction that is appropriate for the artefact at the class level. Thereby, this knowledge can help provide direction to the design process. However, since these direct insights from the interviews are less abstract than the artefact sought in this design and development phase, a summary that brings these insights to a higher level of abstraction (Section 6.2.5) rounds off this design-specific additional knowledge section.

### 6.2.1 General Storylines used by Interviewees

The general storylines can be understood as the result of selecting content aspects and ordering milestones one wishes to go through (either in specific communication situations or in general). With that, two core aspects for building a communication artefact (e.g., a research article, a PowerPoint presentation) are addressed. **First, content aspects need to be identified and selected**. Hence, communicators need to separate specific content items they wish to present (or else omit). Second, **they need to bring these items into an order that allows them to achieve some objective** (by following certain milestones).

#### 6.2.1.1 Identification and Selection of Content Elements

The interviewees discussed many content elements that might be selected for communication. While the details about these content items are not directly relevant to the construction of an abstract solution, the fact that **there are many and diverse content elements to choose from** might be. Table 7 shows some examples for content items obtained from the interviewees, illustrating the wide variety of possible content items.

*Table 7: Examples for Content Items in Design Research Project Communication*

| Content Category | Examples for Content Items |
|---|---|
| Applicability and utility to stakeholders | Arguments for the applicability and usefulness of the artefact; statement on the contribution toward practice; demonstration of the artefact; a use case scenario |
| Assumptions and existing knowledge | Description of understanding about the phenomenon; existing knowledge; justification of approaches; origin of the project idea; problem description |
| Contribution to science | Statement on the contribution to the research community and/or to theory; explication of design knowledge; evidence of the innovativeness of the artefact; DPs |
| Description of the outcome | Description of the artefact (how/why it works, what it is, features, principles); deliverables; limitations; |
| Description of the project phases | Reference approach chosen (and the phases it suggests); any specific phase (mostly current or subsequent phase); anticipated work packages |
| Motivation of the study | Motivation for a design research study; origin of the idea; rationale behind the study; its relevance |
| Object of desired feedback | Prototype (mock-up); theoretical frameworks; |
| Process-related aspects | High-level timeline; role distribution among actors; |
| (Selection of a specific focus) | Selection of content elements based on a specific content focus such as proving rigour (for academia-facing communication) or applicability (facing practitioners) |

#### 6.2.1.2 Building a Storyline

The storyline one chooses to present the chosen contents was presented by the interviewees as being critical for effective communication. A storyline is the abstract compilation of milestones and the rationale that relates one milestone to the next. Most interviewees agreed that they use **different storylines to communicate with practitioners than they use to communicate with academic audiences**.

#### 6.2.1.2.1 Academia-facing Communication

In academia-facing communication (and therein, mostly formal communication situations), high importance lies on respecting and complying with expectations that make a communication 'acceptable.' Researchers' communication should **make apparent that they have a good understanding of related work (including existing design knowledge), are knowledgeable in the methodologies they use, and that their work was done with a high standard for rigour** (more so than that the work is relevant). Contents that are not directly expected can be cut short, moved to an appendix (if this is an option), or omitted entirely. With that, academia-facing communication was described by the interviewees as being governed by expectations. **Practical communication, such as helping someone understand how an artefact is created, is not expected**. Considering that the expected contents must be presented, such contents with low perceived importance are often omitted. This seems to be bothersome for the communicators themselves, much more so than for reviewers and academic audiences in general, as the following excerpt from one interview illustrates:

> *"We propose a set of conceptual model modelling techniques or guidelines to help clean data for machine learning. We went through (...) through two rounds of MISQ. (...) Sow had gotten feedback. One of the things that they asked us was to evaluate even more. We had done a technical evaluation (...), but they said that's not enough. So we ran focus groups (...), (but) now the paper is exploding. What we had to do is take a lot of the design theory – sort of our argumentation on how we came up with these ways to use conceptual modelling – we had to take it out and put it in the appendix. Which, to me, is heart-breaking. That part is really interesting!" (Interviewee 11)*

Based on this understanding of communication toward academia-facing audiences, one of the interviewees suggested the following key milestones:

1. Define the phenomenon/research problem
2. Clarify the methodology and provide evidence for its adequacy
3. Provide theoretical support and ensure the perception of rigour
4. Show how the data supports the overall project and its conclusions

To build storylines for specific communication situations, the interviewees provided some insights into their strategies. Thereby, one commonly used and generally satisfactory strategy is to **build the storyline based on a set of steps or phases that are based on a known reference approach**. However, the interviewees also provided a variety of

examples of how they interpreted the approaches in various communication situations. There seems to be some design freedom, but using a solid reference approach seems to be the go-to solution to select and structure for building a storyline (especially for research papers). While the reference approach seemed important to the interviewees, they did not mention the operationalisation of the approach as being a relevant content item. On the contrary, some indicated that **DSR-specific methodology might be better omitted to focus more on things the audience cares** (more) **about** (such as the methodology used to evaluate the artefact).

##### 6.2.1.2.2 Practice-facing Communication

As opposed to academic audiences, **practitioner audiences prefer storylines that focus on their local problems and the applicability of the artefact for solving these problems**. It is therefore **imperative to integrate the practitioners' challenges into the storyline**. Across the interviews, there is general agreement that this can be achieved by following this abstract storyline:

1. Presentation of the artefact without being overly specific
2. Demonstration of the artefact by illustrating how it can help the practitioners
3. Last priority: evaluation to show its effectiveness

Some interviewees underlined the **importance of convincing the practice partner** (as one specific practice-facing audience) **that they really understood the problem** the practitioners face, as illustrated by the following quote.

> *"We did a lot of research and attended several meetings with the practice partner to really understand the nature of their problem. Because when they talk about their 'problem', they have usually many problems, and the problem is multifaceted. We have only a small solution that is isolated and very focused. In order to convince them, we really had to understand their problems and to an extent that we could build an argumentation chain to (...) make them believe that our innovative, weird thing is really promising to create a significant impact to their problem." (Interviewee 4)*

To summarise the insights about how the interviewees build storylines in general, one can say that **the audience plays a major role in specifying a storyline and that it is knowledge about the audience that helps identify what is important**. These insights provide some understanding of how design researchers cope with the general problem of communicating their projects. At a more situated level of analysis, they also use a

variety of specific techniques that help them overcome specific challenges related to the communication process. These are discussed next.

### 6.2.2 Specific Techniques used by Interviewees

Specific techniques are coping mechanisms to address specific challenges, such as the ones outlined in Section 5.2.2. The interviewees provided a variety of such techniques. Again, the details about these techniques are not relevant for the class level of analysis, but the **fact that there are many techniques for addressing a variety of specific challenges** might be. While a more in-depth account of these techniques can be found in Appendix A: A.3.4, an excerpt of them is presented below (Table 8).

*Table 8: Excerpt of the Specific Techniques used to Overcome Specific Challenges*

| **Setting:** Technique | **Explanation of the Technique** |
|---|---|
| Present the project plan despite unpredictability: Increase conceptual specificity of the project plan | To overcome the challenge of having to clarify the project outline of a design research project with its inherent emergence and unpredictability, one can increase the specificity of the project plan beyond what is decided upon/specified yet, but do so on a conceptual level only (e.g., specifying the various ways in which the artefact will be useful, without explicitly telling how it achieves these benefits; or specifying the data gathering and analysis techniques, without explicitly telling how much data is gathered and from where; use terminology that provides a vision, without being so specific as to not being able to account for emergent effects). (Interviewee 1) |
| Explain the project outline (to practice): Use stages/work packages to share the vision for the project. | It is useful to present procedures to practitioners at a higher level of abstraction as can be found in reference process models or as one may construct through work packages with somewhat specified deliverables for each work package. (Interviewees 1-4, 6-7, 9) |
| Address the emerging nature of the research process: Adjust the degree of details based on temporal distance. | While it is good to outline the project at a relatively generic level, details should be provided on the phases that are closest to the present timeframe. This creates some idea of where things are going and trust in the (immediate) next steps while allowing for pivots down the road. (Interviewees 1 and 3) |
| Explication of the story (to practitioners): Use the practitioner's terminology, metaphors, and | Especially in the beginning, it is important to 'sell' the project or the artefact as something that the practitioner needs and wants. It may be useful to use a metaphorical story to bring them into the right frame of mind/context. Otherwise, the use of specific and meaningful terms used by the |

(continued on the next page)

| | |
|---|---|
| colours to more effectively transport your message to them. | practice partners, their metaphors, colours etc., can also help to increase perceived relevance. (Interviewees 4, 7, 11) |

The key insights from analysing these specific techniques include that it may be useful to differentiate between conceptual and operational specificity. Conceptual specificity is about what is done and why (functional view), whereas operational specificity is the detailed view of how things are done. Several interviewees suggest focusing on conceptual specificity and omitting operational specificity in general. They find this to be a suitable strategy in many communication situations and for overcoming many challenges they face. One way in which this strategy can be operationalised is by focussing on work packages, which seems to be highly effective with practitioner audiences:

> *"(I used) work packages and what these work packages included was basically 'we do some exploratory interviews. We make some prototypes over time. We evaluate the prototypes.' It was more the activities, and the solution was very roughly scheduled. I said: 'Yes, you need some (...) new forms of interaction.' But honestly, I didn't know how it will look like. But you know what people in practice like? They like this kind of work packages and deliverables. So even if I don't know what I will deliver exactly, I just call it deliverable 'prototype', and then they're happy." (Interviewee 9)*

Another key insight from analysing the specific techniques is that the **communication must be operationalised such that the audience is able to understand the communicated contents**. This may require the researchers to first identify the terminology and the frames of reference that the audience is familiar with. Lastly, the absence of a discussion on challenges with explicating the communication (e.g., specific formulations, illustration techniques, rhetoric) indicates that the design researchers generally know how to explicate a defined storyline. However, **the primary challenge is to build a storyline and to adapt this storyline to the specific communication situation**.

### 6.2.3 Dimensions and Characteristics of Communication Situations

A wide variety of 105 communication instances was presented throughout the interviews. An overview of 40 distinct communication situations (a situation is defined by its characteristics and several instances might be part of the same situation), ordered by the following five categories, are outlined in Appendix A (Table 53).

- **Acquisition of resources:** The communication pursues the purpose of acquiring resources that are necessary for the design research project
- **Meetings with collaborators:** The purpose of such communication is to productively further the design research project (e.g., by aligning collaborators, obtaining feedback, or informing stakeholders).
- **Open discussions:** Such communication is used to foster the exchange of ideas with various participants.
- **Presenting to practitioner audiences:** The communication is prepared beforehand, and its purpose is to present the project or aspects of the project to an audience of practitioners.
- **Presenting to academic audiences:** The communication is prepared beforehand, and its purpose is to present the project or aspects of the project to an audience of academics.

The variety of communication situations reveals that there are differences between communication situations. These differences might be characterised by descriptions of the communication instance (Section 6.2.3) and the goals pursued in these communication instances (Section 6.2.4). While the descriptions of communication instances featured many characteristics, only a selection of commonly mentioned ones, as clustered by dimensions, are outlined in Table 9 to illustrate the dimensions of characteristics that are perceived as affecting the communication. Upon request (testing the problem conceptualisation from Section 5.1), the interviewees did confirm that the mode and means of communication do affect the communication as well, along with the time and space available. However, the explication (and thus, the operationalisation of a storyline in the desired mode or with the given means) is not perceived as being problematic. Furthermore, the lack of space (or time, e.g., at a pitch session or a conference presentation) is perceived as being highly problematic. This dimension is problematic to various degrees across all communication situations. It seems to be least problematic in communication with practitioners, however, as their needs are more easily met (Interviewee 9).

*Table 9: Overview of Dimensions and Exemplary Characteristics*

| Dimension | Selection of Characteristics |
|---|---|
| **Audiences and their roles** | - Collaborators (team members, practice partners, developers)<br>- External contributors (financiers, advisors, peers)<br>- Consumers of content (conference attendees, readers, public) |
| **Needs of the audience** | - Needs of practitioners (prototype orientation, specificity, relevance, problem and demonstrated solution)<br>- Needs of academics (generalisable design knowledge, clear methodology, strong evaluation, rigour, academic terminology) |
| **Directionality** | - One-way communication (requiring high clarity and specificity, as the audience cannot ask questions)<br>- Bi-directional communication (requiring less clarity and allowing for more flexible planning and explication) |
| **Stage of the project** | - Early stage<br>- Earlier iterations<br>- Later iterations<br>- Final stage/end |
| **Format of the communication** | - Conference article<br>- Face-to-face communication (e.g., panel discussion)<br>- Grant proposal<br>- Journal article<br>- Team meeting |

### 6.2.4 Communication Goals Pursued by Design Researchers

There are many goals that design researchers pursue in communicating their projects (Appendix A, A.3.6). The most common goals mentioned by the interviewees are the following:

- Access to resources (incl. commitment of time, money, access to data)
- Building trust with the audience (e.g., in one's ability to find a solution)
- Create awareness (e.g., for the problem or the general approach to solving it)
- Create understanding (e.g., of the mechanisms that are central to the artefact)
- Create utility and provide a contribution (to practice and academia)
- Gain an understanding of the problem (e.g., in exchange with practitioners)
- Influencing the wider community (e.g., introducing a new method)
- Reach alignment (e.g., about a project plan or of the terminology used)

These communication goals can be viewed as another dimension of a communication instance. Goals vary from communication instance to communication instance, and no design research project is communicated without pursuing a goal. The way in which the

goal affects the communication is that **it drives the selection of contents and the shaping of the storyline and, to some extent, the way in which the means of communication are used or the vocabulary that is employed**. For example, if the goal was to help practitioners understand how the artefact works, the terminology should be used such that the audience can easily relate (Interviewee 4). The artefact should be shown in some form or other (e.g., by means of a prototype), such that the abstract ideas are contextualised (Interviewee 9).

### 6.2.5 Summary of the Design-Specific Additional Knowledge

The insights presented in this section are contextualised to various degrees. For example, the general storylines are more or less specific to a certain audience characteristic or a characteristic of the means of communication. The specific techniques are instructive for overcoming situated challenges or for improving the effectiveness of communication in specific situations. The characteristics of a communication situation are specific to each communication situation, and the goals pursued vary from situation to situation. Therewith, detailed statements by the interviewees (and even the abstracted and somewhat summarised statements provided above) reside at a different level of analysis than the research problem for which a solution needs to be designed in this section (i.e., at the class level). In the following, the insights from the more contextualised knowledge provided above are de-contextualised and thus, brought to a higher level of abstraction. Thereby, informational granularity is lost, as illustrated below (Figure 25). By de-contextualising, only certain information at any given level of analysis can be assumed to be also valid at a higher level of analysis. Therefore, the larger the distance between the levels of abstraction, the less granularity of information can be transferred. With that, a larger amount of information can be expected to be transferrable from the general storylines to the class level than from, e.g., the specific techniques (see Figure 25).

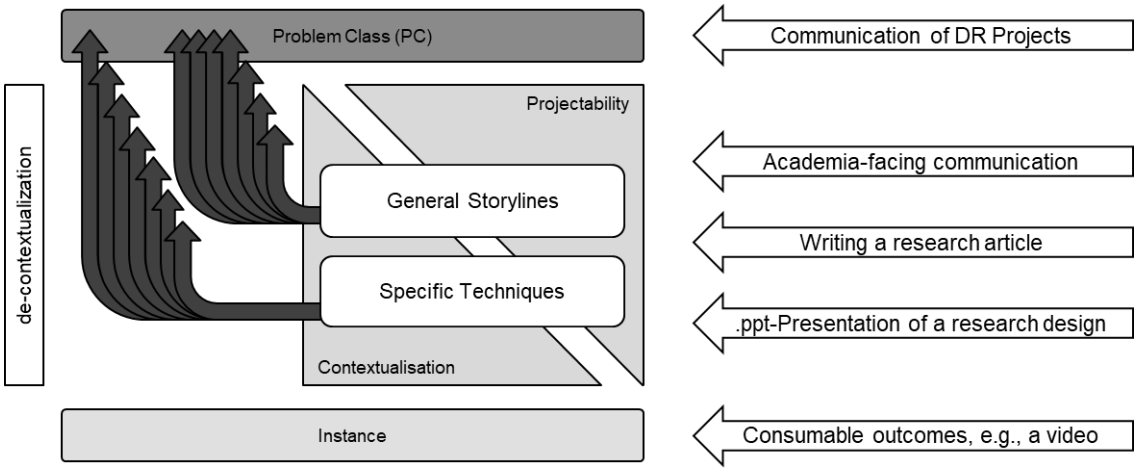

*Figure 25: De-Contextualization of Knowledge incl. Examples*

Bringing the insights from this section to a higher level of analysis, and thus, de-contextualising the insights from the interview, the following extension of the afore created understanding of the phenomenon emerges:

To communicate one's design research project, researchers identify possible content aspects and make a selection among them before presenting the selected ones. Hence, a selection of possible content aspects is compiled, whereas this compilation is the most problematic of the communication-related activities (e.g., illustrating concepts, rhetoric, selection of terminology). To compile these content aspects, researchers need to account for a variety of variables. These variables affect the process of preparing and presenting the communication, including the audience and the role it plays in a given communication situation, the needs of the audience, the directionality of communication (i.e., whether there is the opportunity of direct (low-latency or no-latency) exchange or not), the stage of progress of the project itself, the format of communication, certain situational limitations (e.g., the mode or means of communication available, although these are not per se problematic for design researchers), and the goals that the design researchers pursue through the communication. The variable with the most substantial effect on the selection, compilation and explication of the content aspects is the audience. Communication must cater to the needs of the audience in order to achieve the various goals that the researchers pursue with their communication (another variable). It is therefore critical to know one's audience. One facilitator in 'knowing the audience' is to know whether it is an academic or a practitioner audience since these two groups of audiences each have a relatively stable set of expectations and needs. However, beyond this separation into two groups, the specific audiences have situation-specific needs that the researchers should identify before venturing to compile content aspects. That compilation can be understood as the construction of a storyline (where the storyline is a sequence of milestones that should be reached during the communication process and the rationale leading from one milestone to another). Currently, researchers use project or process steps or phases as a baseline storyline to communicate their design research projects. A storyline for academia-facing communication is usually oriented by a methodological approach that provides these process steps, whereas in practitioner-facing communication, a project plan or specified work packages are often used. The construction of these storylines for a specific communication instance is the central activity that poses problems in the communication of design research.

## 6.3 Artefact Design and its Evolution

This section reports on the design and development of artefacts that may satisfy the requirements (Section 5.3). It fosters knowledge from the knowledgebase (Section 2), the research problem and its associated challenges (Section 5.2), and knowledge about existing coping mechanisms (Section 6.2, Design-specific Additional Knowledge). The artefact design and development process leading to the final artefact for the problem class can be described as iteratively emergent. It emerged from continuous concurrent evaluations based on peer feedback and testing against the insights provided on the research problem and the additional insights for this design activity. Two formative intermediary results of the design journey and the final artefact are presented in the following. The two earlier versions each contributed significantly to the final artefact. Each intermediary artefact is introduced with the origins of its design, a visual representation, the rationales behind its utility, and the reason for continuing the design process. The final artefact for the class level should answer the following research question:

**RQ at the Class Level:** How can design researchers present their design research projects throughout the research process?

### 6.3.1 The initial idea for an artefact

From the analysis of literature and the IPO-Model that emerged, along with the insights from SciCom literature that helped populate the IPO-Model with detail on the input, process, and output parts, the initial idea for an artefact was born. In particular, the IPO-Model (Section 2.2) and the analysis of the research problem (Section 5.1) played a central role in drafting the first idea. The artefact contains known or 'knowable' aspects that can be specified in a communication situation (indicated with green frames) and communication process-related aspects that are yet unclear but might be sensible (indicated in blue). The known aspects can be specified without or (in the case of communication goals) at least before communicating. These aspects tend not to be problematic. The literature-based understanding of the research problem indicates that it is the process that takes the use case with its characteristics and the specificities of a focal design research project into account and effectively allows design researchers to reach their communication goals. Since the IPO-Model was primarily based on general SciCom literature, and since the problem analysis revealed that various challenges relate to peculiarities of a specific design research project, the artefact proposition features a split of inputs into general SciCom inputs and project-specific inputs that may inform the communication process. That process, however, remains a black box at this stage of

artefact development. There are only suggestions from SciCom literature, based on which sub-processes can be specified. However, these are not tested or evaluated yet.

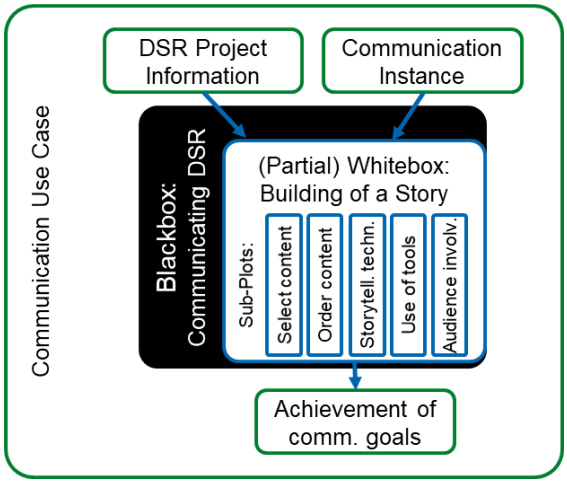


*Figure 26: Initial idea for an artefact*

The rationale behind this artefact's expected utility is the following: Design research project communication situations have many degrees of freedom based on which they may differ from one another. Providing guidance to design researchers might imply that this diversity of settings needs to be somehow accounted for. Evidence for this can be found in both the literature on SciCom and the problem analysis. A useful artefact might thus contain some sort of framework that helps specify the communication situation. If the user of such an artefact can specify their communication situation in such a way that it becomes clear which characteristics of their communication situation are relevant for the communication process, and maybe even how a certain characteristic affects that process, then a first step toward providing the sought-after general-purpose guidance is taken. The more problematic part based on the IPO-Model is the process. This process, especially when considering the problem class and, thus, all design research process communication, is a black box. It is being operationalised, but it is unclear how. Effective guidance should, therefore, not only help identify relevant situational characteristics but also help bridge the input with the targeted output. Hence, there needs to be some white boxing that reveals at least conceptually how that process looks. In this artefact proposition, it contains the literature-derived activities of selecting contents that shall be communicated, ordering these content blocks, applying storytelling techniques to build an adequate story, using tools to communicate the story effectively, and creating audience involvement (see also: explanations about the process in Section 2.2.2).

This artefact was not evaluated in a confirmatory research design. Because it was an early design proposition built upon insights from literature, anecdotal knowledge, and

reflection, the author merely constructed it as a starting point for further iterations. Such iterations should introduce more and more information, notably exploratorily raised evidence from the main stakeholders. After specifying this first idea for an artefact (see also Section 5.1 and therein Figure 24), the exploratory expert interview study revealed that the known or knowable parts (green frames) are mostly adequate. Notably, there are goals pursued by the researchers in their communication endeavour, and they find that a wide selection of characteristics of their communication situations (both generic ones such as the mode, means, or format of communication and DR project-specific ones such as the project stage) affect the communication process. However, the proposition for sub-processes that may help shed light upon the communication process (blue) has not seemed to be adequate. While the five suggested sub-processes have been mentioned, they do not seem to be particularly useful in the process of constructing the communication of a DR project. In particular, the audience-dependence of that process is not adequately featured, though it was perceived as being a central success factor. Apart from the selection of content, the sub-processes do not seem to be directly helping the researchers in solving their communication-related problems. With that, the central part of the artefact suggestion had to be rejected. As obtained throughout the interview study, the insights about the process have provided the starting point for the first major iteration of the artefact.

### 6.3.2 First Major Iteration of the Artefact

The additional knowledge extracted from the interview study (Section 6.2), the improved problem understanding (Section 5.2), and the specification of requirements (Section 5.3) are the foundation for the iteration of the initial artefact. The particular weakness identified in the initial idea for an artefact is the process. The primary issues that make the process appear to be unsuitable are: (1) The process does not suggest that there is a necessity to include stakeholder needs. While this may or may not be part of the process (e.g., content selection), the central role of stakeholder needs seems to require a more explicit inclusion of stakeholder needs. (2) The content selection and ordering of the content are necessary steps. However, how the content is selected and compiled in the sense of choosing a level of specificity seems to be important too. This, again, is not presented specifically in the initially proposed process. Using the idea of presenting content based on various degrees of conceptual and operational specificity may need to be represented more clearly. (3) The explication of a planned communication seems to be less pressing for design researchers than it is to prepare the plan for communication. Therewith, the selection of storytelling techniques, the use of tools, and the involvement

of the audience as three separate aspects of the initial attempt at white-boxing the process do not seem to be as important as the specification of the storyline. Lastly, (4) the communication should provide guidance for many different communication situations. Communication is most strongly influenced by the audience (and stakeholder needs) and the specificities of the communication situation. This could be observed in the interviewees' explanations that there are differences between academic and practitioner audiences or that they would communicate differently in a journal article than, e.g., in a face-to-face communication situation. However, the storyline they choose may not depend on the mode, means, or format (i.e., the storyline can be independently specified from explication, while the explication depends on the mode, means, and format). This suggests that the storyline can and should be specified before going into further detail about the communication situations' operational settings.

These insights combinedly led to the decision to abandon the drafted middle part of the IPO-Model and to redesign a process that more adequately focusses on the stakeholder needs, the building of a storyline, and the adaptation of the information about the design research project to a specific communication situation. This design iteration has yielded the subsequently illustrated method (Figure 27).

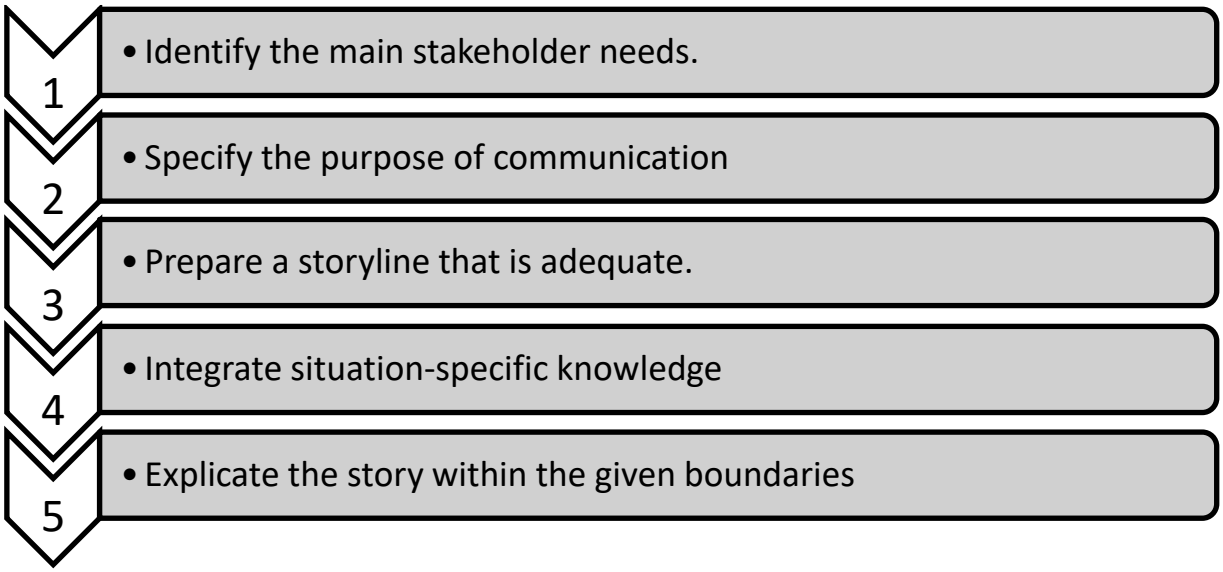


*Figure 27: First iteration of the artefact*

The rationale behind this much-simplified artefact is the following: While it is clarified that any communication has a purpose, this purpose is integrated into the initial draft of an artefact as the achievement of communication goals. However, the purpose of communication may not always be self-evident. Instead, the purpose of the communication might equate to the decision to satisfy some (but probably not all) stakeholder needs.

Indeed, the needs of the stakeholders appear to be central to a communication instance. For this reason, a sensible starting point on a communication endeavour would be to identify the main stakeholder needs (step 1). With several stakeholders, these needs might be conflicting, or they might be extensive, requiring communicators to prioritise and, thus, specify a purpose of communication that provides clarity as to which needs should be satisfied at the end. In other words, the goal of communication may indeed not be a pre-emptively specifiable aspect for a communication use case. Therefore, the iterated artefact features the specification of a purpose as part of the communication process (step 2). Furthermore, the selection and ordering of contents seem to happen in two iterations that differ from each other based on the specificity with which 'content' is understood. In one instance, the general selection of contents based on milestones can be used to build a storyline. This storyline is independent of the details of explicating the story. Instead, it consists of specifying the intermediary goals and how one leads to the other (step 3). The other instance is the formulation and illustration of the content in the sense of explicating the story. That explication, however, depends on various specificities of the communication situation (unlike the storyline). As per the problem analysis and the interview responses, a variety of aspects affect the explication, such as the means, mode, or format of communication. These insights need to be accounted for in the explication and, therefore, may be introduced into the artefact (step 4). Given a storyline and the knowledge about a communication situation's specificities, the explication of the story can take place (step 5). In Table 10, an overview with explanations about the steps of the artefact is given.

*Table 10: Explanations about the Iterated Artefact*

| Step | Explanation |
|---|---|
| **Step 1:** Identify the main stakeholder needs | Clarify who the stakeholders are (cf. Maedche et al., 2019: individuals involved in or affected by something), what their needs are, and prioritise these needs. |
| **Step 2:** Specify the purpose of communication | Select a sub-set of the needs identified in Step 1 and specify a central purpose of communication. This purpose will provide guidance for the next step. |
| **Step 3:** Prepare an adequate storyline | The 'storyline' is a set of milestones that should be reached through the communication instance, along with a line of argumentation that bridges the milestones sequentially. Preparing the storyline means specifying an abstract outline of the intermediary goals. Before adding details (step 4) and explicating the story (step 5), the storyline needs to be evaluated regarding its suitability for reaching the purpose. |

| Step | Explanation |
|---|---|
| **Step 4:** Integrate situation-specific knowledge | Clarify the communication situation-specific characteristics that affect the communication and isolate the implications these may have on the explication process. |
| **Step 5:** Explicate the story within given boundaries | Formulate, illustrate, and therewith produce the communication based on the storyline and under consideration of the communication situation's specificities. |

The identified shortcomings of the initial version (1-4) and the requirements for a solution (R1-R4) were used to demonstrate that this artefact is likely to help solve the identified challenges. Hence, the artefact was initially demonstrated based on a conceptual reflection (see next paragraph). In addition, the artefact was evaluated in doctoral seminars, during which the author presented the artefact and discussed it with the participants. Furthermore, an individual coaching session with a professor and a one-hour discussion session with another doctoral student were part of this doctoral seminar. All of these discussions helped achieve the purpose of evaluation (i.e., identifying how effective the artefact might be at solving a problem).

The reflection of the shortcomings of the first artefact and the requirements revealed that this iteration of the artefact clearly and prominently includes stakeholder needs (1, R2). It does so in the first step of the method and carries the focal stakeholder needs over to the other steps through the definition of the purpose of communication (step 2, R2). Furthermore, the selection and organising of contents are based on the storyline, an abstract approach to planning the communication outline (2, 4). The idea that the storyline should be evaluated based on whether it is likely to achieve the purpose indicates that R3 is accounted for. Furthermore, the creation of a storyline is central to this second version of an artefact, while the detail-level explication of the communication is much less prominent. This aligns with the third issue identified with the first artefact proposition (3). To finalise the reflective demonstration, requirements 1 and 4 need to be addressed: First, the artefact does not discriminate between any phases or other characteristics of a communication situation. Indeed, it should be applicable to any communication situation, therewith satisfying R1. The fact that step 4 specifies that situation-specific knowledge needs to be introduced into the communication process and that the storyline is oriented by the stakeholder needs should satisfy requirement 4. However, R4 is formulated openly ("The artefact must support the operationalisation of knowledge about specific stakeholder needs."), and the usefulness of the artefact in that regard might be satisfied or might not be satisfied. To investigate this, the above-mentioned discussions between fellow researchers took place.

During the discussions about the artefact, the following concerns were raised: (1) What is DSR-specific about this artefact? Indeed, the five steps of this process do not directly refer to DSR, and they might be applicable to the communication of many more types of projects. The steps are abstract and might therewith be not specifically tailored to design research project communication. This concern is not necessarily negative. However, it may indicate that the artefact could be improved regarding its effectiveness if it were specified a bit more (i.e., increasing its contextualisation toward its application domain of design research project communication). Another concern is (2) whether this artefact is indeed useful to design researchers. While the discussion partners agreed that the general procedure might yield communication that is effective (based on its orientation on a specific purpose, which in turn is based on the stakeholder needs), they questioned the applicability of such an artefact. Namely, step 4 caused doubts. How should communicators identify which situation-specific knowledge is relevant and how it may affect the communication? Concern number three (3) is whether this artefact can really be informative for the diverse communication settings or whether it had to be specified further for groups or types of settings. That last concern somewhat relates to the first concern in that it also questions the adequacy of the level of specificity of the artefact.

To probe whether the level of specificity was an issue that can be solved by providing sub-artefacts, each with a certain 'flavour' that provides the (1) DSR and the (2) communication setting specificity, the author proposed the following adaptation: The artefact could be specified based on various dimensions, such that communication process patterns emerge. For example, the artefact could be specified by introducing specificities from certain types of audiences. Thereafter, there might be one version that is more suitable for practitioner audiences or academic audiences, as these have relatively stable needs (see design-specific additional knowledge, Section 6.2.1.2.1). Alternatively, it may be adapted to fit one common set of stakeholder needs. Therewith DSR specificity can be introduced along with existing knowledge about certain characteristics of specific communication situations. This suggestion was thereafter also discussed.

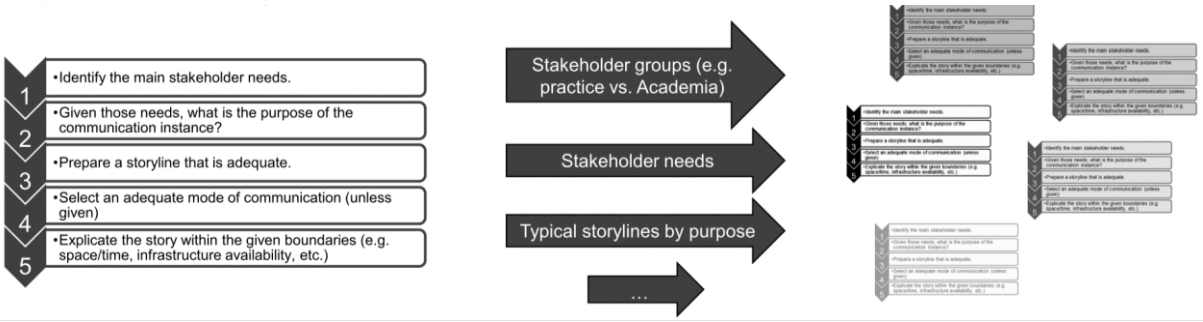


*Figure 28: Adaptation of Iterated Artefact Based on Specific Situations*

This idea was perceived as a slight improvement. However, at this point, the artefacts that emerge from such an adaptation would no longer address the problem at the initially targeted problem class level but at a lower level of abstraction (as operationalised in Section 7). This approach, therefore, does not improve the perceived low adequacy of the artefact at the class level. Instead, the suggestion implies that the artefact is used and contextualised to create new artefacts at a sub-class level. While the creation of such sub-class level artefacts seems much more useful for individual design researchers, this solution approach is only adequate for this dissertation if the class level artefact is created. (About the relevance of and need for a solution at the problem class level, see: Section 1.1 Research Problem and Research Questions, Section 2.3.2 Existing Guidance for Design Researchers, and Section 5.4 Summary of the Problem Analysis.) While the feedback received on this proposition of adapting the class level artefact to more specific and more 'useful' situations is integrated into this dissertation (i.e., two artefacts with increased specificity are created, as reported on in Section 7 and 8, to support design researchers in specific communication use cases: writing research articles and presenting research designs for evaluation in a university course setting), the abstract, class-level artefact is thus still needed and in need of an iteration. Finally, the author acknowledges that this artefact design (Figure 27) does not adequately use the knowledgebase that was gathered (Section 2 and Section 5.1) or benefit enough from the specific additional knowledge gathered to inform the design of the class-level artefact. This primarily concerns the research problem (Section 5.2), but also the design-specific additional knowledge (Section 6.2) and findings from the interview study in general Appendix A.

### 6.3.3 The Resulting Artefact to Address the Problem Class

The third artefact combines the first and the second artefact in such a way that the weaknesses of each version are overcome by the strengths of the other. In particular, the initial artefact's weak point is the process, whereas the surrounding construction of DSR project information, communication situation characteristics, and target outcomes appeared to be correctly identified as being relevant and as informing the process (Figure 26). In the iterated artefact, these aspects were rendered implicit in that they are important still, but their investigation and specification are integral to process steps (i.e., the identification of stakeholder needs and the integration of situation-specific knowledge). This may have caused the discussants to feedback that the design research specific knowledge is missing from the iterated artefact (Figure 27) and that the artefact is not quite useful or usable without substantial additional work (i.e., adaptations of the iterated artefact to situations or groups of situations, see: Figure 28). However, they are fundamentally agreeing with the process, despite it being quite abstract and therefore maybe unnecessarily difficult to contextualise. Based on these insights, the resulting artefact (Figure 29) could be built. It contains an overview of the most relevant dimensions and their respective characteristics that describe the communication situation (morphological box) and the process. Therewith, the specificity and clarity about the communication situations are improved, but the artefact is still applicable to all design research project communication situations – and is therefore situated at the class level of analysis.

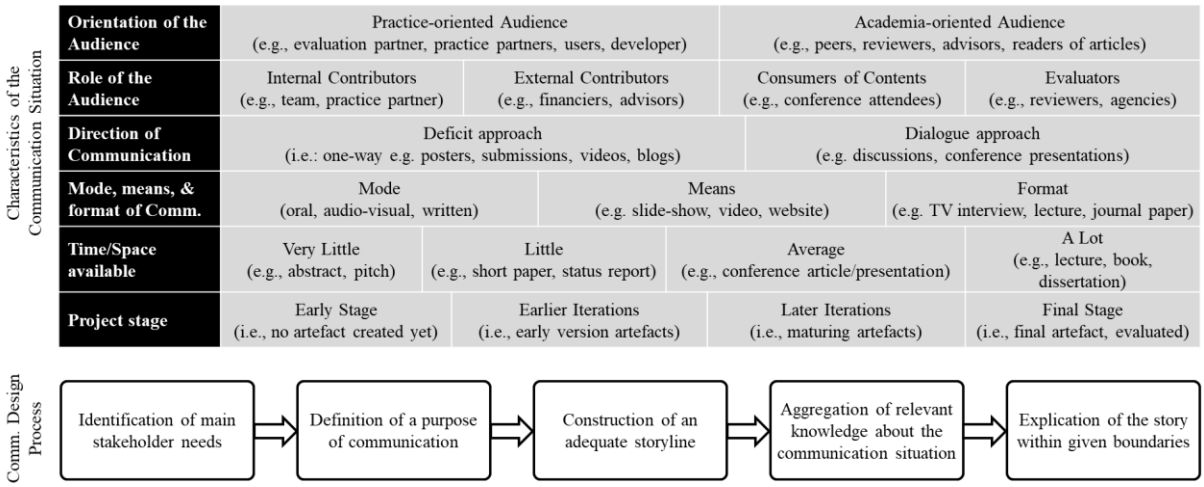


*Figure 29: Resulting Artefact for the Problem Class Level: A DSR Communication Framework*

The rationale behind this artefact is, as a result, mostly equal to the method presented above. The process itself is referred to as the 'Communication Design Process' in the illustration above, and it helps coordinate the relevant design decisions that lead to the communication outcomes. However, the 'Characteristics of the Communication Situation' that were found to be influential on the communication design process (see Sections 5 and 6.2) are made explicit. Therewith, concerns 1 and 3 are partially addressed. The morphological box follows a dual purpose in that it helps identify the communication situation's characteristics that affect the communication process, and it can serve as a knowledge structure that directly informs the communication design process. How this works is illustrated below (Figure 30) with the exemplary communication situation of this dissertation. For each characteristic of the communication situation, a set of known implications can be identified and integrated into the communication design process. Such knowledge chiefly informs the identification of main stakeholder needs (in particular based on the orientation of the audience and the role of the audience) and the aggregation of relevant knowledge about the communication situation (to which potentially all characteristics contribute). The current knowledge associated with these knowledge containers is based on the information gathered throughout the selective literature review and the expert interview study. However, further research can be used to populate these knowledge containers that are associated with each characteristic in the morphological box. For example, one may conduct a systematic literature review for the class level of analysis, or an investigation of a summarising communication use case (sub-class level) such as writing research articles (as in Section 7 and Appendix B-Appendix E), or one could derive a contextualised artefact for a specific communication situation, such as the presentation of a research design as an evaluation task in a research methods course (as in Section 8).

The class level artefact, as illustrated above, can thus be used by a design researcher by first identifying the characteristics of their communication situation. Thereafter, the characteristic's specific implications need to be extracted from these knowledge containers (Figure 30). The design researcher thereafter starts the communication design process, which at this point is already partially populated with the extracted implications. This should not only help build the storyline for the communication (strength of the iterated artefact presented in Figure 27 and core problem across communication situations, as summarised in Section 6.2.5) but also help identify and operationalise knowledge about the communication situation (strength of the first idea for an artefact, as presented in Figure 26 and core weakness of the iterated artefact in Figure 27).

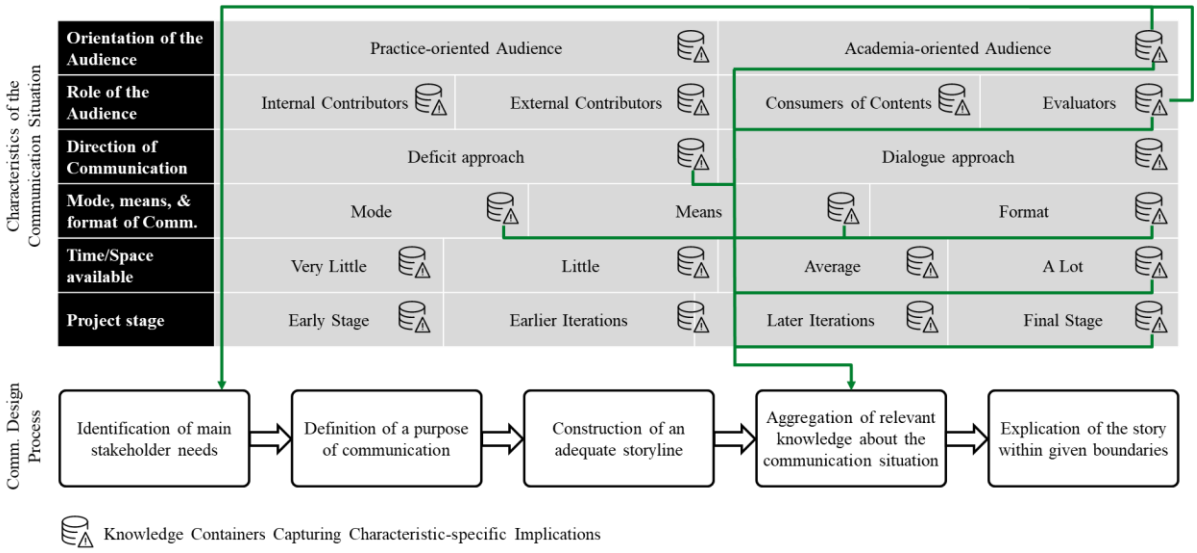


*Figure 30: Using Situational Characteristics to Inform the Communication Design Process, Exemplified with the Communication Situation of this Dissertation*

## 6.4 Demonstration and Evaluation

To demonstrate that this artefact is a suitable candidate to answer the research question and to address the research problem, a thought experiment provides initial evaluative feedback (Section 6.4.1). To further investigate the suitability and especially to find out whether it is likely to have overcome the challenges perceived during the discussions outlined above, the author has collected further feedback in doctoral courses (same format) and submitted and presented a research article at the DESRIST conference (i.e., Cahenzli et al., 2021b). Finally, the class level artefact designed here is used as a foundation for the sub-class level and instance-type level artefact. This tests its applicability and adequacy as a class level artefact. After all, it should be built on generalised knowledge that applies to these lower levels of analysis. The findings of these activities are discussed in Section 9.

### 6.4.1 Matching Requirements with Artefact Functionality

If the artefact cannot satisfy the requirements, then it should be rejected for the specific purpose it was built. As a first assessment of whether the artefact is a reasonable design proposition, the requirements formulated in Section 5.3 are matched with the artefact and its intended functionality based on an exemplary scenario. This is a pragmatic act of demonstration, rather than a more formal evaluation (Peffers et al., 2007), and it refers to an ex-post artificial evaluation strategy for the design product, in which the artefact is enacted against a scenario or a set of scenarios (Pries-Heje et al., 2008). In this

instance, the scenario is the communication of the design research this dissertation is based on, and depending on the requirement, this scenario is specified further. Table 11 contains both the requirements and the functionalities or characteristics of the artefact that should satisfy the respective requirements.

*Table 11: Matching Requirements with Artefact Functionality*

| Requirement | Artefact Functionality or Characteristics |
|---|---|
| **R1:** The artefact must accommodate different application situations along the design research process. | Morphological box: The morphological box that supports researchers in specifying their communication situation accommodates a variety if not all communication situations along the design research process. This is achieved by a selection of dimensions and characteristics that are abstract and common to the variety of communication situations identified in the interview study with design researchers (see: Appendix A, A.3) |
| | Dimension 'Project stage': This dimension accounts for the changing project explicitly. It helps inform early-stage projects as well as finished projects and everything in between. (see: Appendix A, A.3.7, Stage of the Project) |
| | Knowledge containers: Contents are relevant for many situations. Notably, the audience's general needs (e.g., Section 6.2.1.2) apply to various situations. For the dissertation, these include, e.g., the writing of a research proposal, a research article, or this dissertation. Note: Since the "practitioner audience" in this case consists of researchers, they are primarily academia-facing audiences with certain practitioner-facing needs (i.e., applicability to own, situated problems). This is a special case for this research project and should not be problematic in design research projects that solve problems of non-academics (i.e., practitioners in the sense of DSR). |
| | Communication Design Process: The process guides users from the needs of a stakeholder (in any communication situation there are needs) to the specification of a purpose (all communication pursues a purpose), followed by the specification of a storyline (which can be implemented for any communication situation), before aggregating further relevant knowledge about the specificities of a given communication instance. Hence, the constituents of the process depend on the situational characteristics, but it can be used for any communication situation along the design research process. With that, R1 is satisfied. |
| **R2:** The artefact must support the definition of a stakeholder | Knowledge containers: The knowledge containers about the orientation of the audience and the role of the audience provide an initial stack of stakeholder needs. Although these must be extended by more specific needs of the stakeholders of a given |

| | |
|---|---|
| needs-based purpose. | communication situation, this initial stack of needs supports the identification of stakeholder needs. |
| | Communication Design Process: The first two steps of the process are the identification of stakeholder needs and the definition of a purpose of communication—which should be based on a sub-set of the stakeholder needs. This requires the researcher to identify the stakeholder for each communication instance (e.g., this dissertation, a research article etc.). As the process starts with defining a needs-based purpose, R2 is satisfied. |
| **R3:** The artefact must support the selection, organising, and presentation of contents based on the purpose of communication. | Communication Design Process: The third step of the process is the construction of an adequate storyline (see: Table 10). According to the description of this step, a set of milestones is to be devised along with a rationale based on which one milestone after the other can be reached. These two aspects make up a storyline. That storyline needs to be evaluated for its suitability to achieve the purpose of communication. This can be understood as the construction of this dissertation's general structure or the structure based on which the artefacts were presented at the doctoral courses or at the DESRIST conference. |
| | Knowledge containers: The aspect of supporting the presentation of contents is only indirectly covered by the artefact, by the knowledge containers about the mode, means, and format. However, these containers need to be 'filled' first. This includes, for example, to identify the formal requirements for the submission of this dissertation, to attend the technical briefing at a virtual or hybrid conference, or merely to use one's skills in PowerPoint or paper-writing. These aspects have not been mentioned as being particularly problematic and are therefore left for future research. |
| **R4:** The artefact must support the operationalisation of knowledge about specific stakeholder needs. | Communication Design Process: This is covered by the first three steps of the communication design process. For the example of writing a research article, knowledge about academia-facing audiences and evaluators as well as consumers of content need to be considered. The knowledge about the basic needs of these stakeholders provides an initial stack of needs which (extended by, e.g., the outlet's requirements) inform the purpose and thereafter the construction of an adequate storyline. With that, the knowledge about stakeholder needs is integrated into the storyline. Furthermore, additional insights about the stakeholders (and the communication situation) are aggregated and integrated into the process before the explication of the story. In the case of this dissertation, this stakeholder-specific knowledge that needed integration into the final manuscript includes needs of academia-facing audiences, needs from the university, the supervisor and co-supervisor, and the author's personal needs (e.g., quality standards). Therewith, this requirement is fulfilled. |

### 6.4.2 Discursive Evaluation with Fellow Researchers

To evaluate this version of the class level artefact, it was also discussed at two doctoral courses (each course featuring a one-hour long discussion session with a professor and another session with a doctoral student, and two plenary discussions). These courses took place in the spring and the fall semester of 2021. Furthermore, the artefact was also more formally evaluated by anonymous reviewers of a DESRIST paper submission and, after revising it, discussed at the DESRIST paper presentation (Cahenzli et al., 2021b). Lastly, discussions with the authors' dissertation project supervisor and co-supervisor rounded off the discursive evaluation. These efforts focused on the conceptual ideas behind the artefact (rather than the evaluation of its effectiveness in real-world use). Therewith, they can be understood as being demonstration-like (Does it work?), rather than evaluation-like (How well does it work? See: Peffers et al., 2007). However, these exchanges were useful to challenge the artefact's suitability in addressing the research problem.

The evaluation in the narrower sense (i.e., the evidence that it is more efficient and/or effective than existing solutions) is difficult for abstract artefacts. The reason for this is that observable real-world evidence for its usefulness always depends on the contextualisation of the artefact. Hence, it may be difficult to measure the artefact's effectiveness, as observations can be done on derivative evidence only. For this reason, the author focused more on the demonstration (Does it work?) and sought several design researchers to discuss and comment on the artefact. In some sense, this artefact was also evaluated in the construction of the artefacts that are at a lower level of abstraction since it was used as a starting point to create more contextualised guidance. The fact that it was possible to create such guidance indicates that the artefact is indeed working. The effectiveness of this artefact can only be assumed, however, based on expert perceptions.

# 7 Artefact Creation for the Sub-Class Level

The artefact at the class level of analysis is meant to provide utility to design researchers in general for communicating their research projects. However, the interviewed researchers clarified that the most problematic sub-class of communication situations they face are the presentations of their projects in research articles. The relevance of this problem sub-class has been discussed in this dissertation as well. However, a more specific account of the context that makes design researchers strive for publishing their design projects in academic research articles can be found in Tremblay et al. (2018). This article discusses the implications of the quantification of academics' productivity and the difficulty of publishing design research articles are discussed.

The artefact at the class level of analysis (Section 6) applies to a wide range of communication instance (Section 3.1.3). As a consequence of this versatile applicability, using it for specific communication instances, requires some contextualisation. Based on this and the relevance of paper-writing to design researchers, a useful addition to the class level artefact is a more contextualized artefact for writing design research articles. The creation of such an artefact is reported on throughout the following sub-sections, which follow the same structure as above: Staring point, design-specific additional knowledge, artefact design and its evolution, and demonstration and evaluation.

## 7.1 Starting Point

This design and development endeavour builds in large parts upon the class level artefact (Section 6), which in turn is informed by the relevant background knowledge (Section 2), the literature review, and the interview study (Sections 5.1, 5.2, and 6.2). In the creation of an artefact that helps communicate design projects in academic research articles, a special focus lies on the specific insights regarding the publication of design research articles (Section 5.2.2.3) and academia-facing communication (Section 6.2.1.2.1).

The class level artefact presented above is used as a design foundation, based on which a more contextualized artefact can emerge. However, the intention should not be to blindly use the abstract artefact and to add information from the problem environment to the constituents of the class level artefact. Instead, the artefact for the sub-problem class should be adequately informed by the problem environment such that it can accommodate yet undiscovered or unanticipated specificities. The artefact for the problem

class (Figure 29) is therefore only introduced to the design and development after gathering and analysing additional data from the problem environment. This additional knowledge is based on analyses of successfully published design research articles. With that, there are no additional interviews with design researchers about their specific requirements for an artefact that supports them. Instead, the existing artefact is used for the sub-class level after contextualising it as follows:

*Table 12: Situating Class-Level Requirements to Sub-Class-Level Requirements*

| Class-level Requirements | Sub-class-level Requirements |
|---|---|
| **R1:** The artefact must accommodate different application situations along the design research process. | **R1':** The artefact must support researchers in the process of writing a research article about a design research project. |
| **R2:** The artefact must support the definition of a stakeholder needs-based purpose. | **R2':** The artefact must support researchers in identifying a purpose of communication that is compatible with the needs of relevant stakeholders. |
| **R3:** The artefact must support the selection, organizing, and presentation of contents based on the purpose of communication. | **R3':** The artefact must support researchers in constructing appropriate storylines for research papers. |
| **R4:** The artefact must support the operationalization of knowledge about specific stakeholder needs. | **R4':** The artefact must inform researchers in specific ways about how to satisfy the needs of stakeholders of research articles. |

## 7.2 Design-specific Additional Knowledge

The additional knowledge necessary for building an artefact for the problem sub-class of writing academic research articles should stem from the more specific problem environment. After all, such knowledge is more strongly contextualised (i.e., enriched with context specificities). As outlined in the methodology section about the design of an artefact on the sub-class level of analysis (Section 3.3.4), this contextual knowledge is identified with an analysis of well-published design research articles. This section focuses on outlining the core findings of this analysis and does not repeat the insights from the class level or the interview study. However, these co-inform the artefact construction in Section 7.2.4.2.1. The analysis of research articles contains four interrelated studies, as illustrated in Figure 31. These studies' findings are sequentially presented below, whereas further details about the individual studies can be found in the respective appendices. Two of these four studies analyse various aspects of the structure of published design research articles. A qualitative analysis of the structure investigates whether there

are groups of articles that share similar structures regarding their building blocks (selection of contents) and the order in which these building blocks are compiled (storyline). The quantitative structure analysis complements the qualitative structure analysis in the sense of a mixed-methods research design. It also seeks to identify building blocks, but it does by using a different approach. Both of these analyses contribute to a deeper understanding of the structural characteristics of research design articles, and from both studies, insights and primary data emerge that can be used in the fourth study. The fourth study combines these data about the structural characteristics of research articles with evidence about the effects that these articles have on readers. These effects are gathered and analysed in the third study by means of a quantitative survey. In the end, the fourth study should combine the findings from investigating these design research articles into correlative or prescriptive statements (e.g., structural group 1 identified in the first study leads to effect X, whereas structural characteristic identified in the second study is beneficial for the understanding of aspect Y).

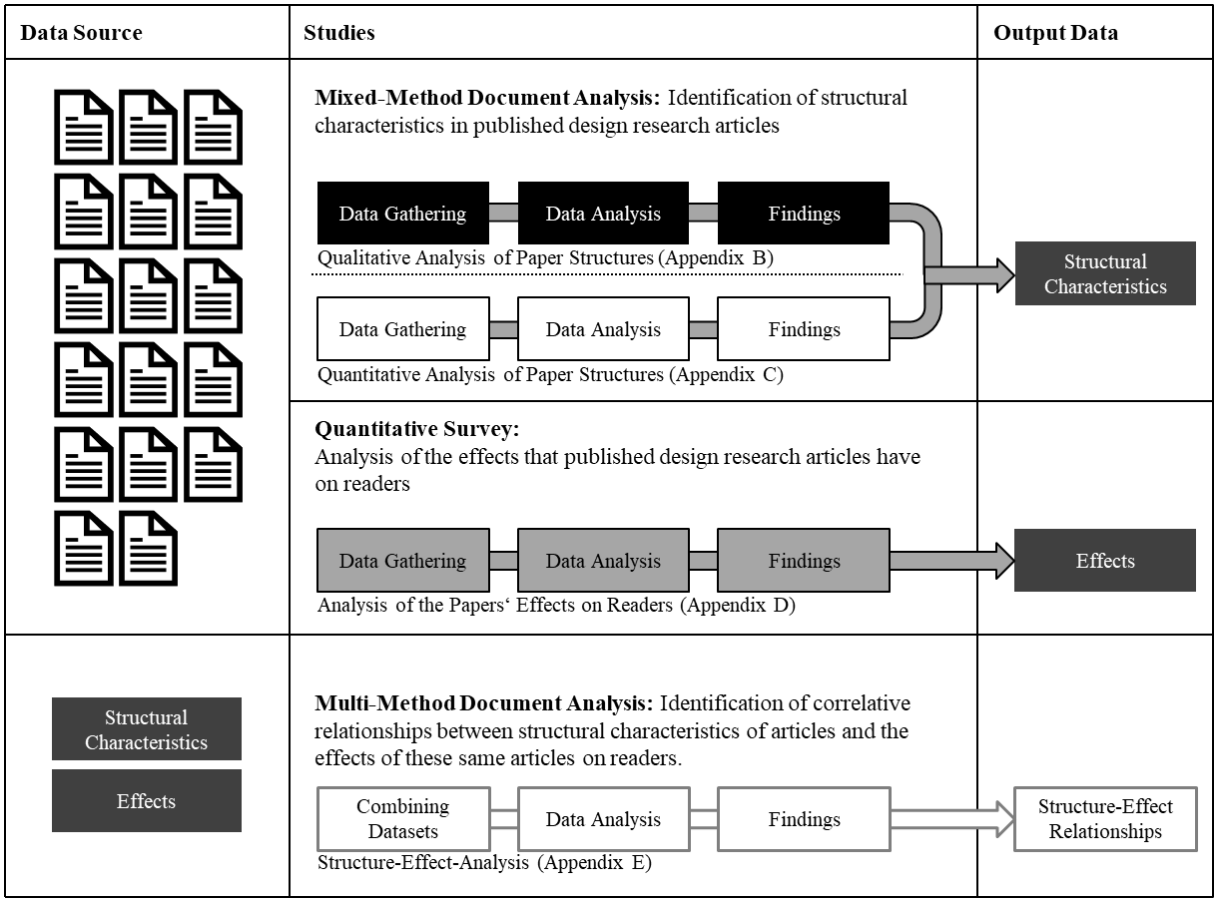


*Figure 31: Overview of the Empirical Studies informing the Sub-Problem Class Artefact*

### 7.2.1 Insights from the Qualitative Analysis of Paper Structures

The qualitative analysis of the structure of 19 IS journal articles revealed six structural groups (Table 13). The qualitative coding allowed for summarising contents such that these groups emerged. These groups differ from each other based on which contents are selected and in which order they are presented. The exact procedures used, further detail about the sample, and the findings are reported in Appendix B. For this design-specific additional knowledge section, only the main insights from this study are presented below.

*Table 13: Overview of the structural groups*

| Nominal Structure | Group 1 (n=2) | Group 2 (n=1) | Group 3 (n=5) | Group 4 (n=5) | Group 5 (n=4) | Group 6 (n=2) |
|---|---|---|---|---|---|---|
| Introduction | Introduction | Introduction | Introduction | Introduction | Introduction | Introduction |
| Background knowledge | Background knowledge | Problem description | Background knowledge | Background knowledge | Background knowledge | Methodology |
| Methodology | Methodology | Background & examples demonstrating the artefact | | Methodology<br>Design process | (high-level) Artefact presentation | Problem description |
| | | | Artefact presentation | Artefact presentation | Design of an instantiation | Artefact presentation |
| Analysis and results | Analysis and results | Evaluation methodology and<br>Analysis and results | Demonstration & evaluation<br>incl. Analysis & results | Demonstration; implementation; Evaluation; or Reflection | Evaluation of instantiation &<br>Analysis and results | Design process that led to the artefact, incl. evaluations |
| Discussion | Discussion | Discussion | Discussion | Discussion | Discussion | Discussion |

#### 7.2.1.1 Characteristics of Structural Group 1

Readers of group 1 articles perceive primarily aspects of the design research project related to traditional explanatory empirical research. These articles are structured according to the nominal structure of empirical research papers (Peffers et al., 2007). Design-related activities (e.g., investigation of the design research problem, elicitation of

requirements, design iterations, artefact demonstration) are omitted or replaced by literature-based arguments. The studies have an explanatory research design (e.g., an experiment that tests hypothesised relationships), and if references to DSR hallmark papers were omitted, these articles would easily be mistaken for non-DSR research.

#### 7.2.1.2 Characteristics of Structural Group 2

There is only one article in group 2. What is special about this group is that the research problem, an investigation of existing solutions, requirements for a better solution, and the evaluation of the artefact are presented, while the design and development of the artefact and the artefact itself are not. With the omission of both the design process and the artefact, but by introducing an analysis of the research problem, requirements, and an evaluation, this group contains some design-related contents, and it is different from the nominal structure of an empirical research article.

#### 7.2.1.3 Characteristics of Structural Group 3

Articles in group 3 present the design knowledge from their respective design research projects, but they omit the design activities. They differ from group 1 as a substantial part of the manuscripts is dedicated to the description of the artefact, and from group 2 because the artefact is presented. As with articles from group 1, the design activities are substituted by literature-derived argumentation. No more than one paragraph is used to explain the methodological aspects of how the artefacts are created.

#### 7.2.1.4 Characteristics of Structural Group 4

As opposed to the manuscripts in group 3, articles in group 4 describe the design process as well. It is part of the methods section. As in the nominal structure of empirical research articles, the first two sections are an introduction and a background knowledge section. However, the fourth section contains the presentation of the artefact(s). This makes group 4 distinct from groups 1 and 2 as well. Articles in this group are clearly design research articles: They feature a DSR reference approach, artefacts, an evaluation of the artefacts, and sometimes explicit iteration loops (e.g., Nguyen, Tuunanen, Gardner, & Sheridan, 2020).

#### 7.2.1.5 Characteristics of Structural Group 5

Group 5 and the subsequently presented group 6 differ from groups 1-3 in that they feature an explication of the design activities (like group 4). They also present the artefact (unlike group 2), which is introduced **before** detailing design procedures (unlike

group 4). These design procedures describe how the artefact was instantiated (group 5) or how the artefact itself was created (group 6).

Hence, one specificity of group 5 articles is that the design activities they contain are about instantiations. Beyond this, they feature a traditional background knowledge section (which group 6 articles do not), and the design activities-related section is followed by a dedicated section on evaluation.

#### 7.2.1.6 Characteristics of Structural Group 6

Manuscripts from this group have this structure: Introduction, research approach, problem description, (literature-derived) presentation of a solution, design iterations that led to the artefact, discussion. The presentation of the artefact before elaborating on the construction process is intended to serve as an "orientation for the description of the iterations in the sections that follow" (Lycett & Radwan, 2019, p. 179). Beyond the commonalities with group 5 (described above), this group has one further characteristic that is noteworthy: There is no dedicated background section after the introduction, nor anywhere in the manuscript. Instead, there is a separate problem description section, which contains some relevant background literature.

#### 7.2.1.7 Summary Insights from the Qualitative Analysis of Paper Structures

The qualitative analysis of paper structures has shown that there is some design freedom in how design researchers structure their articles. Thereby this freedom applies to both the way in which content aspects are selected and ordered. Another finding from this exercise is that design researchers do not generally follow existing guidance on how to structure design research articles, such as Peffers et al. (2007) or Gregor and Hevner (2013). Instead, there are diverse structures with various focuses. For example, while some authors omitted the artefact, others presented it even before explaining the design process. **This indicates that providing just one structure to design researchers might not be appropriate guidance on how to write journal articles**.

### 7.2.2 Insights from the Quantitative Analysis of Paper Structures

The articles used for the qualitative analysis of paper structures were analysed quantitatively by means of a structured coding framework. This framework is split into two sections. The first section tracks content elements (one can think of building blocks of articles), whereas the second one tracks 44 variables across five categories of items. These sections and the findings therefrom are presented sequentially below.

#### 7.2.2.1 Findings from the First Section

The purpose of identifying and keeping track of content elements is to identify the relative importance and the level of detail provided about these elements in research articles. For example: If most articles do not contain one of the elements (e.g., the specification of requirements), then requirement specification may not be part of a binding normative script for writing design research articles. If some do, whereas others do not, one might discern further commonalities between the ones that do and those that do not. If all articles inform about requirements, then this is likely to be a necessary content element. A selection of ten content elements (purposely compiled for this analysis) was tracked. Almost all content could be attributed to one of these ten content elements. This attribution was done by following coding instructions for each of the content element categories (Table 14). Along with attributing a content section to one of these content elements (therewith identifying the selection and order of content elements), the length of each section was noted. This allows for a more differentiated analysis, as the presence or absence of a content element may not provide insights on how much detail is provided about a certain element.

*Table 14: The Ten Content Elements and the Coding Instructions*

| Nr. | Content element categories | Coding instructions |
|---|---|---|
| 1 | Problem description: What, why, who, where? | Does the content describe the research problem or aspects thereof? Does it describe the situation, the stakeholders, the stakeholder interaction, the (denied) goals of these stakeholders, the reasons these goals are not reached, the difference between 'is' and 'to-be'? |
| 2 | Objectives: Goal of the study, RQ | Does the content describe what should be achieved with this design research project? This can be the rationale behind and formulating of a research question, but it can also be a purpose statement |
| 3 | Requirements: Stakeholder's concerns and needs | Does the content describe desired outcomes regarding the solution? Does it, even if implicitly, describe criteria based on which the goodness of an artefact can be assessed? |
| 4 | Knowledgebase: How is the study informed? What exists? | Does the content refer to literature that justifies assumptions for the study? Does it review existing knowledge? |
| 5 | Methodology: Which (generic) approach is used? (e.g., DSR, Peffers et al.) | Does the content indicate a reference approach or a summary of an approach based on existing |

| | | |
|---|---|---|
| | | literature? Does it discuss a general approach to the research project? |
| 6 | Procedures: Description of actions, e.g., data gathering techniques | Does the content discuss specific actions or techniques used in the operationalisation of the methodology? |
| 7 | Iterations and Intermediate learnings | Does the content explicitly discuss intermediary results and whether or why there was an iteration thereafter? |
| 8 | Results: Artefact description, demonstration, evaluation, contributions | Does the content describe final results from the design project, including artefacts and explanations as to how and why they work (demonstration, evaluation, contributions)? |
| 9 | Explication of DK: Formulation of DP, DF, and application of DK | Does the content explicate the design knowledge that emerged or was produced throughout the study? (i.e., explicitly put into words and made recognisable as such) |
| 10 | Discussion: Limitations, avenues of further research | Does the content feature a critical reflection of the methodology or the study in general, or does it outline a research agenda? |

All ten content elements appear to be highly relevant for a design research project. Nevertheless, the analysis revealed that a manuscript addresses on average only 7.5 out of the ten elements. There are, on average, four repetitions of content elements (yielding 11.5 content elements identified per article). Thereby, the frequency and distribution of these repetitions across the ten elements vary (see Table 15). This allows for various insights: On the one hand, some insights on the relative importance of certain content elements can be drawn. For example, a high number of unused ('0x') content elements, such as element number 3 (requirements), indicates that this content element is not required for publication. Similar conclusions can be drawn for content element number 7 (iterations) and number 9 (explication of design knowledge). This confirms one assumption that has co-motivated this dissertation: Some specificities of DSR hardly find their way into published manuscripts. At the same time, a very low number in that '0x'-column indicates that a content element is important (as it is used in most if not all manuscripts). A normative script for design research articles may therefore require the content element number 10 (discussion), and most likely also numbers 1 (problem description), 4 (knowledgebase), 6 (procedures), and 8 (results) to be presented. Notice that 'importance' means that the presence of a content element seems necessary, but it does not allow for inferences about how much information needs to be provided (i.e., how much space in an article is dedicated to them). Hence, with the analysis of the number of times each content element is used, it is entirely possible that the most important content

elements are skimmed over so long as they are present. A different analysis is necessary to identify how much space of an article each element uses.

*Table 15: Repetitions of Content Categories per Manuscript*

| Content Element | Number of times used 0x | 1x | 2x | 3x | 4x | (n) | Weighted |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 10 | 7 | 1 | 0 | 19 | 27 |
| 2 | 5 | 8 | 5 | 0 | 1 | 19 | 22 |
| 3 | 12 | 6 | 0 | 1 | 0 | 19 | 9 |
| 4 | 1 | 9 | 8 | 1 | 0 | 19 | 28 |
| 5 | 4 | 9 | 5 | 0 | 1 | 19 | 23 |
| 6 | 2 | 7 | 7 | 2 | 1 | 19 | 31 |
| 7 | 10 | 6 | 2 | 0 | 1 | 19 | 14 |
| 8 | 2 | 3 | 8 | 6 | 0 | 19 | 37 |
| 9 | 9 | 10 | 0 | 0 | 0 | 19 | 10 |
| 10 | 0 | 18 | 1 | 0 | 0 | 19 | 20 |
| Sum | 46 | 86 | 43 | 11 | 4 | | |

The number of characters used for each identified content element was noted to identify the relative use of space. Thereby, interesting insights might emerge from comparing the relative expected presence of contents of a specific element (measured with a weighted sum of the number of times the element is used) with the actual presence (measured in the relative number of characters used). In such an analysis, large differences are of interest. The most considerable negative difference (i.e., less space used than suggested by the number of times the elements are used) is observed in categories 2 (problem description) and 5 (methodological approach). The largest positive difference (i.e., more space used than suggested) exists in categories 4 (knowledgebase) and 10 (discussion).

Both categories 2 and 5 are somewhat important in the sense that they are featured in a majority of articles. However, the low relative use of space indicates that there is no need to extensively elaborate on them. Both of these categories have a closely related category, which may add relevant details. The problem description of category 2 is extended by the requirements (category 3), and for category 5 it is the operationalization of the research approach in specific procedures (category 6). However, this does not change much for category 2 because category 3 is also exceptionally short (2.6% of the manuscript), and it is of low relative importance (12 articles do not feature category 3 content). With that, one can conclude that content elements 2 and 3 are marginal regarding the space one might dedicate to them in a journal article.

The high coverage of CEs 4 and 10 in terms of the relative difference between suggested space used and actual space used can imply that authors write more about these content elements (longer elements) or that they avoid splitting them (lower number of times used). The latter can be observed for category 10: 18 out of 19 articles have only one appearance of this content element. Hence, while all articles feature the content element discussion, this discussion is presented as one continuous section.

Content element 4 differs from content element 10 in that it not only is more voluminous than suggested by the times it appears in an average manuscript, but in half the manuscripts, it appears more than once. Hence, authors lay a particular emphasis on the description of the knowledge base (category 4), both in relative and in absolute terms.

As illustrated in Table 16, the least amount of absolute space is used for describing the problem (category 2), the requirements (category 3), and the general methodological approach (category 5). Notice, however, that the description of procedures (or the operationalisation of a reference approach) uses up a substantial amount of the average design research article, with 13.6 percent (category 6). This brings the relative space used by methodology-related content to 16.5 percent (i.e., categories 5 and 6). This is a similar relative volume as is used for the discussion section (category 10), and only the knowledgebase (category 4, 21.3 %) and the results (category 8, 21.7%) cover a larger part of the manuscripts.

*Table 16: Relative Use of Categories vs Relative Space Used per Category*

| Category | Suggested by times used | Measured in characters used | Relative difference |
|---|---|---|---|
| 1 | 12.2% | 6.9% | -43% |
| 2 | 10.0% | 1.2% | **-88%** |
| 3 | 4.1% | 2.6% | -35% |
| 4 | 12.7% | 21.3% | **68%** |
| 5 | 10.4% | 2.9% | **-72%** |
| 6 | 14.0% | 13.6% | -3% |
| 7 | 6.3% | 7.0% | 10% |
| 8 | 16.7% | 21.7% | 29% |
| 9 | 4.5% | 6.1% | 34% |
| 10 | 9.0% | 16.7% | **85%** |

The insights from the first section of the quantitative analysis can be summarised as follows: The problem description (category 1), knowledgebase (4), procedures (6), results (8), and discussion (10) are essential for a design research article. Except for the problem description, these content elements are presented with a relatively high level of

detail. At the same time, requirements (category 3, covering 2.9% of an average article), iterations (7, 7.0%), and the explication of design knowledge (9, 6.1%) are only featured in some articles, and they cover mostly small sections of an article.

#### 7.2.2.2 Findings from the Second Section

The second section of the coding framework used to capture the structure of research articles contains 44 structure codes, 41 of which are binary: The value 1 means that the respective characteristic is present in the manuscript, while 0 is used for its absence. Hence, the average coded value per item equates to the percentage of articles in which the respective characteristic is present. In this analysis, the upper, lower, and middle-range are especially interesting: The upper and lower ranges reveal the status quo (e.g., >90% of articles feature a description of the artefact, but only about 10% contain a set of requirements), while the middle-range indicates design options (e.g., about half the articles specify the techniques used for analysing data, and the other half do not). The following table summarizes findings specifically about the items with lowest, highest, and middle ground usage.

*Table 17: Items with the Lowest, Highest, and Middle-Ground Usage*

| Range | Items | Interpretation |
|---|---|---|
| Lowest | 2/19: explicit formulation of the requirements<br>2/19: justification of the technique chosen for analysing data<br>2/19: use of a running example throughout the paper<br>2/19: written to influence readers<br>3/19: the scope of the problem<br>4/19: use of quotes | These characteristics are unlikely to play a central role in getting a manuscript published. Authors may choose to include them, but they are not mandatory content elements. |
| Highest | 19/19: discussion of status quo<br>19/19: objectives of the study<br>18/19: description of the artefact<br>*18/19: contribution to research*<br>*18/19: contribution to practice*<br>*18/19: a research agenda*<br>18/19: use of some illustration(s) | These characteristics are important or even necessary for publishing design research articles.<br><br>Many of these items relate to the discussion section (*cursive*). This indicates that a full discussion including contributions to research and practice, research |

| | | |
|---|---|---|
| | 17:19: specifying which technique was used to gather data<br>*17/19: limitations of the research*<br>17/19: using examples to illustrate important aspects | agenda, and limitations are expected for design research articles. |
| Middle | 11/19: indicating what the stakeholders want to achieve<br>11/19: contextual factors that influence the problem/situation<br>11/19: description of activities that led to the design itself<br>11/19: providing some support to navigate the manuscript<br>11/19: using an example to introduce the problem or stakeholders<br>10/19: justification of the data gathering technique<br>9/19: specification of the techniques used for data analysis<br>9/19: mapping the insights from collected data to designs<br>9/19: usage of the word 'artefact' to refer to the design<br>9/19: specifying the type of artefact that was created<br>8/19: formulated research question | These characteristics feature implied design freedom since about half the articles have them and half do not.<br>This is particularly interesting for the analysis of the effects based on structural design decisions (Structure-Effect-Analysis in Appendix E). |

Appendix C provides an in-depth discussion of all sections of the coding framework. Only a very brief summary of the main findings from the analysis of these characteristics are provided in the following list. The order of the list items maps to the structure of the second section of the quantitative coding framework. An overview of the coded structures can be found in Appendix C (Table 69), and the list of articles, the coding framework and the integrated coding handbook can be found in the supplemental material for the quantitative analysis of paper structures (Appendix I).

- A description of the status quo is a necessary content element for research articles

- Providing information about who the stakeholder is appears to be important (68%). Most articles discuss their challenges (79%). Their goals are less often discussed (58%).
- The specification of the relevance of the research problem (scale and scope) is of low importance for a research article, as only a few explicate it (5 and 3 respectively).
- All articles contain a statement about the research objectives.
- In most articles, literature is provided to support the research design.
- Formulating a research question in a manuscript is optional (8/19 feature one).
- A discussion on requirements is somewhat relevant for design research articles (12/19), but it is often of low detailedness. (e.g., 6/12 discuss how requirements were gathered, 2/12 specify the requirements explicitly).
- Techniques used to gather empirical data are often specified (17/19), whereas the techniques used to analyse such data is specified much less often (9/19), and these techniques are often presented without justification of their suitability (10/19 and 2/19, respectively). An explication of the suitability of the techniques for data analysis is irrelevant for design research publications.
- In many articles, the evaluation is a summative, non-iterating evaluation. Findings are often not reflected in the artefacts presented in the articles (9/19 do).
- Explications on the evaluation are relatively important for design research articles (14/19), while the artefact design procedures are discussed in about half the articles (11/19).
- The discussion section in most articles is complete with the contribution to research (18/19) and practice (18/19), the limitations (17/19) and suggestions for further research (18/19).
- Almost all articles feature some graphical support, mostly illustrating aspects of the artefact or the design process. The only exception to this is Williams, Chatterjee, and Rossi (2008), in which a table was used to help portray central contents.
- A majority of articles is written in active speech (14/19), telling their stories from the authors' perspective. It is not unusual to write 'we' when, e.g., explaining procedures.
- Beyond using titles to provide structure to the articles, many authors omitted further navigation support (e.g., providing an agenda, forward-/backward references). In only eleven articles, the authors explicitly guided the reader through the various sections.

These insights conclude the findings from the two analyses about the structure of the 19 design research articles. They help understand what practices exist. It is possible to infer some limited guidance from them (e.g., since these articles are published, articles that mimic the most common content selection and ordering practices should, from a structure perspective, be acceptable for publishing). However, as per the conceptualisation of communication as input, process, and output, there is still more to be learned. For example, these descriptions of the output of other researchers' communication processes do not directly instruct design researchers about how they should pursue to achieve similar outputs (this is addressed in Section 7.2.4.2.1, where the construction of the artefact is presented). Furthermore, to prescribe something in the sense of a means-end relationship might need to include knowledge about ends that are, need to be, or can be achieved. In the case of writing a research article, one pragmatic end is for the researcher to get their manuscript published. However, other stakeholders may have different ends. This might include understanding the procedures the researcher used or being entertained by the article. To identify such ends that might be achieved; to find out which ends are usually achieved (and therefore likely to be part of the stakeholder needs); and to enable a data-driven matching between possible means (structures of articles) and possible ends (effects on readers) to eventually construct prescriptive guidance for design researchers that wish to publish their work in an academic article, the effects of articles on readers must be investigated.

### 7.2.3 Insights from the Analysis of Effects on Readers

The investigation of effects of articles on readers uses the same 19 articles, as this enables the matching of structures and effects afterwards (Section 7.2.4). A survey was constructed to capture these effects. This survey was built based on the literature review (Section 2 and Section 5.1), and it contains 47 items, all of which are based on a 7-point Likert scale measuring the respondents' agreement with a positively formulated statement (e.g., The narrative is clear to me – it is clear from where to where the narrative goes). The survey features five sections, assessing (1) the perceived overall quality of the article, (2) the clarity of the narrative chosen by the author, (3) the clarity of the research problem description, (4) the clarity of the research design description, and (5) the science impact measures (see Section 5.1 or Burns et al., 2003). The survey is part of the supplemental material provided in Appendix J.

The respondents are doctoral students enrolled in courses on DSR. Taking part in the study was mandatory for the students, and these courses took place in February 2020,

June 2021, and July 2021. Each student was asked to read one of the 19 articles, fill in the standardised survey, and repeat this process with a second article. This has yielded a sample with an average of more than four answers per article (4.3 responses per article, n=82). In the following, a summary of the findings is presented (more details can be found in Appendix D).

#### 7.2.3.1 Descriptive Analysis of the Responses

The average evaluation of these articles indicates that the articles were perceived positively, at 5.26 on a 7-point Likert scale. However, the average score per article and the variance in average scores received per article are not uniform. The average assessment per survey ranges from 4.14 points to 5.77 points, with increasing variance toward the lower-scoring articles. The variances range from 0.02 to 1.69 (see Table 18 and Figure 32). This indicates that some respondents evaluated the lower-scoring articles more critically than others and that there is agreement about the higher-scoring ones.

The scores across the five sections of the survey are:

- Overall quality measures: 5.49
- Clarity of the narrative chosen: 5.47
- Clarity of the research problem: 5.21
- Clarity of the research design: 5.35
- (Usefulness measures: 3.54)*
- Science communication impact measures: 4.98

*(A sub-set of the research design section measures whether the respondents perceive the artefact or the artefact creation process as useful for their own work. These “usefulness measures” are conceptually different and dependent on the specific participants’ situations. Since the responses feature very high variance and disproportionately low scores, they are largely omitted from the dissertation. Further details are in Appendix D).

*Table 18: Average values per manuscript*

| First Author | N | Average value | Variance of averages |
|---|---|---|---|
| Oberländer | 6 | 5.77 | 0.089 |
| Giessmann | 4 | 5.62 | 0.069 |
| Twyman | 4 | 5.57 | 0.312 |
| Yang | 5 | 5.48 | 0.067 |
| Adipat | 4 | 5.44 | 0.020 |
| Avdiji | 4 | 5.4 | 0.393 |
| Dincelli | 4 | 5.3 | 0.336 |
| Nguyen | 4 | 5.23 | 1.185 |
| Ebel | 5 | 5.1 | 0.376 |
| Li | 4 | 5.06 | 0.313 |
| Arazy | 5 | 5.06 | 0.591 |
| Kolkowska | 2 | 4.94 | 0.153 |
| Reinecke | 5 | 4.89 | 0.297 |
| Keith | 5 | 4.88 | 0.343 |
| Goldkuhl | 3 | 4.88 | 1.044 |
| Spagnoletti | 5 | 4.81 | 0.987 |
| Williams | 5 | 4.39 | 1.597 |
| Lycett | 3 | 4.23 | 1.193 |
| Narman | 5 | 4.14 | 1.690 |

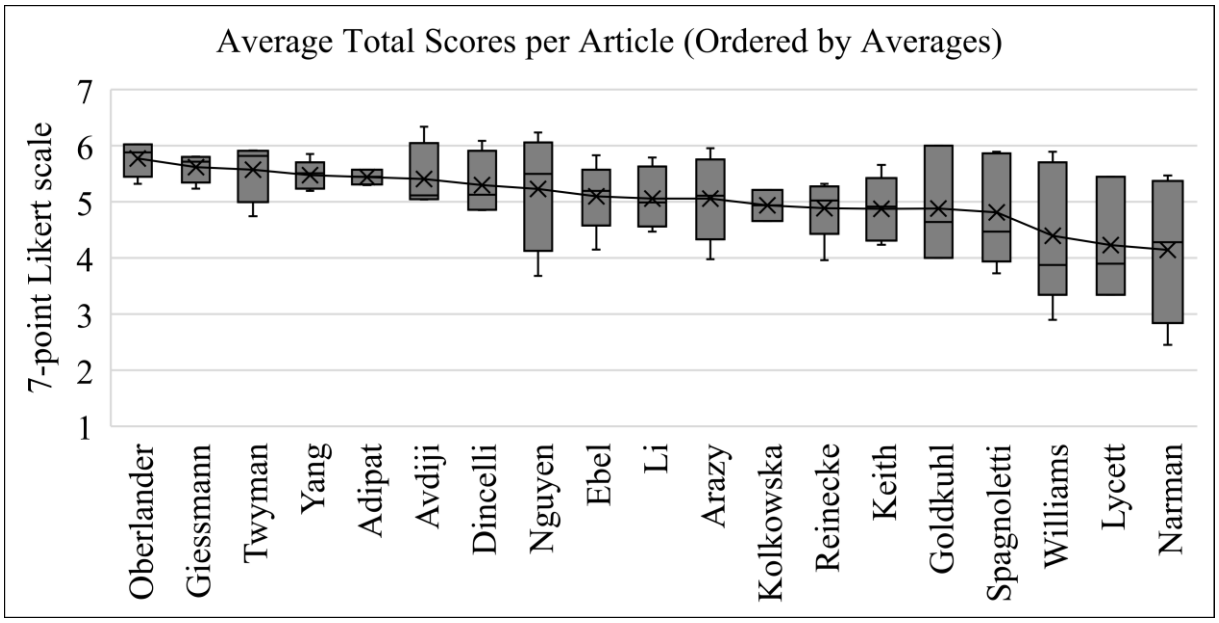


*Figure 32: Spread in Average Answer Values per Article*

Investigating the average values given to the individual survey items (Table 19) reveals that the overall perceived quality of the articles is very high across all items of this section of the survey. Hence, the low scores (primarily) for the usefulness measures (⌀ 3.54), but also the relatively low perceived clarity about the research problem's scope (4.73) and its scale (4.56), the perceived ability to take a related decision (scim_related_decision, 4.54), the perceived entertainment (scim_entertainment, 4.68) and the raised interest—whether one wants to learn more (scim_learn_more, 4.60) or get involved (scim_get_involved, 3.68)—do not prohibit a good overall quality assessment.

Furthermore, the articles seem to have exceptionally clearly specified what the artefact is (rd_whats_artefact: "It is clear to me what the output (artefact) of the study is", 5.87), convincingly presented the relevance of the topic (relevance: "Thematic Relevance: The topic is of societal value/is relevant today", 5.70; and topic_empathise: readers could empathise with the topic, 5.70) and why the research problem is relevant (rp_problem_relevance: "The problem described is relevant", 5.70). However, several items of the research problem, the research design, all usefulness measures, and most communication impact items score relatively poorly compared to these few exceptional ones. Moreover, apart from these exceptionally high ranked items, they also score poorly compared to the overall quality section and the clarity of the narrative section. Hence, the respondents rated the research problem, the research design, the usefulness, and the science communication impact items lower than the clarity of the narrative, and they gave the highest scores to the overall quality. This is interesting because the overall quality should probably reflect the quality of most other items and not merely the clarity of the narrative.

Based on the average scores, one can conclude that design research articles do not need to provide usefulness to design researchers (average usefulness of the artefact to the respondent: 3.99; usefulness of the article for the readers' own theory development: 3.60; usefulness for theory testing: 3.54; likelihood that readers will use the artefact/outcomes for theorising about its usage: 3.16; that they use it to theorize about the building process: 3.14). They also do not need to engage readers (scim_learn_more: 4.60; get_involved: 3.68; scim_related_decision: 4.54). However, the following aspects are and probably should be very clear:

5.87, rd_whats_artefact: "It is clear to me what the output (artefact) of the study is."

5.72, cl_topic_empathise: "The way in which the study is presented allows me to empathise and relate to the topic."

5.70, relevance: "Thematic Relevance: The topic is of societal value/is relevant today."

*Table 19: Average Scores per Item of the Survey*

| | | | | | |
|---|---|---|---|---|---|
| Overall Quality | content_quality | 5.44 | Research Design | rd_rd_decisions | 5.13 |
| | contribution_significance | 5.44 | | rd_whats_artefact | 5.87 |
| | contribution_originality | 5.50 | | rd_artefact_is_useful* | 3.99 |
| | relevance | 5.70 | | (…) for_theory_development* | 3.60 |
| | presentation | 5.40 | | (…) theory_testing* | 3.54 |
| | overall_impression | 5.45 | | (…) theorize_usage* | 3.16 |
| Clarity of Narrative | cl_plotline | 5.51 | | (…) theorize_building_process* | 3.41 |
| | cl_stakeh_empathise | 5.33 | | rd_design_process | 5.15 |
| | cl_researchers_empathise | 5.40 | | rd_evaluation | 5.35 |
| | cl_design_decisions | 5.22 | | rd_contribution_clarity | 5.54 |
| | cl_topic_empathise | 5.72 | | rd_limitations | 5.28 |
| | cl_examples_relatable | 5.54 | Science Communication Impact | scim_issue_familiarity | 5.32 |
| | cl_examples_helpful | 5.55 | | scim_research_problem | 5.27 |
| Research Problem | rp_problem_essence | 5.54 | | scim_enjoyment | 5.17 |
| | rp_situation | 5.50 | | scim_entertainment | 4.68 |
| | rp_stakeholder | 5.28 | | scim_learn_more | 4.60 |
| | rp_stakeh_goals | 5.21 | | scim_get_involved | 3.68 |
| | rp_problem_scope | 4.73 | | scim_related_decision | 4.54 |
| | rp_problem_scale | 4.56 | | scim_understand_procedures | 5.26 |
| | rp_problem_relevance | 5.70 | | scim_procedure_clear_why | 5.06 |
| | rp_problem_persistence | 5.15 | | scim_explain_outcome_to_others | 5.17 |
| | rd_replicability | 4.94 | | scim_implications_practice | 5.54 |
| | rd_objective | 5.48 | | scim_implications_science | 5.44 |
| | rd_general_approach | 5.43 | | *usefulness measures | |

#### 7.2.3.2 First Step of the Cross-correlation Analysis

The cross-correlations were analysed in two steps. First, the correlations that include variables from two different sections of the questionnaire were analysed before investigating correlations within sections (see Section 7.2.3.3). The section-spanning analysis of the resulting correlation data reveals the following: The presentation ("The content is presented well – easy to understand and follow the train of thought, good use of illustration/tables where it makes sense, etc.") and the overall impression of the article ("From a reviewer's perspective, how strongly would you evaluate this document and

therefore suggest for it to be published?") strongly correlate with all other items (Pearson's correlation coefficients of r=0.51 and r=0.48 respectively). That the overall impression correlates positively with all other items might be expected, as these are formulated positively (higher values = better). However, it is interesting that a good presentation of contents is correlated more strongly with all other variables than the perceived overall impression. Only one other item correlates on average more strongly with all other items: The perceived enjoyment while reading the manuscript (r=0.54). Since these are only correlations, it remains unclear whether the enjoyment leads to higher evaluations of other items or of high evaluation of other items leads to higher enjoyment.

Another interesting finding is that the originality of the contribution and the perceived relevance of the problem seem to be largely independent of the other variables (featuring the lowest average correlation at r=0.23 and r=0.24, respectively). This implies, for example, that readers can perceive both the contribution and the relevance of the problem as low while still thinking that the overall article is of high quality (and vice versa).

Furthermore, the clarity of the plotline correlates highly with the readers' ability to empathise with the stakeholder (r=0.77). These two variables vary only across research problem items (empathy with stakeholders correlates more strongly than clarity of plotline with r=0.56 and r=0.49 respectively) and across research design items (empathy with stakeholders correlates less strongly than clarity of plotline, with r=0.24 and r=0.45 respectively). This could indicate that a clearer plotline improves the readers' ability to empathise with stakeholders and that more clarity about the research problem increases the reader's ability to empathise with the stakeholder.

Additionally, the understanding of why which artefact design decisions were taken correlates strongly with the understanding of why which research design decisions (r=0.74), with the clarity about the design process (0.7), and with the selection of research procedures used (0.67). Based on this, one may conclude that manuscripts that excel in explaining one aspect of procedures or design decisions well also explain other design decisions well.

#### 7.2.3.3 Second Step of the Cross-correlation Analysis

In the second step of the cross-correlation analysis, the individual sections of the survey were investigated. The following list is a quick reminder of the content focus of these five sections, along with the average correlation coefficient between the items in each of these sections. The subsequent summary of more specific findings is ordered in the same way as the list—according to the order in the survey.

- r=0.49 Clarity of the Narrative Measures
- r=0.54 Overall Quality Measures
- r=0.60 Research Problem Measures
- r=0.45 Research Design Measures
- r=0.55 Science Communication Impact Measures

The perception of how well the content is presented highly correlates with the overall perceived quality of the manuscript (r=0.7). Furthermore, the perceived overall quality of a manuscript is less strongly related to the quality of its contents than to the way in which these are presented (r=0.63). A high-quality research paper, therefore, does not only need high-quality content but, crucially, it needs to be presented well. The presentation also correlates somewhat with the perceived significance of the contribution (r=0.52) and the quality of the content (r=0.59). Thereby, how the contents are communicated strongly influences the perceived quality of contents, significance of contributions and the overall impression one has of the manuscript. This underlines the importance of good communication of design research projects for publication success.

*Table 20: Correlation among Overall Quality Measures*

| | content_quality | contribution_significance | contribution_originality | relevance | presentation | overall_impression |
|---|---|---|---|---|---|---|
| content_quality | 1.00 | 0.64 | 0.37 | 0.10 | 0.59 | 0.63 |
| contribution_significance | 0.64 | 1.00 | 0.48 | 0.28 | 0.52 | 0.67 |
| contribution_originality | 0.37 | 0.48 | 1.00 | 0.29 | 0.33 | 0.46 |
| relevance | 0.10 | 0.28 | 0.29 | 1.00 | 0.35 | 0.38 |
| presentation | 0.59 | 0.52 | 0.33 | 0.35 | 1.00 | 0.70 |
| overall_impression | 0.63 | 0.67 | 0.46 | 0.38 | 0.70 | 1.00 |

Findings about the narrative in the articles include that the relatability and the helpfulness of examples highly correlate (r=0.83), indicating that the more relatable an example is for the readers, the more likely it is to be helpful to understand related contents and vice-versa. Hence, a good example should be both relatable and helpful. Another notable

correlation is that the clarity of why which artefact design decisions were taken somewhat correlated with the perceived relatability to the researchers ("I understand and can empathise with the researchers that had to take the design decisions in this study.") and the clarity of the plotline (with r=0.54 and r=0.61 respectively). This may imply that a more relatable way of presenting the research (i.e., increasing the relatability with the authors) may be characterised by choosing a clear plotline and by explaining why which design decisions were taken.

*Table 21: Correlation among Clarity Measures*

| | cl_plotline | cl_stakeh_emp | cl_researchers_emp | cl_design_decisions | cl_topic_emp | cl_examples_relatable | cl_examples_helpful |
|---|---|---|---|---|---|---|---|
| cl_plotline | 1.00 | 0.47 | 0.50 | 0.61 | 0.51 | 0.28 | 0.35 |
| cl_stakeh_emp | 0.47 | 1.00 | 0.23 | 0.38 | 0.42 | 0.04 | 0.03 |
| cl_researchers_emp | 0.50 | 0.23 | 1.00 | 0.54 | 0.32 | 0.35 | 0.42 |
| cl_design_decisions | 0.61 | 0.38 | 0.54 | 1.00 | 0.49 | 0.36 | 0.39 |
| cl_topic_emp | 0.51 | 0.42 | 0.32 | 0.49 | 1.00 | 0.43 | 0.43 |
| cl_examples_relatable | 0.28 | 0.04 | 0.35 | 0.36 | 0.43 | 1.00 | 0.83 |
| cl_examples_helpful | 0.35 | 0.03 | 0.42 | 0.39 | 0.43 | 0.83 | 1.00 |

The correlation coefficients between items of the research problem-related section of the survey are, on average, the highest of all survey sections (see list above). This implies that if one research problem measure is highly rated, the chances are high that the entirety of the research problem measures is also good. Hence, articles tend to perform similarly well (or poorly) across research problem-related effects. Furthermore, the items scale and scope are remarkably highly correlated (r=0.75), while their correlation coefficient with the perceived relevance is lower (r=0.57 and r=0.50). This indicates that, while scale and scope are effective in illustrating the relevance of a research problem, there are other means to do so as well. Furthermore, the high correlation between knowing who the stakeholder is and knowing about their goals (r=0.72) indicates that articles that clarify who the primary stakeholder is, also discuss their goals and manuscripts in which stakeholders are barely mentioned do not clarify their goals either.

Considering that manuscripts that articles in which the stakeholders' goals are clear also score higher in the problem scale (r=0.56) but especially in the problem scope item (r=0.67), one may conclude that a discussion of the stakeholders and their goals helps readers understand the problem. Lastly, the relatively high correlation between the understanding of the situation in which the problem occurs and the essence of the problem (r=0.68) implies that a discussion of the research problem that aims a good understanding of the essence of that problem should also describe the context in which it occurs; and that readers with a good understanding of that context tend to understand the essence of the problem.

*Table 22: Correlation among Research Problem Measures*

| | rp_problem_essence | rp_situation | rp_stakeholder | rp_stakeh_goals | rp_problem_scope | rp_problem_scale | rp_problem_relevance | rp_problem_persistence |
|---|---|---|---|---|---|---|---|---|
| rp_problem_essence | 1.00 | 0.68 | 0.60 | 0.47 | 0.50 | 0.55 | 0.39 | 0.42 |
| rp_situation | 0.68 | 1.00 | 0.58 | 0.47 | 0.44 | 0.52 | 0.33 | 0.49 |
| rp_stakeholder | 0.60 | 0.58 | 1.00 | 0.72 | 0.57 | 0.57 | 0.45 | 0.50 |
| rp_stakeh_goals | 0.47 | 0.47 | 0.72 | 1.00 | 0.67 | 0.56 | 0.45 | 0.54 |
| rp_problem_scope | 0.50 | 0.44 | 0.57 | 0.67 | 1.00 | 0.75 | 0.50 | 0.59 |
| rp_problem_scale | 0.55 | 0.52 | 0.57 | 0.56 | 0.75 | 1.00 | 0.57 | 0.62 |
| rp_problem_relevance | 0.39 | 0.33 | 0.45 | 0.45 | 0.50 | 0.57 | 1.00 | 0.63 |
| rp_problem_persistence | 0.42 | 0.49 | 0.50 | 0.54 | 0.59 | 0.62 | 0.63 | 1.00 |

Among the research design items, some of the noticeable correlations are between the research design-related design decisions (rd_rd_decisions) and three other items: the clarity about the artefact design process (rd_design_process, r=0.74), the general research approach (rd_general_approach, r=0.65), and the replicability (rd_replicability, r=0.62). Hence, articles that are articulate about the design decisions taken to design their study (i.e., research design) also clarify the procedures used for building the artefact (i.e., artefact design) and relate their decisions to a reference approach (i.e., general research approach). Therewith, such articles should be perceived as being replicable. That replicability is furthermore correlated with the general research approach (r=0.73).

Interestingly though, the correlation between the understanding of the artefact design procedures and the perceived replicability of the study is not very high (r=0.55). Hence, merely ensuring that the readers understand the artefact design procedures is possibly not enough to help them perceive the study as being replicable.

*Table 23: Correlation among Research Design Measures*

| | rd_replicability | rd_objective | rd_general_approach | rd_rd_decisions | rd_whats_artefact | rd_design_process | rd_evaluation | rd_contribution_clarity | rd_limitations |
|---|---|---|---|---|---|---|---|---|---|
| rd_replicability | 1.00 | 0.64 | 0.73 | 0.62 | 0.37 | 0.55 | 0.43 | 0.39 | 0.39 |
| rd_objective | 0.64 | 1.00 | 0.58 | 0.42 | 0.39 | 0.33 | 0.29 | 0.55 | 0.56 |
| rd_general_approach | 0.73 | 0.58 | 1.00 | 0.65 | 0.40 | 0.59 | 0.35 | 0.41 | 0.37 |
| rd_rd_decisions | 0.62 | 0.42 | 0.65 | 1.00 | 0.48 | 0.74 | 0.41 | 0.49 | 0.33 |
| rd_whats_artefact | 0.37 | 0.39 | 0.40 | 0.48 | 1.00 | 0.49 | 0.56 | 0.45 | 0.26 |
| rd_design_process | 0.55 | 0.33 | 0.59 | 0.74 | 0.49 | 1.00 | 0.44 | 0.44 | 0.27 |
| rd_evaluation | 0.43 | 0.29 | 0.35 | 0.41 | 0.56 | 0.44 | 1.00 | 0.32 | 0.24 |
| rd_contribution_clarity | 0.39 | 0.55 | 0.41 | 0.49 | 0.45 | 0.44 | 0.32 | 1.00 | 0.50 |
| rd_limitations | 0.39 | 0.56 | 0.37 | 0.33 | 0.26 | 0.27 | 0.24 | 0.50 | 1.00 |

Among the science communication impact measures, which are inspired by the respective section in the research background (Section 2.2), the strongest correlations are between the enjoyment of reading the text and the feeling of being entertained by the text (r=0.82) as well as all other items (⌀ r=0.65). The high correlation between feeling entertained and enjoying reading the text might be an important discovery since the enjoyment correlates relatively strongly with all other measurement items. While authors might not be able to directly trigger enjoyment, they may well write their articles in a more entertaining fashion. If that, in turn, increases enjoyment, and enjoyment leads to generally more favourable evaluations, then writing more entertaining articles is a winning strategy. This idea may need further testing, though, as the underlying data is only based on correlations. A further discovery among the science impact measures is that the item measuring whether the respondents felt compelled to get involved has a relatively high correlation only with the question of whether one is interested to learn more

about the study. It does not correlate strongly with any other variable, neither in this section nor any other section. This indicates that whether readers want to get involved depends largely on other variables beyond the characteristics of the manuscript. A research article may therefore not be a suitable vehicle to achieve audience engagement. Lastly, the perceived ability to explain the research problem to others (research_problem) correlates strongly with the perceived familiarity with the issue (issue_familiarity, r=0.72, probably unsurprising), the confidence in being able to take related outcomes (related_decisions, r=0.68), the perceived ability to explain the outcomes of the study to others (explain_outcome_to_others, r=0.68), and the understanding of which procedures were used (understand_procedures, r=0.67). One may thus argue that the confidence in being able to present the research problem convincingly is higher if the outcome and the procedures related to the problem are clearer. In turn, one may conclude that readers that understand the research problem better may be able to better understand why which design decisions are taken, what the artefact is, and how it works. Because these numbers are correlations, further studies would be necessary to identify a directionality in the sense of cause-effect relationships. It is likely, however, that a better understanding of the research problem leads to better scores in these other outcome variables.

### 7.2.4 Insights from the Structure-Effect Analysis

The structure-effect-analysis combines the datasets from the analysis of the effects of the 19 design research articles (Section 7.2.3, Appendix E) with each of the datasets from the analysis of the structures of these manuscripts (Section 7.2.1, Appendix B and Section 7.2.2, Appendix C, respectively). Therewith, the structural groups (finding from the qualitative structure analysis), the data about the ten content elements and the individual characteristics of the articles (findings from the quantitative structure analysis) are used sequentially to split the effects dataset and to analyse these slices for significant differences.

#### 7.2.4.1 Group-Effect-Analysis

First, the effects dataset is matched with the six structural groups. Therefrom, the following average scores per item and per group emerge (Table 25). The summary of the findings from this combined dataset is outlined below by first addressing the groups' overall average scores (Section 7.2.4.1.1 Analysis across Sections of the Survey) and thereafter by addressing the individual sections of the questionnaire. These sections are illustrated with vertical splits in Table 25.

*Table 24: Correlation among Science Impact Measures*

| | issue_familiarity | research_problem | enjoyment | entertainment | learn_more | get_involved | related_decision | understand_procedures | procedure_clear_why | explain_outcome_to_others | implications_practice | implications_science |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| issue_familiarity | 1.00 | 0.72 | 0.49 | 0.40 | 0.46 | 0.24 | 0.62 | 0.54 | 0.38 | 0.50 | 0.52 | 0.46 |
| research_problem | 0.72 | 1.00 | 0.59 | 0.51 | 0.41 | 0.30 | 0.68 | 0.67 | 0.48 | 0.68 | 0.60 | 0.49 |
| enjoyment | 0.49 | 0.59 | 1.00 | 0.82 | 0.63 | 0.48 | 0.65 | 0.63 | 0.59 | 0.64 | 0.60 | 0.63 |
| entertainment | 0.40 | 0.51 | 0.82 | 1.00 | 0.56 | 0.45 | 0.51 | 0.49 | 0.52 | 0.52 | 0.47 | 0.45 |
| learn_more | 0.46 | 0.41 | 0.63 | 0.56 | 1.00 | 0.62 | 0.54 | 0.39 | 0.30 | 0.39 | 0.22 | 0.33 |
| get_involved | 0.24 | 0.30 | 0.48 | 0.45 | 0.62 | 1.00 | 0.52 | 0.26 | 0.38 | 0.35 | 0.17 | 0.27 |
| related_decision | 0.62 | 0.68 | 0.65 | 0.51 | 0.54 | 0.52 | 1.00 | 0.60 | 0.45 | 0.64 | 0.56 | 0.55 |
| understand_procedures | 0.54 | 0.67 | 0.63 | 0.49 | 0.39 | 0.26 | 0.60 | 1.00 | 0.73 | 0.61 | 0.56 | 0.48 |
| procedure_clear_why | 0.38 | 0.48 | 0.59 | 0.52 | 0.30 | 0.38 | 0.45 | 0.73 | 1.00 | 0.50 | 0.47 | 0.43 |
| explain_outcome_to_others | 0.50 | 0.68 | 0.64 | 0.52 | 0.39 | 0.35 | 0.64 | 0.61 | 0.50 | 1.00 | 0.61 | 0.54 |
| implications_practice | 0.52 | 0.60 | 0.60 | 0.47 | 0.22 | 0.17 | 0.56 | 0.56 | 0.47 | 0.61 | 1.00 | 0.68 |
| implications_science | 0.46 | 0.49 | 0.63 | 0.45 | 0.33 | 0.27 | 0.55 | 0.48 | 0.43 | 0.54 | 0.68 | 1.00 |

*Table 25: Group-Effect-Analysis: Group vs Average Effect*

| Number of papers : coders (n) | | 2:8 | 1:5 | 5:23 | 5:21 | 4:21 | 2:8 | |
|---|---|---|---|---|---|---|---|---|
| **Items** | **Group:** | **1** | **2** | **3** | **4** | **5** | **6** | **Avg.** |
| avg. contribution_originality | Overall Quality | 5.75 | 5.20 | 5.43 | 5.38 | 5.88 | 5.13 | 5.50 |
| avg. relevance | | 5.88 | 5.20 | 5.30 | 6.05 | 6.35 | 4.63 | 5.70 |
| avg. content_quality | | 5.63 | 5.20 | 5.35 | 5.67 | 5.29 | 5.38 | 5.44 |
| avg. contribution_significance | | 5.75 | 5.20 | 5.39 | 5.52 | 5.47 | 5.13 | 5.44 |
| avg. presentation | | 6.00 | 4.60 | 5.13 | 5.90 | 5.35 | 4.88 | 5.40 |
| avg. overall_impression | | 6.00 | 4.80 | 5.39 | 5.48 | 5.65 | 5.00 | 5.45 |
| avg. clarity_plotline | Clarity of Narr. | 6.13 | 4.60 | 5.17 | 5.86 | 5.76 | 5.00 | 5.51 |
| avg. empathize_w_researcher | | 5.88 | 4.40 | 5.43 | 5.29 | 5.65 | 5.25 | 5.40 |
| avg. clarity_design_decisions | | 5.88 | 4.40 | 4.78 | 5.57 | 5.29 | 5.25 | 5.22 |
| avg. topic_relatability | | 6.25 | 5.40 | 5.35 | 6.10 | 5.88 | 5.13 | 5.72 |
| avg. examples_relatability | | 5.88 | 4.60 | 5.13 | 6.05 | 5.88 | 4.88 | 5.54 |
| avg. examples_helpfulness | | 6.00 | 4.40 | 5.13 | 6.14 | 5.88 | 4.75 | 5.55 |

(continued on the next page)

| Number of papers : coders (n) | | 2:8 | 1:5 | 5:23 | 5:21 | 4:21 | 2:8 | |
|---|---|---|---|---|---|---|---|---|
| **Items** | **Group:** | **1** | **2** | **3** | **4** | **5** | **6** | **Avg.** |
| avg. empathize_w_stakeholder | Clarity Research Problem | 6.00 | 5.00 | 5.04 | 5.24 | 5.82 | 4.88 | 5.33 |
| avg. problem_essence | | 5.75 | 5.20 | 5.30 | 5.76 | 5.76 | 5.13 | 5.54 |
| avg. problem_situation | | 5.88 | 5.40 | 5.13 | 5.67 | 5.65 | 5.50 | 5.50 |
| avg. problem_stakeholder | | 5.63 | 5.40 | 4.78 | 5.38 | 5.65 | 5.25 | 5.28 |
| avg. clarity_stakeholder_goals | | 5.88 | 5.20 | 4.74 | 5.19 | 5.53 | 5.25 | 5.21 |
| avg. problem_scope | | 5.25 | 5.00 | 4.26 | 5.10 | 4.88 | 4.13 | 4.73 |
| avg. problem_scale | | 4.88 | 6.00 | 3.96 | 4.76 | 4.88 | 3.88 | 4.56 |
| avg. problem_relevance | | 5.75 | 6.00 | 5.35 | 5.86 | 6.12 | 5.13 | 5.70 |
| avg. problem_persistence | | 5.25 | 5.40 | 4.74 | 5.57 | 5.35 | 4.50 | 5.15 |
| avg. replicability | Clarity of the Research Design | 5.63 | 4.80 | 4.48 | 5.48 | 5.00 | 4.13 | 4.94 |
| avg. research_objective | | 6.25 | 5.60 | 5.26 | 5.57 | 5.53 | 4.88 | 5.48 |
| avg. general_approach | | 6.25 | 4.40 | 5.00 | 5.95 | 5.41 | 5.13 | 5.43 |
| avg. research_design_decisions | | 5.63 | 4.00 | 4.96 | 5.62 | 5.00 | 4.88 | 5.13 |
| avg. what_is_the_artefact | | 5.38 | 6.00 | 6.00 | 6.24 | 5.41 | 5.88 | 5.87 |
| avg. usefulness_of_artefact* | | 3.75 | 4.00 | 3.83 | 4.10 | 4.06 | 4.25 | 3.99 |
| (…) theory_development* | | 3.25 | 3.00 | 3.57 | 3.76 | 3.35 | 4.50 | 3.60 |
| (…) theory_testing* | | 2.63 | 2.60 | 3.61 | 3.76 | 3.47 | 4.38 | 3.54 |
| (…) theorize_usage* | | 3.13 | 3.00 | 2.91 | 3.43 | 3.06 | 3.50 | 3.16 |
| (…) theorize_building_process* | | 3.00 | 2.60 | 3.39 | 3.81 | 3.41 | 3.38 | 3.41 |
| avg. design_process | | 5.25 | 5.00 | 4.78 | 5.57 | 4.94 | 5.50 | 5.15 |
| avg. evaluation | | 4.50 | 6.00 | 5.17 | 5.81 | 5.24 | 5.38 | 5.35 |
| avg. contribution_clarity | | 5.88 | 5.80 | 5.43 | 5.43 | 5.47 | 5.75 | 5.54 |
| avg. limitations | | 5.75 | 5.60 | 4.96 | 5.71 | 5.29 | 4.38 | 5.28 |
| avg. familiarity_with_issue | Science Communication Impact | 5.88 | 5.40 | 4.96 | 5.62 | 5.47 | 4.63 | 5.32 |
| avg. can_present_problem_to_others | | 6.25 | 6.00 | 4.91 | 5.48 | 5.12 | 4.63 | 5.27 |
| avg. enjoyed_reading | | 5.88 | 5.00 | 4.39 | 5.62 | 5.65 | 4.63 | 5.17 |
| avg. entertained_by_text | | 5.63 | 4.40 | 3.96 | 5.24 | 5.06 | 3.75 | 4.68 |
| avg. want_to_learn_more | | 4.50 | 5.00 | 4.35 | 4.95 | 4.53 | 4.38 | 4.60 |
| avg. want_to_get_involved | | 4.25 | 4.20 | 3.52 | 3.90 | 3.59 | 2.88 | 3.68 |
| avg. can_take_related_decision | | 5.75 | 5.00 | 4.04 | 4.67 | 4.65 | 3.88 | 4.54 |
| avg. understand_procedures | | 5.75 | 4.80 | 4.96 | 5.52 | 5.24 | 5.25 | 5.26 |
| avg. clear_why_which_procedures | | 5.63 | 4.20 | 4.74 | 5.48 | 5.00 | 5.00 | 5.06 |
| avg. can_explain_outcome_to_others | | 5.63 | 5.80 | 4.74 | 5.67 | 5.00 | 4.63 | 5.17 |
| avg. implications_practice | | 6.13 | 5.20 | 5.30 | 5.81 | 5.41 | 5.38 | 5.54 |
| avg. implications_research | | 6.13 | 5.20 | 5.17 | 5.62 | 5.35 | 5.38 | 5.44 |
| (mean score per group) | | 5.43 | 4.88 | 4.78 | 5.35 | 5.16 | 4.77 | 5.07 |

*usefulness measures

#### 7.2.4.1.1 Analysis across Sections of the Survey

The average score across structural groups and sections of the survey is 5.07 on a 7-point Likert scale. This is above the 'neutral' evaluation (which would be 4.0) and, thus, positive. This is also true for each of the groups, with groups 6 and 3 scoring lowest with 4.77 and 4.78, followed by group 2 at 4.88. The highest scores are achieved by groups 1 (5.43) and 4 (5.35), and the average for group 5 is above-average (5.16).

These scores indicate that the structural group with the best effects on readers is group 1. This group's effects only perform poorly in the "usefulness measures" (see: Section 7.2.3.1) and the artefact-related items 'what is the artefact?' (lowest score across groups) and how the artefact is evaluated (lowest score across groups). The relatively poor performance across these items is unsurprising, as the group follows the nominal structure of empirical research articles—the standard structure used to present behavioural science articles. This structure is highly established, and it may be assumed that it has evolved toward producing positive impacts across effects measures. However, since group 1 focusses on evaluation (empirical study) and since the artefact or design-related contents are omitted, these articles perform poorly on artefact-related items. If those directly artefact-related items were omitted (e.g., if they did not play a role for a specific manuscript), the average score would be an excellent 5.75 on a 7-point Likert scale. One can conclude the following: **For an article in which neither the artefact nor its design process is focal, the structure of group 1 should be chosen**.

The second-highest scoring structural group (i.e., group 4) received above-average scores across almost all items, with two notable exceptions: The clarity of what the contribution is (contribution_clarity: 5.43, lowest score across groups) and the perceived originality of the contribution (contribution_originality: 5.38, much weaker than group 1 and 5 with 5.75 and 5.88, respectively). With that, **authors who wish to use the structure group 4 might need to pay special attention to clarifying the contribution and its originality**. Group 4 does not have any relative weak spots, neither across entire sections nor on an individual item level (see Table 25, where the shading from deep red to white to deep green indicate the relative performance on each item across groups). With that, **the structure of group 4 articles is a consistently effective structure for design research articles**. When considering the limitations of group 1 articles (above), then one can also say that **the structure of group 4 articles is more suitable than the structure of group 1 for presenting a research project in which the focus is on the artefact and its creation**. This can be seen in artefact-related variables such as: Average

usefulness measure (+0.62), clarity about what the artefact is (+0.86), clarity about the design process (+0.32), clarity about how the artefact is evaluated (+1.31).

Further insights across the average scores are that **the structure of group 3 is inferior and should be avoided** in favour of group 1 (focus on non-artefact-related aspects) or group 4 (focus on design-related aspects). The structure of **group 6 is only suitable for communicating design research projects if the focus is on the perceived usefulness of the study to other design researchers' research activities**. In all other cases, the structure of group 6 should be avoided.

To test whether the group is a statistically significant predictor for the overall average scores given to an article, a single factor ANOVA is used. It reveals that the group association is not significant if the usefulness measures are included, but it is significant if these variables are omitted (see Table 16). This indicates that the scores across core quality criteria (excluding the individually perceived usefulness of the article for the respondent's own work) are significantly correlated with the association with a group. Based on this, it can be concluded that **the structural groups are significant predictors of the overall perceived quality of the effects on readers**.

*Table 26: Single Factor ANOVA on the Overall Effect of the Structural Group*

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| Avg_Response overall | Between | 5.588 | 5 | 1.118 | 1.768 | .130 |
| | Within | 48.038 | 76 | .632 | | |
| | Total | 53.626 | 81 | | | |
| Avg_Response without usefulness | Between | 7.063 | 5 | 1.413 | 2.415 | **.044** |
| | Within | 44.461 | 76 | .585 | | |
| | Total | 51.524 | 81 | | | |

The summaries of the analysis of the responses within each section of the survey are presented below. Before diving into details about the five sections, a single factor ANOVA of groups on the average values per section is presented (Table 27). It reveals that the group association is a highly significant predictor for the average clarity of the narrative. Given that the questions in the survey are all formulated positively (higher score = more desirable effect), this finding yields the conclusion that **the best clarity of narrative can be obtained with the structural group 1**, **followed by groups 4 and 5**. Furthermore, the significance of groups with the science communication impact measures is just slightly outside of the α=0.05 level. This indicates that **group 1 is most suitable for high scores on science communication impact**. However, if the **focus is**

**on the artefact and design-related aspects, then group 4 is the best structure to achieve high science communication impact variables**. While Appendix E provides further details and lengthier discussions about the analyses conducted on the items within each section, only a summary of the significant variables is presented below.

*Table 27: Single Factor ANOVA, Groups on Average Values per Section of the Survey*

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| Avg_Overall Assessment | Between | 5.497 | 5 | 1.099 | 1.864 | .111 |
| | Within | 44.824 | 76 | .590 | | |
| | Total | 50.321 | 81 | | | |
| Avg_Clarity of narrative | Between | 13.181 | 5 | 2.636 | 3.924 | **.003** |
| | Within | 51.061 | 76 | .672 | | |
| | Total | 64.242 | 81 | | | |
| Avg_Clarity of research problem | Between | 8.277 | 5 | 1.655 | 1.871 | .109 |
| | Within | 67.242 | 76 | .885 | | |
| | Total | 75.518 | 81 | | | |
| Avg_Clarity of RD without usefulness | Between | 5.232 | 5 | 1.046 | 1.311 | .268 |
| | Within | 60.656 | 76 | .798 | | |
| | Total | 65.888 | 81 | | | |
| Avg_Science communication impact | Between | 10.521 | 5 | 2.104 | 2.197 | **.063** |
| | Within | 72.803 | 76 | .958 | | |
| | Total | 83.323 | 81 | | | |

7.2.4.1.2 Overall Assessment of Quality

The overall assessment of the articles' quality is not significant (see Table 27, p=0.111). Nevertheless, one can clearly discern from the average values that group 1 scores highest and that, based on the findings outlined above, an article with a focus on design-related aspects should probably favour group 4 rather than group 5. In general, the order in which one would choose a structural group for high overall quality assessments is 1, 4, 5, 3, 2, 6.

1. Group 1 with a score of 5.84/7 and n= 8, based on 2 articles
2. Group 4 with a score of 5.67/7 and n=21, based on 5 articles
3. Group 5 with a score of 5.67/7 and n=21, based on 4 articles
4. Group 3 with a score of 5.33/7 and n=23, based on 5 articles
5. Group 2 with a score of 5.03/7 and n= 5, based on 1 article
6. Group 6 with a score of 5.02/7 and n= 8, based on 2 articles

From the individual items of this section, the ANOVAs with the following dependent variables are significant or somewhat significant:

*Table 28: Significant Items of the Overall Assessment of Quality*

| Sig. | **Variable:** "Measurement Item" – Interpretation | **Ranking [group, score, n]** |
|---|---|---|
| **<.001** | Relevance: "The topic is of societal value/is relevant today" – Some structural groups are more suitable for portraying relevance than others. | 1. 5, 6.35/7, n=21<br>2. 4, 6.05/7, n=21<br>3. 1, 5.88/7, n=8<br>4. 3, 5.30/7, n=23<br>5. 2, 5.20/7, n=5<br>6. 6, 4.63/7, n=8 |
| **.093** | Quality of Presentation: "The content is presented well – easy to understand and follow the train of thought, good use of illustrations/tables where it makes sense, etc." – The structure of an article (i.e., the group) leads to not only different content selection, but also different perceived quality of presentation. | 1. 1, 6.00/7, n=8<br>2. 4, 5.90/7, n=21<br>3. 6, 5.40/7, n=8<br>4. 5, 5.35/7, n=21<br>5. 3, 5.17/7, n=23<br>6. 2, 4.60/7, n=5 |

7.2.4.1.3 Clarity of the Narrative

The structural group has a highly significant relation to the clarity of the narrative (see Table 27, p=0.003). Even though the groups themselves stand for different storylines (in particular the selection and order of contents), this is a striking result. The following ranking should be used to decide on a structural group for an article that achieves high clarity of the narrative: 1, 4, 5, 3, 6, 2.

1. Group 1 with a score of 6.00/7 and n= 8, based on 2 articles
2. Group 4 with a score of 5.84/7 and n=21, based on 5 articles
3. Group 5 with a score of 5.72/7 and n=21, based on 4 articles
4. Group 3 with a score of 5.17/7 and n=23, based on 5 articles
5. Group 6 with a score of 5.04/7 and n= 8, based on 2 articles
6. Group 2 with a score of 4.63/7 and n= 5, based on 1 article

From the individual items of this section, the ANOVAs with the dependent variables in Table 29 are significant or somewhat significant.

*Table 29: Significant Items of the Clarity of the Narrative*

| Sig. | **Variable:** "Measurement Item" – Interpretation | **Ranking [group, score, n]** |
|---|---|---|
| **<.001** | Helpfulness of Examples: "The example(s) used were helpful to understand the content" – This finding is surprising, as the structural groups do not affect the authors' freedom to choose and formulate examples. | 1. 4, 6.14/7, n=21<br>2. 1, 6.00/7, n=8<br>3. 5, 5.88/7, n=21<br>4. 3, 5.13/7, n=23<br>5. 6, 4.75/7, n=8<br>6. 2, 4.40/7, n=5 |
| **0.010** | Relatability of Examples: "The example(s) used were easy to relate/illustrative." – see Helpfulness of Examples. | 1. 4, 6.05/7, n=21<br>2. 1, 5.88/7, n=8<br>3. 5, 5.88/7, n=21<br>4. 3, 5.13/7, n=23<br>5. 6, 4.88/7, n=8<br>6. 2, 4.60/7, n=5 |
| **.082** | Clarity of the Plotline: "The plotline is clear to me – it is clear from where to where the narrative goes." – Some structures are easier to follow than others. Groups 1, 4, and 5 are clearly the best structures when it comes to the clarity of the plotline | 1. 1, 6.13/7, n=8<br>2. 4, 5.86/7, n=21<br>3. 5, 5.76/7, n=21<br>4. 3, 5.17/7, n=23<br>5. 6, 5.00/7, n=8<br>6. 2, 4.60/7, n=5 |

7.2.4.1.4 Clarity of the Research Problem

The average clarity of the research problem is not strongly influenced by the structural group (see Table 27, p=0.109). Especially groups 1, 5, 2, and 4 seem to be similarly effective across all research problem items. In comparison, groups 6 and 3 are less effective.

1. Group 1 with a score of 5.59/7 and n= 8, based on 2 articles
2. Group 5 with a score of 5.52/7 and n=21, based on 4 articles
3. Group 2 with a score of 5.40/7 and n= 5, based on 1 article
4. Group 4 with a score of 5.39/7 and n=21, based on 5 articles
5. Group 6 with a score of 4.85/7 and n= 8, based on 2 articles
6. Group 3 with a score of 4.81/7 and n=23, based on 5 articles

From the individual items of this section, the ANOVAs with the dependent variables in Table 29Table 30 are significant or somewhat significant.

*Table 30:Significant Items of the Research Problem*

| Sig. | **Variable:** "Measurement Item" – Interpretation | **Ranking [group, score, n]** |
|---|---|---|
| **.039** | Relevance of the Problem: "The problem described is relevant." – In some groups, the relevance of the problem becomes clearer than in others. | 1. 5, 6.12/7, n=21<br>2. 2, 6.00/7, n=5<br>3. 4, 5.86/7, n=21<br>4. 1, 5.75/7, n=8<br>5. 3, 5.35/7, n=23<br>6. 6, 5.13/7, n=8 |
| **.045** | Problem Scale: "I have a good understanding of the scale of the problem (e.g., how large the financial impact is on an individual stakeholder)" – Some article structures help understand the problem scale more than others. Notice, however, that group 2 only has one representative. | 1. 2, 6.00/7, n=5<br>2. 1, 4.88/7, n=8<br>3. 5, 4.88/7, n=21<br>4. 4, 4.76/7, n=21<br>5. 3, 3.96/7, n=23<br>6. 6, 3.88/7, n=8 |
| **.077** | Persistence of the Problem: "It is clear to me why the problem pertains/does not go away." - | 1. 4, 5.57/7, n=21<br>2. 2, 5.40/7, n=5<br>3. 5, 5.35/7, n=21<br>4. 1, 5.25/7, n=8<br>5. 3, 4.74/7, n=23<br>6. 6, 4.50/7, n=8 |

The following list contains some notes from Appendix E, E.3.4:

- Detailed elaborations about the artefact, its demonstration, and evaluation do not ensure that readers clearly understand the research problem. The latter may need to be elaborated on separately.
- The research problem is very clear in articles that abide by the nominal structure of empirical research articles (i.e., group 1).

7.2.4.1.5 Clarity of the Research Design

The average clarity of the research design is not significantly influenced by the structural group (see Table 27, p=0.268). Nevertheless, one can say that **groups 4 and 1 are more suitable candidates to ensure high clarity of the research design compared to the other groups**.

1. Group 4 with a score of 5.71/7 and n=21, based on 5 articles
2. Group 1 with a score of 5.61/7 and n= 8, based on 2 articles
3. Group 5 with a score of 5.25/7 and n=21, based on 4 articles
4. Group 2 with a score of 5.24/7 and n= 5, based on 1 article
5. Group 3 with a score of 5.12/7 and n=23, based on 5 articles
6. Group 6 with a score of 5.10/7 and n= 8, based on 2 articles

From the individual items of this section, the ANOVAs with the following dependent variables are significant or somewhat significant:

*Table 31: Significant Items of the Research Design*

| Sig. | **Variable:** "Measurement Item" – Interpretation | **Ranking [group, score, n]** |
|---|---|---|
| **.008** | General Approach: "I have a good understanding of the general procedural approach taken." – The understanding of the general research approach taken by the authors can be conveyed more clearly with some article structures than with others. | 1. 1, 6.25/7, n=8<br>2. 4, 5.95/7, n=21<br>3. 5, 5.41/7, n=21<br>4. 6, 5.13/7, n=8<br>5. 3, 5.00/7, n=23<br>6. 2, 4.40/7, n=5 |

The following list contains some notes from Appendix E, E.3.5:

- For reaching high clarity about the artefact and the contribution of the artefact, it is better to show the design process that led to the artefact rather than the design process related to instantiating the artefact.
- Research articles that present both the artefact and the design process that led to the artefact (i.e., group 6) are more useful to design researchers' own practices.
- Focusing on literature, demonstration, and evaluation (and marginalising the design process) is not conducive to a clear understanding of the contribution.

7.2.4.1.6 Science Communication Impact Measures

The groups are somewhat significant indicators for the average score of the science communication impact measures (see Table 27, p=0.063). This provides support for the heuristic of using the ranking of the groups' scores to identify the most suitable article structure for achieving high science communication impact scores. For these items, there is support in favour of groups 1 and 4:

1. Group 1 with a score of 5.62/7 and n= 8, based on 2 articles
2. Group 4 with a score of 5.30/7 and n=21, based on 5 articles
3. Group 2 with a score of 5.02/7 and n= 5, based on 1 article
4. Group 5 with a score of 5.01/7 and n=21, based on 4 articles
5. Group 3 with a score of 4.59/7 and n=23, based on 5 articles
6. Group 6 with a score of 4.54/7 and n= 8, based on 2 articles

From the individual items of this section, the ANOVAs with the following dependent variables are significant or somewhat significant:

*Table 32: Significant Items of the Science Communication Impact*

| Sig. | Variable: "Measurement Item" – Interpretation | Ranking [group, score, n] |
|---|---|---|
| **.037** | Enjoyment: "I enjoyed reading this text." – Some structural groups yield research articles that are more enjoyable to read. | 1. 1, 5.88/7, n=8<br>2. 5, 5.65/7, n=21<br>3. 4, 5.62/7, n=21<br>4. 2, 5.00/7, n=5<br>5. 6, 4.63/7, n=8<br>6. 3, 4.39/7, n=23 |
| **.037** | Entertainment: "It was entertaining to read this text." – Some structural groups yield more entertaining texts than others. While the significance value for entertainment and enjoyment are equal, the order in which the articles rank is slightly different. Hence, these variables differ from one another (despite correlating overall, see cross-correlation analysis of the effects). | 1. 1, 5.63/7, n=8<br>2. 4, 5.24/7, n=21<br>3. 5, 5.06/7, n=21<br>4. 2, 4.40/7, n=5<br>5. 3, 3.96/7, n=23<br>6. 6, 3.75/7, n=8 |

#### 7.2.4.2 Characteristic-Effect-Analysis

As opposed to the group-effect-analysis, this character-effect-analysis matches the insights from the quantitative structure analysis (Appendix C) with the effects (Appendix D). The summarized findings are presented here, whereas more data, analyses, and insights that are less directly related to the artefact creation are reported in Appendix E, E.4 According to the structure of the dataset, the insights are also split into two sections, matching the ten content elements (7.2.4.2.1) and the individual characteristics (7.2.4.2.2).

##### 7.2.4.2.1 Matching the Ten Content Elements with the Effects Dataset

The 'ten content elements' (CE) refer to the content elements outlined in Section 7.2.2.1. The analysis presented in this sub-section uses information about these CEs as independent variables that may or may not affect various effect variables in readers (dependent variables). The findings from analysing these CEs are listed below:

- The coverage of CEs ("x out of 10 elements are covered") does not significantly affect the readers' perceptions of an article, so long as at least 5 CEs are covered. (There is no data on articles with lower coverage.)
- The number of CEs in an article does not significantly affect the readers' perceptions of articles, irrespective of whether these CEs are split up or if not.
- The number of characters used on any given CE does not significantly affect the overall perceptions of readers.

- The research objectives should be presented in one continuous section because this has provided a better understanding of the research objectives (5.921/7) than not mentioning it (5.077) or splitting it into two CEs (5.140). This effect is significant with p=0.02.
- The clarity about the implications for science and the perceived ability to explain the outcomes to others are higher if requirements are not explicitly discussed:
    - Implications for science (p=0.039)
        - 0 sections on requirements: 5.732, n=12
        - 1 section on requirements: 5.075, n=6
    - Ability to explain outcomes to others (p=0.046)
        - 0 sections on requirements: 5.401, n=12
        - 1 section on requirements: 4.625, n=6
- Introducing the reference approach (or general research approach) and re-discussing it at a later stage in the manuscript significantly improves the understanding of the research process across various variables:
    - Research design decisions (p=0.013)
        - 0 sections on research approach: 5.067, n=4
        - 1 section on research approach: 4.639, n=9
        - 2 sections on research approach: 5.710, n=5
    - General approach (p=0.015)
        - 0 sections on research approach: 5.221, n=4
        - 1 section on research approach: 5.006, n=9
        - 2 sections on research approach: 6.190, n=5
    - Procedures (p=0.026)
        - 0 sections on research approach: 4.654, n=4
        - 1 section on research approach: 4.802, n=9
        - 2 sections on research approach: 5.580, n=5
    - Replicability (p=0.038)
        - 0 sections on research approach: 4.692, n=4
        - 1 section on research approach: 4.446, n=9
        - 2 sections on research approach: 5.680, n=5
- Splitting the explications about the procedures used in the manuscript into two rather than one section lowers the readers' interest in the topic (to learn more or get involved), the perceived familiarity with the issue, and the perceived relevance of the research problem.
    - Triggered interest to get involved (p=0.007)

        - 1 section on procedures: 4.221, n=7
        - 2 sections on procedures: 3.224, n=7
    - Triggered interest to learn more (p<0.001)
        - 1 section on procedures: 5.150, n=7
        - 2 sections on procedures: 3.829, n=7
    - Perceived familiarity with the issue (p=0.041)
        - 1 section on procedures: 5.786, n=7
        - 2 sections on procedures: 4.717, n=7
    - Perceived relevance of the research problem (p=0.05)
        - 1 section on procedures: 5.857, n=7
        - 2 sections on procedures: 5.319, n=7
- Articles with only one continuous section about the procedures reach higher clarity about what the artefact is.
    - Clarity about what the artefact is (p=0.034)
        - 1 section on procedures: 6.129, n=7
        - 2 sections on procedures: 5.517, n=7
- The understanding of the reference approach used in the study is lower in articles where the CE results and evaluation appears more than once.
    - General approach (p=0.035)
        - 1 section on results & evaluation: 5.975, n=4
        - 2 sections on results & evaluation: 5.594, n=8
        - 3 sections on results & evaluation: 4.789, n=6
- Articles in which the CE 9 appears (explication of the design knowledge) are perceived as being more useful for readers' own work:
    - Usefulness to own research (p=0.14)
        - 0 sections explicating DK 3.565, n=10
        - 1 section explicating DK 4.423, n=9
    - Usefulness for own theory development (p=0.17)
        - 0 sections explicating DK 3.115, n=10
        - 1 section explicating DK 4.104, n=9

#### 7.2.4.2.2 Matching Individual Characteristics with the Effects Dataset

The second part of the structure-effect-analysis matches individual characteristics with the effects dataset. To obtain any meaningful results, only ambiguous characteristics are used in this analysis (i.e., characteristics that appear in a similar number of cases as they

are omitted). Hence, only the middle-range variables are used (see Table 17: Items with the Lowest, Highest, and Middle-Ground Usage).

Some of these middle-ground characteristics appear to benefit the quality of the manuscripts across the sections of the survey. The findings about these characteristics are listed here. (Unless specified explicitly, these results stem from data that excludes the usefulness measures.)

**Featuring the stakeholders' goals:** This significantly and positively affects the average assessments of the survey overall (p=0.002, avg. diff.= +0.54/7 points), and the average scores of four out of its five sections are below the α=0.05 significance level for this characteristic (see list below). It also has a significant and positive effect on 23 effect variables (α=0.05), and none of the effects is significantly negative. With that, **design researchers should always specify the stakeholders' goals**.

- the overall assessment of the article's quality (p=0.002, avg. diff.= +0.52)
- the clarity of the narrative (p=0.014, avg. diff.= +0.48)
- the clarity of the research problem (p=0.003, avg. diff.= +0.63)
- the clarity of the research design (p=0.063, avg. diff.= +0.37)
- the science communication impact measures (p=0.004, avg. diff.= +0.63)

**Using an introductory example:** Manuscripts that feature an example to introduce the article have no significantly better overall evaluation result compared to articles that do not (average response overall: p=0.061). However, the survey's sections on **the clarity of the research problem** (p=0.019, avg. diff. = +0.49) **and the science communication impact measures** (p=0.025, avg. diff. = +0.52) **are significantly improved in articles that use an introductory example**. Six additional items are significantly and positively associated with the presence of an introductory example (clarity about the scale of the research problem with p=0.002, avg. diff.= +1.04; perceived ability to explain the problem to others with p=0.002, avg. diff.= +0.85; entertainment with p=0.005, avg. diff.= +1.09; understanding of the problem's essence with p=0.011, avg. diff.= +0.7; ability to take related decision with p=0.040, avg. diff.= +0.7; wish to learn more about the project or topic with p=0.041, avg. diff.= +0.7). Generally, **featuring an introductory example improves the understanding of the research problem and the perceived level of entertainment**. Interestingly though, it does not significantly affect the perceived enjoyment (p=0.171, avg. diff.= +0.49).

**Formulating a research question:** Articles that contain a research question have not obtained significantly better scores overall (p=0.107, avg. diff.= +0.35), but the

perceived clarity of the narrative is higher than in articles that do not contain one. **Readers thus seem to more easily understand narratives in which a research question is explicitly formulated**. No variable is significantly negatively affected by a research question, but there are seven significantly and positively affected items (α=0.05), namely: Perceived helpfulness of examples (p=0.005, avg. diff.= +0.72), clarity of the general research approach (p=0.006, avg. diff.= +0.73), perceived relatability of examples (p=0.009, avg. diff.= +0.69), perceived replicability (p=0.020, avg. diff.= +0.58), perceived relevance of the research problem (p=0.031, avg. diff.= +0.47), and perceived clarity why the procedures were used (p=0.047, avg. diff.= +0.50). Many of these items need some further research to understand, however, as their relationship is not self-evident.

**Providing navigation support:** Other findings include that providing navigation support in an article (i.e., forward and backwards referencing) has adverse effects on the clarity of the research problem (p=0.028, avg. diff.= -0.5), the clarity of the problem's scale (p=0.006, avg. diff.= -0.94), and scope (p=0.018, avg. diff.= -0.80). While **navigation support has no significant effect on the clarity of the essence of the problem** (p=0.550, avg. diff.= -0.17)**, it seems to inhibit the readers' ability to put the research problem into perspective**. Furthermore, providing navigation support does not significantly improve the scores in the section about the clarity of the narrative (p=0.13, avg. diff.= +0.26), and therein, crucially, it does not improve the clarity of the plotline (p=0.61, avg. diff.= +0.15). Improving the clarity of the narrative and the plotline is what one would want to use navigation support for. Therewith, the data suggests that it is detrimental to use navigation support.

## 7.3 Artefact Design and its Evolution

As indicated in Section 7.1 Starting Point, the solution should fulfil the following set of requirements (Table 33). Thereby its creation relies on the understanding of the knowledgebase (outlined in Section 2), empirical insights gathered directly from design researchers facing this problem (problem understanding in Section 5.2, coping strategies and specific techniques in Section 6.2, general insights from the expert interview study in Appendix A), the class level artefact design (Section 6.3), and four document analysis studies (Section 7.2). The challenge addressed in this section is to bring all of this together into an artefact that responds to the following research question:

**RQ at the Sub-Class Level:** How can design researchers present their finished design research projects in high-quality research articles?

*Table 33: Sub-Class-level Requirements*

| Sub-class-level Requirements |
|---|
| **R1':** The artefact must support researchers in the process of writing a research article about a design research project. |
| **R2':** The artefact must support researchers in identifying a purpose of communication that is compatible with the needs of relevant stakeholders. |
| **R3':** The artefact must support researchers in constructing appropriate storylines for research papers. |
| **R4':** The artefact must inform researchers in specific ways about how to satisfy the needs of stakeholders of research articles. |

### 7.3.1 The Idea for the Artefact

Considering the conceptualisation of research article writing as being 'sub-class' of the class level research problem, insights from the class level solution design can inform the solution design at the sub-class. However, such a solution would benefit from contextualisation, as a variety of other sub-class level situations do not need to be accounted for in this instance of the solution design (Figure 33). While the class level artefact needs to account for all variants of design research project communication situations, the sub-class of writing a summative article about the research project only needs to generalise to such articles and any possible "sub-classes" within that sub-class (here dubbed "instance types" in Figure 33). Based on this understanding of the problem and solution space as consisting of objects at various levels of abstraction, using an artefact at a higher level and adapting it to a lower level by introducing details that are context-specific for this sub-class (i.e., contextualising it) is a reasonable starting point. The level of ease with which the class level artefact can be contextualised was one of the identified weaknesses of earlier versions, as made explicit in the evaluation of the first major iteration of the artefact (Section 6.3.2). The resulting iteration based on this feedback should feature an improved ability to contextualise. In the following, this is evaluated for the sub-class of paper writing (Figure 34).

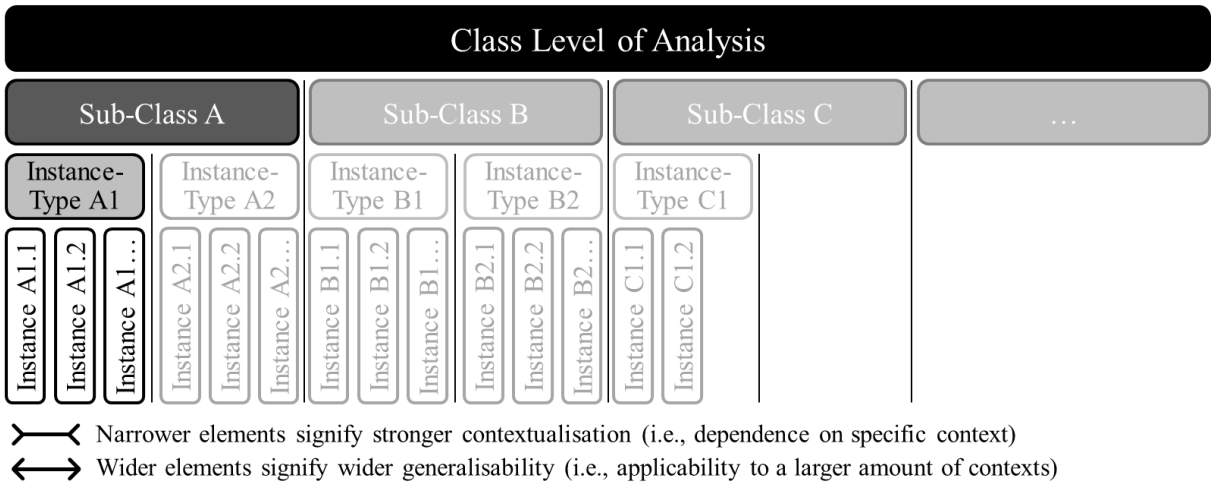


*Figure 33: The Sub-Class Level of Analysis*

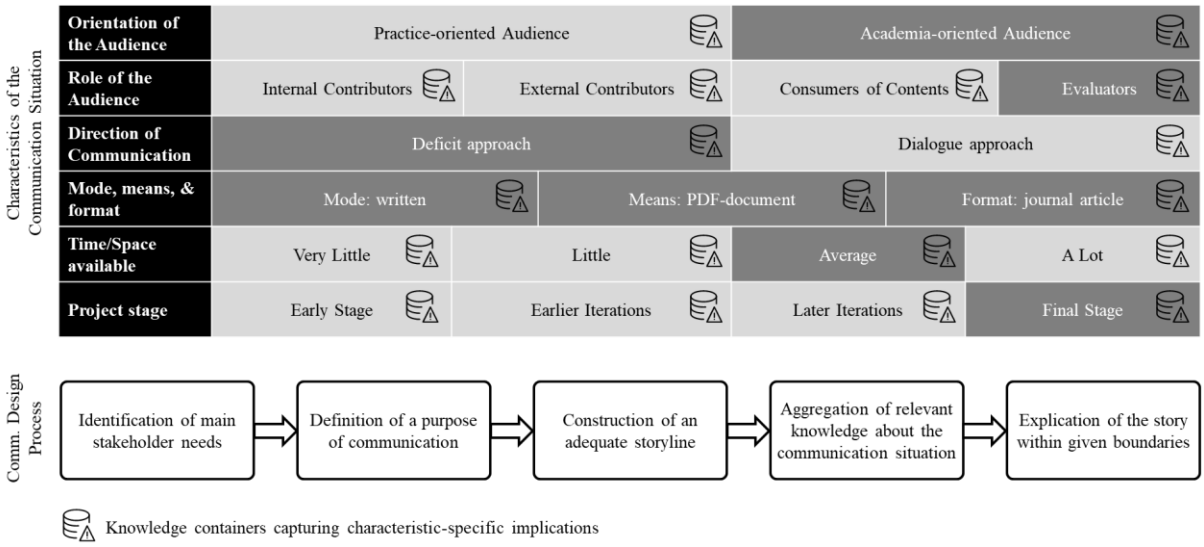


*Figure 34: Contextualising the Class Level Artefact*

## 7.3.2 Contextualisation of the Class Level Artefact

Following the underlying logic of the class level artefact, its contextualisation results from using knowledge about characteristic-specific implications (knowledge that should be available in the knowledge containers or gathered specifically for the context to which it should be specified, see: Section 6.3.3). For the context of writing research articles, the characteristics coloured in dark grey in Figure 34 are relevant:

- The direct audience consists of reviewers and academic readers.
- The role of the reviewers is to evaluate the manuscript. Reviewers are the primary stakeholder for the writing of a research article, but subordinately, the role of consumers of content is also relevant.

- A research article follows a deficit approach. It does not allow for near-real-time feedback or exchange, and all information should be prepared beforehand.
- The mode is written, although research articles allow for using illustrations.
- The means of communication is a PDF document.
- The format is a journal article, which comes with various implications, such as that the author guidelines provided by each outlet need to be followed.
- Journal articles are of an "average" length, as perceived by the interviewees. They indicate that they have "much more space" in a journal article to communicate their presentations as in most other communication instances (e.g., presentation at a conference, conference articles). However, they also indicate that they still perceive stringent space restrictions (see also: Appendix A).
- According to the research question, the artefact should cater to summative communication (hence: the final stage of a design research project).

The related knowledge about these general characteristics needs to be introduced into the communication design process. This activity is analogous to the activity in the adapted iterated artefact (see Section 6.3.2, Figure 28). The following sub-sections operationalise this introduction based on the steps of the communication design process, thereby adopting the ideas behind the class level artefact as closely as possible.

#### 7.3.2.1 Identification of Main Stakeholder Needs

A research article is written primarily such that the reviewers accept it (or at least that they let it go through to another round of revisions). Hence, the most important role of the audience is the role of evaluators and not of consumers of content. This is a rational argument, as it is irrelevant whether potential consumers of content like the article if the article is not published in the first place. However, evidence for this also emerges from the interviews as illustrated by these two quotes:

- "After the project had been done, the paper has been written to convince reviewers to like the paper and to accept it for academic outlets. (…) In the scientific community, (the role of the audience) is not like a customer but a gatekeeper. There is this competition for publication space, and you talk with gatekeepers that somehow manage or assign the scarce resource of publication space by trying to select the best (articles) to assign this resource." (Interviewee 4).
- "In the end, you want (the article) to be written for a lot of readers with similar struggles that seek the guidance you can provide. At the same time, you also

know: First, you need to convince the reviewers and you kind of need to write for them." (Interviewee 6)

After identifying the main stakeholder and the main stakeholder's role, some activities need to be performed to obtain specific needs that this stakeholder has. This can be done by design researchers individually (i.e., using the class level artefact themselves), or it can be prepared (i.e., as done throughout the design of the sub-class level artefact). The prepared needs, which should apply to the problem sub-class of writing (any) design research articles, are identified next. This is done based on the insights from the interview study (Appendix A), the document analyses (Appendix B-E), and knowledge about the process of writing and publishing research articles. The author deemed the following two activities as being crucial based on his knowledge about the phenomenon:

- Using the explicit insights about the needs of academia-facing audiences
- Studying the outlet-specific formal requirements and expectations

The study of outlet-specific formal requirements and expectations is not specific to design research, and design researchers that wish to publish in an IS journal are most likely familiar with this task. Therefore, no guidance is provided for this activity, nor are there insights from the empirical studies about this task. The needs of academia-facing audiences, however, are discussed in Section 6.2.1.2.1 and in Appendix A. Instead of repeating them here, need-statements are listed here (Table 34).

*Table 34: Needs of Academia-facing Audiences*

| Need for Articles to… | Explanation |
|---|---|
| … to comply with expectations | In academia-facing communication, high importance is given to respecting and complying with expectations. These expectations make an article 'acceptable.' In the case of behavioural science, this expectation is more explicit than in design science, where, e.g., a nominal structure has not (yet) emerged (Peffers et al., 2007). What these expectations might be is discussed in this table and below (e.g., in the implicit insights about what contents are necessary/important or in the formal requirements of outlets). Contents that are not expected (e.g., design process) can be cut short or omitted. |
| … address the four essential milestones of a research article | From the interview emerged a set of four essential milestones (define the phenomenon/research problem; clarify the methodology and its adequacy; provide theoretical support; show how the data supports the overall project and its conclusions, see Section 6.2.1.2.1). |
| … be convincing about authors' understanding | Articles need to convince the audience that the authors of the article have understood the related work about the |

| | |
|---|---|
| | phenomenon and existing design knowledge, as well as the research problem itself. |
| … be convincing about the methodology | This includes convincing the audience that the authors are knowledgeable about the methodologies used and that they did their work with a high standard of rigour. |
| … use and contribute to theory | In conference articles, especially at DESRIST, the content selection can be focused more heavily on artefacts or design. IS journals, however, need to be couched toward a theoretical contribution, to 'wrap theory around it.' This need for (explanatory) theory applies to informing the design study but also to the knowledge contribution. Furthermore, design artefacts themselves are not perceived as being sufficient contributions. (Interviewees 2 and 11) |

#### 7.3.2.2 Definition of a Purpose

The needs of the main stakeholder, as outlined above, are not the only relevant aspect for specifying the purpose of communication. Specifying a purpose also requires normative decisions (i.e., what does the communicator think should be achieved?). Whereas the researchers' goals, the general needs (see above), and specific needs in a communication situation need to be combined, this step cannot be fully prepared for the case of writing research articles. The reason for this is that 'writing a research article' is a relatively general activity in the sense of being at a sub-class level that contains several possible instance types (e.g., explanatory evaluation article, editorial, summative project communication). Compared to the artefact for Section 7, the artefact presented in Section 8 addresses a much narrower use case (instance type), for which the goals and the specific needs in that communication situation can be specified.

Hence, researchers need to reflect on their own goals with writing the research article and about the specific needs that may need to be added to the list of needs before specifying what the purpose of communication should be. Adopted from Section 6.2.4 to the paper writing use case, the most common communication goals that one might pursue (as inspiration for identifying one's goal) include:

- Getting access to the scarce resource of publication space (i.e., getting an article published, cf.: Tremblay et al., 2018)
- Creating awareness (e.g., for the problem or general approach to solving it)
- Creating utility through the contribution (to other researchers)
- Influencing the wider community (e.g., through presenting a new methodology)

Once a researcher feels confident to have at least identified the most relevant needs in a particular paper project, they can specify which needs they will attempt to satisfy with

their manuscript. It remains to be stated that researchers should use caution before deciding against any one of the needs outlined in Table 34, though. While these needs are not binding requirements, they are aggregated shared believes that could be identified throughout an interview study.

#### 7.3.2.3 Construction of a Storyline

The construction of a storyline has the purpose of clarifying which milestones should be 'ticked-off' in which order (see Section 6.3.2). This is the primary difficulty perceived by design researchers, as for many articles, they cannot rely on a nominal structure (see Section 5, or Gregor & Hevner, 2013; Peffers et al., 2007; Tremblay et al., 2018). Instead, there may be several appropriate structures, as indicated by the six structural groups of design research articles (Section 7.2.1). The interview study has revealed several ideas on how to generally construct a storyline. One general strategy for constructing a storyline is to build it based on a set of steps or phases that are borrowed from a known reference approach. Another common strategy is to identify a reference article that features a similar design research project. The own article is then built according to the structure used in that article (e.g., interviewees 2 and 7). On a very abstract level, the interviewees furthermore agreed that the central milestones are:

1. Define the phenomenon/research problem
2. Clarify the methodology and provide evidence for its adequacy
3. Provide theoretical support and ensure the perception of rigour
4. Show how the data supports the overall project and its conclusions

However, these instructions might not be useful enough for the purposes of the sub-class level artefact. The structure-effect-analysis and its related studies reveal more granular prescriptions. In particular, researchers can choose from several structural groups based on which they can model their manuscripts. The selection process is outlined in Table 35. For step 2, the 'ranking' refers to the rankings presented in Section 7.2.4.1. This process is presented in a user-friendly way in the summary of this artefact in Section 7.3.3.

*Table 35: Selecting a Structural Group for the Article*

| Step | Explanation (further resources) |
|---|---|
| 1. Become aware of targeted effects | A researcher needs to know more about what they want to achieve than merely the overall purpose, namely what effects the article should target in readers. |
| 2. Identify the ranking of groups for these effects | Based on the targeted effects, the structural groups, ranked by their effectiveness for each effect, need to be identified (see 7.2.1 Insights from the Qualitative Analysis of Paper Structures). |
| 3. Rank the structural groups based on weighted effects | Unless it is clear to authors which structure best suits the targeted effects, they should assign weights to the effects they wish to achieve (e.g., on a scale from one to ten) and compute a weighted sum with the groups or a selection of groups (e.g., by using a linear value system for the groups where the best receives 6 points, the second-best 5 etc.; a non-linear value system where the best group receives disproportionately more points than the second one etc.; or by using the relative scores of each group for each effect). |
| 4. Apply changes if necessary | The structural groups are presented on a very abstract level. However, it may be apparent to authors that their project (despite suiting a group) may have an important peculiarity that needs to be included in its structure. Such changes can be made if perceived as being necessary. (Use of caution is advised, as thereafter findings from the document analyses might no longer apply.) |

#### 7.3.2.4 Aggregation of Relevant Knowledge about the Communication Situation

While this step of the process is relevant for the class level artefact (or: for general-purpose communication of design research projects), it no longer plays an important role for an artefact on the sub-class level task of writing research articles. This is not a general rule for sub-class level artefact but rather a characteristic of the selection of the sub-class level task that requires an artefact. In this specific instance, writing one summative design research article for a scientific journal does not differ from another regarding the situational characteristics that influence communication. Hence, design researchers who wish to communicate their design research projects in a journal article and who use the herein-created artefact for this sub-class level task should not be bothered by aggregating the relevant knowledge about communication in this situation. Instead, the relevant insights should be integrated into the guiding artefact (i.e., in the guidance about how the storyline may be explicated). Notice that this conclusion differs from the earlier suggested adaptation of the iterated artefact (Section 6.3.2, Figure 28).

#### 7.3.2.5 Explication of the Story

For the explication of the story (i.e., writing the article based on a constructed storyline), two conceptually different support structures can be constructed based on the knowledge presented thus far. One support structure is general instructions on what authors should look out for. Some of the general instructions reflect the studies investigating structures and effects of research articles (e.g., Section 7.2.4.2), whereas others stem from the implications of the communication situation's characteristics (Figure 34). The other kind of support structure for explicating the story is a set of techniques that help overcome specific challenges that arise during the writing process. The respective prescriptive knowledge is presented in sequential order below.

##### 7.3.2.5.1 General Instructions Based on the Structure-Effect-Analysis

The quantitative structure framework has two sections. The findings from the quantitative structure analysis (Section 7.2.2) and from the quantitative structure-effect-analysis are interpreted such that only the summary of prescriptive statements about how to write research articles is presented here. Thereby, these same two sections are used to split this content (ten content elements and structural characteristics).

*7.3.2.5.1.1 Instructions based on the Ten Content Elements*

This analysis shows that not all articles feature the same content elements, that some are omitted more often than others, and that some are split more often than others. For design researchers seeking to communicate their research projects, the following guidance can be deduced:

*Table 36: Guidance based on the Ten Content Elements*

| Insight | Foundation |
|---|---|
| A research article should include the content elements problem description, knowledgebase, procedures, results, and discussion. | These content elements are either never (discussion), once (problem description, knowledgebase), or twice (procedures, results) omitted in nineteen articles studied. |
| Reviewers do not require lengthy problem descriptions. | The problem description is featured in 18/19 articles, but on average, it covers only 7% of the manuscript's text. |
| Research objectives should be presented in one continuous section. | Articles that do not feature the content element 'research objectives' (5.077 out of 7 points) and articles that have this section split in two (5.140) reach significantly lower scores on the understanding of research objectives (5.921, p=0.02). |
| (continued on the next page) | |

| Insight | Foundation |
|---|---|
| Requirements, iterations, and the explication of design knowledge are optional content elements. | Only 7/19 of the articles feature any requirements, and the average design research article uses 2.6% of its text for discussing requirements; 9/19 articles and 10/19 articles cover iterations and the explication of design knowledge, respectively (7.0% and 6.1% of the average manuscript). |
| A reference approach should be introduced and re-discussed at a later stage of the manuscript. | This yields a significantly better understanding of the research process compared to not using a reference approach and compared to presenting the reference approach and not re-discussing it. Variables that are improved: Clarity of the research design (p=0.013), of the general approach (p=0.015), of the procedures used (p=0.026), and the perceived replicability (p=0.038). |
| The explications about the procedures should be presented in one continuous section. | Articles that split the explication of the procedures are perceived as less interesting (3.829 vs 5.150, p<0.001), less engaging (3.224 vs 4.221, p=0.007), less relevant (5.319 vs 5.857, p=0.05), and readers feel less familiar with the issue presented in the manuscript (4.717 vs 5.786, p=0.041). Furthermore, it is less clear to them what the artefact is (5.517 vs 6.129, p=0.034) |
| The discussion is one continuous section. | In 18/19 articles, the discussion is one continuous section. In the remaining article, the discussion is split into two sections (where 'split' implies that at least one different content element separates them). |

*7.3.2.5.1.2 Instructions based on Individual Characteristics*

The analysis indicates that some characteristics are necessary (almost all articles use them), some do not need to be featured for publication success (only very few articles feature them), and some are legitimate design options in the sense that they can, but do not need to be present (about half of the articles feature them, whereas the other half does not). These items are outlined in Table 17 and not individually repeated here. However, the implications for guidance are that the most often used characteristics are probably part of the expected characteristics, whereas the ones that are very rarely used are definitely not necessary items (and maybe would be detrimental if they were used, but this cannot be analysed based on lacking data).

Among the characteristics that are present in almost all articles, four items from the discussion section are featured. This indicates that the discussion section is not only mandatory but that it also confirms that it needs to be covered in depth. The items mentioned here are contribution to research (18/19), contribution to practice (18/19), research agenda (18/19), limitations of the research (17/19).

Another interesting finding is that all research articles feature some statement about the research objectives, but only 8/19 contain a research question. The idea that a research question is a generally mandatory content feature for design research articles can therefore be rejected. However, further inspection reveals that group 1 and group 4 articles have a research question (7/7 articles), whereas articles of other groups do not. Hence, design researchers that opt for a structure that is not based on group 1 or 4 do not need to formulate a research question, but they have to clarify the objective of their research. For doing so, authors can use active speech, as observed in 14/19 of the articles. It is not unusual, and therefore it is legitimate for design research manuscripts to include statements such as "we opted for …".

The afore-mentioned legitimate design options also provide some general guidance, and in particular, the peculiar case of the inclusion of the main stakeholder's goal. These findings are presented in Table 37.

*Table 37: Guidance based on the Individual Characteristics*

| Insight | Foundation |
|---|---|
| The main stakeholder's goal should always be presented. | This significantly and positively affects the perceptions of the readers across all topics tested (i.e., sections of the survey, namely: overall assessment of the article's quality (p=0.002), clarity of the narrative (p=0.014), clarity of the research problem (p=0.003), clarity of the research design (p=0.063), science communication impact measures (p=0.004)). It also positively and significantly (α=0.05) affects 23 out of 47 individual measures, and there are no significant negative effects of presenting the main stakeholder's goal (see also: Appendix K, K.1.1). |
| One should use an introductory example. | While the overall evaluation for 'inclusion of an introductory example' is not significant (p=0.061), this characteristic has significant positive effects on a variety of measures, which may be summarised as improving readers' understanding of the research problem (overall: p=0.019, avg. diff.= +0.49, clarity about the scale of the problem, p=0.002, avg. diff.= +1.04, ability to explain the problem to others, p=0.002, avg. diff.= +0.85, understanding of problem's essence, |

(continued on the next page)

| | |
|---|---|
| | p=0.011, avg. diff.= +0.7) their interest to learn more (p=0.041, avg. diff.= +0.7) and feeling of being entertained by the text (p=0.005, avg. diff.= +1.09) |
| An RQ should be added to the manuscript | There are no significant adverse effects of doing so, but the mean across all items is not significantly better either (p=0.107, avg. diff.= +0.35). However, there are seven significantly positively related variables, including the perceived relevance of the research problem (p=0.031, avg. diff.= +0.47), clarity of why the chosen procedures were used (p=0.047, avg. diff.= +0.50). Because the RQ does not use up much space, and because the positive effects are not traded off with negative effects, one should add an RQ. |
| A research article does not benefit from navigation support | Beyond using titles and sections to clarify the structure of an article, providing backwards and forward references within the article does not significantly improve its clarity. This includes the clarity of the narrative (p=0.13, avg. diff.= +0.26) and therein the clarity of the plotline (p=0.61, avg. diff.= +0.15). At the same time, this characteristic shows adverse effects on the clarity of the research problem (p=0.028, avg. diff.= -0.5), its scale (p=0.006, avg. diff.= -0.94), and scope (p=0.018, avg. diff.= -0.80). |

7.3.2.5.2 General Instructions Based on Communication Situation Characteristics

**Role of the Audience:** In their role as evaluators, the primary stakeholder (i.e., reviewer) acts as a gatekeeper. Therewith, it is their interests that are focal—not the interests of readers of published articles. These interests might align, but they might as well not. Thus, design researchers need to formulate their articles such that the evaluators are convinced of the manuscript. Such a result is obtained if the needs of the stakeholders are met. Furthermore, some of the specific techniques (outlined below) are conducive to a better understanding of the contents. For their role, the reviewers need to understand the contents well and thus, these techniques should be used (e.g., check for unanswered potential questions, use adequate terminology and frames of reference, use figures and tables for key elements).

**Deficit approach:** The deficit approach is characterised by a high latency in (or absence of) feedback about the communication. Compared to near-real-time communication, in a research article, all information that is relevant must be presented. This is a challenge insofar that it is hard to sense what content elements should be added (or extended) and what contents can be glossed over (interviewees 5 and 7). For this general implication, there are also a few specific techniques (outlined below) that apply (e.g., check for unanswered questions, focus on explaining rather than reporting, focus on conceptual specificity, use adequate terminology).

**Mode, means, format:** The format is given by the sub-class itself (i.e., journal article), and the means and mode are therefore also given (i.e., a written document). Since these characteristics tend to be unproblematic, based on the interview-informed problem understanding (Section 5.2), the detailed implications are not researched and presented here. However, among the specific techniques (outlined below), there are some that address these particular characteristics (i.e., use appendices, provide navigation support, use figures and tables for key elements).

**Time/space available:** This characteristic is generally problematic. However, the interviewees discussed the journal articles as being the communication instances where they had the most space available. This does not imply that there are no implications of the space available for paper writing but that these are less severe than in many other (academia-facing) communication instances. The specific techniques (see: Table 38) that can be used to help explicate the storyline of a design research article under space restrictions are: use appendices, remove content pragmatically, focus on explaining rather than reporting, and focus on conceptual specificity.

**Project Stage:** The writing of a summative research article implies that the artefact is constructed, and a summative evaluation has shown satisfying results. This is the project stage for which it seems to be the least difficult to communicate a project (beyond the limitation of space, which becomes more pressing the further a project progresses). In earlier stages, aspects such as uncertainty about the remainder of the project or the artefact play a role.

Beyond these commentaries about the implications of the communication situation's characteristics, some general helpful findings emerged from analysing the knowledge base, interview transcripts, and the structure-effect dataset. First, contents that are not part of what reviewers expect in a research article can be omitted without adverse effect. Hence, it is a valid approach to omit information about the project, so long as this does not interfere with the expected contents. This might be a better strategy than to include as much as possible and, as a consequence, to massively shorten everything. Second, established knowledge that is shared within a large part of the community can be cut very short or merely be referred to (e.g., interviewee 7). For example, to save space, one can omit elaborations about DSR-specific methodology beyond referring to a specific reference approach. Third, operational specificity (see Table 38) can and should be avoided. For example, the operationalisation of the approach is not perceived as being a relevant content item (as opposed to the methodological considerations regarding the evaluation). Lastly, there is some design freedom in how one explicates the story (more

so than with traditional explanatory research articles). The research articles analysed for the structure-effect-analysis indicate that the researchers can choose to add various content aspects. To identify possible content aspects as inspiration on what could be discussed, see the respective insights from the interview study (Section 6, Table 7) and the ten content elements from the quantitative analysis of paper structures (Section 7.2.2.1, Table 14).

#### 7.3.2.5.3 Specific Techniques to Overcome Challenges During the Explication

During the explication of the story, there are many challenges that arise (for an overview, see Section 5.2.2). A sub-set of these challenges specifically concern the writing of design research articles. To support design researchers in this stage of the communication design process, the wealth of insights from the interview study can be searched for specific techniques on how to overcome these challenges. These findings are listed in Appendix A, A.3.9, and summarized specifically for writing research articles in the table below.

*Table 38: Specific Techniques to Overcome Challenges During Explication*

| Specific Technique | Explanation |
|---|---|
| Use appendices | The big perceived advantage of a journal article compared to conference articles (in IS) is that one can use appendices. The appendix lends itself to adding contents that are important (e.g., screenshots of prototypes to help understand what is being written about) but not part of the expected contents. |
| Remove content pragmatically | Instead of trying to explain everything, content aspects that are of low perceived value should rather be entirely omitted. This includes, for example, the development of the artefact or details about how certain methods are used. The same applies to contents that the community is familiar with (i.e., there is no need to re-iterate established theories or methodologies, as the audience can be expected to be familiar with them or to read up on them based on referenced articles). (interviewees 3, 7, 10). |
| Focus on explaining rather than reporting | Compared to other communication situations, a journal article allows for a lot of detail because they provide a lot of space. This space should be used for explaining (rather than telling/reporting, interviewees 6 and 8). |
| Check for unanswered potential questions | One should focus on ensuring that no important questions a reader might have, remain open (interviewees 7 and 10) |

(continued on the next page)

| Specific Technique | Explanation |
|---|---|
| Provide navigation support | The longer a communication becomes, the harder it is for the audience to follow. Since research articles are among the longer communication situations (certainly among the longest apart from a dissertation), there might be a need to help the audience follow the storyline (interviewee 4). It is another discussion, however, how extensive such navigation support should be. A minimal support necessary might be the use of titles and subtitles (whereas further support, e.g., forward and backwards references within an article, can have adverse effects on the understanding of the research problem, see Appendix E, E.4.2) |
| Focus on conceptual specificity | Conceptual specificity is about what is done and why. It is a functional view on the research project. Its counterpart (which should thus not be focal) is the operational specificity. Operational specificity refers to the practical view, providing details about how things are done. The latter is of low perceived value and can be omitted (Section 6.2.2). With this, the perceived paradox of needing to provide a lot of detail on everything (e.g., interviewees 2, 7, 11) can be addressed. |
| Use adequate terminology and frames of reference | Whereas the frames of reference used (e.g., for providing illustrative examples) are not necessary for academic audiences, the interviews reveal that they are useful to improve understandability. One aspect of the explication that is absolutely necessary is the use of adequate terminology (this relates to '… to comply with expectations' and '… to be convincing about the authors' understanding (see Table 34). |
| Use figures and tables for key elements | While the audience is expected to read the articles carefully, it is useful to provide tables and illustrations to make sure that readers (1) do notice them and (2) that they can recognize the relative importance of these contents (compared to aspects that are not illustrated). (Interviewees 6 and 7) |
| Use work packages or phases to structure contents | Whereas the interviewees explained that the individual activities are uninteresting to the audience (both practice and academia, and therefore also for journal articles), they agree that structuring contents and content sections by work packages or, e.g., process model phases is beneficial. |

#### 7.3.2.6 Discussion of the State of the Prescriptive Knowledge

The information about the communication use case of writing a design research article collected throughout the studies of this dissertation is interpreted and reframed as prescriptive statements in this section (7.3.2). This is according to the author's initial idea for providing guidance to design researchers (i.e., for responding to the RQ), based on which the empirical studies were conducted (Appendix B-Appendix E). Evaluating the

result in informal discussions with peers and some critical reflection by the author soon yielded the following conclusion: Despite the wealth of prescriptive knowledge, the actionability of its individual statements, and the general structure (analogous to the five steps of the class level artefact), the probability of it being used by design researchers in its current form (i.e., integrated into this dissertation) is low. These discussions culminated in the realisation that this guidance is not actionable enough (as it requires its users to search for the right information within this dissertation) and that it is not useful enough (because it is cumbersome to apply it to one's use case and to share the knowledge with fellow design researchers). This is problematic for a DSR outcome since it is the explicit purpose of design research to provide utility (Simon, 1996). Despite perceived fulfilment of the sub-class requirements (R1'-R4'), these requirements can only be achieved if the artefact is in use. In other words, it might support researchers, but the author concluded that it is unlikely that it does. For these reasons, and because a key differentiator between the class level and the sub-class level artefact should be that the latter requires little (or at least less) work to contextualise the knowledge, a summarising artefact is created that overcomes these shortcomings.

### 7.3.3 Summarising Artefact: A Quick-Guide

This summarising artefact should both satisfy the requirements and fulfil two additional requirements as identified above.

**R5':** The artefact must be easy to use by design researchers.

**R6':** The artefact must be concise and easy to share.

#### 7.3.3.1 Preparatory Reflexions

The overview of empirically founded prescriptive knowledge outlined in Section 6.2 needs to be simplified to prepare this summarising, actionable and concise (ideally shareable) artefact. The following sections bridge the above-described artefact (collection of prescriptions) and an actionable, concise, and shareable artefact by explaining specific rationales behind the design decisions.

##### 7.3.3.1.1 Identification of Stakeholder Needs

Assuming that a researcher attempting to publish an entire design research project in an IS journal is experienced with writing research articles (e.g., from writing research-in-progress conference articles, literature reviews, or evaluation papers), the target artefact can be stripped from the following aspects (Table 39).

*Table 39: Simplifications about the Identification of Stakeholder Needs*

| Aspect to be Removed | Explanation |
|---|---|
| Clarification of the main stakeholder | A researcher who writes a design research article is unlikely to be writing their very first article. It should be clear to them that the primary stakeholders who need to be convinced by the manuscript are the reviewers. |
| Formal requirements from outlets | A researcher who has published anything in the past knows that outlet-specific formal requirements need to be fulfilled. |
| Details about the explanations in Table 34 | If the artefact is supposed to be simple, shareable, and actionable, then it needs to be primarily concise and instructive. The explanations can be stripped of justificatory statements (whereas some statements may need to be added to ensure understandability). |

7.3.3.1.2 Identification of a Purpose

The purposes are not wildly diverse when it comes to writing a research article. Unlike in meetings with practitioners, for example, where acquisition of resources, alignment of the project plan, or gathering first-hand information about users are diverse purposes, design researchers tend to write their articles with the primary purpose of satisfying the reviewers explicit and implicit requirements in order to obtain valuable publication space (interviewees 4, 8, 11, Tremblay et al., 2018). The instances of this communication situation all share the same general needs of the primary stakeholder. According to the discussion in the purpose-related section (7.3.2.2), defining one purpose for all articles is ineffective. Nevertheless, rudimentary storylines for research articles already exist (i.e., the six structural groups). According to the class-level artefact, this should only happen after the identification of stakeholder needs and of the identification of the purpose. In some sense, other researchers have already specified purposes that have evidentially satisfied the most important stakeholder needs since published design research articles exist. Using the structural groups (abstract storylines extracted from such articles) would therefore mask the first two steps of the communication design process. Assuming that stakeholder needs and purposes are very similar across design research articles, relying on a selection of structural groups might be an acceptable trade-off between losing some explicit opportunity to contextualise (as in the presentation of the first two steps in Section 7.3.2.1 Identification of Main Stakeholder Needs, and Section 7.3.3.1.2 Definition of a Purpose), and gaining usefulness through increased applicability and shareability of the prescriptive knowledge.

#### 7.3.3.1.3 Construction of a Storyline

Following this line of argumentation, the abstract storylines do not necessarily need to be 'constructed.' Instead, they should be selected. Considering that prospective users of the artefact are unlikely to write their first article, they may also be familiar with the common strategy of using an idol paper as a basis and adapting it for their particular research projects (as indicated in interviews 2, 6 and 7; the idea of an idol structure for this purpose is also used in Gregor & Hevner, 2013). Hence, for the construction of a storyline, it might suffice for prospective users to select a suitable structural group and to adapt it individually as needed. For this process step, guidance would therefore include a selection algorithm. Based on the rankings for which the group is a significant predictor (α=0.05), the following overview of rankings from (only the) significant group-item-relationships can be compiled:

*Table 40: Ranking Based on Average Values in Significant Items*

| **Items** (ordered by significance) | **1** | **2** | **3** | **4** | **5** | **6** | **Avg.** |
|---|---|---|---|---|---|---|---|
| Overall Response (no usefulness items, p=0.44) | 5.7 | 5.1 | 4.94 | 5.54 | 5.37 | 4.87 | 5.26 |
| Relevance of the topic (p<0.001) | 5.88 | 5.2 | 5.35 | 6.05 | 6.35 | 4.63 | 5.70 |
| Narrative* (p=0.003) | 6 | 4.63 | 5.17 | 5.84 | 5.72 | 5.04 | 5.49 |
| General Research Approach* (p=0.008) | 6.25 | 4.4 | 5 | 5.95 | 5.41 | 5.13 | 5.43 |
| Enjoyment (p=0.037) | 5.88 | 5 | 4.39 | 5.62 | 5.65 | 4.63 | 5.17 |
| Entertainment (p=0.37) | 5.63 | 4.4 | 3.96 | 5.24 | 5.06 | 3.75 | 4.68 |
| Relevance of the problem* (p=0.039) | 5.75 | 6 | 5.35 | 5.86 | 6.12 | 5.13 | 5.70 |
| Problem scale* (p=0.045) | 4.88 | 6 | 3.96 | 4.76 | 4.88 | 3.88 | 4.72 |
| Average of significant values | 5.75 | 5.09 | 4.77 | 5.61 | 5.57 | 4.63 | 5.25 |
| *(measuring understanding/clarity) Rank: | 1 | 4 | 5 | 2 | 3 | 6 | |

*Table 41: Ranking Based on Rankings in Significant Items*

| **Items** (ordered by significance) | **1** | **2** | **3** | **4** | **5** | **6** | **Avg.** |
|---|---|---|---|---|---|---|---|
| Overall Response (no usefulness items, p=0.44) | 1 | 4 | 5 | 2 | 3 | 6 | 5.26 |
| Relevance of the topic (p<0.001) | 3 | 5 | 4 | 2 | 1 | 4 | 5.70 |
| Narrative* (p=0.003) | 1 | 6 | 4 | 2 | 3 | 5 | 5.49 |
| General Research Approach* (p=0.008) | 1 | 6 | 5 | 2 | 3 | 4 | 5.43 |
| Enjoyment (p=0.037) | 1 | 4 | 6 | 3 | 2 | 5 | 5.17 |
| Entertainment (p=0.37) | 1 | 4 | 5 | 2 | 3 | 6 | 4.68 |
| Relevance of the problem* (p=0.039) | 4 | 2 | 5 | 3 | 1 | 6 | 5.70 |
| Problem scale* (p=0.045) | 2 | 1 | 4 | 3 | 2 | 5 | 4.72 |
| Average of significant values | 1 | 4 | 5 | 2 | 3 | 6 | 5.25 |
| Average: | 1.67 | 4.00 | 4.89 | 2.33 | 2.33 | 5.33 | |
| *(measuring understanding/clarity) Rank: | 1 | 3 | 4 | 2 | 2 | 5 | |

Based on this ranking, groups 3 and 6 have alternatives that outscore them across all items. For group 3, this is also true for the non-significant items. Based on this, group 3 would never be the best structure to select, and it can be removed from a decision support artefact for which structural group to select. Group 6, however, has the highest values for the usefulness measures (see 7.2.4.1.5: "Research articles that present both the artefact and the design process that led to the artefact (i.e., group 6) are more useful to design researchers' own practices."). Thus, group 6 should result from using some selection support only in cases where the researcher wants to focus on usefulness.

Group 2 has a relatively weak basis of data that is underlying it (one article and 5 effect scores). Furthermore, its average score is poor, only scoring highly on the items relevance of the problem and problem scale. However, the three other remaining article structures all scored highly on the relevance of the problem (above average). For simplicity and because group 2 only has two strong points, one of which is not even much stronger than the others, this group may also be removed from possible suggestions.

Group 1 is the dominant structure, both regarding its scores overall (highest score across all questions, all sections, and most items) and regarding its scores for the significant items (therein group 1 ranks first in terms of average value and average rank, see also 7.2.4.1 Group-Effect-Analysis). Hence, an intuitive interpretation would be that authors should mostly select group 1 to obtain the best communication outcomes (i.e., the highest scores). However, the primary weakness of this group is its omission of the artefact and design-related activities.

The structure-effect-analysis reveals that the second-best candidate for a structure that features artefact and design-related content is, in almost all cases, group 4. However, considering only the average rankings of the significant effects, groups 4 and 5 are equal. Their primary difference lies in group 5 having poorer clarity about the general research approach but much better evaluations on the perceived relevance (of both the topic and the problem) and (though insignificantly) better scores on the clarity about the stakeholder and their goals. If the authors wish to focus on perceived relevance, then group 5 is a better candidate than group 4. In all other cases where the artefact and design-related aspects are focal, group 4 should be chosen.

##### 7.3.3.1.4 Aggregation of Relevant Knowledge about the Communication Situation

As indicated in the first iteration of the sub-class level artefact, this step does not apply.

##### 7.3.3.1.5 Explication of the Story

According to the preparatory reflections provided thus far, the artefact may supply readers with an abstract storyline, relying on their professional skills to adapt that storyline and to respect the formal requirements of targeted outlets. However, as clearly voiced throughout the interviews (Appendix A), there are some additional challenges the design researchers face in writing research articles (and communicating design research in general). The findings about how to deal with these challenges are valuable inputs for the explication of the story, and these should not be removed if the artefact is to be useful. However, explanations on why these inputs work, data that underlies them, and cross-references to respective sections in this dissertation do not add to the instructiveness of these findings. Instead, they provide a basis for building trust in the prescriptive statements. Such information is required in a dissertation. However, it may not be necessary for an artefact that is meant to be used.

#### 7.3.3.2 Design of the Summarising Artefact

Beyond these reflections, the summarising artefact should easily integrate into the workflows of its prospective users. Furthermore, to improve the chances of it having an impact and thus factually supporting researchers, rather than hypothetically (i.e., to fully satisfy R1'-R4', rather than to conceptually satisfy them), the artefact should be easily shareable among design researchers. To achieve these additional goals, it is presented as a PDF document. This document is split into two conceptually distinct parts: First, it outlines the purpose of communication, the necessary contents, prescriptive knowledge about how to present these, and a few general implications (based on the stakeholder needs, the general instructions, and specific techniques outlined in the first iteration). Second, it helps its users to select a structural order according to which these contents can be outlined. In the following, the artefact is presented in a formatting-adjusted version:

##### 7.3.3.2.1 The Summarising Artefact

## How to Write a Design Research Article? A Quick-Guide

When writing a design research article, authors must keep in mind that it is their task to convince readers that they (1) understand the research problem, (2) know the related work (e.g., literature about the phenomenon, existing design knowledge), (3) have rigorously implemented an appropriate methodology, and (4) have created a research contribution. To obtain such a manuscript, authors may consider these insights on selecting

contents (what needs to be in such a manuscript?), as well as formulating (how should these contents be presented?) and structuring them (how should they be compiled?).

*Table 42: Necessary Content Elements and how to Present them*

| What needs to be in the manuscript? | How should it be presented? |
|---|---|
| **Problem description:** What is the status quo in which the research problem materialises? Who is the main stakeholder? What are their goals (desired to-be state)? | All three questions should be answered. In addition to that, an introductory example should be used to illustrate the topic or the problem. However, there is no need for lengthy problem descriptions (covers on average ~7% of a manuscript). |
| **Objectives:** What is the purpose or primary goal of the study? | Research objectives should be presented in one continuous and succinct text section (<2%). |
| **Knowledgebase:** How is the study informed? What is the central literature about the phenomenon? (*What design knowledge exists already for this problem?*) | This is a substantial part of the manuscript (~20%). To save space and focus this section, one should cut knowledge that is established within the respective community very short (possibly as mere references). |
| **Procedures:** How is the general methodological approach implemented? (Special focus on the data gathering techniques; techniques for analysis are non-essential) | A reference approach should be introduced and re-discussed at a later stage of the article (e.g., what is the reference approach split from its application), whereas the individual procedures should be presented in one continuous text section. There is no need for operational specificity (how?), and a conceptual discussion is sufficient (what and why?). The procedures cover about 15% of a manuscript's space. |
| **Results:** What are the central findings? How are these supported by the research? | The essential results or findings should be given additional visibility by using illustrations or tables, ensuring that their relative importance compared to other aspects is perceived. The results section is a substantial part of the manuscript (~20%). |
| **Discussion:** What are the contributions to research and to practice? What are the limitations of the study? What could be studied next (research agenda)? | All three of these questions must be answered. The discussion should be written as one continuous text section, where 'continuous' means that it is not split by a non-discussion item. The discussion covers about 15% of a manuscript's space. |

This outline of necessary contents implies that the following contents are non-essential: requirements, iterations, explication of design knowledge. Their omission does not significantly affect the perceptions about the article. If authors wish to keep these aspects

in an article, they should consider moving them into an appendix. Furthermore, there is no need to use forward or backwards references within the article.

**How should these contents be compiled?**

All that remains to be done is writing the article. But in which order should the above-described contents be presented? To answer this question, the focus of the article should be clarified. In the following, the most effective structures according to content focus are presented, along with the selection logic:

Choose **Structure A** if the focus is on providing usefulness to other design researchers. Structure A is most effective in providing design researchers with information that is useful for their own practices (e.g., inform their own research, use the artefact to inform theory development, testing or theorising about its usage or its building process).

Choose **Structure B** if neither the artefact nor the design process should be focal. This is the most effective structure to communicate a research project, but it omits design-related aspects.

Choose **Structure C** if the focus is convincing readers about its relevance. Structure C yields the highest perceived relevance of the topic and the research problem.

Choose **Structure D** in all other cases. Structure D focuses on design-related aspects and is highly effective across all relevant communication outcomes.

*Table 43: Effective Content Structure of Manuscripts*

| **Structure A** | **Structure** B | **Structure** C | **Structure** D |
|---|---|---|---|
| **Introduction** (incl. short Problem description, Objectives) | Introduction (incl. Problem description, Objectives, intro. Reference approach) | Introduction (incl. Problem description, Objectives, intro. Reference approach) | Introduction (incl. Problem description, intro. Reference approach, Objectives) |
| **Methodology** (incl. Reference approach) | Background knowledge (i.e., Knowledgebase) | Background knowledge (i.e., Knowledgebase) | Background knowledge (i.e., Knowledgebase) |
| **Problem description** (incl. focused/short Knowledgebase) | Methodology (incl. Reference approach and Procedures) | (high-level) Artefact presentation (Results) | Methodology (incl. Reference approach and Procedures) |
| **Artefact presentation** (Results) | Analysis and results (Results) | Design of an instantiation (Procedures and Results) | Artefact presentation (Results) |
| (continued on the next page) | | | |

| Structure A | Structure B | Structure C | Structure D |
|---|---|---|---|
| **Design process** that led to the artefact, incl. evaluations (Procedures & Results) | Discussion | Evaluation of instantiation (Results) | Demonstration; or Implementation; or Evaluation (Procedures and Results) |
| **Discussion** | | Discussion | Discussion |

## 7.4 Demonstration and Evaluation

The prescriptive knowledge created and presented throughout Section 7.3.2 is not just informed by the findings of various studies (Appendix A-Appendix E); these studies are themselves informed by existing literature (i.e., coding frameworks). With that, the set of prescriptive statements could be formulated in such a way that it is constantly demonstrated, based on the underlying findings. Using utmost care to aggregate the most strongly supported findings, the author does not evaluate the compilation of prescriptive statements beyond (1) double-checking its consistency with the various studies (especially the findings of the structure-effect-analysis) and (2) conceptually probing the fulfilment of the RQ and the requirements. The summarising artefact is evaluated separately (Section 7.4.2).

### 7.4.1 Evaluation of the Set of Prescriptive Statements

The set of prescriptive statements is entirely supported by empirical studies (Section 6.2 Design-specific Additional Knowledge). For this reason, no further empirical studies were conducted to evaluate these findings. However, the author has iteratively matched the findings from the supporting studies with the prescriptive statements to ensure that these are indeed consistent with the findings of the studies (Appendix A-Appendix E). The summative ‘evaluation’ of these statements is thus restricted to conceptually evaluating whether the findings answer the research question and the requirements. The conclusion of this activity is that it satisfies the requirements and the RQ (Table 44). However, as with all artefacts, their usefulness depends on the artefact being in use. This is a weakness of the set of prescriptive statements, as addressed with the summarising artefact.

*Table 44: Sub-Class-level Requirements*

| **Sub-class-level Requirements** | |
|---|---|
| RQ: How can design researchers present their finished research projects in high-quality research articles? | While cumbersome to use, the prescriptive findings outlined in Section 7.3.2 provide many partial answers to this research question. While it is a lengthy answer, these prescriptive insights combinedly answer the RQ. |
| **R1':** The artefact must support researchers in the process of writing a research article about a design research project. | The prescriptive statements support this process in that they sequentially indicate what needs to be considered, both explicitly (e.g., the needs of academia-facing audiences) and instructively (e.g., that formal requirements of outlets or the authors' own goals need to be introduced). However, the artefact can only support researchers after they have studied this and the related material. |
| **R2':** The artefact must support researchers in identifying a purpose of communication that is compatible with the needs of relevant stakeholders. | Section 7.3.2.1 explicates some of the most prominent needs, and Section 7.3.2.2 provides inspiration about possible purposes. Therewith, the prescriptive knowledge does not instruct authors in a step-by-step process on how to reach such a purpose. Nevertheless, it does support the identification. |
| **R3':** The artefact must support researchers in constructing appropriate storylines for research papers. | Section 7.3.2.3 instructs readers about how to identify a suitable structure and that they may apply perceived necessary changes to obtain a storyline. |
| **R4':** The artefact must inform researchers in specific ways about how to satisfy the needs of stakeholders of research articles. | The prescriptive statements throughout Section 7.3.2 provide specific instructions for this purpose. In particular, Section 7.3.2.5 is dedicated to fulfilling this requirement. |

### 7.4.2 Evaluation of the Quick-Guide

Compared to the set of prescriptive statements, the Quick-Guide contains a variety of design assumptions that are not founded on empirical insights. These include that some very basic instructions may be unnecessary for design researchers, that users do not need full details about the origin or empirical evidence that underlies prescriptive statements, or that they may not always need to specify the purpose on their own, but that they can

re-use existing structures within the use case of writing a research article (about these design-specific assumptions, see: Section 7.3.3.1 Preparatory Reflexions). For this reason, there is only empirical evidence about the knowledge that is 'packaged' in the artefact (Quick-Guide), but there is no evidence about the adequacy of the 'packaging.' To evaluate whether the emerging artefact satisfactorily answers the RQ and the requirements, a survey study with active design researchers is conducted. The results of this evaluation are presented below before iterating the artefact based on the insights of the evaluation. The survey can be found in Appendix A.

#### 7.4.2.1 Results of the Evaluation

The results of the evaluation consist of quantitative responses (ten items on a 7-point Likert scale) and some optional qualitative feedback (from one text field).

##### 7.4.2.1.1 Results from the Quantitative Items

The survey was sent to 27 design researchers on December 30th 2021. In the following days, 21 responses returned. In Table 45, the ten measurement items and the respective results are outlined. An evaluative interpretation follows.

*Table 45: Results from the Quantitative Items of the Quick-Guide's Evaluation*

| **Perceived effect of the Quick-Guide (1=much worse, 7=much better, n=21)** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **Avg.** | **Var.** | **n** |
|---|---|---|---|---|---|---|---|---|---|---|
| Paper-writing process in general | 0 | 0 | 0 | 4 | 8 | 7 | 2 | 5.33 | 0.83 | 21 |
| Identification of the article's goals | 0 | 0 | 0 | 7 | 5 | 6 | 3 | 5.24 | 1.19 | 21 |
| Creation of an adequate structure | 0 | 0 | 0 | 0 | 2 | 9 | 10 | 6.38 | 0.45 | 21 |
| Creation of an adequate story | 0 | 0 | 3 | 3 | 8 | 3 | 4 | 5.10 | 1.69 | 21 |
| Clarity of how to present indiv. contents | 0 | 0 | 0 | 1 | 3 | 12 | 5 | 6.00 | 0.60 | 21 |
| | | | | | | | | | | |
| **Agreement with these statements (1=fully disagree, 7=fully agree, n=21)** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **Avg.** | **Var.** | **n** |
| It is useful for design researchers | 0 | 0 | 0 | 0 | 1 | 9 | 10 | 6.45 | 0.91 | 20 |
| Researchers are likely to use it | 0 | 0 | 0 | 0 | 9 | 7 | 4 | 5.75 | 1.26 | 20 |
| It is easy to understand | 0 | 0 | 0 | 0 | 1 | 5 | 14 | 6.65 | 1.36 | 20 |
| It is easy to use | 0 | 0 | 0 | 0 | 2 | 9 | 9 | 6.35 | 0.96 | 20 |
| I would use it to write a DSR paper | 0 | 0 | 4 | 0 | 1 | 4 | 11 | 5.90 | 2.43 | 20 |

All questions are formulated positively (i.e., higher values on the 7-point Likert scale equate to better evaluation results for the Quick-Guide). The ten questions are split into five items evaluating the effectiveness (does it help solve the problem?) and five items measuring perceived usefulness (would design researchers use the artefact? Illustrated

by the horizontal split in Table 45). The overall average across the effectiveness items is 5.61 points, and the average perceived usefulness received 6.22 points on the 7-point scale. Both scales have their neutral point at 4 (i.e., neither helps nor hurts and neither is particularly useful nor useless). Therewith, both the perceived effectiveness and the perceived usefulness are positively evaluated. This indicates that the artefact is generally helpful and that it is likely to be an adequate solution.

The artefact has particular perceived strength in helping design researchers identify an adequate structure for their research articles (6.38) and its clarity on how to present the content (6.05). At the same time, the respondents rated the artefact's impact on their ability to construct an adequate story as being anything from 3 ("somewhat worse") to 7 ("much better"). While the average response is that the artefact makes their story-formulation "somewhat better," the result is much less striking than for their perceived ability to create an adequate structure (5.1 vs 6.38). This could have been expected, as the artefact focuses on conceptually supporting design researchers in the design of their articles rather than operationally explicating the story. In light of the fact that the respondents are all active design researchers, the otherwise mostly average (no improvement) to positive (improvement) evaluation of the perceived effects of the artefact can be judged as follows: Many design researchers think that this artefact, despite their existing experience, improves their paper writing ability. At the same time, some researchers evaluate the artefact neutrally, indicating that, given their existing experience, the artefact does not contribute much. One reason for such a result might be that they are already quite aware of what the goal of a research article is (7x neutral) or that they have an established, effective paper-writing process (4x neutral). Overall, however, the artefact excels in what it is supposed to achieve, which is clarifying how to structure and present contents. Therefore, it does retain a satisfying amount of prescriptive information from the set of prescriptive statements about how to write research articles (Section 7.3.2). This provides evidence that the summarising process did not render the artefact ineffective. However, because it is an artefact at the sub-class level (rather than at the instance-type level), it cannot effectively prescribe how to formulate an adequate story for the many research paper projects.

The participants rated the usefulness of the artefact (i.e., the reason for designing this artefact based on the set of prescriptive statements on how to write an article) higher than the perceived effects. This implies that the artefact is indeed user-friendly. There are four negative outliers that are based on the responses of one participant, rating the usefulness measures as follows (in the order depicted in Table 48): 3, 2, 2, 3, 5. Thus,

this person voted for the artefact to be something he or she would use (5/7) while indicating that it is not useful, that researchers are unlikely to use it, that it is hard to understand, and not easy to use. These responses are contradictory, and they are therefore dropped from the analysis. (Their responses on the effects items are also relatively low, but not contradictory. Therefore, this person's responses were not entirely removed. Notice the differences in the 'n' column.) All responses across the usefulness items are very high, with the perceived likelihood of researchers using it being the lowest-rated item (5.75/7) and the personal propensity to use the artefact being the most controversially rated one (four people indicated that they would rather not use it, whereas more than half of the respondents indicated that they are certain to use it). This might also relate to the relative experience of the respondents. Three out of the four respondents who indicated that they would not use the artefact identified themselves to the author (through the commentary field or in separate response e-mails). All three of them are more senior researchers (one professor, one assistant professor, and one postdoctoral researcher). This might indicate that the guidance is—while being highly useful per se—more likely to be used by more junior design researchers than by highly experienced ones. This is a hypothetical conclusion, however, as the data to base this conclusion on is slim.

To conclude, this analysis of the quantitative part of the survey indicates that the artefact is perceived as having a positive effect on design researchers' article writing, and it is perceived as being highly useful for them. Based on the quantitative part of the survey, the artefact is therefore satisfactory, and the design process can be halted.

##### 7.4.2.1.2 Results from the Qualitative Items

The survey has one text field, through which the participants could provide any thoughts about the artefact. Nine out of 21 respondents used this field, with seven comments being about the artefact. One of these seven is "The guideline is really helpful."

The remaining six commentaries about the characteristics of the artefact, possible improvements or unclarities are summarised below, along with the author's interpretation of their implications for a final artefact design:

*Table 46: Implications of the Qualitative Responses*

| Summarized Response Statement | Author's Interpretation |
|---|---|
| The **naming of the structural groups** may be improved such that the reference structures can be more easily remembered and referred to. | Several respondents addressed this characteristic of the artefact. This may help distribute and encourage the use of the artefact. One of the respondents made suggestions for a naming convention ("Contribution Focus", "Design Focus", "Awareness Focus", and "Balanced Structure"), which is slightly adapted and used for the final artefact (below). |
| Some respondents perceive the Quick-Guide as being **geared toward beginners** or 'rookie' design researchers and that this should be clarified in the document. | While this was not necessarily the idea for the artefact, it is true that the omission of detail between the set of prescriptive insights and the summarising artefact removes clarity about expert-level customisation. To clarify the purpose and the target audience of the artefact, the introduction is extended in the iterated version of the Quick-Guide. Furthermore, users may find that they wish to have more details about specific aspects of the activities related to writing design research articles (i.e., the prescriptive statements omitted between Section 7.3.2 and 7.3.3.2). To address this, see below (linking). |
| If it were **easy to find the research underlying this document**, respondents might be more likely to use it. It might be enough to just provide a footnote with information about the sample or study design. | The author intends to link the dissertation with full information below the artefacts (once the dissertation is publicly available). Furthermore, this link is appended with an introduction about the origin of the artefact (i.e., that it is a result of a dissertation project). |
| The **percentage numbers** provided in the artefact do not add up to 100%: "Although they are estimates, I think it would increase clarity if they would add up to 100%." | This is a complicated matter to address. While this is a good point (percentages should, for example, never exceed 100% when listing distinct things within something), changing the percentages would not be appropriate because there are other content elements that, on average, fill in the gaps. Recognising this as being a potential barrier for acceptance, however, the final artefact is appended by an additional explanation on what the remaining ~20% are used. |

#### 7.4.2.2 Iteration of the Artefact Based on the Evaluation

While the artefact is not changed based on the quantitative analysis, the implications of the qualitative commentary are built into the Quick-Guide as indicated in Table 46. This yields the final artefact for the sub-class level of analysis (i.e., for writing research articles):

### A Quick-Guide on Writing Design Research Articles

The following guide supports novice and experienced design researchers in structuring design research articles. It helps select content elements, indicates how to present them, and suggests four provenly effective article structures. This prescriptive knowledge emerged from a dissertation project and is supported by empirical data.* It has been found to yield articles that convince readers that authors (1) understand the research problem, (2) know the related work, (3) have rigorously implemented an appropriate methodology, and (4) have created a research contribution. To obtain such a manuscript, authors may consider these insights on selecting contents (what needs to be in such a manuscript?), as well as formulating (how should these contents be presented?) and structuring them (how should they be compiled?).

*Table 47: Necessary Content Elements and how to Present them*

| What needs to be in the manuscript? | How should it be presented? |
|---|---|
| **Problem description:** What is the status quo in which the research problem materialises? Who is the main stakeholder? What are their goals (desired to-be state)? | All three questions should be answered. In addition to that, an introductory example should be used to illustrate the topic or the problem. However, there is no need for lengthy problem descriptions (covers on average ~7% of a manuscript). |
| **Objectives:** What is the purpose or primary goal of the study? | Research objectives should be presented in one continuous and succinct text section (<2%). |
| **Knowledgebase:** How is the study informed? What is the central literature about the phenomenon? (*What design knowledge exists already for this problem?*) | This is a substantial part of the manuscript (~20%). To save space and focus this section, one should cut knowledge that is established within the respective community very short (possibly as mere references). |
| **Procedures:** How is the general methodological approach implemented? (Special focus on the data gathering techniques; techniques for analysis are non-essential) | A reference approach should be introduced and re-discussed later in the article (e.g., what is the reference approach split from its application), whereas the individual procedures should be presented in one continuous text section. There is no need for |

| | |
|---|---|
| | operational specificity (how?), and a conceptual discussion is sufficient (what and why?). The procedures cover about 15% of a manuscript's space. |
| **Results:** What are the central findings? How does the research support these? | The essential results or findings should be given additional visibility by using illustrations or tables, ensuring that their relative importance compared to other aspects is perceived. The results section is a substantial part of the manuscript (~20%). |
| **Discussion:** What are the contributions to research and practice? What are the limitations of the study? What could be studied next (research agenda)? | All three of these questions must be answered. The discussion should be written as one continuous text section, where 'continuous' means that a non-discussion item does not split it. The discussion covers about 15% of a manuscript's space. |

This outline of necessary contents implies that the following contents are non-essential: requirements, iterations, explication of design knowledge. Their omission does not significantly affect the perceptions about the article. If authors wish to keep these aspects in an article, they should consider moving them into an appendix. Nevertheless, there are ~20% of the article left that can be used on them or distributed among the necessary elements.

**How should these contents be compiled?**

All that remains to be done is writing the article. But in which order should the above-described contents be presented? To answer this question, the focus of the article should be clarified. In the following, the most effective structures according to content focus are presented, along with the selection logic:

Choose **"Usefulness to Researchers"** if the focus is on providing usefulness to other design researchers. This structure is most effective in providing design researchers with useful information for their own practices (e.g., inform their own research, use the artefact to inform theory development or testing, or to theorize about its usage or its building process). In other areas, however, it scores poorly compared to the other structures.

Choose **"Non-Design Ideal"** if neither the artefact nor the design process should be focal. This is the most effective structure to communicate a research project overall, but it omits design-related aspects.

Choose **"Ultimate Relevance"** if the focus is to convince readers about its relevance. This structure yields the highest perceived relevance of the topic and the research

problem while also yielding decent communication outcomes across other communication outcomes.

Choose **"Design Ideal"** in all other cases. This structure focuses on design-related aspects and is highly effective across all relevant communication outcomes. Therefore, it is ideal for structuring design-focused articles.

*Table 48: Effective Content Structure of Manuscripts*

| Usefulness to Researchers | Non-Design Ideal | Ultimate Relevance | Design Ideal |
|---|---|---|---|
| **Introduction** (incl. short Problem description, Objectives) | Introduction (incl. Problem description, Objectives, intro. Reference approach) | Introduction (incl. Problem description, Objectives, intro. Reference approach) | Introduction (incl. Problem description, intro. Reference approach, Objectives) |
| **Methodology** (incl. Reference approach) | Background knowledge (i.e., Knowledgebase) | Background knowledge (i.e., Knowledgebase) | Background knowledge (i.e., Knowledgebase) |
| **Problem description** (incl. focused/short Knowledgebase) | Methodology (incl. Reference approach and Procedures) | (high-level) Artefact presentation (Results) | Methodology (incl. Reference approach and Procedures) |
| **Artefact presentation** (Results) | Analysis and results (Results) | Design of an instantiation (Procedures and Results) | Artefact presentation (Results) |
| **Design process** that led to the artefact, incl. evaluations (Procedures & Results) | Discussion | Evaluation of instantiation (Results) | Demonstration; or Implementation; or Evaluation (Procedures and Results) |
| **Discussion** | | Discussion | Discussion |

*Further information, including the research that underlies all statements in this quick guide, can be found at: (some link will be added here).

# 8 Artefact Creation for the Instance-Type Level

The class level artefact should provide utility to design researchers who wish to communicate their projects in general. As outlined in Section 7, this artefact can be used to specify further guiding artefacts at a lower level of analysis, trading off the generalisability with contextualised applicability. In this section of the dissertation, the class level artefact is contextualised to a narrowly constricted communication use case. The author knows this use case well (both because of its restrictedness and his direct exposure to the stakeholders in their natural environment over the last seven semesters). Hence, an artefact that specifically integrates the relevant contextual information (Section 8.2) of this use case is created (Section 8.3) and evaluated (Section 8.4). This use case is the presentation of a research design for a design research project in the context of a research methods course.

## 8.1 Starting Point

This design endeavour relies on the class level artefact (Section 6) to inform the design of a contextualised artefact. Because of the narrowly delimited communication situations for which it should be applicable (instance-type level of analysis, see Section 3.1.3. or Figure 33), the additional knowledge required for contextualising is much less substantial than for the sub-class level of analysis. However, additional contextual information about the use case needs to be formulated to justify the design decisions (relevance cycle, Hevner, 2007). Furthermore, the design requirements need to be specified to the instance-type level. For doing so, contextual information is used. Therefore, the requirements and the research question for the artefact are outlined after presenting the design-specific additional knowledge (i.e., in Section 8.3).

One further other foundation for this instant-type level artefact design is the idea of using a checklist. A general-purpose checklist has proven effective in this context (for students with non-design-based research designs), but the checklist used in this specific research methods course is not adequate for students who focus on design-based research designs. Therefore, using a checklist might not only be an effective solution (if specified to design-based research design presentations), but it is also an accepted and appropriate format that can easily be introduced into the natural environment of the research problem. This is beneficial for creating usefulness (central goal of DSR) and evaluating the artefact.

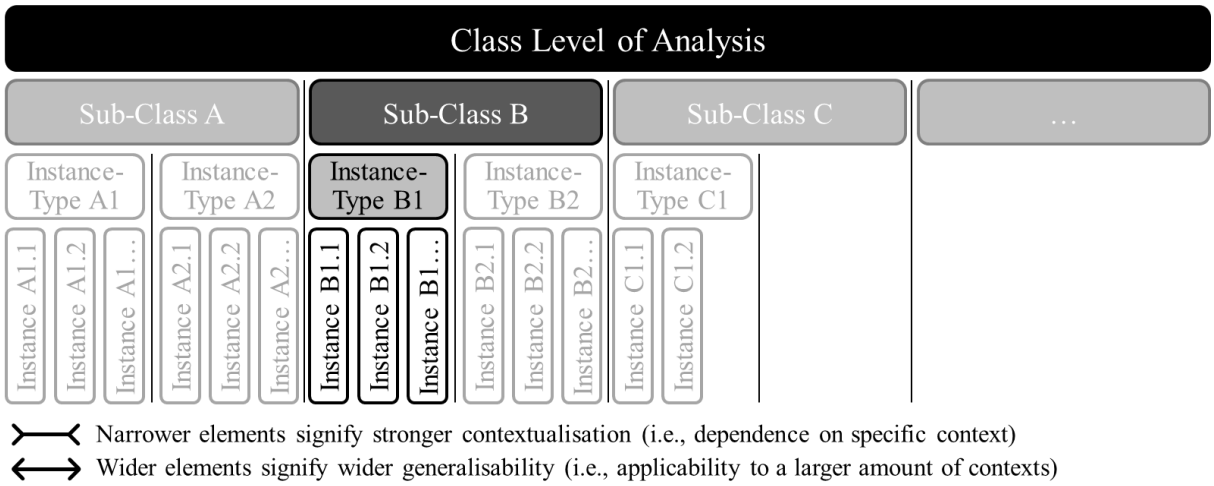


*Figure 35: The Instance-Type Level of Analysis*

## 8.2 Design-specific Additional Knowledge

In this section, the communication use case is presented such that the constituents of the communication situation (i.e., the morphological box of the class-level artefact) are clarified (Section 8.2.1) and that the implications for the student presentations become apparent (Section 8.2.2).

### 8.2.1 Description of the Communication Situation

The specific situation is described along the dimensions of the characteristics of the communication situation (Figure 36). The audience for this communication instance-type consists of the course instructors, which can be characterised as an *academia-facing* audience. Therein, the role of the audience is to *evaluate* the solutions proposed by the students. They do so in up to three iterations (early-stage feedback on a draft of the research design; feedback on a finalised version of the research design; final evaluation of the research design). While these three iterations are similar regarding the requirements from the main stakeholder, the presentation format varies. The last presentation is done virtually and via voice-over-PowerPoint presentation. This is the most important presentation for the students, as it weighs most strongly on their grades for the course. For this reason, the focus for the instance-type level artefact resides on the final evaluation of the research design.

The communication relies on the *deficit approach* since there is no further direct communication between the students and the instructors. The voice-over presentations are *audio-visual* (mode), and the means students may use to implement the presentation is prescribed as *PowerPoint*. The *format* in which the presentations are handed in is a

*voice-over-PowerPoint* presentation document. The voice-over-PowerPoint presentation is the longest presentation of the three instances mentioned above. However, 15 minutes of presentation time is still *little time*, but it is longer than the 7 minutes available for the other two presentations. Hence, their designs should have evolved a bit over the course of the semester, and they should include at least some initial literature review and a clear idea of the outcome of their research design proposition. However, the students are not expected to apply the research design and to have positively evaluated an artefact. Therefore, the project stage is an *earlier iteration*.

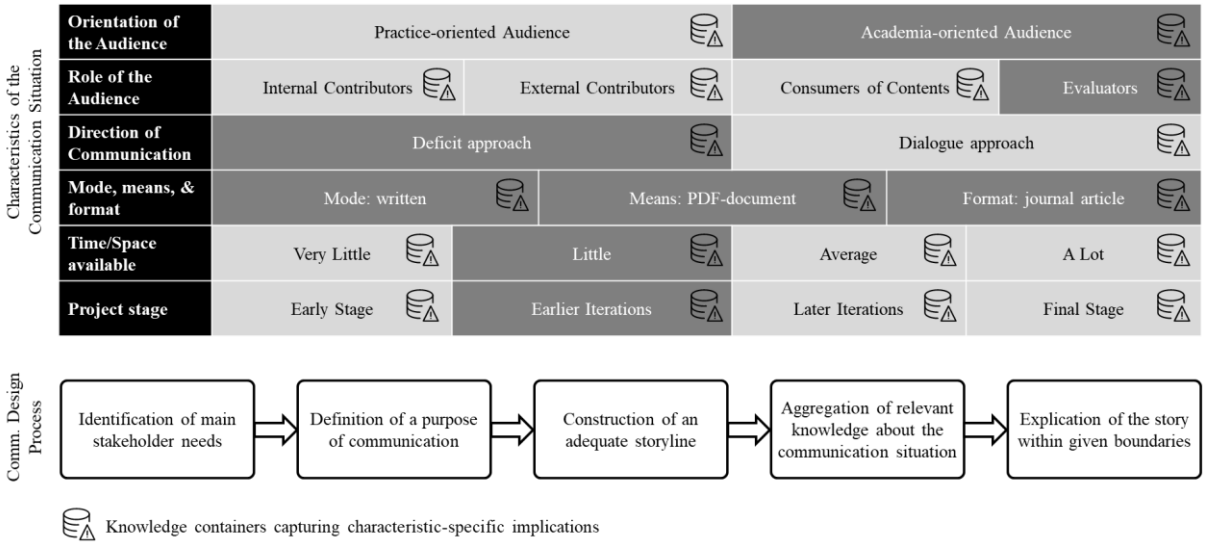


*Figure 36: Characteristics of the Instance-Type*

### 8.2.2 Implications for the Student Presentations

Drawing from the information about the characteristics of the communication situation, the following implications for the communication design process can be deduced:

- **Orientation of the Audience:** The general needs of an academic audience apply. These are outlined in Section 6.2.1.2.1. In this presentation use case, the focus lies on understanding how to create an appropriate research design. For this reason, this particular audience does care about the DSR-specific methodology as well, more so than the overall academic audience, which primarily focuses on the methodology used to evaluate the artefact.
- **Role of the audience:** As evaluators, the primary concern is first to understand the focal issue of discussion and then to form an evaluative opinion (e.g., interviewee 4). The latter thereby strongly depends on the former. Evaluators are to be provided with additional information allowing them to form such an opinion (see also: science communication outcomes in Section 2.2). Thereby, a central

stakeholder need is to get informed such that a well-founded understanding of the matter can be gained and an evaluation can be made.

- **Directionality:** The deficit approach implies that the communication can "stand on its own legs." In other words: The communication must be self-sufficient and therefore be understandable without asking further questions (Mauelshagen & Jakobs, 2016). For the students, this may imply that more information needs to be provided than in face-to-face presentations and that the information needs to be expressed more carefully and clearly. At the same time, under the constraint of time/space, some aspects may be omitted if they are likely to contribute to confusion, as there is no opportunity to clarify further. Which aspects can be or should not be omitted is based on the audience's expectations (as per the needs of academia-oriented audiences).
- **Mode:** Based on the instructions in the course, the students are to present their research designs as a voice-over-PowerPoint presentation. Therefore, they may use their speech, writing, and illustrations so that their ideas come across understandably and clearly.
- **Means:** The means the students are to use is PowerPoint. They are familiar with the tool, and general design etiquette applies. For example, these include, e.g., that one may not overload the slides with content and avoid continuous text sections in favour of bullet-point type notes.
- **Format:** The format is prescribed as being a voice-over-PowerPoint presentation. This leaves much creative freedom to the students, and they may use animations, graphical illustrations, concurrent commentary, or existing video footage as they see fit.
- **Time/Space available:** The presentation time is limited to 15 minutes, requiring students to carefully select the contents they wish to present and set an adequate level of detail for each part of the presentation. For instance, while it is important to indicate the procedures and the rationale behind selecting them, there is only a limited need for elaborating on operational specificities (see also: Section 6.2.2 Specific Techniques used by Interviewees).
- **Project stage:** The project stage is not entirely at an 'early stage,' as the students present their research design several times and therein, they already show prototypes and concrete ideas about how to evaluate such an artefact. However, beyond a limited literature review, they are not expected to operationalise the research and thus, there is no iterated artefact yet (thus, not 'later iterations' in which partial evaluation results would be available). This implies that the

students are not required to present any evaluation results. However, they should present their idea of how to evaluate the eventually emerging artefact.

## 8.3 Design and Evolution of the Artefact

As with the sub-class level artefact design, the instance-type level artefact design is designed by contextualising the class-level artefact. The starting point for this contextualisation includes the idea of using a checklist. This implies that the contextualisation of the class level artefact should be specific enough that guidance emerges which focuses on the explication of a story (i.e., step 5 of the communication design process) in that the students can follow an optimised checklist. To reach this state of the artefact, the knowledge about the communication situation is integrated into the communication design process in such a way that it removes at least the requirement for checklist's user to identify stakeholder means (step 1), define a purpose (step 2), specify a storyline (step 3). Section 8.3.1 elaborates on how this is operationalised. The summarising artefact that considers this contextualisation is presented in Section 8.3.2.

Before designing the instance-type level artefact, the goal (and thus the research question and the specific requirements for this artefact) needs to be specified. The requirements R1-3 from the class level artefact are adapted to the instance-type level. However, R4 does not apply. Instead, a context-specific artefact is appended to the list of adapted requirements to account for the need to make the artefact useful and likely to be used (see also the shortcomings of the contextualisation of the class level artefact to the sub-class level: Section 7.3.2.6). The new set of requirements is presented along with the class-level requirements in Table 49. Based on the context of the instance-type level of the research problem, the following research question should be answered through the artefact:

**RQ at the Instance-Type Level:** How can students present their DSR research designs in the context of a research methods course?

*Table 49: Situating Class Level Requirements to Instance-Type Level Requirements*

| Class-level Requirements | Instance-Type-level Requirements |
|---|---|
| **R1:** The artefact must accommodate different application situations along the design research process. | **R1'':** The artefact must specifically support students in presenting DSR research designs in the context of a research methods course at the master level. |
| **R2:** The artefact must support the definition of a stakeholder needs-based purpose. | **R2'':** The artefact must support the students in creating presentations that satisfy the central stakeholder needs. |
| **R3:** The artefact must support the selection, organising, and presentation of contents based on the purpose of communication. | **R3'':** The artefact must support students in the explication of their research design presentations. |
| **R4:** The artefact must support the operationalisation of knowledge about specific stakeholder needs. | **R4'':** The artefact must integrate well into a course environment. |

## 8.3.1 Contextualisation of the Class Level Artefact

The contextualisation of the class level artefact follows the same procedure as the contextualisation for the sub-class level (i.e., according to the five steps of the communication design process).

### 8.3.1.1 Identification of Stakeholder Needs

Knowing that the audience is made of evaluators and that they have the primary need to understand the content well to form an evaluative opinion about (an aspect of) it. Hence, the primary stakeholder need would be for the presentations to be helping the audience to understand clearly the contents provided. At the same time, the task to evaluate something comes with a focus. For example, maybe the evaluators are to evaluate the presentation capabilities of the communicators – or they may evaluate the feasibility of some idea that is being pitched. Hence, it is relevant to clearly communicate the contents and select them so that the focal evaluation is adequately enabled. From the characteristics of the communication situation (above), two main needs of the academia-oriented audience can be specified:

- Need to understand the contents well
- Need for content that is relevant for the focus of the evaluation

As evaluators of the student presentations, the instructors' task is to judge whether the groups' suggested research designs are of appropriate quality. Based on the lectures, the focus of these presentations is on answering the questions of what, how, and why. The

‘quality’ thus also refers to these points. Hence: What are the relevant aspects of the research project, and are they clearly and explicitly described? Does it become clear how exactly the research should be conducted? Are there good reasons why the proposed research design decisions are chosen and why the procedures were operationalised as proposed? The evaluators primarily need to understand the problem, the solution, and how the solution was created. Thus, combining the general needs for understanding the contents and the need for relevant contents, the following needs in this particular use case arise:

- Understand the **research problem**: what is it, how does it materialise, why does it not disappear?
- Understand the **research question**: what is it, how does it specify, why is this sensible?
- Understand what the **research gap** is and how the group has investigated it.
- Understand what the **knowledgebase is**, how it is used, and why.
- Understand what **methodology** was chosen, how it is applied/operationalised, and why.
- Understand the **design requirements**, how they were elicited, and why.
- Understand the **procedures** used throughout the design and evaluation, how they are applied, and why these procedures were selected.
- Understand the **targeted outcome** of the research process, how the research process leads to that outcome, and why this is a suitable approach. (This includes intended contributions to research and practice, limitations of the design, and opportunities for further research.)

The lecture material explicitly indicates that it is not part of the students’ task to ensure that their topic is interesting or entertaining for the instructors. They furthermore do not need to be willing or able to operationalise their designs in person. If the research design was based on a real research project, then that project’s progress or the design decisions taken therein are irrelevant for the evaluation. The science communication outcomes of creating awareness for a problem, sparking enjoyment of consuming the communication, and raising interest in the topic or project (Burns et al., 2003) are not required.

Beyond the needs of the audience, the students themselves have various needs. The primary shared need is to reach a satisfying evaluation result. While it may be a point of discussion, whether the highest absolute grade or maybe just a passing grade is targeted, the author assumes in the following that the students want to achieve with their

presentation the highest grade possible for the result (research design) they came up with. Hence, their primary interest is likely to be "making the best of what it is."

Regarding the operationalisation of a guiding artefact, these needs can be seen as the benchmark questions to evaluate the communication outcomes. In other words: Guidance for this instance-type with these stakeholder needs should, in the end, satisfy at least the most important of these needs. The most important need is for the presentations to convince the lecturers that the students have reached the goal of the overall course: That they **have understood how good research designs are created**.

#### 8.3.1.2 Purpose of Communication

The students' purpose of communication is thus **to convince the instructors of the quality of their research design to signal their understanding of how good research designs are created**. This includes the signalling of their understanding of the course material. The attainment of this purpose hinges on the students' ability to create understanding in their audience. The actual grading (or the related opinion that the lecturers are to form) is a derived evaluation of the attainment of this purpose. The presentations' explicitly do not need to reach secondary effects such as emotional relatability of the problem, the interestingness of the topic, or the presentation's entertainment.

#### 8.3.1.3 Preparation of an Adequate Storyline

The milestones of the storyline can be thought of as a succession of 'arguments' that should culminate in achieving a goal. In this case, that goal is to achieve the purpose described above. Considering the content of the research methods course (including the task given to the students) and the informational needs of the audience (see Section 8.3.1.1), the following milestones of understanding can be defined. The audience understands:

1. the research problem
2. the specific focus of the proposed research design
3. the research design
4. the implications and limitations

These milestones are quite generic, but they satisfy two aspects of a storyline (i.e., the general milestones that are to be achieved and the order in which they are to be achieved). For these milestones to become more instructive, additional information on what they imply is necessary. This information is provided in the next paragraph. Furthermore, in this phase of applying the framework, the rationale should be clarified, how

each milestone leads to the next one (i.e., the third aspect of this step). These considerations are also included in the explanations that follow.

The **understanding of the research problem** can be split into various aspects, as specified in the course material presented to the students of the course: A research problem consists of (1) a situation in which the problem materialises (i.e., the status quo), (2) stakeholders and their goals, which conflict with that situation (making the situation itself problematic), (3) contextual developments related to the problem (e.g., trends or societal change), and (4) the relevance of the problem (i.e., the scope of stakeholders being affected and the scale of adverse or beneficial effects that arise from the problem or from solving it). To understand a research problem and thus reach the first milestone of the students' project communication, all four aspects need to be satisfactorily clarified. Only once the research problem is clarified can the specific focus of the research design be elaborated on.

Creating an **understanding of the specific focus of the proposed research design** requires some justification as to (1) what the focus shall be and (2) why that focus is interesting or adequate. This is usually done by introducing and formulating a specific research question. However, the focus can also be clarified without formulating the research question (Section 7.2.2.2). The milestone is reached once the audience clearly understands which part of the research problem should be solved by the research project and, hence, what is outside the research project's scope. Only once this is clarified one can reasonably introduce the research design.

The **understanding of the research design** can be achieved by clarifying the central aspects that make up a research design. For the students, this means that the definition of a research design should be consulted. According to the course material, a research design describes (1) an explanation as to why the existing solutions are not satisfactory, (2) the techniques and methods used (e.g., reference approach), (3) a summary of how these are used to solve the focused problem, (4) a description of how the requirements are elicited, (5) a description of the design process, and (6) the validation strategy. The students do not need to implement the research design, but they are requested to show that they know how to plan a research project such that the design decisions are suitable to solve the focal research problem. Therefore, the research design should not only describe procedures but also explain how these procedures fit together to yield contributions to practice and research (implications). Furthermore, the students are expected to prove an awareness of what their design decisions imply regarding limitations.

The **understanding of implications and limitations** builds on the research design. It contains the specification of the expected contributions (what is it and how should it solve the problem?) and the limitations that exist based on the procedures chosen (limitations of the artefact's projectability and the limitations that stem from the procedures used). This milestone relies on the preceding milestones.

#### 8.3.1.4 Selection of Mode, Means, and Format

In the case of the student presentations, it is not up to the students to select the presentation's mode, means, or format. This is common in academia-oriented communication, especially when the audience is made of evaluators. For example, there are usually very specific submission requirements for peer-reviewed outlets or research grant applications. Hence, the students need to know how the specified mode, means, and format are best used. As they are familiar with the modalities required by the instructors and since they are used to presenting under similar circumstances with the same tools, the author does not perceive a need for guidance on how to best use the mode, means, and format.

#### 8.3.1.5 Explication of the story

This last step of the communication design process is when the presentations are compiled. The guidance for students should include specific pointers as to how the above-described storyline may be operationalised (R''3). To achieve this, the artefact is designed to include a checklist-like compilation of half-statements and questions that specify the storyline. It is ensured that the purpose of communication and, thus, the central stakeholder needs are addressed by using the storyline as an underlying structure.

The intention is that students who use this guidance will more effectively present their projects than students who do not use the guidance. 'Effectivity' in this context means that the ones who use the artefact should better satisfy the stakeholder needs in general and the purpose of communication in particular.

### 8.3.2 Summarising Artefact: A Checklist

The designed checklist-like artefact summarises the insights and reflections from the contextualisation of the class level artefact in a similar way as it did for the sub-class level artefact. The original artefact is in German (the course language). However, the author's translation, presented in a re-formatted fashion below, is likely to be adequate, as the underlying rationale for each statement is known to the author.

**Research Problem, Research Question, and Reference Approach**

- □ The design problem is: _____ (neutral description of the situation)
- □ This is a problem for: _____ (which stakeholder group(s)?)
  - o … whose goal it is to: _____ (focal goals that are not reached)
  - o … whose challenges include: _____ (problem-focused challenges)
  - o … in the context of: _____ (which context factors accentuate or perpetuate the problem?)
- □ This is a relevant problem, because: _____ (provide evidence, e.g., scope * scale, hence, number of stakeholders affected * effect size)
- □ We focus on the specific aspect outlined in this research question: _____
- □ The research objective is: _____ (what should be designed?)
- □ To achieve this, we proceed as follows: __ (summarising statement indicating the research approach, e.g., the reference approach of Peffers et al., 2007)

**Design Methodology and the Knowledgebase**

- □ We use the following design methodology: __ (presentation of the operationalisation of the approach, optional: references to, e.g., Peffers et al., 2007 or Hevner, 2007)
- □ We justify the choices for our approach as follows: _____
- □ We research existing solutions as follows: _____
  - o Existing solutions (from research and practice) are inadequate, because: _
  - o However, the following general explanations or solution approaches are promising as a basis for this project: _____
  - o Based on this foundation, our contribution consists of: _____ (name a specific artefact type and use this type consistently)

**Requirements, Construction, and Validation**

- □ We gather, analyse, and prioritise the design requirements as follows: _____
- □ During the artefact construction, we proceed as follows: _____
- □ We validate our design as follows: _____
  - o We iterate the design activity until the following conditions are met: __
  - o We show that the artefact is useable in practice by: _____
  - o We prove the usefulness of the artefact as follows: _____
- □ (For each empirical study: Adequate description of data, namely:
  - o What data is gathered? (quant/qual, content, volume)

- Why and to what end (in the construction process) are these specific data gathered?
- How exactly are these data gathered? Why is this a suitable approach?
- How are these data analysed? Why is this a suitable approach?

**Discussion and Implications**

- □ Our research design is based on the following assumptions/comes with the following limitations: _____
- □ Our research contribution (design knowledge) is: _____
- □ Our results enable the following future research: _____
- □ This is how our results provide usefulness to practitioners: _____

## 8.4 Demonstration and Evaluation

A natural field experiment is used to evaluate this artefact. This method is suitable because it focuses on identifying real-world effects (i.e., external validity). Thereby, the artefact's effectiveness can be evaluated in its natural environment (Cahenzli et al., 2021a; Gupta et al., 2018). Hence, the artefact was implemented within the above-described research methods course, and its effectiveness was measured in specific communication instances (i.e., recorded voice-over-PowerPoint documents containing the students' research design presentations). Because of ethical concerns, all students in the same semester received the same manipulation. Otherwise, some might feel unequally treated (and if the artefact is effective, the ones without access to it would be right to be upset). Furthermore, it is unrealistic to provide some student groups with specific and detailed guidance and to expect the students that do not receive such guidance to be unaware of it. Hence, the class of the spring semester of 2021 was provided with the artefact, which was fully integrated into one of the lectures. The control group is the class of the spring semester 2019, during which the same course material and lecture design were used—apart from the improved checklist.

Researchers with a good understanding of design science research and research designs analysed the dataset (i.e., the voice-over-PowerPoint presentations of both classes). Such researchers assessed it because of their ability to take an evaluator's perspective in this context. However, an evaluation by the lecturers or the author himself is not appropriate, as they can be biased and yield data with poor validity. (For the same reason, simply using the groups' grades on the assignment is inappropriate.) Instead, independent assessors were acquired to assess the presentations based on a double-blinded study design. The full evaluation study can be found in Appendix F.

The results from the assessment of the field experiment data can be seen in Table 50, where the evaluation criteria are listed along with the average scores for the non-manipulated and the manipulated groups' presentations (each with n=42), the absolute and relative difference between the groups and the results of a t-Test per item.

*Table 50: Results and t-Test from the Evaluation of Presentations*

| | Not Manipulated (n=42) | Difference | [%] | t-Test P(T<=t), one-tail | Manipulated (n=42) |
|---|---|---|---|---|---|
| Clarity about the research problem | 5.262 | 0.29 | 5.4% | 0.160 | 5.548 |
| Clarity about the focus of the study | 4.976 | 0.21 | 4.3% | 0.210 | 5.190 |
| Clarity about the research gap | 4.595 | -0.05 | -1.0% | 0.449 | 4.548 |
| Clarity about the knowledge base | 4.548 | 0.00 | 0.0% | 0.500 | 4.548 |
| Clarity about the general approach | 4.619 | 0.62 | 13.4% | 0.047 | 5.238 |
| Clarity about the requirements | 4.548 | 0.05 | 1.0% | 0.444 | 4.595 |
| Clarity about the design process | 4.619 | 0.05 | 1.0% | 0.440 | 4.667 |
| Clarity about the artefact | 4.786 | -0.07 | -1.5% | 0.409 | 4.714 |
| Goal of the course | 4.619 | 0.52 | 11.3% | 0.036 | 5.143 |
| Perceived informativeness | 4.929 | 0.36 | 7.2% | 0.104 | 5.286 |
| Perceived entertainment | 3.810 | 0.05 | 1.3% | 0.443 | 3.857 |
| Overall response averages | 4.665 | 0.18 | 3.9% | 0.182 | 4.848 |

The analysis of the 21 assessors' evaluations (4 evaluations per assessor, n=84) shows that the overall assessment of the satisfaction of the needs and the achievement of the purpose (i.e., items drawn from Sections 8.3.1.1 and 8.3.1.2) is positive, with ratings that are 3.9% higher for the group who had access to the checklist versus the group that did not (manipulated vs not manipulated). However, this average effect is not significant. Furthermore, many of the average values per item are only marginally different (6 items between -1.5% and +1.5%) and insignificant. However, the clarity of the research problem and the perceived informativeness of the presentations improved by more than 5% (though still not significant at the $\alpha$=0.05 level, with +5.4% at p=0.160 and 7.2% at p=0.104 respectively) and the clarity of the general research approach, as well as the perceived achievement of the purpose of communication (i.e., to convince the evaluators of the quality of their research design to signal their understanding of how good research designs are created, item "Goal of the course" in Table 2), are both significant (at the $\alpha$=0.05 level, with +13.4% at p=0.047 and 11.3% at p=0.036 respectively).

The primary purpose of communication was significantly improved, with the highest significance level among the items indicating that the artefact is effective. It also

indicates that several of the needs listed above did not need to be improved to achieve this result. However, the clarity about the general approach is significantly higher (largest difference in scores). This, in turn, may indicate that it is especially important for students to clarify the general approach in order to achieve the purpose of communication.

Overall, these results indicate that the artefact has indeed helped achieve the purpose of communication and that it is effective. The research question and the individual requirements are compared with the outcomes to finalise the artefact creation for the instance-type level of analysis:

*Table 51: Evaluation of the RQ and the Requirements Against the Results*

| Instance-type-level Requirements | Commentary |
|---|---|
| **RQ:** How can students present their DSR research designs in the context of a research methods course? | The checklist answers this question by providing a very specific outline for presenting such research designs in this context. The artefact is validated, and it is effective—it satisfactorily answers the RQ. |
| **R1'':** The artefact must specifically support students in presenting DSR research designs in the context of a research methods course at the master level. | The checklist accounts for the specificities of the research methods course, and it provides a highly specific supporting structure for students. |
| **R2'':** The artefact must support the students in creating presentations that satisfy the central stakeholder needs. | While the evaluation showed that only some of the stakeholder needs were satisfied better with the artefact, it does not have significant adverse effects either. The purpose is achieved, but further development might improve some of the unaffected stakeholder needs. |
| **R3'':** The artefact must support students in the explication of their research design presentations. | The artefact provides insights into the storyline (what should be presented in which order) and sets a level of abstraction (by specifying questions and partial statements) which students can use to orient themselves in the explication. |
| **R4'':** The artefact must integrate well into a course environment. | Given that the context in which the artefact was introduced has already used a general-purpose checklist (i.e., in the course material and discussed during one of the lectures), the more specific checklist-like artefact could be introduced without major alterations of the course material or the lectures. |

# 9 Discussion

This section begins with a summary of the research problem and reflects on this dissertation's questions and answers (Section 9.1). After that, the research limitations are critically discussed (Section 9.2). In light of these limitations, the contributions to research and researchers are formulated (Section 9.3), followed by recommendations for future research.

## 9.1 The Answers to the Research Questions

The communication of design research projects is a sub-process of design science research that takes place throughout each research project. Thereby, the many communication situations design researchers face are diverse. They vary in characteristics, such as stakeholders and the role of the audience, the project stage, or the format in which the communication is performed (Cahenzli et al., 2021b; Mauelshagen & Jakobs, 2016). Furthermore, communication does not just happen. It is a purposeful construction and, therefore, pursues a goal (Davies, 2019; Liang et al., 2014). This middle-ground between the characteristics of a communication situation (i.e., the starting point or setting of a communication process) and the achievement of the communication goals is a process. This process needs to be adapted based on the situational characteristics and the goals pursued in a specific communication instance. What this process looks like is not self-evident. This is because design research is complex, involves communication partners with diverse backgrounds, interests, and terminologies; because it follows a non-linear and hardly predictable course that leads to a wide variety of possible research outcomes (Hevner, 2007; Hevner et al., 2004; Peffers et al., 2007).

The difficulties in communicating design research projects to researchers and practitioners is thought to be a contributing factor to IS research not having as much of an impact in practice as one would expect (e.g., Agarwal & Lucas, 2005; Benbasat & Zmud, 2003; Straub & Ang, 2008). However, based on current literature, design researchers do not have adequate guidance on how they might communicate their research projects effectively. For this reason, the first research question (**RQ 1**) asks for some support for communicating design research projects in general.

Recognising the research problem environment as a combination of situational factors, goals, and a process, the author investigated (1) how the problem materialises, (2) what important situational characteristics are, (3) how these affect the communication process, (4) what this communication process might look like, and (5) what outcomes

design researchers wish to achieve (Sections 5 and 6, Appendix A). Based on these literature and interview-informed investigations and in several design iterations, a use-case agnostic DSR Communication Framework emerged as a solution that answers RQ 1 as follows: Design researchers may gain awareness of their communication situation's characteristics, such that they can access and re-use knowledge about the implications of these situations on the communication design process. Since these implications are relatively stable (e.g., the needs of practice-oriented audiences generally include a discussion on a very low level of abstraction and a direct relation to the audience's practical concerns), they can be collected, shared, and thereby made available to all design researchers. This allows for building knowledge to be re-used situationally (see knowledge containers in Figure 2). After identifying the communication situation's characteristics, the main stakeholder needs are to be specified (first step of the communication design process). The purpose of communication should thereafter be specified under the inclusion of the stakeholder needs. The third step of the communication design process is the construction of an adequate storyline. This means that the main milestones that should be achieved during the communication delivery should be specified and brought into an order that can satisfy the purpose of communication. The first three steps of this process require knowledge about the audience (primarily their needs) and the research project. Other communication-affecting characteristics become only relevant in the explication of the communication story. For this reason, the implications of the remaining characteristics of the communication situation are only introduced to the process in step four. This also implies that once a storyline for a specific situation has been defined, its delivery can be repeated across various situations, so long as the main stakeholder needs remain the same. The last step is the explication of the story, based on the storyline and the boundaries provided by the implications.

This abstract solution applies to all design research project communication instances. To test its usefulness in guiding design researchers in their communication endeavours on the one hand and to solve a relevant sub-class of design researchers communication problem (i.e., writing design research articles) on the other, this framework has been used to answer the second research question (**RQ 2**). The second and third artefact emerged from investigating the situational characteristics related to writing research articles along with their implications (primarily based on document analyses, see Section 7.2 and Appendix B-Appendix E). Considering that the activity of writing research articles is more specific (i.e., a sub-class of the research problem) than general research communication (i.e., the problem class), the DSR communication framework needed to

be contextualised by narrowing its scope (removing aspects that do not apply) and increasing its specificity (by adding contextual information). This removes the need for the morphological box from the first artefact (i.e., 'Characteristics of the Communication Situation' in Figure 37) and enriches the process with generally applicable prescriptive statements and prescriptive statements that apply depending on one's specific goals. The prescriptive statements, ordered by process step, are presented in Section 7.3.2. This is the second artefact, answering the second research question.

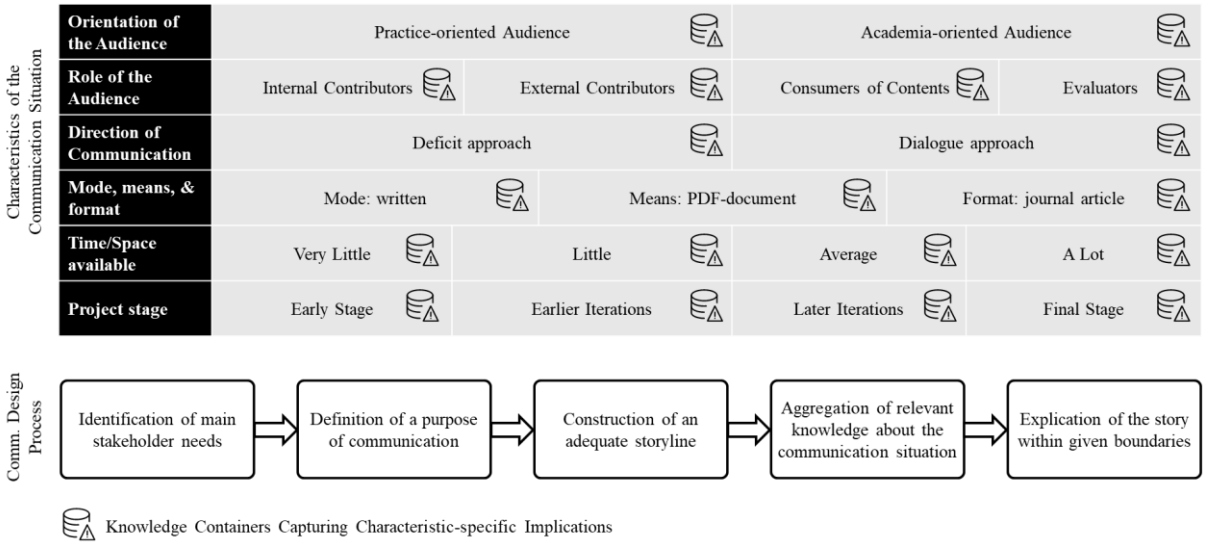


*Figure 37: A DSR Communication Framework*

Early evaluative discussions with peers revealed that artefact 2 is unlikely to gain widespread adoption because it is cumbersome to use. However, its prescriptive statements are based on a solid research design, addressing a real problem. For these reasons, another artefact was designed for this same research question. Its purpose is to increase the potential impact and, thereby, the usefulness of this research. This artefact is a quick-guide (i.e., a short document that provides only the essential information to make an informed decision and help solve one's problem). This guide is a PDF document containing information about the goal of communication, the necessary (vs optional) content elements, how these content elements are best explicated, a selection of four effective article structures, and the selection logic for identifying the right structure for one's specific publication project. Whereas the second artefact is very closely informed by empirical evidence, the derived third artefact needed further evaluation. A survey with design researchers reveals that the artefact is effective, helpful, and would be used by them. Therewith, the second research question is satisfactorily answered.

Furthermore, the third artefact also contains a reference to the source material (i.e., this dissertation, including the second artefact) for the users who wish for more information about the prescriptions on writing a research article. This, in turn, increases the usefulness of the second artefact. Together, artefacts 2 and 3 prove that artefact 1 is applicable and can thus help design researchers in their communication endeavours.

Finally, the third research question (**RQ 3**) focuses on a situated communication use case (an instance-type). A fourth artefact was designed to test whether artefact 1 is also useful to provide guidance in communication situations that are much more narrowly defined than the writing or articles. It is a checklist for students who need to present DSR research designs in the context of a research methods course. To create this checklist, the same procedure was used as for the guidance in writing research articles (i.e., removing aspects of artefact 1 that do not apply, extending what remains with situation-specific knowledge, testing the usefulness of the resulting artefact). In this case, a field experiment is used to provide evidence for its usefulness. While some outcome measures did not significantly improve, the measurement of the achievement of the main purpose of communication did. Therewith, a satisfactory artefact is created, and evidence for its usefulness is found. This answers the third research question.

## 9.2 Limitations

The research presented throughout this dissertation comes with some limitations. These arise partially from the research design and partially normative decisions that are necessarily taken in a design research endeavour. The main limitations that concern the overall research project are discussed in the following, whereas limitations of individual empirical studies are discussed in their respective appendices (Appendix A-Appendix F).

During the problem analysis (reported on in Section 5), one aspect that is also a peculiarity of DSR (see Section 2.3.1.2) emerged that is not addressed explicitly by any of the artefacts. Namely, setting an adequate level of abstraction is perceived as a challenge for design researchers. The level of abstraction used to discuss the research project is an implicit implication of knowing about the main stakeholder needs (step 1 of the communication design process). Hence, knowledge about the primary stakeholder may clarify the level of abstraction that should be used when portraying the research project and its outcomes. This might not do the problem justice, however. Especially in academia-oriented communication, the levels of abstraction are unclear (see also: Section 5.2). This is one aspect that the design might have put forth more strongly. Hence, the usefulness of the artefact might be limited in this problem aspect.

Methodologically, using (IS) DSR for addressing this research problem is not strictly in line with the explicit goal of DSR to create IT-related artefacts (Gregor & Hevner, 2013). After all, it does not venture "to generate prescriptive knowledge about the design of Information Systems (IS) artefacts like software, methods, models, and concepts" (vom Brocke & Maedche, 2019, p. 379). Instead, this dissertation yields useful artefacts for researchers who create IT-related artefacts. The overarching methodology used (Hevner et al., 2004; Peffers et al., 2007) has thus not been developed for this specific application. The author does not believe that this affects the suitability of this pragmatic, utility creating general research approach. However, there are other design-oriented approaches that use principles of science to create actionable solutions. Another approach may be even more suitable for creating guidance (e.g., design-based research in pedagogics, Hoadley, 2002; The Design-Based Research Collective, 2003). The author thus takes a more general viewpoint in judging the suitability of the research approach and does not focus on the 'IS' aspect of DSR. Hence, this implies that DSR is used with the more general understanding that DR projects are projects that "seek to produce knowledge about how to solve important problems in a defined application domain" (vom Brocke et al., 2020).

Lastly, despite using the utmost care and professionalism throughout this design research endeavour, some relevant information might have escaped the author's attention. To minimise this risk, the author has used various techniques such as triangulation (artefact 1: interviews and literature; artefact 2-3: four studies that analyse various interrelated aspects of the phenomenon and a survey to additionally evaluate artefact 3; Bortz & Döring, 2006, p. 365; Morse, 1991), double-blinded study-design (field experiment, Bortz & Döring, 2006, p. 84), random assignment (field experiment, Bortz & Döring, 2006, pp. 54, 524 f.; Cahenzli et al., 2021a), mixed- and multi-method research designs (Creswell & Creswell, 2005), or clearly formulated coding guidelines (interview study, qualitative structure analysis, and quantitative structure analysis, Bortz & Döring, 2006, p. 153). Nevertheless, it cannot be ruled out that something has either escaped the author's attention or was inappropriately judged to be less or more relevant than it really is. Furthermore, as with all design research projects, the author has taken various artefact design decisions throughout this dissertation. Other design proposals could yield the same or better results. This is an inherent characteristic of design research. However, the author's care taken in creating adequate research designs and operationalising them allows for some confidence that its contributions are valid.

## 9.3 Knowledge Contribution

This is a dissertation. It, therefore, should fulfil two major purposes: "(1) show that the candidate can independently address an important problem in the field, and (2) (making) an original contribution to knowledge" (Isaac, Quinlan, & Walker, 1992, p. 242). That the problem is important within and for the field of Information Systems has been introduced based on anecdotal evidence in Sections 1 and 4, underlined with literature in the introduction, the background knowledge section and Section 5.1, and empirically confirmed in an interview study (Section 5.2, Appendix A). The original contribution to knowledge can come in various shapes and forms. For example: at theory, partial theory, incomplete theory, or an empirical generalisation in the form of a new artefact (Gregor & Hevner, 2013). In this section, the various findings spread throughout this dissertation are synthesised to indicate their contribution to researchers and research.

### 9.3.1 Contributions to the Practice of Design Research

The contributions of this dissertation are geared toward design research as an object of study and a practice of research. For this reason, the 'practice' audience to which this dissertation ought to contribute consists of design researchers and not IS practitioners in the narrower sense of this term. After all, the practice of design research communication as investigated here is concerned with activities that researchers do. While the individual artefacts are not repeated here (see instead Section 9.1), these can be seen as individual contributions to the practice of design research. They do so by providing guidance in for a relevant and critical task of the researchers work activities (Liang et al., 2014; Tremblay et al., 2018), both facing academic (Gregor & Hevner, 2013) and practitioner audiences (Mirkovski et al., 2020; vom Brocke & Maedche, 2019). The artefacts provide insights on what is to be considered when facing a communication situation. In addition, they feature explicit prescriptions on how to proceed and when and how the individual characteristics of a communication situation are to be integrated into the communication design process. This is true for all four artefacts. However, the more specific the artefact is, the less its users need to worry about this integration step.

Hence, this dissertation contributes to the practice of design research by providing conceptual and procedural guidance to design researchers. It does so on four levels of specificity. More specificity implies less generalisability (Baskerville, 1996). The artefact at the lowest level of specificity (i.e., the DSR communication framework) is a general communication framework that applies to all design research communication situations. This caters to the finding that there are many and diverse communication situations

throughout a design research project (Section 5.2) and that existing guidance is geared toward only a few communication situations (primarily summative project communication in academic journals, e.g., Gregor & Hevner, 2013). By their nature, such generalised solutions need to be contextualised before use. This indicates that design researchers (practising communicators) need to invest additional effort before using the first artefact. While this is a concern with the current state of the artefact, this provides opportunities for research (see also: Section 9.4). Namely, the class level artefact can be contextualised to a lower level of generality by investigating sub-classes of communication situations or even instance-types (i.e., narrowly delimited communication sub-classes).

To increase the value of the contribution to the practice of communicating design research, this task has been done twice in this dissertation, yielding artefacts 2-4. This provides researchers with more applicable guidance (but with a narrower scope) and insights on how they can contextualise the DSR communication framework for their own communication situations. Namely, it clarifies that prescriptive knowledge needs to be extracted from the environment of the specific problem situations (exemplified with the problems of writing research articles and presenting DR research designs) and used to contextualise the general DSR communication framework. The artefact creation for artefacts 2-4 (Sections 7-8) thereby directly contributes to improving the communication of design research projects in the communication use case of writing research articles (artefacts 2 and 3) and presenting DR research designs (artefact 4), and indirectly contributes to the improvement of DR project communication by showing how the framework can be applied to any communication situation.

Finally, the most crucial communication situation for design researchers is writing research articles (incl. content selection, structure, and presentation) that can be published in prestigious IS outlets (Gregor & Hevner, 2013; Tremblay et al., 2018). For this specific communication problem, artefacts 2 and 3 provide hands-on support in the form of prescriptive statements that are directly based on evidence from these outlets.

### 9.3.2 Contributions to Design Science

The contributions to research concern the field of study that investigates DSR. This has been specified as being Design Science in Section 2.1.2.1, albeit focusing on reflects on artefact construction and artefact evaluation methods on a generic level to establish standards for its rigour (Winter, 2008). Nevertheless, the contributions in this

dissertation can be understood as contributing to the knowledge about practices (but not practices of artefact construction) and procedures (though not artefact evaluation methods).

The primary contribution to understanding practices is descriptive rather than prescriptive. This dissertation features the first research-based investigation of the overarching problem of communicating design research. A very limited body of literature addresses the communication of design research (e.g., Gregor & Hevner, 2013; Peffers et al., 2007; Tremblay et al., 2018; vom Brocke & Maedche, 2019). Within these articles, sub-classes of the problem are investigated (primarily the communication of DR projects in academic journal articles). Having identified the need for a more general understanding of the research problem (and for a more generally applicable solution), the author has analysed the overarching issue (Section 5). This contributes insofar to research, that it provides an improved understanding of the research problem, allowing for the design of further solutions (see also: Section 9.4), but also for identifying further sub-classes of the research problem which may be interesting to investigate (e.g., setting an adequate level of abstraction, see limitations 9.2).

Another contribution of this dissertation is the conceptual understanding of design research project communication as an input, process, output model (see Section 2.2.2 and Appendix G). This conceptualisation of DR project communication is founded in literature, triangulated with empirical evidence (expert interview study), operationalised in artefacts 1-4, and conceptually (artefact 3) and empirically (artefact 4) evaluated. This is new to the discussion about communicating DR projects—both facing academic audiences (e.g., Gregor & Hevner, 2013; Peffers et al., 2007; Pollock & Bono, 2013) and practitioner audiences (vom Brocke & Maedche, 2019). It allows for atomising the problem (e.g., into specific implications of individual characteristics on the communication process) and provides a general direction for approaching DR project communication problems (i.e., as an IPO model in which (1) inputs need to be recognised, (2) a process needs to account for these inputs, and (3) the process needs to be effective in achieving an output).

The third contribution to research that is distinct from the individual artefacts is that it isolates the topic of DR project communication as its own, legitimate stream of study. Communication of DR projects has generally not been perceived as a relevant sub-process of DSR. Instead, it is implicit that communication must take place. This can be concluded from investigating the most influential methodological guidance about DSR, namely: Hevner et al. (2004, the parent article to the herein used three-cycle view in

Hevner, 2007), which accounts for 60 percent of the reference approaches used in DSR articles published in the Senior Scholars' Basket of Journals, and Peffers et al. (2007), which accounts for another 21 percent of these articles, see: Engel et al. (2019). In Hevner et al. (2004) and consequentially in Hevner (2007), 'communication' plays an important but methodically unaddressed role. Indeed, the rigour cycle requires some exchange between the problem environment and the researchers. At the same time, exchange with the scientific community (including the publication of research articles) is crucial for the rigour cycle. One can say that communication in DSR is essential and that this communication includes the communication of DR projects. Somewhat confusingly, Peffers et al. (2007) explicitly includes the communication of DR projects in the DSR methodology—even including both academic and practitioner audiences—but it does so as a summative process step. This is undoubtedly an important part of the research process, and the communication toward practice is arguably even more relevant for design research than it is for descriptive research. After all, it is the purpose of DSR to create utility for the practice of IS in organisations (Hevner et al., 2004; Winter, 2008). However, the fact that communication is a sub-process that parallels all steps of the research process (see Section 5.4) is also merely implied in their methodology (e.g., in the investigation of the research problem (step 1) or for evaluating requirements (step 2), or evaluation in general (step 5)). The fact that effective communication is both methodologically paramount and only implicitly included in design science literature (with some situated exceptions such as Gregor & Hevner, 2013; vom Brocke & Maedche, 2019) is revealed and discussed in this dissertation. Therewith, a new and legitimate stream of study about the DSR methodology is identified.

## 9.4 Research Agenda

As a concluding contribution of this dissertation, the author shares a few thoughts based on his experiences from the underlying research about future research opportunities.

First, the problem analysis revealed that it is not self-evident for design researchers what level of abstraction they may select for communicating their projects. This somewhat applies to practitioner audiences (despite design research's focus on classes of problem instances, practitioners are primarily interested in concrete, instance-level discussions or solutions), but it is much more relevant for academic audiences. As revealed in the interview study, the practice of design researchers writing 'design principle papers' because these appear to be most publishable at this time, and selecting a very low level of

analysis (i.e., an instance type), but formulating almost trivial design principles might be something to ponder. As formulated by one of the more senior interviewees:

> *"The challenge we have is (...) that we don't know at what level of abstraction (...) we should communicate the design knowledge in the end. (...) I don't know whether we are, as design science researchers, going into the right direction when it comes to these design principles that now everyone wants to formulate. (...) If you take these design principles to practitioners, they would just laugh at you. (...) We need to further reflect on how we need to document design knowledge in a way that is (...) really usable (...) and it just shouldn't be trivial." (interviewee 6)*

Second, the primary artefact (i.e., the DSR communication framework) is most useful if knowledge about the implications of certain characteristics of a design situation is available. This dissertation has revealed a few of these implications (about a selection of situations through the interview study and the characteristics of the specific sub-class of article writing in particular). However, there is a need to investigate the precise implications of various characteristics in the framework. The more knowledge exists about these implications, the easier it becomes to contextualise and thus, render the DSR communication framework useful for design researchers.

Third, beyond investigating more implications of individual characteristics, it would be highly desirable to derive further guidance for more sub-classes of the communication problem. As done for the activity of writing a research article, future research may be used to create a deeper understanding of the specificities of various sub-classes of DSR project communication. In this dissertation, only the most relevant communication sub-class was investigated (i.e., writing of research articles). Other interesting sub-classes might include communication for acquiring implementation and evaluation partners, writing grant proposals, or presenting research projects at academic conferences. Doing so would fill the knowledge containers (if these results are shared in a meaningful way) and produce additional contextualised guidance.

Finally, the usefulness of the DSR communication framework depends on it being applied, which indicates that it should be accessed (or at least accessible) to design researchers. While a mature version of the framework has been published (i.e., Cahenzli et al., 2021b), it lacks a lot of the insights and details provided in this dissertation. Therefore, it would be desirable to make its findings more accessible to the relevant stakeholders. To this end, publications about the yet unpublished aspects and findings might

be valuable. In addition, the author proposes that the insights on the communication of DSR projects could be integrated into existing DSR tool support (Morana et al., 2018; vom Brocke, Fettke, Gau, & Seidel, 2017), provided as teaching material to professors teaching about DSR, and to develop a commonly accessible knowledgebase for these insights (e.g., a website, on which one could click onto the characteristics that apply to one's specific communication situation, which would feed all existing knowledge into the general communication design process; or which, if available, would yield Quick-Guides as the one developed for writing research articles).

# Appendix

The Appendix is heavily relied upon in this dissertation. Because the appendix is lengthy and its constituents relate to a variety of sections of the manuscript, an initial guide is provided here:

The Appendix consists of two types of contents: empirical studies (Appendix A-Appendix F) and supplemental material (Appendix G-Appendix M). The supplemental material can be understood as 'additional background information' and it is featured in the last appendix sections (Appendix G-Appendix M). The empirical studies are in some sense central to the project, as their findings directly contribute to it. Because the contextual information of these studies (such as raw data, methodological details or information about the operationalization of their research designs) is not directly relevant to the storyline for this dissertation. As with published literature, the findings of these studies are integrated into the manuscript by reference. As the author's original studies are unpublished as of the writing of this dissertation, evidence for their methodological rigour and adequacy of interpretations need to be provided. This is what can be found in these appendices containing the empirical studies. Each empirical study outlined below is presented in the same fashion, broadly complying with the nominal structure of the empirical research process (Peffers et al., 2007): rationale of the study, research approach, results and discussion, contribution to the design research project, limitations.

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# Appendix A Expert Interview Study

## A.1 Starting Point

The interview study builds on a reflective framework that was built to make sense of the topic and the problems related to design research project communication (Figure 38 shows this framework, Section 5.1 discusses it as a contribution toward the problem understanding, and Appendix G elaborates on its origins). The framework contains three parts: (1) Descriptive characteristics of a communication instance; (2) a crafting process (i.e., activities that lead to and include the communication); and (3) impact measures of the communication (i.e., the audience-facing outcomes created by the communication instance). Since these parts, the dimensions within these parts, and the characteristics of these dimensions were gathered based on existing literature, own experience, and reflection, the validity of this framework is untested. Because this framework is intended to be used as a support for conceptualizing the research problem in this dissertation, the validity should be evaluated. Hence, additional evidence needs to be gathered to probe the adequacy of the framework in general as well as the adequacy and the relevance of its constituents. For doing so, direct contact with design researchers promises to be most insightful. For this reason, the subsequently described interview study with design researchers was conducted. By validating this framework, and thus identifying, confirming, rejecting or appending to its constituents based on insights from the focal stakeholder (i.e., design researchers), the problem understanding should be improved.

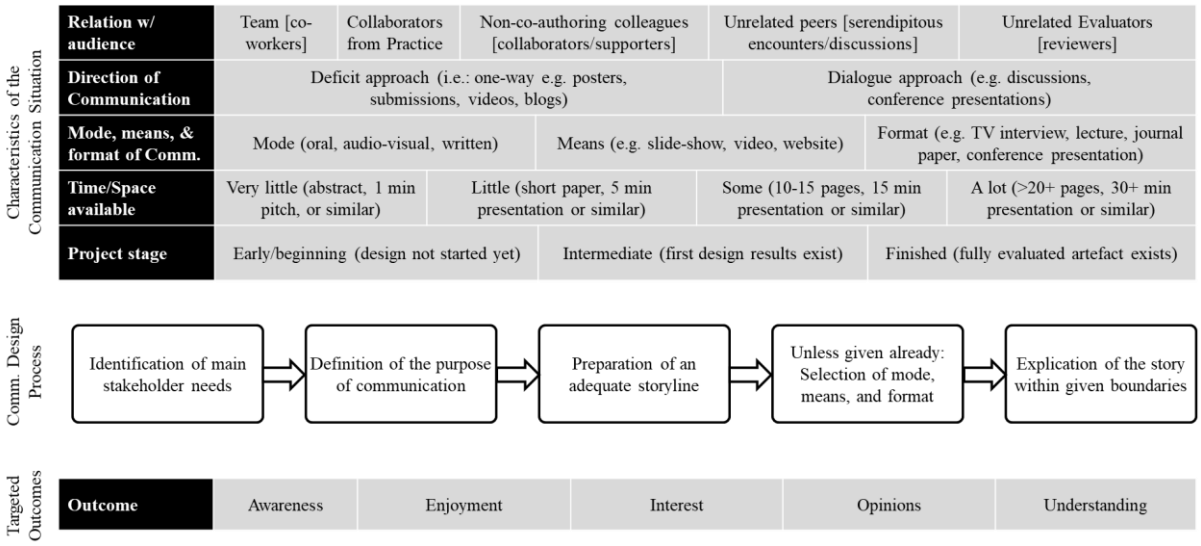


*Figure 38: Conceptualization of the Research Problem's Parts*

## A.2 Research Approach

Appendix A In this section, (1) an overview is provided about the research approach used for the study of the research problem and the larger phenomenon of communicating design research projects, with (2) specifications about the creation of the questionnaire, (3) the data collection procedures, and (4) the technique used to analyse the gathered data.

### A.2.1 Overview of the Research Approach

To validate and improve the understanding of the research problem, and to capture additional knowledge about the communication of design research projects, the author has conducted eleven semi-structured qualitative interviews (Bortz & Döring, 2006) with design researchers experienced as conductors and communicators of design research projects.

The author conducted the interviews as video calls and recorded the interviews for transcribing and for the subsequent analysis. Recording the interviews allows researchers to focus more on the activity of interviewing since there is no need to simultaneously write down answers. This is especially important for the semi-structured and unstructured interview types, as these require interviewers to improvise (Myers & Newman, 2007). The semi-structured qualitative interview is thereby characterized by the use of a broad ('half-explicated') structure that contains the most important questions but relies on the interviewer to add clarifying or deepening questions during the interview. By using this technique, the various aspects of the existing framework can be evaluated for their adequacy or suitability by asking prepared questions about its constituent parts. However, it is also possible to identify new dimensions or yet unanticipated aspects (through open, narrative response questions) or to gain an understanding of the relative relevance of dimensions and their characteristics (through ad-hoc inquiries). This is useful for the validation of the framework because merely testing whether the literature-derived aspects play a role in design research project communication leaves room for overlooking important aspects. Therewith, a deeper understanding of the research problem should emerge, which is an important lever for increasing the likelihood of creating a useful artefact.

### A.2.2 Creation of the Questionnaire

With the purpose of the interview being to evaluate, substantiate, and improve the afore-created framework, some underlying structure for the questionnaire was already given.

Following this study's rationale, the interview questions were to cover (1) descriptions or characterizations of communication instances, (2) descriptions of the process that the researchers went through to create the communication outcomes, (3) and the discussion on what these outcomes are. In addition, (4) to gain a better understanding of the intricacies of the problem from the view of the main stakeholder, and (5) to capture any existing coping strategies and their perceived effectiveness, two additional focuses were added.

To accommodate these five core elements, the questionnaire (see: Appendix H, H.2) was divided into two main parts (more detail on the parts below):

- Part 1: Narrative account of a project and its communication instances.
- Part 2: Characterization of one/few communication instances.

To ensure that the gathered data is valuable, the creation of the questionnaire was an iterative process with pre-tests for preliminary feedback from colleagues, testing for completeness, clarity, and adequacy. Notable trade-offs navigated during the creation of the questionnaire include the granularity of questions versus the time commitment necessary to partake in the interview; the openness of questions versus the comparability of responses; the coverage of the framework versus the openness toward new inputs; and the general level of specificity of the questions (i.e., referring to one's overall experience vs. the experience with one particular design research project). In an attempt to optimize the compromises, not all aspects of the framework were enquired about (only the ones deemed most relevant), and the two parts covered two distinct levels of detail (the project level and the communication instance-level respectively).

#### A.2.2.1 Part 1 of the Questionnaire

To identify a wide range of communication instances and to allow the interviewees to lay out their experiences of these communication situations throughout a design research project, part 1 consisted chiefly of one question. The interviewees were asked to talk through one design research project, from their earliest involvement to the end (or the current day, if ongoing). Thereby they were to focus on communication situations. The interviewer has made use of many clarificatory follow-up questions and mirrored his understanding of statements to test whether the interviewee's message was understood correctly. This part did address all five focus areas outlined above, with a particular focus on goals 1, 3, and 4.

After finalizing their accounts of their projects, the interviewees were asked to identify a particularly influential or relevant communication instance to use in part 2. While this

selection was generally perceived as being difficult, it allowed the author to gain a feeling for the relative importance of certain communication instances. (The difficulty stemmed from the diversity of purposes of communication that seem hard to compare.) Thanks to the situational adaptiveness that the semi-structured interview method allows, sometimes two instances instead of one were selected for part 2 or one primary instance was selected but statements were then related to and compared with a selection of other instances.

#### A.2.2.2 Part 2 of the Questionnaire

The goal of the second part was to reveal the intricacies of a communication instance regarding three parts of the framework (characteristics of the instance; crafting process of the communication; impact measures). To allow for exploratory knowledge discovery and to benefit most from the interviewees' experience and expertise, the questions regarding each of these three parts were kept as open as possible. As an example of this, the impact measures (or targeted outcomes) were elicited as follows: "What did you intend to achieve with this communication instance?" Only once a full response was given, more specific and framework-related questions were added. Therewith, the comparability and completeness of the responses could be ensured, while not placing the interviewer's own ideas in the interviewees mind first and therewith influencing their responses toward confirming the framework's constituents. After all, indicating possible answers manipulates the interviewee towards thinking that the proposed options are the plausible ones, deterring them from providing deviating answers (Bortz & Döring, 2006, p. 238). This phenomenon is also know and "Anchoring-and-Adjustment" heuristic (Tversky & Kahneman, 1974).

The second part closed with questions allowing the interviewees to add any thoughts on their experiences and views on the topic of communication of design research projects. Therewith, unanticipated insights on specific experiences could be revealed on the one hand, while on the other hand the general views on the topic (such as: perceived relevance of communication, need for support, or issues in the publication system in IS) could be reflected on. Part 2 therewith covers all five focus areas.

### A.2.3 Data Collection

Before starting the data gathering, the author has conducted a pre-test of the questionnaire with a colleague who was at the time involved in a design research project himself. The feedback on understandability of questions, level of detail, and duration of the

interview was integrated into the questionnaire and helped shape a briefing document. That briefing document contains useful information for interviewees to consider before the interview takes place. It consists of a short summary of the dissertation endeavour, the study, and the specificities about the interview. The briefing document also features some key terminology and contact information. It neither contains any hints to the framework, nor does it contain the actual questions from the questionnaire. The briefing document, albeit re-formatted, can be found in Appendix H, H.1.

To recruit participants for the study, the personal networks of Prof. Dr. Robert Winter and the author were used. Potential candidates were contacted via e-mail, to which the briefing document was attached. Both the briefing document and the e-mail specify the anticipated length of such an interview. Based on the responses to these requests, a total of eleven interviewees were acquired. This sample contains some junior researchers (4, less than 5 years of experience), some senior researchers (4, more than 10 years), and some renowned experts in the design science research community (3, more than 20 years, see Table 52). This diversity allows for more differentiation in the answers. For example: Younger researchers might have different and/or more problems than more experienced researchers, and senior scholars might have more developed coping strategies than others. All interviewees are active researchers and most of them are currently involved in a design research project.

*Table 52: Overview of the Interviewees*

| | **Interviewee 1** | **Interviewee 2** | **Interviewee 3** | **Interviewee 4** | **Interviewee 5** | **Interviewee 6** | **Interviewee 7** | **Interviewee 8** | **Interviewee 9** | **Interviewee 10** | **Interviewee 11** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Experience (years) | 2 | 2 | 3 | >20 | >10 | >10 | 3 | ~10 | >20 | >20 | >10 |
| Interview time (mins) | 75 | 55 | 45 | 55 | 70 | 45 | 60 | 45 | 40 | 50 | 50 |
| Transcript length (pages) | 17 | 15 | 11 | 13 | 18 | 12 | 13 | 11 | 10 | 12 | 18 |
| Primary codes | 106 | 82 | 42 | 43 | 34 | 40 | 28 | 20 | 33 | 35 | 38 |
| Communication instances | 12 | 14 | 12 | 10 | 7 | 12 | 8 | 6 | 6 | 5 | 11 |

The language used during the interview was the same with everyone (English). While the participants were given the choice to answer in another language, they all agreed on the proposition of using English. This allows for more accurate data analysis and consistency across interviews, as the relevant English terminology is shared among the

interviewees, sicne they publish their research in English. The interviews were conducted via Microsoft Teams or Zoom, in a video-call format. The sessions were recorded to allow the author to focus more on listening and interacting with the interviewees. Based on these recordings, the author has written transcripts, which formed the dataset for the analysis.

### A.2.4 Data Analysis

The qualitative data obtained from the elven interviews is contained in 105 pages of transcripts. To fulfil the purpose of the interview study, insights need to be isolated with an appropriate technique of analysis. As such, both quantitative and qualitative content analyses can be used (Bortz & Döring, 2006, p. 328). For example, some quantitative aggregation of statements can reveal baseline information about the prevalence of certain sub-problems, use cases, or coping mechanisms (e.g., 5 interviewees stated that …). However, for a more detailed analysis of in-depth and limitedly structured data, qualitative content analysis may be more insightful. Qualitative content analysis allows to identify and interpret manifest and latent information in the (qualitative) data (Bortz & Döring, 2006, p. 329). Therewith, researchers can more accurately account for the perspectives of the actors and interpret individual statements more adequately by portraying themselves into the situation of the stakeholders (rather than e.g., merely counting keywords). Qualitative content analysis strives for an intersubjectively comprehensible interpretation of the data. The latter is needed to make sense of the more intricate information provided throughout the interviews (i.e., information that goes beyond the mere aggregation and counting of statements).

Interpretative techniques used in qualitative content analysis can differ significantly from each other. However, there is a shared generic course of action, as argued in Bortz & Döring (2006, p. 329 f.). In the following outline of that course of action, both the description of each sequential step and its operationalization to this interview study are presented:

- **Critique of the data:** As a first step, a critical assessment of the quality and nature of the data is to be conducted, accounting for objectivity, reliability, and validity (Bortz & Döring, 2006, p. 326 ff.). *Objectivity* refers to the research process' transparency. In the case of this interview study, the author provides insights into the acquisition of interviewees and the origin of the questionnaire (above), along with supplemental material containing the briefing document and the questionnaire itself (see Appendix H). *Reliability* refers to the repeatability of

a study. Given the transparently outlaid process and that the process was not changed between individual interviews, neither for the data gathering nor the analysis supports that there is some reliability. However, there are no standardized means to test the reliability of qualitative inquiry. *Validity* refers to the quality of being sound or correct (Merriam-Webster, n.d.-e). Regarding the data collection, interviewees contributions may be valid if they were given authentically, or if the statements remained unaltered. Interviewers' protocols should be unbiased, and statements should be directly clarified, if there is freedom of interpretation. With the goal of achieving adequate validity, the interviewees were not given any information about the initial framework (Figure 38), the questions were open at first (not putting ideas into the interviewees mind) and the interviewer used follow-up questions to clarify his understanding of the responses. This was helped by the fact that the interviewer could focus fully on the activity of interviewing, rather than being distracted by having to simultaneously write a transcript. Overall, a variety of precautions were taken to improve the quality of the data and to achieve objectivity, reliability, and validity, to the extent that this is possible in a study that relies on qualitative data (Bortz & Döring, 2006).

- **Set up data management:** As a general truth, qualitative material and its tentative interpretation yields a large amount of data that needs to be managed effectively. Some minutes of an interview may yield several pages of transcripts, noted ideas, and interpretations by the researcher. To manage such richness of information, transcripts and notes may be governed with software that facilitates coding, aggregation, and cross-document search. For this interview study, Atlas.ti is used, a well-established software "for the qualitative analysis of large bodies of textual, graphical, audio and video data" (cf. https://atlasti.com/product/what-is-atlas-ti/, accessed on the 24th of January 2021).
- **Create short case descriptions:** A short case description helps gaining an overview on the material and contains information about the interviewee, important interview topics, and incisive statements. Such descriptions should not be extensively long and focus on the essential facts about the case. The short case descriptions created for the 11 interview cases are attached in Appendix H, H.4).
- **Selection of cases for detailed analysis:** Bortz and Döring (2006, p. 329) suggest selecting only certain cases if there is not enough capacity to adequately analyze all transcripts, and/or if some cases are peculiarly untypical. This does not apply here. All interview transcripts were used, as all interviewees have

proven to be experienced in design research and they are actively involved in the communication of their projects as well.

- **Framework of categories:** Code categories are summarizing keywords that are associated with parts of transcripts. Categories that are often identified can be split into sub-categories (to maintain further granularity). Eventually, a system of categories depicts the contents. Such a system may arise inductively (based on the contents of the transcripts), deductively (based on theoretical considerations, ex-ante), or somewhere in between the two. In practice, a mixture of inductive and deductive is most common, where a broad framework is initially created, which is later appended to throughout the inspection and interpretation of the empirical data. Such a deductive-inductive approach also applies to the content analysis of the interview transcripts of this interview study. After all, an initial literature-derived framework existed and was used before starting the analysis, however, the analysis was aimed at identifying new aspects and possibly rectifying the existing framework. For more details on the categories and sub-categories, see Appendix H, H.3.
- **Coding:** Coding is the association of contents with (sub-) categories. Thereby, a suitable instance of analysis is to be selected (sentence, paragraph, unit of meaning). The quality of the analysis is depending strongly on the clarity of the definition of categories. This is particularly relevant if several coders code different papers based on the same instructions. In this interview study, the only coder is the author and further information about the coding instructions and categories can be found in Appendix H, H.3.
- **Comparative analysis of cases:** After coding the individual cases an intersubjective comparison can be made to establish similar (and contrasting) groups of cases, which may thereafter allow for a more transferrable interpretation of the cases. The comparison of cases in this interview study spans not only documents (in the narrow sense of axial coding), but also communication situations within individual interviews. Hence, the comparative analysis of cases took place between individual shared experiences, which may or may not stem from the same interviewee.
- **Presentation of the results:** Considering the large amount of material that is being created in such a study, a complete presentation of results is hardly possible. For this reason, Bortz and Döring (2006, p. 330) suggest to move case descriptions, framework of categories and definitions of categories as well as categorizations to an appendix. This leaves the primary manuscript with only a

(transparently communicated) selection of citations from the cases. The choice of such citations should be representative and therefore also include possibly contradictive statements. This allows the readers a better picture of the contents. In this interview study, this is taken into account by moving non-essential contents to a further appendix (Appendix H). In the following section, the results will be presented.

## A.3 Results and Discussion

Upon completion of the coding activities in Atlas.ti, the eleven transcripts (150 pages of text in the formatting of this dissertation) yielded a total of 719 codes, which are associated with 131 code sub-categories and eleven categories. These categories partially emerged throughout the coding, whereas a few code categories were taken from the ex-ante analysis of the phenomenon of communication of design research (categories 1-5). (Details on the implementation of the coding activities, including coding instructions for the categories and sub-categories can be found in Appendix H, H.3) In the following, the results are presented and discussed according to the following (arbitrary) sequence of categories:

1. **Communication Instances:** Situations in which a DR project needed to be communicated.
2. **Content Selection:** Elaboration on what has been communicated
3. **Selected Plotlines:** Elaboration on the order in which contents are presented
4. **Specific Techniques:** Techniques used to get messages across
5. **"Other":** interesting inputs that do not fit other categories*
6. **Stakeholder:** Individuals involved and/or affected by the communication
7. **Goals:** Goals pursued by the researchers through their communication
8. **Stage of the Project:** insights for which the stage of the project is relevant
9. **Challenges:** specific communication-related challenges
10. **Characteristics of Specific Situations:** Communication situation's characteristics and their implications on communicating projects
11. **Coping Strategies:** Suggestions and ideas on how to cope with certain challenges, along with the interviewees' experiences on the effectiveness of such coping strategies.

*The 'other' category was primarily used to store interesting inputs before deciding on creating a new category. It can be understood as an enabling vessel that allows for a single coding run, rather than to have to re-read all transcripts upon identifying a new

coding category. For this reason, the 'other' category is not specifically discussed below. This vessel is also the enabling tweak that allows for both a structured and an unstructured coding approach. This coding strategy was devised specifically for this coding exercise but may also be (or have been) used in other coding endeavours.

### A.3.1 Communication Instances

The category 'communication instances' summarizes the code groups that relate to specific codes given to mentions of specific communication situations. A communication situation is the setting in which the communication is being transmitted. This might be the submission of an article for reviewing, a keynote speech, or a presentation in front of potential project partners. Having assumed based on related literature (Section 2 and Section 5.1) and the DSR methodology (Hevner, 2007; Peffers et al., 2007; Sein et al., 2011), that there must be many and diverse communication situations along a design research project, this code group was predefined in order to make these situations explicit. The latter may help understand the shared and distinct challenges across design research project communication situations. The communication instances that the coding revealed are presented in the table below. It contains two levels of categories: The sub-category of communication instances (axial codes) and underlying communication situations (open codes).

*Table 53: Overview of Communication Instances*

| Sub-Categories | Communication Instances |
|---|---|
| **Acquisition of resources** | Acquisition of a practice partner/partner company |
| | Acquisition of team members/student workers |
| | Negotiations with practice partners (for project and follow-up projects) |
| | Proposal to ethics committee to provide permissions |
| | Acquisition of financing for the project |
| **Meetings with collaborators** | Author team alignment |
| | Briefing evaluation partners |
| | Continuous feedback cycles (w/ practice partners or internally) |
| | Initiation meeting (project kick-off) |
| | Requirement elicitation workshop with partners |
| | Pitch meetings (w/ practice partners, supervisors/professors, sponsors) |
| | Project meetings with other partners/stakeholders |
| | Discussion with practice partner |
| | Initiation meeting |

| | |
|---|---|
| | Talks with team members |
| | Workshops |
| **(open) Discussions** | Talks with fellow researchers |
| | Applicability check |
| | Panel discussion |
| | Discussion support documents (one pager, briefing sheets) |
| | Discussions with experts |
| | Exchange with conference attendees |
| | Exchange with peers/researchers |
| | Intermediary communication with various stakeholders |
| | Meetings with supervisors/professors |
| **Presenting to practitioner audience** | Application for a patent |
| | Application for an award |
| | Discussion support documentation |
| | Elevator pitch |
| | Keynote speech |
| | One pager |
| | Practitioner conference presentation |
| | White paper |
| | Meeting with project partners |
| **Presenting to researcher audience** | Education-related outlets (dissertation, doctoral seminars, …) |
| | Keynote speech |
| | Conference article |
| | Conference presentation |
| | Journal article |
| | Author development workshop manuscript |

From that overview one can gather that there are many and diverse communication instances, indeed. The list of communication situations summarizes the 105 identified communication instances. With that, the transcripts featured an average of more than nine communication situations per interview. Some of these communication instances revolve around the task of acquiring some resources that are necessary for the design research project. Others are collaborative, with goals such as alignment of collaborators, obtaining feedback, or informing stakeholders, ultimately focussing on productively furthering the design research project. The third sub-category features interactive communication situations as well, whereas the main purpose of these discussions is not focused on collaboration, but rather mere exchange of ideas. The last two sub-categories summarize the communication situations in which the researchers prepare the communication and then present it to either a practitioner audience or a researcher audience. The

list of communication situations is not conclusive. However, one may state based on this overview that **there is a wide selection of communication situations and that these pursue various purposes**.

### A.3.2 Content Selection

As with the communication instances, the coded related to content selection are presented below based on sub-categories and elements within these sub-categories as summaries of the codes that relate to the category of content selection. The purpose of this section was to reveal what contents are generally perceived as being relevant for communication, and possibly how these contents are being selected. The table below is ordered alphabetically.

*Table 54: Overview of Content Items*

| Sub-Categories | Content Items |
|---|---|
| **Applicability and utility to stakeholders** | Argument for the applicability and usefulness of the artefact |
| | Contribution to practice |
| | Convincing practice partners of the importance of the project |
| | Demonstration of the artefact |
| | Description of (potential) capabilities of the artefact |
| | Description of the artefact (with or without details on what it is exactly) |
| | Distribution process for the artefact (after it is finished) |
| | Evaluation |
| | Examples from other implementation context to illustrate utility |
| | General purpose of the design research project |
| | Requirements |
| | Use Case Scenario |
| | User/beneficiary of the artefact |
| | Why are the researchers thought to be able to create the artefact? |
| **Assumptions and existing knowledge** | Assumptions taken |
| | Description of the phenomenon |
| | Developments adopted from outside of the project |
| | Existing design knowledge |
| | Justification of approaches |
| | Justification of the need for a solution |
| | Literature review and related work |
| | Origin of the idea for the study |

| | |
|---|---|
| | Presenting status of one's own research (not project-specific) |
| | Problem description |
| | Scope of the project (what it is and what it is not) |
| | Theoretical framework |
| **Contribution to science** | Contribution to research |
| | Contribution to theory |
| | Design knowledge and how it was derived |
| | Design principles |
| | Evidence of innovativeness of the artefact |
| | Establish rigor and relevance |
| | Meta-Requirements/generalizations of prototypes |
| | Two cycles of evaluation |
| **Description of the outcome** | Description of key deliverables (e.g., per project phase) |
| | Description of the potential capabilities of the artefact |
| | Description of the solution |
| | Description of the utility (how and why?) |
| | Design features |
| | Design guidelines |
| | Design knowledge |
| | Design principles |
| | Evaluation results |
| | Implications of the outcomes |
| | Limitations |
| | Presenting the artefact in detail |
| | Purpose of the artefact |
| | Review of the research process/activities |
| | Show/illustrate a draft of the solution |
| | Use case scenario (case company, problem, solution mechanism, impact) |
| | User requirements |
| | Value created |
| **Description of the project phases*** | (…) |
| **Motivation of the study** | Motivation of conducting the design research study |
| | Origin of the idea for the study |
| | Rationale of the study |
| | Specifying who the beneficiary of the artefact is |
| | Why is the situation a problem? |
| **Object of desired feedback** | Measurement system (what is measured and how) |
| | Prototype or mock-up |
| | Theoretical framework as justificatory bases |
| **Process-related aspects** | Current step that is being worked on |
| | Explanation of the design process |
| | High level timeline |

| | |
|---|---|
| | Justification of the approach |
| | Outline of the study as a whole |
| | Project plan |
| | Specifying the partners' roles |
| | Vision for the project |
| **Selection of a specific focus**** | Focus on behavioural aspects of the project (for research articles) |
| | Focus on insights, rather than e.g., data or research process |
| | Focus on one aspect of the project and only publish that |
| | Focus on practical application (for practice partner) |
| | Focus on relevance for practice-oriented communication |
| | Focus on rigour for academia-oriented communication |
| | Focus on the theoretical framework |
| | Focus on what resonates most with the audience (esp. academia vs. practice) |

*"Description of project phases" refers to contents selection based on a project plan that is split into phases, e.g.: based on the DSR process model (Peffers et al., 2007), or any work packages agreed upon with practice partners.

**The "selection of a specific" focus is a bit different from the other sub-categories, in that it does not contain suggestions of specific content items, but rather the suggestion on which content items should be placed most importance. As with all other listed elements, these items are merely coded statements. These statements were voiced within additional context, and the suggested focus areas are therefore not generally applicable. They merely indicate possible focuses.

The list of items in the table above is not meant to be a conclusive overview of possible contents for communicating one's design research project. It illustrates that there are **many content elements that *can* be presented**. The sub-categories help understand, which general themes might be covered in one's communication, whereas the content items indicate how these themes could be discussed. It also becomes evident, that presenting 'everything' about a design research project would be an extensive endeavour. As with communication in general, **one has to decide upon (1) which contents** to present, and **(2) in which order** to present them. With that, the question of which general storylines are used by the interviewees remains yet unaddressed.

### A.3.3 Exemplary Storylines

The interviewees' responses contain some discernible storylines, which indicate with some abstraction how they compile the contents they choose for communicating their design research projects. The third predefined code category captures such storylines. Therewith, the intention was to identify typical orders in which the contents are compiled in general and/or in various communication situations. The interviewees specified in many cases that **they use different storylines for academia-facing or practice-facing communication**. For this reason, the following selection discussing the exemplary storylines is split based on these two types of audiences.

#### A.3.3.1 Academia-facing Communication Situations

In academia-facing communication, the interviewees repeatedly underlined the **importance of respecting and complying with certain expectations**. Especially in written communication such as in research articles, there seems to be a clear expectation to follow certain structures **that make the communication acceptable**. This includes starting with an introduction, featuring a methodology, presenting the results, and providing some sensemaking by discussing implications. Therein, it should become apparent **that the writers understand the related theoretical work**, are aware of **existing design knowledge**, know the relevant **methodological literature**, and focus on **rigour** (rather than on relevance). Furthermore, several interviewees indicated that due to these requirements and usually severely limited space or time availability for communicating the projects, **contents that are not expected can be omitted or moved to an appendix**, including design requirements, design activities, and even the designed artefacts. One interviewee specified that, if the goal was to help someone understand how an artefact was created, how it works, and how it can be (re-)produced, the contents to provide in a communication situation would be much different from what the IS community expects. This would require information about the development process (incl. user stories), insights into interviews, code, or libraries, and there would be much more information required on how to operationalize the design knowledge. However, such content seems to be of low value in most communication situations facing academic audiences. Based on this understanding, one of the interviewees suggested the following key milestones for academia-facing communication that summarizes these reflections is:

1. Define the phenomenon/research problem
2. Clarify the methodology and provide evidence for its adequacy
3. Provide theoretical support and ensure the perception of rigour

4. Show how the data supports the overall project and its conclusions

Beyond these three very general milestones that the academia-facing design research project communication should reach, a variety of storylines were provided. One commonly used **strategy for building a storyline is to use steps or phases of a reference approach based on which the milestones of the communication can be identified**. One interviewee's explication of this approach as applied to the three-cycle view by Hevner (2007) is the following structure:

1. Problem formulation
2. Systematic literature review
3. User/expert interviews and specifying design requirements
4. Deriving design principles based on requirements
5. Instantiation of design principles and features, and evaluating them
6. Refinement of the design principles
7. Evaluation
8. Documentation of design knowledge

Furthermore, the interviewees have provided insights on how they structure various formats of academic presentations, including research articles, conference presentations, abstracts, and short videos. These structures outlined below were mostly presented by individual interviewees and partially merged from several interviews. They may therefore not be interpreted as normative structures. Instead, they illustrate that **the key milestones are packaged diversely**.

#### A.3.3.1.1 Research Article

1. Description of steps and knowledge used leading up to the artefact (excl. process)
2. Presentation of the artefact in detail
3. Argument to support its applicability/usefulness
4. Evaluation (the main part of the communication)
5. Show potential to develop the paper further

#### A.3.3.1.2 Conference presentation

1. Presentation of the artefact/outcome
2. Explanation of why it is exciting
3. Overview of the research activities/methodology
4. Overview of the literature that was drawn from

#### A.3.3.1.3 Abstracts

1. Description of the research problem
2. Descriptions of the actions (what was done instead of how it was done)
3. Summary of the results

#### A.3.3.1.4 Short video

1. Definition of the research problem (incl. theory)
2. Presentation of the artefact (abstract)
3. Presentation of the design features (concrete)
4. Propositions from the study (incl. contribution to theory)

Across the interviews, one striking observation is the low value given to the operationalization of the DSR methodology. Some interviewees even stated that they tend to end up with publications that neither contain the artefact nor its creation process. This is explained in the interviews as being the consequence of reviewer comments that explicitly ask for more detail on the evaluation and indicate a low perceived value of design in general terms (incl. design processes, design artefacts, design theory as contributions).

### A.3.3.2 Practice-facing Communication Situations

As opposed to academia-facing communication, **practice-facing communication focuses on the relevance of the artefact**. Evaluation and rigour throughout the project, generally speaking, do not hold much value to a practitioner audience. **Practitioners prefer storylines that focus on their local problems and the applicability of the artefact** to solve these problems. Therewith, the **argumentation chain used in the practice-facing communication must integrate the practitioners' challenges**—particularly when the audience is the practice partner involved in the project. As opposed to the suggestions for storylines for academia-facing audiences, the proposed **structures for practice-facing communication are mostly consistent** and can be summarized as follows:

1. Presentation of the artefact without being overly specific
2. Demonstration of the artefact by illustrating how it can help the practitioners
3. Last priority: evaluation to show its effectiveness

Thereby, even more so than with academia-facing audiences, the communicators must ensure that the audience's attention is captured, that contents are highly relatable for the specific audience one faces, that the metaphors one may use are relatable from the point of view of the practitioners and that the communication is capturing from the start.

#### A.3.3.3 Insights from the Exemplary Storylines

From the exemplary storylines presented by the interviewees, the following summarising insights can be drawn: First of all, the audience plays a major role in the specification of a storyline. In particular, the interviewees agree that academia-facing communication is strongly different from practice-facing communication. The academia-facing storylines tend to be more detailed in nature and in the accounts of the interviewees. They provided very little information about practice-facing communication. They identified that practitioners focus on relevance (desiring to solve their situated problem), wish to gain insights on how the artefact is helping them and that they use different frames of reference, requiring communicators to be more specific. Academics, however, focus more on procedures, rigour, and the research design of the evaluation efforts. Academia-facing communication appears to require a strong and detailed account of the evaluation, while the design process, and to some extent, even the designed artefact itself, may be optional.

**Insight 1:** The audience plays a major role in specifying a storyline.

**Insight 2:** Knowledge about the audience helps identify what is important.

### A.3.4 Specific Techniques

The specific techniques used by the interviewees in the communication situations they have reported on are coping mechanisms to address a specific challenge they had to overcome. This section is split into an overview of the specific techniques the interviewees reported on, as well as a summary about the insights on specific techniques.

#### A.3.4.1 Overview of Specific Techniques

In the following, the setting in which the techniques were used, the techniques themselves, and an explanation of the techniques are provided in Table 55. The following table contains superscript numbers. These number stand for the respective interview, or rather the number of the interviewee (e.g., abc$^{1}$ stands for a statement that is supported by the contents from interview 1, or interviewee 1). Further details on the interviewees and the summaries of the interview transcripts can be found in Appendix H, H.4.

*Table 55: Overview and Explanations of Specific Techniques*

| **Setting:** Technique | **Explanation of the Technique** |
|---|---|
| Present the project plan despite unpredictability: Increase conceptual specificity of the project plan | To overcome the challenge of having to clarify the project outline of a design research project with its inherent emergence and unpredictability, one can increase the specificity of the project plan beyond what is decided upon/specified yet, but do so on a conceptual level only (e.g., specifying the various ways in which the artefact will be useful – without explicitly telling how it achieves these benefits; or specifying the data gathering and analysis techniques – without explicitly telling how much data is gathered and from where; use terminology that provides a vision – without being so specific as to not being able to account for emergent effects).[1] |
| Explain the project outline (to practice): Use stages/work packages to share the vision for the project. | It is useful to present procedures to practitioners at a higher level of abstraction[4,7] as can be found in reference process models[1,2,3,6] or as one may construct through work packages with somewhat specified deliverables for each work package.[1,9] |
| Address the emerging nature of the research process: Adjust the degree of details based on temporal distance. | While it is good to outline the project at a relatively generic level, details should be provided on the phases that are closest to the present timeframe.[3] This creates some idea of where things are going and trust in the (immediate) next steps while allowing for pivots down the road.[1] |
| Address the emerging nature of the research design: Depending on the audience and the purpose of the communication, the limitations can be communicated much more openly, or they may be held back. | In internal team meetings, workshops, and poster- or even paper presentations at conferences, different avenues going forth can easily be discussed. This is particularly useful in the early to middle stages of the design project. Openly communicating and encouraging feedback in these settings is desirable. However, in a journal publication attempt, such awareness for alternative avenues is counter-productive. There, the paper (contents) should be presented like "this is the way we did it, and this is the way it should be done." Of course, there are some limitations addressed in such an article, but those should be formulated very cautiously since the DR genre is poorly established in high-end IS journals and acceptance for such openness for alternate procedures is perceived with unease.[6] |
| Multi-Stakeholder: To improve shared understanding, state both what something is, and what it is not. | Especially practice partners[1], but also researchers from different fields[11], and sometimes within the same team[3,4], may have different views and understanding of the terminology used and the plans agreed upon. To recognize miscommunication and to ensure alignment, a useful strategy is to not |

| | |
|---|---|
| | only discuss plans and definitions positively ('this is …') but also negatively ('this is not …').[1,11] |
| One-way, non-interactive communication: Make formulations very explicit to avoid misunderstandings. | This may apply in general but is crucial for journal articles. You try to anticipate any questions and answer them already as part of your communication. Thereby the goal is to achieve increased understanding and to ensure that there is no crucial information missing.[10] This may include the provision of additional evidence for the usefulness and applicability of the artefact by featuring additional, external evaluations.[5] |
| Face to Face communication: Unlike in one-way communication (above), formulations and explanations can be kept short and be adapted situationally. | In direct interaction with the audience, given a certain storyline, the explication can be kept relatively short. This 'shortness' is characterized by not pre-emptively answering potential questions, but by identifying such questions or unclarities during the communication and then extending the explication where necessary.[1] |
| Explication of the story (to practitioners): Use the practitioner's terminology, metaphors, and colours to more effectively transport your message to them. | Especially in the beginning, it is important to 'sell' the project or the artefact as something that the practitioner needs and wants.[4,7] It may be useful to use a metaphorical story to bring them into the right frame of mind/context.[11] Otherwise, the use of specific and meaningful terms used by the practice partners, their metaphors, colours etc. can also help to increase perceived relevance.[4] |
| Shorten or lengthen the explication of any story: Use abstraction layers. | The use of abstraction layers is necessary for any communication – as not all the details on all steps taken are being communicated.[4,10] The procedures can be abstracted from by using guiding methodological frameworks[1,2,3,6] |
| Lay a focus on certain aspects: Use illustrations and use examples to insist on certain aspects. | Even when the audience pays attention, it may remain unclear, which aspects of the story are the most relevant ones. It is the communicator's job to make sure that the audience notices what's important. To do so in academic papers, tables and figures may be used.[6,7] In general, the strategic use of examples can also fulfil this purpose.[3,4,11] |
| Very little space or time available: Summarize and refer to additional resources, rather than packing the communication instance with content. | This applies to various content types: Refer to literature without repeating the core principles, if the theory, methodology, or technique in question is established in IS/well known.[7,11] Show exemplary outcomes or explain clusters of artefacts instead of featuring all of them – especially when there are many and space is prohibitively scarce.[7] Move the rest to the appendix where possible.[7] Generalizingly summarize arguments and refer to evidence in other resources.[1,2] |
| Very little space or time available: | While there is an argument to use examples as early on as possible[4], scarcity of time and space requires |

| | |
|---|---|
| Crowding out examples in favour of problem description, solution presentation and utility. | communicators to focus on satisfying the main informational needs first[1] – which means: Content is artefact-focused[9], the problem (space) and solution (space) are explained and matched, and the utility is clarified (practice: demonstration and applicability; academia: more formal evaluation).[4] |
| Introducing the artefact: Show the actual artefact, rather than to only describe it. | If a prototype exists, it should be shown to the audience[9,10]. One should avoid overwhelming (especially practitioners) with constructs and diagrams and focus on helping to understand the artefact.[10] It is already useful to draw some idea for an artefact onto a flip-chart or something similar, to clarify what the artefact is, should or will be.[1] Other means, such as a short video demonstration would be more illustrative and maybe even more useful in portraying what the artefact is.[2] |

#### A.3.4.2 Insights from the Specific Techniques

From the specific techniques outlined by the interviewees, one can draw that the following summarizing insights: First, it appears to be **useful to differentiate between conceptual and operational specificity. Conceptual specificity can be understood as** a functional view of the design research project that specifies **what is done and why**. **Operational specificity is the detailed view of how these activities are being implemented**. For example, one may specify that qualitative interviews with experts are used to identify design requirements (conceptual specificity), without specifying how this plan is implemented (operational specificity, e.g., how many interviewees? How are these selected? What are their characteristics? How long should each interview take?). While the latter is interesting for proving rigour, many of the specific techniques outlined above suggest **focusing on the conceptual specificity when communicating design research projects**. One way of structurally adopting this idea is to modularize contents such that the starting point and the output become evident, as is the case with work packages. A further idea is to strategically use operational specificity where this is most beneficial and omit it otherwise (e.g., for activities that are central at the time of communicating the project and to omit operational specificity about activities that are further in the future or the past). **The general strategy of primarily specifying the project and its activities conceptually seems to be useful** for communicating toward various audiences, helps overcome challenges that relate to the unpredictability of DR projects, lack of space, and the navigation of levels of abstraction.

**Insight 3:** It is useful to differentiate between conceptual and operational specificity.

**Insight 4:** It is useful to modularize the communication content.

**Insight 5:** It is useful to use operational specificity selectively and strategically.

Another theme that can be identified among the specific techniques is that **adequate means should be used to ensure that the audience understands the communicated content**. To that end, a variety of specific techniques were suggested, including introducing a prototype or some visualization of the artefact as early as possible, using both positive and negative examples, or using terminology that matches the terminology used by the audience. **This matches the insights gained about the research problem, which specified that the communication must be adapted based on the audience's needs**. Interestingly, the interviewees did not make out the explication (i.e., the specific formulation and illustration activities of communication) to be problematic. This might suggest that researchers do, in general, know how to explicate a defined storyline, but that **the building of a story and the general adaptation of their communication to the communication situation is challenging** on a conceptual level. Guidance is therefore not sought for, e.g., designing PowerPoint slide decks or for rhetoric designs.

**Insight 6:** It is useful to ensure that the audience understands the content correctly.

**Insight 7:** The communication must be adapted based on the audience's needs.

**Insight 8:** The challenges reside in the planning of communication, rather than in its explication.

### A.3.5 Stakeholders

Somewhat related to the communication situations outlined in Section A.3.1, this category of codes keeps track of the stakeholders involved or affected by the communication. Beyond the mere coding of instances, the analysis of the transcripts has thus also revealed a set of audience-related codes. In the following, these are presented as ordered by their roles in the communication setting.

*Table 56: Overview of Stakeholders and their Roles*

| Role of the Audience | Audience |
|---|---|
| **Collaborators** | Team members (researchers) |
| | Practice Partners (project team) |
| | Users of the targeted artefact |
| | Customers of the practice partner |
| | Developers (employees of practice partner) |
| **Contributors** | Peers (IS and non-IS researchers) |
| | Advisors or mentors (e.g., at author development workshops; PhD supervisors) |

| | |
|---|---|
| | Attendees of academic seminars, workshops, etc. |
| | Financiers & agencies |
| **Consumers of Content** | Attendees at conferences (practitioner/academic) |
| | General public |
| | Policy makers |
| | Readers of articles (practitioner/academic) |
| **Evaluators/Gatekeepers** | Grant agency |
| | Reviewers of outlets (e.g., academic journal) |
| | Supervisors |
| | Practice partners (decision makers) |

From these audience types, one can learn that the audience takes on various roles in these communication situations. **Notable roles include collaborators, contributors, consumers of content, and evaluators/gatekeepers**. They differ in the amount of information they already possess (and thus, in their remaining need for information), the kind of information they possess (e.g., a collaborator is familiar with operative details of the project, a practitioner is familiar with the environment of the problem, and evaluators are familiar with conceptual project phases, revealing different needs for additional information), their focus on rigour, relevance, or both, and common communication settings in which they are exposed to the communication. **The role of the audience may thus directly inform design researchers about some of their needs**, which in turn, should help preparing the communication.

While the insights from the interviews are insufficient to clearly specify the needs of the stakeholder roles outlined above, there are ample descriptions of the needs of practitioners and academic audiences. In the following, their needs are listed, with an introductory citation from interview number 4, in which this differentiation between practice and academic audience is summarized.

*Table 57: Needs of Practitioners and Academic Audiences*

| Needs of Practitioner Audiences | Needs of Academic Audiences |
|---|---|
| "(Practitioner and academic audiences' roles) are really different. I would say in the practice-directed communication this was more the role of a consumer. We wanted to support them, and we wanted their money and their time. At the end it was like a consultancy or vendor presentation—selling them a solution, where | "In the scientific community, it is less like a consumer, but more like a gatekeeper in the competition for published publication space. You talk with gatekeepers that somehow manage or assign the scarce resource of publication space and try to select the best (whatever that means) proposals to assign this resource. So, it is not a customer whom you |

| | |
|---|---|
| we are the vendors, and they are the customer (…).” (Interviewee 4) | provide value for, but it is more like a gatekeeper that you try to pass in a gatekeeping process.” (Interviewee 4) |
| Practice assumes researchers to do things rigorously (no need for presenting and explaining methodology) | It is important to outline the methodology clearly to create trust and credibility with reviewers and the audience. |
| It does not matter much, where propositions come from or why they are expected to work (no need for lit. rev.). | An entire section of the communication is to be dedicated to explaining what leads up to some propositions (theory) and what the input from and contribution to the knowledgebase is. |
| The communication should be geared toward the specific audience, which means in this case: Use same colour codes, frames of reference, examples from the practitioner’s domain, their metaphors and language. | The communication should be geared toward the specific audience, which means in this case: Compliance with accepted practices (e.g., at the outlet (idol papers)), expect. contents, accepted formats and formatting, language/terms. |
| Not interested in abstraction and the use of the artefact beyond the organization, but a situated solution (including applicability examples) or the vision toward it. | Easier to communicate to academia as/if they are aware of the DSR methodology – as opposed to practice. |
| Interested in the peculiarities of the problem and the specific solution that addresses their own problems. | Interested in the class of problems and how the problem is made sense of, as well as solutions that are projectible. |
| Communication can be very much prototype driven. | The development of the artefact is not central and can be kept very brief – while the artefact itself and its evaluation are necessary to make your argument. |
| The terminology and methodology of DSR is not necessary or is rather not to be used/to be rephrased. | All major steps of the project must be presented in a journal paper to be convincing. |
| There isn’t really a need for a big practical report. Instead, a lighter presentation mode is preferred (with some appendix or backlog of information for documentation) | Prototypes are not enough. You need to reveal generalizable design knowledge and present it with various examples that prove generality and predictability. |
| The argument (rationale) for the artefact and the demonstration of its mechanisms are focal, whereas the evaluation does mostly not matter. | Need to be very clear and precise from the beginning in order not to confuse readers or the audience. |
| Within the group ‘practice’ there are many sub audiences to whom the communication needs to be tailored based on what these sub audiences find useful or interesting. | Emphasize key aspects clearly (e.g., by using an illustration or tables) |

| | |
|---|---|
| No perceived need for novelty or rigor. | Main story must be kept concise. If possible, move non-essential content to the appendix. |
| | For research outlets: Regardless of the goals for the readers, a publication must be written for the reviewers as first stakeholders and as gatekeepers. |
| | "Academia" is not only split by outlet or community, but also by field. The field most crucially affects the content. |

### A.3.6 Goals

The goals of communication reported by the interviewees are manyfold, which is why this was another emergent category used in the coding of the manuscripts. The central learning from this coding is the following: **Design research project communication is always done in pursuit of a goal**. While each communication situation comes with a specific goal, some more general categories of goals can be identified (e.g., acquiring a specific amount of money from a specific grant agency can be summarized as the goal of gaining access to resources). The interviews reveal that **the goal of communication drives the selection of contents and storylines, but also the way in which tools or means are used and the way in which the vocabulary is selected**. For example: With the goal of helping practitioners understand how the artefact works, one should use their vocabulary, terminology they are familiar with (explication), take advantage of opportunities to illustrate, rather than to write or talk about the artefact (means), and build the communication around the artefact (e.g., a prototype of the artefact; storyline).

The following list shows a set of commonly mentioned goals. However, no further detail is provided on the specific interviewee's elaborations about these goals. After all, the goal setting depends on the communication situation and the related stakeholders. Therefore, each communication situation might have a different goal that is pursued by the researchers.

- Access to resources (including: commitment of time, money, access to data)
- Building trust with the audience (e.g., trust in the researchers' abilities, the possibility to find a solution)
- Convince potential collaborator to partake (e.g., researchers, organizations)
- Convince audience of the project's contribution (e.g., to the field, generalizable knowledge, usefulness, applicability)

- Create awareness (e.g., for the problem, the general approach to solving it, the solution)
- Create understanding of something (e.g., making sure the audience understands the mechanisms that are central to the artefact)
- Create utility (e.g., ensuring that practitioners can implement the artefact in their organization)
- Gain understanding of the problem (e.g., in exchange with practitioners or academics)
- Getting (useful) feedback from the audience (e.g., about results, or getting fresh ideas)
- Improve career changes (e.g., basket journal publication for a career in academia)
- Influencing the wider community (e.g., introducing a new method or view on something)
- Reach alignment (e.g., about a project plan, or of the terminology used)

### A.3.7 Stage of the Project

Most interviewees pointed out that the progress or stage of a project is relevant. This became apparent in most interviews at the point when the interviewees were asked to reflect on which communication instance was the most relevant one for their project. As interviewee 5 put it:

> *"They are all important, but at different phases. (...) In the beginning it is simply important to get the buy in from the organization. (...) And then talking to those within (the organisation) is important to get the insights that you do not have as an external (person) and even the person that was our (...) point of contact did not have. (...) And talking to other practitioners, that's more to get a journal paper out, because it is (...) more publishable (...) if you say this has worked for one organization, and many experts agree that it would also be useful for them."*

This short excerpt is illustrative for many interviews, in which the purposes of communication and the audiences changed along with stages that the project went through. These stages and respective commentary as to what may be important are outlined below as sub-categories and items of the 'stage of the project' category.

*Table 58: Overview of Insights on the Project Stage*

| Sub-Categories | Project Stage-related Suggestions |
|---|---|
| **Early Stages: Approach** | Be open about where the project might lead (accept uncertainty and be ready for a pivot early on)<br>Use a high-level timeline with low specificity and accuracy<br>Showing a rough description of a/the potential artefact and select the contents to be result-oriented to convince the audience of the project<br>Be cautious and do not make promises or raise unnecessary limitations early on<br>Provide only few details |
| **Early Stages: Goals** | Build trust that the researcher team is able to create a solution<br>Ensure that all important aspects are taken into account<br>Convince the audience of the project<br>Use the communication opportunity to structure the project/reflect on the project |
| **Earlier Iterations: Approach** | Lay a focus on user requirement (their elicitation and evaluation)<br>With time and increased understanding, increase the use of examples to illustrate the ideas for practitioners<br>Use a mock-up artefact as a basis to get feedback (e.g., at a conference or with practitioners) |
| **Earlier Iterations: Goals** | Ensure that the problem is understood well (by the researchers and practitioners)<br>Test/collect feedback (e.g., about the problem formulation) |
| **Later Iterations: Approach** | Make claims for future outcomes that might be achieved by the artefact, despite lack of evidence (as the artefact is not finalized)<br>Increase precision in claims and statements<br>Focus more on applicability, as this becomes more evident over time<br>Publish a part of the research project for further feedback (e.g., the first evaluation)<br>Brush over earlier phases of the project and focus on near-to-date aspects |
| **Later Iterations: Goals** | Getting the research published in academic outlets<br>Keeping partners interested in the project |
| **Final stage/end** | Focus on rigour in the final journal paper (e.g., how was the literature searched? How was the theory transformed into an artefact? How was the artefact evaluated?<br>Focus on the process (rather than the artefact—what did you do?)<br>Move away from prototype-based content to generalizable design knowledge (contribution) |

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| | Only touch upon methodology and results, to leave space for what can be learned beyond the instance<br>Present the solution, how it was built, evaluated, and how it may be applied |
| **Final stage/end** | Getting the project published in a prestigious academic outlet<br>Finish the project (practice-side: demonstration; academia: evaluation)<br>Spread the contribution to the knowledge base |

This overview is not meant to be conclusive either. However, one can learn from it that **at various stages, there are different goals and different purposes of communication on the one hand, and different ways in which researchers attempt to reach these purposes**. Regarding academic outlets, the phases also have more specifically mentioned implications. While various interviewees shared similar thoughts, interviewee 4 provided the most succinct statement on the role of different outlets in different phases:

> *"We communicated this (project) over three years, from the vision to the (final paper). It started with keynotes. Then there were research-in-progress papers and explorations of theoretical baes at conferences and all these 'on-the-way' publications are where you get feedback and where you test ideas, where you try to get support for developing the thing. And once you have done that, and once you did the complete project and collected the data of utility, then of course you can write the 'real' papers. (...) So, it's different kinds of publications for different purposes along the way."*

### A.3.8 Challenges

The category on the challenges perceived by the interviewees contains a variety of specific statements and reflective summaries provided throughout the interviews. The findings on the existing challenges are discussed in Section 5.2.2 Main Challenges Perceived by the Design Researchers. The subsequent list of insights from the analysis of the challenges is provided here as a summary, whereas the context information is not repeated here.

**Insight 9:** Integrating knowledge about a communication situation's diversity into the communication process is a major challenge.

**Insight 10:** Structuring the DR communication is a major challenge.

**Insight 11:** Setting the level of abstraction is a major challenge.

**Insight 12:** Publishing Design Research articles is a major challenge.

**Insight 13:** Effectively communicating with practitioners is challenging.

**Insight 14:** There is a need for coping mechanisms to address the communication-related challenges faced by design researchers.

**Insight 15:** There is a lack of guidance that helps design researchers address the communication-related challenges they face.

### A.3.9 Characteristics of Specific Situations

During the interviews, certain characteristics of specific communication situations were described such that insights about the research problem, the purpose of communication, coping mechanisms or other notable characteristics appeared worth taking note of. Those are summarized in the table below.

*Table 59: Overview of Insights on the Specific Situations*

| **Specific Situations** \| What's special about it | **Note-worthy statements** |
|---|---|
| **Conference Articles** \| There are no appendices in conference articles, which accentuates the problem of using space effectively. | "The big advantage of the journal is that you can work with appendices. That's typically not possible in conferences. I think that's also a challenge in design science. If you want to present the whole process it can get huge quite fast and then you can maybe really work with appendices where you provide for example screenshots of different prototypes and how they developed—you can easily have 10 pages on that in the appendix. That is just not possible in the conference paper." (interviewee 6) |
| **Face to face communication** \| In face-to-face communication there is flexibility that can be used strategically. Instead of fully specifying the content, one can react to the audience immediately, to remove misunderstandings, keep them interested (e.g., through shortening "boring" sections or providing examples), and to receive instant feedback. | "When you are communicating with the audience you can very quickly switch the topic. You can very quickly align them with what you are trying to say, and you can very quickly get feedback if (…) they misunderstood you." (interviewee 1)<br><br>"In live communication, I could ask: 'Are you interested in an example how this was useful in the past?' to win over the sceptics, which I can't do otherwise. I could find out what the most immediate information needs would be. (In written) I could only send it and then hope for the best." (interviewee 5) |

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| | "A conversation (…) allows you to receive some sort of instant feedback (…) whereas in the paper that feedback has some latency, you get rejected or accepted. And I think that (direct exchange) really helps to you to sense what you should be complemented or what you should go over and not invest too much into. (…) I think that's much more difficult in a paper." (interviewee 7) |
| **Grant Proposal \|** The grant proposal requires some early specification of the scope and project plan. This is challenging, but at the same time, it provides some foundation for the design research project. | "(Proposal writing) actually is a big gamble, and during the proposal writing you are making a lot of decisions—a lot. (…) When you are writing a proposal, there is no second chance. (…) And I had absolutely no discussions with the decision makers. I think you are not even allowed to talk with the people who are making decisions on your proposal. (…) (For the proposal I had to make the project way more specific, and I had to specify the scope.)" (interviewee 1)<br><br>"I wrote a proposal as a first step. That was very important, because the proposal and the literature review, also done in the proposal, was the foundation of the research (project)." (interviewee 2)<br><br>"You try to be even more explicit if it is one-way communication to avoid any misunderstandings or possibilities that some crucial information may be missing. (…) You are just trying to really anticipate any questions and answer them already." (interviewee 10) |
| **Internal meetings \|** In team meetings, discussions can be much more detailed (e.g., when discussing the next process steps), and a lot of details can be omitted (since the team members are informed about much of the project already). However, to use internal meetings effectively (that is, to not discuss contextual details, but to discuss selected aspects in detail), a setting that is conductive to collaboration needs to be established. | "Whenever (…) you really want to discuss the next steps on a detailed level, then I think it's very important to have an interactive way of communication so that everyone is able to freely tell his or her opinion about the next steps. (…) This was possible in team meetings. (…) Of course, there was a hierarchy level in there, but within the discussions we are all on the same level and everyone was confident enough to tell you their opinion. And I think this is different if you have an audience in front of you. Not everyone will ask questions. You don't discuss every part in detail – you just discuss on the high level." (interviewee 3) |

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| | "What was very different in this kind of team meetings was the hierarchy level and I think it was crucial (to be on the same level), and this also changed the way how I communicated at the start, because I was kind of the coach and they were researchers (…) with the same goals." (interviewee 3)<br><br>"Among the team, people have an idea of what you are doing, and it is not always new. (…) They are not interested in that level of detail in which you need to outline it in the journal paper." (interviewee 6) |
| **Journal article \|** Journal articles allow for a lot of detail (also by providing the opportunity to use an appendix, see above). Nevertheless, they need to be written such that the contents are crisp and understandable without further explications. This comes at the expense of needing to provide navigation support that, in one way or another, guides the readers through the storyline. | "A journal paper is completely different (from conference papers, focus groups or PowerPoint presentations) because it is much bigger. Explaining something rather than telling things to managers or focus groups. (…) Very different things—way more content." (interviewee 8)<br><br>"Compared to other communication situations, the journal paper is much more detailed. (…) I wouldn't say after listening to our final meeting where we presented our approach, that from that alone other people could really replicate (the project). They know the steps we did, and they could think of what they believe those steps are and that they think one should do, but they don't have those details which are provided in the paper that really guide them through this process." (interviewee 6)<br><br>"That's how you write a journal article: you are just trying to really anticipate any questions and answer them already as part of your presentation." (interviewee 10)<br><br>"What I see that is conceptually different is that the longer the communication is, the more you need to provide navigation support. (…) The shorter it is, the more people can relate to the storyline (…) remember the whole thing. And when it becomes longer and more complex and you have time (or space) to go into details, then of course, people tend to forget (…) and you have to take them back and provide something |

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| | like a navigation support. And we all know techniques to do so, like structuring a document by headings with first, second, third-order headings; or a navigator element in charts, in PowerPoint slides, to basically show where you are in the (communication). The longer time you have, the less restrictions you have, the more you have to take care about navigation and support the remembrance of your audience." (interviewee 4) |

### A.3.10 Coping Strategies

As opposed to the coping techniques outlined above (Section A.3.4), some more general coping strategies emerged. Specifically, four general strategies could be identified. These are outlined below and some underlying statements by the interviewees are provided alongside the summary of the coping strategy. The statements are an excerpt and there may be more statements in the interviews that relate more or less to the strategies.

1. Know your crowd
    a. Academic audiences
    b. Practitioner audiences
2. Remove content to save space
3. Use outlets strategically (academic audiences)
4. Use illustrative support

*Table 60: Overview of Insights on Coping Strategies*

| **Coping Strategy \|** Summary | **Note-worthy statements** |
|---|---|
| **Know your crowd \|** The communication needs to be geared toward the audience. For that, there needs to be some knowledge of what the audience needs or wants, of its terminology, frames of reference etc. To communicate effectively, one needs to take the | Supporting statements from the interviewees have often been made by comparing various implications at once (e.g., for outlet X one should focus on Y, but not for outlet Z). The statements compare academia-facing implications separately form practice-facing implications. For this reason, the following statements are split as well. |

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| audiences needs into account. | |
| Academic Audiences/Outlets | "If it is DESRIST, everybody is happy to hear about an artefact. It is an appropriate crowd for what we're trying to do. If it is an IS journal, then we are going to couch (the storyline) more in what the theoretical contribution of what we are doing could be. (…) We can still call it design science, but it is going to have to have theory wrapped around it." (interviewee 11)<br><br>"I was looking at some DSR papers in MISQ and I found that they really don't follow a typical design process as you would see in conference (articles). (…) I found that they say: 'We did DSR,' but then publish more the quantitative things, (…) because the (journal editors) want groundbreaking research which has an impact on theory." (interviewee 2)<br><br>"For conferences, I expect that the reviewers do not really pay attention. So, it needs to be very clear and precise, just to make sure to not confuse someone at the beginning right away. From journal reviewers, I expect that they read it with more care. Still, you need to make sure that for example, key elements are provided in tables or in figures, just to make sure that people really notice them and are not just reading over it." (interviewee 6)<br><br>"A conversation that is face-to-face (…) allows you to receive some sort of instant feedback. (…) In a paper, feedback has some latency. You get rejected or accepted. And I think that (instant feedback) really helps you to sense what you should be complementing or what you should just go over and not invest too much into. What is important to them to see and what is not. And I think that this is much more difficult in a paper. This is why you (… choose) a model paper (…) that you try to rebuild in a sense." (interviewee 7)<br><br>"I was trying to look how other papers did similar work and then basically described my DSR project and communicate it the in the same way the others did. I think that this played a crucial role for the success of the paper. (…) I heard from (…) a lot of people that have tried to publish in this field, but they didn't get through because (reviewers were not familiar with the methodology)." (interviewee 2) |

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| | "I want to show the evaluation (of the artefact) in the field. I want to show the evaluation in the laboratory. But it is so much and also complicated (…). Maybe presenting stepwise iteration doesn't make sense at this journal level (…), because it is just too much. So, you basically frame it as a theory contribution and put the building of the system in the appendix. (…) You put the design principles and the building of the system and whatever else in the appendix and just say that you built the system, and you test it in two studies to measure the effects. (…) If I reported (on all the steps in) detail, people sometimes miss the coherence of the paper and don't get (for example) what the evaluation in the field has to do with user interviews." (interviewee 2)<br><br>"(In the journal paper) I focused more on the evaluation there than on the process on how to build it. I did not try to walk the reader through all the changes and dead ends and different versions and all that. (Instead, I presented a) summary description of what it took to build it (and) present the artefact in detail, (…) an argument for its applicability or usefulness, and then spend a lot of time on demonstration and evaluation." (interviewee 10)<br><br>"We're targeting Information Systems Research (ISR Journal) and we may be able to publish just the front end (…). Probably without barely talking about the artefact, because we have hypotheses, and we could extend literature (which is what the outlet requires). So probably (the artefact-related contents) will go first, as—at least in my experience with design science—it is really hard to publish it in our top journals." (interviewee 11) |
| Practitioner Audiences/Outlets | "(In communication with practitioners,) I think it is all about what it in it for them, what do they find useful? And of course, that differs with the different sub-groups (of practitioners). So, for instance, someone in higher management with financial responsibility has different things they would find valuable and what would resonate with them, (compared to) an expert (who is) interested in stuff that works. (…) I do not find the term 'practitioner' that useful, because you have many different sub-groups, and every sub-group has their own values that they resonate with." (interviewee 5)<br><br>"(We use examples to convey ideas to practitioners.) A lot of the times he knows what I'm talking about. He just calls it something different. (… His) words aren't the same, so |

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| | we struggle with that. I'm trying to remember (an example), but I mean it happens at least once a meeting that we're like: 'No, that's not what this means.' Or he's like: 'Yeah, we can't do that. That's unethical.' And we're responding: 'No, that's not what we mean' – or he wants to remove questions, but then the construct wouldn't be properly measured." (interviewee 11)<br><br>"You know what people in practice like? They like these work packages and deliverables. So, even if I don't know what exactly I will deliver, I just call it deliverable 'prototype' and then they're happy." (interviewee 9)<br><br>You talk about work packages; did you also talk about the approach in the sense of DSR or ADR? Or did you communicate to them what it was by just talking about work packages? "Exactly. (Only work packages.) They don't care about design science research. And why should they? (…) (I described) a very high-level timeline and to be honest, we didn't deliver all this. (…) What they pushed a lot is these work packages and this timeline and you know, this is typically what they want (…). If they want it, they can get it—no problem for me." (interviewee 9)<br><br>"(How I treat the uncertainty and emergence of the DSR project in the communication) depends on who I am talking to. I mean, obviously, I didn't tell the project partner that I had no clue what I was doing. But I just presented something to them, which I said is very premature and (used) tons of literature and they believed me." (interviewee 7)<br><br>"In the monthly meetings we always had a prototype that we showed. There was always a prototype, every meeting a new version of the prototype (…). You need to demonstrate progress. You need to ensure that they trust you, that you deliver something at some point, and the best thing you can do is to give them something to "eat". And this is what we did. And we progressed with (showing) the prototype, (as we) got valuable feedback from them." (interviewee 9).<br><br>"When they talk about their problems, they have usually many problems and the problem is multifaceted. We have only a small little solution that is isolated and focused and so, in order to convince them, we really had to understand their problems to an extent that we could build an argumentation chain to really be convincing. (…) It was clear that |

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| | for them it was a lot of work and also financial resources. We wanted money for it and we wanted their time. What was even more important, we wanted their data. And so, we had to not only generally, but very specifically exhibit why and how our solution would help. And that requires that we understood their problems (…) before we started to make a proposal (…) of something worth trying. (…) Novelty and Rigor, they were not interested in. They were interested in making their life easier and solving their practice problems." (interviewee 4) |
| **Remove content to save space \|** Rather than to summarize contents, it is sometimes better to just remove certain aspects entirely, or where applicable, to move them into an appendix. | "What has been said so many times before, where I can't add anything, like explaining design science research over and over again, you can cut that thing short. I mean, everyone's doing it in their papers and most probably you're submitting to a design science track, you will get reviewers that have already a slight knowledge about what you have been doing here. These are the things that are not new and that are the same for every paper. So, I cut that short. Of course, I said who's approach I am following (…), but the very general stuff, I just left that out. (…) You can do related work sections and related work sections, right? You can say that you are going to look into what your gap is and (…) where you want to contribute; or you can essentially reproduce everything that has been said. I obviously have done the first of the two. Or explaining theories: (…) the theories I use (…) are super established. You don't have to dig into that." (interviewee 7)<br><br>"I focus more on the insights, so not exactly on the data (…) but on the insights I already received from the evaluations. Not directly the data. For example, if we designed some kind of design, we reported the refinements, not directly the initial data." (interviewee 3)<br><br>"In journals (…) you can work with appendices and maybe structure (the paper) in a better way, so that in the paper you can really keep the attention of the (reader) to certain things, and if they want to have further details you can guide them to the appendix." (interviewee 6)<br><br>"The development of the artefact. I think that's the first one (to drop). You can probably drop it and more describe the process briefly and then show the final result as opposed to showing intermediate steps. (…) I think that's a good candidate to shorten without losing too much on the (story). Because you still have the artefact. You also prove that it is |

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| | good. I think that will still make your argument. And then it gets difficult, if you're thinking of a journal article. I think you need all its components in order to be convincing. So, I can only see that to be shortened. (…) I don't think you should drop the demonstration. I don't think you should drop the evaluation and you certainly shouldn't drop the introduction in which you make your case." (interviewee 10)<br><br>"You need to somehow find how to use your space (in a paper). So, of course we would describe (the artefact) and everything. We would probably also present the requirements or the meta-requirements that inform he design. But it's not like we would talk a lot about how for example the single interviews worked. We would probably have a shorter method section on this and then say we had x user interviews. They were on average so and so long. We used this and this method to analyse the results. But we wouldn't really go into detail on how we derived the final meta-requirements.<br><br>At later stages (of the project) I presented more and more things of course. At later stages I just quickly mentioned the first step so that everyone was on the same page. But I didn't go into detail because of the newer stuff was more important to me because I can receive feedback there." (interviewee 3) |
| **Use outlets strategically (academic audiences) \|** Different outlets may have a different function for the research project. The basket journal article should be used at the end, summarizing a DR project that already contains several evaluations (or for publishing non-design studies); whereas conferences are most suitable to publish intermediate results. | "I would use conferences to test the idea and the problem formulation. I would try to publish a short paper (…) and a possible vision of how the system could look like to just get a feedback from fellow researchers. (…) And then I would publish something about the first evaluation to also see what could be feedback about the evaluation. (…) And then probably publish again an overall (journal) paper about the overall thing." (interviewee 2)<br><br>"The first version (of the article) had a total of 15'000 words. If you want to publish that in IS, this amount of words is a problem, but also helps you to identify the possible target outlets. Because there are just two left: MISQ and JAIS. And then we thought, MISQ is too big for us and then we went into JAIS. So, this helped us make the decision (on which outlet to choose)." (interviewee 8)<br><br>"I published a study, maybe a year ago, in CAIS about this. About how much design science is actually getting published. It is not very much. Unfortunately, that's what |

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| | counts for me. So, I find that I have to balance and do some non-DSR papers." (interviewee 11)<br><br>"There are the suggested design principles, evaluation one, evaluation two, and the combined findings out of that. (… I presented) my whole story to this track chair to receive this suggestion: Rather than communicating the pieces alone, communicate the whole thing as one (for a basket journal)." (interviewee 8) |
| **Use illustrative support \|** Even if space is scarce, the central contents that need to reach the audience should be illustrated or set apart from the rest (e.g., by means of a table rather than only text in a manuscript). | "The only figure that I had was the one (…) where one maps the requirements, principles, and features with (arrows)." (interviewee 7)<br><br>"(A design research project) can be confusing and you can quickly explain (to practitioners) what you mean and if they misunderstood what's the idea or what's the methodological idea behind it, you can quickly tell them. For example, we had to draw the idea on the flip chart of the (…) model. They were never satisfied with the slides that we had." (interviewee 1)<br><br>"You need to make sure that for example, key elements are provided in tables or in figures, just to make sure that people really notice them and are not just reading over it." (interviewee 6)<br><br>"I would find it very useful to write (…) a use case scenario where you have a couple of paragraphs outlining shortly the problem that might be in the organization and how the (artefact) will be helping senior managers to solve it, because really I have a feeling when I present the idea of the product, it is still too abstract." (interviewee 1)<br><br>"I was mostly focusing on benefits (of the artefacts. However,) I would better elaborate how exactly it will be helping them. Maybe I would even outline what it is not, so that they would not be misguided, and they would not think that this is the panacea or solution for everything. Outlining what it is not was also very important, because it helped us to jump into the discussion quicker. (…) So, I would specify exactly what it is and what it is not, so that people really do not misunderstand." (interviewee 1)<br><br>We made good experiences with framing the whole project as a design science project, because it kind of gives you a nice framing with clearly communicable steps. You can for |

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| | example take the Peffers approach or the three-cycle view of Hevner and then you can easily visualize different steps that you take and that also helps in the beginning when you write grants for example. It communicates that it seems that you know exactly what you are doing." (interviewee 6) |

With that, all major insights form the interview are presented. These are only the most central findings, and many statements by individual interviewees are, by nature of a qualitative interview study, are omitted when deemed unimportant. Furthermore, from the findings outlined in this appendix, only a part of the insights is used explicitly in the design research project. The following section specifies the usage of insights form the interview study within the design research project.

## A.4 Contribution to the Design Research Project

These insights from the interview study chiefly add to the first two activities in the Design Science Research Methodology framework (Peffers et al., 2007), as outlined in Section 5. However, the insights also provide information about existing coping strategies, which can be used to inform the design and development of artefacts (i.e., Sections 6-8). While the largest contribution of this interview study is toward the class level artefact (Section 6.3.3), the implications trickle down through all three artefacts (e.g., through the problem understanding, or the re-use of the class level artefact).

### A.4.1 Contributions to the Problem Understanding, Section 5

The interview's contribution toward the problem understanding is substantial. This is in line with the primary purpose of the interview. Because of the central role of the insights gained throughout the interview study, these are elaborated on in depth in the manuscript itself (Section 5.2). The overview of the key insights described therein, based on the contribution of the interview study the following:

*Table 61: Key Contributions of the Expert Interview Study toward Section 5*

| **Overview of the Insights from the Interview that contribute to Section 5** | |
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| **Insight 1:** | The audience plays a major role in specifying a storyline. |
| **Insight 2:** | Knowledge about the audience helps identify what is important. |
| **Insight 3:** | It is useful to differentiate between conceptual and operational specificity. |
| **Insight 4:** | It is useful to modularize the communication content. |
| **Insight 5:** | It is useful to use operational specificity selectively and strategically. |

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| **Insight 6:** | It is useful to ensure that the audience understands the content correctly. |
| **Insight 7:** | The communication must be adapted based on the audience's needs. |
| **Insight 8:** | The challenges reside in the planning of communication, rather than in its explication. |
| **Insight 9:** | Integrating knowledge about a communication situation's diversity into the communication process is a major challenge. |
| **Insight 10:** | Structuring the DR communication is a major challenge. |
| **Insight 11:** | Setting the level of abstraction is a major challenge. |
| **Insight 12:** | Publishing Design Research articles is a major challenge. |
| **Insight 13:** | Effectively communicating with practitioners is challenging. |
| **Insight 14:** | There is a need for coping mechanisms to address the communication-related challenges faced by design researchers. |
| **Insight 15:** | There is a lack of guidance that helps design researchers address the communication-related challenges they face. |

### A.4.2 Contributions to the Artefact Creation at Problem Class Level, Section 6

Since the artefact creation at the problem class builds upon the problem conceptualisation (i.e., Section 5), the interview study indirectly contributes to Section 6 as well. However, beyond the insights presented about the problem understanding, the interview's secondary purpose is to collect information about existing practices (such as coping mechanisms or specific techniques that are used to address certain challenges, see Section A.3.10 and Section A.3.4 respectively). With knowledge about these practices, working solutions and empirically founded strategies can be identified that may help inform the design of an artefact. A variety of insights form this interview is therefore used as contributions in the design-specific additional knowledge section for the artefact at the class level. These insights are discussed, before abstracting from them.

## A.5 Limitations and Conclusion

The interview study is subjected to several limitations, which may affect the results, and therewith the contributions toward the artefact creation and the artefacts themselves. While the author has used the utmost caution and professionalism, these limitations need to be addressed. **First**, the sample of interviewees was chiefly dependent on personal contacts of the author and of Prof. Dr. Robert Winter. Therewith, it is possible that implicit shared views exist among the interviewees. Five out of eleven interviewees have had an affiliation with the university of Saint Gallen at the time of conducting the interview. Six, however, are from other universities. Three of them are based in different

universities in Germany, two in different universities in the United States, and one is based in New Zealand. Therewith, the sample is both international and intercontinental. Furthermore, the sample is varied in the sense that there are both professors (n=3), senior post-doctoral researchers (n=4, one of whom has since become a professor and one has become a junior professor) and doctoral students (n=4, all of whom participated at a late stage of their dissertation, three of whom have graduated within half a year after the interview). Such varying levels of experience adds to the diversity in the responses. This is partially due to varying wealth of coping strategies, and partially due to them having different career-stage-related incentives and associated challenges when it comes to communicating their research (Tremblay et al., 2018). While additional interviews with researchers that have no personal association to the author or the university of Saint Gallen might have added more details, the insights form the interviews have been strongly aggregated anyhow, such that the author believes that the generalised insights with the sample is adequate.

**Second**, the interview transcripts were analysed by only one researcher (the author). Operationalising the coding procedure with at least two researchers would have allowed for computing inter-coder reliability of the pre-defined part of the coding (i.e., code categories 1-5) and the open coding part that has yielded code categories 6-11 could have been refined by (1) independently coding all transcripts and comparing the resulting code categories, or by (2) sequentially having a different researcher code the transcripts with the entire set of codes that emerged. Both suggestions would have improved the reliability of the findings. However, no such resources were available to the author. Instead, he has developed a coding procedure that allows to capture as many insights as possible (code 5 as a temporary storage vessel for openly coded information), while also coding in a structured fashion that increases completeness of coverage of topics (by using the emergent list of code categories and sub-categories.

**Third**, the interviewees might have attempted to help obtain the results sought by the author, who, in turn, might have inadvertently guided the discussion to reach consensus. While this is a drawback of personally conducting qualitative interviews, there are means to counteract such manipulations. In the case of this interview study, the author has used the following techniques: (1) The interviewees were provided with contextual information only, but they were not shown or talked through the conceptualisation that was to be evaluated, extended, and refined through the interviews. (2) The interview was structured such that the interviewees were asked open questions first, then follow-up questions to clarify or learn more about their answers, and only in the end, the author

added further questions that specifically investigate aspects of the problem conceptualisation. (3) The author used interviewing techniques such as mirroring (repeating what has been said) and rephrasing (using different words to repeat the understanding of what has been said), to ensure that the intended message was understood correctly by the author.

To conclude the expert interview study, a wealth of insights has been extracted from eleven interviews, which has informed this dissertation in many ways. The primary purpose of the interviews is to ensure that the author understands the research problem in depth, based on empirical data obtained directly by the main stakeholder of the research problem. The secondary purpose of the interview is to obtain knowledge about locally tested and proven (or rejected) strategies to cope with the research problem. This partially contributes to a deeper understanding of the research problem, but it chiefly adds to the design of an artefact. After all, design propositions that may work at an abstract level of analysis can be crafted by aggregating individually created, locally effective designs. Therewith, this interview has played and fulfilled an important role for the research outlined in this dissertation.

# Appendix B Qualitative Analysis of Paper Structures

## B.1 Rationale of the Study

In the problem description (Section 5), it is established that one particularly problematic communication situation sub-class is the publication of design research articles. Based on a bottom-up approach, investigating published design research articles (i.e., instances of successful attempts at publishing design research articles) can help understand the characteristics a design research article may need to possess to be successful. Such characteristics can refer to objective or subjective characteristics. Objective characteristics may include whether such articles contain illustrations of the artefact, whether the authors discuss specific contents (or not), or the order in which they present these contents. Subjective characteristics may include various perceptions that readers might have from reading the article. These two types of characteristics can be specified as structural characteristics and effect characteristics. These characteristics can be captured using qualitative or quantitative data, the analysis of which might bring forth information about paper structures, effects of papers on readers, and—based on both types of characteristics—a mapping of structural components on effect components. Such findings may be relevant for formulating guidance that helps design researchers overcome the problems they encounter when attempting to publish design research articles. After all, knowing how successful articles are structured may provide prescriptive knowledge on how articles should be structured to improve their likelihood of success. Furthermore, knowing about the effects of successful articles on their audiences may provide prescriptive knowledge on what communication goals communicators should consider. Lastly, knowing which structural design decisions correlate with which perceptions by the audience might help formalize such prescriptive knowledge in the form of specific instructions (i.e., structural design decision X leads to effect Y).

This overarching introduction to the analysis of structures and effects of successfully published design research articles outlines the general rationale for the empirical studies. Figure 39 provides an overview of the four selected studies that operationalize these ideas. The first two empirical studies focus on the structure of research articles (Appendix B and Appendix C), whereas the third study investigates the effects of the articles on readers (quantitative survey, Appendix D). The data used for all three of these studies are published design research articles (see Section B.2 for further details). The source data for the fourth and synthesizing study are the finding of these three studies (Appendix E).

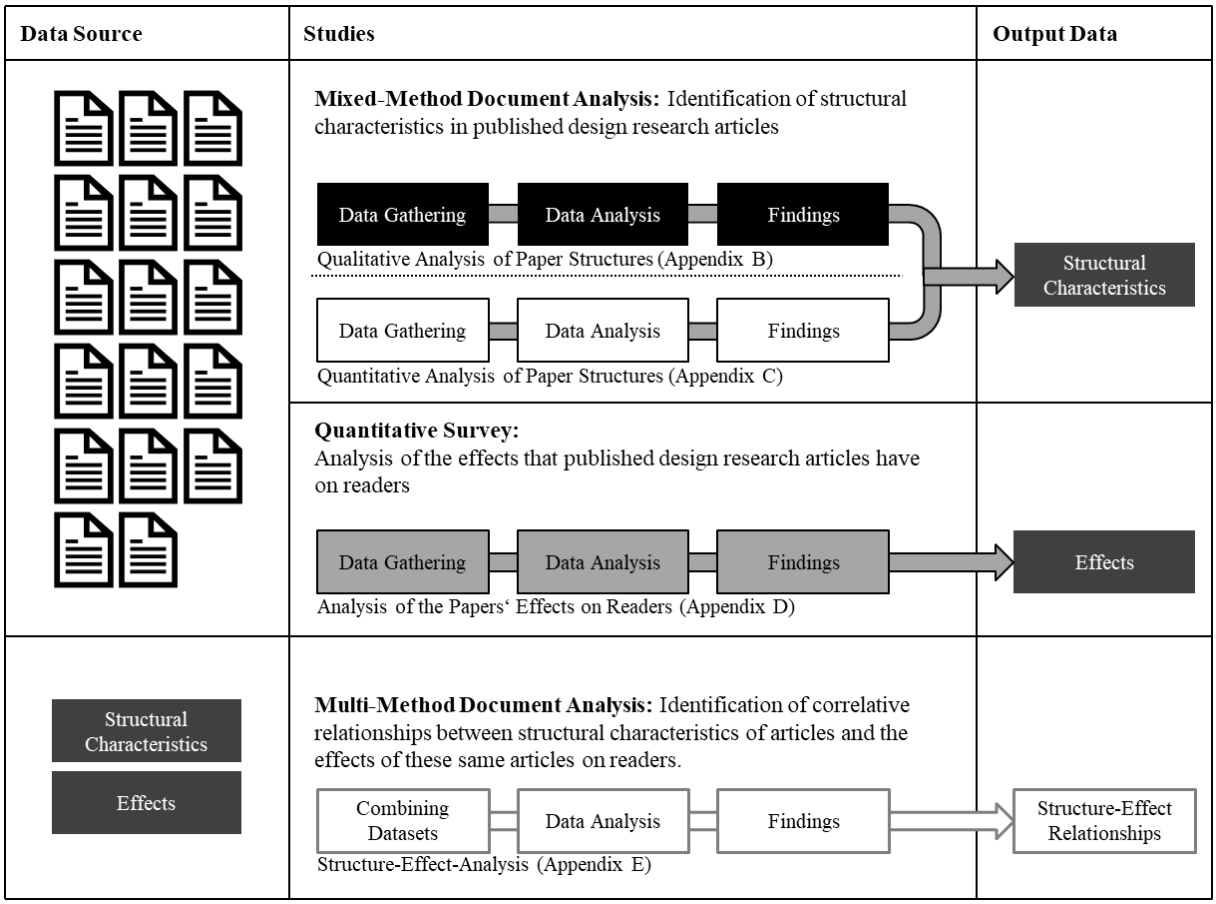



*Figure 39: Overview of the Empirical Studies B-E*

The structural characteristics of these articles are analysed qualitatively in the first study, whereas the second structural analysis follows a quantitative approach (Appendix C). The qualitative approach allows for exploring the existing structures and does not pre-emptively limit the number and quality of observations. Instead, the analysis relies on coding, which allows for capturing yet unanticipated characteristics. This study is described further in this section of the appendix.

## B.2 Research Approach

The following elaborations on the research approach specify the selection of research articles for the analysis and the procedure for the analysis. In the selection process, chosen articles (1) must contain a design research project and (2) be published. The author started with the document list from a recently published literature review on DSR in the Senior Scholars' Basket of Journals (Engel et al., 2019). Engel et al. identified DSR articles and split them into design science and design research articles (as per the terminology used in this dissertation, see Section 2.1.2.1). A random selection of fourteen articles was taken from the design research articles. To ensure that the analysis includes

any newer document structures that may have emerged after the data collection in Engel et al. (2019), the author added five newer articles from the Senior Scholars' Basket of Journals. The same procedure as in Engel et al. (2019) was used to identify these five papers, but with a temporal restriction for articles from 2020. The total number of articles was selected such that the trade-offs between resources available for data analysis and the reliability of the findings are balanced. More articles increase the reliability (e.g., of patterns identified in the data) and increase the work required for the analysis. The final sample contains 19 articles. This qualitative analysis of the document structures, the quantitative analysis of the document structures (Appendix C), and the analysis of the effects (Appendix D) use this sample.

The procedure used in this qualitative analysis of the articles' structures is based on the coding methodology (Bortz & Döring, 2006). No initial framework was used because this analysis is intended to explore the structures one might find within the articles (as opposed to the confirmatory, quantitative analysis of structures, see Appendix C). The author read each article carefully, and each topic covered by the contents in the articles was given a summarizing code. These codes can be understood somewhat like headlines. However, they are purely based on the content and do not correspond to headlines provided in the articles. By doing so, each article's codes should reveal a structure of contents. The latter relates to the communication process elements' select content' and 'order content' described in Section 2.2.2. In addition, the author commented on each section with a summary of what was peculiar about the article. Thus, this analysis reveals structures and provides an improved basis for comparing these structures. Once all articles were coded, the comparison of articles could take place.

The procedure for comparing the articles is axial coding (Bortz & Döring, 2006). By renaming and aggregating the open codes, document-spanning codes emerged. These codes simplified the identified structures of the articles. This aggregation took place with consideration of the free-text commentary to more accurately discern commonness from differences. After an initial axial coding round, the simplified document structures were compared (instead of comparing individual codes). The free-text commentary also supported this comparison. From this comparison, groups of articles with similar structures formed.

Structures that underlie many research articles abide by normative scripts (Tremblay et al., 2018). Namely, most research articles follow the nominal structure of an empirical research paper (problem definition; literature review and hypothesis development; methodology; analysis; results; discussion; conclusion, described in Peffers et al.

(2007)). As per the foundational assumption of this dissertation and the established problem understanding (Section 5 in this dissertation) that design research projects are different from other research projects and that this affects communication, one could expect communication artefacts (here: articles) to differ too. Hence, while the nominal structure of an empirical (non-design) research paper may be suitable for presenting the relevant contents for communicating such projects, this may not hold for design research project communication. Such hypotheses may be answerable by further investigating the groups discerned within the analysed design research articles.

## B.3 Results and Discussion

The analysis of the 19 design research papers for underlying structures revealed a set of six structural groups. Each of these groups has a different structural distance to the nominal structure of empirical research papers. This sub-section presents these groups in the order of their proximity to (or similarity with) the nominal structure. Each group is presented by describing its characteristics and comparing it to other groups before providing an overview of the specificities of its articles.

### B.3.1 Group 1: Nominal Structure of Empirical Research Papers

Among the papers analysed, the closest ones to the nominal structure of an empirical research paper are Adipat, Zhang, and Zhou (2011) and Avdiji, Elikan, Missonier, and Pigneur (2020).

*Table 62: Nominal Structure vs Articles in Group 1*

| Nominal structure | Adipat et al. (2011) MISQ | Avdiji et al. (2020) JAIS |
|---|---|---|
| Introduction | Introduction | Introduction |
| Literature Review and development of hypotheses | Related work and Research model | Literature Review |
| | Theoretical foundation and hypotheses development | |
| Methodology | Methodology | Methodology |
| Analysis and Results | Analysis and Results | Analysis and Results |
| Discussion | Discussion | Discussion |
| Conclusion | Conclusion | Conclusion |

As shown in Table 62, the articles' coded structures nearly perfectly match the nominal structure. Due to the papers' structure, these publications resemble descriptive empirical studies rather than problem-solving design studies. **Despite being design research**

**projects, readers perceive primarily aspects of the project related to traditional explanatory empirical research**. The fact that the authors have designed something (the core outcome of a design research project) remains in the background and is barely addressed in either of these two articles.

Adipat et al. (2011) explain that they followed the design science research framework and implemented the designs for empirical testing. However, the manuscript heavily focuses on the **literature-based derivation** of a research model and related hypotheses. That research model is tested by operationalising its constructs and testing their relationships by employing an experiment. Finally, data from the experiment are analysed, and interpretations for the theoretical model are explicated. In other words, the paper features what seems to be the conceptual elaboration on a solution (leading to a research model) and a **confirmatory research design to evaluate the related hypotheses while omitting a stakeholder-centred problem analysis, the acquisition of their solution requirements, the iterative and stakeholder-focused development and evaluation of designs, as well as the demonstration of design propositions**. The authors replaced these steps with literature- and thus, theory-based elaborations about the hypothesized effects of the proposed design. These explanations are then investigated with a confirmatory experiment. If the explicit reference to Hevner et al. (2004) were omitted, this paper would be indistinguishable from an empirical, confirmatory research paper, in which a research model is initially devised and thereafter tested.

While Avdiji et al. (2020) does not contain theory-based hypotheses development, it also complies with the nominal structure of an empirical research paper. This paper features the idea of combining learnings from a set of three design research projects and abstracting prescriptive knowledge to form a design theory. These cases are explored, and **the designed part of this design research paper is the set of design principles that span the three cases**. This paper does not present the phases of a typical design research project (Peffers et al., 2007) but focuses on theorizing in DSR (Gregor & Jones, 2007; Lee, Pries-Heje, & Baskerville, 2011). The **manuscript's methodology can be considered an exploratory and explanatory document analysis**. The design activities in the paper are omitted, and the design theory is presented as a result of extracting commonalities in the three explored cases. There is no investigation of the research problem, no requirements elicitation, no iterations, and no evaluation.

### B.3.2 Group 2: No Design, no Artefact

The second group merely has one representative among the papers analysed: Keith et al. (2013). In this peculiar case, the authors neither elaborate on **the design and development phase nor present the artefact**. **However, it does feature an elaboration on the problem, existing solutions, requirements for a better solution** and "a description of the SoMSD (artefact) is provided based on theories from the literature on service orientation and modular systems. Then the effectiveness and effects of the SoMSD are demonstrated by an examination of its adoption in the IT unit of a large electrical power company" (Keith et al., 2013, p. 230). Lastly, the post-hoc examination of unintended consequences, limitations, and implications are discussed. Hence, the contents indeed lie within the roam of a DSR project. However, the design process is omitted, and the artefact itself is presented by comparing it to other methods or descriptions of an instantiation. The aspect that made this manuscript stand out from the other manuscripts is that the core artefact was not explicated or shown, despite it being a "high-level methodology." The latter would suggest that presenting it in writing or graphically would be a relatively simple task.

### B.3.3 Group 3: No Design, with Artefact

Representatives of this group are Arazy, Kumar, and Shapira (2010), Goldkuhl and Karlsson (2020), Närman, Holm, Ekstedt, and Honeth (2013), Yang, Singhal, and Xu (2012), and Williams et al. (2008). They share the following structural characteristic: **The design knowledge from the respective design research projects is presented in the manuscripts, while the design activities are largely omitted**. In addition, these manuscripts differentiate themselves from group 1 by consecrating a significant portion of the manuscript to the description of the artefact; and from group 2 by explicitly presenting the artefacts. None of the first three groups explicates the design and development activities. **However, aspects of the artefact designs are justified employing related literature** (to create design hypotheses or to support design elements, e.g. in Yang et al., 2012)

The manuscripts of group 3 use **no more than one paragraph to explain the methodological aspects of how the artefacts are created**. The most detailed explanation spans one paragraph and comes with an illustration of the overall research process activities (Närman et al., 2013). That manuscript guides readers through the research process activities model they used. However, the contents presented are the outcomes of each step, eventually compiling the artefact and not discussing the actual activities.

In the other manuscripts, **the design process explanations are reduced to the claim that the artefacts were derived based on the background knowledge** outlined in the manuscripts. For example: In Goldkuhl and Karlsson (2020), ample background literature is provided to explain the core phenomenon (information system development methods) and the fundamentals of the methodology (DSR). At the same time, the design principles that prescribe how the desired process model should look like (first type of artefact produced in this project) are introduced as follows: "Based on our discussion in previous sections, we have developed eight ME-DS principles that can act as a foundation for a research process. These principles are presented (below)." No additional input on the development, selection, or curation of the principles is provided. The paper furthermore contains a process model, the creation of which is described as: "Based on these ME-DS principles, we designed a process model, illustrated in Figure 4." Methodological explanations are next introduced where the demonstration of the artefact (retrospective demonstration) is explained. With five paragraphs, this section is lengthy compared to the (largely omitted) explanations about the design phase.

In Arazy et al. (2010), the methodological explanation on how the testable design propositions (design principles) were developed is: "The first set of design propositions, TDP1a-e, describe the feasibility of the proposed SRS design, and were derived directly from the meta-design. The remaining propositions, TDP2-2e, relate to the ability to enhance SRS (social recommender system) prediction accuracy and were articulated based on the findings from the evaluation of the applied theoretical model" (Arazy et al., 2010, p. 477). No further details indicate how that derivation or articulation took place.

In Yang et al. (2012), the **design process seems apparent**, as the various aspects of the designed artefact are explained before introducing the final artefact. However, **the activity of designing and iterating is not included in the manuscript**. Instead, a reference approach is suggested, and after that, design hypotheses are derived from literature about the chosen kernel theory: "Using Walls et al.' Model (1992), we propose a design theory of a win-win seeking negotiation agent to be used in the above-defined problem scope. Employing the (…) kernel theory, we describe the meta-requirements of (the artefact). We next present a meta-design (…) as part of our testable design product" (Yang et al., 2012, p. 227). One striking structural aspect of this paper is that the second section of the manuscript is purely focused on presenting the scope of the problem (i.e., which types of situations are addressed by the solution). This creates much clarity but takes about one page of space.

The categorization of Williams et al. (2008) into group 3 rather than group 4 can be explained by the lack of detail in the explanations about the design process. Unlike the other papers in group 3, this manuscript does indicate how the artefact or the design decisions came to be. However, the **procedures themselves are so vague that there might as well be no explanation at all**. This is different from the manuscripts from group 4 (see below). Williams et al. (2008) explain the methodology used to create a taxonomy of digital services as follows: "Thus, our method was interpretive by brainstorming, but also hermeneutic through iteratively refining the basis of the taxonomy. (…) As a basis for the initial classification areas, we started with the 'apparent intention' of the designers and their 'goals' in the design" (p. 508). The design process that led to the design dimensions is not transparent, though it was somewhat explained: "Through an iterative process of observation and analysis, we identified four fundamental design dimensions that we think distinguish one service from the other. That is, not to conclude that this is an exhaustive list, but in any iterative approach becomes the starting for the next iteration" (p. 509).

### B.3.4 Group 4: Design in Methods, with Artefact

As opposed to group 3, representatives of this fourth group made space for the design process. **The design process is described within the section that elaborates on the methods**. In line with the nominal structure of an empirical research paper, this is the **third section in these articles**, after the introduction and a section featuring related research. Five of the articles in the sample are part of this group. All of them **present both a reference approach and details about their operationalization of the respective approaches within the method section**. That section is termed 'design science research approach' in Nguyen et al. (2020), 'methodology' in Giessmann and Legner (2016), 'research design' in Kolkowska, Karlsson, and Hedström (2017), 'research method' in Oberländer, Röglinger, Rosemann, and Kees (2018), and 'research approach' in Reinecke and Bernstein (2013). The level of detail varies, and thus, the space given to the explication of how the reference approaches were applied spans from one page (Nguyen et al., 2020) to two and a half pages (Giessmann & Legner, 2016). The articles from group 4 also have in common that **the subsequent section in these manuscripts contains a presentation of the artefact(s)**. After that, some variability in the structure of the manuscripts exists.

In Nguyen et al. (2020), two types of artefacts are presented in two separate sections (4 and 5). First, **three design principles are presented** along with the literature that

supports them. For each design principle, about half of a page was used. After that, the **primary artefact** (learning analytics information system (LAIS) architecture) was presented, **both in the form of a text (about one page) and with a schematic**. The text focuses on explaining the **constituents and mechanisms of the artefact** and indicates how it complies with the aforementioned design principles. The **evaluation of the artefacts is lengthily explained and illustrated** in the sixth section of the paper, spanning more than eight pages or about half the manuscript. Learnings from the demonstration and evaluation are integrated into the design principles within that section as well. However, the LAIS architecture itself is not repeated in an iterated version. The last section, containing the discussion and implications for research and practice, spans three pages. This article is, compared to articles from group 1, for example, very clearly a design research article, as it features a DSR reference approach, artefacts, an evaluation of the artefacts and an iteration of the design principles.

In Giessmann and Legner (2016), the **Action Design Research (ADR) approach was chosen, and the design activities presented in the methodology section** are organized according to the ADR design search process. The descriptions are extensive such that it becomes **clear what has been done throughout the project**. In the subsequent section, the primary artefact (a design theory for PaaS business models) and its related artefacts (meta-requirements and an instantiation), along with insights from the evaluation, are presented. The paper is finalized with a conclusion section (the fifth section of the manuscript) featuring a discussion, the contributions, limitations, and implications. With **only five sections, this paper feels compact and cleanly structured** (the sections span 2, 5, 6.5, 10.5, and 2.5 pages, respectively). It **contains the design process, the artefact, theoretical foundations, and empirical evidence**. This paper features the design story and **does not extensively justify the (established) method while focusing on the design and its contributions**.

Kolkowska et al. (2017) is similarly structured as Giessmann and Legner (2016). However, while the demonstration is presented alongside the artefact (a method) in the fourth section of the paper as well, the insights from applying the artefact are reflected in an additional section. The discussion and conclusion sections follow thereafter, as one may expect based on the nominal structure of a research article. **This paper benefits from the many examples drawn from the demonstration that illustrate each phase of the artefact.** The drawback of how this paper is presented is that it is **built on six DRS cycles, "of which the final two cycles are presented** in this paper" (Kolkowska et al., 2017). In other words, several aspects of the article remain somewhat unclarified,

including what aspects of the designs or requirements were new in these final two cycles or taken over from former cycles. With that, the paper is both clearly communicating the procedures and not communicating the procedures that have led up to the cycles presented in the manuscript.

The structure in Oberländer et al. (2018) matches the structure in Kolkowska et al. (2017). Hence, section three also presents a reference approach and walks the readers through the procedures. Section four presents the artefact (in this case: a taxonomy), which is reflected upon in section five. That reflection is concerned with learnings from applying the taxonomy as well. However, while section five in Kolkowska et al. (2017) primarily demonstrates that the artefact complies with the meta-requirements, Oberländer et al. (2018) focus more on demonstrating the usefulness of the artefact by conceptually applying it to other cases.

In Reinecke and Bernstein (2013), **the DSR methodology** model (Peffers et al., 2007) is used as a reference approach. It **is illustrated schematically with the various operationalizations in this specific DSR project inserted into the illustration**. Section four presents and justifies five interdependent artefacts. In the fifth section, two experiments evaluate these artefacts. This section contains a detailed description of the methods used, the hypotheses, the operationalization and results of each of the experiments. At last a summary and the discussion of the results from the evaluation is provided.

### B.3.5 Group 5: Design of Instantiation, with Artefact First

In comparison with groups 1-4, groups 5 and 6 **present a version of a solution before presenting design procedures**. Hence, groups 5 and 6 feature some explication of the design activities (unlike groups 1-3) and the artefact (unlike group 2). Furthermore, they differentiate themselves from group 4 by **introducing a version of a solution (artefact) before detailing design procedures**.

The representatives of group 5 are Dincelli and Chengalur-Smith (2020), Li, Larsen, and Abbasi (2020), Spagnoletti, Resca, and Lee (2015), and Twyman, Pentland, and Spitzley (2020). The artefact is presented before elaborating on design activities, as in group 6. However, these articles differ from the ones in group 6 in three ways. First, they come with a **traditional background knowledge section**. Second, the artefact presented before elaborating on design activities is a meta-artefact, while **the design activities report on the process of instantiating that meta-artefact**. That meta-artefact was described explicitly in Li et al. (2020), Spagnoletti et al. (2015), and Twyman et al. (2020) while remaining implicit in Dincelli and Chengalur-Smith (2020). The latter presented

hypotheses for designs that should solve the problem, akin to design principles. Third, **the design section is followed by a dedicated section on evaluation**.

Conceptually, these papers' design activities sections focus on how the (idea of a) solution is instantiated, rather than explaining how the (idea of the) solution itself was designed.

Dincelli and Chengalur-Smith (2020) surprisingly strongly relied on appendices. The author noted that this had a heavily taxing effect on his perception of the manuscript's readability. After the first two sections, the contents became hard to follow as the references to the online appendix portfolio became frequent. The excluded contents amount to ten appendices and more than 30 additional pages.

Spagnoletti et al. (2015) also have a peculiarity compared to the other papers in this group. The instantiation they used to contextualise the meta-artefact and gain knowledge on the implementation of the artefact did not stem from them designing an instantiation. Instead, they used expository instantiations (i.e., existing ones) to test the design propositions.

### B.3.6 Group 6: Design of Artefact, with Artefact First

Group 6 has two representing papers (Ebel et al., 2016; Lycett & Radwan, 2019). Its manuscripts are **structured as follows: Introduction, research approach, problem description, (literature-derived) presentation of a solution, design iterations that led to the artefact (incl. learnings), discussion**. In both instances, the artefact was described in a high-level form before diving into the design activities. Presenting the artefact first has the effect that the subsequent explanations about the design process are more relatable than when the artefact is presented last, as suggested in Lycett and Radwan (2019): "The **model is presented in a high-level form here (section 4) as orientation for the description of the iterations in the sections that follow**" (p. 179). This early presentation is explicit in Lycett and Radwan (2019), where section 4 is fully dedicated to that suggested solution. **The design process that led to the final artefact is elaborated on in the subsequent sections**, which describe two complete design iterations in each paper. While Lycett and Radwan (2019) featured the finished artefact in section 4 already, Ebel et al. (2016) iterated the initially presented model and explicated the final artefact in section 6 again.

One striking characteristic of group 6 is that there is no dedicated background knowledge section (usually section 2 in the nominal structure of a research article).

Instead, section 2 presents the general research approach, and section 3 presents the relevant information about the research problem. In Ebel et al. (2016), section 3 (problem formulation) is extensive and contains two complete studies (literature review and expert interviews), yielding a first version of the framework designed in this study. Of course, the research problem description section therefore also contains related literature and even empirical evidence that describes or defines the problem. However, the **lack of a dedicated background knowledge section is unique to this group**.

### B.3.7 Discussion of the Qualitative Analysis of Paper Structures

The differences between the groups outlined above are summarized in Table 63. It becomes apparent that there is quite some leeway regarding how a publishable design research paper can be structured. For example, while some papers are structured like a non-DSR, nominal empirical research paper, others are missing certain sections (e.g., methodology or analysis and results) or added sections (e.g., problem description, artefact presentation, or design process). Another finding from this exploratory analysis of design research article structures is that existing guidance such as Peffers et al. (2007), or more interestingly, the guidance described in Gregor and Hevner (2013) (which specifically instructed design researchers on how to structure their articles), are not readily used.

As per the elaborations on each group and their associated articles, it becomes evident that different articles are written with different focuses. While some entirely omit the artefact, others present their artefacts before even discussing the antecedents of the artefact design. As with design research projects (see Section 2.1 and Section 2.3.1) and the communication situations throughout such projects (see Section 5), there is variability in how design articles are presented. Not only is the order in which contents are presented different among groups, but also the contents selected for the articles.

*Table 63: Overview of the Structural Groups*

| Nominal Structure | Group 1 | Group 2 | Group 3 | Group 4 | Group 5 | Group 6 |
|---|---|---|---|---|---|---|
| Introduction | Introduction | Introduction | Introduction | Introduction | Introduction | Introduction |
| Background knowledge | Background knowledge | Problem description | Background knowledge | Background knowledge | Background knowledge | Methodology |
| Methodology | Methodology | Background & examples demonstrating the artefact | | Methodology, incl. design process | (high-level) Artefact presentation | Problem description |
| | | | Artefact presentation | Artefact presentation | Design of an instantiation | Artefact presentation |
| Analysis and results | Analysis and results | Evaluation methodology and Analysis and results | Demonstration & evaluation incl. analysis & results | Demonstration; implementation; Evaluation; or Reflection | Evaluation of instantiation & Analysis and results | Design process that led to the artefact, incl. evaluations |
| Discussion | Discussion | Discussion | Discussion | Discussion | Discussion | Discussion |

## B.4 Contribution to the Design Research Project

This study contributes to the design of an artefact at the sub-class level of analysis. Its primary contribution resides in the additional knowledge about the focal phenomenon (here: publishing design research articles). Subsidiary contributions are the six groups that help analyse the articles' effects on readers (Appendix E).

The additional knowledge that contributes to the design and development activities of the sub-problem class artefact contains:

- **There is not one archetypical structure that is followed in successful publications:** This suggests that providing one structure for all design research articles might not be adequate. Instead, several structures may be suitable for presenting design research articles.
- **There is diversity in the storylines:** Among the 19 articles, six article structures emerged during the qualitative structure analysis. Different storylines

characterize these groups. This indicates that there is flexibility and design freedom in writing a research article.

- **The storylines chosen for an article can lead to a different order of the contents and a different selection of content aspects:** While some articles contain the description of design activities, others do not. Some even omit the description of the focal artefact. Others present the artefact as the central content aspect.

## B.5 Limitations and Conclusion

A limitation of this study's research design is that the selection of articles is relatively small, and that the selection was not fully randomized over one sample (the newer articles were added in a second sampling round). It is therefore not advisable to infer from the distribution of articles that some storylines (groups) are more common, or that these six groups are conclusively representing the possible storylines for design research articles. Instead, the results may be interpreted more globally, as discussed above. This limitation can be overcome by re-sampling design research articles and by analysing a much larger set of articles. However, given the fact that the qualitative structure analysis is only one of two structure analyses and that the structure analyses are part of a structure-effects analysis, possible imprecisions of this study may be overcome by triangulation with further analyses.

Another limitation is that the finished articles might not be indicative of how an initial submission was or should be structured. After all, these manuscripts are likely to have passed through several iterations of revisions and re-submissions, which might have significantly changed their structures (cf. Section 5.2). However, the perceivable focus in the published articles varies strongly, such as rigorous evaluation of something (group 1), design and demonstration of an artefact (group 4), or presentation of an artefact and its evolution (group 6). Considering that the identified structures suggest a strong content focus, one could think that they were already somewhat similar to the final version at the submission.

One thing that can be concluded with certainty is that each group has its own storyline, while the articles within a group share very similar, if not the exact same storylines. With that, this study has brought forth a basic understanding of a selection of afore hidden content structures. This understanding can hereafter be used to analyse whether these content structures yield more or less desirable outcomes and which structure might be most suitable for which objective.

# Appendix C Quantitative Analysis of Paper Structures

## C.1 Starting Point

This empirical study is the second part of a set of four inter-related studies, as outlined in the introduction to Appendix B (see also Figure 40, below). This study investigating the structure of the same sample of 19 design research articles is presented here. This study relies on a quantitative approach. The results of the quantitative study are used in combination with the results from the qualitative study (Appendix B) to form an understanding of the existing structures and structure-related design decisions in design research articles. This mixed-methods approach to investigating the structure of successfully published articles yields more granular results than any one of these two studies. Increased granularity serves two purposes: First, beyond the broad groups of structures identified in the qualitative analysis, a quantitative approach can reveal commonalities and differences across articles at a higher level of detail. During axial coding in qualitative data analysis, much detail is lost in favour of comparability across articles (Bortz & Döring, 2006). The quantitative approach to analysing paper structures does not lead to a loss of information during the analysis. However, this is at a trade-off with the preselection of possible observations. Hence, while the qualitative approach allows for exploring but loses detail-level information, the quantitative approach can only pick up on pre-specified characteristics but do not lose informational details thereafter. Because of these trade-offs, it is desirable to conduct mixed-methods research (Creswell & Creswell, 2005).

## C.2 Research Approach

As illustrated in Figure 40, the same sample of articles is used for the qualitative analysis of paper structures (Appendix B), the analysis of effects (Appendix D) and this quantitative analysis of paper structures. As opposed to the qualitative study, an initial framework was used for the coding in this second study. That coding framework needed to be created before starting the analysis. This framework consists of two primary sections: The **first section** contains codes for a quantified structure of topics covered in the articles (see Section C.3). This section of the framework takes note of the topics (selection of contents), their sequence (order of contents) and length. This combination of information should allow for statements about how extensively certain kinds of contents are presented and for tentative statements their relative importance. These two insights are

relevant for addressing the research problem of this dissertation. After all, selecting content elements and splitting and compiling that selection to yield a research paper are problematic activities for design researchers. They often cannot rely on the nominal structure of empirical research articles, and there is no equivalent for design research articles (Section 5).

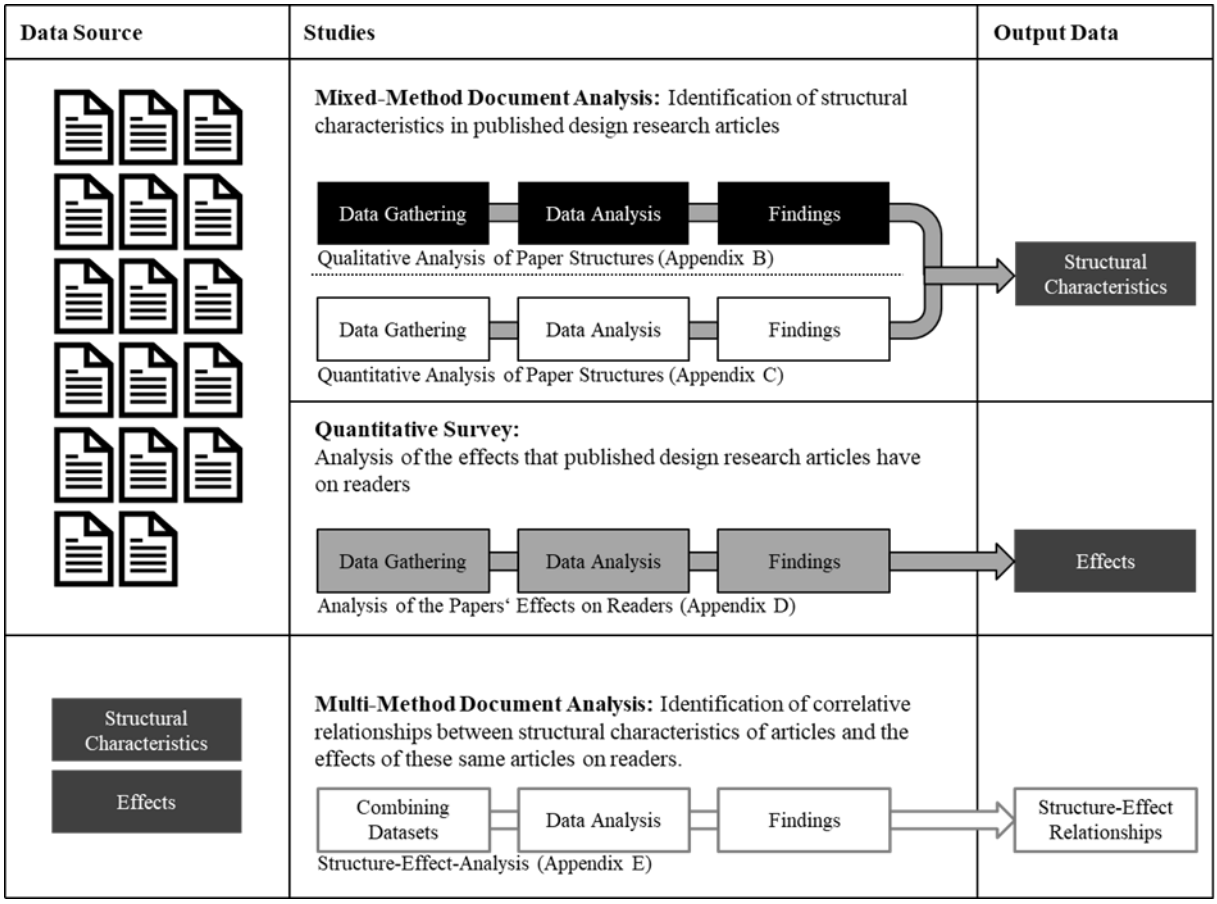



*Figure 40: Overview of the Empirical Studies B-E*

The **second section** of the coding framework should help grasp more fine-grained structural characteristics of these research articles rather than the general structure. For doing so, the author derived an extensive series of characteristics from the literature review (Sections 2 and Section 5.1), and in particular, from the knowledge about design research projects (Section 2.1). These characteristics were selected such that the coding and analysis of the quantitative codes might identify heuristics and standards in designing design research articles. One example of such a code might be: Does the article indicate a reference approach that the researchers used? If most articles do not contain this piece of information, then indicating a reference approach may not be part of a binding normative script for writing design research articles. If some do, whereas others do not, one might discern further commonalities between the ones that do and those that

do not. If all or almost all articles provide a reference approach, then this is likely to be a necessary content element. Such additional insights can help inform the design of an artefact that guides design researchers in formulating an article.

The coding framework for both sections is operationalised within a Microsoft Excel document. Each article is coded in one individual sheet. Each sheet is prepared identically and contains clarifications as to how the quantitative values should be selected (i.e., the coding handbook is integrated into the Microsoft Excel-based coding framework). This helps ensure coding consistency across articles since the coding instructions are always available at the exact location where the codes are set. The coding framework and the codes for each article can be found in the supplemental material of this dissertation (Appendix I).

The techniques of analysis used on the resulting dataset are specified in the sections below, along with the results. Section C.3 presents the results from the first section of the coding framework; Section C.4 presents the results of the second section of the coding framework; Section C.5 introduces the findings from the qualitative analysis of paper structures to the data analysis; finally, Section C.6 summarises the contributions of this study to the design research project.

## C.3 Results and Discussion of the Frist Section

The first section of the coding framework is about the selection and order of contents. It contains ten different content element categories (see: Table 64). These categories emerged from an iterative process including initial brainstorming, selecting a subset of the content categories that appeared most relevant based on the literature review (Section 2), and merging these categories until a manageable number of distinct categories resulted. Hence, the goal was to reach a ‘useful’ number of categories. Therefore, there should not be too many categories because the analysis would not converge enough to identify patterns. At the same time, choosing too few categories may also be of low usefulness, as little granularity hinders the discrimination between cases and, therefore, identifying patterns. The result of this iterative process can be seen in the table above.

*Table 64: The Ten Content Elements and the Coding Instructions*

| Nr. | Content element categories | Coding instructions |
|---|---|---|
| 1 | Problem description: What, why, who, where? | Does the content describe the research problem or aspects thereof? Does it describe the situation, the stakeholders, the stakeholder interaction, the (denied) goals of these stakeholders, the reasons these goals are not reached, the difference between 'is' and 'to-be'? |
| 2 | Objectives: Goal of the study, RQ | Does the content describe what should be achieved with this design research project? This can be the rationale behind and formulating of a research question, but it can also be a purpose statement |
| 3 | Requirements: Stakeholder's concerns and needs | Does the content describe desired outcomes regarding the solution? Does it, even if implicitly, describe criteria based on which the goodness of an artefact can be assessed? |
| 4 | Knowledgebase: How is the study informed? What exists? | Does the content refer to literature that justifies assumptions for the study? Does it review existing knowledge? |
| 5 | Methodology: Which (generic) approach is used? (e.g. DSR, Peffers et al.) | Does the content indicate a reference approach or a summary of an approach based on existing literature? Does it discuss a general approach to the research project? |
| 6 | Procedures: Description of actions, e.g., data gathering techniques | Does the content discuss specific actions or techniques used in operationalising the methodology? |
| 7 | Iterations and Intermediate learnings | Does the content explicitly discuss intermediary results and whether or why there was an iteration thereafter? |
| 8 | Results: Artefact description, demonstration, evaluation, contributions | Does the content describe final results from the design project, including artefacts and explanations as to how and why they work (demonstration, evaluation, contributions)? |
| 9 | Explication of DK: Formulation of DP, DF, and application of DK | Does the content explicate the design knowledge that emerged or was produced throughout the study? (i.e., explicitly put into words and made recognisable as such) |
| 10 | Discussion: Limitations, avenues of further research | Does the content feature a critical reflection of the methodology or the study in general, or does it outline a research agenda? |

### C.3.1 Coding Procedures for the Order of Content Elements

The author focused on identifying pivots in the manuscripts that demarcate the end or the beginning of a new discussion to identify content elements and track how they compile to form an article. These pivots are based on the content of the text rather than sections and sub-sections. In doing so, the elements categorised in each document were expected to depict the content blocks more accurately than matching each (sub-)headline to a category. Therewith, the analysis and comparability of structures may be simplified, as many sub-headings may refer to the same category of content. However, this opens the door for many short discussions to be coded as well. For example: In Nguyen et al. (2020), the research project is introduced by an iterative presentation of a part of the problem (code 1) and the respective research objectives (code 2). This lowers the effectiveness of identifying and ordering content elements for the quantitative analysis.

Nevertheless, this approach to capturing the manuscript structure in numerical terms allows for various insights, as outlined below. In addition to capturing the categories of content, the order in which these categories are presented in the manuscript, and the number of characters each section spans, were noted during the coding procedure. The coder copied the text sections into a Microsoft Word file and used its word count functionality to count the number of characters each section covers. The number of characters per text section includes spaces.

### C.3.2 Findings from the Identification and Order of Content Elements

The quantitative analysis of the manuscripts reveals that the average manuscript features 11.5 sequential content elements of different categories. On average, each manuscript addresses 7.5 out of the ten content elements (see: Table 64). Hence, **the average manuscript does not address all content elements used in the coding** (which validates the choice of the content categories, as this allows for identifying variance), **and it repeats in four sections**. The frequencies with which certain sections are used varies. An overview of the distribution of numbers of times each element code repeats across the manuscripts is shown in Table 65.

*Table 65: Repetitions of content categories per manuscript*

| Content Element | Number of times used 0x | 1x | 2x | 3x | 4x | (n) | Weighted |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 10 | 7 | 1 | 0 | 19 | 27 |
| 2 | 5 | 8 | 5 | 0 | 1 | 19 | 22 |
| 3 | 12 | 6 | 0 | 1 | 0 | 19 | 9 |
| 4 | 1 | 9 | 8 | 1 | 0 | 19 | 28 |
| 5 | 4 | 9 | 5 | 0 | 1 | 19 | 23 |
| 6 | 2 | 7 | 7 | 2 | 1 | 19 | 31 |
| 7 | 10 | 6 | 2 | 0 | 1 | 19 | 14 |
| 8 | 2 | 3 | 8 | 6 | 0 | 19 | 37 |
| 9 | 9 | 10 | 0 | 0 | 0 | 19 | 10 |
| 10 | 0 | 18 | 1 | 0 | 0 | 19 | 20 |
| Sum | 46 | 86 | 43 | 11 | 4 | | |

The shades of green in Table 65 indicate with stronger colour higher numbers of manuscripts that represent the combination of element code (vertical) and the respective number of uses in these manuscripts (horizontal). Hence, while the problem description is rarely absent (very light green at 1:0x), almost all manuscripts contain one uninterrupted text section with the discussion part (dark green at 10:1x). Since 19 manuscripts were coded, the sum of articles that fall on the scale of zero to four (the maximum observed) is always 19. Lastly, the column titled "weighted" indicates the sum of products of the number of times used and the number of manuscripts that fall into each bucket per element code. Hence, the value in "weighted" for element code 1 is 0*1 + 1*10 + 2*7 + 3*1 + 0*4 = 27. This simple method of a weighted sum allows for making some statement about the relative prevalence of each element category.

#### C.3.2.1 Content Categories with Low Relative Importance

Low relative value seems to be given to content categories 3 (stakeholder's requirements), 7 (iterations and intermediate learnings), and 9 (explication of design knowledge), as can be seen by the low number of times this category appears (aggregated: Table 65, by article and structural group: Table 66). This quantification shows that **many manuscripts omit the requirements for the solution that the researchers designed, the implications of the iterative research approach, and an explicit formalisation of the created design knowledge**. This validates one of the underlying assumptions that led to this dissertation in the first place: **Some specificities of DSR hardly find their way into published manuscripts**.

*Table 66: Number of Times a Category Appears per Article*

| Gr | 1 | | 2 | 3 | | | | | 4 | | | | | 5 | | | | 6 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Code/First Author | Adipat | Avdiji | Keith | Arazy | Goldkuhl | Närman | Yang | Williams | Nguyen | Giessmann | Kolkowska | Oberländer | Reinecke | Dincelli | Li | Twyman | Spagnoletti | Ebel | Lycett | average |
| 1 | 1 | 2 | 1 | 1 | 2 | 0 | 2 | 1 | 3 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 2 | 1.42 |
| 2 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 2 | 4 | 2 | 0 | 0 | 2 | 2 | 0 | 1 | 1 | 0 | 0 | 1.16 |
| 3 | 0 | 0 | 3 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0.47 |
| 4 | 2 | 1 | 2 | 2 | 1 | 3 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 2 | 0 | 1.47 |
| 5 | 2 | 2 | 1 | 1 | 0 | 1 | 1 | 1 | 4 | 2 | 1 | 2 | 2 | 1 | 0 | 1 | 0 | 0 | 1 | 1.21 |
| 6 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 3 | 1 | 0 | 1 | 2 | 3 | 0 | 1 | 2 | 4 | 2 | 1.63 |
| 7 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 4 | 2 | 0.74 |
| 8 | 1 | 0 | 3 | 0 | 3 | 3 | 2 | 1 | 2 | 2 | 2 | 1 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 1.95 |
| 9 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0.53 |
| 10 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1.05 |
| ∑ | 10 | 12 | 14 | 11 | 11 | 12 | 9 | 9 | 20 | 14 | 7 | 8 | 13 | 13 | 8 | 10 | 12 | 17 | 11 | |

#### C.3.2.1.1 Requirements

While most manuscripts contain some statement on the purpose of the study (code 2: 14/19), only 7 out of 19 manuscripts elaborated on specific meta-requirements (Walls et al., 1992) or requirements (Peffers et al., 2007). However, according to Walls et al. (1992), meta-requirements (or: the description of the class of goals that a design ought to satisfy) are to be defined first, before the meta-design (or: the solution to a class of problems that is hypothesised to satisfy the meta-requirements) is created (p. 42). This is because requirements help understand the scope of situations in which the artefact can be applied, and they also prescribe what the solution should achieve. The latter is, of course, a measuring stick for the evaluation of the final design (Venable et al., 2016). Therewith, requirements go beyond mere statements of the general objectives of the study. **Therefore, the absence of a discussion of requirements in many manuscripts is somewhat surprising**.

#### C.3.2.1.2 Iterations and Intermediate Learnings

Another peculiarity of DSR is the iterative nature of design research projects. However, **iterations are also featured surprisingly rarely**. They may occur after analysing the

results from the evaluation phase, depending on whether the requirements are satisfied by the resulting design (Peffers et al., 2007; Venable et al., 2016). Another way of explaining iterations is through the cyclicality of design research projects per se, as the design and evaluation activities tend to be cyclical (design cycle), but also the giving and taking from or to the knowledge base (rigour cycle), and the exchange with practitioners, experts, and related stakeholders (relevance cycle). Nevertheless, less than half of the analysed articles feature a discussion of iterations.

Among the ones that discuss iterations (i.e., descriptions of procedures and results associated with more than one iteration), the most prominent use of this content category is in Avdiji et al. (2020). Three design research projects are presented therein, each with several design iterations. More than forty percent of the manuscript is used to describe these iterations. The original artefact presented in this paper is built on aggregating knowledge gained during these iterations.

In Arazy et al. (2010), a fifth of the manuscript is dedicated to deriving and explaining an adaptation of Walls et al.'s (1992) Information Systems design theory framework – an iteration based on which the authors built their final artefact. Therewith, this is the only paper in group 3 (see: qualitative analysis of structure) that addressed iterations. This is in line with what one may expect from the average group 3 paper. After all, by omitting design processes and focussing on final artefacts (see: group 3), one would not expect to learn about iterations. Similarly, it may be of little surprise to see that papers in group 4 only feature very short explications on iterations or omitted them entirely: While these manuscripts explicitly include the design process as part of the methodology section, the explications on each step (and therefore also on the iterations) is cut short. In two of five instances, iterations are even omitted.

In group 5, some papers feature iterations; some do not. Papers in group 5 contain the presentation of an artefact followed by its instantiation. In one instance, learnings from that instantiation are used to improve the artefact (Spagnoletti et al., 2015). Another article integrates learnings from a conceptual iteration into the design of the instantiation used in the evaluation (Twyman et al., 2020).

Lastly, iterations are present in group 6, where the design process that led to the artefact is described in a dedicated section. Hence, more space and detail are granted to the design process in these manuscripts, allowing for the description of iterations.

#### C.3.2.1.3 Explication of Design Knowledge

The last category of low relative importance is the explication of design knowledge (content element number 9). Hence, while the creation of prescriptive knowledge is the purpose of DSR, explicating that knowledge (e.g., by formulating prescriptive design principles) does not seem to be essential for basket journal publications. Instead, a description of artefacts may be sufficient (which would be category 8).

In summary, the rationale of this subsection's analysis concerns the absence of a content category. This absence is used as a positive indication that such contents are of low relative value in manuscripts (for otherwise, there would at least be some mention of them in most/all articles). However, to conclude that the higher presence of specific categories indicates relative coverage of space in a manuscript may be misplaced. After all, the presence of a category alone is not indicative of how much of a manuscript's content is dedicated to it. Hence, even if a category appears to be present in many manuscripts (e.g., out of 19 manuscripts, 14 contain the category "2: Objectives: Goal of the study, RQ"), one cannot conclude that any significant amount of space is granted to such content (e.g., the relative volume of a manuscript that covers contents of element number 2 is 1.2 percent, whereas about 10 percent of the content elements identified are of this category). Therefore, the following subsection discusses categories with low relative use of space.

### C.3.2.2 Content Categories with Low Relative Use of Space

Based on the low rates at which the content categories 3, 7, and 9 are found in the manuscripts, one might assume that these are also the content elements that take up the least space in these papers. However, this is not entirely true, as shown in Table 67.

Between the number of times a category appears (Table 66) and the relative space within the manuscript that each category covers (Table 67), the most considerable negative difference (i.e., less volume of the manuscript is used up by a particular category than what 'category use' might suggest) can be observed in categories 2 and 5. In contrast, the largest upward difference exists in categories 4 and 10 (see: Table 68, higher use of space is discussed in Section C.3.2.4).

The suggested use of space based on the number of appearances of a specific category (one to ten, see: Table 66) is computed by dividing the number of appearances of a specific category by the sum of category elements used in the same manuscript (last row in Table 66). The measured relative use of space is computed by dividing the sum of characters used up by a specific content category by the sum of characters used by all

categories in a manuscript. The 'difference' column in Table 68 indicates the relative difference between these two values. Hence, while the relative use of category 2 (or 5) would suggest that one tenth of the manuscript is concerned with the objectives (or the methodology), the percentage of characters actually used on the contents of this category informs us that much less space is used for it (88% less space used on category 2 yielding a total of 1.2% of characters; or 72% and 2.9% respectively for category 5).

*Table 67: Relative Space Used per Category and Paper*

| Gr | 1 | | 2 | 3 | | | | | 4 | | | | | 5 | | | | 6 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (first author) | Adipat | Avdiji | Keith | Arazy | Goldkuhl | Närman | Yang | Williams | Nguyen | Giessmann | Kolkowska | Oberländer | Reinecke | Dincelli | Li | Twyman | Spagnoletti | Ebel | Lycett | average |
| 1 | .06 | .09 | .07 | .05 | .04 | .00 | .14 | .04 | .04 | .06 | .08 | .07 | .06 | .09 | .17 | .05 | .04 | .06 | .12 | .069 |
| 2 | .01 | .00 | .00 | .02 | .00 | .03 | .00 | .08 | .02 | .02 | .00 | .00 | .01 | .01 | .00 | .03 | .00 | .00 | .00 | .012 |
| 3 | .00 | .00 | .11 | .00 | .00 | .02 | .00 | .05 | .00 | .06 | .00 | .00 | .00 | .00 | .00 | .24 | .03 | .01 | .00 | .026 |
| 4 | .38 | .03 | .10 | .38 | .34 | .38 | .25 | .21 | .18 | .20 | .24 | .19 | .22 | .34 | .24 | .06 | .20 | .10 | .00 | .213 |
| 5 | .03 | .02 | .01 | .04 | .00 | .03 | .03 | .03 | .07 | .07 | .02 | .07 | .01 | .01 | .00 | .03 | .00 | .00 | .09 | .029 |
| 6 | .23 | .14 | .15 | .05 | .06 | .21 | .14 | .08 | .10 | .19 | .00 | .13 | .16 | .21 | .00 | .13 | .20 | .26 | .13 | .136 |
| 7 | .00 | .42 | .00 | .20 | .00 | .00 | .00 | .00 | .02 | .00 | .10 | .00 | .02 | .00 | .00 | .07 | .15 | .13 | .21 | .070 |
| 8 | .11 | .00 | .25 | .00 | .39 | .18 | .27 | .40 | .32 | .10 | .38 | .18 | .36 | .13 | .31 | .23 | .18 | .17 | .16 | .217 |
| 9 | .00 | .08 | .15 | .07 | .02 | .00 | .00 | .00 | .00 | .19 | .00 | .16 | .00 | .00 | .15 | .00 | .11 | .12 | .11 | .061 |
| 10 | .20 | .22 | .15 | .19 | .15 | .16 | .16 | .11 | .25 | .12 | .18 | .20 | .15 | .21 | .14 | .17 | .09 | .15 | .16 | .167 |

*Table 68: Relative Use of Categories vs Relative Space Used per Category*

| Category | Suggested by times used | Measured in characters used | Relative difference |
|---|---|---|---|
| 1 | 12.2% | 6.9% | -43% |
| 2 | 10.0% | 1.2% | **-88%** |
| 3 | 4.1% | 2.6% | -35% |
| 4 | 12.7% | 21.3% | **68%** |
| 5 | 10.4% | 2.9% | **-72%** |
| 6 | 14.0% | 13.6% | -3% |
| 7 | 6.3% | 7.0% | 10% |
| 8 | 16.7% | 21.7% | 29% |
| 9 | 4.5% | 6.1% | 34% |
| 10 | 9.0% | 16.7% | **85%** |

From the low relative space used on categories 2 and 5, we can deduce that while these contents are important (i.e., most manuscripts feature them), there is no need to discuss them extensively. This may be unsurprising, as both categories have an associated category containing additional details. Namely, category 2 (objectives) could be kept short, as the more specific section 3 (requirements) extends the explanations on what should be achieved. Similarly, category 5 (methodology) discusses the methodological reference approach, while the operationalisation of procedures is captured by category 6. Hence, **while both the objectives and the methodology are somewhat important to be mentioned, the level of detail can be kept low**. However, as discussed above, not only are elaborations on the objectives (category 2) kept short, but also explanations regarding the gathering and selecting of requirements. Hence, **categories 2 and 3 seem to be marginal** indeed. Hence, one may conclude that **mentioning the objective of a design study in one's manuscript is important, but there is no need to go into detail**.

These insights summarise the contents that are not important (i.e., often omitted) or do not need to be elaborated on in detail (i.e., take up little space). This, of course, begs the question as to what is both necessary (i.e., is rarely or never omitted) and needs to be elaborated on more deeply (i.e., uses up a substantial amount of space)?

#### C.3.2.3 Content Categories with High Relative Importance

Similar to the sub-section on low relative importance, the rationale for judging whether a category is of high relative importance is based on the number of manuscripts that contain at least one mention of a category. As shown in Table 65, categories 1, 4, 6, 8, and 10 are rarely omitted, as only one, one, two, two, and zero manuscripts respectively did not contain these contents.

Hence, the **problem description (1), knowledgebase (4), procedures (6), results (8) and a discussion (10) are part of almost all manuscripts. Hence, these contents may be seen as a minimum requirement for selecting content elements**. Therein, one may recognise the nominal structure of an empirical research publication (see: Table 63, in Appendix B), with the peculiarity that the description of procedures seems to be more important than the description and justification of the methodological approach chosen (omitted in 4 out of 19 cases: category 5 in Table 65).

Considering the weighted sum of numbers of times a category appears (Table 65) reveals a further peculiarity. Notably, the description of objectives (category 2) appears often several times despite being absent in some manuscripts. Therewith, its weighted sum is higher than the one for category 10 (discussion), which in nearly all cases appeared only

once. The comparison with the categories' relative use of space can be used again to gain an intuition about the level of detail expected in (or at least currently dedicated to) specific content elements.

#### C.3.2.4 Content Categories With High Relative Use of Space

As indicated in section C.3.2.2**,** categories 4 and 10 are relatively voluminous compared to the suggested use of space (number of appearances of these content elements per total number of content elements). This indicates that these content categories are discussed with more detail than others or that authors avoid separating these elements into several smaller sections. (The latter would otherwise increase the number of appearances of the respective categories, increasing the "suggested percentage" of the manuscript being dedicated to that type of content.)

Regarding the discussion (category 10), the high relative use of space can be attributed to the fact that most manuscripts contain only one continuous discussion section. Hence, the fact that category 10 takes up more space in this one appearance per paper can be explained by the fact that it is one of the least split content categories (after category 9, see: Table 65).

However, this explanation does not apply to category 4 (knowledgebase). Category 4 content spans much more than its suggested space in an average manuscript despite the relatively high number of papers that feature more than one section of this category. Half the manuscripts containing category 4 content have two or more sections. Hence, the expected space in terms of characters used in the manuscript is higher in comparison with category 10 (discussion), but the space consecrated to the knowledgebase is still higher than equal use of space per section would suggest. Therefrom one can conclude that **particular emphasis is placed on the description of the knowledgebase used**. This is true both in relative and in absolute terms: Not only are there often more than one section containing information about the knowledgebase, but these sections are also lengthier than the average section in a manuscript (section in the sense of a distinct content element).

#### C.3.2.5 Content Categories' Absolute Use of Space

The above describes the relative importance of content element categories (i.e., the relative number of manuscripts that do not feature specific content element categories and the relative length of each category). In addition, the ratios of characters used in each category compared to the overall amount of characters in a manuscript provide further

insights into the structure of research articles. In this regard, categories 4 (21.3%), 6 (13.6%), 8 (21.7%), and 10 (16.7%) cumulatively cover about three quarters of the manuscripts' text sections. Except for category 1 (problem description), the sections with the highest relative importance (Section C.3.2.3) are thus also the most voluminous ones. Hence, **while the problem description is essential in terms of being presented (category 1), it may not need to take up much space**. However, the **knowledgebase (4), procedures used (6), results (8), and discussion (10) are both necessary contents and require a relatively high level of detail**.

This interpretation also implies that the **requirements (3, 2.9%), iterations (7, 7%), and explication of design knowledge (9, 6.1%)**—being more clearly DSR-specific content categories than the above-mentioned categories 4, 6, 8, and 10—**do not make strong appearances in DSR basket journal publications**. This is in line with many of the commentaries gathered in the expert interview study (Section 6.2.1.2.1 Academia-facing Communication). For example, some respondents recounted that in their efforts to publish basket journal papers, the design journey (including the gathering of requirements (3) and iterations (7)), along with key design knowledge created during that process (9)) soon ended up in some appendix or were thrown out of the publication altogether.

## C.4 Results and Discussion of the Second Section

The second part of the quantitative structure coding framework consists of 44 structure codes, 41 of which are binary. All binary codes are formulated such that the value 1 indicates the inclusion and 0 the absence of a specific characteristic in the manuscript. There are several topical groups of these questions, according to which the subsequent analysis is presented. In this initial section of the analysis of the second part, special attention is given to the distribution of values among papers. Since the variables are binary, the mean value equates to the percentage of manuscripts that contain the respective characteristic. While the very low and the very high end of these percentages can provide an intuition on which characteristics are more or less common, it is the middle range that should be most insightful for analysing the effects of these characteristics. (In the middle range, a similar number of papers does and does not contain the characteristic.) The average values per code are distributed as follows:

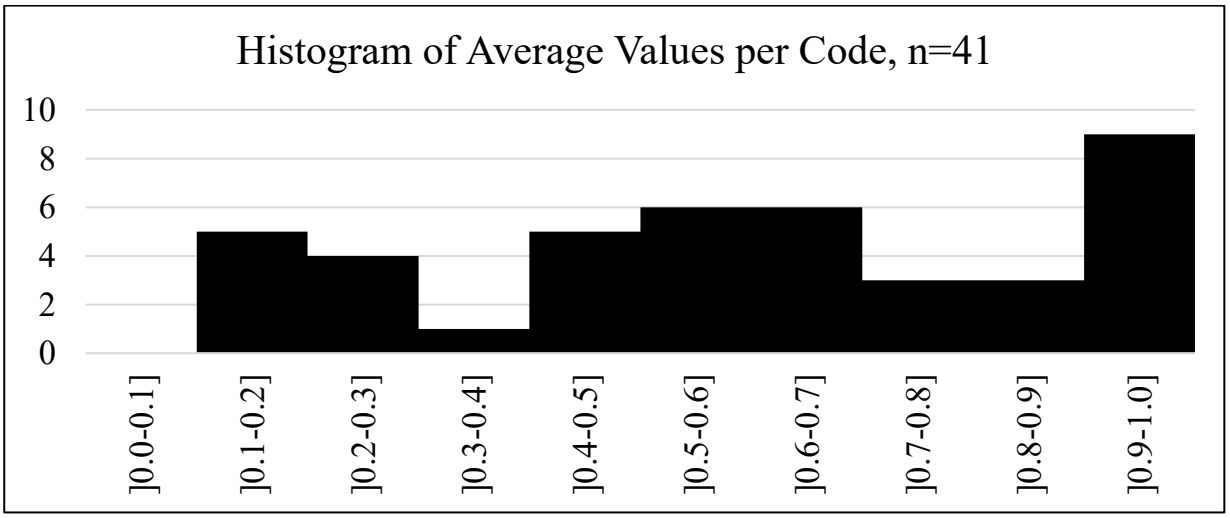



*Figure 41: Histogram of Average Values per Code*

### C.4.1 Upper and Lower Extremes

All codes have been used at least once. The fact that no characteristic is fully absent from the manuscripts indicates that all characteristics are somehow relevant to paper writing. However, the codes that were identified most rarely are unlikely to play a central role in getting such a manuscript published. Particularly rare characteristics are:

- 2/19: explicit formulation of the requirements (requirements_specification)
- 2/19: justification of the technique chosen for analysing data (data_analysis_justification)
- 2/19: use of a running example throughout the paper (running_example)
- 2/19: written to influence readers (goal_transmit_vs_influence)
- 3/19: the scope of the problem (how many are affected? relevance_effect_scope)
- 4/19: use of quotes (use_of_quotes)

On the other end of the scale, three codes were used in all manuscripts. These do not provide any further information on the implications that the presence of the respective characteristics has on the effects as perceived by readers (see Appendix E: Structure-Effects-Analysis) since there is no information on papers where this characteristic is absent. The three codes are: The discussion of a status quo (status_quo_discussed), the objective of the study (study_objectives), and the usage of DSR-terminology (terminology_DSR). While **the discussion of the status quo and a statement on the objectives seem to be necessary content elements for publishing design research papers**, the usage of DSR-terminology in all manuscripts is most likely due to the screening of the eligible papers. (In the search process, DSR terminology was used explicitly to find journal papers in which design research projects are presented.) Other very often appearing characteristics include:

- 18/19: description of the artefact (artefact_description)
- *18/19: contribution to research (contribution_research)*
- *18/19: contribution to practice (contribution_practice)*
- *18/19: a research agenda (research_agenda)*
- 18/19: use of some illustration(s) (use_of_illustrations)
- 17:19: specifying which technique was used to gather data (data_gathering_technique)
- *17/19: limitations of the research (limitations)*
- 17/19: using examples to illustrate important aspects (examples_important_aspects)

Among these characteristics, it is striking that half of them are part of the discussion section of a research paper (*cursive* writing). This indicates that **a full discussion section including contributions to research and practice, research agenda, and some statement about the limitations of the research are likely to be expected in a design research paper**.

### C.4.2 Middle Range

Characteristics that appear in manuscripts about as often as they are absent are possibly most insightful for the combining analysis of structures and effects (see Appendix E). Right around the middle point of 9.5 articles are these characteristics:

- 11/19: indicating what the stakeholders want to achieve (stakeholder_goals)
- 11/19: contextual factors that influence the problem/situation (context)
- 11/19: description of activities that led to the design itself (design_activities)
- 11/19: providing some support to navigate the manuscript (provision_of_navigation_support)
- 11/19: using an example to introduce the problem or stakeholders (introducing_example)
- 10/19: justification of the data gathering technique (data_gathering_justification)
- 9/19: specification of the techniques used for data analysis (data_analysis_technique)
- 9/19: mapping the insights from collected data to designs (data_mapping_to_design)
- 9/19: usage of the word ‘artefact’ to refer to the design (terminology_artefact)
- 9/19: specifying the type of artefact that was created (terminology_artefact_type)
- 8/19: formulated research question (research_question)

The complete list of codes and their respective average use can be seen in Table 69.

*Table 69: Structure Codes per Paper (Ordered by Group)*

| Group number | 1 | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 5 | 5 | 5 | 5 | 6 | 6 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **First Author** | **Adipat** | **Avdiji** | **Keith** | **Narman** | **Yang** | **Goldkuhl** | **Arazy** | **Williams** | **Oberlander** | **Nguyen** | **Reinecke** | **Kolkowska** | **Giessmann** | **Twyman** | **Li** | **Spagnoletti** | **Dincelli** | **Ebel** | **Lycett** | **avg.** |
| status_quo_discussed | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1.00 |
| stakeholder_named | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0.68 |
| stakeholder_goals | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0.58 |
| stakeholder_challenges | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0.79 |
| context | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 0.58 |
| relevance_effect_size | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0.26 |
| relevance_effect_scope | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0.16 |
| study_objectives | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1.00 |
| research_question | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0.42 |
| reference_approach | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0.68 |
| knowledgebase | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0.74 |
| requirements_named | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0.63 |
| requirements_gathering | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0.32 |
| requirements_specification | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0.11 |
| data_gathering_technique | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0.89 |
| data_gathering_justification | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0.53 |
| data_specification | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0.68 |
| data_analysis_technique | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0.47 |
| data_analysis_justification | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0.11 |
| data_maping_to_design | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0.47 |
| design_activities | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0.58 |
| artefact_description | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0.95 |
| demonstration | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0.68 |
| evaluation_procedures | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0.74 |
| evaluation_results | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0.68 |
| contribution_research | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0.95 |
| contribution_practice | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0.95 |
| limitations | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0.89 |
| research_agenda | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0.95 |
| terminology_DSR | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1.00 |
| terminology_artefact | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0.47 |
| terminology_artefact_type | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0.47 |
| terminology_artefact_reference | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0.26 |

(continued on the next page)

| Group number | 1 | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 5 | 5 | 5 | 5 | 6 | 6 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **First Author** | **Adipat** | **Avdiji** | **Keith** | **Narman** | **Yang** | **Goldkuhl** | **Arazy** | **Williams** | **Oberlander** | **Nguyen** | **Reinecke** | **Kolkowska** | **Giessmann** | **Twyman** | **Li** | **Spagnoletti** | **Dincelli** | **Ebel** | **Lycett** | **avg.** |
| examples_important_aspects | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0.89 |
| use_of_illustrations | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0.95 |
| provision_of_navigation_support | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0.58 |
| use_of_quotes | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0.21 |
| introducing_example | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0.58 |
| running_example | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.11 |
| goal_transmit_vs_influence | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.11 |
| active_vs_passive | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0.26 |
| | | | | | | | | | | | | | | | | | | | | |
| (7-point Likert scale items) | | | | | | | | | | | | | | | | | | | | |
| reader_involvement | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1.00 |
| titles_effectiveness | 5 | 5 | 2 | 4 | 5 | 5 | 5 | 2 | 5 | 5 | 5 | 4 | 5 | 3 | 4 | 3 | 3 | 4 | 4 | 4.11 |
| action_vs_commentary | 6 | 3 | 5 | 4 | 6 | 6 | 5 | 7 | 4 | 6 | 5 | 5 | 2 | 5 | 5 | 3 | 3 | 5 | 3 | 4.63 |

### C.4.3 Contents about the Research Problem

As a part of the quantitative analysis of the research design, aspects of (1) the research problem, (2) the research design, (3) terminology, and (4) stylistic elements were coded. These aspects are separated by the horizontal lines in Table 69 (in the order as enumerated here). The coding of the binary variables associated with these categories revealed various insights discussed in the following sections, starting with the research problem.

Seven codes capture the presentation of the research problem. Of these, only one code (status quo) appeared in all manuscripts. Hence, all authors discussed in some form or shape what the initial situation was, in which the problem remained unsolved. One may conclude that a description of the **status quo is a necessary content element for a basket journal** publication.

In addition, providing some **information about the stakeholder appears to be important**. However, the stakeholder remains unclarified in two instances (Goldkuhl & Karlsson, 2020; Närman et al., 2013). Among the codes that address the stakeholder, their **challenges are more prevalent in the manuscripts than the goals they pursue** (78.9% vs 57.9%). The **stakeholders' goals and the context in which the problem evolves seem to be optional content elements**, as about half the manuscripts omit them.

*Table 70: Summary of codes for the research problem*

| Code | Ratio | no [0] | yes [1] |
|---|---|---|---|
| Status Quo | 100.0% | 0 | 19 |
| Stakeholder-related Codes | 89.5% | 2 | 17 |
| Challenges of the stakeholders | 78.9% | 4 | 15 |
| Named the focal stakeholder | 68.4% | 6 | 13 |
| Goals of the focal stakeholder | 57.9% | 8 | 11 |
| Context of the problem | 57.9% | 8 | 11 |
| Effect size of the problem | 26.3% | 14 | 5 |
| Scope of the problem | 15.8% | 16 | 3 |

When discussing a research problem for a design research project, discussing its relevance helps to understand how large the effect of solving—or not solving—the design problem might be and to situate the kind of solution that is being searched (regarding its level of abstraction). Therefore, the low presence of explications about the general problem's relevance (as measured here by the effect size and scope of the problem) is surprising. It can be concluded that **the specification of the problem's relevance** beyond the description of explicit challenges of the stakeholder and naming the stakeholder group **is of low importance for the acceptance of a manuscript** at a high-impact journal.

## C.4.4 Contents about the Research Design

To capture the research design, or rather how the research design is presented in the manuscripts, a set of 22 codes are used. These can be split into the following blocks:

- Preparatory aspects (objectives, RQs, approach, knowledgebase)
- Requirements (presentation of requirements, gathering process, specifications)
- Use of data (gathering technique, justification, specification, analysis, mapping)
- Design iterations (design activities, the artefact, demonstration, evaluation)
- Communication of results (contributions, limitations, research agenda)

### C.4.4.1 Preparatory aspects

As with the status quo, all manuscripts contain statements on the research objectives. This is the only consistently appearing code over all research design related contents. Hence, some **statement on the research objective is a necessary component** of a manuscript.

Three quarters of manuscripts feature some content addressing the knowledgebase used as input to the design and development, and about two thirds present their methodology by reference to an established approach such as Peffers et al. (2007), Hevner (2007), or Nickerson, Varshney, and Muntermann (2013). Hence, **most papers present existing literature to support the research design, using it as a conceptual knowledgebase or prescriptive knowledge**. Only three out of 19 papers feature neither of these two content aspects (i.e., Spagnoletti et al., 2015; Twyman et al., 2020; Williams et al., 2008), five feature one and eleven feature both references to the conceptual and prescriptive knowledgebases.

One content aspect in the preparatory phase that does not seem particularly important is the explication of a research question. Less than half of the manuscripts contain a specific research question (8/19). This is still a relatively high number of papers with this code compared to the relevance-related codes in C.4.3. Hence, **formulating a research question may not be of low importance per se, but featuring it in the manuscript seems to be a legitimate design decision**.

#### C.4.4.2 Requirements

Three codes revolve around the topic of requirements: Requirements (are requirements discussed at all?), gathering requirements (is the process by which the requirements are acquired described?), and specification of requirements (is described how critical requirements are selected and specified?). This way of coding the presence of requirements in the manuscripts leads to the following observations:

In only two papers, all three codes were identified (Ebel et al., 2016; Spagnoletti et al., 2015). These two papers are the only manuscripts in which the specification of the final requirements is presented. Four of the remaining seventeen papers also discussed how the requirements for their design studies were gathered, yielding six out of 19 papers featuring this code. Six more papers discussed requirements but without clarifying how they were gathered or specified.

Hence, in about two thirds of the articles, some discussion of requirements for the solution was presented. However, only half of the manuscript addressing requirements also explains how the requirements for their artefacts were gathered, and one sixth elaborated on how the final requirements were specified. This indicates that **requirements are a somewhat relevant content aspect (12/19), but there is no necessity to go into depth as to how the proposed requirements are gathered (6/12) and then specified (2/12)**.

#### C.4.4.3 Use of Data

Regarding the use of data, the codes focus on the empirical studies presented in the manuscripts (primarily experiments as part of the evaluation procedures). Three codes cover the data gathering process, and three codes cover the data analysis phase. While most manuscripts explicated the techniques used to gather (evaluation) data (17/19), less than half specified the techniques used to analyse the data (9/19). This underlines that data **gathering techniques seem to take a more central role in the manuscripts than data analysis techniques**.

Most of the papers that indicate a specific data gathering technique also specify what data was to be gathered, including the type of data (quantitative vs qualitative) and the content (measurement items). While 13/19 specified what data is to be gathered, **only ten manuscripts contain a justification as to why this data gathering strategy makes sense** for the particular study.

Similarly, the techniques of analysis chosen for each manuscript are more often specified (which technique? 9/19) than justified (why this technique? 2/19). Hence, while the specification of a data gathering technique is more important than the specification of the techniques for data analysis, the rationale behind the selection of techniques is generally rarely presented explicitly. **One can deduce that the suitability of techniques is taken for granted in many cases and particularly** that the **explication of the suitability of techniques for data analysis is irrelevant for design research publications**.

The last code regarding the use of data is the mapping of results from the data analysis to the design and development of the artefact. About half the publications (9/19) explain how the data is used or mapped to the design and development of the respective artefacts. Following the logic of the DSR methodology model (Peffers et al., 2007), this indicates that the role of the evaluation as a source of information for an iteration of preceding phases is often not addressed. In other words: The presentation of the empirical **evaluation in many design research papers is a summative (non-iterating) evaluation, the findings of which are often not reflected in the artefacts**.

#### C.4.4.4 Design iterations

Five codes capture the phases of designing, demonstrating, and evaluating. These are the presentation of the artefact itself (consistent with the qualitative content analysis, **all but one manuscript present the artefact**, 18/19), the design activities (procedures that led to the artefact), the demonstration (why does it work?), the evaluation procedures

(how is effectiveness proven?), and the evaluation outcomes (how to interpret the results and when to iterate?).

More than half the manuscripts contain some explanation as to how the artefact was designed (11/19), demonstrated (13/19), evaluated (14/19), and how the evaluation results were used (13/19). On the flipside, many papers do not feature these contents. As already identified in the qualitative content analysis (Appendix B), not all papers contain central aspects of DSR. However, the **explications on the evaluation seem relatively important for design research publications, while the artefact design procedures seem to be optional** rather than necessary.

#### C.4.4.5 Communication of results

All but four of the manuscripts feature a discussion section that specifies the contribution to research (18/19), the contribution to practice (18/19), the limitations of the research project (17/19), and some kind of research agenda or suggestion of further investigations (18/19). Three of these four articles do not feature only one of the four aspects, and one does not feature two aspects (i.e. the contribution to research and the limitation (i.e., the contribution to research and the limitations in Williams et al., 2008). Therewith, **the discussion section is complete in most manuscripts, indicating that the reflection of the research projects is indeed an important and necessary content aspect in design research papers**.

### C.4.5 Terminology

Regarding the terminology, the coding identified whether DSR-specific vocabulary is used. Thereby all articles refer to design science research explicitly. Hence, at least in one instance, **terms such as Design Science Research, DSR, Design Research, or Design Science** were used with the intention to inform readers about the methodological background of the study. This indicates that the DSR methodology is indeed established in the basket journals. It can and **should therefore be explicitly referred to**.

Beyond DSR-related terms, the coding framework captures whether and how the authors referred to their artefact. About half the manuscripts (9/19) contain a reference to their final solution as “artefact” at some point. Similarly, about half the manuscripts (9/10) specify the type of the artefact (e.g., construct, model, method, instantiation, see: Hevner et al., 2004), with an intercept of 5/19 papers in which both “artefact” and the specific type of artefact are used to refer to the designed solution and 6/19 that do not use the term “artefact” or refer to a specific type of artefact. From this, it can be concluded that

the **terms used for the solution can be "artefact", and the type of artefact can be specified. However, neither is strictly necessary**. In fact, in 5/19 papers, the solution was repeatedly or even primarily referred to as "artefact" – whereas in other articles, the artefact was given a name and only referred to by this name.

### C.4.6 Stylistic Elements

The section on stylistic elements investigates whether the authors used certain typical ways in which the explication of stories is helped (e.g., use of examples or providing simple structuring headlines). This part of the coding framework revealed the following insights:

Except for one article, all manuscripts contain some graphical illustration or metaphors. The exception is Williams et al. (2008), in which a taxonomy is presented. The latter is not graphically illustrated, but the presentation of the core ideas is helped by using tables. In some sense, this is also a visual help to support the understanding of what has been done. Even though such **visual support** uses up space, it can be concluded that using them **is necessary**.

Beyond the graphical illustrations, examples as conceptual aids for understanding the contents are used in almost all manuscripts (17/19). Some of the manuscripts are started with an example to set the scene for the research project (11/19). In two manuscripts, a running example is used throughout the paper. From that, one may conclude that **it is a good idea to use examples in design research papers to illustrate important aspects** and that one can, but does not have to, start the manuscript off with an example or use a running example throughout the paper.

Regarding the writing style, most papers are primarily written in active speech (14/19) and in none of the manuscripts the readers are addressed directly. Hence, **the stories are told from the authors' perspective** and focus on their project and their involvement therein. (It is not unusual to write 'we' when, e.g., explaining the procedures.) **The primary goal of a design research publication is not to influence behaviours and attitudes but to transfer knowledge only** (17/19).

Titles are used effectively to structure the manuscripts (4.1/5), but beyond this, only eleven out of the 19 papers provide any navigation support (e.g., agenda, forward-/backward references) to guide the readers. **Therefore, it may be appropriate not to use navigation support in journal articles** (e.g., to save space). The articles also rarely contain direct quotations from, e.g., practice partners or evaluation participants (4/19).

Lastly, the **contents are mostly balanced between describing actions and explanatory commentary**. However, there is a tendency toward focusing more on explanations (e.g., justifying design decisions ex-post) with a score of 4.63 on a scale from 1 (describing actions) to 4 (balanced), ending at 7 (explanatory comments).

## C.5 Matching the Coding with the Groups

Having discussed the structural coding of the quantitative dataset, a short inquiry into the matching of the structural groups identified in the qualitative structure analysis (Appendix A) and the coding of the quantitative structure analysis may prove insightful. Thereby, a particular focus lies on groups 3-5, as those have the most papers representing them (5, 5, and 4). This compares to only 2, 1, and 2 papers in groups 1, 2, and 6. With such low numbers of papers, an interpretation on group-level is unlikely to be fruitful. Before diving into the differences among groups, one should keep in mind that the very often and the rarely used items discussed in Section C.4.1 are mostly representative of all groups. As there is little variance in these characteristics, they are not discussed further. Instead, the middle range characteristics allow for a more differentiated discussion of the groups. The most striking peculiarities of the structural groups are specified in Table 71, and the overall dataset ordered by structural group can be found in Table 69.

First, peculiarities of group 3 are discussed: One aspect that is worth pointing out is the elaboration on the research problem. While group 5 has high values for research problem-related codes (apart from the generally low 'relevance' code), this is not the case for **group 3, where the stakeholder, their goals, and their challenges are less commonly mentioned**. Group 4 is close to the average regarding the research problem-related codes. The fact that the stakeholder does not seem to play an important role in manuscripts from Group 3 is somewhat consistent with the general **tendency of 3roup 3 papers to rely heavily on background literature to rationalise and justify their content rather than to introduce empirical evidence**. Group 3 also does not show the design activities, how requirements were gathered, specify requirements, or explain how empirically collected data was used in developing or improving the designed artefact, nor is it usual for these papers to include direct citations from the author's fieldwork or to refer to their solutions as "artefacts" (only 1/5 use this word compared to 4/5 in group 4 and 3/4 group 5). The quantitative depiction of the structure aligns with the qualitative analysis, during which **group 3 stood out as being primarily built with background knowledge**. Representatives of group 4 and group 5 differ from group 3 in that these

papers address stakeholders more; they use the term "artefact," discuss design activities and mostly justify the data gathering techniques.

**Group 4 stands out with its strong focus on the research design-related codes.** Interestingly, all articles of group 4 feature a research question (compared to 1/5 in group 3 and 0/4 in group 5), indicate a reference approach (2/5; 1/4), name the requirements explicitly (3/5; 2/4), and feature a demonstration of the artefact (2/5; 2/4). They also include elaborations on how the requirements were gathered (4/5 vs 0/5; 1/4), map the data gained from the demonstration and evaluation to the artefact (4/5 vs 1/5; 1/4), and are more likely to use direct quotes (3/5 vs 0/5; 1/4).

**Group 5 differs from group 4 in that it does not accentuate the research design** (no research question, 1/4 feature a reference approach, 1/4 explain how the requirements were gathered, none explain how the requirements are specified, 1/4 justify the techniques used for data analysis and 1/4 explain how empirical data is introduced into the design and development of the artefact).

*Table 71: Peculiarities of Structural Groups*

| Code | Average | Group 3 | Group 4 | Group 5 |
|---|---|---|---|---|
| stakeholder_named | 0.68 | 0.4 | 0.6 | 1.0 |
| stakeholder_goals | 0.58 | 0.2 | 0.8 | 0.75 |
| stakeholder_challenges | 0.79 | 0.4 | 1.0 | 0.75 |
| research_question | 0.42 | 0.2 | 1.0 | 0.0 |
| reference_approach | 0.68 | 0.4 | 1.0 | 0.25 |
| requirements_gathering | 0.32 | 0.0 | 0.8 | 0.25 |
| data_gathering_justification | 0.53 | 0.2 | 0.6 | 0.75 |
| data_anaysis_technique | 0.47 | 0.4 | 0.0 | 0.75 |
| data_mapping_to_design | 0.47 | 0.2 | 0.8 | 0.25 |
| design_activities | 0.58 | 0.2 | 0.8 | 0.75 |
| demonstration | 0.68 | 0.4 | 1.0 | 0.5 |
| terminology_artefact | 0.47 | 0.2 | 0.8 | 0.75 |
| use_of_quotes | 0.21 | 0.0 | 0.6 | 0.25 |
| running_example | 0.11 | 0.4 | 0.0 | 0.0 |

With that, the quantitative structural analysis is complete. In the following section, the main findings used in the design research project of this dissertation are outlined.

## C.6 Contribution to the Design Research Project

This study contributes to the design of an artefact at the sub-class level of analysis. Its primary contributions are the deepened understanding of the relative importance and detailedness of content elements in design research articles and a set of insights about the prevalence of specific characteristics of design research articles. These are outlined in a summarized fashion in Section 7.2.2 of the dissertation.

A secondary contribution is a set of "middle ground" characteristics. These characteristics are featured in about half the articles but not in the other half. Therewith, these characteristics are interesting for the structure-effect-analysis (Appendix E), where structural differences among research articles are compared to differences in the effects perceived by readers. To identify specific effects, these middle ground characteristics are more suitable than prevalent or rare characteristics because of more equal sample sizes.

## C.7 Limitations and Discussion

This quantitative analysis of the structure of design research articles provides various insights. In particular, a set of striking structural patterns emerged, revealing that some characteristics are shared among almost all articles, whereas others are omitted by most. There is also some middle ground for characteristics present in as many articles as they are absent. Therewith, an idea about what structural characteristics may be required, not required, or optional could be constructed. This is an important step toward the design of guidance that informs design researchers about how to construct their research articles.

However, these insights should be considered with some degree of caution, as the study is subject to a few limitations. In particular, the sample size is nineteen. While this number of articles shows some patterns in the results, it does not compare to other literature reviews that analyse much larger samples (e.g., 160 articles analysed to identify design decisions in behavioural experiments in Cahenzli et al., 2021a). This limits the validity of derived findings. The reason why the sample size is relatively small lies in the amount of work required to process these articles: Since they are analysed in three different studies (Appendix B-Appendix D), each additional article has repercussions on all three studies, and especially on the analysis of the effect on readers. The latter requires, on average, more than four codings by different individuals. Because of limited resources (i.e., personal time to code the articles for the qualitative and the quantitative analysis

of paper structures, and access to independent researchers to code the effects), this sample size results from a trade-off. It is large enough to show striking patterns, but it is small enough to obtain a handful of responses for each article in the analysis of the effects. To account for sampling-related distortions, the author focused on the most explicit patterns (i.e., the lowest, the highest, and a narrow middle ground of characteristic usage).

Another limitation is that the analysis of published articles can only reveal the status quo and it may be over-interpreted to deduce prescriptive statements about how such articles should be designed. For example, currently published articles might not be designed ideally. Other, better structures could be designed. Alternatively, these articles might only have obtained the final structure through various rounds of revisions, and it might be ineffective to adopt structures of finished articles for initial submissions.

# Appendix D Analysis of Papers' Effects on Readers

## D.1 Starting Point

This is the third of four inter-related studies, as presented in Appendix Band illustrated below (Figure 42). This study stands on its own, as it has no direct dependencies on findings from the qualitative (Appendix B) or quantitative analysis of the structure of design research articles (Appendix C). However, it relies on the same research articles as the structure analyses, which is necessary for the fourth part of this set of studies. Hence, while the research design and the findings can be considered a standalone study, it uses the same 19 design research articles as a starting point, and it co-informs the synthesising structure-effect analysis (Appendix E).

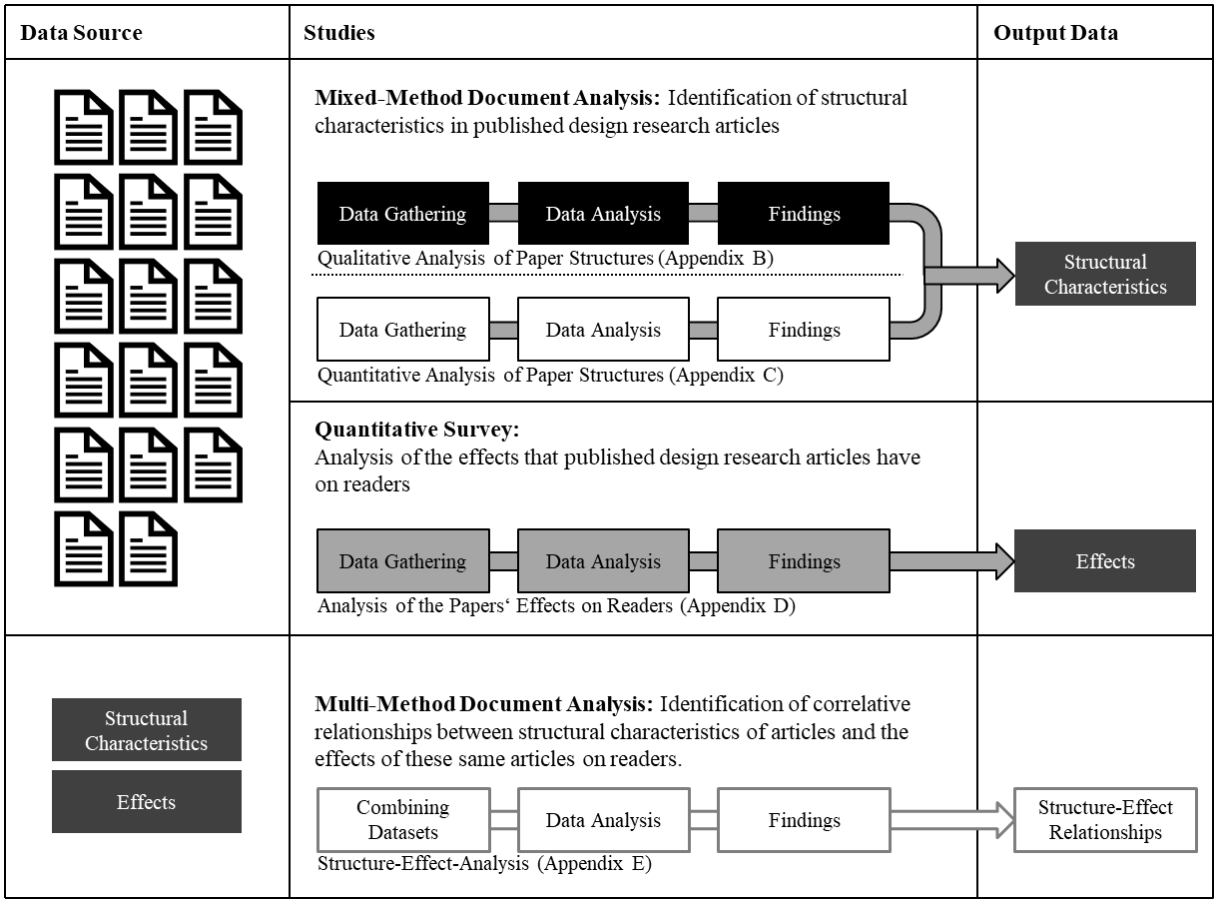



*Figure 42: Overview of the Empirical Studies B-E*

The rationale for this study is the following: While the afore presented structural analyses yield an understanding of the structure (selection, order, and presentation of contents), they can only tentatively help understand what readers might get out of the article. Knowing merely about structures and therewith design options does not suffice to

prescribe how one might use this knowledge to reach specific goals. Indeed, the 'means' side of the means-end relation of prescriptive knowledge has thus far been investigated such that it became apparent what means in the sense of structures are used in published journal articles. Therefore, it would be interesting to investigate further the 'ends' side of the means-end relation. One end, of course, would be to get an article published. However, as outlined in Appendix B and Appendix C, there are some options in the design decisions that led to the articles' structures, and all articles were published. To better understand the effects of these structural design decisions at the recipients' end of the project communication, an analysis of these articles' effects on readers is in order. This is what this study is about.

## D.2 Research Approach

The following analysis of the effects of the design research articles on readers is presented based on a quantitative survey study. This study was conducted with doctoral students enrolled in courses on design science research. Partaking in the survey was a course requirement. These courses were held by Prof. Dr. Robert Winter as a co-teacher, who provided the author access to courses that took place in February 2020, June 2021, and July 2021. Each student read two of the 19 articles and filled in a standardised survey for each of these two articles. All students in each of these courses used the same survey, and participation was not remunerated. The doctoral students were instructed to read one article carefully, thereafter, fill in the survey before repeating this process with the second article.

Each survey contains 47 items, all of which are based on a 7-point Likert scale, measuring their agreement with a positively formulated statement (e.g., I enjoyed reading this article; I understand well, how the result of the study (artefact) was designed; or: The plotline is clear to me – it is clear from where to where the narrative goes.). The survey assesses (1) the perceived overall quality of the document, (2) the clarity of the narrative chosen by the author, (3) the clarity of the research problem description, (4) the clarity of the research design description, and (5) the science impact measures (see Section 5.1 or Burns et al., 2003). The items of the survey are based on the literature review (Section 2 and Section 5.1) and appended with questions that seemed to be promising regarding aspects of the structure-effect-analysis. The survey was pre-tested by the author and one doctoral student (not part of the sample) and discussed with the supervisor and co-supervisor of this dissertation before distributing it. The survey itself can be found in Appendix J, J.1.

The remainder of this appendix focuses on the findings from the filled in surveys. Further insights that take into account the structural group to which the manuscripts belong (see: Appendix B) and other, more specific structural characteristics (based on Appendix C) are not part of this appendix (instead, see: Appendix E: Structure-Effects-Analysis). The results are described in terms of general descriptive statistics and the correlations among answers. Hence, the following sections describe (1) averages and distributions as well as (2) whether and how various answers and answer categories are linked with each other.

## D.3 Results and Discussion

The answers in the survey are all based on a Likert scale ranging from 1 (fully disagree) to 4 (neutral) and finally 7 (fully agree). Furthermore, all questions are asked positively. In other words, a higher value always indicates a 'better' outcome in the sense of better understanding of contents, higher enjoyment of reading the manuscript, or bigger perceived usefulness of the artefact. Each participant filled out the survey twice, once for each of two different journal papers. This led to a total set of 82 answers about the 19 journal papers (average response per paper = 4.3).

### D.3.1 Average Scores and Variances

The average score across all questions and all manuscripts is 5.07. This value indicates that the manuscripts were perceived positively while also leaving room for improvement. Considering that the papers went through rigorous review processes at prestigious journals, it may be expected that the evaluation of various aspects of the papers is positive. However, the manuscripts are not evaluated uniformly, as evidenced in, e.g., spreads of the average evaluations per article (Figure 43) or the variance between the average values given to a manuscript (Table 72). The following analysis describes the data to gain a general understanding of the manuscripts' effects on their readers.

The average evaluation given to each manuscript ranges from 4.14 to 5.77, and the variance of average scores across the individual publications ranges from 0.02 to 1.69 (Table 72). Thereby the variances are generally higher among publications that rank lower in average value, as illustrated in Figure 43. Hence, there seems to be agreement among the participants about the above-average manuscripts, whereas the weaker ones in terms of clarity and understandability are more critically evaluated by some participants than by others.

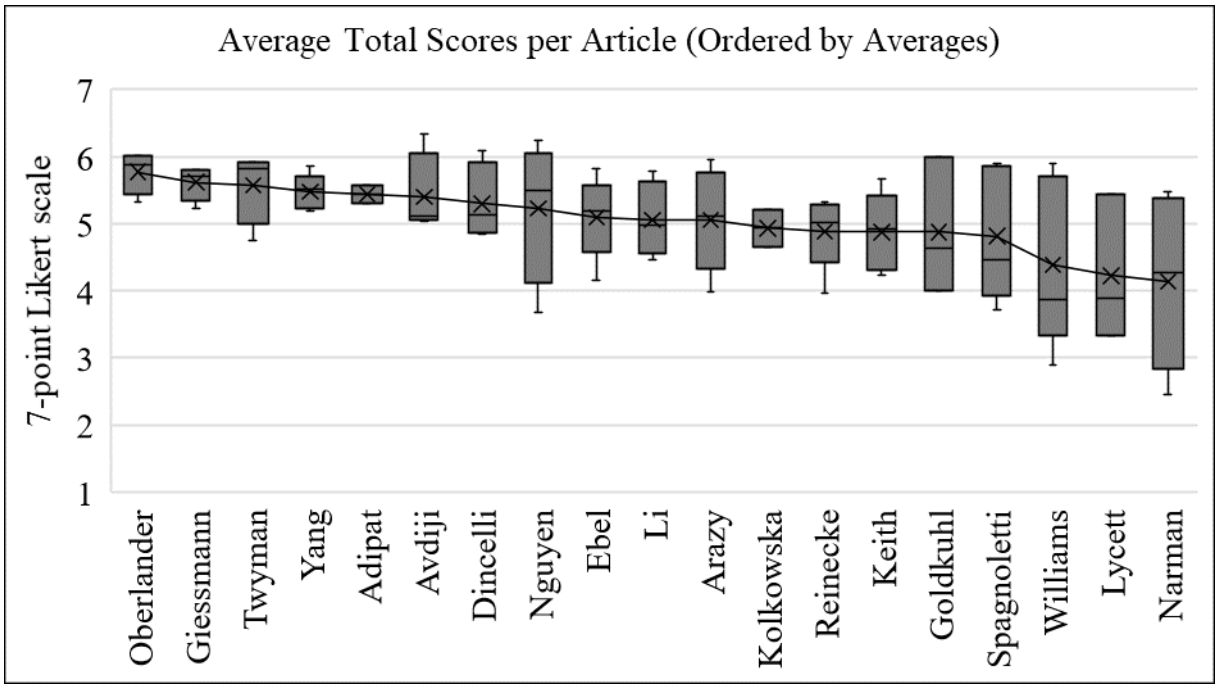



*Figure 43: Spread in Average Answer Values per Article*

*Table 72: Average values per manuscript*

| First Author | N | Average value | Variance of averages |
|---|---|---|---|
| Oberländer | 6 | 5.77 | 0.089 |
| Giessmann | 4 | 5.62 | 0.069 |
| Twyman | 4 | 5.57 | 0.312 |
| Yang | 5 | 5.48 | 0.067 |
| Adipat | 4 | 5.44 | 0.020 |
| Avdiji | 4 | 5.4 | 0.393 |
| Dincelli | 4 | 5.3 | 0.336 |
| Nguyen | 4 | 5.23 | 1.185 |
| Ebel | 5 | 5.1 | 0.376 |
| Li | 4 | 5.06 | 0.313 |
| Arazy | 5 | 5.06 | 0.591 |
| Kolkowska | 2 | 4.94 | 0.153 |
| Reinecke | 5 | 4.89 | 0.297 |
| Keith | 5 | 4.88 | 0.343 |
| Goldkuhl | 3 | 4.88 | 1.044 |
| Spagnoletti | 5 | 4.81 | 0.987 |
| Williams | 5 | 4.39 | 1.597 |
| Lycett | 3 | 4.23 | 1.193 |
| Narman | 5 | 4.14 | 1.690 |

Beyond the overall average across all questions (5.07), the averages on each section are:

- Overall quality measures: 5.49
- Clarity of the narrative chosen: 5.47
- Clarity of the research problem: 5.21
- Clarity of the research design: 4.70
    - Research design without questions on usefulness: 5.35
    - Questions on usefulness: 3.54
- Science communication impact measures: 4.98

All sections show above-average response values in terms of possible answer values on a 7-point Likert scale. The low value of the clarity of the research design is primarily due to a set of questions that investigate whether the respondents understand how the artefact or the artefact creation process might be useful for their own work. These questions were answered with low values (average of 3.54), which might be due to the fact that the respondents are junior design researchers on the one hand and that they have various research areas they focus on, for which there may be few parallels. (Omission of these conceptually different questions raises the overall average score of the responses to 5.26.) The more detailed overview of the measurement items in Table 73 provides insights into the average scores per measurement item. While many measurement items are explained further in the text below, the detailed survey with the questions behind these item variables can be found in Appendix J.

From the average scores per item in the survey, one can learn that the overall perceived quality of the articles is very high across all items of this section of the survey. Hence, the readers judged the articles to be of high quality. In other words, the low scores (primarily) for the usefulness measures (⌀ 3.54), but also the perceived clarity about the research problem's scope (4.73) and its scale (4.56), the perceived ability to take a related decision (scim_related_decision, 4.54), the perceived entertainment (scim_entertainment, 4.68) and the raised interest—whether one wants to learn more (scim_learn_more, 4.60) or get involved (scim_get_involved, 3.68)—do not seem to be crucial for a good overall quality assessment of the article. Furthermore, the articles seem to have exceptionally clearly specified what the artefact is (rd_whats_artefact: "It is clear to me what the output (artefact) of the study is", 5.87), convincingly presented the relevance of the topic (relevance: "Thematic Relevance: The topic is of societal value/is relevant today", 5.70; and readers could empathise with the topic: topic_empathise, 5.70) and why the research problem is relevant (rp_problem_relevance, "The problem described is relevant", 5.70). However, several items of the research problem,

the research design, all usefulness measures, and most communication impact items score relatively poorly compared to these few exceptional ones. Moreover, apart from these exceptionally high ranked items, they also score poorly compared to the overall quality section and the clarity of the narrative section. Hence, the respondents rated the research problem, the research design, the usefulness, and the science communication impact items lower than the clarity of the narrative, and they gave the highest scores to the overall quality. This is interesting because the overall quality should probably reflect the quality of most other items and not merely the clarity of the narrative.

*Table 73: Average Scores per Item of the Survey*

| | | | | | |
|---|---|---|---|---|---|
| Overall Quality | content_quality | 5.44 | Research Design | rd_rd_decisions | 5.13 |
| | contribution_significance | 5.44 | | rd_whats_artefact | 5.87 |
| | contribution_originality | 5.50 | | rd_artefact_is_useful* | 3.99 |
| | relevance | 5.70 | | (…) for_theory_development* | 3.60 |
| | presentation | 5.40 | | (…) theory_testing* | 3.54 |
| | overall_impression | 5.45 | | (…) theorize_usage* | 3.16 |
| Clarity of Narrative | cl_plotline | 5.51 | | (…) theorize_building_process* | 3.41 |
| | cl_stakeh_empathise | 5.33 | | rd_design_process | 5.15 |
| | cl_researchers_empathise | 5.40 | | rd_evaluation | 5.35 |
| | cl_design_decisions | 5.22 | | rd_contribution_clarity | 5.54 |
| | cl_topic_empathise | 5.72 | | rd_limitations | 5.28 |
| | cl_examples_relatable | 5.54 | Science Communication Impact | scim_issue_familiarity | 5.32 |
| | cl_examples_helpful | 5.55 | | scim_research_problem | 5.27 |
| Research Problem | rp_problem_essence | 5.54 | | scim_enjoyment | 5.17 |
| | rp_situation | 5.50 | | scim_entertainment | 4.68 |
| | rp_stakeholder | 5.28 | | scim_learn_more | 4.60 |
| | rp_stakeh_goals | 5.21 | | scim_get_involved | 3.68 |
| | rp_problem_scope | 4.73 | | scim_related_decision | 4.54 |
| | rp_problem_scale | 4.56 | | scim_understand_procedures | 5.26 |
| | rp_problem_relevance | 5.70 | | scim_procedure_clear_why | 5.06 |
| | rp_problem_persistence | 5.15 | | scim_explain_outcome_to_others | 5.17 |
| | rd_replicability | 4.94 | | scim_implications_practice | 5.54 |
| | rd_objective | 5.48 | | scim_implications_science | 5.44 |
| | rd_general_approach | 5.43 | | *usefulness measures | |

The following section investigates how these individual items relate to each other. Hence, it features a cross-correlation analysis of the responses from the participants.

## D.3.2 Cross-correlation Analysis

A correlation analysis was conducted to investigate whether and how some of the measurement items correlate. To do so, the author used the programming language Python. More specifically, the author has used a Google Colab notebook within which he has created an annotated algorithm. The algorithm relies on the pandas library (namely, the dataframe format and the .corr method as well as the handling of .csv-files) and the heatmapz module (for illustrations). The annotated script, including the output illustrations (also shown below), can be found in Appendix J.

Before investigating the various sections of questions in the survey, a cross-correlation analysis was run on the entire dataset. This allows for (1) identifying whether questions within a section correlate and (2) identifying correlations among questions that do not belong to the same section of the survey. Figure 44 illustrates the sections of questions utilising black lines. The squares these lines form along the diagonal line of darkened small squares show the correlations within sections, whereas the rectangles further to the top-right (or bottom-left) corner indicate correlations that span sections of the survey. Before diving into the Pearson's correlation coefficients among items within each section of questions, the correlations that span sections of the survey are discussed.

### D.3.2.1 Section-spanning Correlations

Among the overall document quality assessment measures, the **perceived quality of content, significance of the contribution, quality of presentation and overall impression of the value of the manuscript** seem to correlate with all other variables. In other words, these questions really **capture the overall quality of the documents**. In particular, the average Pearson's correlation coefficient across all variables is 0.38, whereas the average among these four overall assessment variables is 0.45. Most strikingly, the values for presentation ("The content is presented well – easy to understand and follow the train of thought, good use of illustrations/tables where it makes sense, etc.") and overall impression ("From a reviewer's perspective, how strongly would you evaluate this document and therefore suggest for it to be published?") strongly correlate with all other items (with a correlation coefficient of 0.51 and 0.48 respectively). Only the enjoyment associated with reading the manuscripts more strongly correlates on average with all items (0.54). Since correlation cannot inform us about causation, **it remains unclear whether a good presentation style leads to higher values associated with other questions** (such as overall quality, clarity, understanding of the research problem and research design, or general communication outcomes) – **or whether**

**higher values in most questions lead to higher values in the perceived quality of presentation and overall impression**. However, what can be learned is that all sections of the questionnaire appear to be associated with the overall quality of the communication.

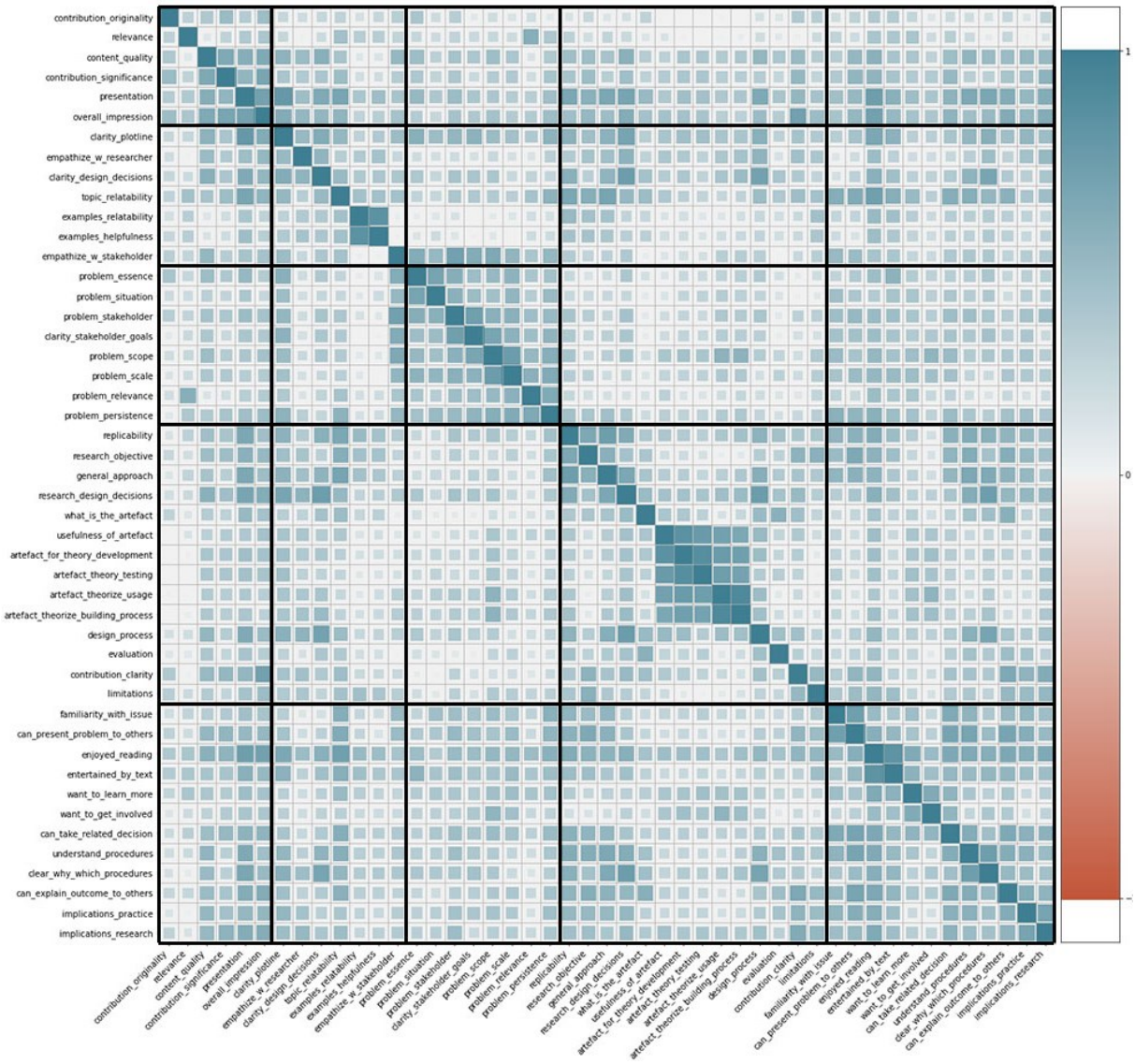



*Figure 44: Correlation Matrix on the Full Dataset*

Interestingly though, the **originality** of the contribution and the perceived **relevance** of the problem do not correlate so strongly with other variables. This indicates that **the remaining questions, including the overall assessment of the presentation and the quality of the manuscript as a whole, do not directly correlate with these two values** (which have the lowest average correlation at 0.23 and 0.24, respectively). Thus, even if a manuscript features a topic of high societal value or relevance, or if the contribution

is novel to the field, the quality of the manuscript, the clarity of contents, the understandability of contents, the research design, and general communication outcomes can still be poor or well done—and vice-versa.

Other notable occurrences are (1) the difference between correlation coefficients of the clarity of plotline and the ability to emphasise with stakeholders; (2) the intercepts of the understanding of design decisions and various other variables; and (3) the correlation coefficients between certain parts of the research design items and the science communication outcome items.

The clarity of the plotline correlates with all other items in a very similar fashion to the presentation (their correlation coefficient is 0.77). Thereby it is striking that for many variables, the readers' ability to empathise with the stakeholders correlates with many items in a similar fashion as the clarity of the plotline. However, this is not true for the items about the research problem (empathy with stakeholders is more highly correlated with the understanding of the research problem than is the clarity of the plotline, 0.56 vs 0.49) and the items on the research design (empathy with stakeholders is correlated more weakly with the understanding of the research design than is the clarity of the plotline, 0.24 vs 0.45). Hence, **when the relevant aspects of the research problem** (including the stakeholders and their goals) are clearer, **the reader's ability to empathise with the stakeholders is higher**. However, knowledge about the problem or the stakeholder does not relate to the clarity with which the research design is laid out—a finding that may be expected. One more difference between the correlation coefficients of these items (i.e., empathy with stakeholders and clarity of plotline) is the correlation with the use of examples and the perceived helpfulness of examples. Interestingly, while **the use and helpfulness of examples slightly correlate (0.28 and 0.35 respectively) with the plotline, they do not correlate with the ability to empathise with the stakeholders (0.04 and 0.03)**. This is somewhat astonishing, as one could think that the use of examples may in particular help understanding the problem that one intends to solve for the stakeholders – which in turn would mean that high values related to the use and helpfulness of examples may signify better understanding of the stakeholder and their problems (and thus, help to empathise with the stakeholder). The correlation can be an indicator that the examples used are not necessarily associated with the stakeholder having the problem.

The clarity of why which artefact design decisions were taken correlates with the clarity of why which study design decisions were taken (0.74), the understanding of the design process (0.7), and the reasons for why which procedures were selected (0.67).

Furthermore, the clarity of reasons for why which procedures were selected correlates unsurprisingly with the understanding of research design decisions (0.74) and the understanding of which procedures were employed (0.79). These items of the questionnaire all ask for the understanding of decisions taken by the researchers throughout the research project. **One may conclude that manuscripts that excel in explaining one aspect of the procedures or design decisions also explain other design decisions well**.

Less strongly correlated, but still featuring correlation coefficients of around 0.6, various **communication impact measures correlate with the research design items**. In particular, the research design items replicability, objective, general approach, research design decisions, and to a bit lesser extent, even the clarity of the research contribution and the limitations correlate with the understanding of the research problem, the enjoyment of reading the manuscript, the understanding of procedures taken and the reasoning behind why those procedures were chosen. These items of the research design understanding also correlate, but to a lesser extent, with the communication measurement items of whether one may be able to explain the outcomes to others and what the implications are for practice or research.

After outlining these general findings on correlations between measurement items of different sections of the questionnaire, the correlations of answers within sections of the questionnaire (or clusters of questions) remain to be discussed.

#### D.3.2.2 Within cluster correlations

To take a closer look at the cross-correlations, the individual sections of the survey are investigated next. The clusters are split as follows: (1) overall quality measures for the manuscript; (2) the clarity of various aspects of the manuscript; (3) aspects related to the research problem; (4) aspects related to the research design; and (5) science communication impact measures.

##### D.3.2.2.1 Overall quality measures

The strongest correlation among the questions in the first section is between the perception of how well the contents are presented (presentation) and the overall perceived quality of the manuscript (0.7, see: Table 74). **This suggests that it is important to present the research project well to make it easy to understand the contents and follow the trains of thought of the authors**. Indeed, the overall impression of the quality of a paper is less strongly related to the quality of its contents than to how the contents

are presented (correlation coefficients of 0.63 and 0.7 respectively, see: Table 74). **Therefore, a good paper does not merely have good (high quality) content but also (or especially) presents its contents well**. The last item with a correlation coefficient in this high range is the correlation between overall impression and the perceived significance of the contribution (0.67). Presentation furthermore correlates somewhat with the perceived significance of the contribution (0.52) and the quality of the content (0.59). It seems as though the presentation of contents in a manuscript – **how contents are communicated – strongly influences the perceived quality of contents, significance of contributions, and the overall impression one has of the manuscript**. This underlines that the presentation is crucial to the successful publication of design research projects.

*Table 74: Correlation among Overall Quality Measures*

| | content_quality | contribution_significance | contribution_originality | relevance | presentation | overall_impression |
|---|---|---|---|---|---|---|
| content_quality | 1.00 | 0.64 | 0.37 | 0.10 | 0.59 | 0.63 |
| contribution_significance | 0.64 | 1.00 | 0.48 | 0.28 | 0.52 | 0.67 |
| contribution_originality | 0.37 | 0.48 | 1.00 | 0.29 | 0.33 | 0.46 |
| relevance | 0.10 | 0.28 | 0.29 | 1.00 | 0.35 | 0.38 |
| presentation | 0.59 | 0.52 | 0.33 | 0.35 | 1.00 | 0.70 |
| overall_impression | 0.63 | 0.67 | 0.46 | 0.38 | 0.70 | 1.00 |

#### D.3.2.2.2 Clarity of Various Aspects of the Manuscript

In the question section on the clarity of the narrative chosen by the authors, only the relatability and the perceived helpfulness of examples strongly correlate. Hence, **the more relatable an example, the more likely the example is helpful to understand the content** and vice-versa. Hence, a good example (i.e., one with a high ranking by readers) is both relatable and helpful. With a correlation coefficient of 0.83, this is the strongest correlation outside of a tight group of questions related to perceived personal usefulness (discussed further in D.3.2.2.4 Aspects Related to the Research Design).

Beyond this strong correlation, the clarity of why which artefact design decisions were taken somewhat correlates with the perceived relatability to the researchers ("I understand and can empathise with the researchers that had to take the design decisions in this study.") and the clarity of the plotline (with r=0.54 and r=0.61 respectively). This may imply that a more **relatable way of presenting the research** (i.e., increasing the relatability with the authors) **may be characterised by choosing a clear plotline and explaining why design decisions were taken**. Furthermore, the plotline might benefit from more clarity on the reasoning behind artefact design decisions. However, since these are merely correlations, one may not directly infer causation and thus interpret these statements with caution. The other items' correlation coefficients in the cross-correlation analysis are relatively low.

*Table 75: Correlation among Clarity Measures*

| | cl_plotline | cl_stakeh_emp | cl_researchers_emp | cl_design_decisions | cl_topic_emp | cl_examples_relatable | cl_examples_helpful |
|---|---|---|---|---|---|---|---|
| cl_plotline | 1.00 | 0.47 | 0.50 | 0.61 | 0.51 | 0.28 | 0.35 |
| cl_stakeh_emp | 0.47 | 1.00 | 0.23 | 0.38 | 0.42 | 0.04 | 0.03 |
| cl_researchers_emp | 0.50 | 0.23 | 1.00 | 0.54 | 0.32 | 0.35 | 0.42 |
| cl_design_decisions | 0.61 | 0.38 | 0.54 | 1.00 | 0.49 | 0.36 | 0.39 |
| cl_topic_emp | 0.51 | 0.42 | 0.32 | 0.49 | 1.00 | 0.43 | 0.43 |
| cl_examples_relatable | 0.28 | 0.04 | 0.35 | 0.36 | 0.43 | 1.00 | 0.83 |
| cl_examples_helpful | 0.35 | 0.03 | 0.42 | 0.39 | 0.43 | 0.83 | 1.00 |

#### D.3.2.2.3 Aspects Related to the Research Problem

Overall, the correlation coefficients between items regarding the research problem are higher than for any other section of the survey:

- r=0.60 Research Problem Measures
- r=0.55 Science Communication Impact Measures
- r=0.54 Overall Quality Measures
- r=0.49 Clarity of the Narrative Measures
- r=0.45 Research Design Measures

This implies that it is more likely that the entirety of the research problem measures is either good or not so good, whereas it is more probable in other sections that some aspects may be evaluated highly, whereas others are not. Hence, **manuscripts leave their readers either poorly or well informed about all research problem measures**.

Among the item pairings within the research problem section, the strongest correlations exist between the understanding of the scope of the problem and the scale of the problem (r=0.75); the certainty about who the stakeholder is and the goals of these stakeholders (r=0.72); the essence of the problem and the context within which the problem appears (r=0.68); and between the scope of the problem and the goals of the stakeholders (r=0.67) (see: Table 76).

The understanding of the scale and scope of the problem strongly correlate. While these items also somewhat correlate with the perceived relevance of the problem (r=0.57 and r=0.5, respectively), this correlation is lower than the one between problem scale and scope. This is interesting insofar as one possible definition of relevance is the product of the scale and scope of some effect. The fact that this correlation is lower may be due to the fact that the question did not ask for the perceived size of scale or scope, but merely whether a good understanding of these variables is possible based on the manuscript. Another explanation might be that if both scale and scope are low, other means are used to portray relevance. In conclusion, the scale and scope are usually well described or not so well described, but rarely one is presented well while the other is not. **Therefore, a good** (or poor) **understanding of scale and scope does not imply that these values also translate to perceived relevance**.

The correlation between the values associated with knowing who the stakeholder is and their goals may indicate that **explanations about the stakeholder or their goals appear together**. Hence, manuscripts that barely explicate who the stakeholder is may not clearly communicate their goals either, whereas those that emphasise the stakeholders of their design problem address and clarify both who the specific stakeholder is and what their goals are. Another measurement item that is associated with the stakeholder's goals is the problem scope. **Manuscripts that emphasise the stakeholders' goals** (goals they cannot achieve in the given circumstances) **tend to leave readers with a firmer grasp of the problem's scope** (i.e., how many individuals may be affected by the problem). While correlation cannot make claims for causation, one can say that a better understanding of the stakeholders and their goals correlates with a better understanding of the scope of the problem. At the same time, a clear understanding of the scope of the problem based on the manuscript is indicative that readers are likely to have a relatively good

understanding of who the stakeholders are that fall within the scope (r=0.57) and what their goals are (r=0.67).

With a correlation coefficient of 0.68, there is a relatively high probability that readers rate their understanding of the research problem's essence and the understanding of the context within which the problem is situated as similarly high or low. This may be indicative that a more thorough discussion of the research problem, for which a solution is to be built, may contain not only the essence of a problem, but also the context within which the problem appears, and that the problem's essence and its context mutually support each other. Hence, **articles that yield a good understanding of the essence of a research problem also yield a good understanding of the problem's context**.

*Table 76: Correlation among Research Problem Measures*

| | rp_problem_essence | rp_situation | rp_stakeholder | rp_stakeh_goals | rp_problem_scope | rp_problem_scale | rp_problem_relevance | rp_problem_persistence |
|---|---|---|---|---|---|---|---|---|
| rp_problem_essence | 1.00 | 0.68 | 0.60 | 0.47 | 0.50 | 0.55 | 0.39 | 0.42 |
| rp_situation | 0.68 | 1.00 | 0.58 | 0.47 | 0.44 | 0.52 | 0.33 | 0.49 |
| rp_stakeholder | 0.60 | 0.58 | 1.00 | 0.72 | 0.57 | 0.57 | 0.45 | 0.50 |
| rp_stakeh_goals | 0.47 | 0.47 | 0.72 | 1.00 | 0.67 | 0.56 | 0.45 | 0.54 |
| rp_problem_scope | 0.50 | 0.44 | 0.57 | 0.67 | 1.00 | 0.75 | 0.50 | 0.59 |
| rp_problem_scale | 0.55 | 0.52 | 0.57 | 0.56 | 0.75 | 1.00 | 0.57 | 0.62 |
| rp_problem_relevance | 0.39 | 0.33 | 0.45 | 0.45 | 0.50 | 0.57 | 1.00 | 0.63 |
| rp_problem_persistence | 0.42 | 0.49 | 0.50 | 0.54 | 0.59 | 0.62 | 0.63 | 1.00 |

#### D.3.2.2.4 Aspects Related to the Research Design

In the section on research design, a few questions regarding the perceived benefit of the artefact for theorising and practical usefulness to the readers were added. These questions do not directly map to the research design (in the sense of "how is the research designed?"), but they focus on what the research was designed for ("how can I use the findings from this paper?"). These questions all correlate very highly, and they are:

1. The output (artefact) is useful to me, informing my own research.
2. I will use the artefact to inform theory development in my own work.

3. I will use the artefact to inform theory testing in my own work.
4. I will use the artefact to theorise about its usage.
5. I will use the artefact to theorise about how it was built/developed.

While the responses to these questions feature high pair-wise correlations of 0.65 to 0.91 (with the three highest correlation coefficients of the dataset at 0.84, 0.87 and 0.91, see: Table 77), the values gathered on the 7-point Likert scale were comparably low. This means that the responses to these items are similar, and the manuscripts scored primarily low. Indeed, only one other item has an average evaluation as low as these five measurements. The other low scorer is the science communication outcome measuring whether readers feel compelled to get involved in the study's endeavour (5$^{th}$ lowest score at 3.68/7). These measurement items have in common that they relate to the readers' personal interests and their research endeavours. The fact that these scores were low may be associated with the fact that the survey respondents could not freely choose a paper that suits their interests or research endeavours. The fact that they correlate may, in this light, not be astonishing. No further insights are drawn from these items' correlations. These measurements re-appear in the structure-effect-analysis, though, dubbed "usefulness items".

The remaining correlations that are high in this section of the survey are between the clarity of the artefact design procedures (design process) and the research design-related design decisions (r=0.74), between the research design-related design decisions and general approach (r=0.65), as well as between study's replicability and the general approach (0.73), the objective of the study (r=0.64), and the research design decisions (0.62).

The fact that the understanding of the artefact design process and the design decisions related to the research design correlate may be due to the fact that **clarity, why which study design decisions are taken, may include the choice of procedures that directly lead to the artefact** (i.e., artefact design decisions). This could also explain the relatively strong correlation between the understanding of the general procedural approach taken with the clarity of why which (study) design decisions were taken.

While it is not astonishing that the perceived replicability correlates with the understanding of the general approach taken (r=0.73), this correlation is much weaker for the artefact design process (r=0.55). Hence, readers felt confident that they could conduct a study just like the one presented in the manuscripts, as indicated by the general approach and probably also informed by the research objective (0.64) and the research design-related design decisions (r=0.62). However, the level of confidence in being able to

replicate the study does not correlate strongly with a clear understanding of how the result of the study (i.e., the artefact) was designed. This is somewhat surprising, hinting at a disconnect between the perceived replicability and the knowledge about the artefact design procedures. Hence, **ensuring that readers understand the artefact design procedures does not ensure that they perceive the study as being replicable**.

*Table 77: Correlation among Research Design Measures*

| | rd_replicability | rd_objective | rd_general_approach | rd_rd_decisions | rd_whats_artefact | rd_artefact_is_useful | rd_artefact_for_theory_development | rd_artefact_theory_testing | rd_artefact_theorize_usage | rd_artefact_theorize_building_process | rd_design_process | rd_evaluation | rd_contribution_clarity | rd_limitations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| replicability | 1.00 | 0.64 | 0.73 | 0.62 | 0.37 | 0.38 | 0.34 | 0.31 | 0.38 | 0.43 | 0.55 | 0.43 | 0.39 | 0.39 |
| objective | 0.64 | 1.00 | 0.58 | 0.42 | 0.39 | 0.18 | 0.19 | 0.15 | 0.05 | 0.10 | 0.33 | 0.29 | 0.55 | 0.56 |
| general_approach | 0.73 | 0.58 | 1.00 | 0.65 | 0.40 | 0.33 | 0.33 | 0.25 | 0.31 | 0.37 | 0.59 | 0.35 | 0.41 | 0.37 |
| rd_decisions | 0.62 | 0.42 | 0.65 | 1.00 | 0.48 | 0.42 | 0.42 | 0.40 | 0.44 | 0.48 | 0.74 | 0.41 | 0.49 | 0.33 |
| whats_artefact | 0.37 | 0.39 | 0.40 | 0.48 | 1.00 | 0.39 | 0.37 | 0.29 | 0.15 | 0.24 | 0.49 | 0.56 | 0.45 | 0.26 |
| artefact_is_useful | 0.38 | 0.18 | 0.33 | 0.42 | 0.39 | 1.00 | 0.84 | 0.76 | 0.70 | 0.65 | 0.49 | 0.26 | 0.36 | 0.19 |
| (…) theory_dev. | 0.34 | 0.19 | 0.33 | 0.42 | 0.37 | 0.84 | 1.00 | 0.87 | 0.75 | 0.72 | 0.47 | 0.26 | 0.34 | 0.08 |
| (…) theory_testing | 0.31 | 0.15 | 0.25 | 0.40 | 0.29 | 0.76 | 0.87 | 1.00 | 0.73 | 0.69 | 0.34 | 0.32 | 0.28 | 0.04 |
| (…) theorize_usage | 0.38 | 0.05 | 0.31 | 0.44 | 0.15 | 0.70 | 0.75 | 0.73 | 1.00 | 0.91 | 0.47 | 0.10 | 0.22 | 0.08 |
| (…) building_proc. | 0.43 | 0.10 | 0.37 | 0.48 | 0.24 | 0.65 | 0.72 | 0.69 | 0.91 | 1.00 | 0.44 | 0.19 | 0.16 | 0.14 |
| design_process | 0.55 | 0.33 | 0.59 | 0.74 | 0.49 | 0.49 | 0.47 | 0.34 | 0.47 | 0.44 | 1.00 | 0.44 | 0.44 | 0.27 |
| evaluation | 0.43 | 0.29 | 0.35 | 0.41 | 0.56 | 0.26 | 0.26 | 0.32 | 0.10 | 0.19 | 0.44 | 1.00 | 0.32 | 0.24 |
| contribution_cl. | 0.39 | 0.55 | 0.41 | 0.49 | 0.45 | 0.36 | 0.34 | 0.28 | 0.22 | 0.16 | 0.44 | 0.32 | 1.00 | 0.50 |
| limitations | 0.39 | 0.56 | 0.37 | 0.33 | 0.26 | 0.19 | 0.08 | 0.04 | 0.08 | 0.14 | 0.27 | 0.24 | 0.50 | 1.00 |

#### D.3.2.2.5 Science communication impact measures

The last set of measurement items covers science communication impact measures. Noticeable correlations include the enjoyment of reading the text with the perception of having been entertained by the text (r=0.82) and all other items in general (Ø r=0.65); the low correlation of whether one feels 'compelled to get involved' with all other science communication impact measures (lowest minimum correlation in this section with r=0.17 vs. Ø lowest r=0.3; lowest maximum correlation with r=0.62 vs. Ø r=0.71; lowest average correlation with r=0.42 vs. Ø r=0.55); high correlation between understanding which procedures were used and why these procedures were used (r=0.73); high correlation between the feeling of familiarity with the issues explained in the text and the confidence to be able to convincingly explain the research problem presented in the text to others (r=0.72); relatively high correlation of the confidence to be able to explain the research problem to others with feeling confident to be able to explain the outcomes to others (r=0.68), to take related decisions (r=0.68), and the understanding of which procedures were employed (r=0.67). For more details, see Table 78.

The respondent's rating of their enjoyment of reading the text strongly correlated with their evaluation of whether they felt entertained by the manuscript (r=0.82). Thus, people that enjoy reading a manuscript more are also likely to rate their feeling of being entertained by it higher. However, the level of enjoyment in reading a text tends to be higher than the feeling of being entertained by the manuscript (average 7-point Likert scale values of 5.17 vs 4.68). Nevertheless, individuals that feel entertained also enjoy reading the manuscript. This may be an important finding, as the enjoyment of reading the text correlate comparably strongly with all other science communication impact measures. Therefore, higher enjoyment scores tend to come with higher scores on all other science communication outcomes. Thus, **writing an entertaining manuscript may spark enjoyment in the readers, which might improve the perception of many other factors.** However, this may need more specific testing, as the underlying data is only a correlation.

Whether respondents felt compelled to get involved in some way correlated very weakly with most other science communication impact measures, apart from whether one would like to learn more about the issue or study (r=0.62). Considering that this item has not only a very low correlation with any of the communication impact measures, but also with all other items, this may indicate that whether readers want to get involved or not does largely depend on variables that are beyond the characteristics of the manuscript but may depend more on, e.g., individual characteristics, backgrounds, or interests. **A**

**research article might thus not be a suitable vehicle to achieve audience engagement**.

The clarity in understanding which procedures were used correlates with the understanding of why these particular procedures were used (r=0.73). Considering that the understanding of which procedures were used was evaluated a bit higher on average (5.26 vs 5.06), this may imply that explaining procedures is often done in a fashion that combines the questions of what is done and why it is done in that fashion and that the procedures tend to be better understood (and therefore may be better explained) than the reasoning behind the selection of the procedures. Hence, **to explain the procedures used, authors tend to clarify both the selection and the rationale behind the selection of procedures, whereas the rationale is less focal**.

The level of familiarity with the issue explained in the text correlated with the level of agreement with the sentence "I can convincingly explain the research problem presented in the text to others" (r=0.72). This is unsurprising since not feeling familiar with an issue may directly imply that one may not feel confident in one's ability to present the issue convincingly. However, higher values on the confidence around explaining the research problem are also somewhat correlated with feeling confident in being able to explain the outcomes to others (r=0.68), to take related decisions (r=0.68), and the understanding of which procedures were employed (r=0.67). One may say that the confidence in being able to present the research problem convincingly is higher if the outcome and the procedures related to bridging the problem with the outcome is clearer. In reverse, a better understanding of the problem (and therefore higher confidence that one can convincingly present it) may lead to a better understanding of why which design decisions were taken and what the artefact is and how it works. Of course, the numbers presented here are correlations, and therefore do not allow to infer any directionality in the sense of cause-and-effect relations. However, improved clarity in any one of these items may improve the understanding of the other aspects.

*Table 78: Correlation among Science Impact Measures*

| | scim_issue_familiarity | scim_research_problem | scim_enjoyment | scim_entertainment | scim_learn_more | scim_get_involved | scim_related_decision | scim_understand_procedures | scim_procedure_clear_why | scim_explain_outcome_to_others | scim_implications_practice | scim_implications_science |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| issue_familiarity | 1.00 | 0.72 | 0.49 | 0.40 | 0.46 | 0.24 | 0.62 | 0.54 | 0.38 | 0.50 | 0.52 | 0.46 |
| research_problem | 0.72 | 1.00 | 0.59 | 0.51 | 0.41 | 0.30 | 0.68 | 0.67 | 0.48 | 0.68 | 0.60 | 0.49 |
| enjoyment | 0.49 | 0.59 | 1.00 | 0.82 | 0.63 | 0.48 | 0.65 | 0.63 | 0.59 | 0.64 | 0.60 | 0.63 |
| entertainment | 0.40 | 0.51 | 0.82 | 1.00 | 0.56 | 0.45 | 0.51 | 0.49 | 0.52 | 0.52 | 0.47 | 0.45 |
| learn_more | 0.46 | 0.41 | 0.63 | 0.56 | 1.00 | 0.62 | 0.54 | 0.39 | 0.30 | 0.39 | 0.22 | 0.33 |
| get_involved | 0.24 | 0.30 | 0.48 | 0.45 | 0.62 | 1.00 | 0.52 | 0.26 | 0.38 | 0.35 | 0.17 | 0.27 |
| related_decision | 0.62 | 0.68 | 0.65 | 0.51 | 0.54 | 0.52 | 1.00 | 0.60 | 0.45 | 0.64 | 0.56 | 0.55 |
| understand_procedures | 0.54 | 0.67 | 0.63 | 0.49 | 0.39 | 0.26 | 0.60 | 1.00 | 0.73 | 0.61 | 0.56 | 0.48 |
| procedure_clear_why | 0.38 | 0.48 | 0.59 | 0.52 | 0.30 | 0.38 | 0.45 | 0.73 | 1.00 | 0.50 | 0.47 | 0.43 |
| explain_outcome_to_others | 0.50 | 0.68 | 0.64 | 0.52 | 0.39 | 0.35 | 0.64 | 0.61 | 0.50 | 1.00 | 0.61 | 0.54 |
| implications_practice | 0.52 | 0.60 | 0.60 | 0.47 | 0.22 | 0.17 | 0.56 | 0.56 | 0.47 | 0.61 | 1.00 | 0.68 |
| implications_science | 0.46 | 0.49 | 0.63 | 0.45 | 0.33 | 0.27 | 0.55 | 0.48 | 0.43 | 0.54 | 0.68 | 1.00 |

## D.4 Contribution to the Research Project

This analysis contributes to the design of the sub-class level artefact that guides design researchers in writing research articles, and it provides a database of perceived effects of the 19 research articles that can be used for the structure-effect-analysis. The direct contribution toward the design of a guiding artefact primarily stems from the insights in Section D.3.1. The direct contribution of the cross-correlation analysis to the design of the artefact is relatively low. This is primarily due to the nature of the insights that can be gathered by such an analysis (i.e., correlations, rather than causal relationships).

## D.5 Limitations and Discussion

This study has revealed that there are very few effects that are evaluated exceptionally positively by readers, namely: the clarity about what the output or artefact of the study

is (5.87/7), the perceived ability to empathise with the topic (5.72), and the perceived relevance of the topic and the research problem (both: 5.70). The initial intent of the effect analysis was to identify clusters of such highly-rated items. This would have allowed for making prescriptive statements about what should be focused on. The results provide these only four such items. However, the opposite end of the scoring sheet (i.e., average or below-average scores) reveals unexpected results: Many effects regarding the research problem, the research design, and science communication impact measures are scored below the overall quality assessment for the article. Readers perceive articles as being of high quality, despite comparably poor scores given by these same individuals to crucial content elements. Notice that these scores are not low (4.56-5.35 on a 7-point Likert scale, excluding outliers). However, they are lower than the overall quality assessments (5.40-5.5, excluding the 'relevance' item) and the narrative items (5.22-5.55, excluding the item on empathising with the topic).

While this is an interesting finding, this study cannot clarify what to do with this information. Indeed, this is one of its limitations: The responses analysed in this study are quantitative, and the data does not allow for inferring causality. Nor does it contain additional details that shed light on various findings. For example: What is the basis for the perceived relevance of the research problem (5.7/7)? It is unlikely that this is the understanding of the scope of the problem (4.73) or its scale (4.56), as those feature much lower scores.

Another limitation of this survey study is that participation was mandatory, and no remuneration was offered. The sample consists of doctoral students that were enrolled in DSR courses. They were asked to read two articles and respond to the survey. Whether they filled in the questions attentively or whether they have read the articles is beyond the control of the author. To counter-act that the participants fill in the survey at random, the author has added free-text fields in which the students were asked to write about their experience. Furthermore, all communication with the students was done by the professors of the courses and not the author. Since the participation took place before the course ended and the professors integrated the reading assignments into their course, they could motivate all students that participated in the course to fill the surveys in. Lastly, the fact that the correlation coefficient of the quality measures with all other variables is clearly positive indicates that the participants paid attention during their task (i.e., higher evaluations of any item means higher evaluations of the overall quality, too).

# Appendix E Structure-Effects-Analysis

## E.1 Starting Point

This is the fourth part of four inter-related studies, as presented in Appendix B and illustrated below (Figure 45). This study combines findings from two document analyses (qualitative structure analysis in Appendix B and quantitative structure analysis in Appendix C) and a quantitative survey study (effects analysis in Appendix D). The purpose of this study is to devise means-end-relations between implemented structures (means) and outcomes that these structures may effect in readers (possible ends one may target). Having analysed the structure of the 19 research articles as introduced in Appendix B, as well as the dataset on the effects of these articles on readers, this final analysis thus matches (1) the six structural groups (qualitative structure analysis, Appendix B) with the scores from the effects survey, (2) the findings about the usage of content elements, and (3) the roughly forty individual characteristics of the research articles with these same effects (both based on the quantitative structure analysis, Appendix C). Therewith, the practices outlined in the structural analyses can be critically reflected on the one hand (what do these practices mean for the effects that are achieved by respective articles?). After all, merely identifying that some structural aspect is often omitted (e.g., specification of requirements) allows for statements that describe the status quo rather than to make prescriptive claims as to what one should consider doing. This is because the knowledge about the effects is missing (e.g., specifying requirements might be detrimental, beneficial, or irrelevant for readers' understanding of, e.g., the research problem or the relevance of the problem). By mapping the practices (the coded structure) with the feedback from readers (effects), the intention is to identify structure-effect relationships that can be used as prescriptive means-end-relations.

## E.2 Research Approach

With the datasets presented above, identifying such relations is achieved in three steps: First, the structural groups identified throughout the qualitative analysis are used to split the effects dataset into sub-groups, which can thereafter be compared to each other (single-factor ANOVA). This approach can reveal that certain structural groups are more likely to yield certain outcomes and thus, that for reaching a specific outcome, a specific structural group may lend itself. Second, the frequency and depth with which the ten content elements form the first section of the quantitative structure analysis can be used to this same end. In this case, however, the effects are compared to the usage of content

blocks that build the articles (rather than structural groups). Third, individual structure codes can be matched with the averaged effects. The latter is likely to yield inconclusive results for many items since the characteristics are much more fine-grained than the groups (41 binary characteristics vs 6 groups) or the ten content elements. However, specific structural items may indeed prove to have a direct impact on specific effects. For example, understanding the research problem (an effect measure) may be better if the manuscript elaborates on the stakeholders' goals (one of the 41 characteristics). These analyses are presented in two sub-sections, matching the structural analyses:

The first sub-section is the group-effect-analysis (Section E.3), and it features an analysis of the effects data split by structural groups. The analysis entails comparing each group's achieved scores and the values achieved in each section of the effects dataset (overall assessment of quality; clarity of narrative; research problem description; research design; science communication impact measures).

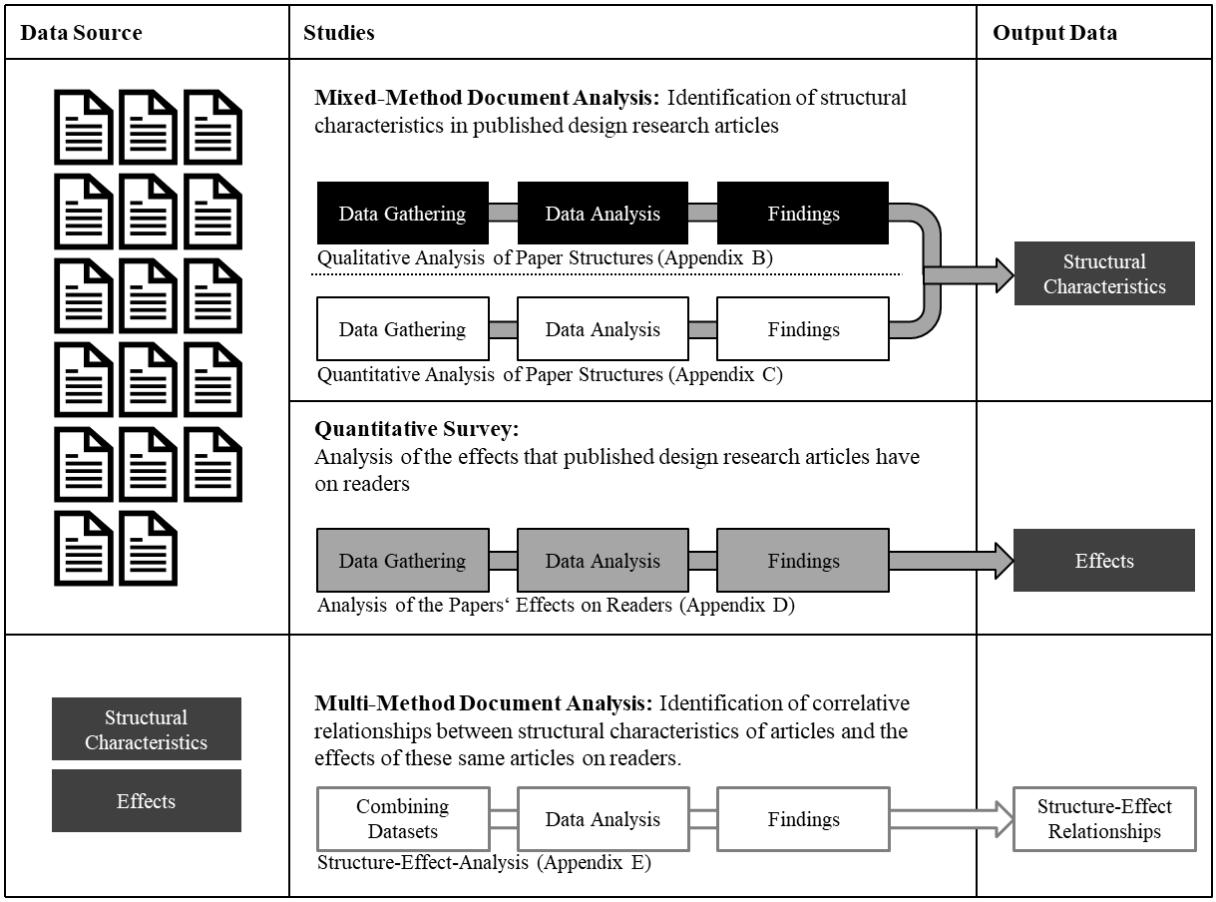



*Figure 45: Overview of the Empirical Studies B-E*

The second sub-section is the characteristic-effect-analysis (Section E.3.5), which focuses on identifying differences in the effects based on the usage of various content elements (Section E.4.1) and individual characteristics of the articles (Section E.4.2). Since most of the characteristics are binary (41 out of 44), this analysis also compares groups. However, these groups are not the (general) structural groups, two groups at a time, differ from each other by featuring or not featuring a specific characteristic.

## E.3 Group-Effect-Analysis

Before diving into the numbers, it is worth repeating that the number of papers per group is low for groups 1, 2, and 6 (with 2, 1, and 2 articles respectively), and that each paper's effects were coded an average of 4.3 times. Considering the number of times a specific effect was coded for each group, the reliability of their averaged value is higher than it is for the structural groups themselves (which were coded by the author only, as per Appendix B). Hence, while caution should be used in associating specific structural characteristics with Group 2 (only one paper), the effects captured about the paper in Group 2 may still allow for some interpretation, as five independent researchers have coded its effects. The number of papers per group and the number of coders per group are shown alongside the entire dataset of mean values per effect code and paper group in Table 79. In the following, each group's overall score is discussed before diving into the five individual sections of the questionnaire (also indicated in the following table).

*Table 79: Group-Effect-Analysis: Group vs Average Effect*

| Number of papers : coders (n) | | 2:8 | 1:5 | 5:23 | 5:21 | 4:21 | 2:8 | |
|---|---|---|---|---|---|---|---|---|
| **Items** | **Group:** | **1** | **2** | **3** | **4** | **5** | **6** | **Avg.** |
| avg. contribution_originality | Overall Assessment of Quality | 5.75 | 5.20 | 5.43 | 5.38 | 5.88 | 5.13 | 5.50 |
| avg. relevance | | 5.88 | 5.20 | 5.30 | 6.05 | 6.35 | 4.63 | 5.70 |
| avg. content_quality | | 5.63 | 5.20 | 5.35 | 5.67 | 5.29 | 5.38 | 5.44 |
| avg. contribution_significance | | 5.75 | 5.20 | 5.39 | 5.52 | 5.47 | 5.13 | 5.44 |
| avg. presentation | | 6.00 | 4.60 | 5.13 | 5.90 | 5.35 | 4.88 | 5.40 |
| avg. overall_impression | | 6.00 | 4.80 | 5.39 | 5.48 | 5.65 | 5.00 | 5.45 |
| avg. clarity_plotline | Clarity of Narrative | 6.13 | 4.60 | 5.17 | 5.86 | 5.76 | 5.00 | 5.51 |
| avg. empathize_w_researcher | | 5.88 | 4.40 | 5.43 | 5.29 | 5.65 | 5.25 | 5.40 |
| avg. clarity_design_decisions | | 5.88 | 4.40 | 4.78 | 5.57 | 5.29 | 5.25 | 5.22 |
| avg. topic_relatability | | 6.25 | 5.40 | 5.35 | 6.10 | 5.88 | 5.13 | 5.72 |
| avg. examples_relatability | | 5.88 | 4.60 | 5.13 | 6.05 | 5.88 | 4.88 | 5.54 |
| avg. examples_helpfulness | | 6.00 | 4.40 | 5.13 | 6.14 | 5.88 | 4.75 | 5.55 |

(continued on the next page)

| Number of papers : coders (n) | | 2:8 | 1:5 | 5:23 | 5:21 | 4:21 | 2:8 | |
|---|---|---|---|---|---|---|---|---|
| **Items** | **Group:** | **1** | **2** | **3** | **4** | **5** | **6** | **Avg.** |
| avg. empathize_w_stakeholder | Clarity Research Problem | 6.00 | 5.00 | 5.04 | 5.24 | 5.82 | 4.88 | 5.33 |
| avg. problem_essence | | 5.75 | 5.20 | 5.30 | 5.76 | 5.76 | 5.13 | 5.54 |
| avg. problem_situation | | 5.88 | 5.40 | 5.13 | 5.67 | 5.65 | 5.50 | 5.50 |
| avg. problem_stakeholder | | 5.63 | 5.40 | 4.78 | 5.38 | 5.65 | 5.25 | 5.28 |
| avg. clarity_stakeholder_goals | | 5.88 | 5.20 | 4.74 | 5.19 | 5.53 | 5.25 | 5.21 |
| avg. problem_scope | | 5.25 | 5.00 | 4.26 | 5.10 | 4.88 | 4.13 | 4.73 |
| avg. problem_scale | | 4.88 | 6.00 | 3.96 | 4.76 | 4.88 | 3.88 | 4.56 |
| avg. problem_relevance | | 5.75 | 6.00 | 5.35 | 5.86 | 6.12 | 5.13 | 5.70 |
| avg. problem_persistence | | 5.25 | 5.40 | 4.74 | 5.57 | 5.35 | 4.50 | 5.15 |
| avg. replicability | Clarity of the Research Design | 5.63 | 4.80 | 4.48 | 5.48 | 5.00 | 4.13 | 4.94 |
| avg. research_objective | | 6.25 | 5.60 | 5.26 | 5.57 | 5.53 | 4.88 | 5.48 |
| avg. general_approach | | 6.25 | 4.40 | 5.00 | 5.95 | 5.41 | 5.13 | 5.43 |
| avg. research_design_decisions | | 5.63 | 4.00 | 4.96 | 5.62 | 5.00 | 4.88 | 5.13 |
| avg. what_is_the_artefact | | 5.38 | 6.00 | 6.00 | 6.24 | 5.41 | 5.88 | 5.87 |
| avg. usefulness_of_artefact | | 3.75 | 4.00 | 3.83 | 4.10 | 4.06 | 4.25 | 3.99 |
| avg. artefact_for_theory_development | | 3.25 | 3.00 | 3.57 | 3.76 | 3.35 | 4.50 | 3.60 |
| avg. artefact_theory_testing | | 2.63 | 2.60 | 3.61 | 3.76 | 3.47 | 4.38 | 3.54 |
| avg. artefact_theorize_usage | | 3.13 | 3.00 | 2.91 | 3.43 | 3.06 | 3.50 | 3.16 |
| avg. artefact_theorize_building_process | | 3.00 | 2.60 | 3.39 | 3.81 | 3.41 | 3.38 | 3.41 |
| avg. design_process | | 5.25 | 5.00 | 4.78 | 5.57 | 4.94 | 5.50 | 5.15 |
| avg. evaluation | | 4.50 | 6.00 | 5.17 | 5.81 | 5.24 | 5.38 | 5.35 |
| avg. contribution_clarity | | 5.88 | 5.80 | 5.43 | 5.43 | 5.47 | 5.75 | 5.54 |
| avg. limitations | | 5.75 | 5.60 | 4.96 | 5.71 | 5.29 | 4.38 | 5.28 |
| avg. familiarity_with_issue | Science Communication Impact Measures | 5.88 | 5.40 | 4.96 | 5.62 | 5.47 | 4.63 | 5.32 |
| avg. can_present_problem_to_others | | 6.25 | 6.00 | 4.91 | 5.48 | 5.12 | 4.63 | 5.27 |
| avg. enjoyed_reading | | 5.88 | 5.00 | 4.39 | 5.62 | 5.65 | 4.63 | 5.17 |
| avg. entertained_by_text | | 5.63 | 4.40 | 3.96 | 5.24 | 5.06 | 3.75 | 4.68 |
| avg. want_to_learn_more | | 4.50 | 5.00 | 4.35 | 4.95 | 4.53 | 4.38 | 4.60 |
| avg. want_to_get_involved | | 4.25 | 4.20 | 3.52 | 3.90 | 3.59 | 2.88 | 3.68 |
| avg. can_take_related_decision | | 5.75 | 5.00 | 4.04 | 4.67 | 4.65 | 3.88 | 4.54 |
| avg. understand_procedures | | 5.75 | 4.80 | 4.96 | 5.52 | 5.24 | 5.25 | 5.26 |
| avg. clear_why_which_procedures | | 5.63 | 4.20 | 4.74 | 5.48 | 5.00 | 5.00 | 5.06 |
| avg. can_explain_outcome_to_others | | 5.63 | 5.80 | 4.74 | 5.67 | 5.00 | 4.63 | 5.17 |
| avg. implications_practice | | 6.13 | 5.20 | 5.30 | 5.81 | 5.41 | 5.38 | 5.54 |
| avg. implications_research | | 6.13 | 5.20 | 5.17 | 5.62 | 5.35 | 5.38 | 5.44 |
| (mean score per group) | | 5.43 | 4.88 | 4.78 | 5.35 | 5.16 | 4.77 | 5.07 |

### E.3.1 Average Effects per Structural Group

The average value given by the survey participants to all effect questions (7-point Likert scale) is 5.07. Since all questions are formulated such that a higher value indicates a more positive outcome (e.g., better understanding, higher clarity, higher quality of content), the aggregation of all responses shows that the readers average perception of the articles is positive (neutral value is 4.0). Furthermore, when combining the aggregated evaluation split by groups, all average values are above 4.0, too (Table 80). Hence, on average, no group yields "bad" articles based on the readers perceived effects. This is expected since the articles were published in prestigious journals.

*Table 80: Average Response Value per Structural Group*

| | Score | (Score – ø) | [%] | n |
|---|---|---|---|---|
| Group 1 | 5.42 | 0.35 | 6.9% | 8 |
| Group 2 | 4.88 | -0.20 | -3.9% | 5 |
| Group 3 | 4.74 | -0.33 | -6.5% | 23 |
| Group 4 | 5.32 | 0.25 | 4.9% | 21 |
| Group 5 | 5.16 | 0.09 | 1.8% | 17 |
| Group 6 | 4.77 | -0.30 | -5.9% | 8 |
| Overall (ø) | 5.07 | | | 82 |

*Table 81: Mean Scores per Section and Group*

| Section of the Survey Group | 1 | 2 | 3 | 4 | 5 | 6 | Avg. |
|---|---|---|---|---|---|---|---|
| Overall Assessment of Quality | 5.84 | 5.03 | 5.33 | 5.67 | 5.67 | 5.03 | 5.49 |
| Clarity of the Narrative | 6.00 | 4.63 | 5.17 | 5.84 | 5.72 | 5.04 | 5.49 |
| Clarity of the Research Problem | 5.59 | 5.40 | 4.81 | 5.39 | 5.52 | 4.85 | 5.22 |
| Clarity of the Research Design | 4.73 | 4.46 | 4.53 | 5.02 | 4.62 | 4.71 | 4.71 |
| Science Communication Impact | 5.62 | 5.02 | 4.59 | 5.30 | 5.01 | 4.54 | 4.98 |
| (mean score per group) | 5.43 | 4.88 | 4.78 | 5.35 | 5.16 | 4.77 | 5.07 |

Among the groups, the highest average values were given to group 1 (5.43) and group 4 (5.35), whereas the lowest ratings were given to group 3 (4.78) and group 6 (4.77). group 2, which has the lowest number of observations, is also below average (4.88), and the remaining group 5 is about average (5.16). Based on these scores, it becomes evident that structural groups 1 and 4 are the best-performing ones across the effects, whereas groups 3 and 6 score much lower on the research problem, the research design and the communication impact measures. Because groups 1 and 4 score better than groups 3 and

6 across all sections of the survey (and therefore yield consistently better communication outcomes), one can conclude that **structural groups 1 and 4 are to be preferred from groups 3 and 6**.

Further investigating the average scores of individual items (Table 79), it becomes evident that group 1 excels in almost all items apart from the usefulness items (how useful is the output or artefact for various activities of design researchers?) and directly artefact-related items (in particular: what is the artefact (5.38) and how is the artefact evaluated (4.50), both scoring lowest across structural groups). That it scores so highly is likely due to its accepted and long-established structure (i.e., the nominal structure of empirical research articles). It is fair to assume that this structure has evolved such that the effects are scored highly. The comparably poor scoring items can be explained by the strong focus of group 1 articles on empirical studies, rather than the design study with which they are associated (e.g., the evaluation is focal in these articles, not the object nor the creation of the object of evaluation). If one were to remove the usefulness items and the two artefact-related items mentioned above, then the average score for group 1 would be an excellent 5.75 on a 7-point Likert scale—indicating an even more dominant structure. This, however, implies that these artefact-related contents are not central to the article. Therefore, the following can be concluded: For an article in which neither the artefact nor its design process are focal, the structure of group 1 should be chosen.

Group 4 articles received high relative scores across almost all items. The two remarkable exceptions are the clarity of what the contribution is (contribution_clarity: 5.43) and the perceived originality of the contribution (contribution_originality: 5.38). Both of these scores are the lowest scores obtained for the respective items across groups. This indicates that **the authors of group 4 articles might need to pay special attention to clarifying the contribution and how it is new**. Apart from these two items, group 4 does not have any weak spots, neither across sections nor in individual items. This can be seen visually as well (in Table 79, where the relative score is coloured on a continuum between dark red (weakest), white (average), and dark green (strongest)). This shows that **group 4's structure effectively communicates design research articles**.

Compared to group 1, group 4 is weaker in many items. However, the caveat of group 1 articles needs to be considered here: Group 1 articles do not focus on (nor feature) the artefact creation process, and the artefact is not focal. Excluding these and the usefulness items from the effects data improves the average score of both, but the difference is more substantial for group 1 (+0.32 vs +0.16). Reversing this insight, one can say that,

if these aspects are focal, group 4 is performing better (⌀ usefulness measure: +0.62, what the artefact is: +0.86, the design process: +0.32, how the artefact is evaluated: +1.31). This leads to the conclusion that **if a design researcher wants to write an article that focuses on the artefact, the structure of group 4 should be preferred from the structure of group 1**.

As with the positive examples of group 1 and group 4 structures, there are negative examples that score lower across the board. This is particularly the case for groups 3 and 6. Group 3 has no item in which it excels. Surprisingly though, the average perceived quality of group 3 is only slightly below average (5.33 vs 5.49). One may conclude from this that **the structure of group 3 articles is undesirable** and that there are better alternatives in group 1 (focus on non-artefact-related aspects) and group 4 (focus on design-related aspects). In contrast, the otherwise weak group 6 dominates the usefulness measures (average usefulness measure of groups 1-5: 3.38, group 6: 4.00). This indicates that **structure 6 is to be used if one wishes to focus on the perceived usefulness of the study for other design researchers' research activities**. At the same time, these comparably high values across usefulness measures indicate one other thing: Even with this strong point, group 6 articles score lowest overall. This means that the structure of group 6 is strongly outperformed across the other sections. Hence, **the structure of group 6 should not be used unless the primary focus is on the perceived usefulness of the study to other design researchers research practice**.

Analysing the mean scores per section and group (Table 81), one can conclude that design research articles in basket journals tend to be of high quality and feature high clarity of the narrative (each section scoring 5.49 on a 7-point Likert scale). However, they receive the lowest scores for the clarity of the research design (4.71/7), and their scores on science impact measures (4.98/7) is also a bit lower compared to their average scores (5.07/7). However, the score about the clarity of the research design might need to be adjusted. There are five items in the questionnaire that do not strictly address the research design in the sense of it being understandable but rather addressing the derived usefulness for the readers. Excluding these items leads to a much better score for the research design (5.35/7, see also: Table 82), which is more consistent with what one may expect of a basket journal article. (The role of these usefulness items is discussed further in Appendix D.) Removing these items does not affect the ranking of the groups by the mean score across all sections (from highest to lowest scoring group: 1, 4, 5, 2, 3, 6). However, the score of group 6 benefits least from this improved focus on the research design description. This is elaborated on further in Section E.3.5.

*Table 82: Average Values per Section and Group (without usefulness items)*

| Section of the Survey Group | 1 | 2 | 3 | 4 | 5 | 6 | Avg. |
|---|---|---|---|---|---|---|---|
| Overall Assessment of Quality | 5.84 | 5.03 | 5.33 | 5.67 | 5.67 | 5.03 | 5.49 |
| Clarity of the Narrative | 6.00 | 4.63 | 5.17 | 5.84 | 5.72 | 5.04 | 5.49 |
| Clarity of the Research Problem | 5.59 | 5.40 | 4.81 | 5.39 | 5.52 | 4.85 | 5.22 |
| Research Design (excl. usefulness items) | 5.61 | 5.24 | 5.12 | 5.71 | 5.25 | 5.10 | 5.35 |
| Usefulness items | 3.15 | 3.04 | 3.46 | 3.77 | 3.47 | 4.00 | 3.54 |
| Science Communication Impact | 5.62 | 5.02 | 4.59 | 5.30 | 5.01 | 4.54 | 4.98 |
| (mean score without usefulness items) | 5.70 | 5.10 | 4.94 | 5.54 | 5.37 | 4.87 | 5.26 |

Before diving into the data about the individual sections of the survey, two quantitative analyses are presented. First, a single factor ANOVA compares the group (factor) with the overall average score per response per group. This analysis thus uses the computed average score obtained in each survey response and compares these within and across groups. For this analysis, the average values are used in two varieties: One average response value was computed across all items, and one omitted the usefulness items in the research design section of the survey. Second, a single factor ANOVA shows the calculated significance of the group as a factor on each of the sections' average scores.

The single factor ANOVA on the average response value across all sections has revealed that the groups are only significant predictors for the relative evaluation of the manuscript if the items about the usefulness for the readers' own practices are removed. In other words: The group is not significant for the average values across all items ($p=0.13$), but it is significant at the $\alpha=0.05$ level upon removing the usefulness measures ($p=0.044$). A further discussion about the appropriateness of removing these usefulness measures ensues below (Section E.3.5). At this point, it is worth noting that these can be removed as they are conceptually different and not directly assessing the quality of the manuscript, but rather the utilitarian outcomes that might be achieved (i.e., can readers use the knowledge obtained in their research?). This, of course, depends strongly on the project that is presented rather than on the presentation of the content. Hence, after omitting these items, **the structural groups identified in the qualitative structure analysis significantly predict the goodness of a manuscript across a large set of evaluation criteria**.

*Table 83: Single Factor ANOVA on the Overall Effect of the Structural Group*

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| Avg_Response overall | Between | 5.588 | 5 | 1.118 | 1.768 | .130 |
| | Within | 48.038 | 76 | .632 | | |
| | Total | 53.626 | 81 | | | |
| Avg_Response without useful-ness | Between | 7.063 | 5 | 1.413 | 2.415 | .044 |
| | Within | 44.461 | 76 | .585 | | |
| | Total | 51.524 | 81 | | | |

The single factor ANOVA on the average response value within each section has revealed that the group is a highly significant predictor for the clarity of the narrative (p=0.003; for a more fine-grained analysis, see Section E.3.3), and somewhat significant for the science communication impact measures (p=0.63, Section E.3.6). With that, and given that all questions were positively framed (higher score equals better outcomes for each question and thus, section), one can say with some certainty that **the clarity of the narrative is highly affected by the structural group** and that **the best clarity of narrative can be obtained with the structural groups 1, 4, and 5**. Furthermore, **to obtain the highest science communication impact values, group 1 should be chosen**. However, if there should be a **focus on design, then group 4 is best to obtain high general science communication impact values**.

*Table 84: Single Factor ANOVA of Groups on Average Values per Section of the Survey*

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| Avg_Overall As-sessment | Between | 5.497 | 5 | 1.099 | 1.864 | .111 |
| | Within | 44.824 | 76 | .590 | | |
| | Total | 50.321 | 81 | | | |
| Avg_Clarity of narrative | Between | 13.181 | 5 | 2.636 | 3.924 | **.003** |
| | Within | 51.061 | 76 | .672 | | |
| | Total | 64.242 | 81 | | | |
| Avg_Clarity of research problem | Between | 8.277 | 5 | 1.655 | 1.871 | .109 |
| | Within | 67.242 | 76 | .885 | | |
| | Total | 75.518 | 81 | | | |
| Avg_Clarity of RD without use-fulness | Between | 5.232 | 5 | 1.046 | 1.311 | .268 |
| | Within | 60.656 | 76 | .798 | | |
| | Total | 65.888 | 81 | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Avg_Science communication impact | Between | 10.521 | 5 | 2.104 | 2.197 | **.063** |
| | Within | 72.803 | 76 | .958 | | |
| | Total | 83.323 | 81 | | | |

## E.3.2 Overall Assessment of Quality

The overall quality assessment contains six questions about the quality of the article (see Appendix J). The average values per item and structural group, along with the mean for each group over this section can be seen in Table 85.

*Table 85: Overall Assessment of Quality, Average Values per Item and Group*

| Number of papers : number of coders (n) | | 2:8 | 1:5 | 5:23 | 5:21 | 4:21 | 2:8 | |
|---|---|---|---|---|---|---|---|---|
| **Items** | **Group:** | **1** | **2** | **3** | **4** | **5** | **6** | **Avg.** |
| avg. contribution_originality | Overall Quality | 5.75 | 5.20 | 5.43 | 5.38 | 5.88 | 5.13 | 5.50 |
| avg. relevance | | 5.88 | 5.20 | 5.30 | 6.05 | 6.35 | 4.63 | 5.70 |
| avg. content_quality | | 5.63 | 5.20 | 5.35 | 5.67 | 5.29 | 5.38 | 5.44 |
| avg. contribution_significance | | 5.75 | 5.20 | 5.39 | 5.52 | 5.47 | 5.13 | 5.44 |
| avg. presentation | | 6.00 | 4.60 | 5.13 | 5.90 | 5.35 | 4.88 | 5.40 |
| avg. overall_impression | | 6.00 | 4.80 | 5.39 | 5.48 | 5.65 | 5.00 | 5.45 |
| (mean overall assessment of quality) | | 5.84 | 5.03 | 5.33 | 5.67 | 5.67 | 5.02 | 5.49 |

Based on the illustration of averages, it quickly becomes apparent that both groups 2 and 6 have received much poorer overall quality assessment values (5.03 and 5.02 respectively vs ⌀ 5.49). This can be observed across the board. Apart from the content quality item (where group 6 has obtained a mid-range value), these two groups' average effect values for the section on the overall assessments of the document's quality share the lowest two values of all groups. While these values are above 'neutral' (the value 4 on the 7-point Likert scale), these two groups score markedly lower than others. This first set of questions should help identify the overall quality of a manuscript. **If the intention is to achieve the perception of a high overall level of quality of the manuscript, then the following ranking should help** identify which group to choose as a reference structure:

7. Group 1 with a score of 5.84/7 and n= 8, based on 2 articles
8. Group 4 with a score of 5.67/7 and n=21, based on 5 articles*
9. Group 5 with a score of 5.67/7 and n=21, based on 4 articles
10. Group 3 with a score of 5.33/7 and n=23, based on 5 articles
11. Group 2 with a score of 5.03/7 and n= 5, based on 1 article
12. Group 6 with a score of 5.02/7 and n= 8, based on 2 articles

*Having received the same score as group 5, but being based on one article more, group 4 might be a stronger candidate for the second-placed group in the ranking outlined above.

1. To test whether these different scores in the questionnaire's section about the overall assessment of quality are indeed a function of the groups, an analysis of variance was conducted (single factor ANOVA in SPSS), the results of which are shown below. The ANOVA was run with the factor group (i.e., groups 1-6), and the dependent variables are all the items of the first section of the survey on the effects (i.e., six items of the overall assessment of quality, see Table 86)

). The single factor ANOVA for perceived relevance ("The topic is of societal value/is relevant today.") is highly significant ($p < 0.001$). The perceived quality of the presentation ("The content is presented well – easy to understand and follow the train of thought, good use of illustrations/tables where it makes sense, etc.") is somewhat significant ($p = 0.093$) on their own. The latter indicates that belonging to one of the six groups not only implies that contents are being presented differently (the nature of these groups, see Appendix B), but also that it is perceived as being of different presentation quality. While this effect is not highly significant, it suggests that some groups' structures make for **better presentations**. The selection logic for writing **an article that is likely to be perceived as a good presentation would be based on the ranking listed below** (albeit group 4 might be an even stronger candidate than the first ranked group 1, because of its more extensive evidence of five articles and 21 responses).

1. Group 1 with a score of 6.00/7 and n= 8, based on 2 articles
2. Group 4 with a score of 5.90/7 and n=21, based on 5 articles
3. Group 6 with a score of 5.40/7 and n= 8, based on 2 articles
4. Group 5 with a score of 5.35/7 and n=21, based on 4 articles
5. Group 3 with a score of 5.13/7 and n=23, based on 5 articles
6. Group 2 with a score of 4.60/7 and n= 5, based on 1 article

Maybe more surprising, however, is the high significance of group association for the answer to the relevance item. Therefore, the highest perceived relevance can be likely achieved by following the structure of the group with the best relevance score. Considering on the one hand that some groups have more representing articles and therefore a much larger number of responses (n), and on the other hand that the two highest scores are among the groups represented by a relatively high number of articles and a high number of responses, these groups ranked first and second **(group 5 and group 4)**

**appear to be particularly suitable to portray the relevance of the topic**. This yields the following selection logic for writing an article that transports the **relevance** of the topic well:

2. Group 5 with a score of 6.35/7 and n=21, based on 4 articles
3. Group 4 with a score of 6.05/7 and n=21, based on 5 articles
4. Group 1 with a score of 5.88/7 and n= 8, based on 2 articles
5. Group 3 with a score of 5.30/7 and n=23, based on 5 articles
6. Group 2 with a score of 5.20/7 and n= 5, based on 1 article
7. Group 6 with a score of 5.38/7 and n= 8, based on 2 articles

*Table 86: Single Factor ANOVA per Item of the Overall Assessment of Quality Section*

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| contribu-tion_originality | Between | 4.956 | 5 | .991 | 1.149 | .342 |
| | Within | 65.544 | 76 | .862 | | |
| | Total | 70.500 | 81 | | | |
| relevance | Between | 24.124 | 5 | 4.825 | 6.885 | **<.001** |
| | Within | 53.254 | 76 | .701 | | |
| | Total | 77.378 | 81 | | | |
| content_quality | Between | 2.232 | 5 | .446 | .435 | .823 |
| | Within | 77.963 | 76 | 1.026 | | |
| | Total | 80.195 | 81 | | | |
| contribu-tion_signifi-cance | Between | 2.068 | 5 | .414 | .357 | .876 |
| | Within | 88.127 | 76 | 1.160 | | |
| | Total | 90.195 | 81 | | | |
| presentation | Between | 15.344 | 5 | 3.069 | 1.970 | **.093** |
| | Within | 118.376 | 76 | 1.558 | | |
| | Total | 133.720 | 81 | | | |
| overall_impres-sion | Between | 6.906 | 5 | 1.381 | 1.149 | .342 |
| | Within | 91.399 | 76 | 1.203 | | |
| | Total | 98.305 | 81 | | | |

### E.3.3 Clarity of the Narrative

The following section shows a similar picture. The average score over all items and all manuscripts is 5.49, as it is for the overall assessment of quality. However, the distances to the mean are larger for groups 2 and 3, which both scored more poorly (4.63 vs 5.03 and 5.17 vs 5.33, respectively). The groups 1, 4, and 5 score higher compared to their scores in the overall assessment of quality (6.0 vs 5.84; 5.84 vs 5.67; 5.72 vs 5.67). It is

worth mentioning that the mean clarity scores of groups 1, 4, and 5 are excellent, at close to six out of seven points. **If one wishes to have a very clear narrative, then groups 1, 4, and 5 provide suitable structures:**

7. Group 1 with a score of 6.00/7 and n= 8, based on 2 articles
8. Group 4 with a score of 5.84/7 and n=21, based on 5 articles
9. Group 5 with a score of 5.72/7 and n=21, based on 4 articles
10. Group 3 with a score of 5.17/7 and n=23, based on 5 articles
11. Group 6 with a score of 5.04/7 and n= 8, based on 2 articles
12. Group 2 with a score of 4.63/7 and n= 5, based on 1 article

However, as with all group-effect-analyses featured in this section of this appendix, the findings need to be critically reflected, as groups 1, 2, and 6 may be more strongly biased by specific articles than the groups 3-5 because of the relatively low number of representing articles per group. In particular, group 2 with only one representative might have received poor evaluation results as a function of the writing of that one article, rather than as a function of the structural group it represents. Hence, the differences between groups 3-5 may be more valid than the others.

*Table 87: Clarity of Narrative, Average Values per Item and Group*

| Number of papers : coders (n) | | 2:8 | 1:5 | 5:23 | 5:21 | 4:21 | 2:8 | |
|---|---|---|---|---|---|---|---|---|
| **Items** | **Group:** | **1** | **2** | **3** | **4** | **5** | **6** | **Avg.** |
| avg. clarity_plotline | Clar. of Narrative | 6.13 | 4.60 | 5.17 | 5.86 | 5.76 | 5.00 | 5.51 |
| avg. empathize_w_researcher | | 5.88 | 4.40 | 5.43 | 5.29 | 5.65 | 5.25 | 5.40 |
| avg. clarity_design_decisions | | 5.88 | 4.40 | 4.78 | 5.57 | 5.29 | 5.25 | 5.22 |
| avg. topic_relatability | | 6.25 | 5.40 | 5.35 | 6.10 | 5.88 | 5.13 | 5.72 |
| avg. examples_relatability | | 5.88 | 4.60 | 5.13 | 6.05 | 5.88 | 4.88 | 5.54 |
| avg. examples_helpfulness | | 6.00 | 4.40 | 5.13 | 6.14 | 5.88 | 4.75 | 5.55 |
| (mean clarity of narrative) | | 6.00 | 4.63 | 5.17 | 5.84 | 5.72 | 5.04 | 5.49 |

A single factor ANOVA on each of the items within the category of questions about the clarity of the narrative has revealed the following (Table 88): The perceived helpfulness of examples ($p<0.001$) is highly significant. The relatability of examples ($p=0.010$) is significant at the $\alpha=0.05$ level, and the clarity of the plotline and the topic's relatability are somewhat significant (0.082 and 0.087 respectively, see Table 88). This indicates that certain groups are associated with better (more relatable and helpful) examples, clearer plotlines and general relatability.

The fact that the use of examples (relatability and helpfulness) is significantly associated with the groups is surprising. Irrespective of the structural group identified in the qualitative analysis of structures, authors can choose examples for illustrating various aspects that may or may not be perceived as being helpful, or that may or may not be perceived as being relatable. Further investigation of the use of examples may be helpful to find out more about this relationship. When comparing the scores of each group across all sections of the survey (Table 79), then one possible explanation for such unexpected findings could be that respondents that perceived an article more favourably scored most values in the survey higher and vice versa. Another possible explanation is that the authors might have used examples for different purposes (e.g., introducing the research problem vs making sense of results in the discussion).

That the clarity of the plotline is associated with the structural groups indicates that some structures are easier to follow. Regarding the six individual groups, **the order form clearest to least clear plotline is the same as for the overall clarity of the narrative: Group 1, 4, 5, 3, 6, 2.**

*Table 88: Single Factor ANOVA per Item of the Clarity of Narrative Section*

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| cl_plotline | Between | 15.478 | 5 | 3.096 | 2.046 | .082 |
| | Within | 115.010 | 76 | 1.513 | | |
| | Total | 130.488 | 81 | | | |
| cl_research-ers_emp | Between | 8.324 | 5 | 1.665 | 1.355 | .251 |
| | Within | 93.395 | 76 | 1.229 | | |
| | Total | 101.720 | 81 | | | |
| cl_design_deci-sions | Between | 13.888 | 5 | 2.778 | 1.574 | .178 |
| | Within | 134.160 | 76 | 1.765 | | |
| | Total | 148.049 | 81 | | | |
| cl_topic_emp | Between | 12.182 | 5 | 2.436 | 2.005 | .087 |
| | Within | 92.367 | 76 | 1.215 | | |
| | Total | 104.549 | 81 | | | |
| cl_examples_re-latable | Between | 20.114 | 5 | 4.023 | 3.243 | .010 |
| | Within | 94.276 | 76 | 1.240 | | |
| | Total | 114.390 | 81 | | | |
| cl_exam-ples_helpful | Between | 26.660 | 5 | 5.332 | 4.963 | <.001 |
| | Within | 81.645 | 76 | 1.074 | | |
| | Total | 108.305 | 81 | | | |

### E.3.4 Clarity of the Research Problem Description

The next set of questions concerns the clarity of the research problem description (Table 89). The highest clarity of the research problem can be obtained according to the following ranking of groups:

7. Group 1 with a score of 5.59/7 and n= 8, based on 2 articles
8. Group 5 with a score of 5.52/7 and n=21, based on 4 articles
9. Group 2 with a score of 5.40/7 and n= 5, based on 1 article
10. Group 4 with a score of 5.39/7 and n=21, based on 5 articles
11. Group 6 with a score of 4.85/7 and n= 8, based on 2 articles
12. Group 3 with a score of 4.81/7 and n=23, based on 5 articles

Since neither Group 1 nor Group 2 feature an artefact, one can say that **the highest clarity of the research problem of a design-focused research paper can be achieved by the structure of Group 5**.

*Table 89: Averages of Clarity of Research Problem Items*

| Number of papers : coders (n) | | 2:8 | 1:5 | 5:23 | 5:21 | 4:21 | 2:8 | |
|---|---|---|---|---|---|---|---|---|
| **Items** | **Group:** | **1** | **2** | **3** | **4** | **5** | **6** | **Avg.** |
| avg. empathize_w_stakeholder | Clarity Research Problem | 6.00 | 5.00 | 5.04 | 5.24 | 5.82 | 4.88 | 5.33 |
| avg. problem_essence | | 5.75 | 5.20 | 5.30 | 5.76 | 5.76 | 5.13 | 5.54 |
| avg. problem_situation | | 5.88 | 5.40 | 5.13 | 5.67 | 5.65 | 5.50 | 5.50 |
| avg. problem_stakeholder | | 5.63 | 5.40 | 4.78 | 5.38 | 5.65 | 5.25 | 5.28 |
| avg. clarity_stakeholder_goals | | 5.88 | 5.20 | 4.74 | 5.19 | 5.53 | 5.25 | 5.21 |
| avg. problem_scope | | 5.25 | 5.00 | 4.26 | 5.10 | 4.88 | 4.13 | 4.73 |
| avg. problem_scale | | 4.88 | 6.00 | 3.96 | 4.76 | 4.88 | 3.88 | 4.56 |
| avg. problem_relevance | | 5.75 | 6.00 | 5.35 | 5.86 | 6.12 | 5.13 | 5.70 |
| avg. problem_persistence | | 5.25 | 5.40 | 4.74 | 5.57 | 5.35 | 4.50 | 5.15 |
| (mean clarity of research prob. descr.) | | 5.59 | 5.40 | 4.81 | 5.39 | 5.52 | 4.85 | 5.22 |

#### E.3.4.1 Analysis of Individual Characteristics of Groups and the Scores

Compared to the overall assessment of quality (E.3.2) and the clarity of the narrative (E.3.3), the section about the research problem description features some stronger deviations from the overall average group evaluation. Most notably, group 2 has obtained comparably high values on the problem scale (6.00 vs average of 4.56 across groups), relevance (6.00 vs 5.70), and persistence (5.40 vs 5.15), despite having scored poorly in both the overall assessment of quality and the clarity of the narrative (5.03 vs 5.49 and 4.63 vs 5.49). With that, group 2 obtains an above-average score on the clarity of the research problem (5.40 vs 5.22). Considering the different structural components of

group 2 (see Appendix B, Table 63), this can be explained by the fact that there is a section that specifically focuses on the description of the research problem. **Featuring a section about the research problem early on in an article may thus increase the clarity of the research problem**. However, this comparison of the group's characteristics with the scores reveals another peculiarity: Articles in group 6 also feature a section on the research problem. This is introduced only after the methodology. Nevertheless, group 6 articles have received the second-lowest scores (4.85), only very little above the weakest score (group 3, 4.81), and clearly below average (5.22). Hence, **if one intends to achieve a high level of clarity about the research problem, it may be beneficial to present the research problem before presenting the methodology**. This finding may need to be investigated further, as it depends on only three articles (one for group 2 and two for group 6).

Another difference in the average scores received in this section compared to the above-described sections is the drop in the scores for articles of group 3. Whereas the averages of group 3 for the overall assessment of quality and the clarity of the narrative are higher than the scores of groups 2 and 6, it receives the lowest scores for the clarity of the research problem. Using the overview of the structural groups in Table 63 in Appendix B again, one can see that a focus of group 3 is on providing background knowledge (extensive literature) before presenting the artefact in length, demonstrating it, and evaluating it. It is surprising that readers of group 3 (who read a lengthy elaboration on the artefact) responded that the research problem was not very clear to them. This indicates that focussing on the artefact presentation, demonstration, and evaluation does not ensure that readers get a firm understanding of the research problem. **If one desires to ensure that readers clearly understand the research problem, it may need to be specified explicitly**.

Lastly, the research problem seems to be very clear in articles that abide by the traditional, nominal structure of empirical research articles (i.e., group 1). It could be that the clarity of the research problem (and most other items) is evaluated with a higher score because the readers are more familiar with the structure of group 1 articles than with the structure in other articles. What cannot be deduced from the score is whether the respondents indeed answered about the clarity of the problem that underlies the design research project or whether they scored the clarity of the problem that underlies the empirical study presented in the article. After all, group 1 articles (among other characteristics) show "primarily aspects of the project that relate to traditional explanatory empirical research" (Appendix B, B.3.1).

### E.3.4.2 Results of Single Factor ANOVA

The single factor ANOVA based on the data for each item on the clarity of the research problem shows significance for the problem scale (p=0.045), the relevance of the problem (p=0.039) at the α=0.05 level. Just outside the 0.05 cut-off, but still somewhat significant, is the persistence of the problem ("I know why the problem pertains/does not go away", p=0.077). Hence, the group is significant for these three items. Interestingly, they do not favour the same groups. Thus, **the scale of the problem is clearest in group 2** (without competition); **the relevance of the problem is clearest in group 5**, closely followed by group 2 and group 4; **the persistence is clearest in group 4**, followed by group 2 and group 5.

*Table 90: Single Factor ANOVA per Clarity of the Research Problem Item*

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| cl_stakeh_emp | Between | 11.998 | 5 | 2.400 | 1.402 | .233 |
| | Within | 130.112 | 76 | 1.712 | | |
| | Total | 142.110 | 81 | | | |
| rp_problem_essence | Between | 5.477 | 5 | 1.095 | .712 | .616 |
| | Within | 116.913 | 76 | 1.538 | | |
| | Total | 122.390 | 81 | | | |
| rp_situation | Between | 5.267 | 5 | 1.053 | .807 | .548 |
| | Within | 99.233 | 76 | 1.306 | | |
| | Total | 104.500 | 81 | | | |
| rp_stakeholder | Between | 9.226 | 5 | 1.845 | 1.307 | .270 |
| | Within | 107.323 | 76 | 1.412 | | |
| | Total | 116.549 | 81 | | | |
| rp_stakeh_goals | Between | 10.392 | 5 | 2.078 | 1.475 | .208 |
| | Within | 107.083 | 76 | 1.409 | | |
| | Total | 117.476 | 81 | | | |
| rp_problem_scope | Between | 13.714 | 5 | 2.743 | 1.195 | .320 |
| | Within | 174.384 | 76 | 2.295 | | |
| | Total | 188.098 | 81 | | | |
| rp_problem_scale | Between | 25.914 | 5 | 5.183 | 2.398 | .045 |
| | Within | 164.281 | 76 | 2.162 | | |
| | Total | 190.195 | 81 | | | |
| rp_problem_relevance | Between | 9.450 | 5 | 1.890 | 2.479 | .039 |
| | Within | 57.929 | 76 | .762 | | |
| | Total | 67.378 | 81 | | | |
| rp_problem_persistence | Between | 12.084 | 5 | 2.417 | 2.083 | .077 |
| | Within | 88.160 | 76 | 1.160 | | |
| | Total | 100.244 | 81 | | | |

### E.3.5 Clarity of the Research Design

In this section, the survey contains the following five questions that strongly correlate (see also Appendix D) and that address the research design from a different point of view (the usefulness of the research design to the reader, as measured by the perceived usefulness of its outcomes). Each of the items is presented in the list below, with the average score obtained across all 86 answers.

- 3.99: The output is useful to me, informing my own research.
- 3.60: I will use the output to inform theory development in my own work.
- 3.54: I will use the output to inform theory testing in my own work.
- 3.16: I will use the output to theorize about its usage.
- 3.41: I will use the output to theorize about how it was built/developed.

This set of questions has obtained negative ratings (4.0 is the neutral value) and therewith lowered the scores about the research design. Since these questions focus on the usefulness of the study to design researchers, they measure an outcome-related aspect of the research design and not directly the understanding of the latter (i.e., asking whether the design's outcomes are useful, rather than whether the design is presented clearly). For these reasons, these five questions are omitted in the subsequently presented analysis (though for completeness' sake, they remain included in Table 91).

*Table 91: Averages Clarity of the Research Design Items*

| **Number of papers : coders (n)** | | **2:8** | **1:5** | **5:23** | **5:21** | **4:21** | **2:8** | |
|---|---|---|---|---|---|---|---|---|
| Items | Gr.: | 1 | 2 | 3 | 4 | 5 | 6 | Avg. |
| avg. replicability | Clarity of the research design | 5.63 | 4.80 | 4.48 | 5.48 | 5.00 | 4.13 | 4.94 |
| avg. research_objective | | 6.25 | 5.60 | 5.26 | 5.57 | 5.53 | 4.88 | 5.48 |
| avg. general_approach | | 6.25 | 4.40 | 5.00 | 5.95 | 5.41 | 5.13 | 5.43 |
| avg. research_design_decisions | | 5.63 | 4.00 | 4.96 | 5.62 | 5.00 | 4.88 | 5.13 |
| avg. what_is_the_artefact | | 5.38 | 6.00 | 6.00 | 6.24 | 5.41 | 5.88 | 5.87 |
| avg. usefulness_of_artefact | | 3.75 | 4.00 | 3.83 | 4.10 | 4.06 | 4.25 | 3.99 |
| avg. artefact_for_theory_development | | 3.25 | 3.00 | 3.57 | 3.76 | 3.35 | 4.50 | 3.60 |
| avg. artefact_theory_testing | | 2.63 | 2.60 | 3.61 | 3.76 | 3.47 | 4.38 | 3.54 |
| avg. artefact_theorize_usage | | 3.13 | 3.00 | 2.91 | 3.43 | 3.06 | 3.50 | 3.16 |
| avg. artefact_theorize_building_process | | 3.00 | 2.60 | 3.39 | 3.81 | 3.41 | 3.38 | 3.41 |
| avg. design_process | | 5.25 | 5.00 | 4.78 | 5.57 | 4.94 | 5.50 | 5.15 |
| avg. evaluation | | 4.50 | 6.00 | 5.17 | 5.81 | 5.24 | 5.38 | 5.35 |
| avg. contribution_clarity | | 5.88 | 5.80 | 5.43 | 5.43 | 5.47 | 5.75 | 5.54 |
| avg. limitations | | 5.75 | 5.60 | 4.96 | 5.71 | 5.29 | 4.38 | 5.28 |
| (mean clarity of the research design, all) | | 4.73 | 4.46 | 4.53 | 5.02 | 4.62 | 4.71 | 4.71 |
| (mean without the usefulness items) | | 5.61 | 5.24 | 5.12 | 5.71 | 5.25 | 5.10 | 5.35 |

With and without removing the usefulness items, the highest-rated group is the same: **Group 4 may be the most suitable if one intends to ensure that readers clearly understand the research design**. The ranking is as follows:

1. Group 4 with a score of 5.71/7 and n=21, based on 5 articles
2. Group 1 with a score of 5.61/7 and n= 8, based on 2 articles
3. Group 5 with a score of 5.25/7 and n=21, based on 4 articles
4. Group 2 with a score of 5.24/7 and n= 5, based on 1 article
5. Group 3 with a score of 5.12/7 and n=23, based on 5 articles
6. Group 6 with a score of 5.10/7 and n= 8, based on 2 articles

#### E.3.5.1 Analysis of Individual Characteristics of Groups and the Scores

Among the questionnaire's items that remain after removing the usefulness-related questions, it is surprising to see relatively high values for what_is_the_artefact ("It is clear to me what the output (artefact) of the study is.") across all groups (5.87), given that group 1 and group 2 do not show the artefact. This might be based on the question itself. The phrasing might have been understood such that "output (artefact)" refers to either an explanatory contribution or if present, an artefact. This would be an undesirable outcome for deciding which group might be best suited for clarifying what the artefact is. In any case, **group 1 and group 2 are unlikely to clarify what the artefact is** (as they do not feature the artefact itself). However, a direct comparison between what_is_the_artefact and contribution_clarity ("It is clear to me what the knowledge contribution is.") should be interesting. After all, the latter is clearly geared toward the article's contribution. It might be unsurprising that the group with the structure that is most common in published research (i.e., the nominal structure of empirical research articles, represented by group 1) obtained the highest value for the clarity of the contribution. Whereas the contribution_clarity item is clearly geared toward the contribution of the article, the what_is_the_artefact item might have been interpreted as intended by some (focus on artefact) and interpreted differently by others (as 'contribution' in more general terms), as revealed in the direct comparison of these two items (Table 92).

*Table 92: Averages Clarity of Output (artefact) and of Contribution*

| **Number of papers : coders (n)** | | **2:8** | **1:5** | **5:23** | **5:21** | **4:21** | **2:8** | |
|---|---|---|---|---|---|---|---|---|
| **Items** | Gr: | 1 | 2 | 3 | 4 | 5 | 6 | Avg. |
| avg. what_is_the_artefact | | 5.38 | 6.00 | 6.00 | 6.24 | 5.41 | 5.88 | 5.87 |
| avg. contribution_clarity | | 5.88 | 5.80 | 5.43 | 5.43 | 5.47 | 5.75 | 5.54 |

While an artefact can be a research contribution, the overall contribution of a research article to the research community might be more than the artefact. In that sense, the clarity of the artefact might be low (or high), while the clarity about the article's overall contribution is high (or low). The direct comparison (Table 92) shows that groups 2, 5, and 6 feature similar clarity of the artefact and the research contribution. Group 2 does not feature the artefact or its design process but focuses on the research problem, existing solutions, requirements, and implications for a (not shown) artefact (see: Appendix B). The similar (high) scores for the clarity of these items probably both refer to the contribution of the article since the artefact was not presented.

In groups 5 and 6, the artefact is shown. Considering the similar scores, it is likely that both response items focus on the artefact as the output of the study and the contribution of the article. Group 5 scored comparably poorly in both items. Group 5 is characterized by a presentation of the meta-artefact before presenting the procedures used to instantiate that artefact (see: Appendix B). One may acknowledge the fact that the scores obtained by group 5 on the clarity of the artefact and the contribution are high (5.41 and 5.47 respectively) in absolute terms (on a 7-point Likert scale) and compared to the average scores across the entire survey and all groups (5.07). They are also above-average compared to the clarity of the research design item for group 5 (5.25) and all groups (5.35). However, in relation to the scores obtained by the other groups on these two items, the clarity of the research output is poorer (5.41 vs 5.87 and 5.47 vs 5.54, respectively). This is a useful insight when comparing the relatively similar groups 5 and 6. As opposed to presenting the design procedures for creating instantiations of the meta-artefact, group 6 follows the presentation of the artefact with the design process that has led to the presented artefact (see: Appendix B). While group 6 scores poorly across all sections of the survey (Table 79), its clarity of the research output is average (group 6: 5.88 vs average of 5.87), the clarity of the contribution is above-average (group 6: 5.75 vs average of 5.54), and the usefulness items (*cursive* in Table 91, with the exception of "I will use the artefact to theorize about the building process") received the highest scores. With that, the following can be said about groups 5 and 6: **For reaching high**

**clarity about the artefact and the contribution of the article, it is better to show the design process that led to that artefact, rather than to show the design processes related to instantiating the artefact**. Furthermore, an article that presents both the artefact and the design process that led to the artefact (i.e., **group 6) is perceived as being more useful to design researchers' own practices than any other structural group**.

To finalize the comparison of the clarity about the artefact versus the contribution, groups 3 and 4 need to be addressed. In both cases, the clarity about the artefact was evaluated high (the highest across the six groups). At the same time, these same evaluators provided the lowest scores to the clarity of the contribution. Hence, while they indicated that they very clearly understood what the artefact is, they were not as sure about what the knowledge contribution is. This is astonishing. A possible explanation for this inconsistency might be that the readers did not perceive the artefact as being the (main) contribution but that the alternative contribution (e.g., the results from the descriptive study) was unclear. This might indicate that the contents of groups 3 and 4 distract from the artefact as a contribution. This might be due to the heavy reliance on literature in group 3 and the focus on demonstration, evaluation, and data analysis in groups 3 and 4, rather than focusing on the artefact and the design process that led to the artefact (group 6). Hence, **it is not conducive to a clear understanding of the contribution to focus on literature, demonstration, and evaluation rather than on the design process**.

Group 4 has received only four below-average scores across all sections of the questionnaire. Two of these are about the contribution (clarity of contribution, as discussed above, and its originality). The other two weak spots of group 4 are the perceived empathy toward the researchers and toward the stakeholders ("I understand and can empathize with the researchers that had to take the design decisions in this study" and "I can understand and empathize with the stakeholder that has the problem."). With that, one may conclude that **group 4 is not the best choice for conveying the contribution of the study**; and that **group 4 articles allow readers less to empathize with researchers and stakeholders than do articles of group 1 (empirical study-style) and group 5 (design study-style)**.

#### E.3.5.2 Results of Single Factor ANOVA

The single factor ANOVA across all clarity of the research design items revealed that the usefulness items are not significant, and for reasons outlined above, they are removed from the discussion below. The analysis of the variance on the data for the clarity

of the research design revealed that the general research approach (p=0.008), and to a lesser degree, the limitations (p=0.078) and the replicability (p=0.87) are significant, see Table 93. These items are essential for explaining a research design. Thereby, the groups' average scores for each of these three items show that the highest scores can be obtained with group 1 (behavioural science style), followed by group 4 (design science style) and that all other groups are much weaker in comparison. Hence, the significant items reveal that **group 1 is the best structure to convey a clear research design for behavioural science style presentations, whereas group 4 is the best structure to convey a clear research design for design science style presentations**.

*Table 93: Single Factor ANOVA per Item of the Clarity of the Research Design Section*

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| rd_replicability | Between | 20.168 | 5 | 4.034 | 2.010 | .087 |
| | Within | 152.527 | 76 | 2.007 | | |
| | Total | 172.695 | 81 | | | |
| rd_objective | Between | 9.063 | 5 | 1.813 | 1.332 | .260 |
| | Within | 103.388 | 76 | 1.360 | | |
| | Total | 112.451 | 81 | | | |
| rd_general_approach | Between | 21.416 | 5 | 4.283 | 3.368 | .008 |
| | Within | 96.645 | 76 | 1.272 | | |
| | Total | 118.061 | 81 | | | |
| rd_rd_decisions | Between | 14.865 | 5 | 2.973 | 1.729 | .138 |
| | Within | 130.659 | 76 | 1.719 | | |
| | Total | 145.524 | 81 | | | |
| rd_whats_artefact | Between | 8.847 | 5 | 1.769 | 1.193 | .320 |
| | Within | 112.677 | 76 | 1.483 | | |
| | Total | 121.524 | 81 | | | |
| rd_design_process | Between | 8.747 | 5 | 1.749 | 1.214 | .311 |
| | Within | 109.497 | 76 | 1.441 | | |
| | Total | 118.244 | 81 | | | |
| rd_evaluation | Between | 13.268 | 5 | 2.654 | 1.660 | .155 |
| | Within | 121.476 | 76 | 1.598 | | |
| | Total | 134.744 | 81 | | | |
| rd_contribution_clarity | Between | 2.185 | 5 | .437 | .345 | .884 |
| | Within | 96.205 | 76 | 1.266 | | |
| | Total | 98.390 | 81 | | | |
| rd_limitations | Between | 15.202 | 5 | 3.040 | 2.075 | .078 |
| | Within | 111.347 | 76 | 1.465 | | |
| | Total | 126.549 | 81 | | | |

### E.3.6 Science Communication Impact Measures

The individual scores obtained for each group within this section provides a similarly consistent image, as do the scores for the sections on the overall assessment of quality and the clarity of the narrative. Group 1 scores highest on nearly all items, whereas groups 3 and 6 share most of the weakest scores. Group 4 somewhat outscores group 5 across most items. Group 2 received mixed scores. However, because there is only one article in this group, this result is not further discussed. Hence, average responses to the aggregated, positively formulated communication impact measures indicate that **the best science communication outcomes** (Section 2.2) **can be achieved by following the best structural group (i.e., group 1); and the best design-focused research article group is group 4**. The ranking for the average science communication score is as follows:

1. Group 1 with a score of 5.62/7 and n= 8, based on 2 articles
2. Group 4 with a score of 5.30/7 and n=21, based on 5 articles
3. Group 2 with a score of 5.02/7 and n= 5, based on 1 article
4. Group 5 with a score of 5.01/7 and n=21, based on 4 articles
5. Group 3 with a score of 4.59/7 and n=23, based on 5 articles
6. Group 6 with a score of 4.54/7 and n= 8, based on 2 articles

One finding among the individual scores that might be underlined here is that group 1 dominates this section so strongly that the comparably good scores for group 4 might be undervalued (Table 94). Indeed, group 1 follows the nominal structure of empirical research articles and historically, this structure has probably developed toward obtaining positive science communication outcomes. The other structures score remarkably lower. Focusing on the groups that **feature the designed artefact, group 4 outperforms the other structures in obtaining high communication outcome scores**. If for whatever reason, group 4 is not suitable, group 5 should be chosen to reach good science communication outcome evaluations, as its score is much better than the scores of groups 3 and 6 (and group 2 does not feature the designed artefact).

The single factor ANOVA is significant for the enjoyment of reading the article (p=0.037), the feeling of being entertained by the article (p=0.037), and somewhat significant for the perceived ability to present the research problem to others after having read the article (p=0.072), the perceived ability to make a decision that is related to the investigated phenomenon based on the article (p=0.073), the understanding why which procedures were used (p=0.077), and whether the readers feel that they can explain the

outcome to others (what it is, how it works, and why it is useful, p=0.084), as outlined in Table 95.

*Table 94: Average Science Communication Outcomes per Group and Item*

| **Number of papers : coders (n)** | | **2:8** | **1:5** | **5:23** | **5:21** | **4:21** | **2:8** | |
|---|---|---|---|---|---|---|---|---|
| Items | Gr.: | 1 | 2 | 3 | 4 | 5 | 6 | Avg. |
| avg. familiarity_with_issue | Science Communication Impact | 5.88 | 5.40 | 4.96 | 5.62 | 5.47 | 4.63 | 5.32 |
| avg. can_present_problem_to_others | | 6.25 | 6.00 | 4.91 | 5.48 | 5.12 | 4.63 | 5.27 |
| avg. enjoyed_reading | | 5.88 | 5.00 | 4.39 | 5.62 | 5.65 | 4.63 | 5.17 |
| avg. entertained_by_text | | 5.63 | 4.40 | 3.96 | 5.24 | 5.06 | 3.75 | 4.68 |
| avg. want_to_learn_more | | 4.50 | 5.00 | 4.35 | 4.95 | 4.53 | 4.38 | 4.60 |
| avg. want_to_get_involved | | 4.25 | 4.20 | 3.52 | 3.90 | 3.59 | 2.88 | 3.68 |
| avg. can_take_related_decision | | 5.75 | 5.00 | 4.04 | 4.67 | 4.65 | 3.88 | 4.54 |
| avg. understand_procedures | | 5.75 | 4.80 | 4.96 | 5.52 | 5.24 | 5.25 | 5.26 |
| avg. clear_why_which_procedures | | 5.63 | 4.20 | 4.74 | 5.48 | 5.00 | 5.00 | 5.06 |
| avg. can_explain_outcome_to_others | | 5.63 | 5.80 | 4.74 | 5.67 | 5.00 | 4.63 | 5.17 |
| avg. implications_practice | | 6.13 | 5.20 | 5.30 | 5.81 | 5.41 | 5.38 | 5.54 |
| avg. implications_research | | 6.13 | 5.20 | 5.17 | 5.62 | 5.35 | 5.38 | 5.44 |
| (mean score per group) | | 5.62 | 5.02 | 4.59 | 5.30 | 5.01 | 4.54 | 4.98 |

*Table 95: ANOVA Across Science Communication Impact Measures Items*

| | | **Sum of Squares** | **df** | **Mean Square** | **F** | **Sig.** |
|---|---|---|---|---|---|---|
| scim_issue_familiarity | Between | 11.662 | 5 | 2.332 | 1.247 | .296 |
| | Within | 142.094 | 76 | 1.870 | | |
| | Total | 153.756 | 81 | | | |
| scim_research_problem | Between | 17.894 | 5 | 3.579 | 2.121 | .072 |
| | Within | 128.204 | 76 | 1.687 | | |
| | Total | 146.098 | 81 | | | |
| scim_enjoyment | Between | 28.547 | 5 | 5.709 | 2.507 | .037 |
| | Within | 173.063 | 76 | 2.277 | | |
| | Total | 201.610 | 81 | | | |
| scim_entertainment | Between | 35.474 | 5 | 7.095 | 2.516 | .037 |
| | Within | 214.282 | 76 | 2.820 | | |
| | Total | 249.756 | 81 | | | |
| scim_learn_more | Between | 5.439 | 5 | 1.088 | .459 | .806 |
| | Within | 180.280 | 76 | 2.372 | | |
| | Total | 185.720 | 81 | | | |
| scim_get_involved | Between | 10.915 | 5 | 2.183 | .818 | .541 |
| | Within | 202.841 | 76 | 2.669 | | |
| | Total | 213.756 | 81 | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| scim_related_decision | Between | 22.510 | 5 | 4.502 | 2.114 | .073 |
| | Within | 161.881 | 76 | 2.130 | | |
| | Total | 184.390 | 81 | | | |
| scim_understand_procedures | Between | 6.569 | 5 | 1.314 | 1.073 | .382 |
| | Within | 93.053 | 76 | 1.224 | | |
| | Total | 99.622 | 81 | | | |
| scim_procedure_clear_why | Between Groups | 12.347 | 5 | 2.469 | 2.077 | .077 |
| | Within Groups | 90.348 | 76 | 1.189 | | |
| | Total | 102.695 | 81 | | | |
| scim_explain_outcome_to_others | Between Groups | 15.958 | 5 | 3.192 | 2.027 | .084 |
| | Within Groups | 119.651 | 76 | 1.574 | | |
| | Total | 135.610 | 81 | | | |
| scim_implications_practice | Between Groups | 6.615 | 5 | 1.323 | 1.146 | .344 |
| | Within Groups | 87.775 | 76 | 1.155 | | |
| | Total | 94.390 | 81 | | | |
| scim_implications_science | Between Groups | 6.506 | 5 | 1.301 | 1.103 | .366 |
| | Within Groups | 89.689 | 76 | 1.180 | | |
| | Total | 96.195 | 81 | | | |

### E.3.7 Conclusion

The findings of how the effects of the basket journal articles relate to the structures identified in the qualitative structure analysis of these articles is herewith completed. Overall, one can say that the structure of an article (including the content selection and order in which selected contents are presented) strongly affects a variety of effects on readers. At this point, it should be reflected upon this fact. It is not self-evident that the structure of an article affects outcomes with readers. One could, for example, assume that articles from the most prestigious outlets score similarly high on all or at least most of the above-discussed effects. Relevance and rigour must be clarified; the outcomes must be clear (what is the contribution?); limitations should be specified, and so on. Indeed, if the qualitative structure analysis were omitted, a much less fine-grained analysis of findings would have emerged (i.e., the findings from Appendix D). However, the fact that an independent qualitative analysis of the structures within the articles of the

sample revealed six structural groups (i.e., findings from Appendix B) and that these structural groups reveal such strongly significant effects with the survey data (obtained from other people, with questions that were developed independently of the qualitative structure analysis) is an outstanding discovery. Therewith, specific prescriptive statements that are already based on empirical data can be formulated. Of course, the single factor ANOVA is not significant for all survey items. However, each section, and within each section a few items, are significant, which provides some confidence in the derived prescriptive statements.

## E.4 Characteristic-Effect-Analysis

While the group-effect-analysis sought to find patterns in the effects based on six qualitatively derived structural groups (Appendix A), the characteristic-effect-analysis is intended to identify effects of individual characteristics of articles (rather than summarized structural groups). As in the analysis of the effects based on the six groups, the findings of the quantitative structural analysis are used to match characteristics with effects such that prescriptive statements (characteristics as means that lead to specific effects as ends) can be formulated. Since the characteristic-effect-analysis is based on the quantitative analysis of structures (Appendix C), the analysis is analogously split into two parts, with a first section on the usage of ten content elements and the second section focusing on a large number of individual characteristics.

### E.4.1 Matching the Ten Content Elements with the Effects Dataset

The ten content elements refer to ten items that summarize distinct content elements within a research article, as explained further in Appendix C. These ten content elements (CE) are outlined in Table 96. In this section of the structure-effects-analysis, these content elements are used as the structure-related independent variables, whereas the effects remain the responses obtained from the quantitative survey (Appendix D).

This analysis is split into four sections. First, the **overall coverage of the ten CEs** is analysed by using a coverage value ("x out of 10 items are covered in article A") in a single factor ANOVA on the effects. Second, the **number of CEs appearing in an article** is used as the independent variable ("article A features y CEs, including the repeated ones"), and a regression on the effects is used to find out whether more CE-breaks affects readers (e.g., whether using many CE deteriorates the clarity of the narrative). Third, the **relative volume used to cover each of the CEs** is used as independent variables to identify whether using more space affects specific effects (or not).

*Table 96: The ten content elements and the coding instructions*

| Nr. | Content element categories | Coding instructions |
|---|---|---|
| **1** | Problem description: What, why, who, where? | Does the content describe the research problem or aspects thereof? Does it describe the situation, the stakeholders, the stakeholder interaction, the (denied) goals of these stakeholders, the reasons why these goals are not reached, the difference between 'is' and 'to-be'? |
| **2** | Objectives: Goal of the study, RQ | Does the content describe what should be achieved with this design research project? This can be the rationale behind and formulating of a research question, but it can also be a purpose statement |
| **3** | Requirements: Stakeholder's concerns and needs | Does the content describe desired outcomes regarding the solution? Does it, even if implicitly, describe criteria based on which the goodness of an artefact can be assessed? |
| **4** | Knowledgebase: How is the study informed? What exists? | Does the content refer to literature that justifies assumptions for the study? Does it review existing knowledge? |
| **5** | Methodology: Which (generic) approach is used? (e.g. DSR, Peffers et al.) | Does the content indicate a reference approach or a summary of an approach based on existing literature? Does it discuss a general approach to the research project? |
| **6** | Procedures: Description of actions, e.g., data gathering techniques | Does the content discuss specific actions or specific techniques used in the operationalization of the methodology? |
| **7** | Iterations and Intermediate learnings | Does the content explicitly discuss intermediary results and whether or why there was an iteration thereafter? |
| **8** | Results: Artefact description, demonstration, evaluation, contributions | Does the content describe final results from the design project, including artefacts, but also the explanations as to how and why they work (demonstration, evaluation, contributions)? |
| **9** | Explication of DK: Formulation of DP, DF, and application of DK | Does the content explicate the design knowledge that emerged or was produced throughout the study? (i.e., explicitly put into words and made recognizable as such) |
| **10** | Discussion: Limitations, avenues of further research | Does the content feature a critical reflection of the methodology or the study in general, or does it outline a research agenda? |

As a hypothetical example, this analysis might show that extensive elaborations on a study's objectives do not help readers understand the objectives better and thus, the elaboration of the objectives can be cut short. Fourth, the possible effects of the **number of splits of a specific CE** are analysed. This could reveal whether it is more or less beneficial to split a content element for various effect items.

#### E.4.1.1 Analysis of the Overall Coverage of the Ten CEs on the Effects

Before conducting the single factor analysis, the number of different content elements covered by each article was computed. Only two articles have less than seven content elements (5 and 6 CEs, summarized in the subsequent analysis). The single factor ANOVA of the coverage on the effects reveals that neither the average effects across the questionnaire nor across its section are significantly different if there are less than seven, 7, 8, or 9 CEs (no articles are cover all 10 CEs). The only statistically significant effects between these four groups (<7, 7, 8, and 9) are the readers' perceived ability to empathize with the researchers ("I understand and can empathize with the researchers that had to take the design decisions in this study.") and the objective ("I have a good understanding of the objective and/or the research question of this study."). However, these effects do not allow for making clear prescriptive statements. For both effects, the scores are low for the <7 CE and the 8 CE groups, and they are high for the 7 CE and the 9 CE groups:

- Group <7 CE, researcher empathy mean: 4.67 objective mean: 5.00
- Group 7 CE, researcher empathy mean: 5.79 objective mean: 5.71
- Group 8 CE, researcher empathy mean: 4.96 objective mean: 4.92
- Group 9 CE, researcher empathy mean: 5.50 objective mean: 5.94

The author does not draw further conclusions based on these findings. If there were significant and strict effects (e.g., higher coverage leads to higher effect values), then prescriptive statements could have been made. However, this is not the case here, as is established by using linear regression analyses between the number of CEs covered per article and the average scores across the survey sections. None of these are significant. Hence, **the coverage of content elements neither significantly positively nor significantly negatively affects readers perceptions of an article**. This finding is based on articles that cover at least 5 CEs, and this statement cannot be used to infer that only covering one CE would therefore also have no significant effect on outcomes.

#### E.4.1.2 Analysis of the Number of CEs Appearing in an Article on the Effects

Unlike coverage CEs, CEs that appear more than once are counted in the number of CEs appearing in an article. Hence, a high value for the number of CEs appearing in an article indicates that one or several CEs are split and spread across the article. This might have an adverse effect on readability, clarity of the plotline, or overall clarity of the narrative, but it might as well not have such an effect. To investigate this, linear regression analysis is used. However, none of the average values (across the questionnaire and across each section) are significant. Thus, **it is not significantly better or worse to have more or less CE, irrespective of whether these are split** (Section E.4.1.2) **or if they cover more or less of the ten CEs** (E.4.1.1).

#### E.4.1.3 Analysis of the Relative Volume Used per CE on the Effects

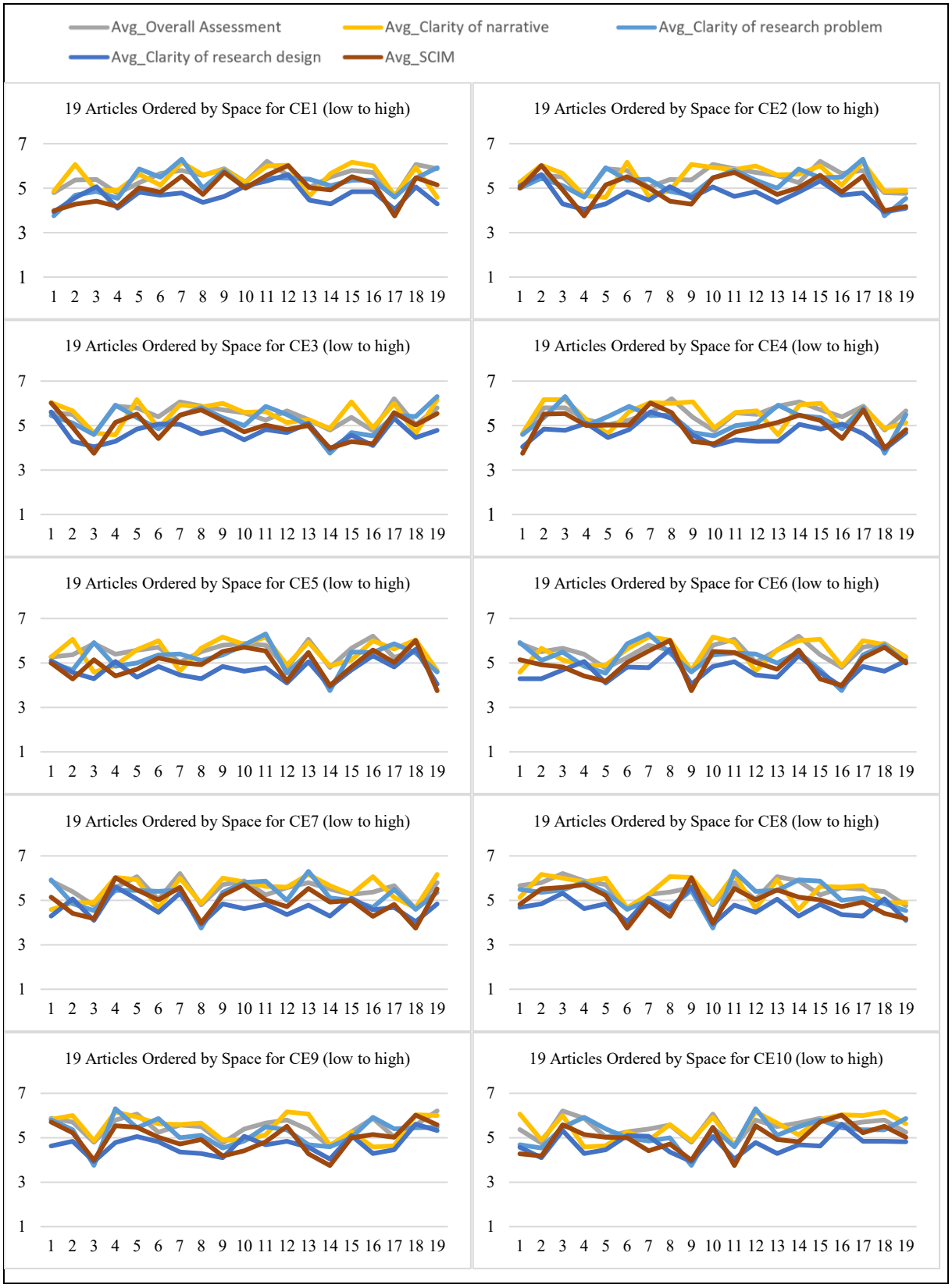
The relative volume used up for any particular CE is not significantly affecting the average effects across the sections of the survey. For each of the ten CEs, the graphs below indicate how an increase of relative volume used per CE (i.e., the percentage of characters used on a specific CE) affects the average scores obtained in the four sections of the survey. The y axis shows the average score obtained per article, whereas these articles are sorted according to the relative amount of space used on the respective CE (x axis). Hence, the further to the right, the more relative space has been dedicated to the CE. The graphs show no consistent improvement or deterioration across any of the sections when more space is used for any of the CEs. This indicates that **it does not matter how much space is used per content element** (beyond, of course, the findings in Appendix C).

#### E.4.1.4 Analysis of the Number of Splits of Specific CEs on the Effects

The first three parts of the analysis of the effects based on the ten content elements have provided limited results in the sense that it did not become apparent how to improve the perceptions of readers. In this last part of this analysis, the number of times a particular CE appears within an article (separated by at least one different CE) is used to group the effects data before comparing these groups using a single factor ANOVA. From this analysis, it could emerge that some CEs should not be split or that some may benefit from being split.

**CE 1, Problem description:** After removing the groups with none or only one article, the remaining 17 articles are split into two groups (0: n=1; 1: n=11; 2: n=6; 3: n=1). There are no significant differences between these groups.

*Figure 46: Score per Section of the Survey, ordered by Relative Volume used per CE*



**CE 2, Objectives:** After removing the groups with none or only one article, the remaining 18 articles are split into three groups (0: n=5; 1: n=8; 2: n=5; 3: n=0; 4: n=1). There are no significant differences between these groups on the section averages. However, the clarity of the research objective item is significant (p=0.02). The scores given to the articles of each group (list below) suggest that **one should present the objectives of the research project in one continuous section**.

- clarity of objectives
    - 0 sections on the objectives: 5.077
    - 1 section on the objectives: 5.921
    - 2 sections on the objectives: 5.140

**CE 3, Requirements:** After removing the groups with none or only one article, the remaining 18 articles are split into two groups (0: n=12; 1: n=6; 2: n=0; 3: n=1; 4: n=0). There are no significant differences between these groups on the section averages. However, the implications for science and the perceived ability to explain the study's outcomes to others are significant items in the single factor ANOVA. Interestingly, both items, **the clarity about the implications for science and the perceived ability to explain the outcomes to others score more poorly if the requirements are specifically discussed**.

- Implications for science (p=0.039)
    - 0 sections on requirements: 5.732, n=12
    - 1 section on requirements: 5.075, n=6
- Ability to explain outcomes to others (p=0.046)
    - 0 sections on requirements: 5.401, n=12
    - 1 section on requirements: 4.625, n=6

**CE 4, Knowledgebase:** After removing the groups with none or only one article, the remaining 17 articles are split into two groups (0: n=1; 1: n=8; 2: n=9; 3: n=1; 4: n=0). There are no significant differences between these groups.

**CE 5, Research approach:** After removing the groups with none or only one article, the remaining 18 articles are split into three groups (0: n=4; 1: n=9; 2: n=5; 3: n=0; 4: n=1). There are no significant differences between these groups on the section averages. On an item level, the understanding of the general approach, the perceived replicability, the understanding about what research design decisions were taken, and why which procedures were chosen are significant. The list below indicates that research design decisions, the research approach, the procedures, and the replicability all become clearer if

the research approach is split into two sections (separated by a different CE) rather than one continuous section. Notice that this CE is about the general research approach (e.g., "Peffers et al. (2007) is used as a reference approach"), rather than explicating the procedures (which is CE 6). Hence, **introducing the reference approach (if there is one) and re-discussing it at a later stage in the manuscript improves the understanding of the research process** (incl. the research design decisions, the general approach, the procedures used, and the replicability).

- Research design decisions (p=0.013)
    - 0 sections on research approach: 5.067, n=4
    - 1 section on research approach: 4.639, n=9
    - 2 sections on research approach: 5.710, n=5
- General approach (p=0.015)
    - 0 sections on research approach: 5.221, n=4
    - 1 section on research approach: 5.006, n=9
    - 2 sections on research approach: 6.190, n=5
- Procedures (p=0.026)
    - 0 sections on research approach: 4.654, n=4
    - 1 section on research approach: 4.802, n=9
    - 2 sections on research approach: 5.580, n=5
- Replicability (p=0.038)
    - 0 sections on research approach: 4.692, n=4
    - 1 section on research approach: 4.446, n=9
    - 2 sections on research approach: 5.680, n=5

**CE 6, Procedures used:** After removing the groups with two or less articles, the remaining 14 articles are split into three groups (0: n=2; 1: n=7; 2: n=7; 3: n=2; 4: n=1). There are no significant differences between these groups. However, the closest result of the single factor ANOVA is on the clarity of the research problem, which is higher if there is only one section that addresses the procedures (p=0.089, difference of two versus one continuous section = -0.38). Among the individual items, the list below shows the significant variables. These indicate that **splitting the explications about the procedures used in the manuscript into two rather than one section lowers the readers interest in the topic (to learn more or get involved), the perceived familiarity with the issue, and the perceived relevance of the research problem**. Furthermore, **articles with only one continuous section about the procedures reach higher clarity about what the artefact is**.

- Triggered interest to get involved (p=0.007)
  - 1 section on procedures: 4.221, n=7
  - 2 sections on procedures: 3.224, n=7
- Triggered interest to learn more (p<0.001)
  - 1 section on procedures: 5.150, n=7
  - 2 sections on procedures: 3.829, n=7
- Perceived familiarity with the issue (p=0.041)
  - 1 section on procedures: 5.786, n=7
  - 2 sections on procedures: 4.717, n=7
- Clarity about what the artefact is (p=0.034)
  - 1 section on procedures: 6.129, n=7
  - 2 sections on procedures: 5.517, n=7
- Perceived relevance of the research problem (p=0.05)
  - 1 section on procedures: 5.857, n=7
  - 2 sections on procedures: 5.319, n=7

**CE 7, Iterations:** After removing the groups with two or less articles, the remaining 16 articles are split into two groups (0: n=11; 1: n=5; 2: n=2; 3: n=0; 4: n=1). There are no significant differences between these groups.

**CE 8, Results and evaluation:** After removing the groups with none or only one article, the remaining 18 articles are split into three groups (0: n=1; 1: n=4; 2: n=8; 3: n=6; 4: n=0). There are no significant differences between these groups apart from a significant effect on the understanding of the general approach used in the study. As can be seen in the list below, **the understanding of the reference approach used in the study is lower in articles where the results and evaluation content element appears more than once**.

- General approach (p=0.035)
  - 1 section on results & evaluation: 5.975, n=4
  - 2 sections on results & evaluation: 5.594, n=8
  - 3 sections on results & evaluation: 4.789, n=6

**CE 9, Explication of design knowledge:** This CE never appeared more than once (0: n=10; 1: n=9). There are no significant differences between these groups apart from the perceived usefulness of the artefact in informing the readers' own research and their theory development. These items refer to **the perceived usefulness of the research**

**output (artefact), which is higher when the design knowledge (DK) is explicated rather than when it is not**.

- Usefulness to own research (p=0.14)
    - 0 sections explicating DK 3.565, n=10
    - 1 section explicating DK 4.423, n=9
- Usefulness for own theory development (p=0.17)
    - 0 sections explicating DK 3.115, n=10
    - 1 section explicating DK 4.104, n=9

**CE 10, Discussion and Limitations:** All articles feature one and only one section that contains the discussion and limitations. Hence, no comparisons can be made.

This concludes the analysis of the ten content elements and the patterns that can be identified in the effects dataset.

### E.4.2 Matching Individual Characteristics with the Effects Dataset

For the analysis of individual characteristics, a focus lies on the characteristics that are ambiguous (i.e., characteristics that are present in a similar number of cases as they are absent). While an analysis of the upper and lower extreme points is interesting for formulating statements about which characteristics are important (or even necessary) and which characteristics are often omitted (and thus less important, see analysis in Appendix C, C.3.2), these are unlikely to reveal reliable structure-effect-pairings, because there are only a few outliers. For this reason, the following analysis focuses on the "middle-range" as specified in Appendix C, C.4.2, and listed again here:

- 11/19: indicating what the stakeholders want to achieve (stakeholder_goals)
- 11/19: contextual factors that influence the problem/situation (context)
- 11/19: description of activities that led to the design itself (design_activities)
- 11/19: providing some support to navigate the manuscript (provision_of_navigation_support)
- 11/19: using an example to introduce the problem or stakeholders (introducing_example)
- 10/19: justification of the data gathering technique (data_gathering_justification)
- 9/19: specification of the techniques used for data analysis (data_analysis_technique)
- 9/19: mapping the insights from collected data to designs (data_mapping_to_design)

- 9/19: usage of the word ‘artefact’ to refer to the design (terminology_artefact)
- 9/19: specifying the type of artefact that was created (terminology_artefact_type)
- 8/19: formulated research question (research_question)

The potential influence of these characteristics’ presence (i.e., coded as 1) as compared to their absence (i.e., coded as 0) can be discussed by investigating individual effect variables (i.e., does characteristic X affect effect A?), or in aggregated form (e.g., the average scores obtained across all sections of the survey, or across each section of the survey). The average effects of these variables are presented first as averages (overall and per section of the survey) before outlining the largest individual effects. Since there are many characteristics (twelve out of over forty are listed here as the middle-ground characteristics) and many effects (47 effect variables), investigating averages of only the middle ground characteristics allows for identifying interesting candidates for a more in-depth analysis.

The effects dataset is iteratively split into two groups per characteristic, one with it and one in which it is absent. The overall averages and the averages per section of the survey are then calculated. If there is a difference in the average scores between these characteristic-derived groups, then the characteristic might be interesting to investigate further. Table 97 shows the difference in average scores of characteristic-based groups.

Among the characteristics, the (1) **stakeholder_goals, introducing_example, and research_question** characteristics appear to be of particular interest, as the average article that features these characteristics score 0.59, 0.35 and 0.3 points higher averages (excluding usefulness items) than the ones that do not feature these characteristic. Similarly, but to a lesser degree, there seems to be (2) an **adverse effect of using the artefact typology** for addressing the artefact (i.e., terminology_artefact_type, -0.19). Other notable observations are (3) the adverse effects observed with the **provision_of_navigation_support and the terminology_artefact_type characteristics on the clarity of the research problem** (-0.5 and -0.4 respectively); as well as (4) the effects on **usefulness items** across the board, but in particular of featuring an introducing_example (-0.48) and using the term ‘artefact’ in the text (+0.63). In the following, these four observations are analysed further.

*Table 97: Difference Between Average with the Characteristic and Average without the Characteristic, Overall and per Section of the Survey*

| | Overall Average Across all Sections | Overall Assessment of Quality | Clarity of Narrative | Clarity of Research Problem | Clarity of Research Design (w\ Usefulness) | (Usefulness Measures) | Science Communication Impact | (Average without Usefulness Measures) |
|---|---|---|---|---|---|---|---|---|
| stakeholder_goals | 0.50 | 0.55 | 0.55 | 0.67 | 0.42 | -0.24 | 0.71 | 0.59 |
| context | 0.09 | 0.17 | 0.07 | 0.32 | -0.12 | -0.19 | 0.18 | 0.13 |
| design_activities | -0.03 | -0.04 | 0.15 | -0.24 | 0.03 | 0.18 | -0.09 | -0.05 |
| provision_of_navigation_support | -0.12 | -0.06 | 0.26 | -0.50 | 0.02 | -0.04 | -0.21 | -0.13 |
| introducing_example | 0.25 | 0.28 | 0.10 | 0.49 | 0.18 | -0.48 | 0.52 | 0.35 |
| data_gathering_justification | 0.20 | 0.13 | 0.52 | 0.22 | 0.18 | -0.03 | 0.16 | 0.23 |
| data_analysis_technique | -0.13 | -0.18 | 0.03 | -0.15 | -0.07 | -0.29 | -0.14 | -0.11 |
| data_mapping_to_design | -0.01 | 0.07 | -0.13 | 0.15 | -0.08 | -0.07 | -0.03 | 0.00 |
| terminology_artefact | 0.23 | 0.20 | 0.17 | 0.11 | 0.30 | 0.63 | 0.14 | 0.18 |
| terminology_artefact_type | -0.16 | -0.03 | -0.06 | -0.40 | -0.09 | 0.15 | -0.24 | -0.19 |
| research_question | 0.26 | 0.17 | 0.45 | 0.16 | 0.30 | -0.15 | 0.41 | 0.30 |

### E.4.2.1 Overall Beneficial Characteristics

Three items seem to be especially beneficial for the quality of the manuscript across the sections of the survey. These are analysed further by employing a single variable ANOVA for each characteristic across the various sections and the various items within the sections.

#### E.4.2.1.1 The Effects of Featuring Stakeholder Goals

The mean response value across each section of the survey (apart from the usefulness measures) is strongly and positively affected by the presence of a description of

stakeholder goals. This is a minor adaptation to a manuscript, and it is a non-required feature (as about half the articles omit it, see Appendix C). A single factor ANOVA was run to test whether this effect is statistically significant, with stakeholder_goals being the factor and the average score across survey responses (Avg_Response overall and Avg_Response without usefulness) across the individual sections of the survey responses as dependent variables. The overview of the results from that ANOVA is featured in Table 98. It notably shows that **featuring the stakeholders' goals significantly positively affects the readers' perceptions of the article** (responses overall: p=0.01), the overall assessment of the article's quality (p=0.002), the clarity of the narrative (p=0.014), the clarity of the research problem (p=0.003), and the science communication impact measures (p=0.004). The significance of the clarity of the research design is just outside of the α=0.05 level, at p=0.063. All sections are highly significant or somewhat significant if the usefulness items are excluded. Exclusion of the usefulness items from the overall average also leads to a new significance value for the overall impact of featuring the stakeholder goals: p=0.002 (instead of p=0.01).

In combination with the average difference of featuring the stakeholder goals versus not featuring them (see Table 97), these findings very clearly suggest the following:

- Featuring the goals of a stakeholder does not help improve the perceived usefulness of the article to its readers.
- Design researchers should always specify the stakeholders' goals.

*Table 98: ANOVA of Stakeholder Goals on Aggregated Sections of the Effects*

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| Avg_Response overall | Between | 4.332 | 1 | 4.332 | 7.030 | .010 |
| | Within | 49.294 | 80 | .616 | | |
| | Total | 53.626 | 81 | | | |
| Avg_Overall Assessment | Between | 5.480 | 1 | 5.480 | 9.777 | .002 |
| | Within | 44.841 | 80 | .561 | | |
| | Total | 50.321 | 81 | | | |
| Avg_Clarity of narrative | Between | 4.721 | 1 | 4.721 | 6.345 | .014 |
| | Within | 59.521 | 80 | .744 | | |
| | Total | 64.242 | 81 | | | |
| Avg_Clarity of research problem | Between | 8.118 | 1 | 8.118 | 9.635 | .003 |
| | Within | 67.400 | 80 | .843 | | |
| | Total | 75.518 | 81 | | | |
| | Between | 2.800 | 1 | 2.800 | 3.551 | .063 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Avg_Clarity of RD without usefulness | Within | 63.088 | 80 | .789 | | |
| | Total | 65.888 | 81 | | | |
| Avg_Usefulness Items | Between | .658 | 1 | .658 | .254 | .616 |
| | Within | 207.477 | 80 | 2.593 | | |
| | Total | 208.135 | 81 | | | |
| Avg_SCIM | Between | 8.071 | 1 | 8.071 | 8.581 | .004 |
| | Within | 75.252 | 80 | .941 | | |
| | Total | 83.323 | 81 | | | |
| Avg_Response without usefulness | Between | 5.884 | 1 | 5.884 | 10.314 | .002 |
| | Within | 45.640 | 80 | .570 | | |
| | Total | 51.524 | 81 | | | |

The aggregation of responses into average evaluations per respondent and section of the questionnaire helps simplify the discussion of the specific effects that can be measured of a characteristic on the effects. However, using an ANOVA on each effect item might also reveal interesting findings that may help formulate prescriptive statements. The findings of this analysis are presented selectively below (Table 99), where only the significant effects are outlined. The full table can be found in the supplemental materials of the structure-effects-analysis: Appendix K.

The ANOVA reveals that many of the effect items are positive and significant, underlining the prescriptive statement above that one should use them. Out of all the 47 items, only six show a negative effect (i.e., the average response within the group with the stakeholder goals is higher than the one for the group that does not feature stakeholder goals in all but six instances). Five of these six are the usefulness measures, and the remaining item is ‘it is clear to me, what the outcome (artefact) is.’ None of these negative effect-items are significant.

23 items are significant at the $\alpha=0.05$ level, with the significance of the contribution being just outside of this cut-off ($p=0.051$, see Table 99, ordered by significance). All of these effects are positive. Hence, **if one wishes to improve any of these outcome variables, one may feature a description of the stakeholders’ goals**. Considering that there are no significant adverse effects and that many of the effects listed above are not only highly significant but that the difference of average scores is substantial as well (on average +0.70 out of 7 points), one might **conclude that the stakeholder goals should always be included in the manuscript.**

*Table 99: Significant Effects of Including the Stakeholders' Goals*

| Significance, Average Difference | Item |
|---|---|
| p=0.0001, avg. diff. = +1.09/7 points | Perceived empathy toward the stakeholder |
| p=0.002, avg. diff. = +0.92/7 points | Perceived familiarity with the focal issue |
| p=0.003, avg. diff. = +0.88/7 points | Perceived ability to explain the problem to others |
| p=0.004, avg. diff. = +1.10/7 points | Perceived level of entertainment while reading |
| p=0.004, avg. diff. = +0.72/7 points | Perceived empathy toward the topic |
| p=0.005, avg. diff. = +0.67/7 points | Perceived overall impression of the article's quality |
| p=0.006, avg. diff. = +0.72/7 points | Perceived clarity about what the stakeholder's goal is |
| p=0.010, avg. diff. = +0.68/7 points | Perceived clarity the general research approach |
| p=0.011, avg. diff. = +0.68/7 points | Perceived clarity of the essence of the problem |
| p=0.012, avg. diff. = +0.61/7 points | Perceived clarity about which procedures were used |
| p=0.014, avg. diff. = +0.85/7 points | Perceived enjoyment while reading the text |
| p=0.014, avg. diff. = +0.69/7 points | Perceived clarity of the plotline |
| p=0.014, avg. diff. = +0.58/7 points | Perceived clarity about the implications for practice |
| p=0.014, avg. diff. = +0.53/7 points | Perceived relevance of the research problem |
| p=0.018, avg. diff. = +0.79/7 points | Perceived clarity about the scope of the problem |
| p=0.019, avg. diff. = +0.78/7 points | Perceived ability to take a related decision |
| p=0.019, avg. diff. = +0.70/7 points | Perceived clarity of design decisions |
| p=0.021, avg. diff. = +0.61/7 points | Perceived clarity about who the main stakeholder is |
| p=0.021, avg. diff. = +0.50/7 points | Perceived content quality |
| p=0.024, avg. diff. = +0.57/7 points | Perceived clarity of the current situation |
| p=0.037, avg. diff. = +0.51/7 points | Perceived clarity about why the problem persists |
| p=0.039, avg. diff. = +0.59/7 points | Perceived quality of the presentation of the project |
| p=0.042, avg. diff. = +0.51/7 points | Perceived clarity about why the procedures were used |
| p=0.051, avg. diff. = +0.46/7 points | Perceived significance of the contribution |

#### E.4.2.1.2 The Effects of Using an Introductory Example

The second of three generally beneficial characteristics is whether the authors used an example to introduce the research problem or the study. As per the overview of average differences in Table 97, articles that feature this characteristic have an average score of 0.35 points higher on the 7-point Likert scale. Whereas the effect of featuring stakeholder goals is much higher (+0.59 points), the overall effect is positive for the introductory example as well. A single factor ANOVA on the aggregated answers reveals that the effect of using an introductory example is not significant for the overall average of effects, being slightly off the α=0.05 cut-off, at p=0.061. However, the sections on clarity of the research problem (p=0.019, avg. diff. = +0.49) and the section on the science communication impact measures are significant (p=0.025, avg. diff. = +0.52). With that, one can state that:

- **Using an introductory example significantly improves the overall clarity of the research problem.**
- **Using an introductory example significantly improves the science communication impact measures**.

*Table 100: ANOVA of Introductory Examples on Aggregated Sections of the Effects*

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| Avg_Response overall | Between | 1.402 | 1 | 1.402 | 2.147 | .147 |
| | Within | 52.225 | 80 | .653 | | |
| | Total | 53.626 | 81 | | | |
| Avg_Overall Assessment | Between | 1.405 | 1 | 1.405 | 2.298 | .133 |
| | Within | 48.916 | 80 | .611 | | |
| | Total | 50.321 | 81 | | | |
| Avg_Clarity of narrative | Between | .051 | 1 | .051 | .063 | .803 |
| | Within | 64.191 | 80 | .802 | | |
| | Total | 64.242 | 81 | | | |
| Avg_Clarity of research problem | Between | 5.026 | 1 | 5.026 | 5.704 | .019 |
| | Within | 70.492 | 80 | .881 | | |
| | Total | 75.518 | 81 | | | |
| Avg_Clarity of RD without usefulness | Between | .572 | 1 | .572 | .701 | .405 |
| | Within | 65.316 | 80 | .816 | | |
| | Total | 65.888 | 81 | | | |
| Avg_Usefulness Items | Between | 1.957 | 1 | 1.957 | .759 | .386 |
| | Within | 206.178 | 80 | 2.577 | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Total | 208.135 | 81 | | | |
| Avg_SCIM | Between | 5.134 | 1 | 5.134 | 5.253 | .025 |
| | Within | 78.189 | 80 | .977 | | |
| | Total | 83.323 | 81 | | | |
| Avg_Response without usefulness | Between | 2.224 | 1 | 2.224 | 3.609 | .061 |
| | Within | 49.300 | 80 | .616 | | |
| | Total | 51.524 | 81 | | | |

Further analysis of the individual effect items reveals that six items are significant at the α=0.05 level and one is just outside that cut-off (the problem scope with p=0.051, see Table 101, or for the full list: Appendix K, K.1.2). All of these effects are positive. Hence, **if one wishes to improve any of these outcome variables, one may feature an introductory example** (ordered by significance level):

*Table 101: Significant Effects of Using an Introductory Example*

| Significance, Average Difference | Item |
|---|---|
| p=0.002, avg. diff. = +1.04/7 points | Perceived clarity about the scale of the problem |
| p=0.004, avg. diff. = +0.85/7 points | Perceived ability to explain the problem to others |
| p=0.005, avg. diff. = +1.09/7 points | Perceived level of entertainment while reading |
| p=0.011, avg. diff. = +0.70/7 points | Perceived understanding of the essence of the problem |
| p=0.040, avg. diff. = +0.70/7 points | Perceived ability to take a related decision |
| p=0.041, avg. diff. = +0.70/7 points | Indicated wish to learn more about the project or topic |
| p=0.051, avg. diff. = +0.67/7 points | Perceived clarity about the scope of the problem |

Many of the problem-related effect measures are significantly or just not significantly improved because there is an introductory example. Among the not problem-related effects that are above the α=0.05 level are the understanding of why the problem persists (p=0.074, avg. diff. = +0.45) and the clarity about the situation in which the research problem exists (p=0.92, avg. diff. = +0.43). With that, one can say that **featuring an introducing example significantly improves the understanding of the research problem**. Interestingly, **the provision of an introductory example also increases the perceived level of entertainment while reading the article** (p=0.005, avg. diff. =

+1.09) while not significantly affecting the perceived enjoyment (p=0.171, avg. diff. = +0.49).

#### E.4.2.1.3 The Effects of Formulating a Research Question

The last overall beneficial factor that stems from the middle-ground characteristics (i.e., characteristics that are used or not used in about equal measures) is formulating a research question. Its direct effect indicated in Table 97 is an increase of the overall average score without usefulness measures of +0.30. This, however, is not significant, as the ANOVA in Table 102 shows (p=0.107). However, **articles in which a research question was formulated tend to have clearer narratives** (p=0.035). All other average section values are not significant.

*Table 102: ANOVA of formulating a Research Question on Aggregated Sections of Effects*

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| Avg_Response overall | Between | 1.337 | 1 | 1.337 | 2.046 | .156 |
| | Within | 52.289 | 80 | .654 | | |
| | Total | 53.626 | 81 | | | |
| Avg_Overall Assessment | Between | .427 | 1 | .427 | .684 | .411 |
| | Within | 49.894 | 80 | .624 | | |
| | Total | 50.321 | 81 | | | |
| Avg_Clarity of narrative | Between | 3.499 | 1 | 3.499 | 4.609 | .035 |
| | Within | 60.742 | 80 | .759 | | |
| | Total | 64.242 | 81 | | | |
| Avg_Clarity of research problem | Between | .466 | 1 | .466 | .497 | .483 |
| | Within | 75.052 | 80 | .938 | | |
| | Total | 75.518 | 81 | | | |
| Avg_Clarity of RD without usefulness | Between | 1.652 | 1 | 1.652 | 2.058 | .155 |
| | Within | 64.236 | 80 | .803 | | |
| | Total | 65.888 | 81 | | | |
| Avg_Usefulness Items | Between | .004 | 1 | .004 | .001 | .970 |
| | Within | 208.131 | 80 | 2.602 | | |
| | Total | 208.135 | 81 | | | |
| Avg_SCIM | Between | 3.118 | 1 | 3.118 | 3.110 | .082 |
| | Within | 80.205 | 80 | 1.003 | | |
| | Total | 83.323 | 81 | | | |
| Avg_Response without usefulness | Between | 1.656 | 1 | 1.656 | 2.657 | .107 |
| | Within | 49.868 | 80 | .623 | | |
| | Total | 51.524 | 81 | | | |

In addition to the ANOVA on aggregated section values, the analysis of the effect of formulating a research question on individual effects has revealed seven significant items, all of which are positive (i.e., yield improved communication outcomes if the research question is present as compared to when there is no research question). Hence, **if one wishes to improve any of these outcome variables, one may formulate a research question** (ordered by significance level):

*Table 103: Significant Effects of Using an Introductory Example*

| Significance, Average Difference | Item |
|---|---|
| *p=0.005, avg. diff. = +0.72/7 points* | *Perceived helpfulness of examples* |
| p=0.006, avg. diff. = +0.73/7 points | Perceived clarity about the general research approach |
| *p=0.009, avg. diff. = +0.69/7 points* | *Perceived relatability of examples* |
| p=0.020, avg. diff. = +0.76/7 points | Perceived replicability of the study |
| p=0.022, avg. diff. = +0.58/7 points | Perceived empathy toward the topic |
| p=0.031, avg. diff. = +0.47/7 points | Perceived relevance of the research problem |
| *p=0.047, avg. diff. = +0.50/7 points* | *Perceived clarity about why the procedures were used* |

Among these items, some unlikely relationships would benefit from further studying to interpret them (*cursive*). Notably, whether the explication of a research question really has an influence on the perceived clarity about why which procedures are used during the study or what the examples-related items have to do with a research question. The other variables might hint to a possible circumstance that in articles in which a research question is formulated, the research problem, topic, and research approach are elaborated on more. This might need further investigation, however, as the data in this dataset does not provide such answers.

#### E.4.2.2 Overall Detrimental Characteristic

Only one of the middle ground characteristics appears to be detrimental to the overall communication outcomes, as measured by the survey (using the artefact typology to refer to the artefact, see: Table 97). However, an ANOVA on the averages across and within the sections of the questionnaire responses did not reveal any significant results. Hence, despite an average score that is 0.19 lower if the authors have used the type of the artefact to refer to their artefact (e.g., model or method), this lower value is not significant on an aggregated level, and there is no significant deterioration in any of the section averages either.

A single factor ANOVA of usage of the artefact typology on the individual effect items reveals that there are only the helpfulness of examples (p=0.030, avg. diff. = +0.56), the clarity about the problem scope (p=0.051, avg. diff. = -0.66), and the clarity about the problem scale (p=0.038, avg. diff. = -0.7) that are significant. The helpfulness of the examples is unlikely to be directly related conceptually to the artefact typology usage. However, the clarity about the problem scope and scale might be. The fact that the clarity of the problem's scope and scale is lower in articles in which the artefact is specified by using an established typology is the opposite of what one might hope. The typology should, after all, help categorise and make sense of the type of artefact that is being discussed. Additional knowledge about the nature of the artefact should probably improve one's understanding of both the solution and the problem being addressed (including its scope and scale). This is not the case in the dataset of this analysis, and this could be a hint that the artefact typology might benefit from further developing it.

#### E.4.2.3 Characteristics that Negatively Affect the Clarity of the Research Problem

Among the average value changes based on the middle-range characteristics, two particularly detrimental characteristics toward the clarity of the research problem are perceptible (Table 97): The provision of navigation support (avg. diff. = -0.5) and using the artefact typology to refer to one's artefact (avg. diff. = -0.4). While the use of the typology is discussed above already (Section E.4.2.2), the provision of navigation support remains unaddressed. By navigation support is meant here that the author (or communicator in general) helps the audience to follow along by referring back and forth within the article, beyond the mere outline of the article in the introduction. Articles that feature this characteristic have received a much lower score for the clarity of the research problem than others. On an aggregated level, considering only the average scores for the survey's section about the research problem, a single factor ANOVA shows that this negative effect is significant (p=0.028, avg. diff. = -0.5). Hence, **in articles in which navigation support is provided, the clarity of the research problem is lower than in articles where no navigation support is provided**. This relationship is not quite intuitive, and it should be interpreted with caution. Further analysis of the articles might be necessary to understand how the navigation support was used and how the research problem was presented specifically. It is possible, for example, that the research problem was split into several parts more often in articles in which additional navigation support was provided.

Apart from the average clarity of the research problem, the items on the clarity about the problem scale (p=0.006, avg. diff. = -0.94) and about the problem scope (p=0.018, avg. diff. = -0.80) are the only significant items in the section about the research problem. Hence, the scale ("I have a good understanding of the scale of the problem (e.g. how large the financial impact is on an individual stakeholder)") and scope ("I have a good understanding of the scope of the problem (e.g. how many individuals may be affected)") are significantly less clear to readers in articles that provide additional navigation support. At the same time, the respondents did not have a significantly poorer understanding of the essence of the problem ("The authors' explanations are sufficient to understand what the (research) problem is, incl. its adverse effects of not solving it (i.e. the essence of the problem)."). The latter is clearly not significant, with a p-value of p=0.550 and an average difference equal to -0.17. With that, one might conclude that **referencing forward and backwards within an article inhibits the readers' ability to put the research problem into perspective**.

Navigation support is something one might expect to improve the clarity of the narrative. After all, this is the reason why it is used in the first place. Interestingly though, while this is the only section of the survey that is noticeably more positively scored by the authors that have read an article with navigation support, it is not a significant effect based on a single factor ANOVA across the average section values (clarity of narrative: p=0.13, avg. diff. = +0.26). An additional single factor ANOVA of the provision of navigation support on items about the clarity of the narrative showed that the clarity of the plotline (which is arguably the main goal pursued by authors that provide navigation support) is not significant either (p=0.61, avg. diff. = +0.15). Hence, **providing navigation support does not significantly improve the clarity of the narrative or the plotline**. However, **the provision of navigation support seems to increase the readers' ability to empathize with the researchers** ("I understand and can empathize with the researchers that had to take the design decisions in this study."). This item is significant and positive (p=0.038, avg. diff. = +0.52).

#### E.4.2.4 Usefulness Items

The average scores of the middle-range characteristics negatively affect the usefulness measures. Among the largest differences in average scores per characteristic are the use of the term 'artefact' to refer to the research output (avg. diff. = +0.63), using an introductory example (avg. diff. = -0.48) and the specification of which technique of data analysis was used in the presented study (avg. diff. = -0.29). To test whether these

differences are significant, for each of the factors terminology_artefact, introducing_example, and data_analysis_technique, a single factor ANOVA was conducted with the average usefulness measures and the individual usefulness measures as dependent variables. The results of this analysis show that most effects are not significant. The only significant effect (across averages of the usefulness item section and on the individual usefulness items) is between articles that use the term 'artefact' to refer to the research outcome and theory testing ("I will use the output (artefact) to inform theory testing in my own work."), with p=0.019 and an average difference equal to +0.9. This implies that people are more likely to see themselves use aspects of an article for theory testing in their own work if the output is specified as being an artefact. While this finding is significant, the values attributed to this item are low (i.e., on average of 3.5 out of 7 points). Maybe it is more appropriate to conclude, therefore, that **readers of articles in which the output is termed an 'artefact' may be less unlikely to use parts of the article for their own theory testing**.

*Table 104: Singe Factor ANOVA on the use of the term 'artefact'*

| | | Sum of Squares | df | Mean Square | F | Sig. | Avg. | Value |
|---|---|---|---|---|---|---|---|---|
| rd artefact theory_testing | Between | 16.771 | 1 | 16.771 | 5.743 | .019 | Without | 3.1 |
| | Within | 233.619 | 80 | 2.920 | | | With | 4.0 |
| | Total | 250.390 | 81 | | | | avg. diff. | +0.9 |

## E.5 Contribution to the Research Project

This structure-effect-analysis directly informs the design of a guiding artefact at the subclass level of analysis, namely guidance for writing design research articles (Section 7). It culminates the work from Appendix B, C, and D, bringing three studies together in a strategically planned manner. The fact that many highly significant effects could be identified helps gain confidence in the artefact presented in Section 7. While the broad database on which these findings are built does not technically replace an evaluation in the sense of the DSR methodology based on Peffers et al. (2007), it is used as such anyhow. In other words, the artefact from Section 7 is both informed initially by the knowledge extracted throughout this study (design) and an ex-post evaluation of whether the designed artefact adequately accounts for these findings (evaluate).

## E.6 Limitations and Discussion

The primary purpose of this structure-effect-analysis is to contribute actionable knowledge toward the design of the sub-class level artefact that guides design researchers in writing research articles—and it delivered. There are many interesting relationships within these sections above. Since the underlying datasets are reasonably large (especially the effects dataset), many apparent relationships could be confirmed as being significant. This allows for making prescriptive claims, as the structures and the effects are necessarily sequential (i.e., the effects cannot affect the structure, and since these relationships are significant, there is evidence that the structural design decisions lead to these effects). Such knowledge is precisely what the author sought for the creation of an artefact that guides researchers in the design or their own design research article.

Despite utmost care in gathering the data used for the analysis in this study, some limitations need to be discussed. In particular, the data analysis is restricted to a set of only 19 research articles. The related trade-offs have been discussed in Appendix B-Appendix D and are therefore not repeated here. One additional way the limitation of having used a limited sample of articles is offset is, of course, the triangulation of the structural analyses. However, the fact remains that it is entirely possible that there are other structural designs and design decisions that are neither captured by the qualitative nor the quantitative structural analyses.

Another limitation is that the findings are not necessarily factual. Hence, even though some findings feature relatively high significance values based on ANOVA or regression analysis, there is still a chance that the results do not hold. This is a relevant limitation for this dissertation, as the conclusions from this structure-effect-analysis are used so heavily in Section 7 (i.e., for the design and the evaluation of the artefact).

# Appendix F Field Experiment

## F.1 Starting Point

This field experiment is used to assess the effectiveness of a checklist for students that instructs them on how to explicate their presentations. Hence, it is the empirical evaluation that ensues the creation of an artefact (that checklist). The artefact, its origins and the construction process can be found in Section 8 of this dissertation. To provide a minimal context for the subsequently presented empirical study, the specific need for the artefact and the solution approach is repeated here:

### F.1.1 Need for the Artefact

In the context of a master course on research methods at a Swiss university, students learn about the behavioural science and the design science paradigms, as well as common reference approaches in both paradigms, techniques for data gathering, techniques for data analysis, with a special focus on how to construct a research design for a relevant research problem. As part of their examination, the students need to create and present a research design (from the paradigm of their liking), as constructed by them in groups. The groups that opted for design science research designs perceived difficulties in presenting their research designs convincingly and, especially in comparison to the groups that opted for a behavioural science research design, they were uncertain as to what contents to present, in which order, and what to focus on. An initial supporting checklist for all groups (behavioural and design science) only improved the presentations of the behavioural science research designs, but not of the design science research designs. (Notice that this issue is not related to the quality of the research designs, but rather to the quality of the presentation of the latter). For the presentation of design science research designs, there is a need for more specific guidance to help these students to present their research designs.

### F.1.2 Solution Approach

Given that the students which opted for a design science research design need specific guidance that accounts for their needs in particular (i.e., for the use case of presenting a design science-based research design for critical evaluation by professors), a strongly contextualized guiding artefact needed to be designed. This artefact construction took place after having created a decontextualized (and therefore projectable) artefact (see Section 6). To evaluate this abstract solution, and to solve the students' local problem,

the decontextualized artefact was contextualized (by adding contextual information and therewith specifying the artefact until it became a directly applicable artefact). Inspired by the effective solution for the behavioural science research design, the contextual artefact also takes on the form of a checklist. However, this checklist caters specifically to the needs of student groups that present their design science research designs in the context of this research methods course. Whether this contextualized artefact is indeed effective (i.e., leads to better presentations in the context of this course) needs to be evaluated.

## F.2 Research Approach

A natural field experiment lends itself to evaluate real-world effects of hypothesized relationships (i.e., the perceptible effects and thus the external validity, see also Cahenzli et al., 2021a). In the case of the checklist, the external validity is the key target outcome: Observably better presentations, as measured by the local goals in this specific use case. Therefore, to measure whether the relationship of using this new checklist and obtaining better presentations of design science research designs as compared to the ones obtained by providing students with a general-purpose checklist, a natural field experiment was used. The artefact was hence implemented and used in the natural environment for which it is intended. Data was gathered for both a condition that was unmanipulated (i.e., the specific framework was not available to students) and a condition that was manipulated (i.e., the specific framework was available to students). To measure the outcome, independent assessors were asked to evaluate these presentations in a double-blind study. Each assessor was asked to iterate four times the process of watching a presentation and filling in a survey. With that, the study is a between subject design (student groups were either manipulated or not), but the analysis was done with mixed subject assessors (i.e., they evaluated several presentations (four) but not all the presentations (18)). In the following, the data gathering and the data analysis are presented.

### F.2.1 Data Gathering

The gathering of data is split into two sections, as one workflow was to gather presentations and a subsequent workflow was to gather quality assessments about these presentations.

#### F.2.1.1 Gathering Presentations

To evaluate the specific checklist in a natural field experiment, the students (participants) needed to be unaware of their participation in the experiment, in order for them to portray unbiased behaviour. To operationalize this in the context of a university course, fairness and non-discrimination needed to be respected at all time. Since the same class could therefore not be split into groups where some receive additional support and others do not, the two conditions (i.e., with and without the updated checklist) were separated into two different semesters. In one semester (spring 2019), the general checklist for presenting research designs in the course setting was presented. The final student presentations were recorded as Voice-over-PowerPoint presentations. In the semester with manipulation (i.e., the semester with the updated checklist, spring 2021), both the general checklist (framed as being instructive for behavioural science research designs) and the specific checklist (framed as being instructive for design science research designs) were presented. The final student presentations were recorded as Voice-over-PowerPoint presentations as well. The course format, modalities, and all other contents of the course remained the same. This includes their freedom of choice to decide with whom to form a group and what research problem to address. They also decided themselves whether they create a research design for a behavioural science or a design science project. This yielded a dataset of 24 design science research design presentations (15 in 2019 and 9 in 2021).

#### F.2.1.2 Gathering Quality Assessments

Given the fact that the author has graded all of these presentations, he knows both the presentations and which ones are part of the manipulated condition. Therewith, a bias of the author toward assessing the presentations from the manipulated group as higher is likely. For this reason, the quality assessment should ideally be done by researchers that are neither familiar with the artefact, nor with the details of the experiment. This is the reason for this second data gathering effort in this field experiment. In the following, the procedures related to this effort are outlined, split by the definition of assessment criteria and the measurement tool, the selection and preparation of presentations for the quality assessment, and the acquisition and instruction of evaluators.

##### F.2.1.2.1 Definition of Assessment Criteria and Measurement Tool

The assessment criteria for evaluating the artefact (checklist) based on the empirical implementation (presentations by students that had access to the checklist versus students that did not have access to the checklist) need to be oriented by the purpose for

which the artefact was created. For this reason, the assessment criteria are deduced form the artefact creation outlined in Section 7, rather than re-using the grading framework used for grading the student presentations. The assessment criteria to evaluate the checklist's effectiveness are listed in Table 105, along with the measurement items which are assessed on a 7-point Likert scale and should identify whether the purpose of the presentation is fulfilled better with rather than without the artefact:

*Table 105: Assessment Criteria and Measurement Items for the Quality Assessment*

| No. | Criterium | Measurement item |
|---|---|---|
| **1** | Clarity about the research problem | I understand what the research problem is, how it is expressed in its context, and why it persists. |
| **2** | Clarity about the focus of the study | I know which part of the research problem is being addressed by the group. |
| **3** | Clarity about the research gap | I understand what the (literature-based) research gap is and how the research design contributes to closing it. |
| **4** | Clarity about the knowledge base | It is clear to me what knowledge base the group builds on and why they selected it. |
| **5** | Clarity about the general approach | I understand which reference approach was selected, how it was operationalized and why this is suitable for the proposed study. |
| **6** | Clarity about the requirements | I know how the requirements for a solution are identified and which ones these are. |
| **7** | Clarity about the design process | It is clear to me how the artefact is designed and why which procedures are chosen. |
| **8** | Clarity about the artefact | It is clear to me, what the proposed artefact is and how the research design leads to that artefact, and why it solves the research problem. |
| **9** | Goal of the course | I think that this group has understood how a good research design is created. |

To gather the data on these assessment criteria, a Microsoft Forms survey was created. This form contains five sections, whereas four of these sections are exact copies of each other. The first section captures information about which playlist of four presentations the assessors evaluated (more on this below), and the subsequent sections each feature the measurement items outlined above as well as one item to measure whether the assessors perceived the presentation as being informative and whether they perceived it to be entertaining. Each of these four sections also contain a free-text section for any

additional observations about the presentations (screenshots of the survey can be found in the supplemental material of the field experiment, in Appendix M).

#### F.2.1.2.2 Selection and Preparation of Presentations

The design science research design presentations for the two semesters are not of equal numbers (i.e., 15 vs. 9 in 2019 and 2021 respectively). To obtain an equal sample, which facilitates the data gathering and analysis, only a subset of the articles from the spring semester of 2019 are used. To select this subset, outliers were identified and removed. An outlier is interpreted here as a particularly poor presentation (as measured by the lowest grades), particularly strong presentations (as measured by the highest grades), and one presentation that did not use design science per se (but design thinking). Therewith, six presentations were removed from the 2019 sample, yielding a total of 9 unmanipulated (2019) and 9 manipulated groups' presentations (2021).

Each presentation is about 15 minutes in length. Based on a pre-test, filling in the survey takes between 6 and 8 minutes. To assess all 18 presentations would take one assessor on average 378 minutes, or about 6.5 hours (excluding an initial briefing and setting themselves up). Considering that the average attention span is much lower than 6.5 hours, that the assessors should both be familiar with research methods in IS (and especially: design research) and that asking researchers for such an extensive time commitment requires extensive financial means or exceptional goodwill, the author decided to package the videos into more manageable playlists of four videos. Therewith, each assessor needs to invest about 1.5 hours of their time and provides 4 evaluations. This implies that the author needed to acquire more assessors, but that the acquisition might be less difficult.

To create these packages of four videos, parings of two videos from the unmanipulated and two videos from the manipulated group were randomly selected. In addition, to offset possible order effects (i.e., that watching an evaluating the first presentation affects the subsequent ones), nine playlists were created with different orders and selections of videos. To 'blind' the author about which video belongs to which condition, numbers were used to identify the videos.

The procedures used to create the playlists is as follows: First, the clips were named with group numbers and arranged in arrays, such that one array contained the unmanipulated groups' presentations (A) and the other the manipulated groups' presentations (B):

- A (ordered) = ["13", "16", "18", "22", "25", "26", "30", "34", "37"]
- B (ordered) = ["14", "15", "17", "21", "27", "28", "31", "32", "35"]

These arrays were then randomized, in case there was any order effect in these presentations (higher numbers indicate that the student groups are more likely to have been part of the second of two feedback sessions, however the submission for the evaluated presentation was the same for all groups). The randomized arrays were generated with the python module 'random' and the method 'sample(x, 9)' for each "ordered" array. This has led to the following randomized arrays.

- A = ['25', '26', '30', '16', '22', '13', '34', '18', '37']
- B = ['35', '21', '17', '14', '32', '31', '27', '15', '28']

Next the playlists of four videos needed to be created. Each playlist is a group of two sequential videos from each of the randomized arrays (e.g., Playlist 1 = A[0,1] and B[0,1], where 0 and 1 stand for the index of the selected videos from the randomized arrays). For each playlist, the index numbers were increased by 2 (or reset to 0 or 1 in case the respective index was 7 or 8; e.g., Playlist 2 = A[2,3] and B[2,3]). This procedure has yielded the following playlists:

- Playlist 1 (ordered) = A[0,1] and B[0,1] → 25, 26, 35, 21
- Playlist 2 (ordered) = A[2,3] and B[2,3] → 30, 16, 17, 14
- Playlist 3 (ordered) = A[4,5] and B[4,5] → 22, 13, 32, 31
- Playlist 4 (ordered) = A[6,7] and B[6,7] → 34, 18, 27, 15
- Playlist 5 (ordered) = A[8,0] and B[8,0] → 37, 25, 28, 35
- Playlist 6 (ordered) = A[1,2] and B[1,2] → 26, 30, 21, 17
- Playlist 7 (ordered) = A[3,4] and B[3,4] → 16, 22, 14, 32
- Playlist 8 (ordered) = A[5,6] and B[5,6] → 13, 34, 31, 27
- Playlist 9 (ordered) = A[7,8] and B[7,8] → 18, 37, 15, 28

Since these lists are in some sense ordered (first two items are from Group A, whereas the second pair of videos are from Group B), each list was re-sampled randomly. To do this, the same sampling method from the random module in Python was used. Therewith, a broad selection of orders and combinations of the videos was obtained in the playlists which should help remove order effects. The final playlists are:

- Playlist 1: [26, 21, 25, 35]
- Playlist 2: [17, 30, 14, 16]
- Playlist 3: [22, 13, 31, 32]
- Playlist 4: [15, 27, 34, 18]

- Playlist 5: [28, 25, 35, 37]
- Playlist 6: [30, 17, 21, 26]
- Playlist 7: [14, 16, 22, 32]
- Playlist 8: [31, 27, 13, 34]
- Playlist 9: [18, 37, 15, 28]

With that, the assessment tool (survey) and the object to be assessed (4-video-playlists) were prepared. Next, the acquisition and instruction of the assessors is explicated.

#### F.2.1.2.3 Acquisition and Instruction of Assessors

The requirements for potential participants were that they are proficient in German (as the presentations are in German), that they are familiar with IS research and with design research in particular, and that they are knowledgeable about research designs and related design decisions (such that they can evaluate the quality of various aspects, see Table 105). With that, only active and German-speaking researchers could be acquired. The acquisition was done by the author himself and the target group was his personal network of fellow doctoral students. All of them are familiar with research design decisions and the ones asked to partake are German speaking and familiar with design research. To motivate them to invest the predicted 1.5 hours of their time, the following was offered: Participants would gather in the same location and do the experiment at the same time (though individually, as the playlists differ from participant to participant). Therewith, the motivation to pay attention until the end and to follow through with finishing the evaluation was expected to be increased. Furthermore, after the evaluation sessions, an apéro riche was offered, a particularly attractive incentive, given that the participants mostly knew each other, and the sessions were scheduled toward the end of the day.

The acquisition of the participants was mostly based on an initial direct contact, followed by an e-mail (see supplemental material in Appendix M), or more informal coordination to set up group sessions. These acquisition efforts yielded three sessions and a total of 21 participants (11, 4, and 6 respectively). Therewith, 84 responses were captured (42 evaluations of manipulated and 42 evaluations of unmanipulated presentations).

The instructions for the assessors consisted of three distinct elements: The *invitation* e-mail (sometimes omitted), the introduction in the beginning of each session, and the material provided during the session. The invitation to the participants that have already agreed to take part in the experiment contained general information about the venue and

the agenda of the event. Furthermore, a link to a playlist of four videos that succinctly explain what DSR is was attached, as a reminder. Watching these videos was not mandatory, as many participants were actively using DSR themselves or they have used it in the past.

At the time of the experiment, the participants gathered in a large room, where they were provided with an introduction by the author. During this short speech he reminded them about DSR and explained their tasks. The exact details of the experiment remained omitted, such that the participants could not guess what the experimenters' expected outcomes were. The focus of the explanation of the task was on the questionnaire, and more specifically on explaining how each of the central items was to be understood. The purpose of this step was to lower the potential ambiguity of these items. Any questions were resolved before continuing to the execution of the tasks.

Before starting the individual tasks, each participant received an e-mail with a short explanation about the experiment along with a set of links. One part of the links led to the playlists they were to assess, another link led to the playlist about DSR, and one link led them to the survey. The participants watched the videos with headphones, fulfilled their tasks in silence and left the room upon completion.

## F.3 Results and Discussion

The results from the field experiment can be seen in Table 106, where the evaluation criteria are listed along with the average scores for the non-manipulated and the manipulated groups' presentations (each with n=42), the absolute and relative difference between the groups and the results of a t-Test per item.

On average, the groups that were provided with the specific checklist had a higher score. This is the expected (or rather: intended) direction of the effect of using the checklist. However, the overall average score per response only improved by 3.9 percent. Further investigation of the effects per item reveals that five items have a larger effect than this average, and only two effects are significant at the $\alpha$=0.05 level: the achievement of the goal of the course (p=0.036, avg. diff. = +0.52 points out of 7 points) and the clarity about the general approach (p=0.047, avg. diff. = +0.62). The effects on the perceived informativeness (p=0.104, avg. diff. = +0.36) and the clarity about the research problem (p=0.160, avg. diff. = +0.29) also have a relatively high significance, but these criteria are not significant at the $\alpha$=0.05 level. Apart from these four items and the clarity about the focus of the study (avg. diff. = +0.21), the average scores of the presentations have not changed much between the groups (absolute changes of less than or equal to 0.07).

*Table 106: Results and t-Test from the Evaluation of Presentations*

| | Not Manipu-lated (n=42) | Dif-fer-ence | [%] | t-Test P(T<=t), one-tail | Manipu-lated (n=42) |
|---|---|---|---|---|---|
| Clarity about the research problem | 5.262 | 0.29 | 5.4% | 0.160 | 5.548 |
| Clarity about the focus of the study | 4.976 | 0.21 | 4.3% | 0.210 | 5.190 |
| Clarity about the research gap | 4.595 | -0.05 | -1.0% | 0.449 | 4.548 |
| Clarity about the knowledge base | 4.548 | 0.00 | 0.0% | 0.500 | 4.548 |
| Clarity about the general approach | 4.619 | 0.62 | 13.4% | 0.047 | 5.238 |
| Clarity about the requirements | 4.548 | 0.05 | 1.0% | 0.444 | 4.595 |
| Clarity about the design process | 4.619 | 0.05 | 1.0% | 0.440 | 4.667 |
| Clarity about the artefact | 4.786 | -0.07 | -1.5% | 0.409 | 4.714 |
| Goal of the course | 4.619 | 0.52 | 11.3% | 0.036 | 5.143 |
| Perceived informativeness | 4.929 | 0.36 | 7.2% | 0.104 | 5.286 |
| Perceived entertainment | 3.810 | 0.05 | 1.3% | 0.443 | 3.857 |
| Overall response averages | 4.665 | 0.18 | 3.9% | 0.182 | 4.848 |

At this point it is worth mentioning that one major difference between the significance values obtainable in field experiments as opposed to fully controlled laboratory experiments is that field experiments tend to obtain much lower significance levels. The reason for this is the lack of control over extraneous variables in the natural environment. In the case of the student presentations, these extraneous variables that were not controlled for include: the individual group members and their abilities and experiences; the group dynamics that developed leading up to the presentation; the amount of effort put into the presentation for each group; the ambitions of the group; the topic (some topics are easier to understand, for example); the visual quality of the presentations; the voices of the presenters; or maybe the colour tones used throughout the presentations. To obtain significant results, much larger group sizes (that is: more evaluation data) can be used (randomization). Considering the demanding requirements for finding adequate participants and the length of the task for each participant, it was not possible for the author to increase that number.

Nevertheless, two variables are significant at the $\alpha=0.05$ level. This indicates that these variables are very likely to be affected by the outcomes of the manipulation. Both of these variables are central to the purpose of the artefact. Therewith, the goal of the course (to convince the audience that the group has understood how to create a good (design) research design) and the central task of convincingly present which research approach was chosen, why, and how it was applied to their research design (clarity about the research problem) could be improved with the checklist. Beyond these criteria, no

criterium has been noticeably negatively affected. Hence, using the checklist has not shown adverse consequences. From that it can be concluded that **the checklist is useful for students and that it improves the achievement of the courses main goal and helps conveying the general research approach more clearly than the general checklist**.

## F.4 Contribution to the Design Research Project

This field experiment contributes to the design research project as an empirical evaluation of an instantiated artefact (i.e., the checklist). The results provide direct support for the artefact's effectiveness in improving the audience's perception that students (i.e., users of the artefact) have understood well how good research designs are created (i.e., the goal of the course). Therewith they are helped in achieving their targeted communication outcome. Students are also more successful at clarifying the general research approach of the research designs they present. Other outcomes that would be desirable as well did not improve. However, they have not deteriorated either. With that, the field experiment has yielded encouraging results for the usefulness of the proposed artefact.

## F.5 Limitations and Discussion

The independent evaluation of the data gathered during the experiment contains significant effects on two target variables, one of which is the purpose of communication. This is evidence for the usefulness of the artefact in practice. Hence, the experiment has fulfilled its purpose as an evaluation of the checklist artefact (Section 8). While the results leave some questions open, these are questions of local interest (i.e., concerning the instantiation of an artefact for local use in a specific case). Therewith, not research agenda is provided. However, the limitations of field experiments need addressing still. The **first** limitation of this evaluation is that the usage of the artefact (i.e., evidence that each student group in the manipulated group used the checklist explicitly) was not measured. Furthermore, it was not ensured that all members of all groups were present at the lectures during which the checklists were presented. It can therefore be that there are several of the nine presentations in the manipulated group that did not, in fact, benefit from the manipulation. Furthermore, it is possible that some of the unmanipulated groups inadvertently followed the (not yet existing) checklist. This was also not controlled for. Both of these limitations could have been controlled for by analysing the presentations. If they show compliance with the checklist, they could be assigned to the manipulated group, and if not, they could be assigned to the non-manipulated group.

While this would increase the internal validity of the experiment, it would deteriorate the external validity. The design question here is, whether the artefact itself is to be evaluated, or whether the artefact in use is to be evaluated. The evaluation proposed above does the latter and therefore accepts ignorance of the checklist as a natural circumstance to which the artefact is exposed. This is compliant with the understanding of a natural field experiment (Harrison & List, 2004).

Second, the checklist might have contained aspects that were not understood as intended and this was not checked explicitly. Hence, if students used the checklist as intended, they might have misunderstood certain items. The author judges the probability of this having happened as low, however. The checklist was introduced and presented step-by-step by the lecturer of the manipulated groups and there were feedback sessions in which the lecturers could have identified misinterpretations. The groups were furthermore instructed to use the course information system to ask questions in case of any unclarity about the course material. In any case, while there are significant effects, a cleaner execution of the experiment (i.e., including pre-tests and manipulation checks, see: Cahenzli et al., 2021a) would certainly have been beneficial regarding the data gathering.

Lastly, the concentration of the assessors in the evaluation part of the experiment could have suffered during the lengthy experiment. In hopes of keeping the motivation up, the author has gathered the participants into the same room at the same time. He has also hand-picked reliable and willing participants and has raised awareness among the participants that their full concentration is crucial for their time to be valuably spent. Still, measuring the level of concentration explicitly could have improved the certainty whether the participants were able to keep up the concentration. To ensure that the author did not manipulate the participants in their evaluation task, however, the setting was a double-blind design. Neither the assessors nor the author was aware at the time of the evaluation which presentation was part of which condition.

# Appendix G Evolution of the Initial Problem Conceptualization

Before conducting the interview study (Appendix A), the author focused on creating an initial understanding of the communication of DR projects. The purpose of the related activities was to obtain the knowledge and intuition necessary to use the time with the interviewees effectively. Hence, by conceptually framing the existing knowledge (creation of an initial framework) and therewith obtaining a testable and improvable baseline understanding of the research problem, the expert interview study can be used more effectively, and the time of the interviewees is used more efficiently, allowing for more comparable information quickly.

## G.1 First Version of the Problem Conceptualization

The earliest version of the problem conceptualization emerged from a variety of iterations of reading and summarizing literature and connecting the gathered knowledge in a fashion that helps grasping the problem space. The purpose of such a conceptualization of the problem was meant to be that the problem can be analysed along a variety of relevant dimensions. In that earliest version of the framework, the author suggestively isolated three primary dimensions or axes of analysis with various characteristics:

| Dimension | Characteristics |
|---|---|
| Project stage | - Start (acquisition of e.g., team members, project partners, funds)<br>- Middle (e.g., research-in-progress, conferences, doctoral consortia)<br>- Finished research (e.g., paper, conferences, dissertation) |
| Audiences | - Internal (e.g., co-authors, supervisors, superiors, friendly reviewer)<br>- External (e.g., advisors, reviewers, financiers, scientific readers, conference visitors) |
| Response variables to SciCom[1] | - Awareness<br>- Enjoyment<br>- Interest<br>- Opinions<br>- Understanding of Science |

With that, a three-dimensional outline of possibly relevant communication situations can be illustrated. Some of the combinations of these dimensions (e.g., finished project presented to an audience of reviewers, with the targeted response of enabling them to

[1] Science Communication, as per the science communication literature. For further details, see Section 2.2 of this dissertation.

form an opinion about the project) might turn out to be of high or particularly low relevance, helping to identify areas that may be most beneficial to provide guidance for. Furthermore, herewith specifying communication situations (their commonalities and differences) could prove valuable for the analysis of the problem: How does it materialize in various situations? The following illustration attempts to capture this logic (Figure 47). Some additional explanations about this conceptualisation are provided below, as it is not self-explanatory. (This is part of the reason why this conceptualization did not end up being used.)

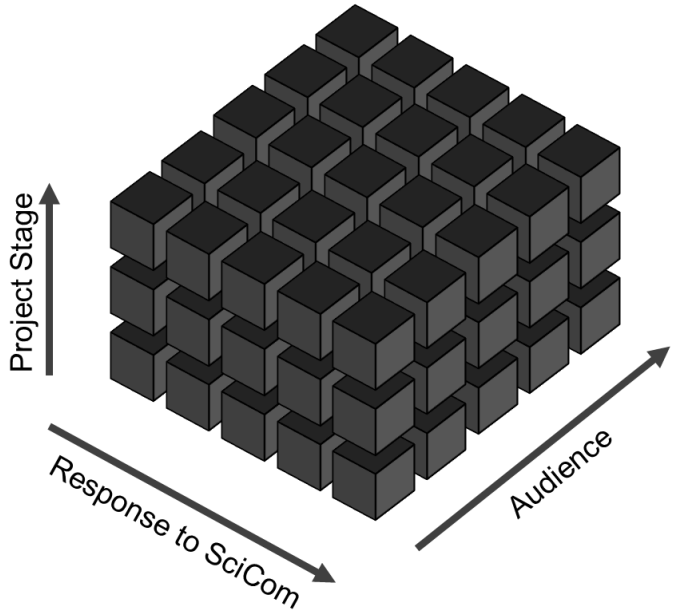
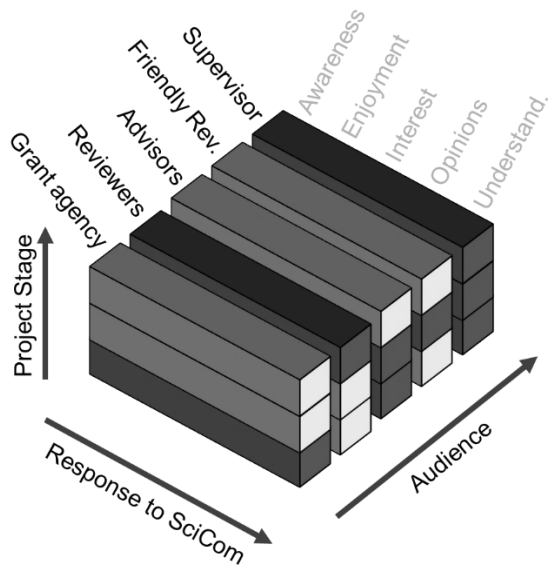



*Figure 47: Illustration of the first Version of the Problem Conceptualisation*

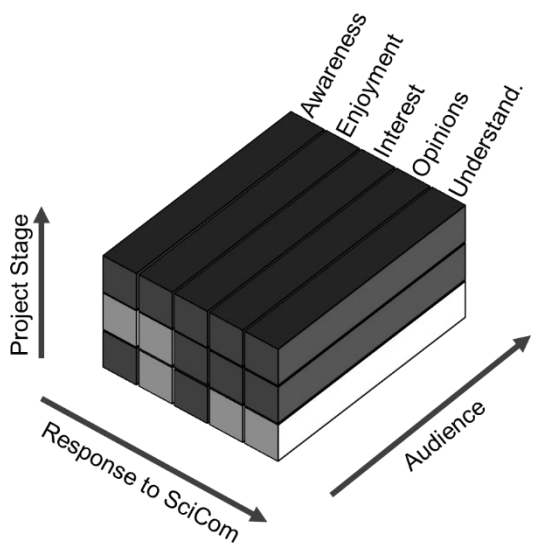
Each cube in this representation can be understood as a situation-goal-pairing. The goal is the response to science communication. Communication pursues some goal and the five response variables to SciCom can be used to characterize that goal. The situation describes the combination of the project stage (early, middle, end) with the audience. Referring to the illustration, one may hold one or several characteristics stable, allowing for a focused analysis of the remaining combinations. This would help improve the understanding of the problems that emerge in more specific situations, making the object of investigation clearer. Furthermore, some communication situations with low relevance can be omitted early on in the research process, such that the focus can reside on the more relevant communication situations. These ideas are illustrated in the following tables, where one dimension is held constant and analysed regarding one or both other dimensions.

*Table 107: Analysis of the Stakeholder Type per Project Stage*



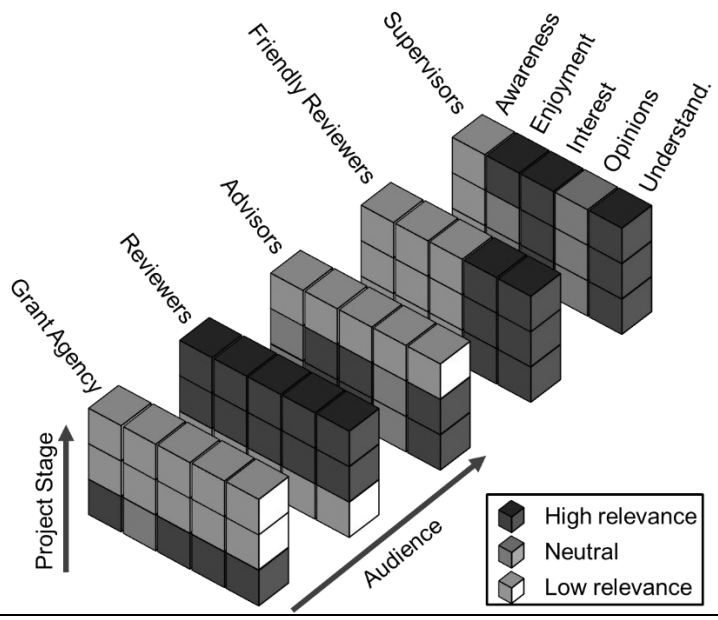

For every stage of a DR project, there are some stakeholders that are particularly relevant, whereas others may not be involved. E.g.: At late stages of a project, the grant agency might not be a particularly relevant stakeholder, while reviewers are. For identifying relevant communication issues, one might therefore not spend too much effort on the communication with grant agencies at late stages, but rather at early stages – or to focus on problems regarding the communication with reviewers instead.

*Table 108:Analysis of the Responses to SciCom per Project Stage*

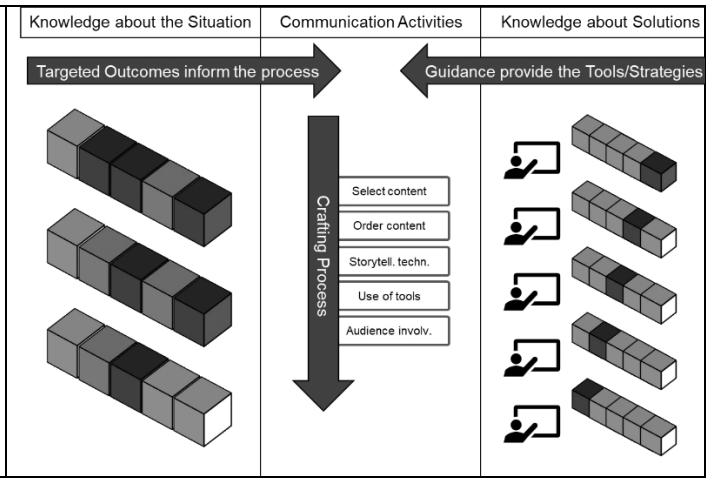


The five types of responses to SciCom may not play the same role at each stage of the project. For example: Understanding might not be quite as important at the outset of a DR project as it is to raise interest in the study and create awareness for the problem. During the problem analysis for this dissertation, such a view on the possible problem dimensions allows to ask more specific questions to isolate relevant sub-problems (e.g., do design researchers perceive the raising of interest at an early stage as important? Do they perceive it as difficult?).

*Table 109: Analysis of the Stakeholders per Stage and Response to SciCom*




When combining the analyses of the two examples above, one may reach a more granular picture of the problem, allowing to not only identify more important stakeholders per stage, but also to specify the relevance of response types per stakeholder and stage. Such a conceptualization of the research problem might help identify difficulties in reaching certain relevant communication outcomes in relevant communication situations, along with existing coping strategies or best practices for these situational goals. Hence, one might be able to specifically investigate certain (relevant) communication situations in an expert interview study, and learn about what has worked these situations, learn about processes that remain problematic, and learn about approaches that are worth transferring. This conceptualization of the research problem might also allow to select e.g., one stakeholder type and to develop holistic guidance (regarding the other two dimensions, see illustration below).

| | |
|---|---|
| Example: For each stakeholder and project stage (early, middle, end), a different set of outcomes might be most relevant. Knowledge on how these outcomes can be achieved individually might help solve the problem efficiently and effectively based on modularly. |   |

This first version of a problem conceptualization seemed to be quite complex, considering the purpose for which it was built (i.e., to gain an initial understanding of the problem and to help inform the expert interview study). In particular, its function of being a foundation for the interview study is problematic. After all, given three (and potentially more) stages and five outcome variables, there are fifteen situational communication aspects that would have to be discussed for every stakeholder group. At a few minutes per outcome variable and project stage, this would lead to interviews that are tediously lengthy and that are still in need of more abstract discussions and exchanges on the overall problem. After all, such strongly situated knowledge might be hard to relate to an overarching problem, without the help of the interviewee. Considering that there is little information about the intricacies of the problem to start with, such a strong focus on situated experiences seemed inadequate, requiring a more abstract discussion of the problem.

## G.2 Second Version of the Problem Conceptualization

Having hence perceived that a more abstract representation would be more suitable to inform the interview study, while holding onto a variety of insights gathered already, another version needed to be created. With a more abstract view on the first version of the problem conceptualization, the ideas of separating the problem into situational aspects, a process for which guidance may be needed, and target outcomes, were selected as abstract concepts. Therewith, the understanding of the research problem was reframed as an Input-Process-Output (IPO) model. With the understanding that the description of a communication situation is the initial state based on which researchers ‘build’ their communication, the input part of such a model is a given fact for each communication situation. As such, the researchers’ problem might not be concerned with the description

of the situation, but rather with what is being done given a situation. Furthermore, communication tends to contain activities that pursue a certain goal. The goals (output) thus are the target, which should be achieved by a set of activities of communication (process), which presumably are at the core of the problem. The problem could therefore be conceptualized as the difficulty to define or execute a process that bridges the initial situation (input) such that the desired outcomes (output) are reached.

With that, the research problem could be depicted more abstractly as an IPO model. This model could be used to ask experts in the interview study about their perception of which input aspects play a role for communication, which output variables are most relevant to them, and which coping strategies they use along the process of bridging the input and the output. Findings from the selective literature review (Sections 2 and 5.1) could be inserted at this point into the model to allow for specific (confirmatory) questions.

Refining the model, the author has split the input section of the IPO model into two distinct parts. One is the general description of a communication instance, which is mostly independent of the specific DR project's characteristics. The other part contains specificities about the research project, such as its current stage or the artefact type pursued.

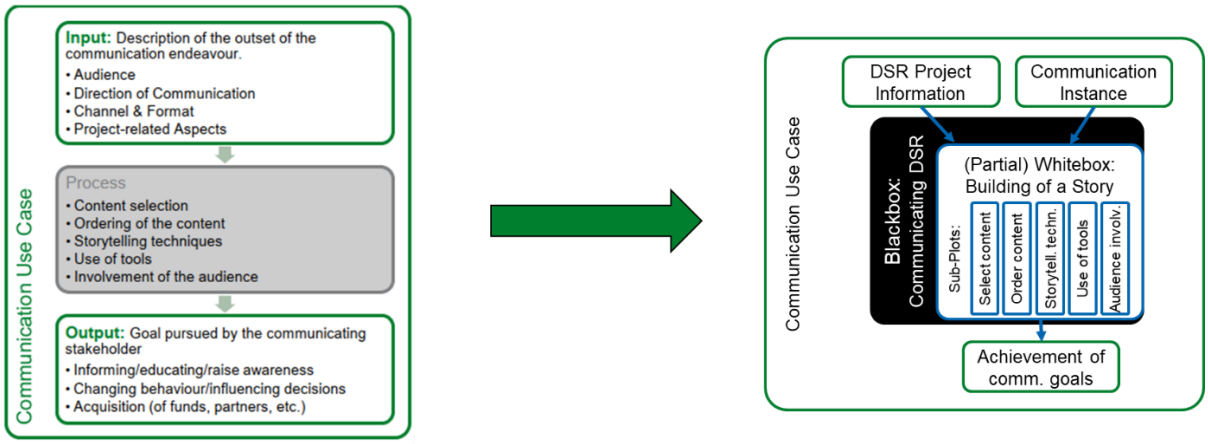



*Figure 48: Iterated Input-Process-Output Model*

This version significantly impacted the way in which the further investigation of the research problem was pursued. However, because of its apparent focus on one communication instance at a time and considering that the further problem identification should be able to capture the problem at a variety of abstraction levels (issues with communicating DR projects in general; in certain categories of situations; in certain types of situations; in specific instances according to the interviewee's own experience), this form of conceptualizing the knowledge captured thus far was iterated further.

## G.3 Third Version

Combining the reflexions about the apparently problematic process through which design researchers bridge a situation and desired outcomes and the lack of generality of this understanding, the following intermediary conclusion was reached: The problem can be better understood by (1) attempting to figure out, which dimensions and characteristics are relevant (i.e., evaluating and improving the literature derived set of dimensions that describe communication situations as input and the possible communication outcomes as output), and (2) exploring the existing processes (i.e., coping strategies or approaches that are used currently and the past). Therewith expert interviews can be conducted with relatively open-ended questions that capture the problem on various levels of abstraction and reveal conceptual bank spots of aspects that are yet missing. This is important, because the problem has at this stage of the project been investigated with a selective literature review only, and because the topic has not been thoroughly studied yet.

The third version of the problem conceptualisation that integrates these conclusions is featured below (Figure 49). It can be summarized as a morphological box with which the "input" state can be specified; a selection of steps that seem to be important to produce the desired outcomes ("process"), and the five communication impact variables ("output"). Therewith, the knowledge gathered from the initial selective literature review was used as illustrated below, to inform the expert interview study. This understanding of the research problem is the conclusion of Section 5.1 and it informs the interview study, as presented in Appendix A, from which the conclusions about the research problem are drawn in Section 5.2.

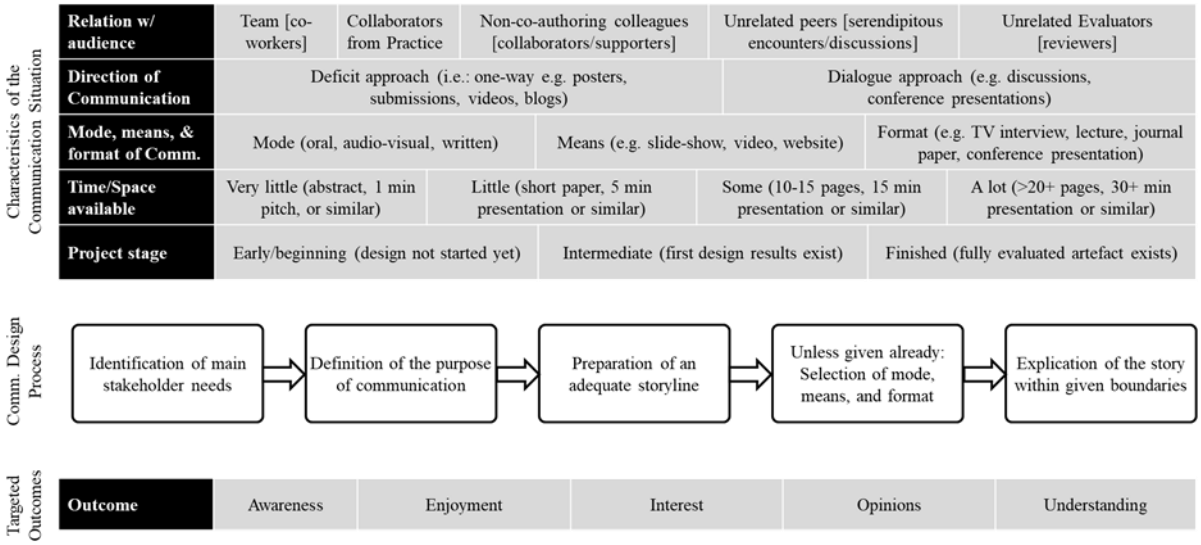



*Figure 49: Final Problem Space Conceptualization, as Featured in Section 5.1*

# Appendix H Supplemental Material of the Expert Interview Study

The expert interview study presentation, as presented in Appendix A, contains references to supplemental material. This supplemental material is listed below in the following order:

**Section H.1:** The **briefing document** sent to prospective participants in the interview study. It contains a short description of the context (dissertation project), the study (expert interview study), the interview (requirements for participation, duration, general outline of contents), key terminology, and contact information.

**Section H.2:** The **semi-structured questionnaire** used during all interviews. It is split into three parts. The first part is about the researchers themselves (e.g., experience with DSR). The second part captures a narrative account of the communication situations throughout a design research project. The third part captures deep-dives into individual communication situations.

**Section H.3:** The **coding handbook** for the interview study. The coding handbook provides insights into how the qualitative data was analysed. In particular, it features some predicted code categories (1-5) and some emergent code categories (6-11). Each of the code categories features sub-categories (also emergent), which were used to accelerate the aggregation of the open coding.

**Section H.4:** The **summaries of the interview transcripts**. Considering the less than perfect text quality, the relatively low density of insights, and the length of the full interview transcripts, only summaries of the interviews are attached to this dissertation. The summaries are one to two pages long per interview.

## H.1 Briefing Document

Interview with Design Researchers

**Design Research Communication Use Cases**

About the larger research endeavour

Design science (DS), the domain that contributes to developing and reflecting Design Science Research methodology (DSR), provides guidelines on how to conduct design research (DR) endeavours. While there has long been a focus in DSR literature on developing guidance, some relevant processes are not yet explained. One of these is the process of communicating a research endeavour to various stakeholders (e.g.: project/evaluation partners, sponsors, communities of practice and science, or peers). This communication is not straight forward, and there is a lack of guidance as to how to do it. We intend to address and at least partially close this gap by providing guidance to design researchers for communicating their projects effectively.

**About this study**

To better understand the various communication use cases in which design researchers find themselves, we interview researchers who have participated in a design research project. Our interest lies on the most relevant communication instances, based on which we derive and evaluate a framework with the aim of differentiating use cases.

**About this interview**

To participate in this interview, you should have actively participated in at least one design research project. The interview will be semi-structured. We will therefore ask relatively open-ended questions. The underlying questionnaire is split into three parts (see below) and the duration of each interview is about 40 minutes. The interviews will take place electronically online.

**Part 1: Background information**

- What is your background regarding Design Research or Design Science Research?
- What is your experience in conducting Design Research?

**Part 2: Narrative account of a project and its communication instances**

- You will be asked to recall a design research project of your choice and indicate the communication instances (situations in which the project was explained or presented to stakeholders).

**Part 3: Characterization of 1-2 communication instances**

- What were your goals in these communication instances?
- For a selection of the 1-2 communication instances that were most central to your project, we will try to find generalizable characterizations that describe the use case.
- Questions on how the communication was constructed (e.g.: Which contents were relevant? In what order were they presented? Were some specific storytelling techniques used?)

**Key Terminology**

- **Design Research (DR):** Research aimed at creating projectable solutions to specific classes of relevant problems.
- **DR projects:** are temporary endeavours undertaken to create DR outputs.
- **Communication:** Process of transmitting information between stakeholders. Many different means can serve this end.
- **Communication instance:** Concrete instance of transmitting information between stakeholders.
- **Communication use case:** Class of communication instances that share certain characteristics.

**Contact and next steps**

Please contact Marcel Cahenzli for more information about this research endeavour and/or the interview. He can be reached via e-mail: marcel.cahenzli@unisg.ch

or telephone: (+41) 07x xxx xx xx[2]. Thank you!

[2] Phone number masked here.

## H.2 Semi-structured Questionnaire

| **Introduction** |
|---|
| Presenting myself and what this research is about. |
| Building a connection: You have been involved in a design research project. Could you please tell me in a few sentences how you got in contact with design research and what role it plays in your work-life? |
| As you know from the briefing document, this interview is part of a larger research project and we gather data on communication instances. In other words, we try to understand the situations in which you and other design researchers explain your project to others. Based on your answers we will define a set of characteristics that help differentiate between communication instances. Based on this research we want to find out which situations are most relevant, and what factors make communication successful in each use case. For comparability and purposes of analysis, I would like to stick to English and record our conversation. Your statements will be treated anonymously and confidentially. Do you agree with me recording our conversation? |
| To start with, I would like to specify some key terminology that will be used in the following. If something is not clear, please feel free to interrupt me at any point. |

| **Definitions** |
|---|
| Design Research (DR): research aimed at creating projectable solutions to specific classes of relevant problems |
| DR Projects – are temporary endeavours undertaken to create DR outputs. |
| Communication – is the process of transmitting information between stakeholders. Many different means can serve this end. |
| Communication instance – concrete instance of transmitting information between stakeholders |
| Communication use case – class of communication instances that share certain characteristics. |

| **Part 1: Background information** |
|---|
| You have been part of a researcher team that conducted at least one design research project. If you have been part of several projects, please select the one you are most familiar with or the one you remember most clearly. What would you say was your role in that study? What activities were your responsibility? Which ones were not yours? |
| Have you reviewed a design research paper or project in the past? Have you noticed some major difference between DR papers and non-DR papers? |
| How many DR studies have you been a part of? |

| **Part 2: Narrative account of a project and its communication instances** |
|---|
| Please select one project you have been a part of and tell me about the various situations along the project's lifetime in which the project was explained or presented to certain stakeholders. In other words, I would like you to recall the timeline of that project, but not focussing on the content, but rather on the communication instances. |
| Among these communication instances, which ones would you consider having been the most important ones and why? (aim for 2 instances) |

| **Part 3: Characterization of 1-2 communication instances** |
|---|
| Part 3.1: Instance 1 |
| What did you intend to achieve with the communication instance? |
| How did you approach the communication instance? What were the main steps? |
| What did you actually communicate? (content) |
| How would you characterize the communication instance? What were its main features? |
| Comparing this instance with projects that are not DR, what are the most relevant differences? |
| If not mentioned: Can you please elaborate more on … |
| ... the relation with the audience? Who is it and what role did it play? |
| ... the direction of communication. What was the effect of having one-/two-way communication on the way you approached it? |
| ... the mode of communication. What was the effect of having to use/using oral/audio-visual/written/* communication over other modes? |
| ... the role that the time/space availability played? Would you have approached it differently with more/less time/space? |
| ... the role that the stage of the project played? What was peculiar about communicating an early/intermediate/final-stage project over an early/intermediate/final-stage project? |
| What other factors played a role in how you approached this communication instance?<br>What made a communication instance successful or unsuccessful for you? |
| Having reflected a bit on this instance, what would you do the same way again vs. change? |

| **Part 3.2: Instance 2** |
|---|
| What did you intend to achieve with this communication instance? |
| How did you approach the communication instance? What were the main steps? |
| What did you actually communicate? (content) |
| How would you characterize the communication instance? What were its main features? |
| Comparing this instance with projects that are not DR, what are the most relevant differences? |
| If not mentioned: Can you please elaborate more on … |
| ... the relation with the audience? Who is it and what role did it play? |
| ... the direction of communication. What was the effect of having one-/two-way communication on the way you approached it? |
| ... the mode of communication. What was the effect of having to use/using oral/audio-visual/written/* communication over other modes? |
| ... the role that the time/space availability played? Would you have approached it differently with more/less time/space? |
| ... the role that the stage of the project played? What was peculiar about that stage? |

| |
|---|
| What other factors played a role in how you approached this communication instance? |
| Having reflected a bit on this instance, what would you do the same way again vs. change? |

| **End** |
|---|
| Is there something else you would like to reflect upon concerning the communication of design research projects? |

## H.3 Coding Handbook for the Interview Study

The coding of the expert interview transcripts (see: Appendix A) was done in the qualitative data analysis and research software Atlas.ti. Considering the wealth of information in the transcripts and hence, the anticipated large number of codes, the author decided to use pre-fixes for codes that fall within similar categories of content. Some of these categories were specified based on the author's intuition after having conducted the interviews (1-5), whereas the others emerged throughout the coding activity. The high-level code pre-fixes used in the coding of the transcripts are:

1. **Communication Instances:** The pre-fix 01_ announces that the subsequent codes and the underlying text in the transcripts refer to a communication instance type. There may be many such types, which could be identified and characterized by analysing the transcripts. Examples for codes that fall under this pre-fix are: briefing of evaluation partners or discussion with experts.
2. **Content Selection:** The pre-fix 02_ indicates that the respective codes and text sections discuss contents that were communicated. Such codes include: Description of the artefact's utility, plan for distributing the artefact, or existing design knowledge.
3. **Selected Storyline:** The pre-fix 03_ stands for codes that relate to elaborations of storyline. Hence, the related text sections indicate that the interviewees described the milestones and order in which these were to be reached within a communication instance. An example of this is: Devise a quant/qual paper, focusing on evaluation and featuring design principles as side-products, in order to get into high end journals. (Notice that these codes are relatively lengthy.)
4. **Specific Techniques:** After the pre-fix 04_ are codes that summarize a technique used by the interviewees to get their messages across and to reach their communication goals. Examples include: Degree of detail decreases with distance in time, or exclude examples because of little space available.
5. **"other":** The pre-fix 05_ stands for an interesting input within the transcripts that, at the time of coding it, does not yet fit any of the other categories. For example: Fear of practice partners turning away at DSR terminology. These codes were aggregated and appended to the other code groups in case they appeared to be important.
6. **Stakeholders:** Codes with the pre-fix 06_ indicate a stakeholder group. Examples are: Reviewers, supervisor, practice partners, or peers.

7. **Goals:** 07_ announces goals that the interviewees pursued with their communication activity. Examples are: Stakeholder alignment, build trust, or getting published.
8. **Stage of the Project:** 08_ indicates that the coded text section discriminates specifically between stages in the explanations of some communication-related phenomenon. Examples include: "early: not introduce unnecessary limitations e.g., of scope."
9. **Challenges:** Codes with the pre-fix 09_ were used wherever a specific challenge was mentioned. Examples include: Get complicated ideas across, How can I structure the communication?, or need to claim an impact on theory.
10. **Characteristics of Communication Situations:** pre-fixed with 10_, specific characteristics of communication situations are kept track of as well. Examples include: "Proposals: there's no second chance and therefore, things need to be very clear in the text" or "Journal Paper: is 'much bigger' than other outlets"
11. **Coping Strategies:** Statements that answer the question of how the interviewees cope with the challenges, with a particular focus on their suggestions as to what worked for them, are pre-fixed with 11_. Examples include: Be highly explicit in one-way communication, use DSR methodology to frame clearly communicable steps, or specify not only what is meant, but also what is not meant, in order to increase clarity.

This remainder of this appendix features the coding framework based on these categories. In some categories, there were sub-topics that emerged. Those were given names as well and they contain the primary categories' code number. Not only are these categories and sub-categories or "code groups" named below, but the association criteria for each code group are provided as well. The dataset of 11 interview transcripts has yielded 719 primary codes and 130 code groups (most of which are listed below).

### H.3.1 Communication Instances

| Code | Definition |
|---|---|
| **01** | 01 stands for 'communication instances' and it precedes codes that help answer the question of what communication situations exist. |
| **01_acquisition of resources** | This code was used, when the communication instance was directly related to the acquisition of resources such as project partners, workers, or financing. |

| | |
|---|---|
| **01_meetings with collaborators** | Communication instances that relate to situations where the audience is part of the team or contributors in an ongoing project, this code group was used. |
| **01_(Open) discussion** | Non-committal discussions such as at a panel discussion are associated with this code group. |
| **01_Practice oriented outlets** | Whenever a specific outlet for practitioners was mentioned, the codes used were also associated with this group. |
| **01_Academia oriented outlets** | Same as above, but with academic audiences. |
| **01_Proposals** | Research proposals were associated with this group. |
| **01_Short summary or breifings** | Very short communication instances such as an update or a summary of the status quo are associated with this group. |

### H.3.2 Content Selection

| Code | Definition |
|---|---|
| **02** | 02 stands for 'content' – primarily answering the question of 'which content was communicated?' A related question that is answered within the 02 category is 'What helps decide which content was communicated?' |
| **02_(sel. crit.)_Audience specific selection** | Content selection for the communication was somehow a direct result of the consideration of the audience. Notable representatives of this category include: "I choose different content for practice than for academia, because of ___. For practice I choose ___. For academia I choose ___." |
| **02_upcoming activities** | The content of communication referred to in the interview revolves around the next steps (such as: alignment, planning, or brainstorming on next steps). |
| **02_Assumptions/pre-knowledge** | This code engenders instances where it was openly discussed which assumptions are adequate (or maybe true) as an active content element, as well as the existing knowledgebase that is used by the researchers, as a passive content element. |
| **02_Guiding Elements** | Contents whose primary purpose is to guide the audience may be inserted here. These include examples from other domains, presentation of interesting cases, stories, introductions, and the like. |
| **02_Theory/-ies** | If some theory or theoretical backgrounds are suggested as contents, this is the category that captures this. |
| **02_Object of desired feedback** | Codes that relate to objects for which one desires feedback in the communication. |

| | |
|---|---|
| **02_Motivation of study** | Providing a reason as to why this particular study is relevant. |

### H.3.3 Selected Storyline

| Code | Definition |
|---|---|
| **03** | Specification of storyline chosen by the interviewees. This code is used if the interview sheds light on how contents of the communication were compiled/ordered to form a story. |
| **03_01_Beginning/Early** | The content aspect with this code is presented to the audience at a very early stage of the communication instance. |
| **03_02_Middle** | The content aspect with this code is presented to the audience in the middle stage of the communication instance. |
| **03_03_End** | The content aspect with this code is presented to the audience toward the end of the communication instance. |
| **03_Argumentation chain that integrates partner's challenges** | Ensuring that the practice partner's actual problems are featured in the story. |
| **03_Artefact_Purpose_ Evidence** | This code stands for the generic order of presenting the artefact first, explain its exact purpose and show evidence for it to reach its purpose. |
| **03_Phenomenon_Theory embeddedness_contribution** | This code stands for the generic order of presenting the phenomenon, explaining the theory support and embeddedness of the artefact and its creation, as well as the explication of the contribution (in particular to theory). |
| **03_Use Steps/Phases** | Code contains statements that hint to the practice of splitting the communication content into project phases or steps to guide the audience through the content. |
| **03_Sideline 'DSR' and focus on behavioural study** | If the communication contents focus on a quant/qual study within the DSR project and the DSR-part is omitted or marginally mentioned. |
| **03_Whitepaper-style** | Framing is done as in a white paper – usually this code applies to practitioner-oriented communication. |
| **03_Overall goal_next iteration_upcoming tasks** | Descend in the abstraction level while increasing specificity toward the current state of the project (for ongoing projects). |
| **03_Use idol paper for structuring contents** | This code is used if the structure of the content is inspired by or copied from another paper (usually from the same outlet). |

| | |
|---|---|
| **03_Prototype-driven vs. Exemplification** | This code is used for comments that focus on the driving role of the prototype (is it the driver, or the instantiating example?) |
| **03_Frame the project as a sales pitch** | If the comment by the interviewee indicates that the communication was geared toward 'selling' their project (and probably also the solution) to the audience for reaching their goals, this code is used. |
| **03_Present artefact creation process transparently** | If the comment suggests that the creation process of the artefact should be presented transparently to reach their goal (e.g., foster understanding), then this code is used. |

### H.3.4 Specific Technique

| Code | Definition |
|---|---|
| **04** | Specific techniques: Codes starting with 04 relate to techniques used to convey ideas or content in general. It responds to the question: How was the content (02) in its plot-line (03) operationalized as a narration/story? |
| **04_P (vs. 04_S, vs. A)** | P (S, or A) stands for practice-facing communication (scientists-facing and agency-facing respectively). |
| **04_f2f** | F2F stands for face-to-face and means that the code following this prefix is situational to f2f instances. |
| **04_p_illustrate the artefact** | Comments advocating for actually showing the artefact (rather than describing it through diagrams or constructs). |
| **04_f2f_add excurses when needed** | This code contains statements that indicate that once lacking understanding is identified, additional excurses and explanations are to be provided (as opposed to e.g., trying to provide all context/explanations, or to stick with contents). |
| **04_Anticipate and answer potential questions** | Statements indicating that the content should be 'bullet proof.' (Notice: this is a general strategy for paper-writing.) |
| **04_seeking feedback/open formulations** | |
| **04_Be carful about the limitations of the paper** | Code for comments in which there is an argument for positioning one's work as being 'how it should be.' |
| **04_A_Go for high specificity** | Provide a lot of (procedural & technical) details. |
| **04_S_Creating trust in the process (rigor)** | This code summarizes statements about a science-facing effort to establish that one's methods were suitable and adequate. Language used, vision, or purpose are not that important here. |

| | |
|---|---|
| **04_Decide on a story independently of mode** | Statements indicating that it doesn't matter what mode of communication is available, when it comes to crafting a story. |
| **04_Temporal distance as a measure for level of detail** | The further away an event is, the lower the level of detail provided, whereas immediate next steps are very detailed. |
| **04_P_Explain research process, but at a higher level of abstraction** | If the practice-facing communication did include the explanation of the research processes, but only at a very high level of abstraction, i.e. letting them know about the big picture, but not such that they could actually replicate it. |
| **04_Tell an interesting story** | |
| **04_P_Fill uncertainty with other evidence (lit.) and state that it is an early stage** | Comment on how to deal with uncertainty about the upcoming work/stages of the project – where one part of the solution is to state that this is normal and the other part is using literature to avoid perceptions of being lost. |
| **04_Grasp the attention in the first sentences** | Comment on how the start of the communication is to be captivating. |
| **04_use illustrations to make sure people notice key elements** | Comments that hint to aspects of the content being lost and that it is the researcher's task to make sure that this does not happen with key elements. |
| **04_A_Use low specificity to ensure completeness without overpromising** | E.g., outlining benefits for practitioners and that the artefact supports them in a specific activity – that the artefact may guide them – without explicating how it will do that. |
| **04_Provide summary instead of fully detailed (e.g., list of features)** | If in the central story not all the work results are presented, but the entirety of the work results is indicated as a summary e.g.: by showing certain candidates, but not all of them. |
| **04_Mirror (the language of) the audience** | Comments that indicate that one adopts traits or characteristics from the audience such as their language, colour coding, visions, and metaphors. |
| **04_If possible, refer to appendix/further resources rather than packing the instance** | Comments on isolating certain contents and referring to them, without presenting them explicitly and directly. |
| **04_Align viewpoints by saying both what it is, and what it is not** | As a strategy to overcome the distance between practice and research or even between fields of research: State what you are NOT going to do as well, allowing for better alignment. |
| **04_Use abstraction layers to shorten or lengthen story** | |

| | |
|---|---|
| **04_Tell the story from the 'customer' POV to show the need for the project.** | Comments that suggest not to use one's own terminology and analogies, but rather the ones the 'customer' (main stakeholder) is familiar with. |

### H.3.5 "Other"

| Code | Definition |
|---|---|
| **05** | 'Other' category – i.e.: whatever comments seemed interesting, but were not associated with any of the other categories is tagged with 05. |
| **05_Terminology** | Captures considerations of terminology, be it DSR terminology or other terminology used in communication. |
| **05_Proposition of Solution** | This code is set for comments by interviewees that contain some proposition as to how communication could be improved or simplified in some way. |
| **05_Problem specification** | For comments that add details to the problem of communication in design research. |
| **05_Practice vs Academia Considerations** | For comments that elaborate on differences and similarities between practice-facing and academia-facing communication. |
| **05_How to cut volume** | For hints on how to communicate one's projects while satisfying the audience's requirements and adequately representing the project. |
| **05_quant/qual/beh. paper** | For comments on splitting a project into quantitative or qualitative behavioural studies. |
| **05_Feedback** | Contains comments that refer to the role of feedback. |
| **05_Time/Phase dependent change** | Contains comments on how the progress in the project or the passing of time affected the communication practices, contents, and maybe even the direction of the project itself. |
| **05_DSR vs. explanatory research** | Contains comments on differences between communicating DSR projects vs. explanatory research projects. |
| **05_Field of Research Considerations** | Comments on differences in Field of Research such as: in IS DSR terminology is accepted now, but not in e.g., HCI. |
| **05_Incentive structures** | Comments on incentives by the interviewee's institution and how this affects their approach or considerations regarding communication activities. |

### H.3.6 Stakeholders

| Code | Definition |
|---|---|
| **06** | 'Stakeholders' are put into the 06 category. This summarizes the kind of stakeholders (groups) and possibly the way in which their views may differ. The primary |

| | |
|---|---|
| | focus is on capturing the richness and variety of stakeholders of DR project communication. |
| **06_Academia** | Contains explicit reference to 'academia' (incl. 'researchers' or 'science'). Notice that this is a 'catch-all' category. |
| **06_Practice** | Contains explicit reference to 'practice.' |
| **06_Academia vs. Practice** | Contains academia and practice with some kind of assessment as to how these relate/how they differ. |
| **06_Specific audiences of outlets** | Refers to comments that indicate that despite being of the same category (e.g.: conference) the audiences and their expectations |
| **06_...** | (Self explanatory – code = category of stakeholders) |

### H.3.7 Goals

| Code | Definition |
|---|---|
| **07** | 'Goals' indicate what the interviewees intended to achieve through their communication efforts. |
| **07_time from the audience** | Refers to comments that state that the time of the audience is somehow the target outcome – i.e. that the/some members of the audience commit to give their time. |
| **07_Reach alignment** | This might be alignment such that everyone understands the same thing in the same way, or that the participants co-create a shared understanding of the object of interest. |
| **07_Allow audience to form an opinion/to give feedback** | If the goal was that the audience really understood things such that they could mirror their perceptions of e.g., usefulness. This code may appear mostly in the context of evaluation or in early stages – shaping a project. |

### H.3.8 Stage of the Project

| Code | Definition |
|---|---|
| **08** | 'Stage of the project' indicates the influence of the progress or current phase in the DSR project. |
| **08_General insights** | For comments that summarize a general influence of the progress on communication. |

### H.3.9 Challenges

| Code | Definition |
|---|---|
| **09** | 'Challenges' – indicating specific difficulties that were mentioned by the interviewees regarding the communication of their projects in various contexts. |

| | |
|---|---|
| **09_...** | (self-explanatory names were used to build code groups that refer to the same challenges) |

### H.3.10 Characteristics of Communication Situations

| Code | Definition |
|---|---|
| **10** | 'Characteristics of communication instances' feature specific insights into characteristics of communication situations. The categories below are used to bring some order to the codes. |
| **10_Grant Proposal** | Grant Proposal-related characteristics |
| **10_Conference** | Conference-related characteristics |
| **10_F2F** | Comments on characteristics of face-to-face communication |
| **10_Internal meetings** | Communication situations with peers that work on the same project |
| **10_Journal Paper** | Journal paper-related characteristics |
| **10_Pitch Meetings** | Communication situations in which the research project was pitched |
| **10_Practice partner meetings** | Communication situations in which the researchers directly communicate with the practice partners involved in the research project. |

### H.3.11 Coping Strategies

| Code | Definition |
|---|---|
| **11** | Coping Strategies: What are your strategies to overcome difficulties in communicating? |
| **11_Not to publish DSR, but its constituents** | Coping strategies that suggest to publish constituents of a research projects as a coping strategy. |
| **11_Unclear how to convey a story that's simple to follow/understand** | Coping strategies that focus on how to overcome the problem of facing the uncertainty and emergence inherent in DR projects. |
| **11_How to deal with little time/space** | Coping strategies that focus on dealing with little time/space available to communicate one's project. |
| **11_unclarity what to keep and what to remove from the communication** | Coping strategies that focus on the logic used to select certain contents to be communicated or to be excluded from communication. |

## H.4 Summaries of the Interview Transcripts

In the following, summaries of the interview transcripts are provided. The summaries are structured as follows: An initial overview presents the interview case including the interviewee's affiliation to a university, the interviewees experience as a design researcher, the research project on which they focused throughout the interview, the number of codes that this interview contributed to the entirety of codes, the stakeholder types involved in their research project, and the specific instance that was discussed in detail (second half of the interview). Thereafter, the problematic activities, specific challenges, coping mechanisms, and ideas and suggestions provided by the interviewees are summarized.

### H.4.1 Case Summary – Interview 1

| **Institution** | **University of Saint Gallen** |
|---|---|
| **Experience** | Novice – 2y |
| **Research Project** | Designing a corporate agility maturity model based on a practice-oriented grant. The project is ongoing. |
| **Number of codes** | 110 |
| **Stakeholders involved** | - Grant agency<br>- Fellow researchers<br>- Practice partners<br>- Doctoral students/Lecturers of doctoral courses<br>- Person that is both familiar with practice and academia |
| **Specific instance** | Grant Proposal to Innosuisse. |

Selection of Content:

- What:
  - Convincing:
    - Research partner is able and suitable to generate necessary knowledge.
    - Practice partner is willing and able to produce and implement the solution to create a suitable evaluation. (This was a particular interest by Innosuisse – the specific grant agency.)
    - Explaining what the plan is and why this is sensible.
  - Project outline
  - Focus on benefits of a solving artifact
- Challenges:
  - Uncertainty about what contents must/should be presented.
  - It took a very long time to get all the information gathered and design decisions taken.

    - Only very little space available – e.g., no space for examples – space limitations were enforced with character limitations for the various fields.
    - Explaining why your doing this that way was very difficult within the character limits granted by the form.
    - Very little information available in the beginning of the project.
    - No access to past accepted grant proposals of that agency – therefor it was unclear what the expectations were, in particular regarding scope, level of detail, etc.
- Coping mechanisms:
    - Iterations with a consultant for grant proposals to that agency.
    - Iterations with more senior researchers and practitioners.
    - Specify in very few sentences what the problem and the intended way to a solution is by e.g., referring to study results in published literature to save space.
    - Not providing examples, as these take up too much space.

Ideas and suggestions:

- Presentation of an idea for an artefact
    - How: Initially tried to explain the methodological idea behind the artefact to practice partners.
    - Challenges: The practice partners did not understand correctly what the methodological idea was, and the slides did not adequately remove misunderstandings.
    - Coping mechanisms: Drawing the idea of the artefact onto a flipchart – i.e.: creating a somewhat tangible prototype of the artefact as a basis for the creation of a common understanding of the vision.
- It would be useful to present the project based on a use case scenario to better illustrate what the problem, the relevance, and the usefulness of the artefact is.
- Looking back, he would use more applicability examples – i.e. not focus so much on the expected benefits of the artefact, but focus more on how exactly the artefact may help/be applied by the stakeholders. This may include statements on what it is not (doing), such that the stakeholders don't get misguided into thinking that it is a panacea/solution for everything.
- In the early stages, over-precision is not desirable, as this limits the exploratory aspect of the research and inhibits development.

### H.4.2 Case Summary – Interview 2

| Institution | University of Saint Gallen |
|---|---|
| **Experience** | Novice – 3y |
| **Research Project** | Design of an adaptive writing support system. |
| **Number of codes** | 101 |
| **Stakeholders involved** | - Grant agency (local institution)<br>- Conference attendees (IS and non-IS conference)<br>- Conference reviewers (IS and non-IS conference)<br>- Practitioners at practitioner conference (Adeline Award)<br>- Author development workshop mentors<br>- Fellow researchers/Internal PhD seminar |
| **Specific instance** | Final journal submission at the end of the project. |

Selection of Content:

- What:
  - Focus on theory (or increase the focus on theory) rather than on transparency in presenting the artefact and its creation.
  - Focus on the process (rigor) rather than on the artefact itself (how does it look? How can it be implemented? How exactly will it work?) if publishing in IS.
- Challenges:
  - Conflict of interest: Strong theory contribution focus in reviewers of high end journals, but desire to transparently show and explain the development process by the researchers. Researcher wants to publish, but also wants artefacts to be replicable, useful, transparently understandable, etc.
  - Too much detail, too little focus on the theory – how can I structure the DSR project in one big paper?
  - Publish usefulness – of the artefact with DSR – or publish the truth in the sense of a theoretical contribution? In higher ranked publication, you have to make a theory contribution in the sense of answering a knowledge/truth-finding question and not usefulness. However, from a DSR perspective, usefulness is very important, posing a problem.
  - The outlet and the target group's or AEs' affinity to DSR must be taken into account when communicating. American journals may not be used to DSR as much.
- Coping mechanisms:
  - Organize the paper based on the steps derived Hevner's three cycle view. Steps are:
    - Problem formulation
    - Systematic literature review

        - User expert interviews
        - Deriving design principles based on the requirements
        - Instantiating the design principles and design features and an artefact – including evaluation
        - Refining the design principles
        - Evaluation
        - Documentation of design knowledge
    - Focus on the evaluation of the artefact and put almost everything in the appendix. The evaluation shall be included in the sense of testing a theory under the influence of the artefact (not the artefact per se).
    - I would try to look what people publish there in this Journal, which is similar to my project and then find idol papers and then do the same like they do. So I think the concept of idol papers is very important if you are publishing at places where you haven't published before and you have nobody in the author team who published there before. And probably that's the best way to then do it.

Ideas and suggestions:

- In general, the role of theory becomes an issue in higher outlets, where mere design (theory) is often perceived as insufficient and a contribution toward explanatory theory such as the kernel theory is somehow expected. (No coping strategy mentioned for this issue.)
- Instead of calling it a DSR study, he called it "theory-motivated and user-centred design" where they did a bottom-up and top-down and bottom-up approach at the same time (expert interviews; literature review; testing of low-fidelity prototypes).
- To reviewers that do not have a DSR background, a method for designing the artefact is more appealing/looks more like a contribution than the artefact or its design principles.
- Publish a quant/qual paper with the evaluation/experiments of the design knowledge rather than e.g., a DSR paper presenting the DPs. Instead, refer to: by the way, the theory/DPs we tested are X, they come from Y.
- Find an idol paper within the field/outlet you want to publish in and write the paper accordingly (regarding selection of contents, order of contents, structure of publication etc.
- Publish experimental papers (quant/qual) and the process itself. Divide the project into parts and publish them at different conferences (in different fields) and the overall project in IS.

### H.4.3 Case Summary – Interview 3

| Institution | University of Saint Gallen |
|---|---|
| **Experience** | Novice, 4y |
| **Research Project** | Smart Personal Assistant design |
| **Number of codes** | 46 |
| **Stakeholders involved** | - Scientific community (IS)<br>- Research team (internal, master students)<br>- Conference attendees & Reviewers |
| **Specific instance** | Internal communication with collaborators (weeklies, master students) |

Selection of Content:

- What:
  - Alignment on overall goal
  - Definition of goals until the next meeting (brainstorming-like)
  - Breaking goals down into tasks
  - Assignment of tasks
- Challenges:
  - Keeping the focus clear was a challenge.
  - In the beginning many steps of the process were uncertain or unclear. This poses a challenge to the alignment on the overall goal.
- Coping mechanisms:
  - Using a time limitation for the meeting (half hour or so) helped focus everyone on the most important topics and to reach the meeting's goals quickly. The definition of what's most important may be informed directly by the users (e.g., if they rank some design principles, one can start working from the most crucial one downwards).
  - Focus more on insights (rather than the results, i.e. the initial data).
  - The timeline was usually focused on the immediate past and (in particular) the immediate future, only glossing over the past and vaguely indicating the future.

Ideas and suggestions:

- At conferences or with professors, it is sometimes hard to break the project down, whereas it is easy to dive into details with team members, since these are aware of the higher-level plan and issues. That higher level is usually what can be discussed at conferences. (I.e.: the alignment of assumptions is much better in internal meetings and therefore, communication requires much less priming and suggestions or feedback is much more specific and useful.)
- Highly interactive communication with internal team members, as opposed to relatively sequential (presentation -> discussion) in conference settings. Perceived success factor was that everyone was able to add their thoughts at all

times. Basis for this was that everyone felt confident enough to tell their opinion and that there was no perceived hierarchic distance among the participants.
- For brainstorming/collaborative ideation it makes sense to offer something visual, some boundary object to which everyone can contribute (e.g., a whiteboard).
- As a young researcher you try to sell your stuff – so you tell people your work is rocket science. And there you wouldn't speak about weaknesses or limitations much, only providing general limitations that wouldn't weaken the paper. At later stages, that focus on reaching 'accept' is lower and the focus shifts to getting feedback. This may depend on the audience as well. Internally, communication would best be very open from the beginning, whereas with the supervisor sometimes it will be open (when you really want some feedback that guides you) and other times it will be selling (when you want to convince them of your work).

### H.4.4 Case Summary – Interview 4

| Institution | University of Saint Gallen |
|---|---|
| **Experience** | Expert, >20y |
| **Research Project** | Creation of an informal enterprise architecture management mechanism |
| **Number of codes** | 53 |
| **Stakeholders involved** | - (Potential) Author team members<br>- Practice partners<br>- Reviewers of academic outlets<br>- The wider scientific community |
| **Specific instance** | Comparative discussion of practice discussion vs. scientific publication |

Selection of Content:

- Challenges:
  - The longer a presentation (whichever shape or form) becomes, the less people can relate aspects of it and the more likely they are to get lost.
- Coping mechanisms:
  - Even in a half-hour talk, people get easily lost. They tend to forget what was said 5 minutes earlier and so the presenter has to provide some navigation support. Techniques for that are well known, including: structure through headings, navigator elements in charts, PowerPoint slides with a visual indicator on where one is in the presentation, …

Ideas and suggestions:

- The criteria to assess DR papers vs. non-DR papers are different, as descriptive research needs to be reviewed or evaluated against more or less completely

different criteria than design research. While both kinds of research are evaluated for relevance and rigor, the operationalization of the latter differs for each genre. In descriptive research, rigor is operationalized by the quality of the validation of the data, whereas in DR you have to provide a different kind of evidence for the validity of your insights.

- It is hard to prioritize certain communication instances. They are all important: you need practice collaboration. You need evaluation. You need to provide evidence for relevance. Having implemented the project somewhere is a key factor. At the same time, an academic publication was also necessary. It's hard to prioritize between these two – though those may form the most important two types of instances.
- It is crucial to get a practice partner to buy into the project. For this reason, there were several meetings in the beginning dedicated to really understanding the nature of their problem. We wanted money for it and we wanted their time, what was even more important: we wanted their data and so we had to not only generally, but very specifically exhibit why and how our solution would help. (Which requires researchers to understands the organization's problems well.)
- The way in which the artefact and the evaluation of the artefact are presented is more or less identical in the scientific publication and for the practice communication (though the level of detail may be different – e.g., less into the construction but more the evaluation of the effects for practice).
- With the practice partner it is important to talk in their language, use their terminology, colour coding, and metaphors, fitting their way of thinking, providing examples from their environment, to make it tangible - whereas such aspects can be neglected in scientific communication. In scientific publications, the audience is able to translate the language into their own and they are more interested in the process and the rigor (method). It is not about a convincing vision, but about building trust into the process and being transparent on how the result was created and evaluated.
- The story one wants to tell depends on the purpose of the communication (which is based on the stakeholder needs). Beyond that, it doesn't matter what mode of communication is used, e.g., PowerPoint vs. whitepaper vs. oral pitch. In more detail, there may be more formal expectations depending on the mode, such that in written you may be expected to present limitations – but the main story should be the same.
- I think a design story is always a story about a problem: Why is it a problem, what is the essence of the problem, what is the basic mechanism to approach the problem, how does a solution look like, and what utility and effect does it have? For me, that's the central elements of a design story. Essentially: Understand the problem and talk about what and how construction was made and how and to what extent utility is provided.

### H.4.5 Case Summary – Interview 5

| Institution | Victoria University of Wellington |
|---|---|
| **Experience** | Expert, >10 y |
| **Research Project** | How can a local (IT) project be taken to the global level – i.e. extend it throughout a corporation. |
| **Number of codes** | 45 |
| **Stakeholders involved** | - Practice partner (various stakeholders within this category)<br>- Evaluation partners<br>- Journal paper reviewers and audience<br>- Conference paper reviewers and audience |
| **Specific instance** | Evaluation of the artefact with evaluation partners |

Selection of Content:

- What:
  - Present the framework and give them time to ponder it (i.e. preparatory task)
  - Discussion on the framework and answering questions by the researcher
  - Goal was to elicit opinions on utility and improvement potentials
- Challenges:
  - Catch the attention to motivate people to participate
- Coping mechanisms:
  - Inform potential partners about the next steps and essentially what they would sign up for.
  - Making sure to address the stakeholders based on their needs and using their language. I.e.: show each stakeholder what is in it for them.
  - Skipping stuff they don't care much about – e.g., how the artefact was created.

Ideas and suggestions:

- F2f Communication: I could provide additional examples on how something similar was useful in the past/other areas to win over sceptics, which I can't do otherwise.
- Take your time with writing the journal paper: You have to do all the work beforehand and condense everything to very short sections.
- One should investigate what kinds of work is being accepted where one is intending to publish.

### H.4.6 Case Summary – Interview 6

| Institution | University of Kassel |
|---|---|
| **Experience** | Expert, >10y |
| **Research Project** | Creation of an application that supports employees in repairing cars. |
| **Number of codes** | 49 |
| **Stakeholders involved** | - Project partners (related projects within the same funding)<br>- Conference reviewers and audience<br>- Journal paper reviewers and audience<br>- Grant agency<br>- Fellow researchers/scientific community |
| **Specific instance** | Writing of a research paper. |

Selection of Content:

- What:
  - (Lower end publications/conferences): Prototype-driven publications. This is not going to work for high-end journal papers though.
- Challenges:
  - Being prototype-driven throughout the project, it is a challenge to reach generalizable design knowledge. (No effective coping strategy for that found yet.)
  - In journals it may be better to publish a method toward the prototype, rather than focussing on the prototype itself. However, it is a great challenge to evaluate methods. This is a pertaining difficulty.
  - Despite reviewers of journal articles are generally doing a good job, it may happen that the most important aspects form the authors' perspective are not perceived as central aspects (or are being glossed over by them).
  - In a journal paper, there is so much information that is required (projects tend to yield huge amounts of information that must be reported on), that reviewers and readers might get lost easily or skip important parts.
  - In a journal paper, you are expected to do things correctly (i.e. in the 'right' way). You can therefore not address certain open questions and must be very cautious about discussing limitations. This is a challenge in design research in particular, as there are usually many ways that lead to utility and that are valid.
  - We don't know exactly at what level of abstraction we should communicate the design knowledge in the end. In behavioural studies it is clearer what people want to see, but in DR this is more of a challenge. Everyone seems to make design principles now – which become trivial at higher abstraction and useless at lower abstraction. We still need to figure this

out. How can we document and communicate design knowledge to make sure that people can really systematically build on it and enrich it? How can design knowledge be passed on such that it is really usable and easily usable? We should find a level of practical guidance so that it can be easily used, but at the same time not be trivial.

- Coping mechanisms:
    - Focus in journal papers more on meta requirements and then seeing the prototype as one possible instantiation of this research problem.
    - Find an idol paper the reviewers may be familiar or comfortable with.
    - Use illustrations (e.g.: tables, graphs, pictures) for the most important aspects – the ones reviewers should not overlook.
    - In journal papers, one can build a story that allows to guide readers trough the most important aspects coherently, whereas further information and detail that might lead to confusion or make the story boring, can be put into the appendix.
    - Formulate the journal paper such that it is positioned as "this is the way we did it and this is the best way to do it."

Ideas and suggestions:

- In general I think what we made good experiences with is framing the whole project as a design science project, because it kind of gives you a nice framing with clearly communicable steps, so you can for example, take the Peffers approach or the three cycle view of Hevner and then you can easily visualize different steps that you take and that that also helps in the in the beginning, for example when you write grants. It communicates that it seems that you know exactly what you're doing, so it's a very structured way, so that helps a lot.
- In the conference paper a lot of focus was on this one prototype. So to show that our that our approach helped but we didn't provide a lot of insights helping people to replicate our approach on their own. So at least that was our feeling.
- In the Journal Paper we put more emphasis on this whole process view. So really providing a method with I don't know five or six steps that people should subsequently go through with certain guiding questions and also help with methods they could use in each step - leading them to our prototype. And then we again used the evaluation for the usefulness of the prototype. However, it is quite challenging to evaluate a method.
- In a journal paper, space limitations do not affect the selection of content as much (i.e.: all information for decent replicability can and should be included, which is not the case or not possible in conference papers). In cases where space limitations are harsh, one may communicate the project such that they know the steps you took and they can think of what they believe those steps are and what one may have to do, but not providing them with the details that really gide others through the process.

- The communication has to be very clear and precise, especially in the beginning (e.g., of a paper) and in a non-journal context. In the journal context, the audience may pay enough attention. (For conferences, for example, I always expect that the reviewers don't really pay attention, so it needs to be very clear and precise, just to make sure to not confuse someone at the beginning right away. So from Journal reviewers, I expect that they read it with more detail. Still, you need to make sure that for example, key elements are provided in tables or in figures, just to make sure that people really notice them and are not just reading over it. So for example: We had a discussion at a conferences, where we presented the work where people then said well you should maybe first focus on measuring the culture gap or something like that which is just not what we wanted to do or what the water project was about, but that kind of indicates that maybe we weren't able to communicate that clearly what we wanted to achieve and why we did what.)
- To keep the contents reasonably short: Even in the end of a project, we would probably still present the requirements or meta requirements that inform the design. But it's not like that we would talk a lot about how for example the single interviews worked. We would prbably have a short method section on this and then say well, we had 20 user interviews with an averag lenth of x. We used method y to analyze them. We would not go into detail on how we derived the requirmenets though. Still everything is presented – but shorter.

### H.4.7 Case Summary – Interview 7

| **Institution** | **University of Saint Gallen** |
|---|---|
| **Experience** | Novice, 3y |
| **Research Project** | How can wearables effectively change users' health behaviors? |
| **Number of codes** | 34 |
| **Stakeholders involved** | - Research Council<br>- Practice partner (incl. UX and development employees)<br>- Implementation partner<br>- (prospective) Users<br>- Government agencies<br>- Research community and peers<br>  o Conference (reviewers and participants)<br>- Professor/supervisor, PhD courses |
| **Specific instance** | Conference paper and *pitch to implementation partner* |

Selection of Content:

- What:
  - Sell the project with a hypothetical artefact (isn't built and tested yet) as a finished project. (Probably not going to get through because of that, but try it anyway.)

    - *Sell the project, such that the implementation partner may implement it based on the guidance from the project.*
    - *Strong focus on the problem and alignment of the understanding of the latter.*
    - *Less focused on principles, but showing how many problem classes are touched and how the artefact(s) can be used and what exactly they are/do.*
- Challenges:
    - Harsh space limitations (12 pages for ECIS) for conference papers.
    - It is not self-evident to realize which aspects of the project are really interesting or necessary to the reviewers. Since there is latency in this feedback process (i.e. the reviews are sequential and may not allow for subsequent corrections), this poses a challenge.
- Coping mechanisms:
    - Cut all illustrations and tables – only keep what's crucial, maybe the requirements-principles-features map.
    - Choose a model paper to rebuild in some sense.
    - Cut out things that have been said many times before – e.g., cut the explanation on the methodology or the procedures if you use, e.g., Peffers et al. anyway. Just make sure that this only applies to a context where the audience is very likely to be familiar with the bits you cut – e.g.: in a DSR track at a conference, Peffers et al. might be expected to be known, but not so much at a generic IS journal. The same goes for theories, especially ones that are established in the respective field.
    - Cut the background section short to the essentials: What is the gap? Where does this article contribute to? (vs. reproducing what has been said)

Ideas and suggestions:

- For practice: About the method – I always tell everyone it's a problem-solving paradigm and you look at the problems and then come up with solutions. So, they don't really care a lot about the methodology, I would say. What is important though is that they gain the conviction that there is scientific grounding (which can be operationalized by inserting some name of a theory here and there, but not necessarily with describing the methodology).

### H.4.8 Case Summary – Interview 8

| Institution | Saarland University |
|---|---|
| **Experience** | Expert, ~10y |
| **Research Project** | Design of an assistant/support in an information system. |
| **Number of codes** | 24 |
| **Stakeholders involved** | - Industry partner (employees and management)<br>- Focus group participants<br>- Interview partner<br>- Conference publication (reviewers and participants)<br>- Journal paper (reviewers and readers) |
| **Specific instance** | Conference and journal paper publications |

Selection of Content:

- What:
  - Design principles
  - Evaluations 1 and 2
  - Combined findings
- Challenges:
  - Individual pieces of a DR project are difficult to 'sell' to journals, especially high-end journals.
  - Space limitation is a big problem and may even mean that some outlets are not available for publishing full DSR project papers. Projects could only be presented at a very high level of abstraction, becoming unscientific in its precision.
- Coping mechanisms:
  - Write up the individual pieces in combination, such that one big story emerges. This worked well for a Basket Journal
  - Try to go for an outlet that allows you to add enough content for the full story to be communicated.
  - Focus on the essential aspects and cut out what does not fit that criterium. E.g.: literature review, some design cycles, etc. may be cut nearly or actually entirely.

Ideas and suggestions:

- To get the buy in by the practice partner is crucial. i.e. to get access to data in exchange for some benefit. To reach that agreement, it has to be clarified what that benefit for the practice partner may be.
- Different content for different audiences. Notably for managers, there was no talking about the grounding in theories – but rather 'we grounded it in research, it should work' and then get to the point of committing to implement the project. Hence, the content is presented more pragmatically to practitioners,

whereas for academia, there is more need for explanations about the technical backgrounds.
- In non-written circumstances, complicated content can be rephrased, examples can be provided (also unusual ones, e.g.: cooking recipe), or one can draw some sketches, which helps bring the point across based on the specificities of the audiences. (Since one can get visual feedback on whether they understood or not.)
- Early on, focus on promising "to solve a problem" without much specificity – and once mock-ups or tools exist, swich to using these as central hooks for the storylines.
- You need to understand the project in order to communicate it so if you're not able to communicate your project, it might be that you do not fully understand it yet.

### H.4.9 Case Summary – Interview 9

| Institution | Karlsruhe Institute of Technology |
|---|---|
| **Experience** | Senior scholar, >20y |
| **Research Project** | How to simply access controlling data beyond spreadsheets for use within the company? |
| **Number of codes** | 35 |
| **Stakeholders involved** | - Practice Partner<br>  o Steering board<br>  o Employees/interviewees<br>  o Person with background in academia working there<br>  o Corporate research (sponsor)<br>  o users<br>- Focus groups |
| **Specific instance** | Communication with practice partner (4-weekly project meetings) |

Selection of Content:

- Challenges:
  - Practitioners always have a latent concern that universities tend to not deliver tangible things. Just papers and a lot of abstract things, but nothing real.
- Coping mechanisms:
  - If you have little time available to present to
    - practice, then the best thing is to show the prototype or artefact. Because that is what people can touch, so to say. When you have more time, then you can tell the bigger story and motivate etc.
    - academia, then you should focus on what the audience values most. In CS they value the prototype, but in IS they don't care

about the prototype. The framing of your story becomes a strategic decision based on the audience.

- The strategy I always try to push for is to deliver very tangible things to the practitioners (e.g.: mock-ups, prototypes). This is important to show progress and this allows them to develop more trust and to stay committed.

Ideas and suggestions:

- With practitioners – summarize the main ideas on some PowerPoint slides that are easy to understand for them.
- When the artefact is not started yet: Pitch work packages showing the activities, a timeline, and maybe a very abstract idea of a solution. People in practice like these kind of work packages and deliverables. Even if I don't know what exactly I will deliver, I just call it deliverable prototype and then they're happy.
- You need to demonstrate progress. You need to ensure that they trust you, that you deliver something at some point, and the best thing you can do is to give them something to eat. And this is what we did. And we progressed with the prototype, got valuable feedback from them. That was really helpful and honestly, I'm not sure there is so big of a differences in terms of communication of empirical study versus design science study. You also need to describe the problem and you need to describe the key deliverables that you will deliver.
- My standard procedure with practice partners is to create some slides and present them in a meeting. I avoid writing reports for them because the academic papers, I have to write them anyhow, but it's a different audience. So I'll write them differently. And I don't see any big value to write big practical reports for companies, as they probably won't read them.
- With practitioners you need to talk differently than with academics. You pick different content and you pick a different language.
- Computer science is different from IS. No one cares about DSR – so you don't name it. There is not this need to mention theory and you don't articulate explicit knowledge, only a very short, compressed related work section. Instead, you propose your artefact, evaluate it rigorously, maybe bring in some requirements as well – and you're done.
- In IS you focus more on the knowledger that is fed into the process (knowledgebases) and one has to make it more explicit and articulated that the contribution is a knowledge contribution (and not a technology contribution).

### H.4.10 Case Summary – Interview 10

| Institution | University of Nevada Las Vegas |
|---|---|
| **Experience** | Senior scholar, >20y |
| **Research Project** | Development of a software re-use and a performance measure for formalizing the production of reusability in software development. |
| **Number of codes** | 39 |
| **Stakeholders involved** | - Practice partner (interviews with management, developer/user)<br>- Whitepaper-style presentation (to practice partner)<br>- Conference (an abbreviated version of a research paper)<br>- Journal paper (presented as a case study) |
| **Specific instance** | Journal paper |

Selection of Content:

- What:
  - (academia): Present the artefact (here: re-use measure), its usefulness (i.e. the demonstration), and evidence for the usefulness (i.e. the evaluation results).
  - (journal): The goal is to get accepted by the reviewers – this drives the presentation: you want to cover your bases, make sure you're convincing.
- Challenges:
  - Space limitation and the fact that the case has to be convincing – while still showing usefulness (by allowing others to use/implement/re-create the artefact).
  - Journal paper is a one-shot game to get through to the (second) next round. Things have to be good enough the first time round.
- Coping mechanisms:
  - Focus on the evaluation, rather than the process on how to build the artefact. Not walking the reader through changes and dead ends along the way, but summarize what it took to build it and then spend a lot of time/space on demonstration and evaluation.
  - You try to be highly explicit in one-way communication – avoid misunderstandings or possibilities that some crucial information is missing by anticipating any questions and answer them as part of the presentation. (In two-way communication you can afford more flexibility in content selection.)
  - To cut the paper shorter, the first thing to go would be the development of the artefact – drop it or briefly describe the process. So long as there is a description of the artefact and evidence for its usefulness, not much is lost. Beyond that, it becomes difficult, as all other parts are necessary in

order to remain convincing. They must be shortened. Demonstration shouldn't be dropped – evaluation and introduction shouldn't be dropped either to make your case.

Ideas and suggestions:

- The 'final' presentation at the practice partner in the style of a white paper can be part of the evaluation for academic outlets. The measure's evaluation may be based on the assessment of the perceived utility – which may be gathered then and there through e.g., a survey or subsequent interviews – or a focus group. In other words, toward practice the content focuses on the artefact and the demonstration, and much less or not at all the evaluation.
- The communication instance you spend the most thought on is the journal publication of course.
- In design research, as opposed to explanatory research, there is much more in-depth communication and contact with the subject company. Such projects are more about understanding what's going on in the case company, developing an artefact within that context, and having all these different points of communication with them to do it right.
- To practice: If you don't talk about the evaluation, you may not talk about statistics either and there is no need to use DSR terminology. You may talk about design and designing.
- If the presentation is really short, you want to focus on the usefulness – just using a face validity argument if you don't have time for any formal demonstration.
- If the artefact exists, you need to show it. Otherwise, if it doesn't, you have to make a case for it. That's the first priority. Then the demonstration, and last priority is the evaluation, depending on how much time is available.
- To save time, you can omit details – not showing what you did, but saying what you did. Summarize the results of an action, rather than how the result was derived.
- While some papers (especially conference papers) don't contain an evaluation, I would always go for entire iterations and then present them. If it is a very large project, I would cut it by artefact – but each artefact ought to have gone through each step of an iteration.
- In the US system, there is no reward in conference publications. If time allows, a conference might be nice, but otherwise I go straight for a journal.

### H.4.11 Case Summary – Interview 11

| Institution | Raymond A. Mason School of Business |
|---|---|
| **Experience** | Expert, >10y |
| **Research Project** | Development of a monitored exchange platform for breast cancer patients. |
| **Number of codes** | 41 |
| **Stakeholders involved** | - Practitioners/(prospective) users, here: physicians<br>- Conferences (reviewers & audience)<br>- Practice partner<br>- Focus groups<br>- Patent office<br>- Local IS professors' conference<br>- Team (incl. one colleague that's from the medical field/non-IS)<br>- EHR companies<br>- Panel discussion participants |
| **Specific instance** | Three instances: Discussion with multi-disciplinary colleagues; high-end journal publication; conference publication |

Selection of Content:

- What:
  - Design is particularly hard if you are being asked to first of all ground your work in some sort of kernel theory. So, we have to explain that. Then we have to create this artefact and now they're asking for design guidelines either before or after. (…) And then two cycles of evaluation, right? It's a lot!
- Challenges:
  - "I don't work on anything unless there's a journal. I mean that's my currency (…) I get credit for journal articles, and conferences they don't care."
  - It is really hard to publish design research papers in our top journals.
  - Not all IS audiences are comfortable with DSR.
  - Interdisciplinary team members may have different associations with certain terms which causes misunderstandings.
  - "I think that part of the problem arises from us having to target certain journals and with limited real estate, right? It doesn't make sense and it doesn't move science forward. I have a huge issue with that, but it is what it is. That's what our deans look at. It's like at the end of the day, when the cookies are distributed, that's what matters, right? My approach has been

more pragmatic. I still do the work that I like to do, but I also do now behavioral work because I know that this will get published."

- Coping mechanisms:
    - Balance one's publishing efforts in top journals by submitting some non-DSR papers.
    - Engage in projects that contain a behavioural part such that you can focus on quant/qual and barely touching on the artefact. This increases the chances of getting it published in the top journals → making sure that there are hypotheses which are tested (based on the artefact) and therewith extend the literature.
    - If it's DESRIST, everybody is happy to hear about an artefact. It's a happy crowd and an appropriate crowd for what we're trying to do. If it's an IS journal, we're going to couch it more in what the theoretical contribution could be. It can still be DSR but it's going to have to have some theory wrapped around it.
    - Within the team, there should be a lot of discussions and everyone should freely comment on things they don't quite understand or see differently, to identify misunderstandings early.
    - Toward practice: drop all the theory, apart from maybe very generically introducing core ideas. Then focus on the problem and the need for a solution instead.
    - Only 7 Minutes at DESRIST this year → presented only Problem, artefact, design features, emerging propositions, focusing mostly on theoretical bases.

Ideas and suggestions:

- Communicate with people in the field about the ideas you have – as their perceptions might be completely different and they might find obvious barriers to the ideas/drafts right away.
- If you are going to work in healthcare (a different field), you need to have a clinician (or a person from within that field) on board, or no one's willing to give you money or to help you.
- Probably the most important communication is getting ideas and feedback from people at conferences. And that's not necessarily during the conference, but in the reviews.
- "Whatever I'm working on has to have a piece that's more behavioural that lends itself to publishing. I have gotten so many rejections for trying to publish design science and just finally, I hate to say, but I sort of gave up. I mean, if you look at the numbers – just the numbers are astounding. Not many [DR papers] hit."
- At MISQ, by the second round the technical part was in the appendix and the paper was no longer about the artefact. If one goes to Decision Support Systems, however, they tend to understand the design work. There is no need to

mention design science. In IS however, with all good intentions, we continue to put out these frameworks. But they just make it harder [to publish] because now you have all these boxes to check.

- "I remember with my PhD students… I get so frustrated because they didn't get invited to present to the conference and they'd spent the first 10 minutes on the literature review. I'm like: No one cares! I mean, I like to start my presentation with the end, like: 'this is what we found. This is why it's exciting. This is what we did and then end with like: here's the literature that we drew from.'"
- With multiple evaluation, it's like their own little studies, all of which are to be put into one paper, which frustrates many design researchers. In the second round MISQ rejection, they asked for another evaluation – but the problem then was that the paper was exploding. We had to take out a lot of the design theory – the argumentation on how we came up with the artefact – and put it into the appendix. This is heart-breaking.
- "We are IS professors, why don't we use technology more? Why don't we allow for links to videos or links to prototypes? I mean it's there, it exists. Why does everything have to be like this? It's like in the 1980s, I don't get it."
- "I just wish that we didn't have to communicate everything in one paper. So, what if we had a paper that just formulated the problem? Like the problematisation of what we want to study. That, to me, would be interesting to read and also would be related to research. And then we could have a paper that probably is not targeted to IS, but maybe computer science. That's the technical aspect. ACM Journal or IEEE journal. And then perhaps the evaluation comes back to IS.
- "We found that assistant professors and PhD (students) won't do design science because they're scared that it's not published. So, most design science work being done is being done by associates and above." (CAIS paper)

# Appendix I Supplemental Material for the Quantitative Analysis of Paper Structures

The quantitative analysis of paper structures presented in Appendix C, contains references to supplemental material, namely to the filled-in quantitative coding framework.

## I.1 Filled in Quantitative Coding Framework

The coding framework and the codes for each of the 19 research articles are presented on the following pages. The first line in the coding framework, where the name of the first author of the respective article is noted, identifies the article. The full references to which these first author names refer are listed below, in alphabetical order (as are the subsequently provided coding framework pages):

First Author Adipat

Structure

| Order | Code | Chars |
|---|---|---|
| 1 | 1 | 4000 |
| 2 | 2 | 410 |
| 3 | 5 | 790 |
| 4 | 4 | 2900 |
| 5 | 6 | 1160 |
| 6 | 4 | 23910 |
| 7 | 5 | 1020 |
| 8 | 6 | 14910 |
| 9 | 8 | 7810 |
| 10 | 10 | 14200 |

Structure Elements:

1 Problem description: What, why, who, where?
2 Objectives: Goal of the study, RQ
3 Requirements: Stakeholder's concerns and needs
4 Knowledgebase: How is the study informed? What exists?
5 Methodology: Which (generic) approach is used? (e.g. DSR, Peffers et al.)
6 Procedures: Description of actions, e.g. data gathering techniques
7 Iterations and Intermediate learnings
8 Results: Artefact description, demonstration, evaluation, contributions
9 Explication of DK: Formulation of DP, DF, and application of DK
10 Discussion: Limitations, avenues of further research

Detailed description of contents

Research Problem

| | |
|---|---|
| 1 | Description of the status quo/situation |
| | Description of the stakeholder (who is it?) |
| 1 | Naming the stakeholder (group) |
| 1 | Goals of the stakeholder |
| 1 | Challenges of the stakeholder |
| 1 | Context (what perpetuates/accentuates the problem situation?) |
| | Relevance |
| 0 | Effect size |
| 0 | Scope (how many are affected (adversely)?) |

Research Design

| | |
|---|---|
| 1 | Research objective (statement on what shall be achieved) |
| 1 | Research question (explicitly phrased RQ) |
| 1 | Reference approach (e.g. Hevner or Peffers et al.) |
| 0 | Description on how the existing knowledge base is used/searched |
| 0 | Requirements (are they discussed at all?) |
| 0 | Gathering requirements (how to they get them?) |
| 0 | Specifying requirements (how do they select the most important ones?) |
| 1 | Data gathering technique (which technique? for empirical data) |
| 1 | Justification for the data gathering technique (why this one?) |
| 1 | Specification on what data (type & content) is to be gathered |
| 1 | Data analysis (which technique?) |
| 0 | Justification for technique of analysis (why this one?) |
| 0 | Mapping data to design and development (how is data used?) |
| 0 | Description of design and development activities (how do they design the artefact?) |
| 1 | Description of the artefact (what is it and how does it work?) |
| 1 | Demonstration (why does it work? How to prove that it works?) |
| 1 | Evaluation (how is the artefact evaluated? Procedures) |
| 1 | Evaluation outcome (how to interpret results? When to re-iterate?) |
| 1 | Contribution to research (explicit statement on how the study contributes) |
| 1 | Contribution to practice (explicit statement on how the study contributes) |
| 1 | Limitations (what can the artefact not do/when does it not apply?) |
| 1 | Avenues for further research |

Terminology

| | |
|---|---|
| 1 | Explicit reference to DSR (here: Design Research, 'gestaltungsorientierte Forschung') |
| 0 | Use of the term "artefact" to refer to the result |
| 0 | Reference to the type of artefact (method, model, instantiation,...) |
| 0 | Primarily refering to the artefact as "artefact" (rather than more specific terms such as 'model') |

Style

| | |
|---|---|
| 5 | Effective use of titles [1-5: no titles (1) - some titles/hard to interpret (3) - effective titles (5)] |
| 1 | Examples were used **to illustrate important aspects** |
| 1 | Use of illustrations/graphical metaphors |
| 0 | Navigation support (e.g. agenda, forward-/backward references) |
| 0 | Use of quotes to illustrate context and use scenarios |
| 1 | An example was used **to set the scene**/introduce me to the topic/issue. (0=no, 1= yes) |
| 0 | A **running example** was used throughout the presentation (0=no, 1=yes) |
| 6 | Use of action and commentary [1-7: primarily describing actions (1) - balanced (4) - primarily explanatory commentary (7)] |
| 0 | Goal (the framing caters to: 0=transmit knowledge; 1=influence attitudes & behaviours) |
| 1 | Involvement of the audience (scale:1=not at all, 3=appeal to pers. experience, 5=asked to get involved/change beh.) |
| 1 | Active/passive speech (0/1) |

First Author Arazy

Structure

| Order | Code | Chars |
|---|---|---|
| 1 | 4 | 3490 |
| 2 | 2 | 1620 |
| 3 | 1 | 3980 |
| 4 | 2 | 300 |
| 5 | 7 | 13230 |
| 6 | 4 | 29620 |
| 7 | 5 | 3270 |
| 8 | 7 | 3670 |
| 9 | 9 | 5700 |
| 10 | 6 | 4460 |
| 11 | 10 | 16740 |

Structure Elements:

1 Problem description: What, why, who, where?
2 Objectives: Goal of the study, RQ
3 Requirements: Stakeholder's concerns and needs
4 Knowledgebase: How is the study informed? What exists?
5 Methodology: Which (generic) approach is used? (e.g. DSR, Peffers et al.)
6 Procedures: Description of actions, e.g. data gathering techniques
7 Iterations and Intermediate learnings
8 Results: Artefact description, demonstration, evaluation, contributions
9 Explication of DK: Formulation of DP, DF, and application of DK
10 Discussion: Limitations, avenues of further research

Detailed description of contents

Research Problem

| | |
|---|---|
| 1 | Description of the status quo/situation |
| | Description of the stakeholder (who is it?) |
| 0 | Naming the stakeholder (group) |
| 0 | Goals of the stakeholder |
| 1 | Challenges of the stakeholder |
| 1 | Context (what perpetuates/accentuates the problem situation?) |
| | Relevance |
| 0 | Effect size |
| 0 | Scope (how many are affected (adversely)?) |

Research Design

| | |
|---|---|
| 1 | Research objective (statement on what shall be achieved) |
| 0 | Research question (explicitly phrased RQ) |
| 1 | Reference approach (e.g. Hevner or Peffers et al.) |
| 1 | Description on how the existing knowledge base is used/searched |
| 1 | Requirements (are they discussed at all?) |
| 0 | Gathering requirements (how to they get them?) |
| 0 | Specifying requirements (how do they select the most important ones?) |
| 1 | Data gathering technique (which technique? for empirical data) |
| 0 | Justification for the data gathering technique (why this one?) |
| 1 | Specification on what data (type & content) is to be gathered |
| 0 | Data analysis (which technique?) |
| 0 | Justification for technique of analysis (why this one?) |
| 1 | Mapping data to design and development (how is data used?) |
| 0 | Description of design and development activities (how do they design the artefact?) |
| 1 | Description of the artefact (what is it and how does it work?) |
| 1 | Demonstration (why does it work? How to prove that it works?) |
| 1 | Evaluation (how is the artefact evaluated? Procedures) |
| 0 | Evaluation outcome (how to interpret results? When to re-iterate?) |
| 1 | Contribution to research (explicit statement on how the study contributes) |
| 1 | Contribution to practice (explicit statement on how the study contributes) |
| 1 | Limitations (what can the artefact not do/when does it not apply?) |
| 1 | Avenues for further research |

Terminology

| | |
|---|---|
| 1 | Explicit reference to DSR (here: Design Research, 'gestaltungsorientierte Forschung') |
| 0 | Use of the term "artefact" to refer to the result |
| 0 | Reference to the type of artefact (method, model, instantiation,...) |
| 0 | Primarily refering to the artefact as "artefact" (rather than more specific terms such as 'model') |

Style

| | |
|---|---|
| 5 | Effective use of titles [1-5: no titles (1) - some titles/hard to interpret (3) - effective titles (5)] |
| 1 | Examples were used **to illustrate important aspects** |
| 1 | Use of illustrations/graphical metaphors |
| 1 | Navigation support (e.g. agenda, forward-/backward references) |
| 0 | Use of quotes to illustrate context and use scenarios |
| 1 | An example was used **to set the scene**/introduce me to the topic/issue. (0=no, 1= yes) |
| 0 | A **running example** was used throughout the presentation (0=no, 1=yes) |
| 5 | Use of action and commentary [1-7: primarily describing actions (1) - balanced (4) - primarily explanatory commentary (7)] |
| 0 | Goal (the framing caters to: 0=transmit knowledge; 1=influence attitudes & behaviours) |
| 1 | Involvement of the audience (scale:1=not at all, 3=appeal to pers. experience, 5=asked to get involved/change beh.) |
| 0 | Active/passive speech (0/1) |

First Author Avdiji

Structure

| Order | Code | Chars |
|---|---|---|
| 1 | 1 | 3100 |
| 2 | 2 | 140 |
| 3 | 5 | 960 |
| 4 | 10 | 800 |
| 5 | 1 | 6420 |
| 6 | 5 | 1750 |
| 7 | 6 | 2010 |
| 8 | 4 | 3810 |
| 9 | 6 | 12940 |
| 10 | 7 | 45940 |
| 11 | 9 | 8970 |
| 12 | 10 | 23090 |

Structure Elements:

1 Problem description: What, why, who, where?
2 Objectives: Goal of the study, RQ
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Research Problem

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| 1 | Description of the status quo/situation |
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| 1 | Challenges of the stakeholder |
| 0 | Context (what perpetuates/accentuates the problem situation?) |
| | Relevance |
| 0 | Effect size |
| 1 | Scope (how many are affected (adversely)?) |

Research Design

| | |
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| 1 | Research objective (statement on what shall be achieved) |
| 1 | Research question (explicitly phrased RQ) |
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| 1 | Description on how the existing knowledge base is used/searched |
| 0 | Requirements (are they discussed at all?) |
| 0 | Gathering requirements (how to they get them?) |
| 0 | Specifying requirements (how do they select the most important ones?) |
| 1 | Data gathering technique (which technique? for empirical data) |
| 1 | Justification for the data gathering technique (why this one?) |
| 1 | Specification on what data (type & content) is to be gathered |
| 0 | Data analysis (which technique?) |
| 0 | Justification for technique of analysis (why this one?) |
| 1 | Mapping data to design and development (how is data used?) |
| 1 | Description of design and development activities (how do they design the artefact?) |
| 1 | Description of the artefact (what is it and how does it work?) |
| 0 | Demonstration (why does it work? How to prove that it works?) |
| 0 | Evaluation (how is the artefact evaluated? Procedures) |
| 0 | Evaluation outcome (how to interpret results? When to re-iterate?) |
| 1 | Contribution to research (explicit statement on how the study contributes) |
| 1 | Contribution to practice (explicit statement on how the study contributes) |
| 1 | Limitations (what can the artefact not do/when does it not apply?) |
| 1 | Avenues for further research |

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| 3 | Use of action and commentary [1-7: primarily describing actions (1) - balanced (4) - primarily explanatory commentary (7)] |
| 0 | Goal (the framing caters to: 0=transmit knowledge; 1=influence attitudes & behaviours) |
| 1 | Involvement of the audience (scale:1=not at all, 3=appeal to pers. experience, 5=asked to get involved/change beh.) |
| 0 | Active/passive speech (0/1) |

First Author Dincelli

Structure

| Order | Code | Chars |
|---|---|---|
| 1 | 1 | 5600 |
| 2 | 8 | 890 |
| 3 | 4 | 18580 |
| 4 | 2 | 180 |
| 5 | 6 | 800 |
| 6 | 5 | 590 |
| 7 | 4 | 2530 |
| 8 | 2 | 480 |
| 9 | 6 | 2530 |
| 10 | 8 | 990 |
| 11 | 6 | 9950 |
| 12 | 8 | 6420 |
| 13 | 10 | 13470 |

Structure Elements:

1 Problem description: What, why, who, where?
2 Objectives: Goal of the study, RQ
3 Requirements: Stakeholder's concerns and needs
4 Knowledgebase: How is the study informed? What exists?
5 Methodology: Which (generic) approach is used? (e.g. DSR, Peffers et al.)
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Research Problem

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| 1 | Description of the status quo/situation |
| | Description of the stakeholder (who is it?) |
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| 1 | Goals of the stakeholder |
| 1 | Challenges of the stakeholder |
| 1 | Context (what perpetuates/accentuates the problem situation?) |
| | Relevance |
| 0 | Effect size |
| 0 | Scope (how many are affected (adversely)?) |

Research Design

| | |
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| 1 | Research objective (statement on what shall be achieved) |
| 0 | Research question (explicitly phrased RQ) |
| 1 | Reference approach (e.g. Hevner or Peffers et al.) |
| 1 | Description on how the existing knowledge base is used/searched |
| 0 | Requirements (are they discussed at all?) |
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| 1 | Involvement of the audience (scale:1=not at all, 3=appeal to pers. experience, 5=asked to get involved/change beh.) |
| 0 | Active/passive speech (0/1) |

First Author Ebel

Structure

| Order | Code | Chars |
|---|---|---|
| 1 | 1 | 2200 |
| 2 | 6 | 1400 |
| 3 | 1 | 1740 |
| 4 | 4 | 2300 |
| 5 | 6 | 3000 |
| 6 | 7 | 1600 |
| 7 | 3 | 350 |
| 8 | 6 | 5040 |
| 9 | 7 | 3270 |
| 10 | 4 | 4460 |
| 11 | 6 | 7520 |
| 12 | 8 | 2290 |
| 13 | 7 | 1400 |
| 14 | 8 | 8750 |
| 15 | 7 | 2600 |
| 16 | 9 | 8150 |
| 17 | 10 | 9810 |

Structure Elements:

1 Problem description: What, why, who, where?
2 Objectives: Goal of the study, RQ
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| 1 | Challenges of the stakeholder |
| 0 | Context (what perpetuates/accentuates the problem situation?) |
| | Relevance |
| 0 | Effect size |
| 0 | Scope (how many are affected (adversely)?) |

Research Design

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| 1 | Research objective (statement on what shall be achieved) |
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Style

| | |
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| 4 | Effective use of titles [1-5: no titles (1) - some titles/hard to interpret (3) - effective titles (5)] |
| 0 | Examples were used **to illustrate important aspects** |
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| 1 | Involvement of the audience (scale:1=not at all, 3=appeal to pers. experience, 5=asked to get involved/change beh.) |
| 0 | Active/passive speech (0/1) |

First Author Giessmann

Structure

| Order | Code | Chars |
|---|---|---|
| 1 | 1 | 1790 |
| 2 | 2 | 460 |
| 3 | 1 | 1600 |
| 4 | 2 | 730 |
| 5 | 5 | 840 |
| 6 | 4 | 9820 |
| 7 | 5 | 2840 |
| 8 | 6 | 10490 |
| 9 | 8 | 2060 |
| 10 | 3 | 3090 |
| 11 | 4 | 1080 |
| 12 | 9 | 10490 |
| 13 | 8 | 3240 |
| 14 | 10 | 6800 |

Structure Elements:

1 Problem description: What, why, who, where?
2 Objectives: Goal of the study, RQ
3 Requirements: Stakeholder's concerns and needs
4 Knowledgebase: How is the study informed? What exists?
5 Methodology: Which (generic) approach is used? (e.g. DSR, Peffers et al.)
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| 0 | Effect size |
| 0 | Scope (how many are affected (adversely)?) |

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| | |
|---|---|
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| 1 | Limitations (what can the artefact not do/when does it not apply?) |
| 0 | Avenues for further research |

Terminology

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| 1 | Involvement of the audience (scale:1=not at all, 3=appeal to pers. experience, 5=asked to get involved/change beh.) |
| 0 | Active/passive speech (0/1) |

First Author Goldkuhl

Structure

| Order | Code | Chars |
|---|---|---|
| 1 | 1 | 3690 |
| 2 | 2 | 240 |
| 3 | 1 | 260 |
| 4 | 8 | 1050 |
| 5 | 6 | 1770 |
| 6 | 4 | 34750 |
| 7 | 9 | 1540 |
| 8 | 8 | 15070 |
| 9 | 6 | 4750 |
| 10 | 8 | 23040 |
| 11 | 10 | 15190 |

Structure Elements:

1 Problem description: What, why, who, where?
2 Objectives: Goal of the study, RQ
3 Requirements: Stakeholder's concerns and needs
4 Knowledgebase: How is the study informed? What exists?
5 Methodology: Which (generic) approach is used? (e.g. DSR, Peffers et al.)
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| 0 | Challenges of the stakeholder |
| 0 | Context (what perpetuates/accentuates the problem situation?) |
| | Relevance |
| 0 | Effect size |
| 0 | Scope (how many are affected (adversely)?) |

Research Design

| | |
|---|---|
| 1 | Research objective (statement on what shall be achieved) |
| 0 | Research question (explicitly phrased RQ) |
| 0 | Reference approach (e.g. Hevner or Peffers et al.) |
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| 1 | Involvement of the audience (scale:1=not at all, 3=appeal to pers. experience, 5=asked to get involved/change beh.) |
| 0 | Active/passive speech (0/1) |

First Author Keith

Structure

| Order | Code | Chars |
|---|---|---|
| 1 | 1 | 4150 |
| 2 | 2 | 105 |
| 3 | 3 | 290 |
| 4 | 4 | 890 |
| 5 | 5 | 860 |
| 6 | 4 | 5530 |
| 7 | 3 | 3060 |
| 8 | 8 | 1910 |
| 9 | 3 | 3360 |
| 10 | 8 | 7150 |
| 11 | 6 | 9400 |
| 12 | 8 | 6070 |
| 13 | 9 | 9340 |
| 14 | 10 | 9110 |

Structure Elements:

1 Problem description: What, why, who, where?
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Detailed description of contents

Research Problem

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| 1 | Description of the status quo/situation |
| | Description of the stakeholder (who is it?) |
| 1 | Naming the stakeholder (group) |
| 0 | Goals of the stakeholder |
| 1 | Challenges of the stakeholder |
| 0 | Context (what perpetuates/accentuates the problem situation?) |
| | Relevance |
| 1 | Effect size |
| 0 | Scope (how many are affected (adversely)?) |

Research Design

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| 1 | Research objective (statement on what shall be achieved) |
| 0 | Research question (explicitly phrased RQ) |
| 1 | Reference approach (e.g. Hevner or Peffers et al.) |
| 1 | Description on how the existing knowledge base is used/searched |
| 1 | Requirements (are they discussed at all?) |
| 0 | Gathering requirements (how to they get them?) |
| 0 | Specifying requirements (how do they select the most important ones?) |
| 1 | Data gathering technique (which technique? for empirical data) |
| 0 | Justification for the data gathering technique (why this one?) |
| 1 | Specification on what data (type & content) is to be gathered |
| 1 | Data analysis (which technique?) |
| 0 | Justification for technique of analysis (why this one?) |
| 0 | Mapping data to design and development (how is data used?) |
| 0 | Description of design and development activities (how do they design the artefact?) |
| 1 | Description of the artefact (what is it and how does it work?) |
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Terminology

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| 1 | Explicit reference to DSR (here: Design Research, 'gestaltungsorientierte Forschung') |
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| 2 | Effective use of titles [1-5: no titles (1) - some titles/hard to interpret (3) - effective titles (5)] |
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| 0 | A **running example** was used throughout the presentation (0=no, 1=yes) |
| 5 | Use of action and commentary [1-7: primarily describing actions (1) - balanced (4) - primarily explanatory commentary (7)] |
| 0 | Goal (the framing caters to: 0=transmit knowledge; 1=influence attitudes & behaviours) |
| 1 | Involvement of the audience (scale:1=not at all, 3=appeal to pers. experience, 5=asked to get involved/change beh.) |
| 1 | Active/passive speech (0/1) |

First Author Kolkowska

Structure

| Order | Code | Chars |
|---|---|---|
| 1 | 1 | 5140 |
| 2 | 8 | 830 |
| 3 | 4 | 15310 |
| 4 | 5 | 1500 |
| 5 | 7 | 6630 |
| 6 | 8 | 23830 |
| 7 | 10 | 11580 |

Structure Elements:

1 Problem description: What, why, who, where?
2 Objectives: Goal of the study, RQ
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5 Methodology: Which (generic) approach is used? (e.g. DSR, Peffers et al.)
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First Author Li

Structure

| Order | Code | Chars |
|---|---|---|
| 1 | 1 | 5640 |
| 2 | 8 | 1800 |
| 3 | 1 | 8850 |
| 4 | 8 | 3320 |
| 5 | 4 | 20420 |
| 6 | 6 | 12710 |
| 7 | 8 | 21470 |
| 8 | 10 | 11890 |

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First Author Lycett

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|---|---|---|
| 1 | 1 | 3210 |
| 2 | 5 | 4720 |
| 3 | 1 | 2940 |
| 4 | 8 | 2560 |
| 5 | 7 | 7080 |
| 6 | 6 | 2115 |
| 7 | 7 | 3580 |
| 8 | 6 | 4480 |
| 9 | 8 | 5690 |
| 10 | 9 | 5600 |
| 11 | 10 | 8290 |

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First Author Närman

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| Order | Code | Chars |
|---|---|---|
| 1 | 2 | 1090 |
| 2 | 4 | 7280 |
| 3 | 5 | 1310 |
| 4 | 3 | 640 |
| 5 | 4 | 750 |
| 6 | 6 | 3250 |
| 7 | 4 | 7780 |
| 8 | 8 | 2420 |
| 9 | 6 | 5540 |
| 10 | 8 | 2190 |
| 11 | 10 | 6590 |
| 12 | 8 | 3090 |

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First Author Nguyen

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|---|---|---|
| 1 | 1 | 1660 |
| 2 | 2 | 260 |
| 3 | 1 | 1360 |
| 4 | 2 | 190 |
| 5 | 1 | 655 |
| 6 | 2 | 460 |
| 7 | 5 | 2640 |
| 8 | 4 | 6730 |
| 9 | 2 | 410 |
| 10 | 5 | 570 |
| 11 | 7 | 1550 |
| 12 | 6 | 2280 |
| 13 | 6 | 990 |
| 14 | 4 | 7820 |
| 15 | 5 | 760 |
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First Author Oberländer

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|---|---|---|
| 1 | 1 | 3380 |
| 2 | 5 | 1010 |
| 3 | 4 | 9910 |
| 4 | 5 | 2610 |
| 5 | 6 | 6490 |
| 6 | 8 | 9010 |
| 7 | 9 | 8080 |
| 8 | 10 | 10390 |

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|---|---|
| 1 | Explicit reference to DSR (here: Design Research, 'gestaltungsorientierte Forschung') |
| 1 | Use of the term "artefact" to refer to the result |
| 1 | Reference to the type of artefact (method, model, instantiation,...) |
| 0 | Primarily refering to the artefact as "artefact" (rather than more specific terms such as 'model') |

Style

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|---|---|
| 5 | Effective use of titles [1-5: no titles (1) - some titles/hard to interpret (3) - effective titles (5)] |
| 1 | Examples were used **to illustrate important aspects** |
| 1 | Use of illustrations/graphical metaphors |
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| 0 | Use of quotes to illustrate context and use scenarios |
| 1 | An example was used **to set the scene**/introduce me to the topic/issue. (0=no, 1= yes) |
| 0 | A **running example** was used throughout the presentation (0=no, 1=yes) |
| 4 | Use of action and commentary [1-7: primarily describing actions (1) - balanced (4) - primarily explanatory commentary (7)] |
| 0 | Goal (the framing caters to: 0=transmit knowledge; 1=influence attitudes & behaviours) |
| 1 | Involvement of the audience (scale:1=not at all, 3=appeal to pers. experience, 5=asked to get involved/change beh.) |
| 0 | Active/passive speech (0/1) |

First Author Reinecke

Structure

| Order | Code | Chars |
|---|---|---|
| 1 | 1 | 4340 |
| 2 | 2 | 210 |
| 3 | 5 | 170 |
| 4 | 8 | 1690 |
| 5 | 4 | 17540 |
| 6 | 2 | 660 |
| 7 | 5 | 560 |
| 8 | 6 | 3520 |
| 9 | 8 | 17680 |
| 10 | 6 | 8930 |
| 11 | 7 | 1910 |
| 12 | 8 | 9080 |
| 13 | 10 | 12140 |

Structure Elements:

1 Problem description: What, why, who, where?
2 Objectives: Goal of the study, RQ
3 Requirements: Stakeholder's concerns and needs
4 Knowledgebase: How is the study informed? What exists?
5 Methodology: Which (generic) approach is used? (e.g. DSR, Peffers et al.)
6 Procedures: Description of actions, e.g. data gathering techniques
7 Iterations and Intermediate learnings
8 Results: Artefact description, demonstration, evaluation, contributions
9 Explication of DK: Formulation of DP, DF, and application of DK
10 Discussion: Limitations, avenues of further research

Detailed description of contents

Research Problem

| | |
|---|---|
| 1 | Description of the status quo/situation |
| | Description of the stakeholder (who is it?) |
| 0 | Naming the stakeholder (group) |
| 1 | Goals of the stakeholder |
| 1 | Challenges of the stakeholder |
| 1 | Context (what perpetuates/accentuates the problem situation?) |
| | Relevance |
| 0 | Effect size |
| 0 | Scope (how many are affected (adversely)?) |

Research Design

| | |
|---|---|
| 1 | Research objective (statement on what shall be achieved) |
| 1 | Research question (explicitly phrased RQ) |
| 1 | Reference approach (e.g. Hevner or Peffers et al.) |
| 1 | Description on how the existing knowledge base is used/searched |
| 1 | Requirements (are they discussed at all?) |
| 0 | Gathering requirements (how to they get them?) |
| 0 | Specifying requirements (how do they select the most important ones?) |
| 1 | Data gathering technique (which technique? for empirical data) |
| 1 | Justification for the data gathering technique (why this one?) |
| 0 | Specification on what data (type & content) is to be gathered |
| 0 | Data analysis (which technique?) |
| 0 | Justification for technique of analysis (why this one?) |
| 1 | Mapping data to design and development (how is data used?) |
| 1 | Description of design and development activities (how do they design the artefact?) |
| 1 | Description of the artefact (what is it and how does it work?) |
| 1 | Demonstration (why does it work? How to prove that it works?) |
| 1 | Evaluation (how is the artefact evaluated? Procedures) |
| 1 | Evaluation outcome (how to interpret results? When to re-iterate?) |
| 1 | Contribution to research (explicit statement on how the study contributes) |
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| 0 | Active/passive speech (0/1) |

First Author Spagnoletti

Structure

| Order | Code | Chars |
|---|---|---|
| 1 | 1 | 2380 |
| 2 | 2 | 170 |
| 3 | 6 | 990 |
| 4 | 4 | 1100 |
| 5 | 8 | 610 |
| 6 | 4 | 12250 |
| 7 | 3 | 2100 |
| 8 | 9 | 7150 |
| 9 | 6 | 12640 |
| 10 | 8 | 11210 |
| 11 | 7 | 10310 |
| 12 | 10 | 5860 |

Structure Elements:

1 Problem description: What, why, who, where?
2 Objectives: Goal of the study, RQ
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| 0 | Justification for technique of analysis (why this one?) |
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| 0 | Active/passive speech (0/1) |

First Author Twyman

Structure

| Order | Code | Chars |
|---|---|---|
| 1 | 1 | 3470 |
| 2 | 2 | 1780 |
| 3 | 5 | 1850 |
| 4 | 4 | 4500 |
| 5 | 3 | 16850 |
| 6 | 7 | 4850 |
| 7 | 8 | 7785 |
| 8 | 6 | 8940 |
| 9 | 8 | 8440 |
| 10 | 10 | 12050 |

Structure Elements:

| | |
|---|---|
| 1 | Problem description: What, why, who, where? |
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| 4 | Knowledgebase: How is the study informed? What exists? |
| 5 | Methodology: Which (generic) approach is used? (e.g. DSR, Peffers et al.) |
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| 1 | Active/passive speech (0/1) |

First Author Williams

Structure

| Order | Code | Chars |
|---|---|---|
| 1 | 1 | 1430 |
| 2 | 2 | 1100 |
| 3 | 5 | 910 |
| 4 | 4 | 6810 |
| 5 | 2 | 1460 |
| 6 | 6 | 2750 |
| 7 | 3 | 1480 |
| 8 | 8 | 12980 |
| 9 | 10 | 3490 |

Structure Elements:

1 Problem description: What, why, who, where?
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| 0 | Active/passive speech (0/1) |

First Author Yang

Structure

| Order | Code | Chars |
|---|---|---|
| 1 | 1 | 4330 |
| 2 | 2 | 220 |
| 3 | 5 | 1430 |
| 4 | 1 | 2670 |
| 5 | 4 | 11970 |
| 6 | 8 | 2760 |
| 7 | 6 | 6850 |
| 8 | 8 | 10350 |
| 9 | 10 | 7850 |

Structure Elements:

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# Appendix J Supplemental Material of the Analysis of Papers' Effects on Readers

The analysis of papers' effects on readers, as presented in Appendix D, contains references to supplemental material. This supplemental material is namely (Section J.1) the **survey form**, which the participating readers were asked to fill in, and (Section J.2) the illustrated and commented **script used for the cross-correlation analysis**.

## J.1 The Survey Form

In the following, a copy of the survey form is provided. The survey form was distributed via Dropbox repository as a Word form in which only the two free text fields on the first page and the checkboxes on the 7-point Likert scale could be changed. The participants handed in the survey via Dropbox link and the answers were thereafter extracted manually into an Excel-File.

**Exercise: Reflection on Design Research Publications**

| | |
|---|---|
| Title of the document you read: | |
| Authors of the document: | |

Summary: Please describe in a few sentences, what the paper you have just read was about and what stuck with you most. (E.g.: What problem was solved? Why? How did they do it? Is there something that remained unclear?)

| |
|---|
| |

How well did that communication work out? Please indicate your own perceptions of this:

| Miserable | Poor | Mediocre | Average | Good | Great | Outstanding | Overall Assessment of the Quality of the Document |
|---|---|---|---|---|---|---|---|
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | **Quality of content:** Statements are well-founded, assumptions and conclusions are reasonable |
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | **Significance of contribution:** The contribution adequately addresses the problem and solves the latter reasonably (i.e. not just a tiny bit and not on the instance level only) |
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | **Originality of the contribution:** The contribution is novel to this and very closely related fields of application. |
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | **Thematic Relevance:** The topic is of societal value/is relevant today. |
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | **Presentation:** The content is presented well - easy to understand and follow the train of thought, good use of illustrations/tables where it makes sense, etc. |
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | **Overall Impression:** From a reviewer's perspective, how strongly would you evaluate this document and therefore suggest (or not) for it to be published? |

| Fully disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Fully agree | Clarity of the Narrative |
|---|---|---|---|---|---|---|---|
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | The **plot line** is clear to me - it is clear from where to where the narrative goes. |
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | I understand and can **empathize with the stakeholder** that has the problem. |
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | I understand and can **empathize with the researchers** that had to take the design decisions in this study. |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | It is clear to me, **why which artefact design decisions** were taken. |
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | The way in which the study was presented allowed me to empathize and **relate to the topic**. |
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | (if examples were used:) The example(s) used were easy to relate/illustrative. |
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | (if examples were used:) The example(s) used were helpful to understand the content. |

| Fully disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Fully agree | Clarity of the Research Problem Description |
|---|---|---|---|---|---|---|---|
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | The authors' explanations are sufficient to understand what the (research) problem is, incl. its adverse effects of not solving it (i.e. the essence of the problem). |
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | It is clear to me, what the current situation is (status quo containing the problem, i.e.: context). |
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | I can clearly pin down who the stakeholder with the problem is. |
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | I know what goal the stakeholder pursues. |
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | I have a good understanding of the scope of the problem (e.g. how many individuals may be affected) |
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | I have a good understanding of the scale of the problem (e.g. how large the financial impact is on an individual stakeholder) |
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | The problem described is relevant. |
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | It is clear to me, why the problem pertains/doesn't go away. |

| Fully disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Fully agree | Clarity of the research design: |
|---|---|---|---|---|---|---|---|
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | Based on the content provided, I feel confident that I could conduct a study that is just like this one. |
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | I have a good understanding of the objective and/or RQ of this study. |
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | I have a good understanding of the general procedural approach taken. |
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | It is clear to me, why which (study) design decisions were taken. |
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | It is clear to me what the output (artefact) of the study is. |
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | The output (artefact) is useful to me, informing my own research. |
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | I will use the output (artefact) to inform theory development in my own work. |
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | I will use the output (artefact) to inform theory testing in my own work. |
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | I will use the output (artefact) to theorize about its usage. |
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | I will use the output (artefact) to theorize about how it was built/developed. |
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | I understand well how the result of the study (artefact) was designed. |
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | It is clear to me, how the authors evaluated the artefact/judged its goodness. |
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | It is clear to me what the knowledge contribution (to the IS DSR community) is. |
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | It is clear to me what the limitations of the applicability of the output (artefact) are. |

| Fully disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Fully agree | Science Communication Impact Measures: |
|---|---|---|---|---|---|---|---|
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | I feel familiar with the issue explained in the text. |
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | I can convincingly explain the research problem presented in the text to others. |
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | I enjoyed reading this text. |
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | It was entertaining to read this text. |
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | Having read the text, I would like to learn more about the issue or study. |
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | I feel compelled to get involved in some way. |
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | Based on the content of the text, I can help someone else take a related decision. |
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | I understand what the procedures are that were employed. |
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | It is clear to me, why the employed procedures were selected. |
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | I can explain the outcome to others (what it is, how it works, why it is useful). |
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | The implications for practice are clear to me. |
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | The implications for science are clear to me. |

## J.2 Script for Data Analysis

Below a copy of the script used for the correlation analysis of the effects dataset is provided. It was implemented in python in a Google Colab notebook. All commentary is provided alongside the code (commentary is pre-fixed with """ or #, whereas the code is indented).

"""This is an exploratory analysis of the Effects dataset from the structure-effects analysis. First off, upload the document as a .csv and run the code block below. It should show rows 0-5 of a filled in table."""

```
import pandas as pd
data = pd.read_csv("/content/Effects_data.csv", sep=";")
```

#preview the first few lines to check if it worked

```
data.head()
```

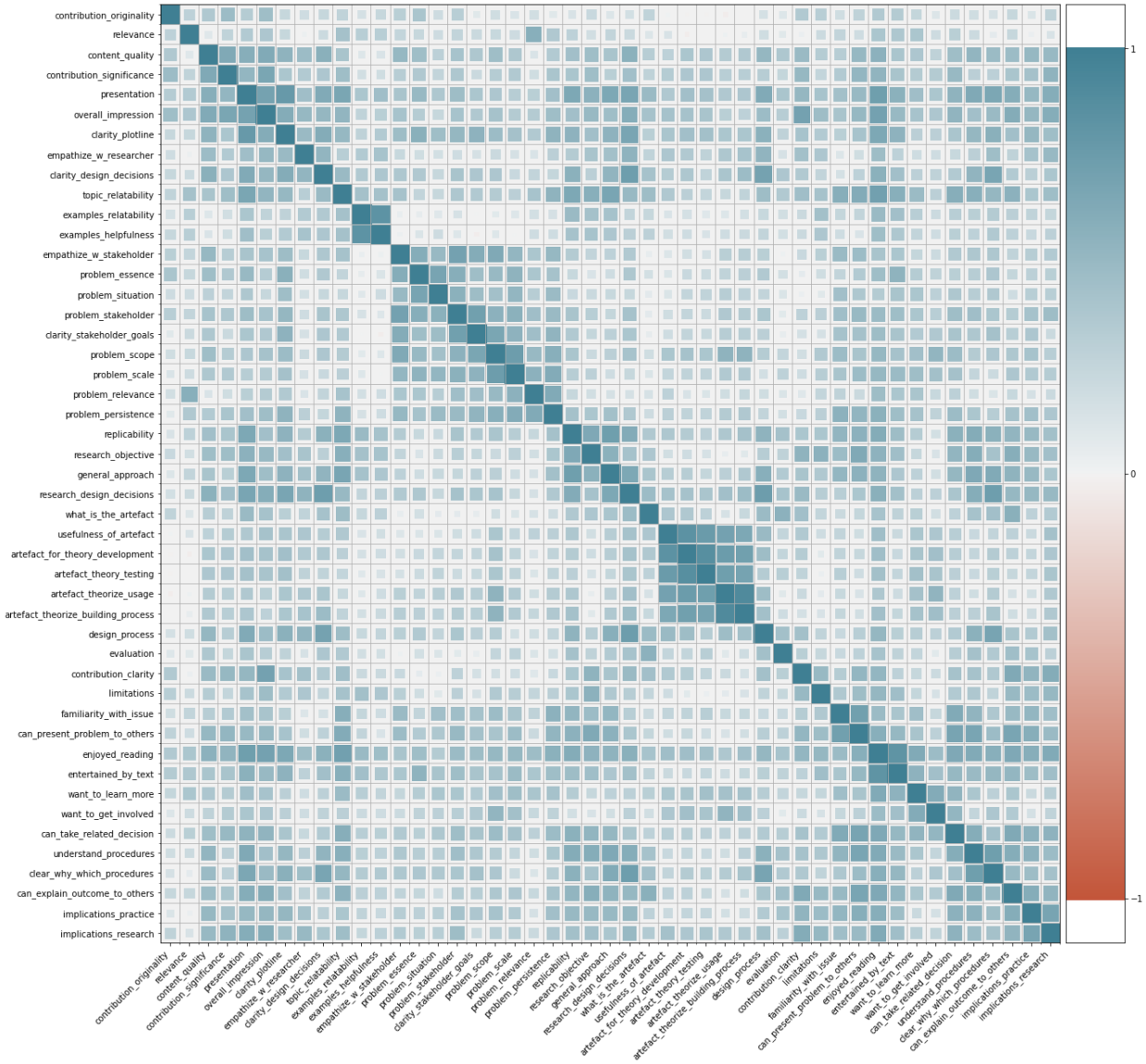
"""Fetch matplotlib and install a heatmap module."""

```
from matplotlib import pyplot as plt
!pip install heatmapz
from heatmap import heatmap, corrplot
```

"""Plot the correlation matrix of the entire dataset data. figsize increases the size of the sides of the illustration, while size_scale the increases the size of the coloured squares."""

```
plt.figure(figsize=(20,20))
corrplot(data.corr(), size_scale=500);
```

(continued on the next page)




# Export data

```
data.corr().head()
data.corr().to_csv("data_core.csv", sep=";")
```

"""Create a subset of datapoints based on the structure of the questionnaire.

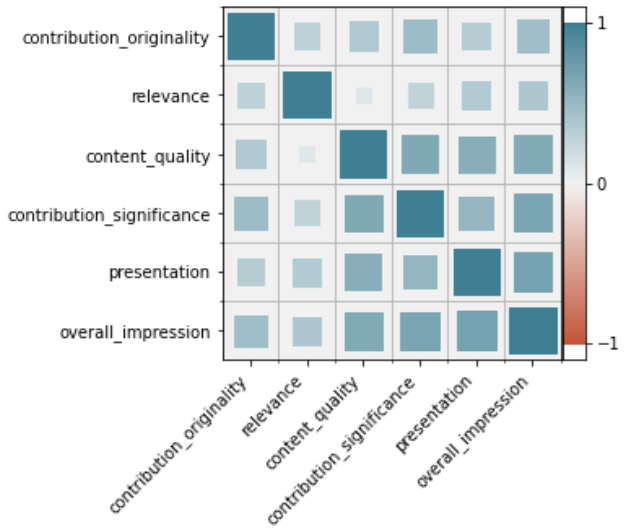
Overall quality of the manuscript: ["content_quality", "contribution_significance", "contribution_originality", "relevance", "presentation", "overall_impression"]

"""

```
data_overall_quality = data[["contribution_originality", "relevance", "content_quality", "contribution_significance", "presentation", "overall_impression"]]
data_overall_quality.head()

plt.figure(figsize=(4,4))
```

```
corrplot(data_overall_quality.corr(), size_scale=800);
```

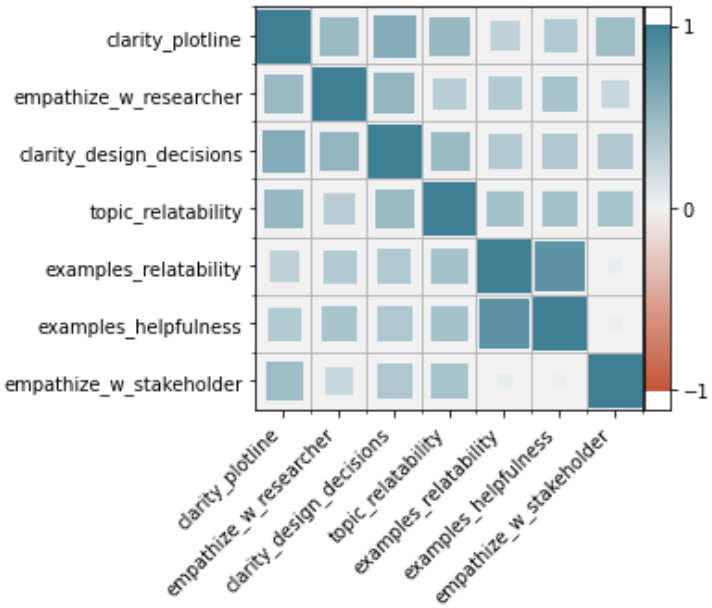



# Export data

```
data_overall_quality.corr().head()
data_overall_quality.corr().to_csv("data_overall_quality.csv", sep=";")
```

"""Clarity measures: ["clarity_plotline", "empathize_w_researcher", "clarity_design_decisions", "topic_relatability", "examples_relatability", "examples_helpfulness", "empathize_w_stakeholder"]"""

```
data_clarity = data[["clarity_plotline", "empathize_w_researcher", "clarity_design_decisions", "topic_relatability", "examples_relatability", "examples_helpfulness", "empathize_w_stakeholder"]]
data_clarity.head()
plt.figure(figsize=(4,4))
corrplot(data_clarity.corr(), size_scale=800);
```



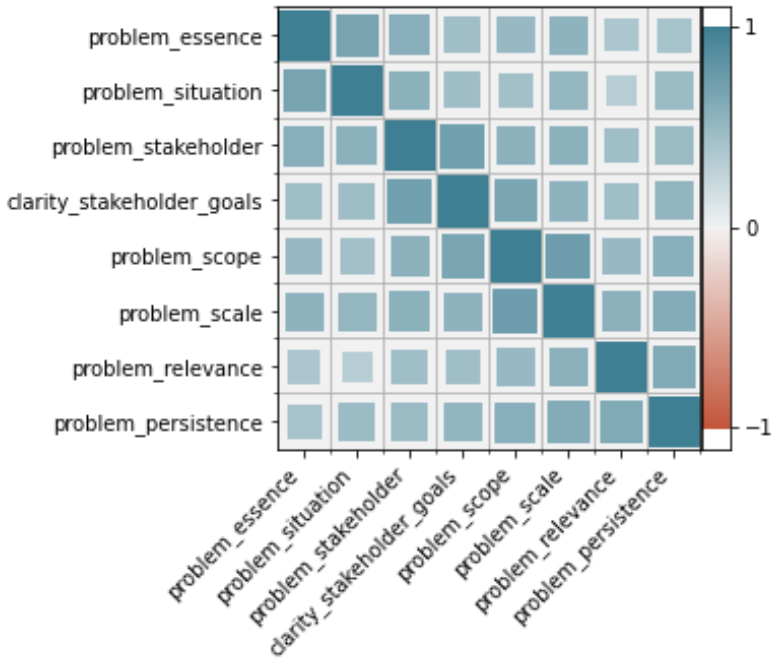
# Export data

```
data_clarity.corr().head()
data_clarity.corr().to_csv("data_clarity.csv", sep=";")
```

"""Research Problem measures: **["problem_essence", "problem_situation", "problem_stakeholder", "clarity_stakeholder_goals", "problem_scope", "problem_scale", "problem_relevance", "problem_persistence"]**"""

```
data_research_problem = data[["problem_essence", "problem_situation", "problem_stakeholder", "clarity_stakeholder_goals", "problem_scope", "problem_scale", "problem_relevance", "problem_persistence"]]
data_research_problem.head()

plt.figure(figsize=(4,4))
corrplot(data_research_problem.corr(), size_scale=600);
```



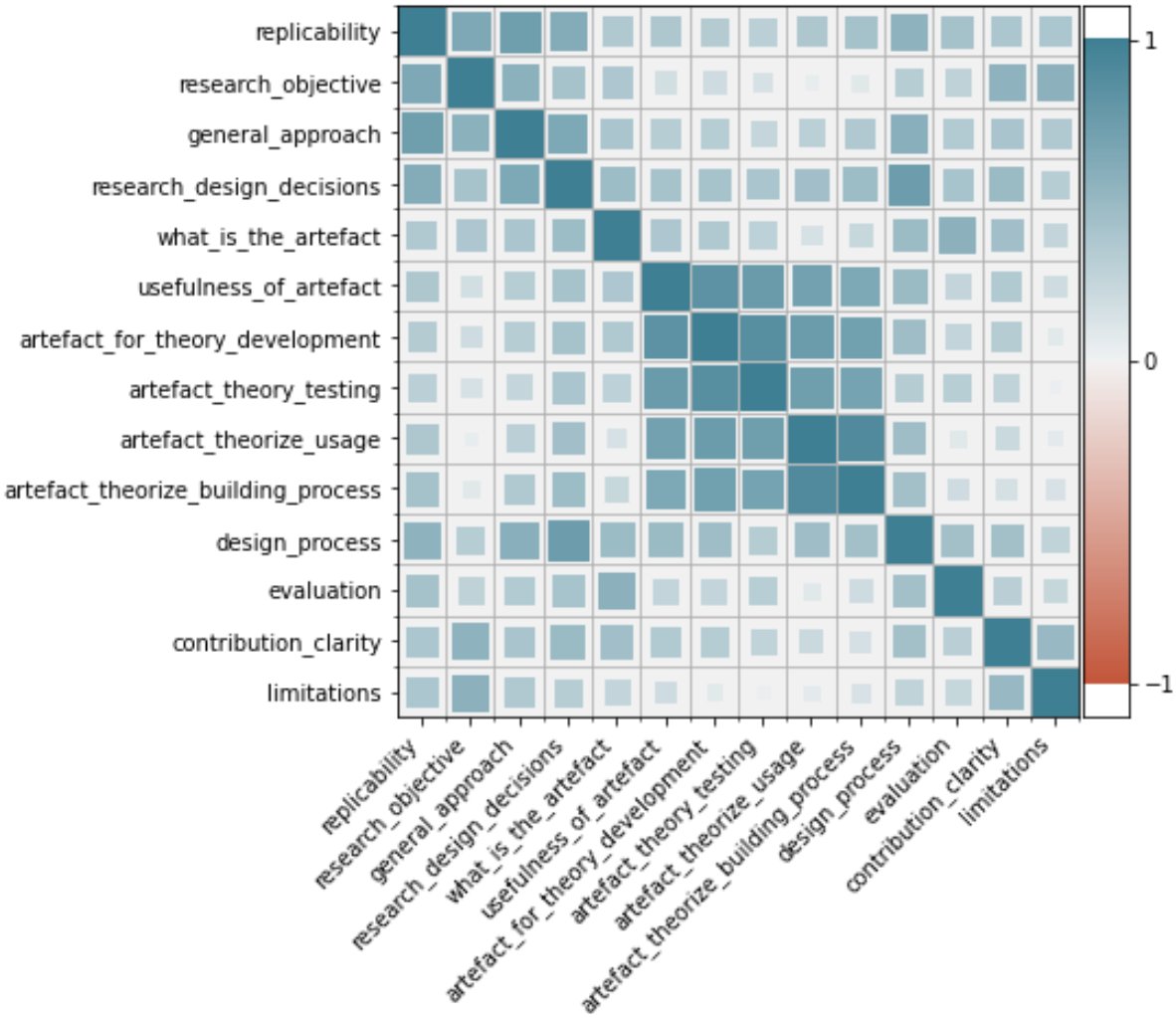

# Export data

```
data_research_problem.corr().head()
data_research_problem.corr().to_csv("data_research_problem.csv", sep=";")
```

"""Research Design measures: ["replicability", "research_objective", "general_approach", "research_design_decisions", "what_is_the_artefact", "usefulness_of_artefact", "artefact_for_theory_development", "artefact_theory_testing", "artefact_theorize_usage", "artefact_theorize_building_process", "design_process", "evaluation", "contribution_clarity", "limitations"]"""

```
data_research_design = data[["replicability", "research_objective", "general_approach", "research_design_decisions", "what_is_the_artefact", "usefulness_of_artefact", "artefact_for_theory_development", "artefact_theory_testing", "artefact_theorize_usage", "artefact_theorize_building_process", "design_process", "evaluation", "contribution_clarity", "limitations"]]
data_research_design.head()
```

```
plt.figure(figsize=(6,6))
corrplot(data_research_design.corr(), size_scale=450);
```




# Export data

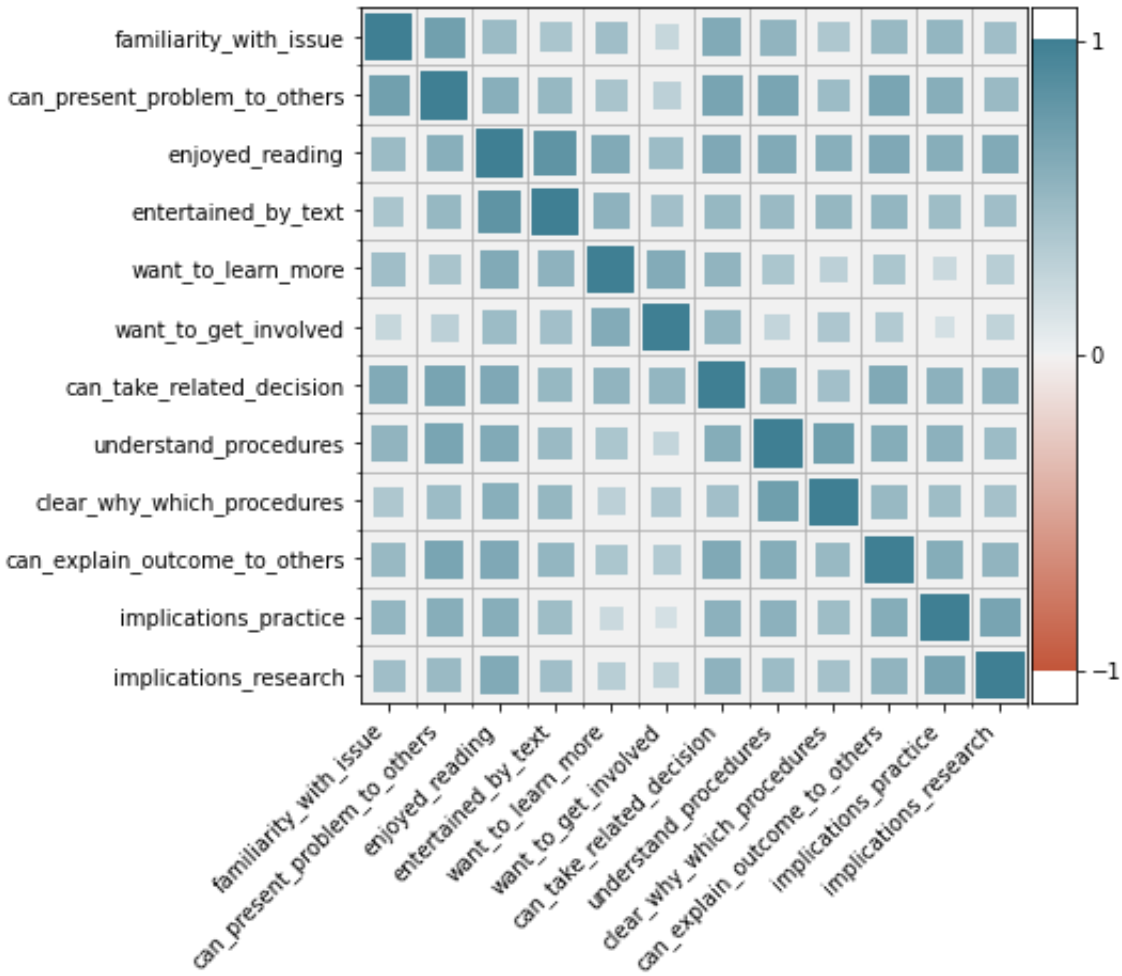
```
data_research_design.corr().head()
data_research_design.corr().to_csv("data_research_design.csv", sep=";")
```

"""Science Communication Impact Measures: ["familiarity_with_issue", "can_present_problem_to_others", "enjoyed_reading", "entertained_by_text", "want_to_learn_more", "want_to_get_involved", "can_take_related_decision",

"understand_procedures", "clear_why_which_procedures", "can_explain_outcome_to_others", "implications_practice", "implications_research"]"""

```
data_scim = data[["familiarity_with_issue", "can_present_problem_to_others",
"enjoyed_reading", "entertained_by_text", "want_to_learn_more",
"want_to_get_involved", "can_take_related_decision", "understand_procedures", "clear_why_which_procedures", "can_explain_outcome_to_others", "implications_practice", "implications_research"]]
data_scim.head()

plt.figure(figsize=(6,6))
corrplot(data_scim.corr(), size_scale=450);
```




# Export data

```
data_scim.corr().head()
data_scim.corr().to_csv("data_scim.csv", sep=";")
```

# Appendix K Supplemental Material of the Structure-Effects Analysis

The structure-effects-analysis, as presented in Appendix E, contains references to supplemental material, namely additional data on overall beneficial characteristics.

## K.1 Additional Data on Overall Beneficial Characteristics

The analysis of overall beneficial characteristics includes a set of single factor ANOVAs with a specific characteristic as the factor and all effect items as the dependent variables. This yields large tables, containing some data that is not used for the further interpretation and for deriving prescriptive statements. For this reason, only an outtake of these tables are presented in Appendix E. The full tables are featured without further commentary below, under the matching headings.

### K.1.1 The Effects of Featuring Stakeholder Goals

*Table 110: Single Factor ANOVA of Stakeholder Goals on Effects*

| | (… Groups) | Sum of Squares | df | Mean Square | F | Sig. | Featured | N | Mean \| Δ 1-0 | SD |
|---|---|---|---|---|---|---|---|---|---|---|
| **content_quality** | Between | 5.17 | 1 | 5.17 | 5.5 | 0.021 | 0 | 37 | 5.16 | 1.14 |
| | Within | 75.03 | 80 | 0.94 | | | 1 | 45 | 5.67 | 0.80 |
| | Total | 80.20 | 81 | | | | | | 0.50 | |
| **contribution_significance** | Between | 4.21 | 1 | 4.21 | 3.9 | 0.051 | 0 | 37 | 5.19 | 1.10 |
| | Within | 85.99 | 80 | 1.07 | | | 1 | 45 | 5.64 | 0.98 |
| | Total | 90.20 | 81 | | | | | | 0.46 | |
| **contribution_originality** | Between | 2.77 | 1 | 2.77 | 3.3 | 0.074 | 0 | 37 | 5.30 | 0.97 |
| | Within | 67.73 | 80 | 0.85 | | | 1 | 45 | 5.67 | 0.88 |
| | Total | 70.50 | 81 | | | | | | 0.37 | |
| **relevance** | Between | 5.66 | 1 | 5.66 | 6.3 | 0.014 | 0 | 37 | 5.41 | 1.01 |
| | Within | 71.72 | 80 | 0.90 | | | 1 | 45 | 5.93 | 0.89 |
| | Total | 77.38 | 81 | | | | | | 0.53 | |
| **presentation** | Between | 6.96 | 1 | 6.96 | 4.4 | 0.039 | 0 | 37 | 5.08 | 1.46 |
| | Within | 126.76 | 80 | 1.58 | | | 1 | 45 | 5.67 | 1.07 |
| | Total | 133.72 | 81 | | | | | | 0.59 | |
| **overall_impression** | Between | 9.24 | 1 | 9.24 | 8.3 | 0.005 | 0 | 37 | 5.08 | 1.23 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Within | 89.07 | 80 | 1.11 | | | 1 | 45 | 5.76 | 0.88 |
| | Total | 98.30 | 81 | | | | | | 0.67 | |
| **cl_plotline** | Between | 9.59 | 1 | 9.59 | 6.3 | 0.014 | 0 | 37 | 5.14 | 1.49 |
| | Within | 120.90 | 80 | 1.51 | | | 1 | 45 | 5.82 | 0.96 |
| | Total | 130.49 | 81 | | | | | | 0.69 | |
| **cl_stakeh_emp** | Between | 24.23 | 1 | 24.23 | 16.4 | 0.000 | 0 | 37 | 4.73 | 1.45 |
| | Within | 117.88 | 80 | 1.47 | | | 1 | 45 | 5.82 | 0.98 |
| | Total | 142.11 | 81 | | | | | | 1.09 | |
| **cl_researchers_emp** | Between | 0.41 | 1 | 0.41 | 0.3 | 0.570 | 0 | 37 | 5.32 | 1.20 |
| | Within | 101.31 | 80 | 1.27 | | | 1 | 45 | 5.47 | 1.06 |
| | Total | 101.72 | 81 | | | | | | 0.14 | |
| **cl_design_decisions** | Between | 9.82 | 1 | 9.82 | 5.7 | 0.019 | 0 | 37 | 4.84 | 1.59 |
| | Within | 138.23 | 80 | 1.73 | | | 1 | 45 | 5.53 | 1.04 |
| | Total | 148.05 | 81 | | | | | | 0.70 | |
| **cl_topic_emp** | Between | 10.53 | 1 | 10.53 | 9.0 | 0.004 | 0 | 37 | 5.32 | 1.36 |
| | Within | 94.02 | 80 | 1.18 | | | 1 | 45 | 6.04 | 0.80 |
| | Total | 104.55 | 81 | | | | | | 0.72 | |
| **cl_examples_relata-ble** | Between | 3.04 | 1 | 3.04 | 2.2 | 0.144 | 0 | 37 | 5.32 | 1.29 |
| | Within | 111.35 | 80 | 1.39 | | | 1 | 45 | 5.71 | 1.08 |
| | Total | 114.39 | 81 | | | | | | 0.39 | |
| **cl_examples_helpful** | Between | 1.39 | 1 | 1.39 | 1.0 | 0.312 | 0 | 37 | 5.41 | 1.24 |
| | Within | 106.92 | 80 | 1.34 | | | 1 | 45 | 5.67 | 1.09 |
| | Total | 108.30 | 81 | | | | | | 0.26 | |
| **rp_problem_essence** | Between | 9.45 | 1 | 9.45 | 6.7 | 0.011 | 0 | 37 | 5.16 | 1.50 |
| | Within | 112.94 | 80 | 1.41 | | | 1 | 45 | 5.84 | 0.85 |
| | Total | 122.39 | 81 | | | | | | 0.68 | |
| **rp_situation** | Between | 6.51 | 1 | 6.51 | 5.3 | 0.024 | 0 | 37 | 5.19 | 1.45 |
| | Within | 97.99 | 80 | 1.22 | | | 1 | 45 | 5.76 | 0.71 |
| | Total | 104.50 | 81 | | | | | | 0.57 | |
| **rp_stakeholder** | Between | 7.55 | 1 | 7.55 | 5.5 | 0.021 | 0 | 37 | 4.95 | 1.37 |
| | Within | 109.00 | 80 | 1.36 | | | 1 | 45 | 5.56 | 0.97 |
| | Total | 116.55 | 81 | | | | | | 0.61 | |
| **rp_stakeh_goals** | Between | 10.60 | 1 | 10.60 | 7.9 | 0.006 | 0 | 37 | 4.81 | 1.27 |
| | Within | 106.88 | 80 | 1.34 | | | 1 | 45 | 5.53 | 1.06 |
| | Total | 117.48 | 81 | | | | | | 0.72 | |
| **rp_problem_scope** | Between | 12.72 | 1 | 12.72 | 5.8 | 0.018 | 0 | 37 | 4.30 | 1.75 |
| | Within | 175.37 | 80 | 2.19 | | | 1 | 45 | 5.09 | 1.22 |
| | Total | 188.10 | 81 | | | | | | 0.79 | |
| **rp_problem_scale** | Between | 3.78 | 1 | 3.78 | 1.6 | 0.207 | 0 | 37 | 4.32 | 1.86 |
| | Within | 186.42 | 80 | 2.33 | | | 1 | 45 | 4.76 | 1.19 |
| | Total | 190.20 | 81 | | | | | | 0.43 | |
| **rp_problem_rele-vance** | Between | 1.61 | 1 | 1.61 | 2.0 | 0.165 | 0 | 37 | 5.54 | 0.99 |
| | Within | 65.77 | 80 | 0.82 | | | 1 | 45 | 5.82 | 0.83 |
| | Total | 67.38 | 81 | | | | | | 0.28 | |
| | Between | 5.34 | 1 | 5.34 | 4.5 | 0.037 | 0 | 37 | 4.86 | 1.11 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **rp_problem_persistence** | Within | 94.90 | 80 | 1.19 | | | 1 | 45 | 5.38 | 1.07 |
| | Total | 100.24 | 81 | | | | | | 0.51 | |
| **rd_replicability** | Between | 2.95 | 1 | 2.95 | 1.4 | 0.242 | 0 | 37 | 4.73 | 1.63 |
| | Within | 169.74 | 80 | 2.12 | | | 1 | 45 | 5.11 | 1.30 |
| | Total | 172.70 | 81 | | | | | | 0.38 | |
| **rd_objective** | Between | 2.84 | 1 | 2.84 | 2.1 | 0.154 | 0 | 37 | 5.27 | 1.35 |
| | Within | 109.61 | 80 | 1.37 | | | 1 | 45 | 5.64 | 1.00 |
| | Total | 112.45 | 81 | | | | | | 0.37 | |
| **rd_general_approach** | Between | 9.37 | 1 | 9.37 | 6.9 | 0.010 | 0 | 37 | 5.05 | 1.53 |
| | Within | 108.69 | 80 | 1.36 | | | 1 | 45 | 5.73 | 0.75 |
| | Total | 118.06 | 81 | | | | | | 0.68 | |
| **rd_rd_decisions** | Between | 4.89 | 1 | 4.89 | 2.8 | 0.099 | 0 | 37 | 4.86 | 1.53 |
| | Within | 140.64 | 80 | 1.76 | | | 1 | 45 | 5.36 | 1.13 |
| | Total | 145.52 | 81 | | | | | | 0.49 | |
| **rd_whats_artefact** | Between | 0.19 | 1 | 0.19 | 0.1 | 0.724 | 0 | 37 | 5.92 | 1.36 |
| | Within | 121.33 | 80 | 1.52 | | | 1 | 45 | 5.82 | 1.11 |
| | Total | 121.52 | 81 | | | | | | -0.1 | |
| **rd_artefact_is_useful** | Between | 2.73 | 1 | 2.73 | 0.8 | 0.362 | 0 | 37 | 4.19 | 1.78 |
| | Within | 260.25 | 80 | 3.25 | | | 1 | 45 | 3.82 | 1.83 |
| | Total | 262.99 | 81 | | | | | | -0.37 | |
| **rd_artefact_for_theory_development** | Between | 0.18 | 1 | 0.18 | 0.1 | 0.820 | 0 | 37 | 3.65 | 1.86 |
| | Within | 269.54 | 80 | 3.37 | | | 1 | 45 | 3.56 | 1.82 |
| | Total | 269.72 | 81 | | | | | | -0.09 | |
| **rd_artefact_theory_testing** | Between | 0.49 | 1 | 0.49 | 0.2 | 0.694 | 0 | 37 | 3.62 | 1.85 |
| | Within | 249.90 | 80 | 3.12 | | | 1 | 45 | 3.47 | 1.70 |
| | Total | 250.39 | 81 | | | | | | -0.15 | |
| **rd_artefact_theorize_usage** | Between | 0.48 | 1 | 0.48 | 0.2 | 0.686 | 0 | 37 | 3.24 | 1.77 |
| | Within | 234.46 | 80 | 2.93 | | | 1 | 45 | 3.09 | 1.66 |
| | Total | 234.94 | 81 | | | | | | -0.15 | |
| **rd_artefact_theorize_building_process** | Between | 0.35 | 1 | 0.35 | 0.1 | 0.748 | 0 | 37 | 3.49 | 1.94 |
| | Within | 267.55 | 80 | 3.34 | | | 1 | 45 | 3.36 | 1.73 |
| | Total | 267.90 | 81 | | | | | | -0.13 | |
| **rd_design_process** | Between | 4.37 | 1 | 4.37 | 3.1 | 0.084 | 0 | 37 | 4.89 | 1.39 |
| | Within | 113.88 | 80 | 1.42 | | | 1 | 45 | 5.36 | 1.00 |
| | Total | 118.24 | 81 | | | | | | 0.46 | |
| **rd_evaluation** | Between | 1.27 | 1 | 1.27 | 0.8 | 0.385 | 0 | 37 | 5.22 | 1.44 |
| | Within | 133.47 | 80 | 1.67 | | | 1 | 45 | 5.47 | 1.16 |
| | Total | 134.74 | 81 | | | | | | 0.25 | |
| **rd_contribution_clarity** | Between | 1.69 | 1 | 1.69 | 1.4 | 0.241 | 0 | 37 | 5.38 | 1.28 |
| | Within | 96.70 | 80 | 1.21 | | | 1 | 45 | 5.67 | 0.93 |
| | Total | 98.39 | 81 | | | | | | 0.29 | |
| **rd_limitations** | Between | 5.30 | 1 | 5.30 | 3.5 | 0.065 | 0 | 37 | 5.00 | 1.49 |
| | Within | 121.24 | 80 | 1.52 | | | 1 | 45 | 5.51 | 0.97 |
| | Total | 126.55 | 81 | | | | | | 0.51 | |
| | Between | 17.28 | 1 | 17.28 | 10.1 | 0.002 | 0 | 37 | 4.81 | 1.52 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **scim_issue_familiarity** | Within | 136.48 | 80 | 1.71 | | | 1 | 45 | 5.73 | 1.10 |
| | Total | 153.76 | 81 | | | | | | 0.92 | |
| **scim_research_problem** | Between | 15.83 | 1 | 15.83 | 9.7 | 0.003 | 0 | 37 | 4.78 | 1.64 |
| | Within | 130.27 | 80 | 1.63 | | | 1 | 45 | 5.67 | 0.88 |
| | Total | 146.10 | 81 | | | | | | 0.88 | |
| **scim_enjoyment** | Between | 14.77 | 1 | 14.77 | 6.3 | 0.014 | 0 | | 4.70 | 1.84 |
| | Within | 186.84 | 80 | 2.34 | | | 1 | 45 | 5.56 | 1.22 |
| | Total | 201.61 | 81 | | | | | | 0.85 | |
| **scim_entertainment** | Between | 24.42 | 1 | 24.42 | 8.7 | 0.004 | 0 | 37 | 4.08 | 1.93 |
| | Within | 225.33 | 80 | 2.82 | | | 1 | 45 | 5.18 | 1.43 |
| | Total | 249.76 | 81 | | | | | | 1.10 | |
| **scim_learn_more** | Between | 2.49 | 1 | 2.49 | 1.1 | 0.300 | 0 | 37 | 4.41 | 1.66 |
| | Within | 183.23 | 80 | 2.29 | | | 1 | 45 | 4.76 | 1.38 |
| | Total | 185.72 | 81 | | | | | | 0.35 | |
| **scim_get_involved** | Between | 0.90 | 1 | 0.90 | 0.3 | 0.563 | 0 | 37 | 3.57 | 1.68 |
| | Within | 212.86 | 80 | 2.66 | | | 1 | 45 | 3.78 | 1.59 |
| | Total | 213.76 | 81 | | | | | | 0.21 | |
| **scim_related_decision** | Between | 12.38 | 1 | 12.38 | 5.8 | 0.019 | 0 | 37 | 4.11 | 1.65 |
| | Within | 172.01 | 80 | 2.15 | | | 1 | 45 | 4.89 | 1.30 |
| | Total | 184.39 | 81 | | | | | | 0.78 | |
| **scim_understand_procedures** | Between | 7.67 | 1 | 7.67 | 6.7 | 0.012 | 0 | 37 | 4.92 | 1.32 |
| | Within | 91.96 | 80 | 1.15 | | | 1 | 45 | 5.53 | 0.81 |
| | Total | 99.62 | 81 | | | | | | 0.61 | |
| **scim_procedure_clear_why** | Between | 5.18 | 1 | 5.18 | 4.2 | 0.042 | 0 | 37 | 4.78 | 1.42 |
| | Within | 97.51 | 80 | 1.22 | | | 1 | 45 | 5.29 | 0.76 |
| | Total | 102.70 | 81 | | | | | | 0.51 | |
| **scim_explain_outcome_to_others** | Between | 4.28 | 1 | 4.28 | 2.6 | 0.111 | 0 | 37 | 4.92 | 1.62 |
| | Within | 131.33 | 80 | 1.64 | | | 1 | 45 | 5.38 | 0.91 |
| | Total | 135.61 | 81 | | | | | | 0.46 | |
| **scim_implications_practice** | Between | 6.92 | 1 | 6.92 | 6.3 | 0.014 | 0 | 37 | 5.22 | 1.23 |
| | Within | 87.47 | 80 | 1.09 | | | 1 | 45 | 5.80 | 0.87 |
| | Total | 94.39 | 81 | | | | | | 0.58 | |
| **scim_implications_science** | Between | 1.92 | 1 | 1.92 | 1.6 | 0.205 | 0 | 37 | 5.27 | 1.24 |
| | Within | 94.28 | 80 | 1.18 | | | 1 | 45 | 5.58 | 0.94 |
| | Total | 96.20 | 81 | | | | | | 0.31 | |

### K.1.2 The Effects of Featuring an Introductory Example

*Table 111: Single Factor ANOVA of the Introductory Example on Effects*

| | | Sum of Squares | df | Mean Square | F | Sig. | Featured | N | Mean | SD |
|---|---|---|---|---|---|---|---|---|---|---|
| **content_quality** | Between | 0.62 | 1 | 0.62 | 0.6 | 0.433 | 0 | 33 | 5.33 | 1.11 |
| | Within | 79.58 | 80 | 0.99 | | | 1 | 49 | 5.51 | 0.92 |
| | Total | 80.20 | 81 | | | | | | 0.18 | |
| **contribution_significance** | Between | 2.13 | 1 | 2.13 | 1.9 | 0.168 | 0 | 33 | 5.24 | 1.12 |
| | Within | 88.06 | 80 | 1.10 | | | 1 | 49 | 5.57 | 1.00 |
| | Total | 90.20 | 81 | | | | | | 0.33 | |
| **contribution_originality** | Between | 2.14 | 1 | 2.14 | 2.5 | 0.117 | 0 | 33 | 5.30 | 0.88 |
| | Within | 68.36 | 80 | 0.85 | | | 1 | 49 | 5.63 | 0.95 |
| | Total | 70.50 | 81 | | | | | | 0.33 | |
| **relevance** | Between | 1.79 | 1 | 1.79 | 1.9 | 0.173 | 0 | 33 | 5.52 | 1.09 |
| | Within | 75.59 | 80 | 0.94 | | | 1 | 49 | 5.82 | 0.88 |
| | Total | 77.38 | 81 | | | | | | 0.30 | |
| **presentation** | Between | 0.93 | 1 | 0.93 | 0.6 | 0.457 | 0 | 33 | 5.27 | 1.40 |
| | Within | 132.79 | 80 | 1.66 | | | 1 | 49 | 5.49 | 1.21 |
| | Total | 133.72 | 81 | | | | | | 0.22 | |
| **overall_impression** | Between | 1.21 | 1 | 1.21 | 1.0 | 0.321 | 0 | 33 | 5.30 | 1.16 |
| | Within | 97.09 | 80 | 1.21 | | | 1 | 49 | 5.55 | 1.06 |
| | Total | 98.30 | 81 | | | | | | 0.25 | |
| **cl_plotline** | Between | 1.22 | 1 | 1.22 | 0.8 | 0.388 | 0 | 33 | 5.36 | 1.34 |
| | Within | 129.27 | 80 | 1.62 | | | 1 | 49 | 5.61 | 1.22 |
| | Total | 130.49 | 81 | | | | | | 0.25 | |
| **cl_stakeh_emp** | Between | 2.39 | 1 | 2.39 | 1.4 | 0.245 | 0 | 33 | 5.12 | 1.27 |
| | Within | 139.72 | 80 | 1.75 | | | 1 | 49 | 5.47 | 1.36 |
| | Total | 142.11 | 81 | | | | | | 0.35 | |
| **cl_researchers_emp** | Between | 1.66 | 1 | 1.66 | 1.3 | 0.253 | 0 | 33 | 5.58 | 1.09 |
| | Within | 100.06 | 80 | 1.25 | | | 1 | 49 | 5.29 | 1.14 |
| | Total | 101.72 | 81 | | | | | | -0.29 | |
| **cl_design_decisions** | Between | 0.26 | 1 | 0.26 | 0.1 | 0.711 | 0 | 33 | 5.15 | 1.52 |
| | Within | 147.79 | 80 | 1.85 | | | 1 | 49 | 5.27 | 1.24 |
| | Total | 148.05 | 81 | | | | | | 0.11 | |
| **cl_topic_emp** | Between | 1.67 | 1 | 1.67 | 1.3 | 0.257 | 0 | 33 | 5.55 | 1.28 |
| | Within | 102.88 | 80 | 1.29 | | | 1 | 49 | 5.84 | 1.03 |
| | Total | 104.55 | 81 | | | | | | 0.29 | |
| | Between | 0.37 | 1 | 0.37 | 0.3 | 0.611 | 0 | 33 | 5.45 | 1.23 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **cl_examples_relata-ble** | Within | 114.02 | 80 | 1.43 | | | 1 | 49 | 5.59 | 1.17 |
| | Total | 114.39 | 81 | | | | | | 0.14 | |
| **cl_examples_helpful** | Between | 0.77 | 1 | 0.77 | 0.6 | 0.452 | 0 | 33 | 5.67 | 1.08 |
| | Within | 107.54 | 80 | 1.34 | | | 1 | 49 | 5.47 | 1.21 |
| | Total | 108.30 | 81 | | | | | | -0.20 | |
| **rp_problem_essence** | Between | 9.53 | 1 | 9.53 | 6.8 | 0.011 | 0 | 33 | 5.12 | 1.43 |
| | Within | 112.86 | 80 | 1.41 | | | 1 | 49 | 5.82 | 0.99 |
| | Total | 122.39 | 81 | | | | | | 0.70 | |
| **rp_situation** | Between | 3.66 | 1 | 3.66 | 2.9 | 0.092 | 0 | 33 | 5.24 | 1.39 |
| | Within | 100.84 | 80 | 1.26 | | | 1 | 49 | 5.67 | 0.90 |
| | Total | 104.50 | 81 | | | | | | 0.43 | |
| **rp_stakeholder** | Between | 0.92 | 1 | 0.92 | 0.6 | 0.428 | 0 | 33 | 5.15 | 1.30 |
| | Within | 115.63 | 80 | 1.45 | | | 1 | 49 | 5.37 | 1.13 |
| | Total | 116.55 | 81 | | | | | | 0.22 | |
| **rp_stakeh_goals** | Between | 3.12 | 1 | 3.12 | 2.2 | 0.144 | 0 | 33 | 4.97 | 1.33 |
| | Within | 114.36 | 80 | 1.43 | | | 1 | 49 | 5.37 | 1.09 |
| | Total | 117.48 | 81 | | | | | | 0.40 | |
| **rp_problem_scope** | Between | 8.76 | 1 | 8.76 | 3.9 | 0.051 | 0 | 33 | 4.33 | 1.63 |
| | Within | 179.33 | 80 | 2.24 | | | 1 | 49 | 5.00 | 1.40 |
| | Total | 188.10 | 81 | | | | | | 0.67 | |
| **rp_problem_scale** | Between | 21.34 | 1 | 21.34 | 10.1 | 0.002 | 0 | 33 | 3.94 | 1.66 |
| | Within | 168.86 | 80 | 2.11 | | | 1 | 49 | 4.98 | 1.30 |
| | Total | 190.20 | 81 | | | | | | 1.04 | |
| **rp_problem_rele-vance** | Between | 1.79 | 1 | 1.79 | 2.2 | 0.144 | 0 | 33 | 5.52 | 1.00 |
| | Within | 65.59 | 80 | 0.82 | | | 1 | 49 | 5.82 | 0.83 |
| | Total | 67.38 | 81 | | | | | | 0.30 | |
| **rp_problem_persis-tence** | Between | 3.95 | 1 | 3.95 | 3.3 | 0.074 | 0 | 33 | 4.88 | 1.22 |
| | Within | 96.29 | 80 | 1.20 | | | 1 | 49 | 5.33 | 1.01 |
| | Total | 100.24 | 81 | | | | | | 0.45 | |
| **rd_replicability** | Between | 1.26 | 1 | 1.26 | 0.6 | 0.445 | 0 | 33 | 4.79 | 1.60 |
| | Within | 171.43 | 80 | 2.14 | | | 1 | 49 | 5.04 | 1.37 |
| | Total | 172.70 | 81 | | | | | | 0.25 | |
| **rd_objective** | Between | 0.15 | 1 | 0.15 | 0.1 | 0.748 | 0 | 33 | 5.42 | 1.30 |
| | Within | 112.31 | 80 | 1.40 | | | 1 | 49 | 5.51 | 1.10 |
| | Total | 112.45 | 81 | | | | | | 0.09 | |
| **rd_general_ap-proach** | Between | 1.31 | 1 | 1.31 | 0.9 | 0.346 | 0 | 33 | 5.27 | 1.44 |
| | Within | 116.75 | 80 | 1.46 | | | 1 | 49 | 5.53 | 1.02 |
| | Total | 118.06 | 81 | | | | | | 0.26 | |
| **rd_rd_decisions** | Between | 0.99 | 1 | 0.99 | 0.6 | 0.460 | 0 | 33 | 5.00 | 1.41 |
| | Within | 144.53 | 80 | 1.81 | | | 1 | 49 | 5.22 | 1.30 |
| | Total | 145.52 | 81 | | | | | | 0.22 | |
| **rd_whats_artefact** | Between | 1.06 | 1 | 1.06 | 0.7 | 0.404 | 0 | 33 | 5.73 | 1.38 |
| | Within | 120.46 | 80 | 1.51 | | | 1 | 49 | 5.96 | 1.12 |
| | Total | 121.52 | 81 | | | | | | 0.23 | |
| | Between | 3.58 | 1 | 3.58 | 1.1 | 0.297 | 0 | 33 | 4.24 | 1.90 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **rd_artefact_is_useful** | Within | 259.41 | 80 | 3.24 | | | 1 | 49 | 3.82 | 1.73 |
| | Total | 262.99 | 81 | | | | | | -0.43 | |
| **rd_artefact_for_theory_development** | Between | 4.37 | 1 | 4.37 | 1.3 | 0.255 | 0 | 33 | 3.88 | 2.06 |
| | Within | 265.35 | 80 | 3.32 | | | 1 | 49 | 3.41 | 1.64 |
| | Total | 269.72 | 81 | | | | | | -0.47 | |
| **rd_artefact_theory_testing** | Between | 5.37 | 1 | 5.37 | 1.8 | 0.189 | 0 | 33 | 3.85 | 1.82 |
| | Within | 245.02 | 80 | 3.06 | | | 1 | 49 | 3.33 | 1.70 |
| | Total | 250.39 | 81 | | | | | | -0.52 | |
| **rd_artefact_theorize_usage** | Between | 1.15 | 1 | 1.15 | 0.4 | 0.532 | 0 | 33 | 3.30 | 1.81 |
| | Within | 233.79 | 80 | 2.92 | | | 1 | 49 | 3.06 | 1.64 |
| | Total | 234.94 | 81 | | | | | | -0.24 | |
| **rd_artefact_theorize_building_process** | Between | 0.14 | 1 | 0.14 | 0.0 | 0.836 | 0 | 33 | 3.36 | 2.00 |
| | Within | 267.76 | 80 | 3.35 | | | 1 | 49 | 3.45 | 1.71 |
| | Total | 267.90 | 81 | | | | | | 0.09 | |
| **rd_design_process** | Between | 0.51 | 1 | 0.51 | 0.3 | 0.558 | 0 | 33 | 5.24 | 1.37 |
| | Within | 117.73 | 80 | 1.47 | | | 1 | 49 | 5.08 | 1.10 |
| | Total | 118.24 | 81 | | | | | | -0.16 | |
| **rd_evaluation** | Between | 1.11 | 1 | 1.11 | 0.7 | 0.418 | 0 | 33 | 5.21 | 1.19 |
| | Within | 133.64 | 80 | 1.67 | | | 1 | 49 | 5.45 | 1.35 |
| | Total | 134.74 | 81 | | | | | | 0.24 | |
| **rd_contribution_clarity** | Between | 0.00 | 1 | 0.00 | 0.0 | 0.953 | 0 | 33 | 5.55 | 1.33 |
| | Within | 98.39 | 80 | 1.23 | | | 1 | 49 | 5.53 | 0.94 |
| | Total | 98.39 | 81 | | | | | | -0.01 | |
| **rd_limitations** | Between | 3.46 | 1 | 3.46 | 2.2 | 0.138 | 0 | 33 | 5.03 | 1.33 |
| | Within | 123.09 | 80 | 1.54 | | | 1 | 49 | 5.45 | 1.17 |
| | Total | 126.55 | 81 | | | | | | 0.42 | |
| **scim_issue_familiarity** | Between | 3.63 | 1 | 3.63 | 1.9 | 0.168 | 0 | 33 | 5.06 | 1.64 |
| | Within | 150.12 | 80 | 1.88 | | | 1 | 49 | 5.49 | 1.16 |
| | Total | 153.76 | 81 | | | | | | 0.43 | |
| **scim_research_problem** | Between | 14.40 | 1 | 14.40 | 8.8 | 0.004 | 0 | 33 | 4.76 | 1.44 |
| | Within | 131.69 | 80 | 1.65 | | | 1 | 49 | 5.61 | 1.17 |
| | Total | 146.10 | 81 | | | | | | 0.85 | |
| **scim_enjoyment** | Between | 4.71 | 1 | 4.71 | 1.9 | 0.171 | 0 | 33 | 4.88 | 1.62 |
| | Within | 196.90 | 80 | 2.46 | | | 1 | 49 | 5.37 | 1.54 |
| | Total | 201.61 | 81 | | | | | | 0.49 | |
| **scim_entertainment** | Between | 23.52 | 1 | 23.52 | 8.3 | 0.005 | 0 | 33 | 4.03 | 1.74 |
| | Within | 226.24 | 80 | 2.83 | | | 1 | 49 | 5.12 | 1.64 |
| | Total | 249.76 | 81 | | | | | | 1.09 | |
| **scim_learn_more** | Between | 9.55 | 1 | 9.55 | 4.3 | 0.041 | 0 | 33 | 4.18 | 1.63 |
| | Within | 176.17 | 80 | 2.20 | | | 1 | 49 | 4.88 | 1.38 |
| | Total | 185.72 | 81 | | | | | | 0.70 | |
| **scim_get_involved** | Between | 9.29 | 1 | 9.29 | 3.6 | 0.060 | 0 | 33 | 3.27 | 1.57 |
| | Within | 204.46 | 80 | 2.56 | | | 1 | 49 | 3.96 | 1.62 |
| | Total | 213.76 | 81 | | | | | | 0.69 | |
| | Between | 9.53 | 1 | 9.53 | 4.4 | 0.040 | 0 | 33 | 4.12 | 1.60 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **scim_related_decision** | Within | 174.86 | 80 | 2.19 | | | 1 | 49 | 4.82 | 1.39 |
| | Total | 184.39 | 81 | | | | | | 0.70 | |
| **scim_understand_procedures** | Between | 1.00 | 1 | 1.00 | 0.8 | 0.369 | 0 | 33 | 5.12 | 1.19 |
| | Within | 98.62 | 80 | 1.23 | | | 1 | 49 | 5.35 | 1.05 |
| | Total | 99.62 | 81 | | | | | | 0.23 | |
| **scim_procedure_clear_why** | Between | 1.27 | 1 | 1.27 | 1.0 | 0.319 | 0 | 33 | 4.91 | 1.18 |
| | Within | 101.42 | 80 | 1.27 | | | 1 | 49 | 5.16 | 1.09 |
| | Total | 102.70 | 81 | | | | | | 0.25 | |
| **scim_explain_outcome_to_others** | Between | 3.78 | 1 | 3.78 | 2.3 | 0.134 | 0 | 33 | 4.91 | 1.35 |
| | Within | 131.83 | 80 | 1.65 | | | 1 | 49 | 5.35 | 1.23 |
| | Total | 135.61 | 81 | | | | | | 0.44 | |
| **scim_implications_practice** | Between | 1.12 | 1 | 1.12 | 1.0 | 0.329 | 0 | 33 | 5.39 | 1.14 |
| | Within | 93.27 | 80 | 1.17 | | | 1 | 49 | 5.63 | 1.03 |
| | Total | 94.39 | 81 | | | | | | 0.24 | |
| **scim_implications_science** | Between | 0.01 | 1 | 0.01 | 0.0 | 0.920 | 0 | 33 | 5.42 | 1.06 |
| | Within | 96.18 | 80 | 1.20 | | | 1 | 49 | 5.45 | 1.12 |
| | Total | 96.20 | 81 | | | | | | 0.02 | |

### K.1.3 The Effects of Formulating a Research Question

*Table 112: Single Factor ANOVA of Formulating a Research Question*

| | | Sum of Squares | df | Mean Square | F | Sig. | Featured | N | Mean | SD |
|---|---|---|---|---|---|---|---|---|---|---|
| **content_quality** | Between | 0.00 | 1 | 0.00 | 0.0 | 0.987 | 0 | 48 | 5.44 | 0.92 |
| | Within | 80.19 | 80 | 1.00 | | | 1 | 34 | 5.44 | 1.11 |
| | Total | 80.20 | 81 | | | | | | 0.00 | |
| **contribution_significance** | Between | 0.06 | 1 | 0.06 | 0.1 | 0.821 | 0 | 48 | 5.42 | 1.01 |
| | Within | 90.14 | 80 | 1.13 | | | 1 | 34 | 5.47 | 1.13 |
| | Total | 90.20 | 81 | | | | | | 0.05 | |
| **contribution_originality** | Between | 0.45 | 1 | 0.45 | 0.5 | 0.474 | 0 | 48 | 5.56 | 0.85 |
| | Within | 70.05 | 80 | 0.88 | | | 1 | 34 | 5.41 | 1.05 |
| | Total | 70.50 | 81 | | | | | | -0.15 | |
| **relevance** | Between | 4.41 | 1 | 4.41 | 4.8 | 0.031 | 0 | 48 | 5.50 | 1.03 |
| | Within | 72.97 | 80 | 0.91 | | | 1 | 34 | 5.97 | 0.83 |
| | Total | 77.38 | 81 | | | | | | 0.47 | |
| **presentation** | Between | 4.36 | 1 | 4.36 | 2.7 | 0.104 | 0 | 48 | 5.21 | 1.37 |
| | Within | 129.36 | 80 | 1.62 | | | 1 | 34 | 5.68 | 1.12 |
| | Total | 133.72 | 81 | | | | | | 0.47 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **overall_impression** | Between | 0.02 | 1 | 0.02 | 0.0 | 0.894 | 0 | 48 | 5.44 | 1.13 |
| | Within | 98.28 | 80 | 1.23 | | | 1 | 34 | 5.47 | 1.08 |
| | Total | 98.30 | 81 | | | | | | 0.03 | |
| **cl_plotline** | Between | 1.57 | 1 | 1.57 | 1.0 | 0.327 | 0 | 48 | 5.40 | 1.40 |
| | Within | 128.92 | 80 | 1.61 | | | 1 | 34 | 5.68 | 1.07 |
| | Total | 130.49 | 81 | | | | | | 0.28 | |
| **cl_stakeh_emp** | Between | 0.07 | 1 | 0.07 | 0.0 | 0.841 | 0 | 48 | 5.35 | 1.38 |
| | Within | 142.04 | 80 | 1.78 | | | 1 | 34 | 5.29 | 1.27 |
| | Total | 142.11 | 81 | | | | | | -0.06 | |
| **cl_researchers_emp** | Between | 0.36 | 1 | 0.36 | 0.3 | 0.595 | 0 | 48 | 5.46 | 1.11 |
| | Within | 101.36 | 80 | 1.27 | | | 1 | 34 | 5.32 | 1.15 |
| | Total | 101.72 | 81 | | | | | | -0.13 | |
| **cl_design_decisions** | Between | 2.85 | 1 | 2.85 | 1.6 | 0.214 | 0 | 48 | 5.06 | 1.45 |
| | Within | 145.19 | 80 | 1.81 | | | 1 | 34 | 5.44 | 1.19 |
| | Total | 148.05 | 81 | | | | | | 0.38 | |
| **cl_topic_emp** | Between | 6.69 | 1 | 6.69 | 5.5 | 0.022 | 0 | 48 | 5.48 | 1.29 |
| | Within | 97.86 | 80 | 1.22 | | | 1 | 34 | 6.06 | 0.78 |
| | Total | 104.55 | 81 | | | | | | 0.58 | |
| **cl_examples_relata-ble** | Between | 9.51 | 1 | 9.51 | 7.3 | 0.009 | 0 | 48 | 5.25 | 1.28 |
| | Within | 104.88 | 80 | 1.31 | | | 1 | 34 | 5.94 | 0.92 |
| | Total | 114.39 | 81 | | | | | | 0.69 | |
| **cl_examples_helpful** | Between | 10.33 | 1 | 10.33 | 8.4 | 0.005 | 0 | 48 | 5.25 | 1.16 |
| | Within | 97.97 | 80 | 1.22 | | | 1 | 34 | 5.97 | 1.03 |
| | Total | 108.30 | 81 | | | | | | 0.72 | |
| **rp_problem_essence** | Between | 0.38 | 1 | 0.38 | 0.3 | 0.618 | 0 | 48 | 5.48 | 1.41 |
| | Within | 122.01 | 80 | 1.53 | | | 1 | 34 | 5.62 | 0.92 |
| | Total | 122.39 | 81 | | | | | | 0.14 | |
| **rp_situation** | Between | 0.45 | 1 | 0.45 | 0.3 | 0.557 | 0 | 48 | 5.44 | 1.30 |
| | Within | 104.05 | 80 | 1.30 | | | 1 | 34 | 5.59 | 0.86 |
| | Total | 104.50 | 81 | | | | | | 0.15 | |
| **rp_stakeholder** | Between | 0.01 | 1 | 0.01 | 0.0 | 0.921 | 0 | 48 | 5.29 | 1.24 |
| | Within | 116.53 | 80 | 1.46 | | | 1 | 34 | 5.26 | 1.16 |
| | Total | 116.55 | 81 | | | | | | -0.03 | |
| **rp_stakeh_goals** | Between | 0.05 | 1 | 0.05 | 0.0 | 0.861 | 0 | 48 | 5.19 | 1.33 |
| | Within | 117.43 | 80 | 1.47 | | | 1 | 34 | 5.24 | 1.02 |
| | Total | 117.48 | 81 | | | | | | 0.05 | |
| **rp_problem_scope** | Between | 4.18 | 1 | 4.18 | 1.8 | 0.181 | 0 | 48 | 4.54 | 1.57 |
| | Within | 183.92 | 80 | 2.30 | | | 1 | 34 | 5.00 | 1.44 |
| | Total | 188.10 | 81 | | | | | | 0.46 | |
| **rp_problem_scale** | Between | 1.22 | 1 | 1.22 | 0.5 | 0.475 | 0 | 48 | 4.46 | 1.64 |
| | Within | 188.98 | 80 | 2.36 | | | 1 | 34 | 4.71 | 1.38 |
| | Total | 190.20 | 81 | | | | | | 0.25 | |
| **rp_problem_rele-vance** | Between | 0.09 | 1 | 0.09 | 0.1 | 0.739 | 0 | 48 | 5.67 | 0.97 |
| | Within | 67.28 | 80 | 0.84 | | | 1 | 34 | 5.74 | 0.83 |
| | Total | 67.38 | 81 | | | | | | 0.07 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **rp_problem_persistence** | Between | 2.48 | 1 | 2.48 | 2.0 | 0.158 | 0 | 48 | 5.00 | 1.17 |
| | Within | 97.76 | 80 | 1.22 | | | 1 | 34 | 5.35 | 1.01 |
| | Total | 100.24 | 81 | | | | | | 0.35 | |
| **rd_replicability** | Between | 11.42 | 1 | 11.42 | 5.7 | 0.020 | 0 | 48 | 4.63 | 1.57 |
| | Within | 161.28 | 80 | 2.02 | | | 1 | 34 | 5.38 | 1.18 |
| | Total | 172.70 | 81 | | | | | | 0.76 | |
| **rd_objective** | Between | 0.40 | 1 | 0.40 | 0.3 | 0.594 | 0 | 48 | 5.42 | 1.25 |
| | Within | 112.05 | 80 | 1.40 | | | 1 | 34 | 5.56 | 1.08 |
| | Total | 112.45 | 81 | | | | | | 0.14 | |
| **rd_general_approach** | Between | 10.55 | 1 | 10.55 | 7.8 | 0.006 | 0 | 48 | 5.13 | 1.35 |
| | Within | 107.51 | 80 | 1.34 | | | 1 | 34 | 5.85 | 0.82 |
| | Total | 118.06 | 81 | | | | | | 0.73 | |
| **rd_rd_decisions** | Between | 4.48 | 1 | 4.48 | 2.5 | 0.115 | 0 | 48 | 4.94 | 1.37 |
| | Within | 141.05 | 80 | 1.76 | | | 1 | 34 | 5.41 | 1.26 |
| | Total | 145.52 | 81 | | | | | | 0.47 | |
| **rd_whats_artefact** | Between | 1.55 | 1 | 1.55 | 1.0 | 0.312 | 0 | 48 | 5.75 | 1.33 |
| | Within | 119.97 | 80 | 1.50 | | | 1 | 34 | 6.03 | 1.06 |
| | Total | 121.52 | 81 | | | | | | 0.28 | |
| **rd_artefact_is_useful** | Between | 0.13 | 1 | 0.13 | 0.0 | 0.845 | 0 | 48 | 4.02 | 1.68 |
| | Within | 262.86 | 80 | 3.29 | | | 1 | 34 | 3.94 | 1.98 |
| | Total | 262.99 | 81 | | | | | | -0.08 | |
| **rd_artefact_for_theory_development** | Between | 0.27 | 1 | 0.27 | 0.1 | 0.778 | 0 | 48 | 3.65 | 1.80 |
| | Within | 269.45 | 80 | 3.37 | | | 1 | 34 | 3.53 | 1.88 |
| | Total | 269.72 | 81 | | | | | | -0.12 | |
| **rd_artefact_theory_testing** | Between | 1.38 | 1 | 1.38 | 0.4 | 0.507 | 0 | 48 | 3.65 | 1.72 |
| | Within | 249.01 | 80 | 3.11 | | | 1 | 34 | 3.38 | 1.83 |
| | Total | 250.39 | 81 | | | | | | -0.26 | |
| **rd_artefact_theorize_usage** | Between | 1.58 | 1 | 1.58 | 0.5 | 0.464 | 0 | 48 | 3.04 | 1.71 |
| | Within | 233.36 | 80 | 2.92 | | | 1 | 34 | 3.32 | 1.70 |
| | Total | 234.94 | 81 | | | | | | 0.28 | |
| **rd_artefact_theorize_building_process** | Between | 1.21 | 1 | 1.21 | 0.4 | 0.549 | 0 | 48 | 3.31 | 1.78 |
| | Within | 266.69 | 80 | 3.33 | | | 1 | 34 | 3.56 | 1.89 |
| | Total | 267.90 | 81 | | | | | | 0.25 | |
| **rd_design_process** | Between | 1.27 | 1 | 1.27 | 0.9 | 0.354 | 0 | 48 | 5.04 | 1.25 |
| | Within | 116.98 | 80 | 1.46 | | | 1 | 34 | 5.29 | 1.14 |
| | Total | 118.24 | 81 | | | | | | 0.25 | |
| **rd_evaluation** | Between | 0.21 | 1 | 0.21 | 0.1 | 0.727 | 0 | 48 | 5.40 | 1.22 |
| | Within | 134.54 | 80 | 1.68 | | | 1 | 34 | 5.29 | 1.40 |
| | Total | 134.74 | 81 | | | | | | -0.10 | |
| **rd_contribution_clarity** | Between | 1.38 | 1 | 1.38 | 1.1 | 0.289 | 0 | 48 | 5.65 | 1.04 |
| | Within | 97.01 | 80 | 1.21 | | | 1 | 34 | 5.38 | 1.18 |
| | Total | 98.39 | 81 | | | | | | -0.26 | |
| **rd_limitations** | Between | 2.10 | 1 | 2.10 | 1.3 | 0.249 | 0 | 48 | 5.15 | 1.22 |
| | Within | 124.45 | 80 | 1.56 | | | 1 | 34 | 5.47 | 1.28 |
| | Total | 126.55 | 81 | | | | | | 0.32 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **scim_issue_familiarity** | Between | 3.39 | 1 | 3.39 | 1.8 | 0.183 | 0 | 48 | 5.15 | 1.50 |
| | Within | 150.36 | 80 | 1.88 | | | 1 | 34 | 5.56 | 1.16 |
| | Total | 153.76 | 81 | | | | | | 0.41 | |
| **scim_research_problem** | Between | 3.12 | 1 | 3.12 | 1.7 | 0.190 | 0 | 48 | 5.10 | 1.42 |
| | Within | 142.98 | 80 | 1.79 | | | 1 | 34 | 5.50 | 1.21 |
| | Total | 146.10 | 81 | | | | | | 0.40 | |
| **scim_enjoyment** | Between | 2.60 | 1 | 2.60 | 1.0 | 0.310 | 0 | 48 | 5.02 | 1.55 |
| | Within | 199.01 | 80 | 2.49 | | | 1 | 34 | 5.38 | 1.61 |
| | Total | 201.61 | 81 | | | | | | 0.36 | |
| **scim_entertainment** | Between | 10.98 | 1 | 10.98 | 3.7 | 0.059 | 0 | 48 | 4.38 | 1.78 |
| | Within | 238.78 | 80 | 2.98 | | | 1 | 34 | 5.12 | 1.65 |
| | Total | 249.76 | 81 | | | | | | 0.74 | |
| **scim_learn_more** | Between | 4.71 | 1 | 4.71 | 2.1 | 0.153 | 0 | 48 | 4.40 | 1.48 |
| | Within | 181.01 | 80 | 2.26 | | | 1 | 34 | 4.88 | 1.53 |
| | Total | 185.72 | 81 | | | | | | 0.49 | |
| **scim_get_involved** | Between | 6.97 | 1 | 6.97 | 2.7 | 0.104 | 0 | 48 | 3.44 | 1.60 |
| | Within | 206.78 | 80 | 2.58 | | | 1 | 34 | 4.03 | 1.62 |
| | Total | 213.76 | 81 | | | | | | 0.59 | |
| **scim_related_decision** | Between | 3.02 | 1 | 3.02 | 1.3 | 0.252 | 0 | 48 | 4.38 | 1.45 |
| | Within | 181.37 | 80 | 2.27 | | | 1 | 34 | 4.76 | 1.58 |
| | Total | 184.39 | 81 | | | | | | 0.39 | |
| **scim_understand_procedures** | Between | 1.41 | 1 | 1.41 | 1.1 | 0.288 | 0 | 48 | 5.15 | 1.18 |
| | Within | 98.21 | 80 | 1.23 | | | 1 | 34 | 5.41 | 0.99 |
| | Total | 99.62 | 81 | | | | | | 0.27 | |
| **scim_procedure_clear_why** | Between | 4.95 | 1 | 4.95 | 4.1 | 0.047 | 0 | 48 | 4.85 | 1.17 |
| | Within | 97.74 | 80 | 1.22 | | | 1 | 34 | 5.35 | 1.01 |
| | Total | 102.70 | 81 | | | | | | 0.50 | |
| **scim_explain_outcome_to_others** | Between | 3.37 | 1 | 3.37 | 2.0 | 0.157 | 0 | 48 | 5.00 | 1.37 |
| | Within | 132.24 | 80 | 1.65 | | | 1 | 34 | 5.41 | 1.16 |
| | Total | 135.61 | 81 | | | | | | 0.41 | |
| **scim_implications_practice** | Between | 0.38 | 1 | 0.38 | 0.3 | 0.570 | 0 | 48 | 5.48 | 0.92 |
| | Within | 94.01 | 80 | 1.18 | | | 1 | 34 | 5.62 | 1.28 |
| | Total | 94.39 | 81 | | | | | | 0.14 | |
| **scim_implications_science** | Between | 0.06 | 1 | 0.06 | 0.0 | 0.827 | 0 | 48 | 5.42 | 0.92 |
| | Within | 96.14 | 80 | 1.20 | | | 1 | 34 | 5.47 | 1.31 |
| | Total | 96.20 | 81 | | | | | | 0.05 | |

# Appendix L Complemental Material About the Evaluation of the Quick Guide

To evaluate whether the Quick-Guide (Section 7.3.3) satisfactorily answers the RQ and the requirements, a survey study with active design researchers was conducted. This appendix contains a screenshot of the questionnaire (results and context: Section 7.4.2).

How familiar are you with Design Science Research (DSR)? *

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| What is DSR? | ○ | ○ | ○ | ○ | ○ | I was pers. involved in DSR |

You write a design research article. How do you think would using (vs. not using) the Quick-Guide affect the following items? *

| | much worse | 2 | somewhat worse | 4 | somewhat better | 6 | much better |
|---|---|---|---|---|---|---|---|
| Paper-writing process in general | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Identification of the article's goals | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Creation of an adequate structure | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Creation of an adequate story | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Clarity of how to present indiv. contents | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Please indicate your level of agreement on these general attributes for the Quick-Guide. *

| | fully disagree | 2 | somewhat disagree | 3 | somewhat agree | 6 | fully agree |
|---|---|---|---|---|---|---|---|
| It is useful for design researchers | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Researchers are likely to use it | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It is easy to understand | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| It is easy to use | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| I would use it to write a DSR paper | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Is there something you wish to add to these responses?

Your answer

# Appendix M Complemental Material About the Field Experiment

The field experiment, as presented in Appendix F, contains references to supplemental material. This supplemental material is namely (Section M.1) screenshots of **the survey** used to gather data, and (Section M.2) the **invitation e-mail** sent to potential assessors.

# M.1 The Survey Used to Gather Data

The survey used by the assessors to gather their evaluation of the presentations with regard to the purpose of the artefact (checklist) is depicted below. The second section appears four times (once for each presentation and assessor).

## M.1.1 Section 1, Identifying which Videos were Assessed

Kommunikation von DSR Projekten

Herzlichen Dank für Deine Experiment-Teilnahme. Um das Experiment erfolgreich ausfüllen zu können, musst Du zunächst ein separates Briefing erhalten haben. Darin findest Du Deine Playlist für die Videos, welche Du anschauen und danach evaluieren solltest. Wenn Du dieses Briefing nicht bekommen hast, oder dieses unklar ist, wendest Du Dich am besten direkt an mich (Marcel Cahenzli).

...

* Erforderlich

Einleitung

1. Zu welcher Playlist füllst Du diesen Fragebogen aus? (siehe Namen der Playlist über der Liste der Videos) *

- ○ 1
- ○ 2
- ◉ 3
- ○ 4
- ○ 5
- ○ 6
- ○ 7
- ○ 8
- ○ 9

2. Wie vertraut fühlst Du Dich mit... *

| | kenne ich gar nicht | 2 | weiss worum's geht | 4 | kenne mich bestens aus |
|---|---|---|---|---|---|
| Forschungsmethoden | ○ | ○ | ○ | ◉ | ○ |
| Forschungsdesign | ○ | ○ | ○ | ◉ | ○ |
| Gestaltungsorientierte Forschung (DSR) | ○ | ○ | ○ | ◉ | ○ |

3. Bitte fülle die nachfolgenden Fragen jeweils so aus, dass Du ein Video schaust und danach einen Abschnitt beantwortest, bevor Du zum nächsten Video gehst.

## M.1.2 Sections 2-5, Capturing the Assessments for each Presentation

Kommunikation von DSR Projekten ...

* Erforderlich

### Video 1 Deiner Playlist

Schau Dir nun bitte das erste der vier Videos an. Du brauchst Dir keine Notizen zu machen - einfach nur aufmerksam zuschauen und zuhören. Nachdem Du damit fertig bist, kannst Du die untenstehenden Fragen beantworten. Es gibt kein Richtig oder Falsch - evaluiere einfach für Dich, was passend erscheint.

4. Die 7-Punkte Skala geht von 1 (stimmt überhaupt nicht) zu 4 (so ungefähr) zu 7 (stimmt perfekt). *

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Ich verstehe was das Forschungsproblem ist, wie es sich ausdrückt und warum es ohne etwas zu tun nicht weggeht. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Ich weiss, worauf die Gruppe den Fokus gelegt hat - also welchen Teilaspekt des Problems die Gruppe adressiert und warum. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Ich verstehe was die Forschungslücke ist, und wie die Gruppe diese schliessen möchte. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Mir ist klar auf welchem bestehenden Wissen aufgebaut wird, und warum dieses gewählt wurde. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Ich verstehe, welcher Forschungsansatz gewählt wurde, wie dieser angewendet wurde und warum das für dieses Forschungsproblem sinnvoll ist. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Ich weiss wie die Anforderungen an eine Lösung erarbeitet wurden und welche diese sind. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Mir ist klar, wie es zum tatsächlichen Design gekommen ist, und wie sich die Gruppe für ihr Vorgehen entschieden hat. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Mir ist klar, was der Lösungsvorschlag (Artefakt) der Gruppe ist, wie das vorgeschlagene Vorgehen zu dieser Lösung führt, und warum diese das Problem lösen könnte. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

5. Die Gruppe musste aufzeigen, dass sie versteht wie man ein Forschungsdesign erstellt (sie mussten dieses aber nicht selbst umsetzen).

Die 7-Punkte Skala geht von 1 (stimmt überhaupt nicht) zu 4 (so ungefähr) zu 7 (stimmt perfekt). *

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Ich fand die Präsentation informativ. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Ich fand die Präsentation unterhaltsam. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Ich denke diese Gruppe hat ein gutes Forschungsdesign erstellt. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Ich denke diese Gruppe hat gut verstanden, wie man ein Forschungsdesing erstellt. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

6. Wie findest Du diese Präsentation? Ist etwas daran besonders gut gelungen? Ist etwas unklar geblieben? *

Ihre Antwort eingeben

## M.2 Invitation E-Mail to Potential Assessors

To motivate potential assessors, the author has sent invitational e-mails informing the evaluation task and the associated remuneration (here: shared participation with an ensuing apéro riche). The invitation e-mail was sent in German, since the assessors needed to presentations are in German as well. The text used in the e-mail is copied below (this is the version sent to fellow researchers at the institute of information management at the university of Saint Gallen):

*Liebe IWI-aner*innen*

*Ich lade Euch zu einem sympathischen Experiment ein. (:*

*Wie ihr wisst, befasse ich mich mit dem Thema Kommunikation von Design Science Research Projekten. Konkret möchte nützliche Hilfestellungen entwickeln, welche Forschenden dabei helfen, ihre Projekte effektiver zu kommunizieren. Solche Hilfestellungen habe ich in den letzten Semestern erstellt. Entsprechend nützlich ist nun ein Feldexperiment, bei welchem ich gewissen Leuten zusätzliche Unterstützung biete, während Andere diese nicht bekommen. Dieses Experiment habe ich bereits durchgeführt (d.h. die Daten sind gesammelt). Allerdings kann (oder besser: sollte) ich diese*

*Daten nicht selbst analysieren. Schliesslich weiss ich, wer meine Hilfestellung verwendet hat, und wer nicht.*

*Somit muss ich uneingeweihte Personen finden, welche sich etwas Zeit nehmen, und mir bei der Auswertung der Daten helfen. Hierfür muss man sich ein paar Präsentationen anschauen (je 4 Videos à ca. 15 min) und nach jeder Präsentation ein paar Fragen beantworten. Diese Fragen sehen dann beispielsweise so aus: Verstehst Du was nun genau das Forschungsproblem war? (1=keine Ahnung; 4=so-so-la-la; 7=perfekt klar!) Die Präsentationen an sich sind übrigens spannend: Studierende des MBI haben sich relevante Forschungsprobleme gesucht, für welche sie mit Design Science Research innovative Lösungen bauen möchten. Ich gehe davon aus, dass das Ganze pro Person rund 1.5h dauert.*

*Mit dieser Analyse steht und fällt mein Feldexperiment, welches die zentralste Studie meiner Dissertation ist. Daher wäre Deine Teilnahme extremst geschätzt! Und damit es nicht einfach ein langweiliges in-die-Röhre-gucken ist, sondern eine nette Experience 😄 schlage ich folgendes Setting vor:*

*Ich reserviere einen grossen Raum am IWI und alle die teilnehmen sind herzlichst eingeladen, zeitgleich und am gleichen Ort diese Videos zu schauen (mit Kopfhörer und jede*r für sich – aber gemeinsam ist's eine nettere Experience und dann sind auch alle ungefähr gleichzeitig fertig). Gleich anschliessend an diese Session würden wir uns dann bei gutem Wetter auf die IWI-Dachterrasse und bei schlechtem Wetter in die IWI-Küche begeben. Dort warten dann gekühlte Getränke und ein reichhaltiges Buffet auf Euch um den restlichen Abend gemeinsam zu geniessen.*

*Bist Du dabei? Dann fülle bitte Deine Verfügbarkeit unten ein.*

*Es grüsst freundlichst,*
*Marcel*

*PS: Falls der Termin an Ende so fällt, dass Du nicht dabei sein kannst, wäre ich über eine Teilnahme natürlich trotzdem extremst froh. Gerne kann ich für Deine Mühen stattdessen anbieten, meine Kenntnisse in Forschungsmethodik zur Verfügung zu stellen (bspw. friendly Review vor einer Paper-Submission), oder einmal ein Mittagessen für Dich mitbringen.*

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# Curriculum Vitae

| | |
|---|---|
| Name: | Marcel Pascal Cahenzli |
| Date of birth: | 01.11.1992 |
| Place of birth: | Frauenfeld, TG, Switzerland |
| Nationality: | Swiss |

**Education**

| | |
|---|---|
| **2018-2022** | **University of St. Gallen (HSG), St. Gallen, Switzerland** |
| | Ph.D. Program in Management (Business Innovation) |
| **2016-2018** | **University of St. Gallen (HSG), St. Gallen, Switzerland** |
| | Master of Arts (M.A.) in Business Innovation |
| **2012-2016** | **University of St. Gallen (HSG), St. Gallen, Switzerland** |
| | Bachelor of Arts (B.A.) in Business Administration |
| **2008-2012** | **Gymnase d'Yverson and Kantonsschule Frauenfeld** |
| | Maturité Bilingue, French-German |