Designing an Artifact for Informal Control in Enterprise Architecture Management

Completed Research Paper

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Abstract

Aligning local business and technology initiatives with enterprise-wide objectives remains a challenge for many organizations. To this end, Enterprise Architecture Management (EAM) imposes formal control mechanisms such as architecture plans and principles aimed at leveraging enterprise-wide standards and harnessing information systems (IS) complexity. Addressing recent calls to complement EAM control portfolios with informal control mechanisms, this study reports on the design, implementation and adoption of an Enterprise Architecture Label at a large multinational engineering company. Based on recent research on nudging, we deliberately designed the choice architecture of local decision makers. The Enterprise Architecture Label aims to influence the decision-making process, so that IS design alternatives that are preferable from an enterprise-wide perspective appear to be more attractive. Following an Action Design Research approach, the paper highlights the process of defining the underlying measurement system, designing an appropriate presentation, and the learnings and theory implications made throughout this process.

Keywords: Enterprise Architecture Management, Informal Control Mechanism, Action Design Research.

Introduction

Senior (IT) managers of large and complex organizations, such as multinational financial service providers or industrial companies, often find it challenging to align and coordinate business and technology initiatives on an enterprise-wide level. According to their experience, local entities, such as software development teams and regional business units, tend to take business and technology design decisions limited to a *local perspective* (i.e., by opting for what is in the interest of their specific stakeholders at a particular point in time), and rarely with an *enterprise-wide perspective* (i.e., by opting for what would be best for the entire enterprise in the long run) (Malaurent and Avison 2016). Unfortunately, design decisions taken with a local perspective often create negative side effects such as increasing complexity on an enterprise-wide level, which in turn make it difficult to cope with technology innovation, newly arising business models, or regulatory (data) requirements (Bernus et al. 2016; Buckl et al. 2010).

Enterprise Architecture Management (EAM) is a well-established management approach to address this challenge. EAM provides the fundamental organization logic of business processes and IT infrastructure to pursue goals, such as flexibility and efficiency, on an enterprise-wide level (Richardson et al. 1990; Ross et al. 2006; Zachman 1987). Ultimately, EAM intends to drive a maturation process, where organizational entities learn over time why and how to design, implement, and leverage enterprise-wide standards (Ross et al. 2006).

To this end, various *control mechanisms*, i.e., the means to align local decision-making with enterprise-wide objectives, are available to address the particular challenges of each maturity level (Cram et al. 2015; Schilling et al. 2018). At a low maturity level, frameworks (The Open Group 2018; Zachman 1987) and modeling methods (Lankhorst 2005; Winter and Fischer 2007) are used to structure and describe EA, measurement systems quantify the needs and effects of EAM (Lange et al. 2016; Schmidt and Buxmann 2011; Tamm et al. 2011). Architecture principles (Richardson et al. 1990), EA planning processes, and EA governance structures are exemplary implementations of control mechanisms for intermediate maturity levels. At a high EAM maturity level, architectural norms and values should become institutionalized across the organization (Aier et al. 2015; Ross and Quaadgras 2012; Winter 2016). However, the appropriate control mechanisms for this high maturity level are less known. This becomes evident when looking at the many organizations that have a long track record of EAM, but have not yet succeeded in *institutionalizing an enterprise-wide perspective across the organization* (Ross and Quaadgras 2012). Hence, we aim at designing and implementing an artifact that complements existing EAM control mechanisms for institutionalizing architectural norms and values, i.e., a control mechanism suitable for high levels of EAM maturity.

We draw upon research on *nudging* (Mirsch et al. 2018; Thaler and Sunstein 2008; Weinmann et al. 2016), stating that decision-making of local entities may be changed by altering the way in which choice alternatives are presented. This may help address the challenge that design options that are preferable from an enterprise-wide perspective appear to be less attractive for local entities for several reasons: Firstly, the effects of design decisions in the context of Enterprise Architecture (EA) are delayed and, thus, not immediately noticeable (Rolland et al. 2015). The selection of a technology standard, for example, restricts the number of design alternatives available for future projects. Secondly, there is, typically, no immediate or direct feedback for local entities, as only a few organizational members are concerned with EA (Gardner et al. 2012). Thirdly, there is an ambiguous relation between choice and outcome, as EAM benefits are realized only in the long term, shared throughout the organization (Cram et al. 2015), and, thus, create little direct benefit for local decision makers.

Following this line of argument, it is difficult for local entities to adopt an enterprise-wide perspective. Providing them with *relevant information* may improve their *decision-making process*. A designated *nudging method* that provides relevant information to decision makers and reduces negative effects by highlighting the side effects of a certain choice of alternatives is the *use of labels* like for example energy consumption labels for light bulbs, refrigerators, or washing machines (De Boer 2003; Heinzle and Wüstenhagen 2012; Rubik et al. 2007). Inspired by the positive effects the introduction of such labels had (Egan and Waide 2005), we aim to design and implement an *Enterprise Architecture Label*. Accordingly, we address the following research question **(RQ)**: How should an Enterprise Architecture Label be designed and implemented so that local decision makers opt for alternatives favoring an enterprise-wide perspective?

The Enterprise Architecture Label presented in this paper emerged from an 18-month Action Design Research (ADR) (Sein and Rossi 2019; Sein et al. 2011) project, conducted by the authors together with a team of enterprise architects and senior IT managers at a large multinational organization in the engineering industry. The current paper highlights the process and learnings attained while designing and implementing the Enterprise Architecture Label.

In the following, we discuss the findings of related studies on control mechanisms in EAM, and the design and implementation of labels. These insights drove the selection of the research approach, which is subsequently introduced. Then, the main aspects of the four stages of the ADR project are summarized and the Enterprise Architecture Label is presented. The paper closes with a critical discussion and an outline of future research.

Related Research

Over the past few decades, EAM has received considerable attention in both academia and in practice, which has led to an extensive collection of processes, methods, and tools to coordinate local business and technology initiatives from an enterprise-wide perspective (Saint-Louis et al. 2017; Simon et al. 2013; Tamm et al. 2011). However, despite intensively applying these control mechanisms, many enterprises have not yet reached the desired outcomes (Ross and Quaadgras 2012). Accordingly, the institutionalization of enterprise-wide perspectives across the organization, and all its local entities, has become a major concern for recent EAM research endeavors (Brosius et al. 2019; Dang 2017; Dang and Pekkola 2016; Weiss et al. 2013).

While early studies mostly propose formal modes of control (e.g., monitoring output, implementing policies and procedures), more recent studies argue for complementing these formal modes with informal modes of control (e.g., motivating individuals by offering rewards, and establishing values and norms) for higher EAM maturity levels (Cram et al. 2015; Schilling et al. 2018). Weiss et al. (2013), for example, name social legitimacy as a relevant institutional pressure in the process of institutionalizing enterprise-wide perspectives. Similarly, Winter (2016) highlights the potential of influence-based approaches for complementing traditional and formal modes of control.

EAM researchers were not the first ones to propagate the use of informal control to align local decision-making with overarching goals, as the following examples indicate. To address environmental issues, such as pollution, authorities have long been looking for means to encourage customers to opt for more sustainable products. As formal modes of control, such as regulations and taxes, alone were not sufficiently effective, they started to emphasize information provisioning and made changes to the choice architectures, i.e., the way products are presented to customers (Thøgersen 2002; Thøgersen 2005). Examples include the definition of default options for energy contracts (Brennan 2007), information provisioning on the behavior of peers (Brennan 2007), as well as the introduction of labels (Thøgersen 2002). Notably, labels were found to be very effective in changing an individual's decision-making (Piotrowski and Kratz 2005). Given the similarity of the control goals between addressing environmental issues and EAM (i.e., changing local decision-making to reach global/enterprise-wide goals), the use of labels may also be effective in EAM.

Labels are nudges to encourage decision makers opt for certain choice alternatives (Codagnone et al. 2016). A nudge makes deliberate changes to the choice architecture "that alters individuals' behavior in a predictable way without forbidding any options or significantly changing their economic incentives" (Thaler and Sunstein 2008, p. 6). To this end, labels describe and disclose certain properties of a product or service, by referring to "certain characteristics of the procedure under which the label is awarded" (De Boer 2003, p. 255). By doing so, they help overcome information barriers and make it easier for decision makers judge on potential benefits and costs of the various choice alternatives (Newell and Siikamäki 2013).

To design and implement a label, related studies follow a step-wise procedure, by first identifying elements of choice alternatives that lead to negative effects, assessing these effects, setting the criteria and thresholds for rating classes, and, finally, reviewing and refining the label allocation (Piotrowski and Kratz 2005). To successfully institutionalize the label, Axel (2013) additionally highlights the need to actively involve the stakeholders affected when defining the rules.

Research Approach

The ambition to ascertain utility and acceptance of the proposed artifact, i.e., the Enterprise Architecture Label, as well as the existing guidelines to develop labels (Axel 2013; Piotrowski and Kratz 2005), determined the selection of the research approach. Among the different forms of Design Science Research (DSR) (Gregor and Hevner 2013; Peffers et al. 2006; Winter 2008), we opted for ADR, as it allows for an iterative approach, where the solution is "partially designed and partially emergent from the practice" (Sein and Rossi 2019, p. 24).

Inherent to any ADR project is (a) the intervention in a case organization to co-produce knowledge with practitioners, and (b) several iterations allowing for a guided emergence of the artifact (Sein and Rossi 2019; Sein et al. 2011). To this end, Sein et al. (Sein and Rossi 2019; Sein et al. 2011) propose four project stages, and seven corresponding principles for conducting ADR. In the following, we introduce the four stages, as well as the corresponding principles, and explain how they affected the research activities of this study.

Stage I – Problem Formulation: A prototypical ADR project is centered around a problem perceived by practitioners and/or anticipated by researchers. To derive generalizable design knowledge, it is crucial that the specific problem addressed is an adequate instantiation of a more general class of problems *(principle 1)*. The ADR team should therefore use theoretical and conceptual knowledge to analyze the problem, identify potential solutions, and/or to guide the initial design *(principle 2)*.

We initiated the ADR project with a mutual introduction of the two teams: While the practitioners presented their approach to EAM and elaborated on their current challenges, the researchers presented their research interests, existing insights, and preferred theoretical lenses. While control theory (Kirsch 1996; Kirsch 1997; Ouchi 1979; Ouchi 1980) was supportive in structuring the problem, the concept of nudging (Thaler and Sunstein 2008) was a valuable source for an initial ideation on solution alternatives.

According to control theory, EAM should apply various control mechanisms and adapt the portfolio in alignment with changing circumstances (Cram et al. 2016a). While in some situations formal control mechanisms (i.e., control through resource allocation, governance processes, or goal definition) will be appropriate, informal control mechanisms (i.e., control through shared norms and values) will be more suited in others. In most situations, however, the portfolio of control mechanisms should combine both formal and informal control mechanisms (Kirsch 1996; Kirsch 1997; Ouchi 1979; Ouchi 1980)

Stage II – Building, Intervention, and Evaluation (BIE): Based on the initial understanding gained in stage I, the ADR artifact is developed through several iterations of combined design and evaluation activities within the case organization. These iterations allow the simultaneous creation of organizational insights and apply them in the design process *(principle 3)*. Researchers bring theoretical and conceptual knowledge into the project, while practitioners contribute with their knowledge on the organization's particularities *(principle 4)*. Where reasonable and appropriate, the artifact and its utility are evaluated on an ongoing basis *(principle 5)*.

The Enterprise Architecture Label was developed over a period of 18 months, during which a total of 18 meetings and one- to three-hour workshops took place. A core team comprising four persons (two researchers and two enterprise architects) was in charge to iteratively develop the Enterprise Architecture Label. This iteration process included regular alignment meetings with a sounding board comprising eight participants (three researchers and five senior IT managers). The outcomes of these meetings were regularly evaluated to ascertain the organizational fit and effectiveness of the developed artifact. The evaluation included both quantitative (survey) and quantitative (focus group, expert interviews) evaluation activities, which were selected based on the respective evaluation needs.

Stage III – Reflection and Learning: In parallel to stages I and II, any ADR project should reflect on what can be learned from the solution of the specific organizational issue in order to address the general problem class. This requires that the ADR team develops an understanding on which adjustments to the artifact are of general validity, i.e., are not specific to the participating organization *(principle 6)*.

While developing the Enterprise Architecture Label, the authors systematically documented the emergence of the artifact as well as the rationale behind design decisions. These outcomes were categorized into organization-specific and generalizable artifact components and rationales, respectively.

Stage IV – Formalization of Learning: Based on the learnings attained in the ADR project, the ADR team can propose general solution concepts by moving from a specific and unique setting to a more generic and abstract one. An ADR project may conceptually contribute by generalizing the problem, the solution, and the derivation of design principles *(principle 7)*.

While the problem being addressed by the ADR project is already rather well documented in existing research, the most potential for a valuable contribution of this study lies in the solution domain. Hence, the insights of this study can be used as a reference to design informal control mechanisms.

Development of the Enterprise Architecture Label

The following section outlines the guided emergence of the Enterprise Architecture Label. It is structured according to the four stages of ADR (Sein and Rossi 2019; Sein et al. 2011) and starts with a general introduction of the case organization, the problem, and scope being addressed, as well as the underlying conceptual foundations and existing relevant knowledge. Subsequently, the design decisions considering the measurement system, aggregation process and presentation are outlined, and important learnings are shared and formalized. In Figure 1, the core activities and outcomes of the ADR project are summarized.

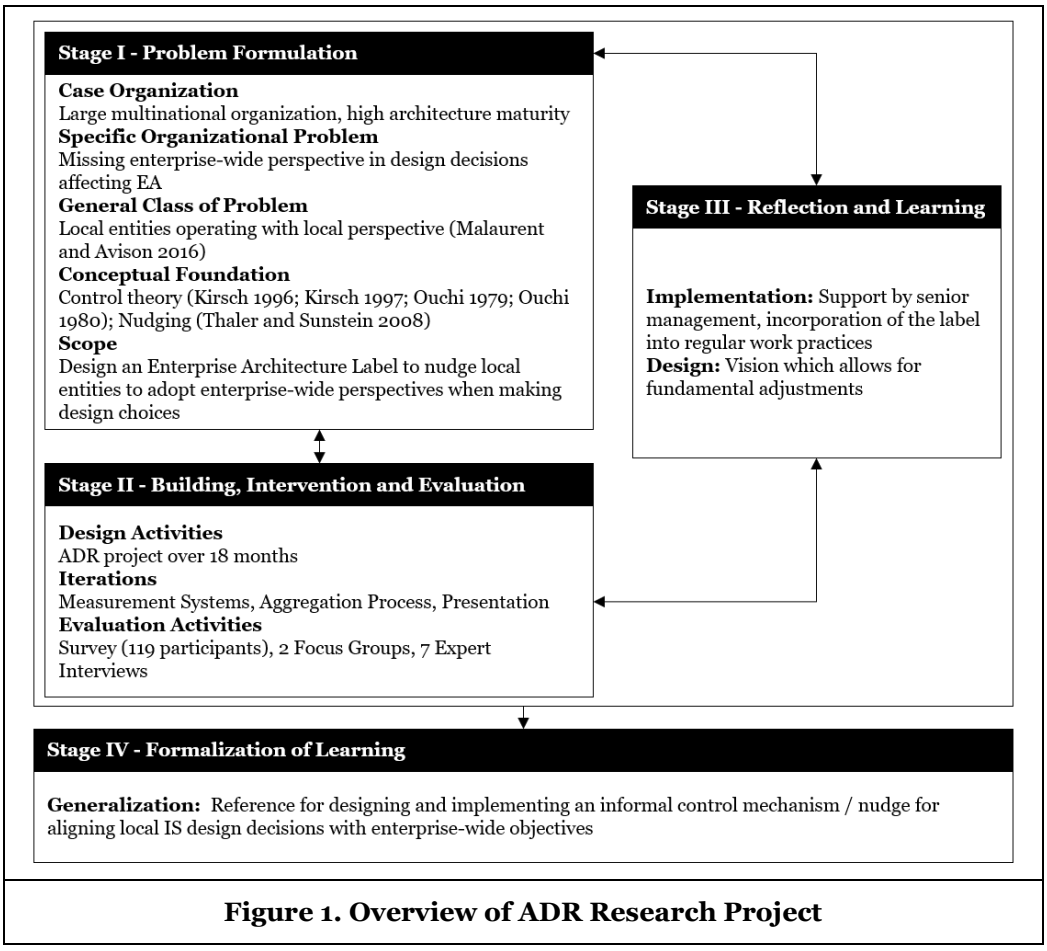


Figure 1. Overview of ADR Research Project

Stage I – Problem Formulation

Case Organization: When choosing the case organization, a predefined sampling logic was applied to ensure that the case organization offered the need and conditions to design an artifact for informal control in EAM (Dubé and Paré 2003). Hence, EAM had to have a long tradition and have reached a considerable maturity level (Ross et al. 2006). Further, the case organization needed to be organized in a somewhat decentralized manner, so that the control of local entities' activities through central governance was limited (Löhe and Legner 2014). Furthermore, the management of the case organization needed to be interested in

improving the level of IS integration and standardization and it needed to be willing to collaborate with the team of researchers. Most importantly, they needed to be motivated to share relevant information and be open to try out new forms of control.

A large multinational organization in the engineering industry [1] was selected as case organization. Traditionally, the case organization has been operating in a diversification mode and, hence, had a relatively low level of business process and information system integration and standardization. In 2016, the organization started to intensify its architecture management activities on the enterprise-wide level. As an initial step, senior management appointed an EAM team with enterprise-wide scope and objectives. These objectives included measures to increase business processes and user productivity, to enable end-to-end processes and reporting, to reduce IS operating costs, and to enhance security and compliance.

To achieve these objectives, the EAM team implemented a considerable number of control mechanisms: The case organization defined architectural principles and plans for a target architecture, and established a formalized approval process for all changes that affect the EA. Furthermore, the team trained more than 430 employees (mostly project managers and business process owners) on EAM topics.

With regard to the four architecture maturity stages outlined by Ross et al. (2006), the case organization is reaching stage 3, where "companies move from a local view of data and applications to an enterprise [-wide] view" (Ross et al. 2006, p. 76) and where "standardizing shared data and core business processes involves taking control over business process design from local business unit leaders" (Ross et al. 2006, p. 77). On this maturity level, the core governance issue is to find the means to align project priorities (i.e., local perspectives) with EAM objectives (i.e., enterprise-wide perspective).

Specific Organizational Problem: Despite having both implemented a wide range of architectural governance processes (i.e., formal control mechanisms) and trained a considerable number of employees on EAM, the EAM team did not yet achieve its objectives. More precisely, the EAM team was confronted with the fact that a larger and relevant group of employees were still reluctant to adopt enterprise-wide perspectives when taking design decisions affecting EA. According to control theory, informal control was missing, as the shared norms and values did not yet emphasize the value of an enterprise-wide perspective.

This reluctance was, for instance, manifested in project owners who still had a clear local (product, process, project) perspective, and did not sufficiently consider the side effects, or the use of synergies. Also, the costs created for later integration, operation, and decommissioning were not sufficiently taken into consideration when making design choices. As a result, the case organization was confronted with the negative consequences of operating a complex EA, such as high operating costs (75%+ of all IS costs), lacking global visibility of applications, and, as a consequence, redundancies (among the 5,000 applications), heterogeneity in technology infrastructure, and difficulties in reflecting business processes end-to-end in the IS landscape.

The observation of the EAM team is thereby congruent with the perception of other members of the organization. As a survey among 119 employees[2] has shown, only approximately half of the participants (52%) were familiar with architectural guidelines and the organization's target architecture ("I am familiar with the architectural guidelines and target architecture"). At the same time, only 15% of the participants believed that the IT application landscape met the requirements defined by the EAM team ("The application landscape is in line with the architectural guidelines and the target architecture").

General Class of Problem: On a high level of abstraction, the case organization has not yet fully learned to leverage enterprise-wide standards. Hence, the interests of local and global entities are not in balance, where local entities continue to operate with a local perspective and tend to opt for local optimization over an enterprise-wide perspective and optimization (Malaurent and Avison 2016). Taking a control theory's perspective, informal control was largely missing.

Scope: The aim of this ADR project is to influence the decision-making process of local entities, so that these entities opt for design alternatives that are in line with enterprise-wide perspectives. The objective of the ADR project was, therefore, to create a label that provides information on the contribution of local

[1] To be compliant with company policies, the selected case is anonymized.

[2] Survey was sent out by email to 350 employees (IT managers and product owners), response rate: 34%

entities to the overall state of the EA. The Enterprise Architecture Label would then nudge local entities to consider enterprise-wide perspectives when making design choices.

Stage II – Building, Intervention and Evaluation

The label[3] was designed in three iterations. The first iteration encompassed all design activities with regard to the measurement system, i.e., the collection of measurement items to assess the degree to which local entities follow an enterprise-wide perspective. The second one focused on the aggregation process, i.e., the procedure to transform the results of the individual measurement items into an overall label rating. The third iteration was dedicated to the presentation, i.e., the actual design of the label.

The Measurement System: To define the measurement system, the ADR project team made use of previously existing measurement scales for EAM outcomes (Lange et al. 2016; Matthes et al. 2012; Mocker 2009; Schmidt and Buxmann 2011). However, before taking over these measurement scales one on one, a critical reflection was required to make sure that the measurement items would capture the negative effects of local entities not adopting an enterprise-wide perspective when making design choices. Furthermore, it had to be ensured that the data could be collected with adequate effort and would also be understood by non-architects. To this end, the ADR project team defined and adhered to the following three design principles when selecting the measurement items (Table 1). Likewise, they are also in line with recent research on the design of measurement systems for complex IS (Beese et al. 2015):

Table 1. Design Principles for Selecting the Measurement Items

Nr.	Principle	Rationale
1	Domain experts (i.e., enterprise architects and researchers) consider the measurement item to be relevant.	Ensures that the measurement system is theory-ingrained and in line with the practices at the case organization.
2	The required data is already available in suitable quality and can be automatically retrieved.	Ensures that the data can be gathered efficiently and no bias is introduced during the data gathering process (Axel 2013).
3	Each measurement item is easy to understand and accepted by the targeted decision makers.	Ensures that complex normalizations or corrections are avoided and, hence, a clear linkage from the data source into the label is assured.

After a careful discussion of various potential measurement items, the ADR team ended up with a list of seven promising candidates (following design principle 1). Table 2 provides details on the underlying rationales and calculation procedure. It is important to note, that the selected measurement items can and are intended to—compared to existing measurment scales—only refelct partial but arguably important and widely understood aspects of EAM.

Although the case organization had a rather large IT application management repository with collected data in place, two of the potential measurement items could not be calculated due to missing data or insufficient data quality (following design principle 2). Hence, the ADR team agreed to remove “Apps per Capability” (as capabilities were not yet harmonized across the organization) and “Interfaces per Application” (as the data quality varied significantly and would have led to wrong conclusions).

The remaining five measurement items were then evaluated with regard to understandability and acceptance by the targeted decision makers(following design principle 3). To this end, a survey was used as the evaluation method, as this evaluation strategy allowed the team to receive feedback from a broad audience, and it is generally found to be adequate to validate applicability with real users (Sonnenberg and vom Brocke 2012). The survey was sent out to 350 employees (IT managers and product owners) and filled

[3] As local entities were not necessarily familiar with the term “Enterprise Architecture”, the ADR team preferred to call the label “IS Efficiency Label”. In the following, we use the term “label” as the artefact had different designations for different stakeholder groups.

out by 119 respondents (response rate: 34%). The results indicated that the majority of the targeted decision makers agree or strongly agree that the proposed measurement items are appropriate to evaluate the degree to which local entities have applied an enterprise-wide perspective when taking local design decisions (Figure 2). The most controversial measurement item was the "Average Age of Applications", where only 47 (39 %) respondents indicated agreement and 40 (34 %) were indifferent. Nethertheless, the ADR team opted to continue using the measurement item, as it can be seen as a proxy for IS architecture complexity.

Table 2. Measurement Item Candidates

Measurement Item	Rationale	Calculation
Match to Target Architecture	EAM strives for a transformation from an "as is" towards a "to be" state. This item indicates the progress on this journey with regard to the target architecture (Lange et al. 2016).	# of applications in target architecture divided by # of total applications
Match to Technology Targets	EAM strives for a transformation from an "as is" towards a "to be" state. This item indicates the progress on this journey with regard to technology targets (Lange et al. 2016).	# of applications in line with technology and database targets divided by # of total applications
Average Age of Applications	The longer an application is in use, the more likely this induces higher operating and change costs due to increasing levels of complexity (Mocker 2009).	Average of time elapsed since implementation of applications
Costs per IS User in Domain	Costs for application operation are an indicator for complexity (Mocker 2009). Includes a break down per user to scale absolute numbers and to make them 'more' comparable and tangible.	Total application costs divided by # of employees in the domain
End User Satisfaction	Cost and technological restrictions need to be in balance with user requirements.	Average satisfaction score of users within application domain
EXCLUDED: Apps per Capability	An indicator of efficiency, as functional redundancies are expected to increase maintenance- and operating costs (Schmidt and Buxmann 2011).	Distinct count of installation ID divided by distinct count of capabilities
EXCLUDED: Interfaces per Application	A minimal number of interfaces is likely to be more cost efficient (Schmidt and Buxmann 2011) and more flexible since many interfaces lead to many affected systems through the propagation of local changes.	Average # of interfaces per app

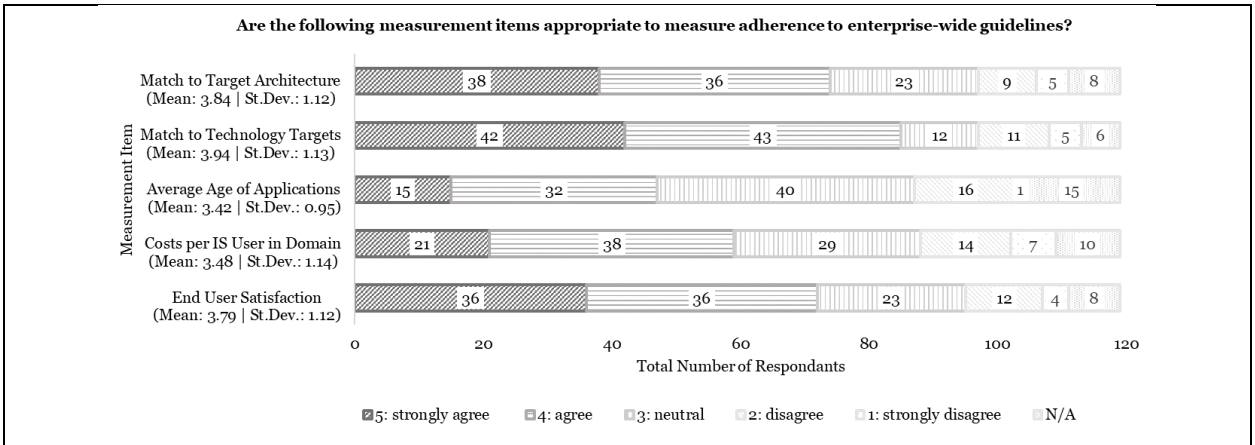


Figure 2. Appropriateness of Measurement Items (N=119)

Aggregation Process: Inspired by the framework for energy labeling of the European Union[4], the ADR team decided to derive an overall rating based on the individual measurement items. After a short discussion of whether some measurement items should be considered to be more important, the ADR team opted for equally weighting all five items, as this would further increase the transparency and acceptance of the calculation process by local entities (design principle 3). To define thresholds, reference data was collected for two functional areas of the organization and the rating system was calibrated. The label could then be calculated by applying the following procedure (Figure 3):

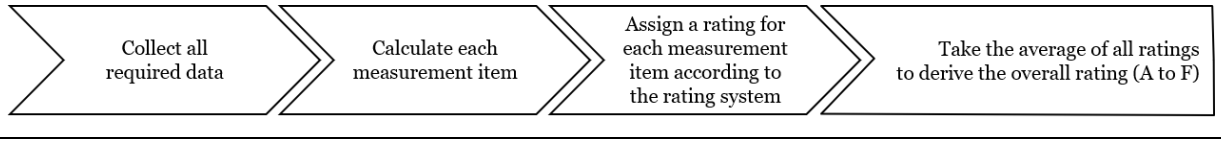


Figure 3. Aggregation Process of the Label

At this point in time, the ADR team felt confident enough to present the concept to the targeted audience, i.e., local entities. To this end, the ADR team opted to discuss the label concept in two focus groups, as this is a suitable evaluation strategy to improve an artifact and confirm its utility in the application field (Sonnenberg and vom Brocke 2012; Tremblay et al. 2010). A focus group is a moderated discussion, where the evaluator pays much attention to the feelings, comments and thoughts raised by a group of people who are asked to comment on an artifact (Tremblay et al. 2010).

To this end, the local entities (Table 3) were invited to a meeting (2 meetings lasting for 1.5 hours each), where they were asked to share their thoughts and impressions after being introduced to the measurement items, the aggregation process, and to the respective results for their entity. The discussion of the focus group was documented by one of the researchers and then analyzed with regard to the likelihood that the label could be supportive in changing the decision-making process of local entities. The three steps of the assimilation process (i.e., awareness, understanding and use) were thereby taken as evaluation criteria (Table 4). Assimilation is defined as the process in which an idea, system or method (in this case adopting enterprise-wide perspectives when making design choices) becomes an integral part of an organization's work life (Swanson and Ramiller 2004).

Table 3. Overview of Focus Group Participants

	Enterprise Architect	Product Owner	Solution Architect	Delivery Manager	Total # of participants
Focus Group 1 (FG1): Domain A	2	4	3	3	**12**
Focus Group 2 (FG2): Domain B	2	5	3	4	**14**

The analysis of the discussions of the two focus groups indicated that the label had potential to trigger an assimilation of a decision-making practice that considers an enterprise-wide perspective (Table 4). Hence, the ADR team decided to progress with the label design.

[4] https://eur-lex.europa.eu/eli/reg/2017/1369/oj

Table 4. Outcome of Focus Group	
Evaluation Criteria	**Evidence from Focus Group Discussions**
Awareness: Does the label create awareness for the consequences if local entities do not adopt enterprise-wide perspectives when making design choices?	FG1: "Where can I get information on the target architecture?" FG2: "Why is the rating so poor?" FG2: "What should the guys at the front prioritize?"
Understanding: Does the label increase the understanding/improve the perception of an enterprise-wide perspective?	FG1: "It's important to not only have an internal perspective but also compare with others, like benchmarking and collecting best practice from outside." FG1: "This [the label] looks like the one of my house." FG2: "I would like to get some advice on how I can improve my scores!"
Action: Does the label trigger willingness to adhere to enterprise-wide perspectives?	FG1: "It [the label] can support discussions with business." FG2: "It [the label] triggers a desire to improve things!"

Presentation: Finally, the ADR team had to decide which amount of information would be presented in the label. The options ranged between providing only a little information by issuing a kind of certificate (e.g., "this entity is taking design decisions with an enterprise-wide perspective"), publishing a simple rating (e.g., this is an "A" entity), or providing detailed information (e.g., this entity reached the targets with regard to technology X by Y %). Providing too much information would thereby introduce the danger of information overload (Jacoby 1984). At the same time, the ADR team wanted to incorporate findings from related studies, stating that the effectiveness of labels would increase if more information was provided, as decision makers could better compare alternatives (Bei and Widdows 1999). As this would particularly hold true for decision makers who have some domain knowledge (Bei and Widdows 1999), the ADR team opted to provide more information than just a simple rating on the label. The arguments for the information details provided, which emerged during the discussions, are shown in Table 5.

Table 5. Levels of Detail of Information Provided Through the Label	
Information	**Rationale**
Number of categories in the rating scale	A high number of categories makes it more likely to experience progress and differentiate between local entities (Bei and Widdows 1999; Sammer and Wüstenhagen 2006). At the same time, the risk of information overload has to be considered, hence the number of categories to be limited (Jacoby 1984).
Information on data quality	If the data quality is already high, this information increases the perceived trustworthiness of the label (Thøgersen 2000). If the data quality is low, it may trigger a desire for corrective actions and help to improve data quality.
Information on calculation date	Evaluation results may change over time. Hence, only labels calculated at a similar point in time should be compared.
Positioning on a range	Provides a performance indication and provides a source of reference for local entities.
Trends	Allows accounting for improvements and corrective actions or – conversely – highlights a negative evolution.
EXCLUDED: Average values	Provides information on one's own behavior/performance compared to that of peers (Brennan 2007). This information was excluded due to strong opposition of some local entities.

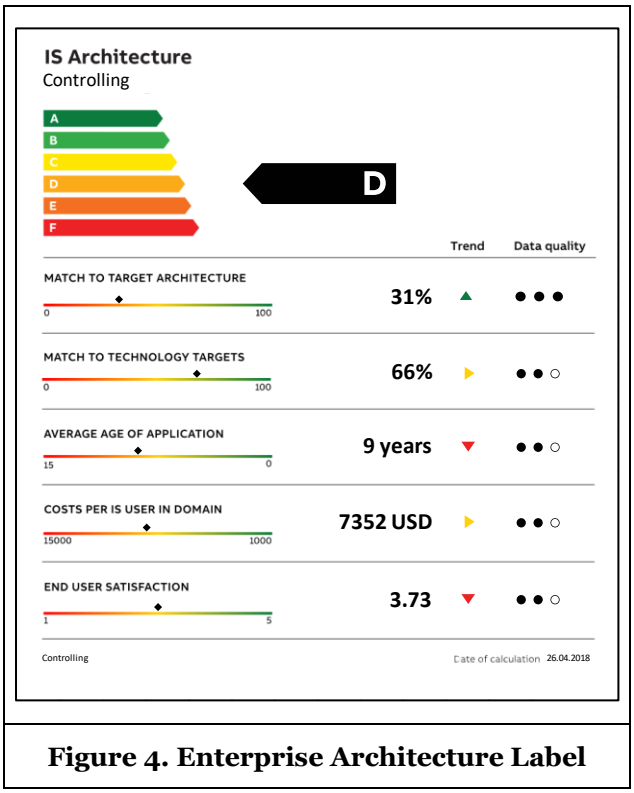


Figure 4. Enterprise Architecture Label

After several rounds of internal adjustments to the graphic design, the label (Figure 4) was ready to be evaluated in its entirety. The ADR team opted for expert interviews as an evaluation method, as this evaluation strategy allowed to evaluate how well the label was received and understood by targeted stakeholders (Sonnenberg and vom Brocke 2012). The hierarchy of evaluation criteria proposed by Prat et al. (2015), was taken as a source of reference when defining the aspects that should be covered beyond the general thoughts and perceptions the stakeholders had about the label. Following the design principles being applied when defining the measurement items (Table 1), the ADR team agreed to evaluate understandability (i.e., the degree to which the label could be comprehended), trustworthiness (i.e., the degree to which the label was perceived as being accurate and representing reality) and simplicity (i.e., the degree to which the label contained the minimal number of elements) by interviewing stakeholders who have extensive experience at the case organization and represent both business and IT perspectives (Table 6).

Table 6. Profiles of Interviewees

Organizational Level	#	Role	Total Years Working at the Company	Duration of the Interview in Minutes
Business	1	Product Owner	12	38
	2	Product Owner	14	42
	3	Product Owner	17	38
	4	Product Owner	23	40
IT	5	Delivery Manager	3	30
	6	Delivery Manager	8	34
	7	Solution Architect	8	43

The semi-structured interviews were conducted by one of the researchers and lasted between 30 and 43 minutes. All interview partners supported the idea of introducing the label to trigger an assimilation of a decision-making practice that considers an enterprise-wide perspective. In particular, it was argued that the label would be a valuable trigger for discussing architectural issues with non-architects:

"There is a long journey ahead of us to become really efficient. We have several applications duplicating itself. Having such guidelines would be a huge support for my discussions with business about our plans and future projects." (Interviewee 5)

Besides this general appreciation of the label, the interviews also revealed some further potential for improvement (Table 7).

Table 7. Evaluation Expert Interviews

Evaluation Criteria & Exemplary Questions	**Illustrative Answers**
Understandability: Which elements of the label were particularly difficult to understand?	[5]: "For me it is not clear with whom we are compared." [3]: "My stakeholders, like the head of business, would have difficulties in understanding the concepts of architecture and technology targets. Here, we would need a drill-down to something they can better relate to like 'degree of digital transformation'." [4]: "It is a bit difficult to understand how one came up with the number for target architecture – it sounds like an opinion-based number."
Trustworthiness: Do you think the label reflects the reality with regard to IS Architecture efficiency?	[1]: "Yes." [6]: "In my area, the information available in the application repository is about 90-95% trustworthy/up to date."
Simplicity: Do you have suggestions for further simplifying the label without limiting its value contribution?	[5]: "For me, the label is very clear, very simple and easy to understand. However, I would also expect another slide providing some more information on the calculation and assumptions." [3]: "I would consider to merge technology and architecture targets into one measurement item: It's not easy for many to differentiate between architecture and technology."

While the label was found to meet the requirements with regard to understandability, trustworthiness and simplicity, the ADR team learned that the label could be further improved by adding a guideline on how the ratings of the label should be interpreted and could be improved by local entities. Given the promising feedback, the ADR team decided to implement the label across the case organization and made the label an integral part of the architectural documentation and discussions.

Stage III – Reflection and Learning

Given the emergent nature of the ADR research project, numerous adjustments and corresponding learnings were made while designing and implementing the Enterprise Architecture Label. In the following, we highlight the most important ones, as some of them may also be relevant in other organizations.

Adjustments to The Measurement System: Compared to the exhaustive list of measurement scales found in the existing literature (Lange et al. 2016; Matthes et al. 2012; Mocker 2009; Schmidt and Buxmann 2011), the measurement system of the label may be perceived as being too simplistic. The corresponding adjustments are mostly related to the fact that the label is not intended to be applied as a performance measurement system for EAM, but rather a nudge for changing the decision-making process of non-architects. To reach this goal, the ADR team learned the importance of favoring simplicity over absolute accuracy. This was supportive to ascertain understandability (e.g. by dropping established EAM measurement items such as "EAM tool support availability" (Lange et al. 2016)). However, the exclusion of relevant complexity aspects (i.e., Apps per Capability, Interfaces per Application) is clearly an organization-

specific adjustment, as the data, which was required to calculate these measurement items, was not (yet) available at the specific case organization.

Adjustments to Aggregation Process: While there were no fundamental adjustments made with regard to the aggregation process, the decision to equally weight all five measurement should be highlighted, as it created transparency for local entities, and arguably also holds true in other cases.

Adjustments to The Presentation: At the beginning, the need to include information on data quality in the label was not foreseen. This adjustment was made after calculating the label for several different local entities, during which differences with regard to data quality were discovered. As this design decision may also be applied by other organizations facing data quality issues, this learning is of general validity. The decision to exclude average values is probably an organization-specific adjustment, as it was taken due to the strong opposition of some local entities.

Procedural Learnings: It was helpful that the vision to design and implement a label was strongly supported by senior management and shared among the ADR project team members. This made it clear that the project was allowed (and even expected) to fundamentally extend the prevalent portfolio of control mechanisms employed by EAM. Having such a clear vision in mind allowed the limiting of the amount of discussion on the control mode to be applied, and helped to find an appropriate form of informal control.

By having a clear vision in mind, it was important to let the label emerge and be open for fundamental adjustments along the process. Therefore, the scope of the label changed from labeling individual projects or IT applications toward labeling local entities (encompassing multiple applications), as this allowed the provision of more design freedom to local entities.

Stage IV – Formalization of Learning

This study may motivate and support others who are aiming at assimilating local and enterprise-wide perspectives by extending their portfolio of control mechanisms. While previous studies (Weiss et al. 2013; Winter 2016) offer conceptual arguments for the need of informal control mechanisms, the newly designed label (Figure 4) is a practical instance of such a control mechanism. Based on a) the detailed description of the measurement items (Table 2) and b) the recommendations for information details to be shared on the label (Table 5), the proposed artifact may as well be used by other organizations. Probably even more important are the learnings gained with regard to the procedure. When designing and implementing a new informal control mechanism, one should have a clear vision in mind, address organizational particularities, and incorporate the control mechanism into the working practices of the organization. Finally, it is important to keep in mind that the optimal control portfolio in many cases is a combination of various control mechanisms (Kirsch 1996; Kirsch 1997; Ouchi 1979; Ouchi 1980) and that different maturity levels require different control mechanisms (Cram et al. 2016b; Schilling et al. 2018). Hence, control theory is also relevant for overarching management processes like EAM (Cram et al. 2015; Cram et al. 2016b).

Discussion and Conclusion

Institutionalizing an enterprise-wide perspective across the organization remains a core challenge for organizations reaching high EA maturity (Ross and Quaadgras 2012). To this end, several studies motivate to complement the existing portfolio of control mechanisms in EAM through informal control mechanisms (Cram et al. 2015; Schilling et al. 2018; Weiss et al. 2013; Winter 2016). While there are many possible ways such informal control mechanisms could be designed, we apply the concept of nudging (Mirsch et al. 2018; Thaler and Sunstein 2008; Weinmann et al. 2016), in the context of EAM. Accordingly, this research is dedicated to the question of how an Enterprise Architecture Label, as a nudge, should be designed and implemented, so that local decision makers opt for a choice of alternatives favoring an enterprise-wide perspective.

Main Findings

The ADR project, which was conducted over a period of 18 months at a large multinational organization in the engineering industry, yielded not only a precise description of an Enterprise Architecture Label (Figure 4) together with the underlying measurement system (Table 2) and aggregation process (Figure 3), but also

a collection of various conceptual and procedural learnings acquired throughout this process (see ADR project stages III and IV, above).

The results of the evaluation activities performed during the ADR project make us confident that the design and implementation of Enterprise Architecture Label is an appropriate extension of the portfolio of control mechanism to change the decision-making process of local entities, so that these entities opt for design alternatives that are in line with enterprise-wide perspectives. More precisely, we identify the Enterprise Architecture Label to be an appropriate facilitator of an assimilation process (Swanson and Ramiller 2004), as it helps to create awareness of the consequences if local entities do not adapt enterprise-wide perspectives, increases understanding on architectural topics and triggers willingness to adhere to enterprise-wide perspectives as it facilitates discussions among various stakeholders.

Limitations and Future Research

Inherent to any ADR approach is the ambition to derive generalizable knowledge from a particular case (Sein et al. 2011). While the ADR team is convinced it has found a promising informal control mechanism for the case organization, the experiences most certainly differ from the ones that would potentially be made at other organizations. The derived knowledge on design practices and the procedure to develop a label may thus not be equally relevant in other cases. For example, could the strong EAM background of the ADR team have influenced the selection of measurement items. The use and extension of the Enterprise Architecture Label by other teams at other organizations will help to further crystalize the general knowledge.

While the reactions of the local entities clearly indicate a willingness to adhere to enterprise-wide perspectives in the future, it remains to be seen whether the increased awareness and understanding for architectural norms and values will also result in corresponding actions (Brosius et al. 2018). Accordingly, we plan to closely monitor the evolution of the measurement items, which would allow us to analyze the long-term effects of the label introduction on a quantitative basis. In addition to that, we consider conducting a further, multivariate survey, which would allow for a more fine-grained evaluation. Furthermore, we would also like to better understand how the label affects decision-making. To this end, we plan to conduct a series of lab experiments designed to reveal differences in the perception of the label (e.g. depending on the organizational and hierarchical position of the decision maker).

Other studies have pointed out the importance of combining the introduction of a label with a set of training and communication initiatives (Teisl et al. 2008). Hence, the actual label may only be seen as one element in a portfolio of control mechanisms. Future research is needed to understand how the effectiveness of the Enterprise Architecture Label can be further improved, and how it can be incorporated into regular work practices of the case organization.

Implications

By offering insights into the design of a nudge, we extend a nascent stream of literature on the design and use of (digital) nudges (Kretzer and Maedche 2018; Mirsch et al. 2018; Weinmann et al. 2016) by introducing a novel nudge targeting decision-making in IS development instead of IS use. Furthermore, the Enterprise Architecture Label can be seen as control mechanism for addressing challenges faced in the management of overarching IS processes, a perspective which is found to be not yet fully covered by existing literature on control mechanisms (Cram et al. 2016b; Schilling et al. 2018).

IT managers and enterprise architects may appreciate this research as a valuable source of inspiration when extending their portfolio of control mechanisms. They may on the one hand adopt the presented Enterprise Architecture Label to their particular needs or on the other hand be encouraged to try out new, innovative control mechanisms.

Acknowledgements

This work has been supported by the Swiss National Science Foundation (SNSF) as well as the Basic Research Fund of the University of St. Gallen.

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