# CCTS – A NOVEL FRAMEWORK FOR CONCEPTUAL DATA MODELLING

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## Abstract

*With increasing importance of semantic interoperability in B2B contexts, the need for adequate standards becomes imperative – on a process level as well as on the message or data level. Although a multitude of standards have been proposed in recent years none of them became widely accepted as they fell short of offering a satisfying solution. The UN/CEFACT e-business standards stack represents a promising framework for enabling semantic interoperability with the Core Component Technical Specification (CCTS) being an integral constituent for semantic data modelling. However, the scientific foundation of such standards remains rather faint. Therefore, this paper remediates this deficiency by contrasting the standard to two theories of information science research, namely Conceptual Modelling theory and the Design Science paradigm. After presenting both the standard with its essential characteristics and the two concepts as a theoretical framework, CCTS is mirrored against the basic theoretical requirements. From this comparison the author concludes a conformance of the CCTS approach with both scientific concepts and points out the contribution of CCTS to conceptual modelling. Nonetheless, the evaluation of CCTS as an information science artefact is not satisfactorily resolved. For this reason, a multi-perspective evaluation framework is drafted for enhancing a sound scientific foundation.*

*Keywords: Core Component Technical Specification, Design Science, Conceptual Modelling, Evaluation.*

# 1 INTRODUCTION AND MOTIVATION

In the past decades, numerous e-business frameworks have evolved starting from EDI technology to more recent approaches like ebXML or RosettaNet tending to increase cross-organizational integration and operational efficiency. The theoretical embedding of those standards, however, normally lacks behind as the driving forces behind such standardization initiatives in most cases were, and still are, industry consortia that are mainly interested in fast applicability and improved efficiency in doing business. Hence, scientific rigour plays a subordinate role. The United Nations Centre for Trade Facilitation and Electronic Business (UN/CEFACT) is currently working on an e-business stack that consists of ten components (Janner et al. 2006, pp. 2ff.) covering the whole continuum of B2B-standardization (i.e. processes, data, documents). This stack aims at solving one of the challenges enterprises – particularly large-scale companies – consider most exigent today: (inter-sector) interoperability (e-Business Watch 2005, p. 40). Among this stack of standards, the Core Component Technical Specification (CCTS) is designed to contribute to the solution of interoperability problems between applications on a data level.

The following article aims at presenting this novel method[1] for semantic data modelling as an essential component of a truly interoperable e-business framework. CCTS provides a new paradigm in defining and describing data for storage, application use, and information sharing through consistent semantics and a unique context mechanism. The concept will be embedded in the theoretical context of conceptual modelling as an approach for representing selected semantics of a real-world domain (Weber 2003) and in the research context of design science.

The remainder of the paper is structured as follows: After this first introductory part, section 2 provides the theoretical framework for the rest of the paper. In this chapter the design science paradigm as well as important characteristics of conceptual modelling are presented in detail based on literature review. The following chapter three is tripartite: First, the CCTS framework is described to provide the reader with a basic understanding; then the framework is measured against the theoretical framework – i.e. design science and conceptual modelling –; and lastly, required extensions to the CCTS approach are derived and discussed. The latter section includes the outline of a multi-perspective evaluation of CCTS as the evaluation of IT artefacts constitutes a pivotal requirement for scientific rigor. The paper concludes with a summary of major findings of the paper and an outlook on future research work.

# 2 THEORETICAL FOUNDATION

## 2.1 Design Science

Design science serves as a research framework for the scientific study in the field of IT where artificial, human-made phenomena, such as organizations and/or information systems are examined (March & Smith 1995, p. 252). Design science as a clearly proactive, problem-solving oriented research approach is focussed on creating and evaluating innovative artefacts (Simon 1996, p. 11) intended to achieve defined goals and tackle identified organizational problems. Therefore, it demarcates from behavioural-science paradigms that are generally fundamental to natural science research and rather descriptive and explanatory (March & Smith 1995, p. 254). The degree of

[1] With regard to the discussion of a correct denotation and positioning of CCTS within conceptual modelling research, see chapter 3.3.

formalism by which those artefacts are described, is not determined – both mathematical models and textual descriptions are acceptable depending on the specificity of the problem to be solved. Design science can, consequently, be characterized by four essential types of output: constructs, models, methods and instantiations (Hevner et al. 2004, p. 77). While the former constitute the basic vocabulary conceptualizing the problem domain, models use these constructs to represent problems and their solutions as well as the relationships among them in an abstract way (March & Smith 1995, p. 256). Methods, in turn, describe procedures how to solve a problem consisting of several steps (i.e. algorithms or best practices) based on the underlying constructs and methods. Finally, instantiations are realized artefacts (such as implemented IT-systems) necessary to operationalize and demonstrate the feasibility of the contained models and methods (Hevner et al. 2004, p. 79).

Moreover, the importance of rigorously evaluating created artefacts with regard to their utility and relevance for solving existing problems is inherent to the design science paradigm. Therefore, measures of success need to be defined before implementation against which the artefact can be evaluated thereafter (Rossi & Sein 2003, p. 7). This allows determining whether any progress has been achieved due to the new artefact and assessing its effectiveness and quality (March & Smith 1995, p. 258). Besides, the evaluation can provide feedback to the design and construction phase for further improving the artefact (Hevner et al. 2004, p. 85).

## 2.2 Conceptual Modelling

Conceptual Modelling, as one of the core topics within the information science discipline (Frank 1999, p. 697), can be generally defined as a process of developing a (semi-)formal representation of selected phenomena of a certain real-world domain (Shanks et al. 2003, p. 85) that serves for detecting user requirements (Wand & Weber 2002, p. 363). In addition, conceptual models are described as design artefacts that do not simply serve for describing but rather constructing the real world (Moody 2005, p. 244).

The main idea is to ease the understanding of the domain through the reduction of complexity as basis for facilitating communication between Business and IT and, hence, for the planning and development of information systems (Becker & Pfeiffer 2006, p. 3, Frank 1999, p. 695). For this purpose, conceptual models are typically incorporating three significant elements. Firstly, they include semantic annotations; secondly, they dispose of abstraction mechanisms, such as generalizations or aggregations, to condense information about the real world and, lastly, they are generally represented by graphical notations (Mylopoulos 1998, pp. 129f.). Recently, the concept of conceptual modelling has been transferred to other research domains then information science, such as business process modelling or reengineering, business networks and business models (cf. Winter 2003).

Within the process of systems and software engineering conceptual modelling is used at an early stage (analysis and design) for defining functional specifications (cf. Becker & Pfeiffer 2006). Daniels (2002) points out the level of abstraction from the concrete implementation as a criterion to distinguish conceptual models from physical ones – while the latter are mainly concerned with implementation issues, the former disregards the constraints imposed by the underlying technology and reflects knowledge about the application domain (Wand et al. 1995, p. 285, Daniels 2002, p. 8). Furthermore, conceptual models are recognized for constituting an integral element for interoperability on a system level (Chen et al. 1998, p. 8).

Wand and Weber (2002) differentiate between four constituent components of a research framework for conceptual modelling (Wand & Weber 2002, p. 364):

- Conceptual-modelling grammars, i.e. modelling languages, define the syntax by providing a set of constructs or building blocks (metamodel) and rules to model real-world phenomena;

- Conceptual-modelling methods describe the process how the defined grammar is used in order to create a model;
- Conceptual-modelling scripts, meaning the resulting models, representing the outputs of the conceptual-modelling method and
- Conceptual-modelling contexts describing external factors that affect both the modelling process and the usage of the modelling scripts.

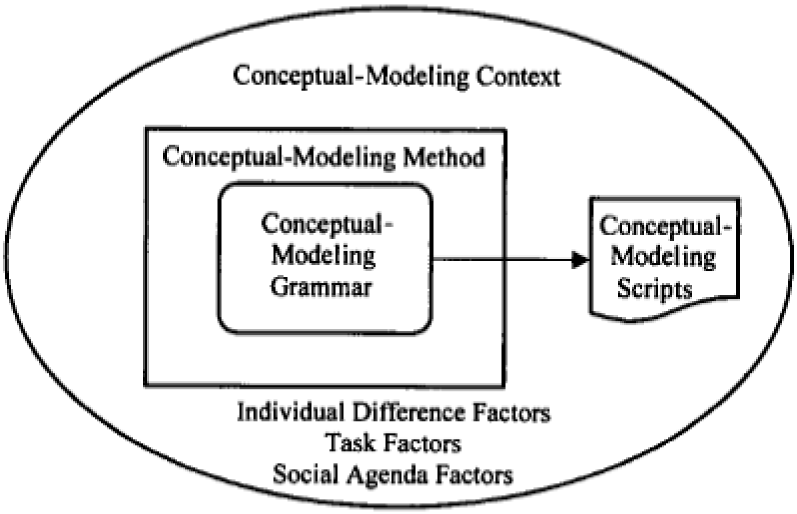


*Figure 1. Research Framework on Conceptual Modelling (Wand & Weber 2002, p. 364)*

The first two elements of this characterization correspond to the components of the “basic tool kit” for conceptual modelling propagated by Sinz (2005) and can consequently be seen as pivotal. Furthermore, Sinz adds the necessity of a software tool for computerized modelling support (Sinz 2005, p. 158).

Current objects of research in conceptual modelling comprise, among others, the search for a sounder theoretical base, the use of ontologies, model-driven architecture and the automatic processing of models (Sinz 2005, p. 158). One of the major unsolved challenges in the field of conceptual modelling, however, remains the lack of accepted guidelines or methods and standardized metrics for evaluating conceptual models (Moody 2005, pp. 245ff., Frank 1999, p. 695). The lack of evaluation results from the constructivist principle that is underlying conceptual modelling (cf. Schütte 1998). This induces, firstly, models for future worlds (such as an information system that is to be implemented in the future), and, secondly, that the quality of conceptual models – being the result of a mental construction of the modeller – cannot be easily assessed, resulting in a less formalized and objective evaluation. This leads to quality aspects of conceptual models that cannot be evaluated using objective measures. In research there have been extensive discussions lately, about whether such an evaluation should be rather conducted via ontologies or empirically (cf. Simons 1994, Rosemann 2005, Parsons 2005, Frank 1999, Shanks et al. 2003).

# 3 CCTS AS A REPRESENTATIVE FOR DESIGN SCIENCE RESEARCH IN CONCEPTUAL MODELLING

This chapter pursues three goals: In a first step it will provide a short overview over the basic concepts of the CCTS framework, as a basic knowledge appears helpful for the further understanding of the paper. The framework is confronted with the requirements on a research method defined within the design science approach in the second sub-chapter and then positioned within conceptual modelling theory. Finally, extensions to the current CCTS method that result from both practical and scientific requirements are discussed.

### 3.1 Basic Concepts of CCTS

The Core Component Technical Specification is embedded in a comprehensive stack of e-business standard specifications (see Figure 2) and, hence, cannot be considered independently. This integration guarantees a consistent derivation of relevant messages, business contexts and data elements respectively from the collaborative business processes modelled in the UN/CEFACT Modelling Methodology (UMM) in a stringent top-down approach.

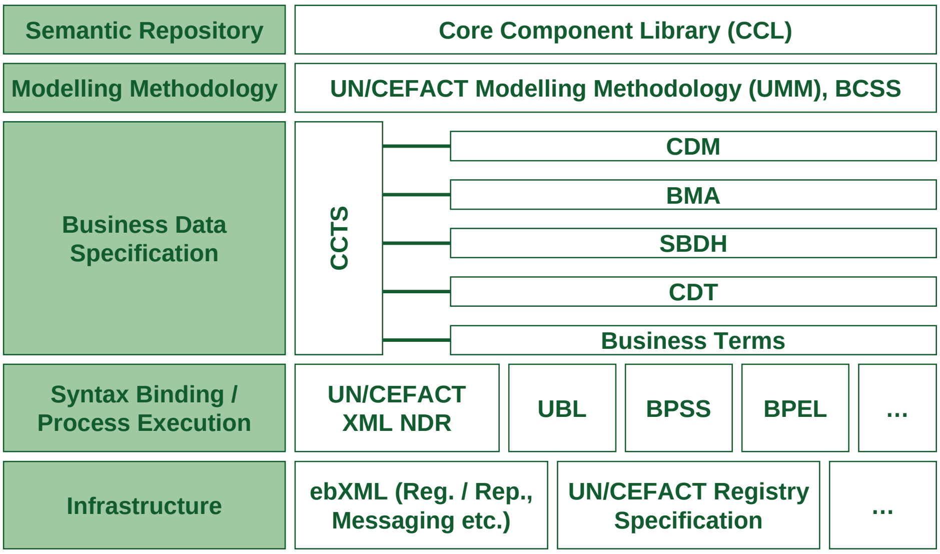


*Figure 2. The UN/CEFACT e-business stack.*

For the Business Data Specification CCTS incorporates the *Core Data Type (CDT)* standard as the smallest (atomic) pieces of information without any business meaning on which the Core Components are based; the *Business Message Assembly (BMA)* specification for composing complete electronic business messages (enabling cross-organizational interoperability); and the *Standard Business Document Header (SBDH)* specification, supporting the determination of application based logical routing requirements of business information. Finally, the *Context Driven Methodology (CDM)*, as a novel and unique concept, allows an adaptation of generically defined business data core components to the user's specific context (CDM will be broached in more detail at the end of this section).

The essential element of the CCTS method consists in a two-stage modelling approach: While in a first step *Core Components (CC)* are specified, describing semantic buildings blocks on a generic, context-neutral level (Stuhec 2006, p. 4), in a second step the conceptually modelled business information are transferred to a specific context (see Figure 3). This adaptation process is achieved by classifying situational parameters into predefined context categories. The resulting artefacts are called *Business Information Entities (BIE)* and contain a precise business semantic definition.

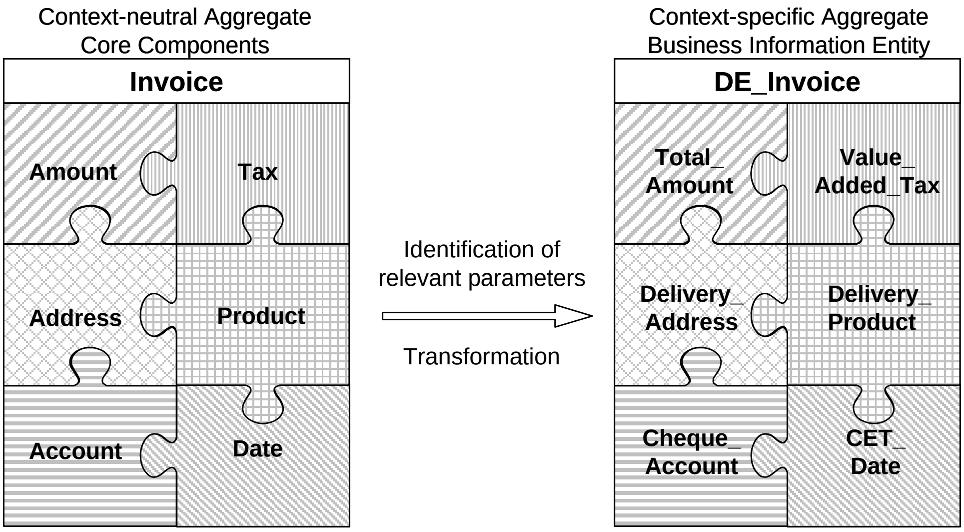


*Figure 3. Context-specific adaptation of reusable building blocks.*

Consequently, CCs constitute real-world objects that can be reused in different contexts, such as products or addresses. Both artefacts – CCs as well as BIEs – are represented by so-called *Dictionary Entry Names (DEN)* consisting of three constituent components, namely *Object Classes* (representing the logical grouping of business data), *Property Terms* (including characteristics of the business information) and *Representation Terms* (i.e. data types defining the domain of the business data). With the help of these DENs the business information is stored in a common repository for retrieval and reuse (Kramer 2007, p. 15).

Three types of CC can be differentiated. As a collection of related pieces of business information representing a single real-world object with a distinct business meaning *Aggregate Core Components (ACC)* consists of at least one *Basic Core Component (BCC)* that describes a unique property of the parent ACC inheriting its Object Class (UN/CEFACT 2003, pp. 11ff.). Moreover, an ACC can include further ACCs, so-called *Association Core Components (ASCC)*. Similar to the Unified Modelling Language (UML) Aggregations and Compositions are possible relationships between ACCs.

According to the Core Components, their semantically enriched equivalents, the Business Information Entities, are divided into three components: *Aggregated Business Information Entities (ABIE)*, *Basic Business Information Entities (BBIE)* and *Association Business Information Entities (ASBIE)*. The only difference in their representation consists in the additional *Qualifier Term (QT)*, i.e. an identifier determining the semantic meaning of the context that allows an adaptation to the specific business environment in which the information is used. This QT, hence, enables the deduction of multiple BIEs from the same CC. Therefore, the generation of semantically specified information entities is achieved by a “derivation by restriction”-mechanism (Stuhec 2006, p. 5). Figure 4 summarizes the mentioned CCTS components and shows the relationships among them in UML notation.

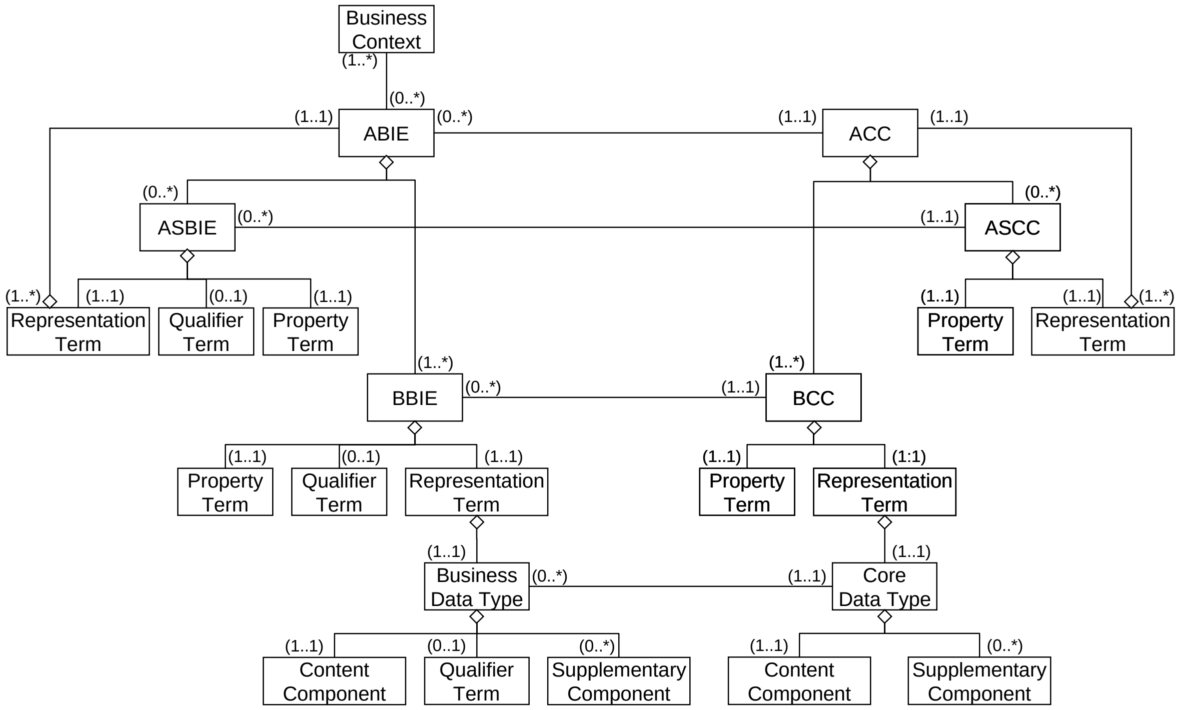


*Figure 4. Conceptual model of the CCTS components.*

For the “contextualization” the Context Driven Methodology of the CCTS framework (see Figure 2) offers eight different context categories that are summarized and characterized in Table 1. (UN/CEFACT 2003, pp. 37f.).

| Context Category | Definition |
|---|---|
| Business Process | • Primary categorization based on the company’s business processes and comprised activities<br>• UN/CEFACT Catalogue of Common Business Processes |
| Product Classification | • Products and Services exchanged or modified within a business transaction<br>• Product classification code lists, such as the Universal Standard Product and Services Code |
| Industry Classification | • Branch or industry in which business processes are executed<br>• External code lists, such as the International Standard Industrial Classification |
| Geopolitical Context | • Categorization due to geographical, i.e. regional, national or international factors<br>• ISO-standards 3166.1 and 3166.2 provide an adequate catalogue |
| Official Constraints | • Comprises regulatory and legal constraints of a business transaction |
| Business Process Role Context | • Role-specific aspects of partners within a business process<br>• UN/CEFACT Catalogue of Common Business Processes |
| Supporting Role Context | • Actors participating in the business process, but not being directly involved<br>• Standardized classification: UN/CEFACT Code List for DE 3035 Party Roles |
| System Capabilities Context | • System constraints influencing the business processes |

*Table 1. Predefined context categories of the CDM and their corresponding meaning.*

In order to accomplish a consistent derivation of multiple BIEs it is crucial to have semantically uniform definitions of the underlying Core Components. This is realized with the help of the *Core Component Library (CCL)* that is publicly available. Furthermore, a common repository where all the CCs, BIEs, context-values and relationships between those components are stored and enriched with metadata is intended as a central “single source of truth” for all users (Kramer 2007, p. 24). The possibility to trace back context-specific BIEs to their original CCs whose business meaning is semantically unambiguous constitutes the fundament for true semantic interoperability.

### 3.2 Design Science Characteristics of CCTS

The essential elements of the design science approach are summarized in the seven guidelines, propagated by Hevner (2004). For proving the conformity of CCTS with the design science paradigm, we need to check this novel modelling paradigm against these guidelines which will be the purpose of this chapter.

*Guideline 1: Design as an Artefact*

The first guideline propagates the necessity for design-science research to generate viable artefacts, such as models or methods (Hevner et al. 2004, p. 82). With regard to this guideline, we detect that CCTS does not only provide a standard framework for semantic data modelling, but results moreover in concrete models as a result of the modelling process. As first use cases suggest – the adoption of the method of the Australian government just being one of numerous examples lately[2] – the applicability of CCTS can be taken for granted (validation).

*Guideline 2: Problem Relevance*

As shortly outlined at the beginning of this paper, a multitude of companies consider interoperability problems as critical for e-business. As the CCTS standard offers a concept for semantically unambiguous representation of business information, the approach makes an important contribution for a seamless B2B message exchange, fulfilling the requirement of addressing an important, unsolved organizational problem (Hevner et al. 2004, p. 84).

*Guideline 3: Design Evaluation*

With regard to the third guideline (Design Evaluation), the Core Component Technical Specification as a relatively recent concept that is still under development[3] needs further extensive evaluation through case studies and corresponding implementations in order to prove the utility, quality and efficacy of CCTS. Hevner (2004) postulates rigorous demonstration “via well-executed evaluation methods” (Hevner et al. 2004, p. 85). In this context one of the major obstacles is related to the lack of comparative analysis as well as an accepted set of metrics of data modelling concepts (March & Smith 1995, p. 263), which considerably complicates the possibility of evaluating (and not only validating) respective approaches (see chapter 2.2). In addition, the practical value of artefacts in information science (such as a modelling method) for which it is conceived, is revealed during its application in a real-world scenario (Frank 2000a, p. 42), complicating an ex ante evaluation. Nonetheless, even an ex post evaluation is mandatory within the design science paradigm and appears scientifically reasonable, as the real world can serve as an objective instance for estimating the utility of an IT artefact (Frank 2000a, p. 45). Chapter 3.4 is dedicated to this open issue and will provide a possible framework for evaluating CCTS as an information science artefact.

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[2] The example is publicly accessible under the following link: https://www.govdex.gov.au/pubdata/Repository/index.htm

[3] While development of version 3.0 is still in process, the current version of the core components standard released by the UN/CEFACT is 2.1 (UN/CEFACT 2003).

*Guideline 4: Research Contributions*

Guideline 4 covers the requirement to contribute clear and viable results to the field of research – either with regard to a design artefact, the design construction knowledge or the design evaluation knowledge (Hevner et al. 2004, p. 87). The CCTS approach extends the existing knowledge base by providing a clear methodological contribution to the research area of conceptual data modelling with and business interoperability by adding innovative concepts, such as the inclusion of semantics or the context-driver principle, to existing modelling frameworks.

*Guideline 5: Research Rigor*

Research rigor refers to the application of rigorous methods in the design science research process (Hevner et al. 2004, p. 83). The theoretical foundation of CCTS has to be estimated as rather weak as it has been the case for conceptual modelling in general (Weber 2003, p. 2). However, the CCTS framework satisfies this requirement partly as it draws on existing knowledge. It uses established concepts of conceptual data modelling, such as aggregations and cardinalities, as well as the UML as a de facto standard modelling notation as fundament for its graphical representation. Moreover, it evolved out of the experience made with several standardization efforts before (among others UN/EDIFACT) considering the shortcomings of former concepts.

*Guideline 6: Design as Search Process*

This guideline expresses the necessity of design science research to constitute an iterative, heuristic search process who does not necessarily lead to an optimal solution (Hevner et al. 2004, p. 88). The iterative character of the method design is ensured by the continuous improvement process of the CCTS specification. Starting with its first specification in 2002, the framework successively started to incorporate the experience made with first implementations and to detach discrepancies leading to a rectified specification that is currently under review (V3.0).

*Guideline 7: Communication of Research*

The results of the research process in information science need to be communicated to both technology- and management-oriented audience according to guideline 7 (Hevner et al. 2004, p. 90). Due to the rising importance of cross-organizational value chains and its intuitive accessibility for both business experts and more technology-oriented practitioners, CCTS experiences an increasing dissemination in B2B as well as B2G exchanges. The recommendations expressed by independent institutions, such as the “Bundesverband Informationswirtschaft Telekommunikation und neue Medien” (BITKOM)[4] will further enhance this process. In the near future, the modelling framework should expand into and gain recognition from academia.

Lastly, as a central characteristic of design science (Hevner et al. 2004) designate the necessity to address “important unsolved problems in unique and innovative ways” (Hevner et al. 2004, p. 81). CCTS fulfils this requirement for the semantic data modelling by defining semantically unambiguous building blocks, enabling increased reuse, and, at the mean time, allowing country- and industry-specific adaptation of these context-neutral components through the Context Driven Methodology (Stuhec 2005, pp. 13ff.). Contrary to most other B2B standards this provides a flexible assembly of interoperable business messages and their storage in shared libraries, contributing a novel approach to the research area of conceptual modelling.

[4] For further information see: http://www.bitkom.org/de/themen_gremien/36235_34874.aspx

### 3.3 CCTS as a Conceptual Modelling Framework

In corresponding articles, CCTS is often referred to as a “methodology” (cf. Stuhec 2005). However, this notion appears to be incorrect, as the term “methodology” in the proper sense denotes the epistemological or scientific investigation of principles of deploying methods. For the purpose of this article we intend a clear distinction between methodologies and methods in order to avoid a misuse of the term. CCTS is hence described as a method or, more generally spoken, as a modelling framework.

As outlined in chapter 2.2, research in conceptual modelling is spread on different artefacts of the domain. Accordingly, the research framework by Wand & Weber (2002) comprises four constituting components among who CCTS needs to be positioned. Therefore, and for the sake of a more elaborated presentation, this chapter shows whether and to what degree the elements of a conceptual modelling method are incorporated in CCTS. Confronted with the elements postulated by Sinz (2005) two pivotal constituents emerge.

First, the graphical notation of CCTS as an approach for semantic data modelling is derived from UML class diagrams which are recommended as modelling language. Consequently, the UML provides the modelling grammar defining the modelling syntax. Constructs, such as classes (ACCs or ABIEs in CCTS), attributes (BCCs or BBIEs) and relationships (particularly aggregations), are combined with rules to map a problem domain. Besides, an underlying metamodel (see Figure 4) specifies the semantics of the available constructs and ensures their common understanding.

Second, the process of using the grammar and creating new data models is detailed in the procedure model of the CCTS specification (UN/CEFACT 2003, p. 21), revealing an important characteristic of methods in information science. The method definition according to Gutzwiller (1994) requests six components of which five are fulfilled by CCTS. The specification encompasses both a metamodel and (a verbal description of) a procedure model with respective activities. In addition, the specification characterizes the modelling entities and relationships as results of the modelling process (CCs and BIEs) as well as appropriate techniques and tools supporting the modelling process. The only component missing is an explicit role model that, however, seems to be of minor importance in our case as CCTS only represents one part of a the entire UN/CEFACT modelling framework (see Figure 2) that does not need a large number of involved actors.

### 3.4 Necessary Extensions to the Current Framework

Necessary extensions to the current CCTS approach result from two different requirements: On the one hand side, the exigency to allow a seamless B2B communication process, stretching from conceptual data modelling and message assembling to the transformation into a standardized, machine-readable syntax. On the other hand side, there are additional requirements arising from the scientific and methodological perspective, particularly the above-mentioned characteristics of design science and conceptual modelling.

With regard to the first point, the automated transfer from the conceptual level to the message implementation represents a challenge for obtaining seamless interoperability. Although the UN/CEFACT emphasizes the syntax-neutral character of the CCTS method, an automated transformation into XML syntax – as a de facto standard for the automated message exchange – appears preferable and even necessary. With its XML Naming and Design Rules (see Figure 2) the UN/CEFACT provides a specification for systematically “translating” the syntax-independent CCTS components into XML Schemas and XML instances (UN/CEFACT 2006). This transfer needs to be supported by a tool in order to reduce the time- and cost-intensive manual effort for the mapping. With first implementations of commercial software that aim at providing a solution, in turn, new problems arose due to the non-compliance of the generated XML code with UN/CEFACT’s XML Naming and

Design Rules. As a consequence, a conforming transformation from CCTS components to XML Schema remains one of the significant goals for the near future.

One of the major obstacles that remain unsolved, however, refers to the requirements postulated by the design science paradigm: The validation and evaluation of created artefacts. The two activities need to be clearly distinguished. While the former is rather concerned with assessing the feasibility of IT artefacts, the latter estimates their utility.

In our case, we first need to prove the possibility of applying the CCTS approach and implementing a truly interoperable B2B message exchange based on conceptual CCTS data models. This proof-of-concept implies the necessity of sample implementations, such as the one provided by the Australian government or those intended by the EU-funded ITAIDE project.[5]

The validation, therefore, has to be conducted empirically with the help of case studies. Case studies representing a standard method for empirical study allow companies as well as researchers to evaluate the benefits of information science artefacts (Kitchenham et al. 1995, p. 53). Although case studies lack a certain generalizability and are exposed to subjectivity, they are predestined to prove consistency and usefulness of modelling concepts (Braun 2007, pp. 207f.).

With regard to the evaluation, as the problem of cross-organizational interoperability clearly originates from a practical business problem that companies have been trying to solve for several years, the consequences for the evaluation are twofold. First and foremost, the modelling framework needs to fulfil the objectives, enterprises would pursue by using CCTS for their data and message modelling in order to achieve semantic interoperability in a B2B context.

From a scientific point of view, House (1993) describes evaluation as a systematic estimation of either material or immaterial objects with the aid of well-founded, reasonable criteria and procedures. Within this article, this applies to the possibility of assessing the quality and utility of the CCTS method and the resulting conceptual data models. This is not only one of the vital requirements of design research but an unresolved issue in the field of conceptual modelling as well (March & Smith 1995, p. 263). However, several authors highlight difficulties with regard to quality assessment of information models (Frank 2000b, Schütte 1999, Schütte 2000, Becker et al. 2002). On the one hand side, these difficulties result from diverging perspectives on what quality of IT artefacts is (Fettke & Loos 2004, p. 6). From the user's perspective quality is mainly concerned with usability and applicability of the models for the specific user context while companies tend to emphasize cost-benefit ratios and research and academia again set high value on correctness, completeness and preciseness. On the other hand side, the evaluation generally can be based on qualitative criteria only, such as simplicity, understandability, flexibility etc. as shown for conceptual Entity-Relationship-Models by Moody and Shanks (1994).

This brief overview of discussions lead in research reveals the complexity and multidimensionality of evaluating a conceptual modelling method, such as CCTS. Consequently, the evaluation of artefacts, such as conceptual data models and methods, in information science needs to consider multiple perspectives (Braun 2007, p. 206). For this purpose, Fettke & Loos (2004) propose a multi-perspective evaluation framework (see Figure 5) that incorporates different dimensions and was originally intended to systematically evaluate reference models (Fettke & Loos 2004, p. 12). Nonetheless, the framework is applicable to other information science artefacts (methods, metamodels etc.) as well (Braun 2007, p. 207). Each of the four perspectives clusters several evaluation methods that can be applied according to the underlying research method (empirical if knowledge is generated on the basis of experience, analytical if knowledge is logically deduced) and the origin of the utilized criteria (are they derived from theory or not).

[5] For more information about the ITAIDE project see http://www.itaide.org

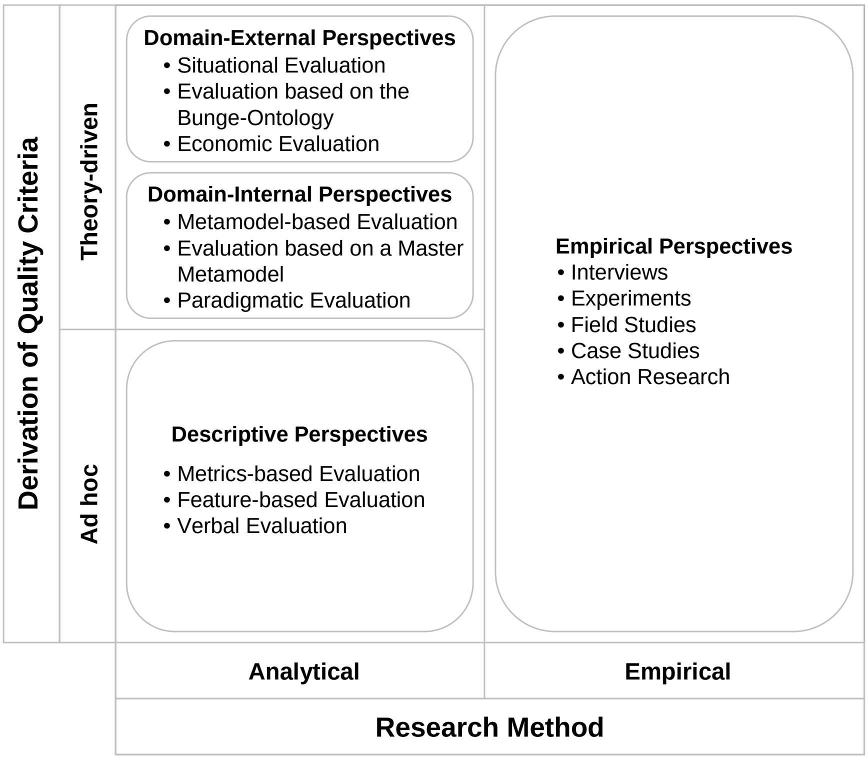


*Figure 5. Multi-perspective evaluation framework for IT artefacts (Fettke & Loos 2004, p. 12).*

The evaluation of the CCTS modelling framework will not be conducted in detail in this article; instead vital components of a possible evaluation will be outlined in the following. Such an evaluation should be pluralistic and at least consider the following dimensions of the evaluation framework depicted above:

As argued before (see chapter 3.2) and supported by numerous authors (cf. Rosemann 2005, Moody 2005, Sinz 2005) the evaluation of IT artefacts, particularly methods, needs to include an empirical dimension. Therefore, field and case studies or even action research, allowing a real-world application of the CCTS method, are possible tools to gather information about the utility of the CCTS approach, particularly regarding the ease of handling, the capability of allowing for semantically interoperable exchange of data between companies etc. At the same time they allow to keep efforts and costs limited, remedying one of the major deficiencies of empirical studies.

The descriptive perspectives, in turn, are differentiated according to the degree of operationalization of their quality criteria (Fettke & Loos 2004, p. 11). As there are still no generally accepted and objectively determinable metrics available and due to the highly qualitative nature of evaluation criteria for methods and models, an evaluation with regard to this dimension can only be conducted textually or – provided that criteria are defined beforehand – based on specified features. While textual evaluations analyze strength and weaknesses in a relatively subjective way (Braun 2007, p. 208), feature-based evaluations are generally based on a set of ad hoc criteria, such as consistency, degree of formalization, applicability, accurateness of the mapping, tool support etc. whose selection is not intuitively evident.

As shortly outlined in chapter 3.3 the CCTS modelling method can be evaluated with the aid of the method metamodel specified within the method engineering approach (cf. Gutzwiller 1994) in terms of an theory-based evaluation. In this regard, the required method elements need to be discussed in more detail and detected in the CCTS method in order to prove its completeness.

Concerning the CCTS modelling grammar, both domain-internal and domain-external approaches need to be considered, evaluating its completeness and redundancy. On the one hand, an ontology-based evaluation provides a mean to objectively evaluate the expressiveness of modelling languages. In the past, similar evaluations have been conducted, e.g. for ARIS (cf. Rosemann & Green 2000) and reference models in general (cf. Fettke & Loos 2003). However, there is still no commonly accepted ontology although in most cases the Bunge-Wand-Weber Model as an extension of the Bunge ontology served as the underlying framework (Rosemann & Green 2000, Shanks et al. 2003, Fettke & Loos 2003).

On the other hand, an metamodel-based evaluation that examines the meta entity types and relationships with a master-metamodel composed of several metamodels (Braun 2007, p. 235) defining the required elements of the domain. Due to the lack of such a master-metamodel, a self-contained composition of metamodels is necessary. As a result, syntactical correctness and the modelling process (in case of process-based metamodels) can be evaluated.

# 4 CONCLUSION AND OUTLOOK

The article at hand pursued three essential objectives: Firstly, it intended to present a novel framework for conceptual data modelling that has not been regarded by the scientific community so far; secondly, it aimed at embedding CCTS, a standard that has emerged as a result of mainly practice driven institutions (particularly standardization bodies such as the UN/CEFACT but companies as well), in a scientific context. Therefore, two fundamental concepts of information science research, namely the design science paradigm and the theory of conceptual modelling, were introduced as a theoretical framework for the paper at hand and characterized with their pivotal components in a first step.

After outlining the CCTS approach and highlighting its innovative elements (common repository, inclusion of semantics, context-driver principle, degree of reuse), it was confronted with the basic requirements of the theoretical framework. As a result, the compliance of CCTS as a method for conceptual modelling with the guidelines of design science research became evident.

The essential pitfall in the future remains the proper evaluation of the CCTS method and their resulting artefacts (i.e. data models). For this purpose – and this is the third contribution of this article –, the paper discussed a possible multi-perspective evaluation approach adapted from the evaluation framework by Fettke & Loos (2004). The evaluation needs to consider both empirical evidence provided by case and field studies (particularly for validating the practicability of the approach) and analytical examination that should incorporate the theory-based evaluation perspective (using metamodels and ontologies) and less formal approaches, such as feature-based or textual evaluations. The realization of this evaluation constitutes one of the major research tasks in the near future.

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