BUSINESS TRANSACTIONS AND STANDARDS

TOWARDS A SYSTEM OF CONCEPTS AND A METHOD FOR EARLY PROBLEM IDENTIFICATION IN STANDAD IMPLEMENTATION PROJECTS

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Table of contents

Part I. Background 1
Chapter 1. Introduction 3
1. Introduction 3
2. Thesis outline 4
Chapter 2: Introduction to the research problem 6
1. Introduction 6
2. Standards: further insights 9
3. Technical and inter-organizational interoperability 17
4. Research problem 25
5. Research approach 29
Part II. Construction of the system of concepts 39
Chapter 1. Exploration 41
1. Introduction 41
2. Business transaction 42
3. Business communication 56
4. Linking business transaction to business communication 66
5. Conclusions 67
Chapter 2. Focus 68
1. Introduction 68
2. Mono and multi-disciplinary research 69
3. The range of issues to be covered by the system of concepts 70
4. Reflection on existing frameworks and models 71
5. The role of the views in the construction of the system of concepts 72
6. High-level system of concepts 73
7. Example 81
8. Conclusions 85
Chapter 3: Elaboration of the views 86
1. Introduction 86
2. Subject matter view 89
3. Communicative act view 96
4. Business rule view 101
5. Business process view 103
6. Business network view 109
7. Focal exchange view 110

8. The detailed views 112
9. The kitchen example 116
10. Final remarks 121
Part III. Method 123
Chapter 1: Method 124
1. Introduction 124
2. Components of the method 126
3. Fit analysis 134
4. DBT analysis 142
5. Impact analysis 148
5. Final remarks 149
Part IV. Case study 151
Chapter 1. The Energy Case 152
1. Introduction 152
2. Background concerning energy liberalization 153
3. Research design 156
4. Analysis 169
5. Reflection and conclusions 184
Part V. Conclusions 187
Chapter 1. Conclusions and further research 188
1. Introduction 188
2. Results and contributions 189
3. Reflection on the research process and limitations of the research 193
4. Contribution to research 196
5. Contribution to practice 196
6. Directions for further research 197
7. Possible use in commercial products 199
Bibliography 201
Summary 209
List of abbreviations 214
List of publications from this research 215
Acknowledgements 216
Annex 1. 220

Part I. Background

Chapter 1. Introduction

1. Introduction

One might question the relevance of research regarding business transactions and standards, the focus of this thesis, as both notions may seem dated. Trade, which can be traced to ancient times, requires a degree of shared understanding as well as common language: therefore the invention of business standards.

One reason to place business transactions and standards at the forefront of research is technological developments of recent decades. As technology advances, companies look for ways to gain advantages from it and implement efficient business transactions. For example, the 1970s saw growth in the idea of eliminating paper documents for exchanging business data by linking computer systems, allowing typically paper-based data to be sent from one system to another. This concept became known as Electronic Data Interchange (EDI) and in 1985 two domain EDI standards evolved: ANSI X.12 and UN/EDIFACT. EDI standards promised significant advantages in facilitating the exchange between business partners by automating parts of a business transaction (Damsgaard (2000)). The benefits of EDI standards are widely discussed in the literature (Kekre 1992; Jelassi 1994; Wrighly 1994; Sokol 1995). These benefits, such as reducing errors, increasing speed, and cutting costs, create a competitive advantage. EDI standards were seriously criticized, however, for lacking a clear and complete lexicon, having no fully specified grammar, and nearly no semantics (Kimbrough 2000). Critics also found these languages deposit character strings into particular places on a remote computer rather than representing a language for exchanging knowledge (Covington 1997). In addition, costs associated with standard implementation were high, making EDI standards too expensive for small and medium-size companies. Finally, EDI projects focused on how to provide technical tools rather than how to support the way people do business (Covington 1997; Huang 1998). There was often a running technical solution with unclear business benefits as a result.

The Internet promised new opportunities, providing interconnectivity at a lower cost and allowing small- and medium-sized companies to participate in electronic exchange. The development of new standards continues, serving various purposes while attempting to provide interoperability. EbXML, for example, aims to provide an open, XML-based infrastructure enabling the global use of electronic business information. The UBL standard strives to support cross-industry business communication using standard electronic business documents and a

standard cross-industry vocabulary. Other domain standards attempt to cover more complex domain-specific business communication in terms of process, content and data (HL7; RosettaNet). Although the number of standard development initiatives constantly increases, the standards research community still struggles to order this complex world. There have been several attempts to provide frameworks enabling classification of different standard types (Guarino 2000; Lagendijk and Stegwee 2001; VIZI 2001). These classifications halt at high levels however, and provide little insight into what a standard can do in a particular situation.

When researching standardization literature, we find two phases addressed: standard development and standard adoption. A review by Fomin and Keil (2000) shows theories on standardization can be classified along the phases standard creation/ selection and standard diffusion/ selection. These standardization theories work to explain the complex phenomena of standard creation and adoption, taking different focal points (e.g., game theoretic standard selection (Farrell and Saloner 1988; Besen and Farrell 1994); diffusion of innovation (Rogers 1995); or power relations (Star 1991)). However, as argued by Quantz & Wichmann (2003) and Söderström (2004), little research exists concerning standard implementation, the process of introducing a standard into a specific business situation.

Companies have an interest in making use of new technology and adopting standards because they expect that doing so will improve the execution of business transactions. As mentioned earlier in the context of EDI, standard implementation projects were viewed as IT projects with practitioners focusing on achieving technical solutions. Such projects resulted in creating technical solutions with little bearing on the way of doing business (Covington 1997; Huang 1998). A thorough analysis at early stages of a standard implementation project, identifying the requirements of a business transaction and the extent to which a chosen standard can address these requirements may avoid such problems. The early identification of problems is also essential. Researchers in the requirements engineering domain argue that errors made in the requirements stage of a project can have serious consequences in terms of project cost, time and quality (Gustas, J. et al. 1996; Yu 1997). The problem we address in this thesis is as follows: *How can we identify at an early stage of a standard implementation project, potential problems with the execution of a business transaction when deploying a standard in a specific DBT situation?*

Within this thesis we develop a system of concepts and a method to analyze the requirements of the business situation and the capabilities of a chosen standard, identify possible mismatches between the two, as well as identify potential problems arising from this. In addition we provide initial insights about the feasibility of both the system of concepts and the method.

This thesis contributes to both the scientific and the business community. We contribute to the research community on standardization by providing insights concerning the standard implementation phase and some further understanding of how to analyze what a standard can offer for a particular business situation. We contribute to the business community by providing a mechanism to evaluate the fit between the requirements of a given situation and the chosen standard at the early stages of a standard implementation project. The early identification of possible mismatches between the two allows taking additional measures to mitigate differences, which may ultimately result in better project execution (in terms of time and resources) or a better project outcome.

2. Thesis outline

The thesis is structured as follows: Part 1 chapter 2 introduces basic concepts enabling better understanding of the research problem context. We discuss the notions of business transaction,

business communication, to-be automated business communication, and standards. We then provide insight concerning the standard life cycle focusing explicitly on the use of standards in specific situations, relating further to the standard implementation and the standard usage stage. Next we provide a discussion of problems related to standard implementation and usage, followed by a discussion concerning technical versus inter-organizational interoperability.

Part 1 chapter 2 also formulates the research problem concerning early problem identification in standard implementation projects by proposing to create a system of concepts and a method to facilitate this early problem identification. We then formulate three research questions concerning the construction of the system of concepts, the construction of the method, and gaining initial insights about the feasibility of the system of concepts and the method to be used in problem identification. We finally outline a research approach on how to answer the research questions.

Part 2 addresses the construction of the system of concepts, following a predominantly theoretical approach. The construction of the system of concepts is structured in three phases. Part 2 Chapter 1 addresses the first phase, "Exploration". During this phase, an exploration of theories addressing business transaction and business communication is undertaken. We discuss the second phase of the construction of the system of concepts, "Focus", in Part 2 Chapter 2. Here we explain our multi-disciplinary approach in the construction of the system of concepts. As a result of the focus phase, we define a number of views which serve as a basis for the high-level system of concepts. We present the last phase in the construction of the system of concepts, "Choice", in Part 2 Chapter 3. During this phase, we elaborate each view, and identify additional concepts, resulting in a detailed system of concepts. We illustrate the use of the system of concepts throughout the different phases of the construction with examples from the healthcare domain.

Part 3 Chapter 1 describes a method of applying the system of concepts in practice. In Part 4 Chapter 1 we describe a case study concerning the liberalization of the energy market. In this study we use the system of concepts and the method to theoretically identify a number of potential problems. We then compare these potential problems with actual problems encountered in practice. As a result, we draw initial conclusions concerning the feasibility of the system of concepts and method. Part 5 Chapter 1 evaluates the contribution of this thesis and outlines directions for further research.

Chapter 2: Introduction to the research problem

1. Introduction

1.1 Business transactions and business communication

Business transactions (or the exchange of goods/services for some form of compensation) are part of our everyday life, as for example buying a book from a bookstore, or a ticket for the cinema. We buy books, tickets, and numerous other goods or services that we need, providing some compensation (usually payment) in return. These are business transactions involving the end customer and they are referred to as business-to-consumer transactions. To produce a good/service for the end customer companies also enter into business transactions with other business parties by playing a number of different roles. They buy goods/ services they need from their suppliers, providing compensation in return. They then sell the goods/services they produce and receive compensation. We will refer to business transactions between business parties as business-to-business transactions. Within this thesis we focus on business-to-business transactions, as companies mount significant efforts within these transactions to improve their performance.

Some transactions are done with little interaction between the buyer and the seller: a person picks up a book from the shelf of a bookstore and pays for it at the counter. Carrying out business transactions is not always this simple and straightforward however; it sometimes involves complex communication. For example, if one goes to a tourist agency to book a flight, this can involve complex communication to determine the day of the flight, the preferred time, the preferred type of meal, and method of payment.

In business-to-business transactions, communication between business parties with respect to the transaction (we will refer to this as business communication) is essential. It is important that the trading parties specify the good/service to be exchanged, the delivery terms, and the terms of payment. If the customer does not receive the required good/service, communication also plays an important role in the claim-filing process.

1.2 Technological developments and the pursuit of automated communication

In a business-to-business setting, companies have an interest in carrying out transactions more efficiently. A number of technological developments in the last few decades encouraged companies to consider automating parts of their business communication. Technological

developments are often seen as a means to achieve faster and better automated communication between business parties via computer systems. We refer to business transactions in which disparate applications[1] perform a part of the business communication, as a distributed business transaction (DBT). Improved communication between business parties eventually may result in faster execution of business transactions.

Let us now take a closer look at some of these technological developments. More than thirty years ago, the introduction of the Electronic Data Interchange (EDI) provided a platform for connectivity between disparate computer systems. At the time, some large companies considered connecting their systems via EDI. However, the costs of connectivity via an EDI network were high, making this solution improbable for small- and medium-sized companies (Iacovou 1995). The emergence of the Internet allowed for low connectivity costs enabling small and medium companies to connect their systems.

Although this technology allows companies to achieve connectivity, connectivity alone is not adequate to achieve the meaningful communication needed to support the execution of a business transaction.

1.3. Standards

Soon after the introduction of EDI it became evident that it was insufficient to only establish a physical connection between computer systems or to pass messages from one system to another. Defining the structure of the message, the data contained therein, and having business parties agree on what they need to communicate became important goals.

Working with binary agreements between businesses parties raises problems in cases when a company prefers to enact similar business transactions with a number of different parties. For example, if different companies offer the same product, the customer may decide to buy the product based on the best price. A company will benefit if it can choose the supplier with the best offer, yet this requires investing and implementing each bilateral agreement it has with each supplier.

Figure 1.1 illustrates a case in which one company needs to communicate with a number of parties with respect to the same class of business transactions. In this case it has to implement a proprietary solution for each communication relationship. Eventually it may be very costly to set up and maintain the automated business communication.

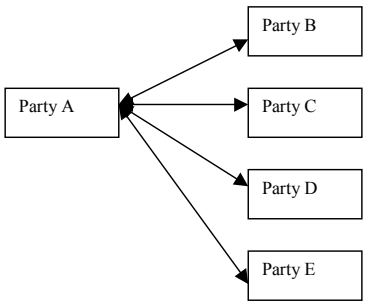

Fig. 1.1 Many proprietary interfaces

One solution to this problem is to use communication standards. We can broadly define a communication standard as set of definitions, specifications, and guidelines developed by a standard-development organization, which aim at defining some aspect of business communication. From now on we will use the word standard to refer to communication standards which enable the communication between disparate applications with respect to a specific class of business transactions.

[1] By application here we mean a software system.

Figure 1.2 illustrates a case in which the trading parties agree to use a communication standard. In this case, each party needs to implement only the agreed upon standard. Once this is done the trading parties will be able to easily communicate with each other using this standard. In this situation, party A can communicate with parties B, C, D, and E by implementing only the agreed upon communication standard.

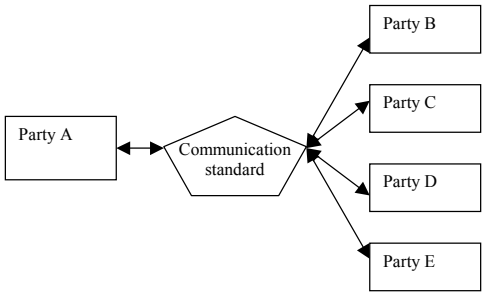

Figure 1.2 Use of communication standard

Following this concept, a number of standard development initiatives and working groups devoted their efforts to creating communication standards. In the 1980's two domain standards emerged: EDIFACT in Europe and X.12 in the US. EDI standards promised significant advantages in facilitating the exchange between business partners by allowing parts of the business communication to be automated (Damsgaard and Truex 2000). Researchers widely discuss the benefits of EDI standards (Kekre 1992; Wrighly 1994; Sokol 1995). Some benefits include reducing errors, replacing paper-based communication, increasing speed, cutting costs, and building in competitive advantage. With the emergence of the Internet, which lead to cheep connectivity and allowed for small and medium size companies to connect at low cost, the number of standard development initiatives has significantly increased. Numerous standard development initiatives emerged, such as xCBL, RosettaNet, and ebXML, to mention only a few. For further examples of such standards see Guarino (2000) and Söderström (2004). We will return to this topic in the next section.

1.4 Business transactions, business communication, automated communication and standards

Figure 1.3 summarizes some of the major issues we have discussed.

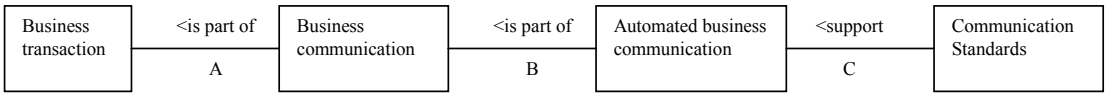

Figure 1.3 Business transactions, business communication, to-be automated business communication and standards

As we mentioned earlier, companies enter in business transactions, when they want to exchange goods/services for some form of compensation. We have further discussed that business communication is a coherent part of the business transaction and that is important in order to reach agreements and coordinate actions. In order to achieve more efficient communication, companies may decide to automate parts of their business communication. We have further defined a business transaction, in which a portion of business communication is carried out via disparate applications as a distributed business transaction (DBT). To be able to achieve automated business communication, companies may opt for communication standards.

In figure 1.3 we indicate some links between these elements, as briefly discussed below. If we examine the relationship between business transactions and business communication (relationship A), we can say that business communication is part of a business transaction. Relationship (B) shows that automated business communication is part of business communication while relationship (C) depicts the use of communication standards to support automated business

communication. Although automated communication is achievable without the use of standards, we focus on those cases using standards.

2. Standards: further insights

In the previous section we introduced the idea of communication standards, using figure 1.3 to present an ideal case of improving the execution of a business transaction with the use of standards. However, the use of standards is not necessarily straightforward: although there are numerous standards, it is not always easy for companies to understand the benefits of a particular standard. Additionally, as the number of standards grows, so do the problems associated with their use. We return to the issues related to the use of standards in section 2.3.6. Before continuing, we investigate the different stages of standard development and usage. These insights assist us in defining where our interest in standards lies.

2.1. Standard life cycles

In the standardization literature there are a number of studies describing standards life cycles. Söderström (2004) finds that most of these focus both on the first life cycle phases and on the activity of standards development. Table 2.1 provides a comparison of different standards related life cycles.

Cargill /Burrows	Initiate	Develop standards	Develop products	Implement		Feedback
Köller et al.		Define		Implement/ install	Use	
Ollner	Pre-standardization	Standardization	Post-standardization			
De Vries	Need	Develop		Implement		Feedback
Weiss & Spring		Develop/ distribute	Implement			
Egyedi	Plan	Negotiate		Implement		
Hanseth & Braa	Conception	Define		Implement	Use	

Table 2.1 Comparison of standard-related life cycles adapted from Söderström (2004)

To elaborate the phases described in the table adapted from Söderström (2004), the initiation stage is the stage before standard development starts. This phase, referred to by different names among researchers, involves the birth of the idea of the standard based on needs and estimations, and preparations for the standard development process. It may also include setting the standard scope and instructions on how the standardization process should be performed.

The next stage includes the actual development of the standard, usually conducted by standard-development organizations. Standard development is a complicated process, which we will not discuss in detail. There are a number of factors including power, which determine the outcome of the standardization process. It is important to note that standards are often developed outside of the situation where they are actually applied.

The third stage concerns the phase of product creation based on one or more standards. Although Weiss & Spring consider this phase implementation, Söderström positions it in the column of product development, as by definition it deals with product creation, rather than with user implementation.

Implementation involves the application of standards and/or standard based products, while the use phase refers to the actual use of standards and standards based products in the organization. As noted by Söderström, only two of the studies include the use stage, indicating an area for further research. The last phase is feedback, concerning reactions about standards and products from users to developers.

Figure 2.1 presents a generic standards lifecycle model, developed by Söderström based on the research discussed above. It is important to notice that there are three additional activities made explicit in the model: conformity assessment, education and maintenance[2].

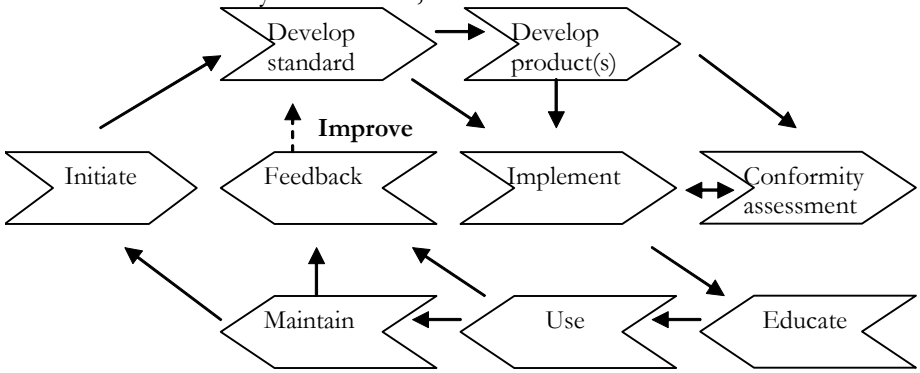

Figure 2.1 General life-cycle model (adapted from Söderström, 2004)

Conformity assessment aims to ensure that the product/implementation meets the requirements as set in the standard. Maintenance is an important activity as the substantial investments of companies do not allow system replacement with the emergence of each new standard on the market. Education is also made explicit as a separate activity. As Söderström (2004) points out, users may not know how standards work or what they can do for them, instead outsourcing their standards activities management (e.g. to consultancy firms). We have come to a similar observation during our empirical work, as elaborated in Part 2.

It is not within the scope of this thesis to make a complete investigation of all possible standard lifecycle models. In this respect, it is not our goal to question the completeness of such models. It is our goal to provide a general idea concerning the major steps related to standard development and usage. Such orientation is important, helping to delimit the scope of our work. Our concern relates to standard implementation and usage, rather than standard development, as discussed in the next section.

2.2 Standards and a specific situation

The standard implementation stage involves the introduction and use of a standard or product based on standards in a specific situation, as illustrated in figure 2.2.

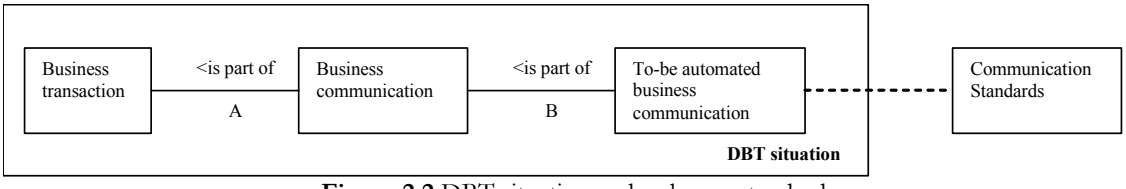

Figure 2.2 DBT situation and a chosen standard

Let us define a distributed business transaction situation (DBT situation) as a situation in which the business parties make a decision to carry out parts of the business communication using

[2] Söderström also mentions "termination" as an additional activity; however it is not included in the general model.

disparate applications. To achieve this, they decide to use standards. The dotted line in the figure above indicates that the standard attempts to cover the "to-be automated business communication". As a result, a standard implementation project begins involving the introduction of a standard in a specific situation.

From a business point of view, the standard implementation and usage stages are extremely important, as they illustrate the improvement (or lack of improvement) of using a standard in the organization. Standard implementation and usage are also intriguing from a scientific viewpoint within the field of information systems (IS). As Markus (2003) shows, the IS field focuses largely on the use of technology products by non-producer firms. Within the context of this research, standards (and products based on standards) are specific examples of such technology products. As representatives of the IS field, we consider it less interesting to study standards development, and more important to understand potential benefits as well as issues occurring through the implementation and use of a standard in a specific situation (i.e. when introducing a standard to organizations that need to communicate). In addition, there has been very little research in this direction, making the study of standard implementation more interesting. As Quantz and Wichmann (2003) and Söderström (2004) point out, standards research focuses on standard development and standard adoption, while standard implementation remains largely unexplored, providing rich grounds for discovery. With this in mind, we now concentrate on the standard implementation project.

2.3 Standard implementation projects

When analyzing a standard implementation project we roughly distinguish the following phases: initial stage, implementation stage and usage stage, schematically represented in the figure below.

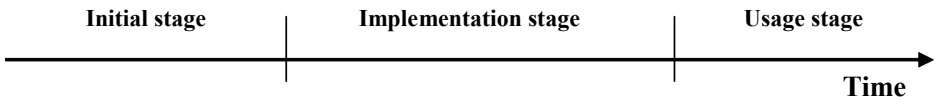

Figure 2.3 Standard implementation project stages

2.3.1 Initial stage

In the initial stage, decision-making occurs both in terms of the DBT situation and the standard. For the DBT situation, this stage involves specifying what parts of the business communication to automate (related to the DBT situation), resulting in the specification of DBT requirements. Regarding the standard, this stage entails making the decision to adopt a given standard. We discuss several issues concerning the initial stage below.

2.3.2 Standards developed outside of the situation where applied

First, standards development, a process in which different working groups develop parts of a standard, often occurs outside of the situation of actual use. Working groups may represent a balance of individuals from a wide variety of companies working in a given domain; though this is not always possible. In some cases, a dominant party infuses a standard with its own requirements. In other cases, varying requirements from different representatives yield compromise, meaning either a sacrifice of some individual requirements or the development of vague standards requiring individual interpretation. We will not elaborate about standards creation, but it is important to acknowledge the forces influencing the process of standard development and the standard itself. As standards development often occurs outside of the application situation, and different situations have specific requirements, clearly we can expect differences between the DBT situation requirements and a standard.

2.3.3 The standard adoption decision

The second issue involves standard adoption, the decision to introduce a standard in a specific situation. One might argue that during this stage a standard is chosen which best fits a specific situation, yet this is not always a straightforward process.

The first problem is that choice, in some cases, may not be determined by decision-makers, but by the external environment. These external forces vary; for example a standard may become dominant in a given domain (e.g. the HL7 standard concerning clinical data interchange), or its use may be required by law (e.g. the EDINE standard used to exchange data between energy market participants in the Netherlands). The choice of such a standard is easily justifiable: staying in business requires adopting a given standard, while not adopting it results in a loss of competitive advantage.

The second problem is that when decision-makers have choices, they sometimes fail to understand to what extent a chosen standard suits their specific situation. As Söderström (2004) finds, user organizations often do not know how standards work or what they can do for them. Instead, they outsource standards activities management to others (e.g. consultancy firms). This may occur for several reasons. Decision makers usually work with informal and high-level requirements and models. In contrast, standards come in complex specifications and exhibit fine details. In many cases, standards include the level of detail and formality needed to implement the standard in a computer system, while lengthy message specifications often mask the model behind the standard. In this respect, practitioners cannot easily understand what a standard offers for a specific situation.

Both practitioners and researchers experience difficulty understanding what a standard may offer. Next we discuss the research community's difficulties in understanding standards.

2.3.4 Difficulties understanding a standard

Researchers working on standards still struggle to order and understand existing standards. Though the need for understanding is urgent, there is still a long way to go to achieve the level of understanding needed to actually reason to what extent a standard suits a specific situation. Below we present some examples of attempts to provide high-level frameworks for classifying different types of standards. Although they provide direction about how to think about standards, they remain too high-level to enable performing fine-grained evaluations. Here we present some examples of classifications, an attempt to illuminate the types of existing standards as well as to outline what types of standards are needed.

One method for distinguishing between standards is to differentiate horizontal from vertical (Markus 2003). Horizontal standards, applicable in many domains, include telecommunication protocols and XML. Although applicable across different domains, these types of standards remain limited in supporting complex communication. Specifically, they do not embody the domain knowledge necessary for this type of communication. In contrast, vertical standards are only applicable in a specific domain. Examples are the HL7 standard for clinical data interchange and the SWIFT standard in the financial industry. Although domain standards are applicable only within a specific domain, their added value lies in their ability to capture the specificity of the communication, the particular language, for a domain (e.g. the HL7 standard denotes terms such as specimen and patient). In the field of business information systems it is more interesting to deal with domain standards, as they aim to cover aspects of the business communication in a specific domain. Although it can be theoretically helpful to think in terms of domain and domain-independent standards, in practice this distinction is not always clear-cut. The problem being that

domain standards often include technical details better suited to be covered by domain-independent standards.

Another attempt to categorize standards is presented in the VIZI report (Stegwee 2001), as shown in the table below.

Category	*Description*	*Sample question in healthcare*
Method	A common way of thinking, working, and modelling during the development or use of an artefact.	How do I define a communication interface between two systems?
Meta-model	A generic description of the domain, to be used in projects that adhere to a chosen method.	Which generic functions can be discerned in the architecture of a communicating computer-based patient record system?
Concrete model	A specific description of the interactions and data to be exchanged, having a one on one relationship with the relevant reality.	Which patient data is to be exchanged with respect to a patient referral from one care provider to another?
Operational standard	A detailed specification of the interactions and data to be exchanged, that can be used without further detailing or interpretation in the implementation of communication links between computer based patient record systems.	How do I exchange data between different parties and their systems?

Table 2.2 Categories of standards found relevant for interoperability of computer-based patient record systems (based on VIZI, Stegwee, 2001)

This study found international standards contributing to the interoperability of computer-based patient record systems fall roughly in four categories: method, meta-model, concrete models, and operational standards. Stegwee (2001) argues that if different organizations use the same concrete model standard, cases failing to achieve interoperability may result. Thus, achieving true interoperability requires looking at operational standards.

VIZI is an attempt to understand standards in terms of different levels of modelling which remains at a conceptual stage, lacking further grounding and justification in modelling theories. This study can be seen as an interesting starting point for further research, providing appealing ways of looking at standards types with respect to different modelling levels. Furthermore, it seems logical that to achieve true interoperability one needs to look at operational standards, as this is the level providing the specification's full detail.

One example of a further attempt in this vein is the work of Guarino et al. (2000), though we will not elaborate attempts to order the standards field. There is little understanding in this area, as shown by the recent special issue workshop of MIS Quarterly, resulting in frameworks and classifications helpful for high-level analysis yet lacking the depth needed to understand the suitability of a standard for a particular situation.

In the field of standardization, most research focuses on how standards develop, adoption decisions, types of existing standards, and those needing further development. Like Söderström (2004), we found there is little research in the area of standard implementation and even less on how to evaluate the fit between requirements of a specific situation and a standard. Even when appraising recent calls for papers we see that only recently, almost four years after this research began, attention is slowly moving towards implementation (where one confronts the requirements of the situation with the capabilities of a chosen standard).

Due to the limited body of knowledge in this direction, we found it difficult to locate mature research addressing the problem. One relevant piece of work is the study of Lagendijk & Stegwee (2001), which attempts to go beyond the simple classification of standards, while using this classification to identify the fit between the standard and a specific application (software system), upon which the standard is to be implemented. Within this study, a Framework of Health Information Standards is provided. The framework defined by Lagendijk & Stegwee (2001) consists of four dimensions of standardization, where values are defined for each dimension (table 2.3).

	Dimensions			
Values	Level of acceptance	Application area	Object	User
	Institutional	Institutional	Message structure Message intention Message representation	Human
	Regional	Regional	Procedures	Machine
	National	National	Terminology and vocabulary	
	International	International	Authorization/ authentication	

Table 2.3 A Framework of Health Information Standards (adopted from Lagendijk & Stegwee, 2001)

The specified dimensions are: level of acceptance of a standard, application area of a standard, object of standardization, and user of a standard. Regarding the level of acceptance, the authors distinguish between standards with institutional, regional, national and international levels of acceptance. Concerning the application area of a standard, they identify the same categories. Within the user dimension, they distinguish between human and machine user. The object of standardization dimension is one of the most important and will be discussed in more detail.

Lagendijk & Stegwee (2001) identify the following concerning the objects of standardization: messages, procedures, terminology and vocabulary, and authorization/authentication. Within the "message object", a further distinction can be made between message structure, intention and representation. The message structure refers to the elements included in the message and their internal relationships. The message intention defines what the purpose of the message is. The message representation refers to the format of (parts of) the message. Standard procedures are meant to increase the quality of care. Standard terminology and vocabulary are used to clarify definitions. Standardization of authorization is related to the issue of privacy and is deals with who has the right to access medical information.

The use of such a framework becomes more interesting when applied to identify the fit between an application (software system) and a standard, or a combination of standards. The interesting thing about the Framework for Health Information Standards is that it provides some common dimensions (and values for each dimension), which can be used as a common point of reference when evaluating the fit between the needs of an application and a standard. The needs of a Lab application are matched against the characteristics of standards in Table 2.4.

In this case it is clear that using only one of the standards (the HL7 standard) would not be sufficient to cover the needs of the application. Thus, there is the need for additional standards (LOINC and metric), which can be used in combination to fill the gaps. This illustrates that even very abstract concepts can be useful to identify mismatches between the needs of an application and a standard.

Although the idea of defining dimensions with respective values and using them to express both the needs of an application and the capabilities of the standard seem very interesting, the work of Lagendijk & Stegwee (2001) is limited in several respects. Although the authors look at an organization as a combination between people, processes and technology, in the analysis they

focus only on the communication between applications without elaborating how this automated communication is embedded and related to the broader communication context between organizations as socio-technical systems. Though communication standards can help disparate computer systems to communicate in the example, as specified in the table above it is illustrated how a standard is mapped against one application only, rather than against the communication requirements with respect to the two applications.

Application	**Dimensions**				**Limitations**
	Expected need for acceptance	Application area	Object	User	
Lab	Regional	Regional	Message ▭ Structure ▭ Intention ▭ Representation Terminology	Machine and Human	Medical content
HL7	International	Institutional	Message ▭ Structure ▭ Intention	Machine	Hospital processes
LOINC	National	Regional	Terminology	People	Orders
Metric	International	International	Message ▭ Representation	People	Measurements
Standard	**Level of acceptance**	**Application area**	**Object**	**User**	

Table 2.4 Matching application requirements and the capabilities of standards

The point here is that even in research communities it is still unclear what types of standards exist and what they have to offer. Research that can elucidate to what extent a standard is suitable for a specific situation is scarce, and appears undeveloped and limited when available. As there is very little understanding in the research communities of how to evaluate what characteristics a standard has and how one can evaluate to what extent a standard is suitable for a particular situation, it is not surprising that such issues are difficult for practitioners. Since standards and their use are poorly understood, this can lead to situations where even if there is a choice for a standard, a decision can be made without having a clear idea to what extent that standard is suitable for that particular situation.

2.3.5 Implementation and usage stage

The implementation stage is the stage when the standard is actually introduced in the organization.

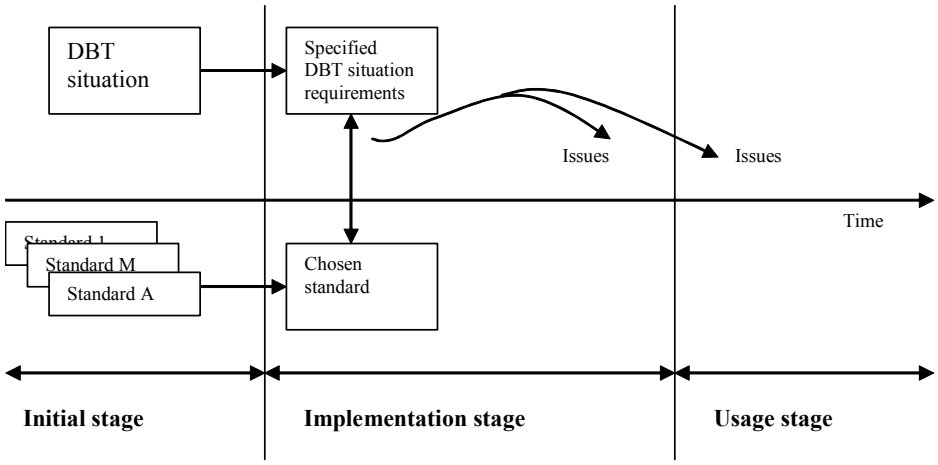

Figure 2.4 Implementation and usage stage

As discussed in section 2.3.1, during the initial stage the DBT situation is defined (i.e. a decision is made concerning the to-be automated communication), the requirements concerning the DBT situation are specified, and a choice of a standard is made. During the implementation stage, decisions taken during the initial stage are executed. During this stage, practitioners are confronted with the specified DBT situation requirements and the chosen standard. The implementers are confronted with the requirements of the specific situation where the standard needs to be introduced on the one hand, and with the chosen standard on the other. The confrontation between the DBT situation requirements and the standard is illustrated by the arrow between the specified requirements and the standard.

The usage stage is the stage when the standard is actually used to carry out parts of the automated business communication. This is the stage in which the implemented standard would need to support the way of doing business.

Due to insufficient understanding of the characteristics of the standard, it is difficult to reason about the fit to the specific situation at the early stages of implementation. The result is that many issues are detected throughout the implementation and even at the usage stage which may be very costly to resolve. For example, during the usage stage the business parties may discover that the products are not delivered to the right customer, or not delivered at the right place, or the wrong product is delivered. This would be especially damaging if the errors in the communication between the applications affected a large number of customers. Apart from the reputation of the business parties being negatively affected, it may also be very costly to go back and change already implemented systems.

From the IS literature it is known that the costs in terms of time and money needed to fix errors discovered at a later stage of a project are enormous compared to those needed if the same error had been discovered earlier. In that respect, we consider early problem identification also important in the specific context of standard implementation.

In the next section, we provide further insights concerning problems identified during the implementation and the usage stage.

2.3.6 Problems with the implementation and usage stage

Project failures are not rare in the development of information systems. As Block (1983) states: "If I define a successful system as one that is developed on time and within budget; it is reliable (bug-free and available when needed), and maintainable (easy and inexpensive to modify); meets its goals and specification requirements; and satisfies the user, how many of you would say that your organization has successful systems? I have asked this question to hundreds of people at all levels of data processing and the overwhelming response is one of silence".

This observation from the 1980's is still valid (Sauer 1999; Standish Group 2001). Standard implementation projects are no exception. In the context of EDI, Bergeron et al (1994) state: "Realizing the promises of EDI is neither automatic nor easy to achieve. Many firms indicate that they have not benefited from implementing EDI, and that they have been in fact disadvantaged by it." Previous studies report numerous issues related to standard implementation (Kubicek 1992; Parker and Case 1993; Bergeron, Raymond et al. 1994; Söderström 2003). A well functioning standard-based e-business system takes time to implement. It is also associated with high costs and business integration is not as smooth as desired or promised. Some of the reasons for the long implementation time and the high implementation costs in the context of EDI standards like EDIFACT are that the standards are too general in its form, i.e. they try to cover too much at a high level. The result is that there are too many options and variants and that

organizations use only part of it. One of the reasons the standard implementation projects end up in solutions different from what was desired or promised is due to the failure to account for the specific situation. Huang (1998) further argues that the focus of many practitioners involved in standard implementation projects is how to pass messages from one computer system to another, rather than how to support the way of doing business. The result of such a project is a system which after some efforts can work technically but the business benefits of it often remain unclear. The failure to consider the business consequences of a standard implementation project has led to systems with unclear value and even project failures.

Based on the discussion above, we can distinguish between problems related to implementation of the standard itself and its capability to automate the message exchange between computer-based systems, and problems which relate to the actual support the system provides for the method of doing business. In the next section we further elaborate these notions by discussing technical and inter-organizational interoperability.

3. Technical and inter-organizational interoperability

3.1 Technical interoperability

Experience with the EDI standards and observations concerning the implementation and use of the new standards illustrate that in a business transaction setting, it is not enough to exchange messages between computer systems. What is needed is to communicate the correct information and take the required actions to achieve the goal of the business transaction. This means that achieving technical interoperability is not enough; inter-organizational interoperability is needed.

Let us first introduce the notion of interoperability. As a starting point for our discussion on interoperability we choose to use the definition of IEEE (1990). Interoperability is defined by IEEE as, "the ability of two or more systems or components to exchange information and to use the information that has been exchanged". We would like to focus the attention on the notion of "systems or components", which are to exchange and use the information. Within this definition, system seems to be implicitly defined as a purely technical system.

The idea of technical interoperability within the context of business transactions is illustrated in figure 3.1.

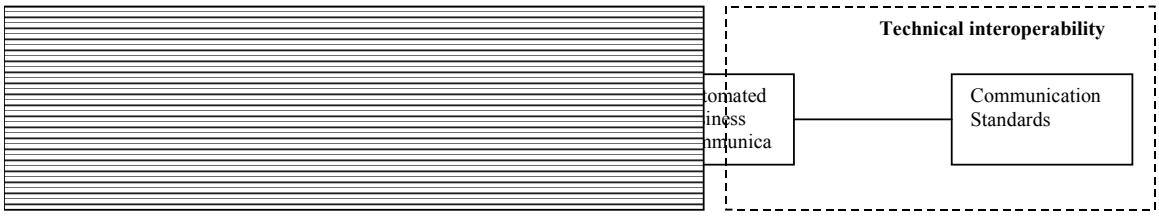

Figure 3.1 Technical interoperability

Some degree of automation, as well as interoperability between the computer systems, can be achieved purely by implementing standards. However, how and to what extent the automated communication achieved after the implementation of the standard covers the to-be automated communication, remains unclear. It is not considered what the consequences of possible mismatches on the way of doing business will be. Such a situation can occur when, for example the specified DBT requirements are related only to the information exchange between computer systems.

In a business transaction setting however, it is not enough to have systems exchanging messages; it is necessary for the automated communication to become an integral part of the business

communication, which ensures the proper execution of the transaction (e.g. the customer receives the good that he ordered). In this case, the definition of a system as only a technical system is too limited.
Before elaborating how to expand the notion of a system, we will first introduce some ideas from organizational semiotics, to provide a deeper understanding of business communication and the role of standards.

3.2 Business communication: a semiotic perspective

3.2.1 The semiotic framework

To be able to further reason about business communication, we will make use of some ideas from the area of organizational semiotics.

Semiotics is the study of signs. Organizational semiotics uses and further develops some ideas from semiotics in an organizational context. One of the fundamental ideas in organizational semiotics (Stamper 1996), is that organizations communicate by using signs. For a sign to have any meaning it needs to be interpreted correctly at six different levels: physical, empirical, syntax, semantic, pragmatic, and in the social world. These levels are represented in the so-called semiotic framework (figure 3.2).

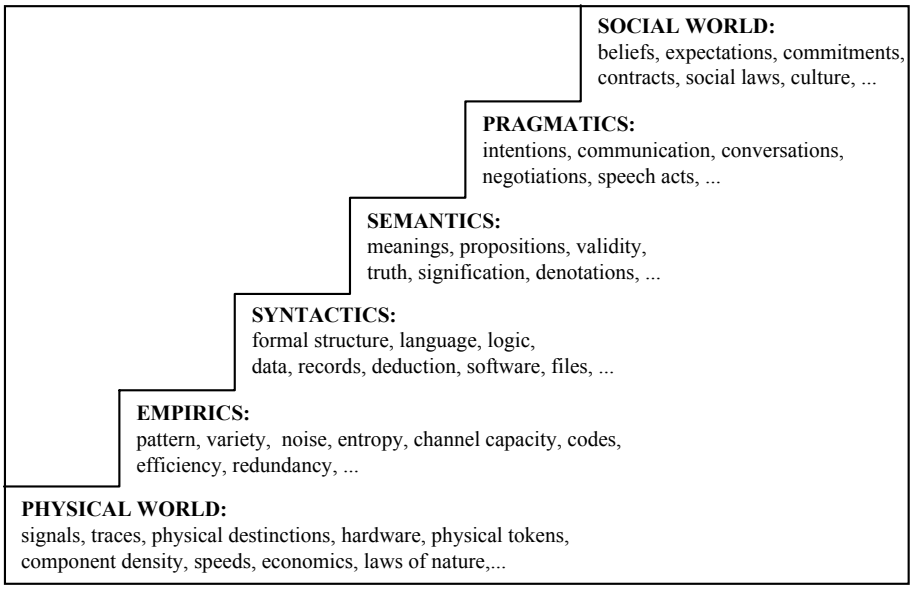

Figure 3.2 The semiotic framework

The physical world addresses the physical means to produce, store, and transmit signs. The empirical level addresses issues such as noise and capacity of the channel. Syntactics is concerned with formal structures of complex signs and how to manipulate them. The semantic properties of signs deal with the meaning in the special sense of how signs relate to reality, how they represent, designate and signify things. The pragmatic aspects of a sign refer to the intention that the sign carries. Finally, the social level is the level where the social effect of the conversation becomes visible. This is the level which refers to beliefs, expectations, commitments, and determines the social norms which regulate the rules of behaviour when receiving a sign.

When applying the semiotic framework in the context of EDI, Stamper refers to the lower three layers of the semiotic framework as IT infrastructure and to the upper three layers as human information function. It is further argued that with some efforts, standards are successful in covering the physical, empirics, and syntactic levels of business communication but fail to address

the more difficult issues of semantics, pragmatics and the social world. In that respect, the upper three levels that refer to the human information function are more interesting to study.

The observation that issues related to the human information function are more interesting to study is very important, as it allows us to delimit the types of issues. Within this thesis we are mainly interested in issues related to the human information function, in other words issues that may cause misunderstandings at the semantic, pragmatic, or social world level, and which may ultimately hinder the execution of the business transaction.

3.2.2 The information flow and information field paradigms

The distinction between IT platform and the Human information function is also important from another point of view; it provides the grounds for switching ontological and epistemological assumptions when studying business communication.

Two major views can be defined concerning ontological assumptions: the objectivist and subjectivist view (Burrel and Morgan 1979). According to the objectivist's view, there is objective reality and people can directly access it. The essence of the objectivist position is, "(to) apply models and methods derived from natural sciences to the study of human affairs. It treats the social world as if it were the natural world" (Burrel and Morgan 1979). Subjectivists deny the appropriateness of natural science methods for studying the social world. "The principal concern is with an understanding of the way in which the individual creates, modifies, and interprets the world in which he or she finds him or herself (Burrel and Morgan 1979). Falkenberg et al. (1998) argue that in the information system field, there is the problem that many of its representations are subject to personal interpretation. The authors further state that no one doubts that one may record meaningful data regarding stocks, orders, tasks and academic achievements but that numerous "facts" in society only hold true because they have been agreed. Searle (1969) says these might be considered "institutional" facts, which only concern "reality" to the extent that they resulted from some societal negotiation. Social reality is essentially "constructed" (Searle 1995), and the same applies to that which makes up "information".

Stamper (1992) argues that the objectivist view can be suitable when addressing the IT infrastructure (or the physical, empirics, and syntactic levels), but when it comes to the human information function one needs to adopt a constructivist's view. The meaning of information depends on the social context in which it is interpreted and the same information can be interpreted differently in different contexts. Within a given community, people create a shared understanding about their world; they create a shared understanding about how to perceive and conceive the world in their minds and how to represent it using signs. Taking an objectivist view will not allow studying these contextual differences essential for understanding the human information function.

Stamper (1992) also makes a distinction between the information flow and information field paradigms. Within the information flow paradigm, an information system collects, processes, and stores information. Information field paradigm defines an organization as a real information system in which people communicate by exchanging signs. Meaning of the signs is socially constructed and can be interpreted correctly only within a given context where people share the same norms on how to understand, interpret, and act upon them. In the information field paradigm organizations are seen as the real information systems in which participants communicate through signs to coordinate their actions and achieve organisational objectives. Stamper argues that organisations have many layers of information systems but three are very important: the informal IS layer, the formal IS layer, and the technical IS layer (Stamper, 1996).

The informal IS layer is the most important; in this layer culture plays an important role. This is where meanings are established, intentions are understood, beliefs are formed and commitments with responsibilities are made, altered and discharged (Stamper, 1996).

The second layer is the formal IS layer. This is where form and rule replace meanings and intentions. This becomes important if tasks become routine and repetitive. The formal IS layer plays a valuable but limited supporting role to the informal IS.

The last layer is the technical IS layer. The technical IS system is the automated part of the formal IS system and the technical IS layer plays a limited supporting role with respect to the formal IS layer.

We schematically represent the three layers below. We also illustrate that the technical IS provides limited support with respect to the formal IS and the formal IS in its turn provides a limited support to the informal IS.

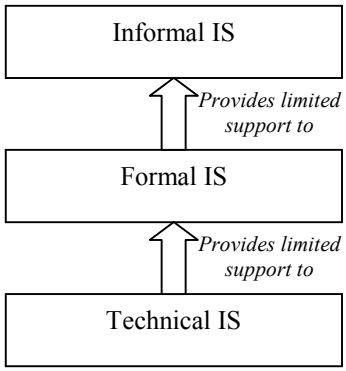

Figure 3.3 Layers of information systems

Stamper (1996) also argued that intelligence, knowledge, and meaning are more appropriately regarded as products of a social and informal system. Any formal system we are likely to create is trivial in complexity compared with the encompassing social system that uses it. He continues that only by correctly embedding the computer-based system in the social system can the data it contains have any meaning, express intention, represent knowledge or support intelligent behaviour. In other words, the fact that a computer system functions with technical perfection does not guarantee that it will do anything valuable for a business. Thus computer-based systems only have a value to a business in so far as they embody solutions to problems belonging to the social domain.

3.3 Towards inter-organizational interoperability

Let us return to the concept of interoperability. Viewing a system as only technical is too limited and needs to be expanded to a socio-technical system (Stamper 1996; Warboys 1999; Mykkanen 2003). With this broader view of system, the definition of interoperability can be extended to inter-organizational interoperability (Stegwee 2003).

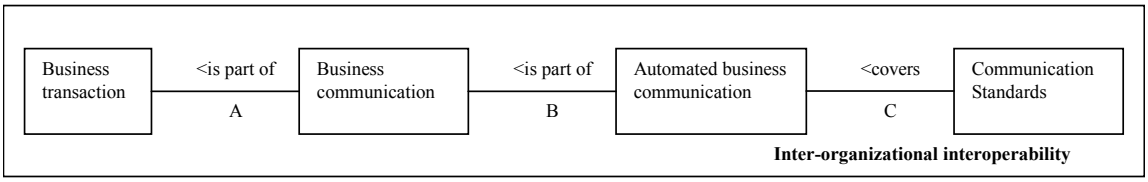

Figure 3.4 Inter-organizational interoperability

In that respect we define inter-organizational interoperability as the ability of two or more socio-technical systems to exchange information, to interpret the information that has been exchanged and to act upon it in an appropriate and agreed upon manner. We consider that inter-organizational interoperability is needed, where the automated communication becomes an integral part of business communication, and in return supports the execution of the business transaction. This idea is schematically represented in figure 3.4. In the next section we elaborate on business communication and the role of standards.

3.3.1 Elaboration on business communication, automated business communication and the role of standards

The major challenges of business communication, as discussed earlier, refer to the human information function (including semantics, pragmatics and the social world); in order to deal with these issues we need to acknowledge that meaning is socially constructed. Let us consider a situation where several companies need to communicate to support the execution of a business transaction. Each company operates in its own context. As argued in the literature however (Stamper 1996; Vermeer 2000), business parties need to establish a shared context in order to interpret the signs that are exchanged and act upon them in a meaningful manner.

Figure 3.5 provides a simplified case where only two parties need to interact. Each company can operate in its own context but if the two companies want to communicate they need to establish a shared context. We have further indicated that the shared context can be explicit or implicit.

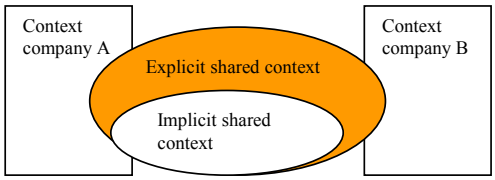

Figure 3.5 Business communication between two companies

In case the parties decide to automate parts of this business communication, this means that some of the business communication traditionally done by humans will have to be embedded in the computer systems (figure 3.6).

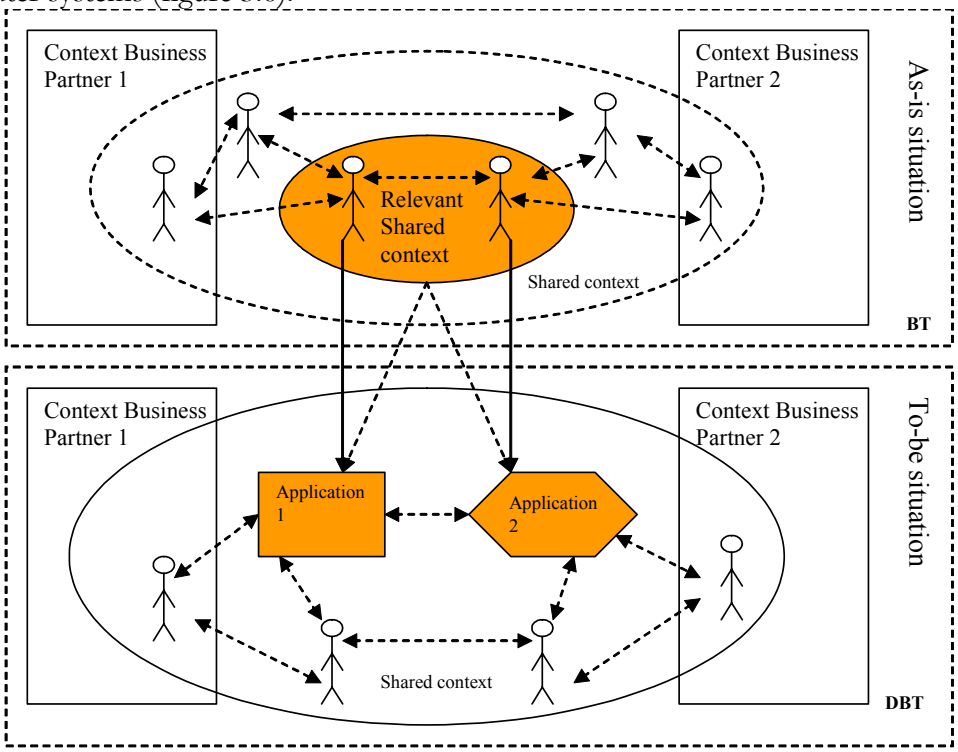

Figure 3.6 Taking the relevant shared communication context to the application level

This means that the relevant shared context[3] needs to be captured and made explicit, before embedded in the computer system, so that the systems become an integral part of this context (see section 3.2.2). The systems will then be able to communicate meaningful information to one another as well as to the human participants in this context; the two socio-technical systems can work together towards a common goal (in our case the execution of a business transaction).

How to arrive at such a shared context is out of the scope of this research. However, even if one is able to make the relevant shared context explicit, this context will need to be formalized in order to be embed it into the computer systems. Formalization is not a deterministic process with a fixed outcome. Even by applying the same formal modelling method the outcome may vary and one needs to have a one-to-one relationship between the relevant shared context and its shared formalization. In that respect operational standards may be helpful.

Here we refer only to operational standards; Stegwee (2003) points out that to achieve true interoperability one needs to consider standards at the operational level which contain full detail and formalizations. The reason to focus on operational standards rather than other high-level standards is that the high-level standards would need to be further operationalized and formalized, which may lead to differences in the formalization and operationalization, and this may hinder interoperation.

Let us assume a decision is made to adopt a certain standard to facilitate the electronic execution of a part of a business transaction and a standard-implementation project is undertaken. As discussed in section 2.3.2, practitioners are confronted with a chosen standard and a given DBT situation during the standard implementation. As discussed in section 2.3.4, various factors and pressures can lead to a decision to adopt a standard. As the standard is usually developed outside of the situation where it is to be applied; there can be mismatches between the requirements of the DBT situation and the standard. This means that it is possible that the standard is unable to cover all the elements of the relevant shared context. This idea is illustrated in figure 3.7 and 3.8.

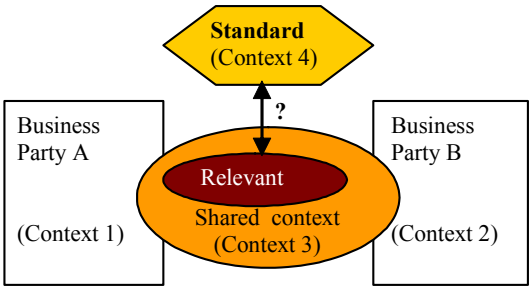

Figure 3.7 Fitting standards to the shared communication context (general)

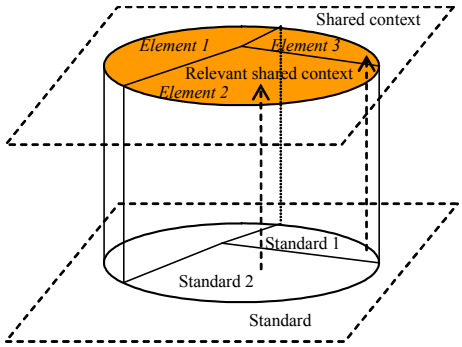

Figure 3.8 Fitting standards to the shared communication context (detailed)

Figure 3.7 illustrates two business parties which operate in their own context and which have established a shared context in order to be able to do business. The relevant shared context is the context which business parties would like to automate. It is illustrated that a chosen standard is to be used for achieving this automation.

Figure 3.8 illustrates the relevant shared context and the standard. It illustrates a situation where a standard can cover some elements of the requirements of the relevant shared context but fails to

[3] Not the whole communication context of the business transaction needs to be made explicit; only the shared context of those people involved in the transaction whose roles need to be replaced by disparate applications. This context we call the relevant shared context.

cover others. Even if some automation is achieved with the use of standard, part of the business communication will be disturbed due to these mismatches. Such disturbed communication can lead to communication problems between the business participants and in the worst case problems with the execution of a business transaction. Examples of such problems can ultimately lead to situations where the customer does not receive the good/service ordered or the delivery is late, which would mean financial penalties for the supplier.

When we want to embed a computerized information system in a social context we also need to address the issue of completeness and formality of the specified requirements of the relevant shared context. This will be briefly addressed in the next section.

3.3.2 Conceptualization and mapping

It has been argued in the information systems development literature[4] that there are two general problem-solving techniques during development: conceptualization and mapping (Brinkkemper 1990). As defined by Brinkkemper, *conceptualization* is the creation of a complete and formal system specification starting from informal rough specifications and *mapping* is the transformation of the specifications on a conceptual level (i.e. without presentation and implementation details) to the machine executable specifications.

The figure below (Hesse 1983; Brinkkemper 1990) depicts development as a pathway in a two dimensional area.

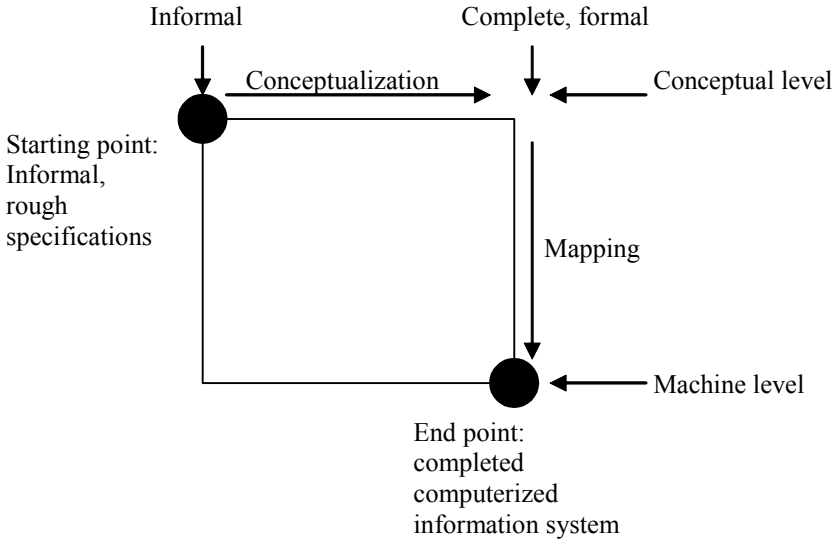

Figure 3.9 Conceptualization and mapping (adapted from Hesse 1983; Brinkkemper 1990)

The starting point of the development process is the informal rough specifications and the end point is the completed system, including hardware and software. Brinkkemper (1990) argues there are many possible ways between these two points but the recommended or ideal way is to separate conceptualization and mapping activities completely. In terms of figure 3.9 this means that first the upper line is followed to the complete, conceptual, and formal specifications and thereafter follows the right line, which means the mapping of these specifications to the machine level via some transformational steps. As the discussion above suggests, the ideal method when developing computerized information systems is to start from rough and informal specifications and through conceptualization reach complete and formal specifications, which afterwards will be mapped to the machine level.

[4] Here the information system is referred to as only the computerized information system.

Let us now reason what happens when operational standards are used. As mentioned earlier, standards are often developed outside of the situation where they are applied. Operational standards provide the detail needed to be embedded in a machine level. This means that it is easy to embed the standard in the computer system directly without having to specify the complete and formal requirements of the specific situation. This hides several dangers. If the complete and formal specification of the requirements is missing this means that the requirements of the relevant shared context have not been fully captured and it will be difficult to compare the requirements and the standard and identify potential gaps between them.

3.3.3 Where to look for inter-organizational interoperability problems

Let us return to the picture linking business transaction and business communication and try to relate the elements with the discussion from the previous section. Recall that the business transaction aiming at exchange of good/service for some compensation, is supported by business communication.

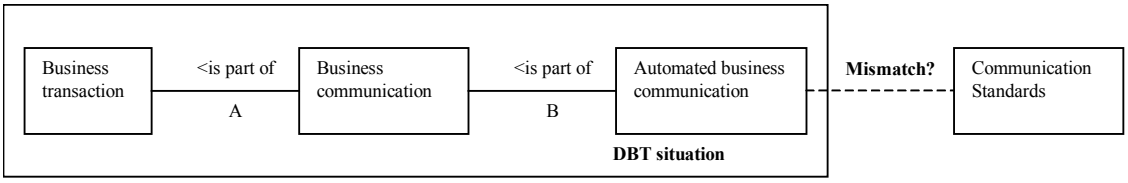

Figure 3.10 Inter-organizational interoperability problems

According to organizational semiotics the parties that need to communicate with respect to that business transaction need to establish a shared context, which can be explicit or implicit. Figure 3.7 shows a simplified example where only two parties are involved in. The relevant shared context is only that part of the shared context which is related to the to-be automated business communication. The relevant shared communication context needs to be made explicit and formalized by the use of standards before being embedded in the computer systems. A mismatch between the relevant shared context and the standard (figure 3.8), would mean that this standard will not be able to fully cover the to-be automated business communication. This can disturb the whole business communication and negatively affect the execution of the transaction. As illustrated in figure 3.10, one important check is whether there are mismatches between the DBT situation and the standard.

Let us go back to figure 2.4, which we discussed in section 2.3.5. Figure 3.11 below is similar with the difference that the DBT situation, the specified DBT situation requirements and the chosen standard are now shaded. We have also specified that in terms of the semiotic framework, we are interested in issues related to the human information function and are not interested in the technical IT platform.

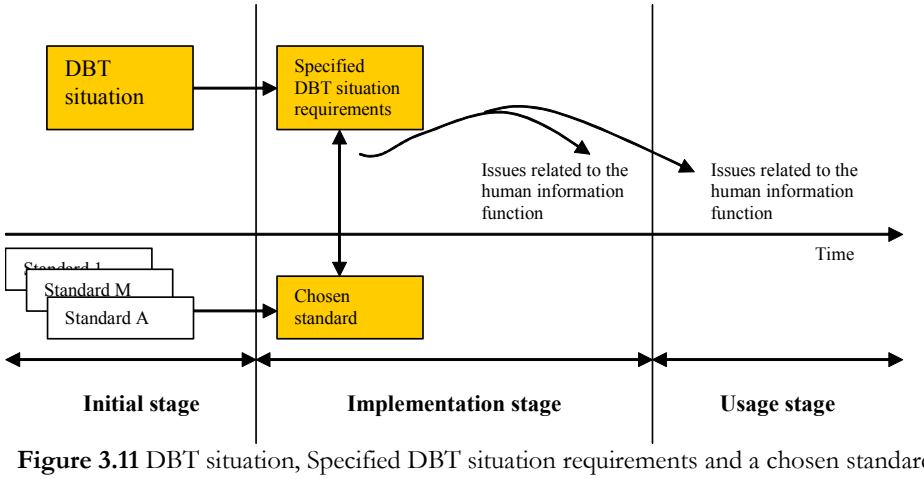

Figure 3.11 DBT situation, Specified DBT situation requirements and a chosen standard

The reason to return to this figure is to illustrate some of the constraints with which people will need to work in the implementation stage. To be able to understand the complexities involved, figure 3.12 zooms in on these three components and the relationships between them.

Here we represent the direct relationship between the specified DBT requirements and the chosen standard (relationship 1) and the direct relationship between the specified DBT requirements and the DBT situation (relationship 2) with solid lines. We illustrate the indirect relationship between the DBT situation and the chosen standard (relationship 3) with a dotted line.

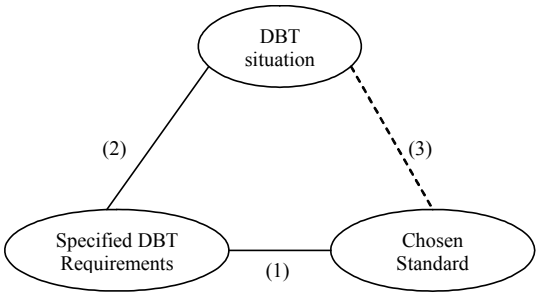

Figure 3.12 DBT situation, Specified DBT situation requirements and a chosen standard and their relationships

Although to achieve inter-organizational interoperability it is important to make sure that the chosen standard is properly embedded in the DBT situation, reflected in relationship 3, in practice it is very hard to reason directly and compare the DBT situation and the chosen standard. That is why we will study relationship 1 and 2, and based on that we will make inferences about relationship 3.

During the implementation phase of a standard implementation project, practitioners are constrained with specified DBT Requirements and a chosen standard. We have argued that it is usually hard to evaluate what a chosen standard has to offer (see discussion in 2.3.4). In that respect, it is difficult to compare the specified requirements of the DBT situation with the characteristics of the standard and identify possible mismatches and potential problems at early stages; explicit conceptual models behind the requirements and the standard are often missing. It then becomes even more difficult to reason and compare the requirements and the standard. One of the areas where we can look for potential problems is the relationship between the specified requirements and the standard.

As discussed in section 3.3.2, there can be situations, where the specified DBT requirements do not provide complete and formal specification of the DBT requirements. Another area where we can look for potential problems is in the relationship between the DBT situation and the specified DBT situation requirements.

It is difficult to reason directly about the relationship between the chosen standard and the DBT situation; if potential problems are identified in the previous two cases by inference, this will signal potential problems concerning the relationship between the DBT situation and the chosen standard.

4. Research problem

We argue that even though practitioners in standard implementation projects are confronted with given requirements and a given standard, early identification of issues that can occur during the implementation and usage stage in a standard implementation project are important. The issues here are issues related to the human information function as discussed by Stamper; issues that may lead to misunderstanding on a semantic, pragmatic, and social world level and may hinder the execution of the business transaction. If such issues are identified at the early stages of standard implementation projects, this will allow business managers to take proactive measures. The idea for early problem identification is represented in figure 4.1.

Early problem identification can have several important implications. It will provide a basis for awareness at an early stage of the standard implementation project, and identify what issues might occur in the course of the project. Why is awareness important? When the problem is clearly identified, additional measures can be taken, together with the implementation of the standard, to overcome these issues. Knowing that a problem will occur and taking measures at early stages can reduce the number of reworks, which can ultimately affect the cost and time associated with the project.

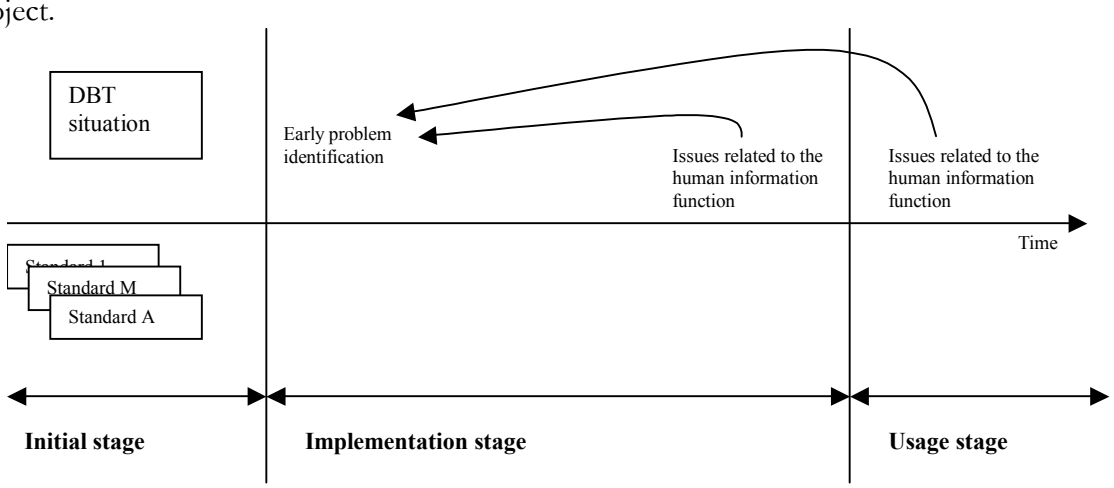

Figure 4.1 Early problem identification

A situation specific mechanism is needed to reason at an early stage of a standard implementation project what kind of issues might occur with the use of the standard in a specific situation. This leads to our main research problem, formulated in the following section.

4.1 Main research problem

The main research problem that we will address in this thesis is:
How does one identify at an ***early*** *stage of a standard implementation project, potential problems with the execution of a business transaction that can occur when deploying a standard in a specific DBT situation?*

Before proceeding, we would like to outline some limitations regarding the research problem. We have already elaborated these limitations in the earlier sections; we provide a short summary below.

4.1.1 The goal of the standard implementation project

It is important to note that in the context of business-to-business transactions, a standard implementation project needs to aim to achieve inter-organizational, rather than technical interoperability.

4.1.2 The standard

If we want to achieve true interoperability, it is necessary to analyze standards at an operational level; operational standards will be focus of our research. We have also made a distinction between horizontal and vertical (or domain specific) standards. Within this research we focus on vertical standards, as these are paramount for achieving interoperability between organizations (section 3.3).

4.1.3 Potential problems

With respect to the potential problems from the point of view of the semiotic framework, we are interested in those problems that refer to the human information function (semantics, pragmatics,

and social world), rather than problems related to the IT platform (physical, empirics, syntax). We are interested in those types of problems which refer to either the DBT situation, the specified DBT requirements, the chosen standard, or the relationships between these elements. Apart from that, we are interested in tracing the impact these problems can have on the execution of the business transaction.

4.1.4 Problem identification rather than problem solving

It is important to notice that we would like to focus on problem identification. Understanding the problem is the first step towards finding an appropriate solution. We focus on this initial step. We consider that it important to create awareness about potential problems. Once aware of the problem, the companies, depending on the specific situation and policy, can consider different alternatives for addressing these potential problems. It is out of the scope of this research to provide solutions for the identified problems.

4.2 How to approach the research problem: initial insights

In the previous section we formulated the following research problem: *How does one identify, at an **early** stage of a standard implementation project, potential problems with the execution of a business transaction that can occur when deploying a standard in a specific DBT situation?*

In section 3.3.3 we made an explicit distinction between the DBT situation and the specified DBT requirements; to facilitate the discussion we will repeat figure 3.3.9 (figure 4.2 below).

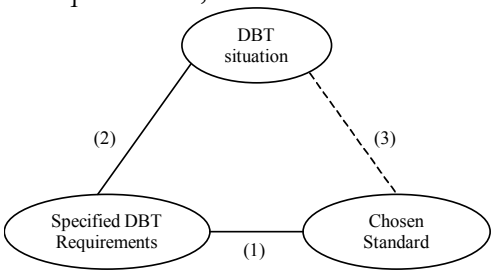

Figure 4.2 Explicit distinction between the DBT situation and the specified DBT requirements

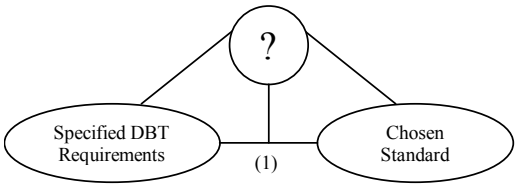

Figure 4.3 No distinction between the DBT situation and the specified DBT requirements

Although we will come back to this distinction later in this chapter, for reasons of simplicity let us assume that the specified requirements are a complete representation of the requirements of the DBT situation. What is then needed is a mechanism to reason about the specified requirements, the chosen standard, and to compare the two (see figure 4.3).

4.2.1 Ideas from ontology

When we look at the area of information systems, we can say that conceptual modelling has been widely used for identifying, analyzing and describing the essential concepts and constraints of a domain. "Conceptual modelling focuses on capturing and representing certain aspects of human perception of the real world so that these aspects can be incorporated into an computerized information system"(Wand, Storey et al. 1999). Conceptual modelling is done with the use of modelling languages that define how to look at the world and what to model. Meta models of the modelling languages contain the basic concepts of how to look at the world.

It is argued that the meaning of all conceptual modelling concepts needs to be articulated within the context of the theory of ontology (Wimmer 1992; Guarino 1995; Ashenhurst 1996; Wand, Storey et al. 1999). Ontology is "that branch of philosophy which deals with the order and structure of reality in the broadest possible sense" (Angeles 1981). Ontological modelling captures the relevant entities of a domain using an ontology specification language based on a small set of basic, domain independent ontological categories, forming an upper-level ontology (Guizzardi,

Herre et al. 2002). A number of researchers illustrate the evaluation of a conceptual modelling languages' power via ontologically based concepts (Weber and Zang 1996; Wand, Storey et al. 1999).

As we are trying to identify concepts to help us understand and reason about differences and similarities of the conceptions of different contexts (see figure 4.4) we consider that the idea behind the foundational ontologies can be very useful for our purposes. The idea used for evaluating conceptual modelling languages is to compare them against concepts from foundational ontologies, which serve as a reference point.

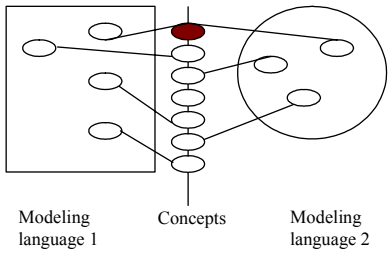

Figure 4.4 Comparison based on concepts from ontology

The main value added of this approach is that it uses concepts, which serve as a common base for comparison.

4.2.2 A return to the research problem

Based on the discussion in the previous section, we can say that if we have a system of concepts, which contain some common elements concerning the specified DBT requirements and the chosen standard, we can use this system of concepts to in reasoning about both the specified requirements and the standard, as well as compare the two. (see figure 4.5.). In this research we consider concepts abstract entities determining the ontological view of the "world", i.e. providing a way of looking at the phenomenon under study (based on Falkenberg et. al

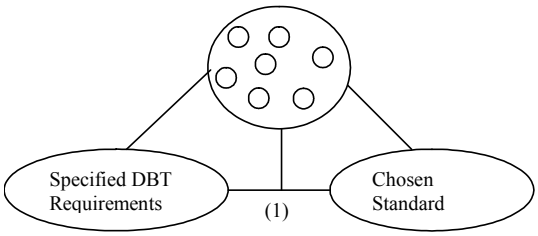

Figure 4.5 Comparison between the Specified DBT requirements and the chosen standard using a system of concepts

.). We define a system as "any entity, conceptual or physical, which consists of interdependent parts"(Ackoff 1960). In this respect, the system of concepts provides us with interrelated abstract entities, offering a common language to reason about the specified DBT requirements and chosen standards.

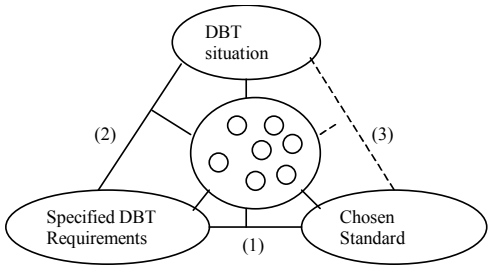

Figure 4.6 Comparison among the DBT situation, specified DBT requirements and the chosen standard using a system of concepts

Earlier, we assumed that specified DBT requirements provide a complete representation, and now we apply similar reasoning concerning the specified DBT requirements and the DBT situation. Specifically, if there is a system of concepts concerning the DBT situation and the specified DBT requirements, we can use it to reason about the DBT situation and the specified DBT requirements as well as about mismatches between the two. As a result of that, we can say that if we are able to construct such a system of concepts, we can use it to reason analytically about the DBT situation, the specified DBT requirements, and the chosen standard, as well as relationship 1 and 2 (see figure 4.6). Apart from that, to be able to use the system of concepts for an early problem identification in a standard implementation project, we will need a method how to apply this system of concepts (by method here we me "a way, technique, or process for doing

something", Merriam-Webster Online Dictionary) . This leads us to our first two research questions:

Research question 1
1. What should a system of concepts consist of in order to:
   - help in analyzing the DBT situation, the specified requirements of the DBT situation, and the chosen standard;
   - help in analyzing possible mismatches between the specified DBT requirements and the chosen standard, and between the DBT situation and the specified DBT requirements;
   - identify potential problems with the execution of a business transaction, based on the above analyses.

Research question 2
What should a method of how to apply the system of concepts consist of in order to:
- help in analyzing the DBT situation, the specified requirements of the DBT situation, and the chosen standard;
- help in analyzing possible mismatches between the specified DBT requirements and the chosen standard, and between the DBT situation and the specified DBT requirements;
- identify potential problems with the execution of a business transaction, based on the above analyses.

The first research question focuses on the construction of the system of concepts; the second focuses on devising a method of applying this system. As a result the outputs of this research, its very core, are a system of concepts and a method.

A logical step to continue is to perform thorough testing of the system of concepts and the method in empirical settings. However, we consider that it is not feasible, within a single PhD study, to perform both the construction of the system of concepts and the method and to conduct thorough empirical testing. That is why, the complete testing of the system of concepts and the method is out of the scope of this research. We do consider it feasible and important, however, to gain initial insights, checking whether the system of concepts and the method have the potential to fulfil the goals of their design, facilitating problem identification in standard implementation projects. This brings us to our third research question:

Research question 3
Can the system of concepts and the method be applied in practice and if so, do they bring any meaningful results?

This question asks, if we have a given standard, specified DBT requirements, and a DBT situation, can we analyze them using the system of concepts and the method, and does the resulting analysis point to potential problems. Research question three provides us with first insights concerning the applicability of the system of concepts and the method.

5. Research approach

Figure 5.1 outlines the major steps that we have followed throughout the process. The choices and the justification of these choices will be discussed later in this chapter and throughout the thesis. We briefly discuss the different steps below.

We began with a research problem and have used literature to further understand the problem and to formulate three research questions, which will be addressed in Part 2, 3, and 4 of this thesis. The first question relates to construction of the system of concepts. The second is concerned with construction of a method of how to apply the system of concepts. Finally, research question three is concerned with gaining initial insights about the applicability of the system of concepts and the method in practice.

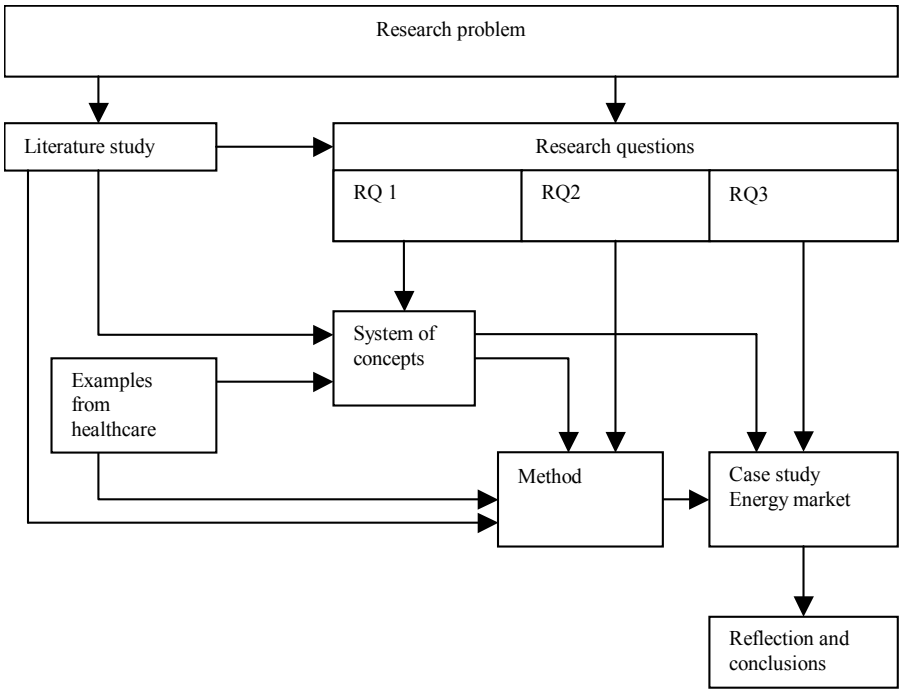

Figure 5.1 Major steps in the research process

For the construction of the system of concepts, we followed a predominantly theoretical approach using existing literature as a major input. Additionally, we have used examples from healthcare as inspiration. For the construction of the method we used the system of concepts, literature, and examples from healthcare as major inputs. To gain initial insights concerning the applicability of the system of concepts and the method in practice, we conducted a case study concerning liberalization of the energy market. Finally, we have reflected on the results achieved with respect to the research questions and problems and have arrived at final conclusions. Figure 5.1 outlines only the logic of the progress. The process that we followed includes a number of iterations between the different steps not explicitly represented for simplicity. We will now discuss key decisions that we made with respect to the construction of the system of concepts, the method, and the feasibility study concerning the applicability of the system of concepts and the method in practice.

5.1 Research approach for the construction of the system of concepts

Empirical and theoretical studies are the most common ways to classify approaches to research (Remenyi, Williams et al. 1998). As described by Remenyi et al. (1998), the research theorists study the subject through the writings of the others and through discussions with learned or informed individuals, usually without any direct involvement in observation of behaviour and the collection of the actual evidence. The theorist uses his intellectual capabilities to construct a different view of the situation, which sometimes may be regarded as a new theory. The empiricists on the other hand go into the world and observe what is happening. They study these observations and collected evidence and based on that, draw conclusions and make claims that something of value has been added to the body of knowledge (Remenyi, Williams et al. 1998).

Remenyi et al. further argue that although the two approaches are quite different, the differences are not as big as they seem. The theories used as a starting point in the theoretical studies are often based or derived from empirical evidence. Furthermore, empirical research is often conducted from some theoretical standpoint.

Now that we have addressed the two major approaches, let us go back to the construction of the system of concepts. Before making a decision, which approach to predominantly follow in the construction of the system of concepts, let us go back and reflect on the indented purpose of the system of concepts. If we go back to the first research question, we can say that the purpose of the system of concepts is to provide common grounds to reason about the DBT situation, the specified requirements, and the chosen standard. In that respect, concerning the construction of the system of concepts, one of the first decisions that we needed to make is what starting point to take and where to look for such common grounds. We considered a number of possibilities: to start from the standard, the requirements, or from the DBT situation (see figure 5.2. below).

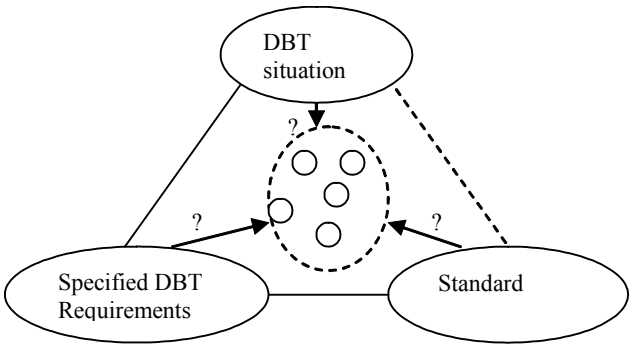

Figure 5.2 Alternative approaches for the construction of the system of concepts

5.1.1 Starting from standards

We first investigated constructing the system of concepts by analyzing different standards. In this scenario, we would take a number of communication standards, abstracting key elements covered by different standards, next identifying common elements to be used as an input for the system of concepts.

When analyzing this possibility at the beginning of this project we found it inappropriate for several major reasons. For example, standards come in complex documents including lengthy message specifications and technical details. Extracting key elements covered by the standard would be both time consuming and difficult. As argued earlier, the standards research community still debates how to understand the focus of different standards. The standards development communities also dispute the types of standards needed (Stegwee 2003). In essence, even after dealing with the complex documentation of a standard, and identifying key elements, these elements may not shed light on the requirements of the DBT situation. In this respect, we choose not to base the system of concepts on elements identified in the standard.

5.1.2 Starting from specified requirements

The second approach involved starting from specified DBT requirements. This would necessitate identifying a number of standard implementation projects, analyzing requirements documents for such projects, then deriving a number of concepts. These concepts would be used to compare the requirements and standards. At the beginning of this project we conducted interviews to identify the type of information usually contained in requirements documents, briefly analyzing some sample requirements documents. Here we found requirements often at a very high level and not thoroughly elaborated. Further, requirements are often specified with the goal of achieving

technical interoperability rather than inter-organizational interoperability. In this respect, we found this potential method unsatisfactory.

5.1.3 Starting from the DBT situation

The third alternative was starting from the DBT situation. We chose this method as both standards and requirements fail to provide a solid foundation for the construction of the system of concepts.

In Part 1, Chapter 2 we reasoned that business communication is part of a business transaction (relationship A) and that to-be-automated communication is part of business communication (relationship B). We also argued that to achieve inter-organizational interoperability, the role of standards is to formalize the to-be-automated business communication (relationship C).

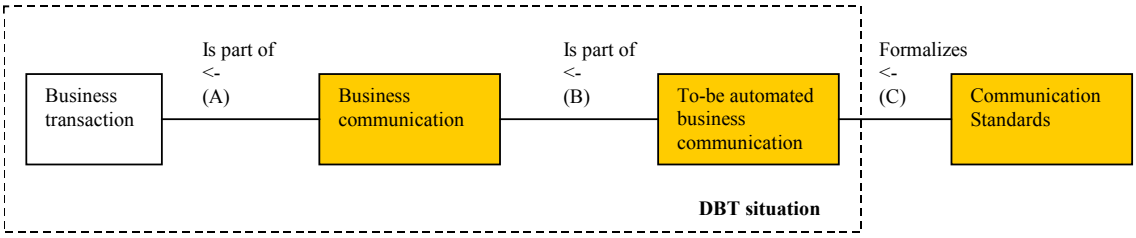

Figure 5.3 Starting from the DBT situation

Both the to-be automated business communication and the standard refer to parts of business communication regarding a particular business transaction. If we look at the figure above, we see the shaded business communication, to-be automated business communication, and communication standard. From this we can conclude that if we are able to identify key elements of the business communication, they can be used as a comparison between the to-be automated business communication and the standard. As discussed in the context of research question one, we need to have some elements that can help us reason about potential problems that may occur with the execution of the business transaction. This means that apart from key elements describing business communication as such, we also need to identify key elements of a business transaction and how they relate to business communication.

Based on the discussion above, we consider that elements that refer to the business transaction and business communication can provide a basis for the construction of the system of concepts.

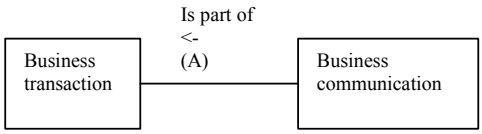

Figure 5.4 Business transaction and business communication as a basis for the construction of the system of constructs

So far, we have tried to reason about the different alternative starting points that we can use for the construction of the system of concepts. As we have argued earlier, neither starting from standards, (which are still very difficult to make sense of) nor from the requirements (which are often high-level and incomplete) seemed attractive options. Starting from the DBT situation seemed to be an attractive alternative, as following this approach we concentrate on understanding business transactions and business communication. Business transactions and business communication have been studied for years from different research communities; there is a rich body of knowledge, which we can investigate to understand these two phenomena and how they are related.

At this point in the research, one important decision to make was whether to use the theoretical or empirical approach for the construction of the system of concepts. Both approaches have strong points and limitations, and require a different way of working. The value added by the theoretical approach is that there is a vast amount of knowledge available and further intellectual efforts can be put into whether and how the existing knowledge can be used to address the problem at hand. The limitation is that some theoretical studies tend to drift away from reality, producing research outcomes with limited relevance for practice. On the other hand, a purely empirical approach is valuable, as the researcher observes the phenomenon under study and the knowledge produced in an empirical study can be of great practical relevance. One important limitation of a purely empirical approach is that one might rediscover the wheel. This is a subject of the already long-lasting rigor vs. relevance discussion. Although the distinction between empirical and theoretical approaches is not always clear-cut, we needed to choose a predominant approach.

To take a final decision on how to proceed, we have taken into account the possibilities and limitations of both approaches. After conducting a quick literature search, we found a rich body of knowledge concerning business transaction and business communication. As argued by Järvinen (2001), in theoretical or conceptual-analytical studies one starts from theories, models and frameworks from previous research and then applies logical reasoning. As we considered the rich theoretical material already available, we decided to follow a theoretical, conceptual-analytical approach for the construction of the system of concepts. Following a purely theoretical approach can be dangerous; as such approaches are criticized that the resulting contribution may be theoretically sound, but practically irrelevant. Although the elements to be included in the system of concepts will be based on theory, we will use examples from practice for inspiration.

5.1.4 Strategy for the construction of the system of concepts

Phases for the construction of the system of concepts

As argued by Järvinen (2001), in conceptual-analytical studies the starting point is to identify theories, models and frameworks from previous research. The author continues that after that, logical reasoning is applied to use insights gained from the previous theories to address the problem at hand. In that respect, the first step to construct the system of concepts will be to explore existing models and theories, which address the phenomena of business transaction and business communication. To explore existing models and theories, we follow existing guidelines on how to conduct a literature review (Webster and Watson 2002). The next step in conducting conceptual-analytical studies, as suggested by Järvinen, is to use logical reasoning. However, while we found research papers, which describe how to explore existing theories, we were unable to find guidelines of which steps to follow in terms of how to use existing theories and apply logical reasoning to arrive at a research outcome. To overcome this limitation, we developed an explicit way of working which is introduced below and elaborated throughout the construction of the system of concepts.

So far we have taken the decision that the system of concepts will need to capture key elements of business transactions and business communication. We consider three main phases towards the construction of the system of concepts. These stages should not be associated with a linear process, as the model construction will include iteration between the different stages. The three stages are "exploration", "focus", and "choice" (figure 5.5).

The first phase is called "exploration". During this phase, we will explore and provide a quick scan of available theoretical accounts, which addressed the subject of business transactions and business communication. The second phase we call "focus phase". During this phase we will examine pieces of work, which we considered relevant with respect to understanding business

transactions and business communication. We will consider a piece of work relevant if it is based on theories well established within the domain from where we borrow it, and if we consider that the ideas can contribute to addressing the problem at hand. The third phase we call the "choice phase". During this phase, a set of concepts will be selected from the theories.

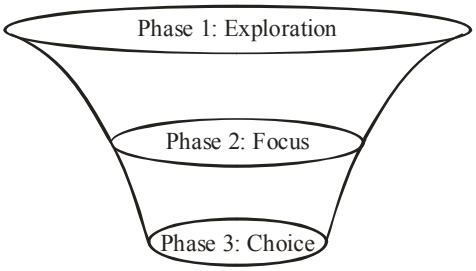

Figure 5.5 Strategy for the construction of the system of concepts

The role of the examples in the construction of the system of concepts
We used examples from the healthcare domain during the construction of the system of concepts because the healthcare domain is characterised by complex processes and information requirements; there is already a history of using standards in that domain and we had good access to both hospitals and the standardization bodies, which set up the standards.
The role of the insights from practice was twofold. The first was to help us better understand the nature of standard implementation projects, to get acquainted with examples of DBT situations and standards used in these situations, and identify examples of issues that have occurred in practice. The second was to use the insights gained from practice in our reasoning process, and provide examples of how the system of concepts can be applied in practice. Ultimately, the idea of using insights from practice was to ensure that the ideas we develop throughout the process can be used to reason about real-life situations.

The collection of practical insights from the healthcare domain was longitudinal and most intense in the first two years of the project. We used multiple sources of information to gain insights about the use of standards in practice including studies of standard specifications (mainly of the HL7 standard), project documentation, and external reports. Furthermore, we conducted interviews with representatives of three hospitals in the Netherlands involved in standard implementations. We participated in discussions with HL7 experts, in order to better understand the standard, and we spoke with software vendors who use HL7 in their systems.

The insights collected from the healthcare industry have been used as an input for the reasoning process when constructing the system of concepts and the method. The insights that we gained will become visible throughout Part 2 Chapter 2, Part 2 Chapter 3, and Part 3 Chapter 1, in the form of examples.

We construct the system of concepts by going through the three phases specified earlier. Further details about the construction of the system of concepts will be provided in Part 2 of this thesis.

5.2 Insights for the construction of the method

The goal of the second research question is to construct a method which would help in applying the system of concepts in practice. The method will define a process of how to analyze the DBT situation, the specified requirements and the standard using the system of concepts and identify potential problems based on this analysis.

To construct the method, we need to have the system of concepts as a prerequisite. At this point, we cannot say much about the method, apart from the functionalities that it will need to cover. Figures 5.2.1 and 5.2.2 illustrate two types of analysis the method needs to cover.

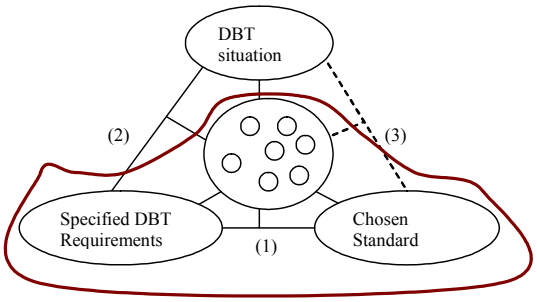

Figure 5.6 Comparison between the specified DBT requirements and the chosen standard, using the system of concepts

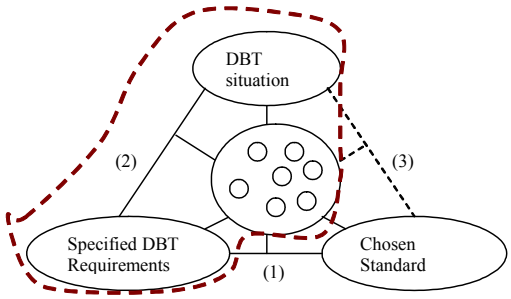

Figure 5.7 Comparison between the specified DBT requirements and the DBT situation

The first analysis (figure 5.6) aims to identify potential problems by using the system of concepts to analyze the specified DBT requirements, the chosen standard and mismatches between the two. The second type of analysis (see figure 5.7.) aims to identify potential problems by using the system of concepts to analyze the DBT situation and mismatches between the DBT situation and the specified requirements. A more detailed representation of the two types of analysis can be found in figure 5.8.

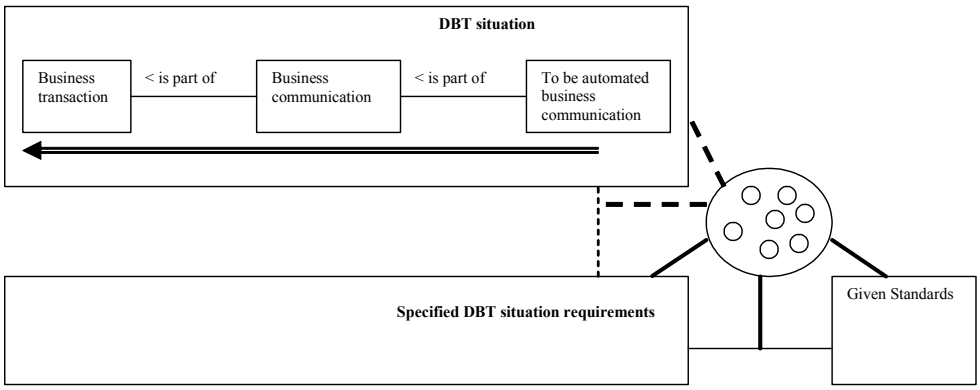

Figure 5.8 Detailed view

Here we can identify the three components: the DBT situation, the specified requirements, and the chosen standard, as well as the system of concepts. The DBT situation is further divided into the elements discussed earlier (business transaction, business communication, and to-be automated business communication).

It is not known what is specified concerning the specified DBT requirements, as this will depend on the specific project. We do expect that there is some information in the requirements concerning the requirements of the to-be automated communication.

The solid lines coming from the system of concepts can be seen as the use of the system of concepts with respect to analysis type one, and the dashed lines with respect to analysis type two; these two types of analysis will identify potential problems.

The method will also cover a third type of analysis, tracking the consequences of potential problems identified with analysis type one and two on the execution of the business transaction. This is illustrated with the double arrow within the DBT situation in figure 5.8. Similarly to the

construction of the system of concepts, for the construction of the method we have used the examples from the healthcare industry for inspiration. Further details concerning the method construction will be provided in part 3 of this thesis.

5.4 Research approach concerning research question 3

It is important to clarify that construction and evaluation are two different research activities (March and Smith 1995; Järvinen 2001). The system of concepts and the method are the major contributions of this research and the focus is therefore on construction. On the other hand, the goal of research question 3 is to gain insights into how the system of concepts and the method perform in practice and here the focus is on evaluation. As argued earlier, for the construction of the system of concepts and the method we have decided to follow a predominantly theoretical approach, and consider such an approach inappropriate for addressing research question 3. The reason is that with research question 3, we aim to gain insights about the feasibility of the system of concepts and the method to be used in practice, and we consider such insights best gained by empirical research.

To be able to gain these insights we needed a design, which would allow us to test whether the system of concepts and the method have the potential to do what they are intended for. In that respect, a logical way to proceed is to conduct empirical study with respect to a standard implementation project.

We considered two main approaches to address research question 3. The first is the direction of action research (Lewin 1947; Checkland 1981; Baskerville and Wood-Happer 1996; Baskerville 1999). In action research the researcher is actively involved; the knowledge obtained can be immediately applied, and there is no sense of detached observer. Finally, research is a cyclical process linking theory and practice (Baskerville 1999). Such an alternative could have been very useful to understand actual problems that occur and to get a good grasp of the business situation and standard. The problem is that in such a case, we as researchers would have to be involved in the project. The danger is then that we might influence the course of action in the project. It would be very difficult to evaluate the use of the system of concept and the method, as we would not have a clear reference what would have been the situation if we had not intervened. Being involved in an actual project can also be time consuming, as some projects take years to complete and did not fit our time limitations.

The second option was to conduct a case study concerning a standard implementation project approaching its end. The case study method is an empirical inquiry that investigates a contemporary phenomenon in its real-life context, where the boundaries between the phenomenon and the context are not clearly evident, and where multiple sources of evidence are used (Yin 1984). In that respect we considered it suitable for investigating standard implementation projects. Conducting a case study also has limitations compared to action research. One is the lack of full access to the DBT situation and the people involved in the project. However, the benefits are that we as researchers have little influence on the course of the project. Furthermore, we will not be dependant on the project duration, as we seek a project at final stage. Having in mind these two choices, we decided to proceed with the second option, the main reasons being limited influence on the course of the project and limited time available to conduct research.

Figure 5.9 illustrates the research design that we have adopted to gain first insights about the applicability of the system of concepts and the method. We decided to study a standard implementation project that is completed or that is in a final stage. The benefits of looking at

standard implementation projects that are almost finished is that it is possible to collect data about problems that have actually occurred in practice.

With respect to the same project, we consider two types of analysis. The first analysis is theoretically driven analysis. During this analysis we will use the DBT situation, specified DBT requirements and Standard as inputs and we will conduct analysis using the system of concepts and the method. As a result of this process, we will arrive at categories of potential problems. The second analysis is empirically driven. During this analysis, with respect to the same project, we will collect empirical data to identify what types of problems have actually occurred in practice. As a final step, we will compare the potential problems that we have identified using the system of concepts and the method, with the actual problems that have occurred.

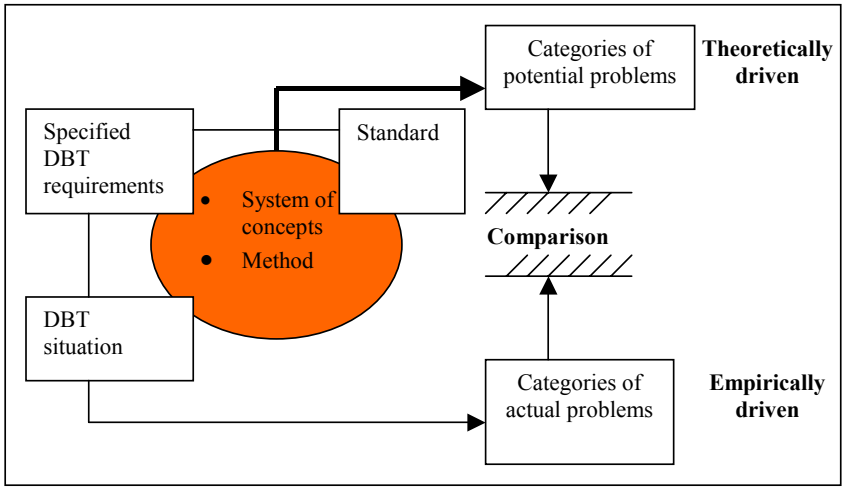

Figure 5.9 Research design for answering research question 3.

As a result of that, we will be able to gain first insights about the applicability of the system of concepts and the methods. Further details of the method of how we have actually conducted the case study will be provided in part 4 of this thesis.

5.6 Structure of the remaining part of the thesis

The remaining part of this thesis is structured as follows. Part two deals with the construction of the system of concepts. In part three, the method is developed. Part four discusses a case study in the energy sector and provides insights concerning the applicability of the system of concepts and the method. At the end, in part five, we will state conclusions and recommendations.

Part II. Construction of the system of concepts

Because any real "machine" has an infinity of variables, from which different observers (with different aims) may reasonably make an infinite or different selection, there must first be given an observer…, a system is then defined as any set of variables that he selects from those available on the real "machine". It is thus a list nominated by the observer…

W. Ross Ashby, Design for a Brain

Chapter 1. Exploration

1. Introduction

The previous chapter outlined three phases concerning the construction of the system of concepts: exploration, focus, and choice. Within this chapter, the exploration phase will be addressed.

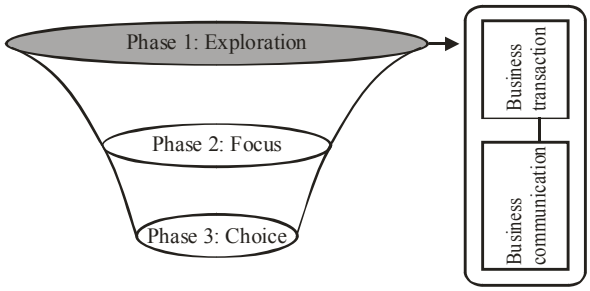

Figure 1.1 Exploration phase

As argued in part 1 chapter 2, the system of concepts needs to capture elements of business transactions and business communication. During the exploration phase we will explore possible ingredients of the system of concepts. We will review models and theories, which describe business transactions and business communication from different research areas. These theories will be the inspiration for the further construction of the system of concepts in the focus phase.

During the exploration phase we begin with models and theories describing business transactions and business communication available in the IS literature. We will also briefly discuss some of the reference disciplines on which these models are based on. The strategy during the exploration phase is as follows. We first start with a model concerning business transactions, and gradually introduce other models, which bring further insights on the subject. We will repeat the same procedure when exploring business communication.

To facilitate the reader, we decided to introduce the notion of the exploration map (figure 1.2). The map is a summary of the topic and theories explored and can help the reader for orientation while going through this chapter. The map contains the notions of business transactions and business communication represented in the figure above with labelled rectangles. It also contains marked points, which we will call orientation points, and the paths between the points. Each orientation point contains a label which briefly summarizes the topic being explored and a

number which indicates the logic of the presentation that we will follow during the exploration phase.

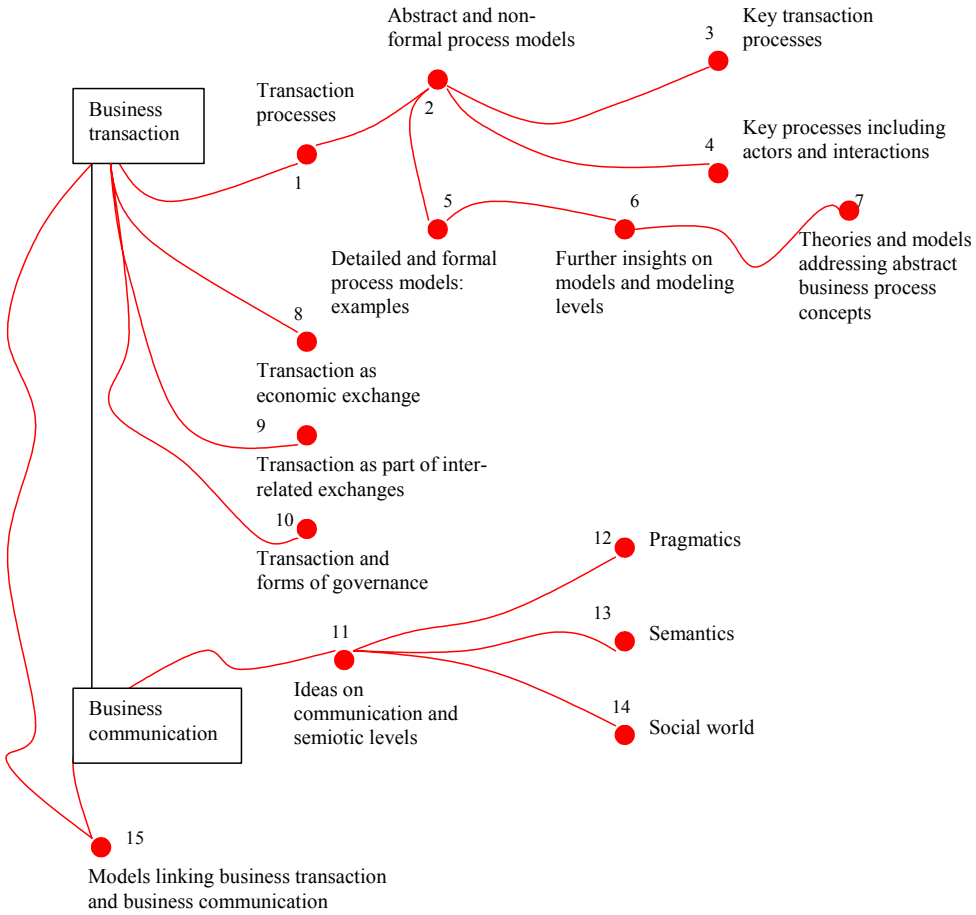

Figure 1.2 Exploration map

2. Business transaction

2.1 Transaction processes

A review of IS literature on business transactions shows a large number of models on business transactions focused on transaction processes. We begin by exploring the notion of a transaction by looking at transaction processes.

2.1.1 Abstract and non-formalized models of transaction processes

Major transaction sub-processes

As a starting point for exploring the transaction processes, we will use a summary of transaction processes provided by Gebauer (1999). It provides a summary which combines a number of works on transaction processes. This figure indicates that the transaction process can be roughly defined in four sub-processes: information, negotiation, settlement, and after sales.

These four sub-processes are based on the work of (Schmid 1993; Dobler 1996; Gebauer 1996; Nissen 1997; Kraut 1998; Schmid 1998).

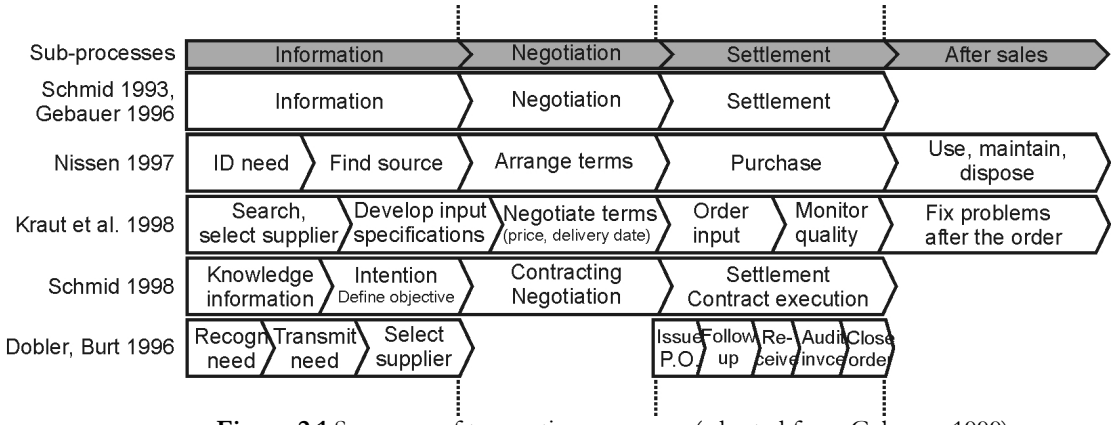

Figure 2.1 Summary of transaction processes (adopted from Gebauer, 1999)

An interesting observation from figure 2.1 is that transaction processes can be described at different levels of granularity. For example, the information sub-process as defined by Gebauer (1999) is also seen as an information sub-process by Schmid (1993) and Gebauer (1996). It is further divided in the other models to ID need and find source in Nissen (1997) and recognize need, transmit need, and select supplier in Dobler (1996). We return to the discussion of the different levels of process granularity later in this section.

The basis for the models can be traced to earlier studies on transactions in economics. One such example is the work of Commons (1951) where he distinguishes three stages of a transaction: the negotiations, which are closed when the agreement on intentions is reached, the commitment, which imposes the obligation of performance and payment, and finally the performance of the obligation agreed upon.

Additional insights on how to look at a transaction process are provided by Kambil (1997). This model outlines the importance of looking not only at basic trade processes (similar to those discussed by the model above), but also at the trade context processes.

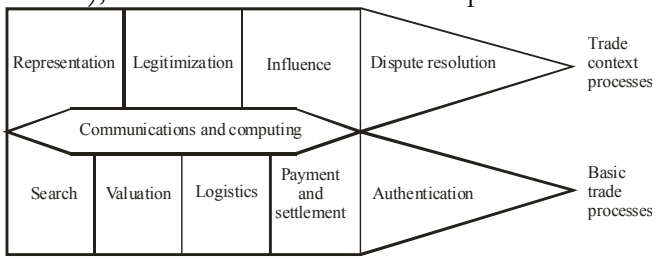

Figure 2.2 Generalized model of exchange processes (adopted from Kambil, 1997)

The basic trade processes in the model of Kambil (1997) are similar to those discussed earlier: search, valuation, logistics, payment and settlement, and authentication. The trade context processes are: representation, legitimization, influence, and dispute resolution. What is also interesting in the model of Kambil (1997) is that it explicitly identifies the importance of the communication and computing process which spans the basic trade processes and the trade context processes.

Actors in the transaction processes

Both the summary of transaction processes provided by Gebauer (1999), and the model of exchange processes of Kambil (1997), describe a transaction in terms of sub-processes without explicitly including the actors. The commerce model of Nissen (1997), adds to the understanding of a transaction by explicitly introducing the notion of the actors and the activities performed by each in the context of the transaction.

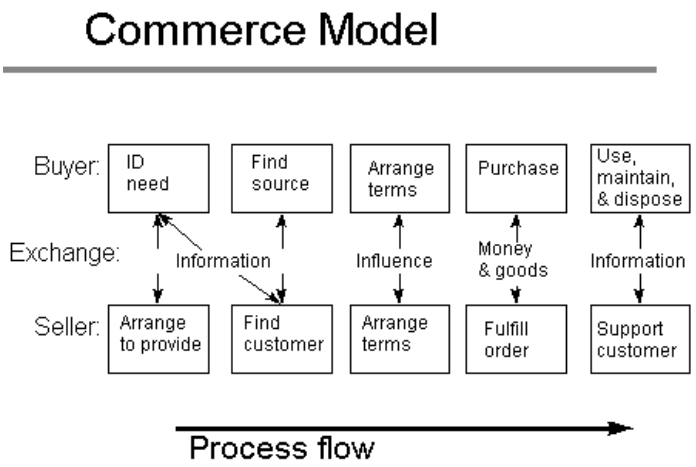

Figure 2.3 Commerce model (adopted from Nissen, 1997)

The commerce model explicitly identifies two actors: the buyer and the seller. The model identifies activities, which need to be performed by each actor. The activities to be performed by the buyer are as follows: identify need, find source, arrange terms, purchase, use, maintain, and dispose. The activities performed by the seller are: arrange to provide, find customer, arrange terms, fulfil order, and support customer. It is also interesting that the model identifies a number of exchanges between the actors, mainly exchange of information, influence, and money/goods. It is interesting to notice that the exchange of goods and money is only one part of the transaction process. We will come back to this discussion section 2.2, when we discuss transaction as exchange.

If we look at the commerce model and compare it to the summary of transaction processes, we see that they have some relationships. The activities "purchase" and "fulfil order" for example, can be characterized as part of the settlement process, and "use, maintain, dispose" and "customer support" refer to the after sales process.

A similar model to the commerce model is presented in the business action theory (BAT) (Goldkuhl 1998), which is presented at figure 2.4. Comparing the BAT model to the commerce model also shows two actors, the activities performed by each during the transaction, and the interactions between the two.

The BAT model is similar to the two models discussed at the beginning as it also provides grouping of the activities performed by the supplier and the customer into higher-level sub-processes.

Different terms can be used to refer to the actors in the transaction. The buyer and the seller are identified as the main actors in terms of exchanging goods or services (sellers) for some form of compensation (buyers) (Gebauer and Scharl 1999; Hawkins and Verhoest 2002). In the BAT the terms supplier and customer are used. However we consider these terms to be interchangeable.

There are other models similar to those discussed so far (the business transactions model of Gebauer, 1999), including them however, will not provide new insights compared to the models presented so far.

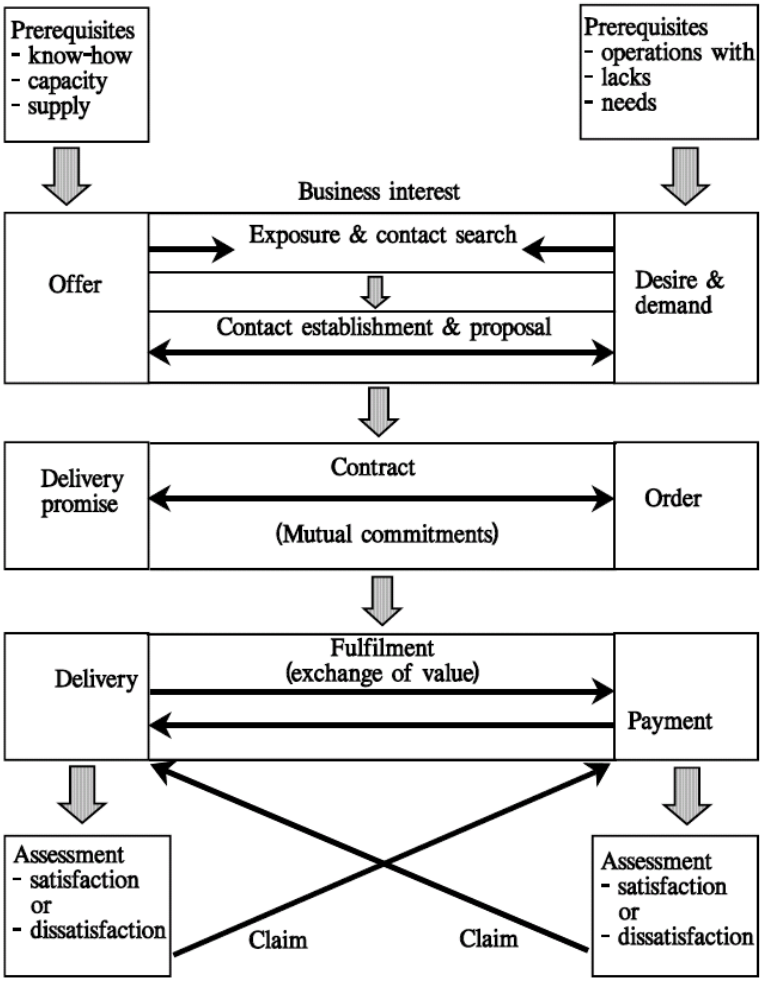

Figure 2.4 Business action theory: a phase mode (building on Goldkuhl, 1998)

2.1.2 Detailed and formal transaction processes

We have discussed that a transaction can be broken down in terms of sub-processes. We also discussed that each sub-process can be further discussed in terms of activities performed by the buyer and the seller. The models are abstract process descriptions, which include major sub-processes and activities in a business transaction. These types of models are addressed by Wijers (1991) as free models. Wijers argues (1991), that free models cannot be verified by computer and for that purpose more structured models are needed. Brinkkemper (1990) adds that if part of the model is to be embedded in a computer system it needs to be formal.

One of the purposes of the system of concepts is to analyze a chosen operational standard. As discussed in part 1 chapter 2, the operational standard contains the level of detail needed to embed it in the computer system. In that respect it is necessary to understand the full detail of a transaction process as well as the process elements embedded in the standard. To do that, structured and formal models are needed. We thus need to gain further insights concerning formal modelling of processes and the key concepts used in modelling.

To address the issue of formal models and formal modelling of transaction processes, we will start with some examples of formal models and illustrate that these models can capture different levels of detail. We then continue in a more theoretical direction and discuss the different levels of modelling. Finally, we return to the issue of process modelling and review models which attempt to capture key business process concepts, which we will consider at a later stage when constructing the system of concepts.

Examples of different levels of detail

The example that we discuss is adopted from van der Aalst (1999). A customer orders good *a* from a producer. Once the producer receives the order, he orders product *b* from supplier 1 and product *c* from supplier 2. After the producer receives product *b* and product *c* from supplier 1 and supplier 2, the producer assembles the product and delivers it to the customer. The producer also sends an invoice to the customer and finally the customer pays the producer for the product. This example is an example of a transaction which covers only some of the sub-processes as discussed with respect to the model presented in figure 2.1 (partly the negotiation and partly the settlement sub-process), however we consider that sufficient to illustrate how one can proceed towards a more detailed analysis of transaction processes.

This example can be represented at different levels of detail. In the figure below this example is presented with the modelling technique called "message sequence chart".

The message sequence chart models the actors (presented with rectangles with the name of the actor inside). It illustrates the interactions between the actors (represented with labelled arrows), and the sequence in which these interactions occur (the vertical lines starting from each actor represent a timeline and indicates how the interactions occur in time). The same example can be modelled at a more detailed level.

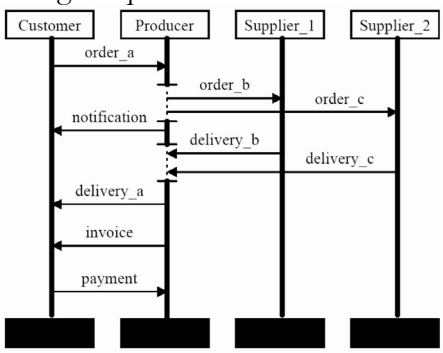

Figure 2.5 Example with Message Sequence Charts (adopted from van der Aalst, 1999)

The model in figure 2.6 provides one example of a more detailed level of representation. While the model represented with the message sequence chart focuses on describing the interactions between the actors, the model in figure 2.6 provides an additional level of detail by explicitly representing the activities as they occur regarding each individual actor. This model is produced using the Petri Net modelling technique.

Comparing it with the message sequence chart, this model also represents the notion of actor (represented by labelled rectangles[5]). It provides additional detail about the activities however, and states as they occur during the process within, as well as between actors (in Petri Nets activities are represented by squares; states are represented by circles). For further discussion on Petri Nets see van der Aalst, (2002).

By presenting these examples, we illustrate two important points. The first is that when talking about transactions from a process perspective, we can discuss different levels of abstraction. The models presented earlier looked at a transaction in terms of high-level processes or phases. The commerce model and the BAT model include the notion of actors and general steps that the actors perform to achieve the desired exchange and a general indication of what types of interactions occur between the actors. The message sequence chart and especially the Petri Nets, aim to present a process in more detail, which is sufficient to actually execute the process.

The second point is that transactions do not always occur in isolation but can be related to other transactions. If we look carefully at the examples presented in figures 2.5 and 2.6, we can identify three related transactions: between the customer and the producer (with respect to the exchange of product *a* for compensation), between the producer and supplier 1 (with respect to product *b*),

[5] The explicit modeling of actors is not part of the petri net modeling technique

and between the producer and supplier 2 (with respect to product *c*)[6]. The idea of related transactions has its roots in marketing literature. It has received a lot of attention there, so we will provide a separate discussion in section 2.3 of this chapter.

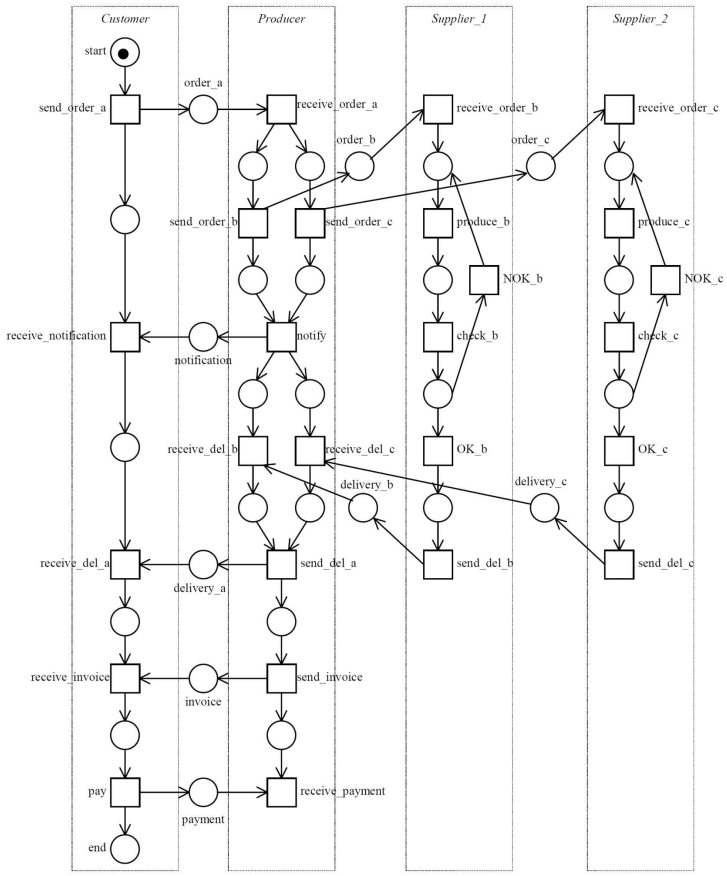

Figure 2.6 Example with Petri Nets (adopted from van der Aalst, 1999)

The modelling techniques presented here are just two examples and they have limitations regarding which process concepts they can capture; for instance, they do not capture the concepts related to the information aspect. The concepts covered in the modelling technique are not directly visible on a model level, but can be identified if we look at a higher level of abstraction or at a meta level. Before going further and presenting different studies, which identify key business process concepts, we will first introduce the different modelling levels.

Models and modelling

The following is a brief introduction to the different modelling levels and models. We use the Framework for Information Systems Concepts, or the FRISCO report in short (Falkenberg, Hesse et al. 1998). FRISCO presents the results of the work of the IFIP WG 8.1 Task Group FRISCO. The motivation behind FRISCO is expressed in the first manifesto (IFIP 1988):

> There is a growing concern within IFIP WG 8.1 about the present situation, where too many fuzzy or ill-defined concepts are used in the information system area. Scientific as well as practice-related communication is severely distorted and hampered, due to this fuzziness and due to the frequent situation that different communication partners associate different meanings with one and the same term. There is no commonly accepted

[6] In the example above the flow of compensation between the producer and supplier 1 and the producer and supplier 2 is not explicitly included

conceptual reference and terminology, to be applied for defining or explaining existing or new concepts for information systems.

The goal of FRISCO is to solve the problem of miscommunication between parties coming from different domains by providing a commonly accepted conceptual reference and terminology. FRISCO combines knowledge from multiple disciplines allowing for a broader view on what the important information systems concepts are and how to model them. FRISCO also provides a clear and formal definition for each concept used. Below, we adopt some of the FRISCO definitions to introduce the discussion on models and modelling levels (figure 2.7):

> A model is a purposefully abstracted, clear, precise and unambiguous conception. Models are conceptions, i.e. they exist in person's mind. When the models are represented in some way then we have a model denotation. A model denotation is a precise and unambiguous representation of a model, in some appropriate form of formal or semi-formal language. The model of a specific domain is called a base model. "A meta-model is a model of the conceptual foundation of a language, consisting of set of basic concepts, and a set of rules, determining the set of possible models denotable in that language. In that respect, a meta-model determines the "specific conceptual or ontological view of the "world", a specific classification of concepts dealt with, and the general rules every model denoted in that language has to obey." Going one level further (meta level 2), one will result in a meta language and meta language representation.

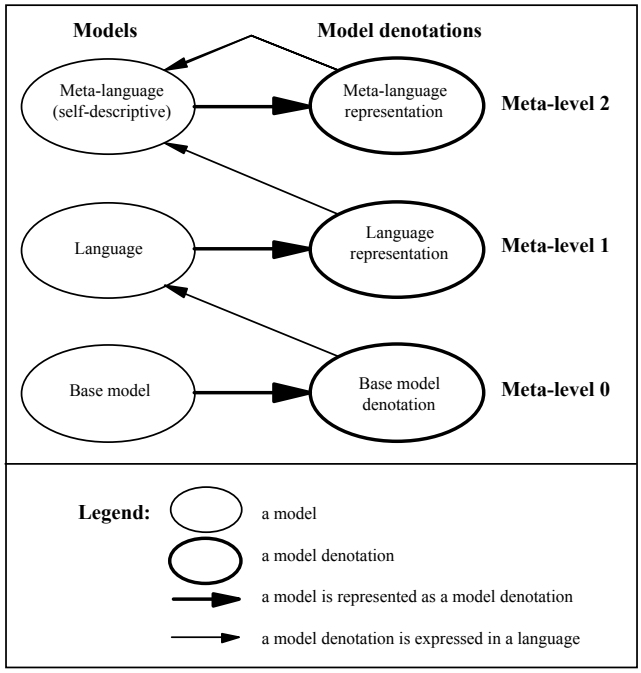

Figure 2.7 Models, model denotations and meta-levels (adopted from FRISCO)

A distinction is made in FRISCO between an intentional and extensional model:

> An intentional model is that part of a model comprising the possibilities and necessities of a domain only, i.e. the types and rules. An extensional model is that part of a model containing a specific population of the types in the corresponding intentional model, whereby this population must obey all rules determined in that intentional model.

In terms of modelling levels, the concepts that we ultimately include in the system of concepts fall under the meta level which defines a specific conceptual or ontological view of the "world" and includes a classification of concepts. The next section continues the discussion concerning business process concepts and investigates different research efforts that address this issue. The

goal of such a review is to identify theories which identify business process concepts and which we may use in the further construction of the system of concepts.

Overview of research efforts addressing the issue of business process concepts

The importance in evaluating the modelling power of conceptual modelling languages in terms of ontological constructs has been discussed in literature (Wand 1989; Weber and Zang 1996). Rosemann & Green (2002) further argue that a meta model based on these ontological constructs can facilitate the evaluation process models. The figure below is adopted from Rosemann & Green (2002) and illustrates how a meta model based on the Bunge-Wand- Weber ontology can be used to evaluate the ARIS Event-driven Process Chains (EPC) and the UML activity diagram.

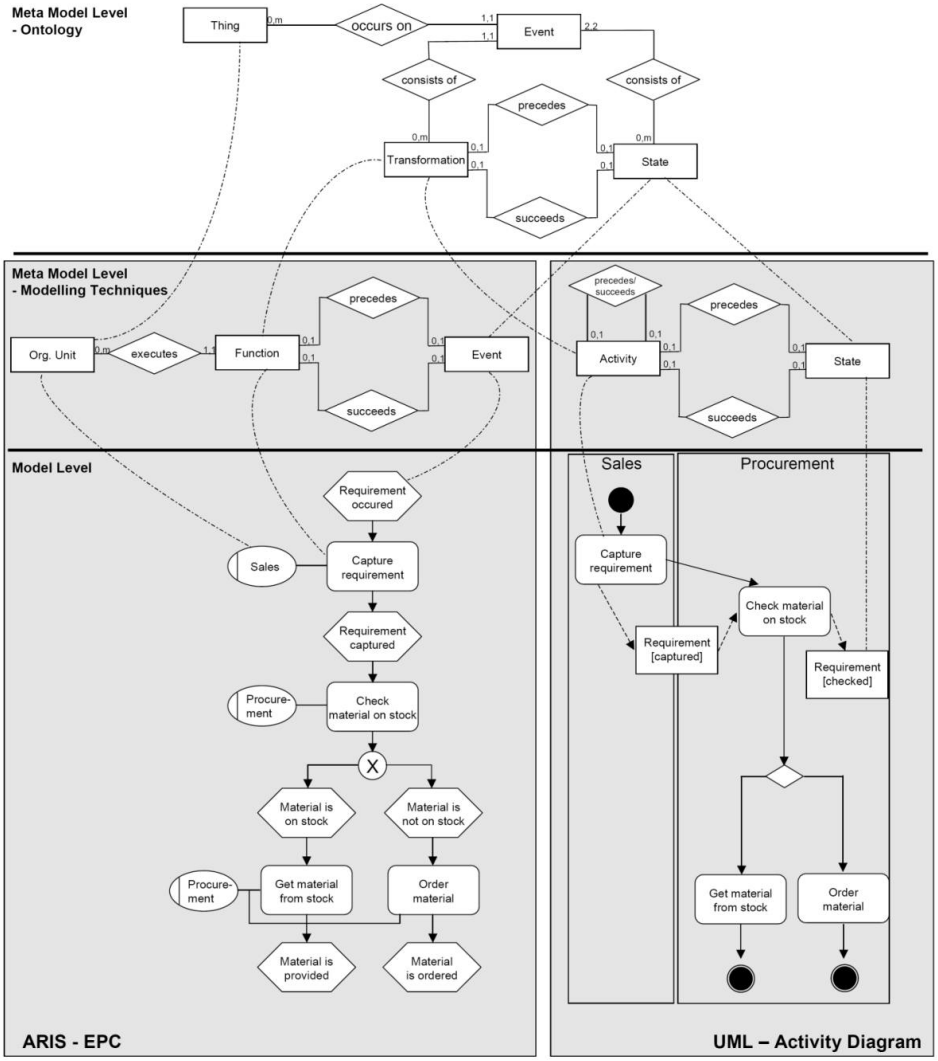

Figure 2.8 The use of BWW ontology to evaluate ARIS and UML (adopted from Rosemann and Green, 2002)

The problem when using a general ontology like Bunge-Wand-Weber is that it contains concepts in addition to those related to business processes. A general ontology does not isolate business process concepts, making it difficult to evaluate the process elements covered in the DBT situation and those embedded in the standard. In this respect, while the ontology provides formal definitions of concepts it is not focused on capturing the essential business process concepts.

On the other hand, within the business process literature, there have been several attempts to understand the business process essentials and to identify a set of business process concepts. Mayer et al. (2000) review existing modelling techniques and evaluate their usefulness in capturing

specific elements of a business process. While they provide for a better high-level understanding of the existing modelling techniques and their capabilities, they do not aim to arrive at a set of key business process concepts. Lin et al. (2002) also attempt to identify business process essentials. The authors extensively study of a number of methods, tools and techniques (MTTs), producing a list of concepts which they link to a model (figure 2.9).

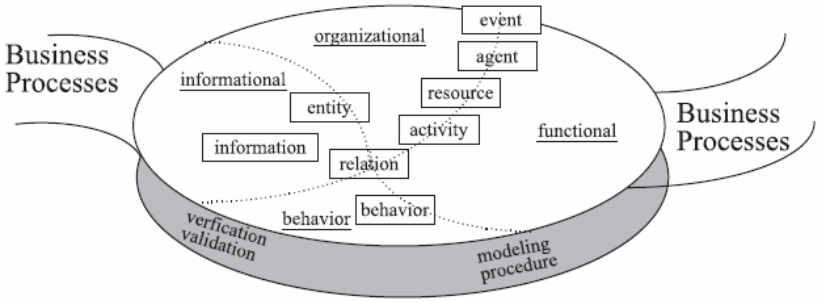

Figure 2.9 Essential concepts for business processes (adopted from Lin et al. 2002)

The concepts are not well defined however, while the logic for grouping these concepts remains implicit.

A study by Söderström et al. (2002) also seeks to identify business process concepts, resulting in the presentation of a conceptual meta model (figure 2.10).

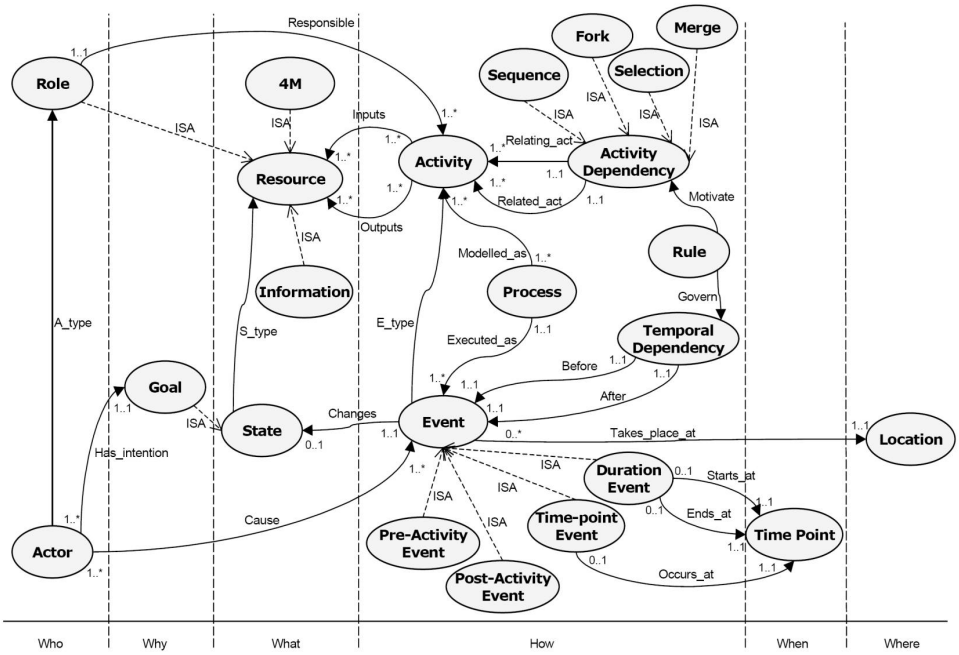

Figure 2.10 Meta model of business process concepts (adopted from Söderstrom et al. 2002)

How they produce the meta model and how they define the concepts remains unclear. In follow-up research, Wohed et Anderson (2005) and Rukanova et al. (2005) independently criticized the work of Söderström et al. (2002). Wohed & Anderson (2005) provide formalization of the work of Söderström et al. (2002) while Rukanova et al. (2005) propose a method of how to arrive at such a system of business process concepts.

The formal model developed by Wohed & Anderson (2005) is presented in figure 2.11. To develop this model the authors use formal concepts from FRISCO and build upon the model developed by Söderström et al. (2002).

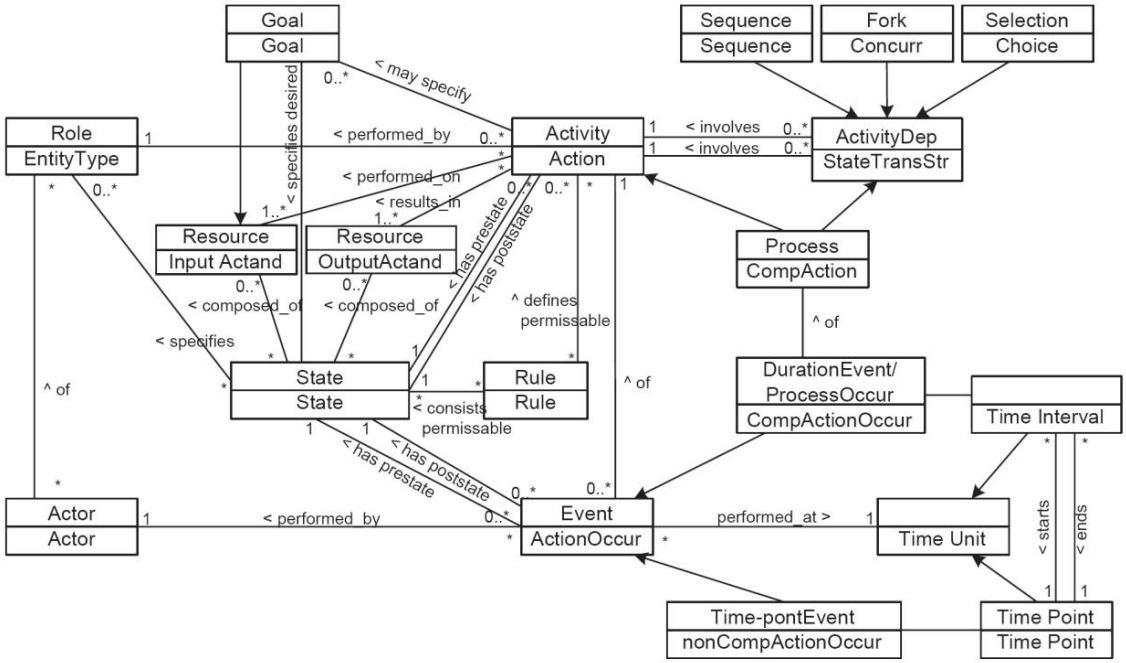

Figure 2.11 Consolidated meta model (adopted from Wohed & Anderson, 2005)

Rukanova et al. (2005) advocate the idea that it is important to have a systematic way of capturing the business process essentials and formalizing them by using existing ontologies.

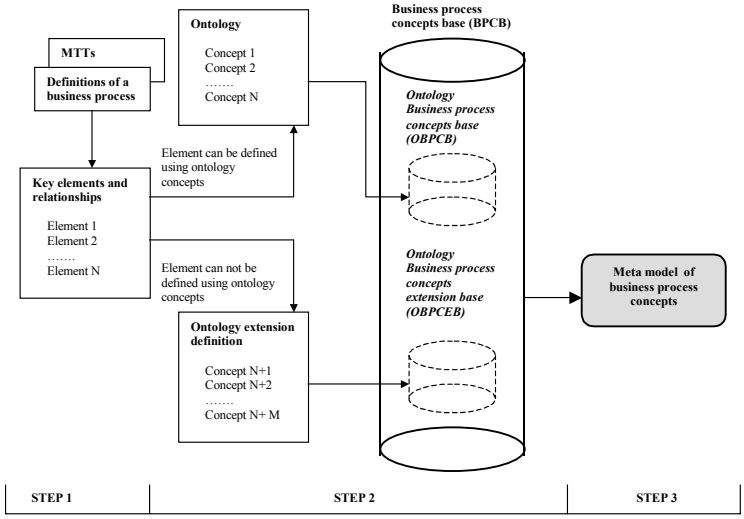

Figure 2.12 Method for construction of a meta model for business process concepts

Figure 2.12 illustrates the steps to be followed to produce a consistent, formally defined, set of business process concepts. The authors also illustrate the use of the method using the FRISCO ontology and arrive at a preliminary set of business process concepts.

We will not elaborate the discussion of business process concepts. Based on this section's discussion we can conclude that there remains a desire in the business process research community to arrive at a complete, formal and consistent set of business process concepts useful for different purposes. Our purpose for using business process concepts is to comprehend the business process requirements of the DBT situation and the process elements covered in the standard. From the discussion above it becomes clear that efforts in the business process community continue toward the construction of a stable and formally defined set of business

process concepts. We find, however, that the theories presented in this section can provide fertile ground for the further development of the system of concepts.

2.1.3. Summary

With respect to transaction processes, we make a distinction between basic and support processes; communication and computing are related to all the other processes. We observe that the processes can be presented in an abstract and detailed form. The detailed level deserves attention, as detailed presentation of processes also requires formal modelling. With respect to formal modelling, we identify a number of studies discussing business process concepts. Furthermore, in a transaction, we identify two main actors, customer and supplier, who take part in different activities. It is interesting to note that the models discussed can represent different exchanges (e.g. influence, information, good/money), the exchange of a good for money being only one type. The economic exchange of a good/service for some form of conversation is a main driver for actors to enter in business transactions. Therefore in the next section we present another set of theories on business transaction, analyzing a business transaction as economic exchange.

2.2. Business transaction as economic exchange

The models of transaction processes presented (explicitly or implicitly) centre on the transfer of a good/service from the seller to the buyer, coupled with the transfer of compensation in the other direction. Yet in the IS literature, most of the models presented focus on discussing the process view of a transaction instead of the exchange itself. A clear reaction to this is the work of Gordijn (2000), who argues it is important to make an explicit distinction between business modelling and process modelling. According to Gordijn, the goal of business models is to identify who exchanges what with whom in return for what. In that respect Gordijn argues that such a model needs both to represents transfer of ownership, and to exclude all the operational details. In comparison, the goal of process models is to describe the way such an exchange is put into operation, therefore including operational details.

The process models discussed in the previous section always feature the delivery of goods and payment (explicitly or implicitly, as part of the fulfilment sub-process). Gordijn argues the delivery of goods and payments are simply seen as steps in the process model and do not refer to the transfer of ownership.

For Gordijn, the distinction between business model and process model is essential, as he uses the business model as a basis for evaluating the profitability of an e-business idea. Business models as discussed by Gordijn represent a number of related exchanges, a discussion we will address in section 2.3. As a starting point for discussing business models Gordijn uses the principle of economic reciprocity, which we explore below.

Looking at a business transaction in terms of economic reciprocity is rooted in economic theories. Economic reciprocity is synonymous with the economic term "quid pro quo", which is of Latin origin, meaning "something for something". The exact origins of this principle are unknown, though its roots are in ancient times pre-dating the occurrence of money. This notion of transaction, however, has been adopted as one of the most fundamental units of analysis in economic organization theory (Milgrom 1992). In the 19th century transactions were seen as a "voluntary exchange" between individuals of one item of physical property for another item (Commons 1951). Later, the notion of transaction expanded to include three types: rationing transactions by "policy-makers" of the organization in laying down working rules; managerial transactions between superiors and inferiors, mainly wage earners and salary earners in the

production of wealth; and bargaining transactions on the markets, which transfer ownerships of corporeal property and the new kinds of incorporeal and intangible property of bonds and stock of corporations (Commons, 1951). To better grasp the basic notions describing transactions, we explore ideas concerning bargaining transactions, which reflect economic exchanges between independent actors, as is often the case in business-to-business transactions.

Commons (1951) develops an interesting argument concerning bargaining transactions: that free bargaining transactions among individuals were the legal foundations of the early science of economics, though it was not clear what exactly was exchanged. In time, the term transaction developed a double meaning, the proprietary meaning, intended by the court, of the acquisition and the technological meaning used by the economists (where technological refers to the transportation and physical delivery of the things owned). As argued by Commons (1951), in business economics there is a clear distinction between a transaction and exchange; a transaction[7] is a double transfer of ownership. The word "exchange" continues to mean both legal transfer of ownership and the labour transfer of the items owned. In addition, in point of time duration, bargaining transactions are cash, short-time and long-time transactions. In cash transactions the negotiation, the performance and payment begin and end together, without a measurable interval of time. In case of short-time and long-time, it can be hours, days, even years between the closing of the negotiations, or transaction origination, and the final transaction closing by execution of the duties of performance and payment. Commons (1951) also distinguishes between strategic transactions altering the nature of agreements and those shaping subsequent routine transactions. While we will not further elaborate the work of Commons, an overview may be found in Van de Ven (1993).

In economic literature, one interesting discussion concerns the objects of exchange. In this literature a distinction is made between barter and mediated exchange. To barter means to exchange goods for other goods (Atchison 1991). However, barter is not always easy to achieve in the absence of double coincidence of wants, i.e. when the buying actor is unable to provide the good the selling actor desires in return (Jevons 1975; Kiyotaki and Wright 1989; Williamson and Wright 1994). In these cases it becomes useful to use a medium of exchange, or "an object that many actors who have no interest in that object for their own consumption or for the use in production nevertheless accept the object in trade with rational expectation that they will be able to trade it for goods which are of intrinsic value to themselves" (Duffy and Ochs 1999). Money is one example of a medium of exchange.

We have provided high-level understanding of a business transaction as an economic exchange and discussed some key concepts of a business transaction from an economic perspective, which may be used in the construction of the system of concepts. In the following section we will go a step further and discuss inter-related exchanges.

2.3 Inter-related exchanges

In section 2.1.2, we noted that a transaction can be related to and can trigger other transactions. Ideas about inter-related exchanges can be easily identified, as mentioned earlier, in the context of business models (Timmers 1998; Gordijn, Akkermans et al. 2000; Komulaien 2005). As Komulaien (2005) summarizes, various definitions of a business model share three core elements: the product/service, the business actors and their roles, and value exchanges among actors. The last elements clearly refer to inter-related exchanges.

[7] He refers to it as a bargaining transaction.

The inter-related value exchanges in business models can be traced even in situations featuring an intangible object of value. One of the often-cited examples in the context of Internet business is the advertising business model (Rayport 1999).

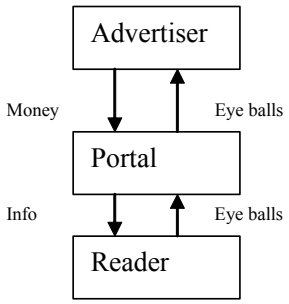

Figure 2.13 The Add example

The figure on the left represents the inter-related value exchanges in this business model. In this example we have three actors: advertiser, portal and a reader. The value that the portal provides for a reader is information, and the value that the portal receives from the reader is called "eye balls" or attention. The "eyeballs" that the portal attracts represent a value object that the portal offers to the advertiser. The audience size, or traffic, is used to negotiate the price that the Portal requests in order to place an advertisement.

This phenomenon of inter-related exchanges is explained in marketing literature where the idea to look beyond the dyadic transaction has been discussed. The focus of the analysis is often the exchange relationship in marketing literature. Although the notion of exchange relationship includes more than the individual transactions parties enter into (other issues such as trust), there is valuable knowledge which we can use to understand the interrelationship between transactions.

A number of models and frameworks which try to understand the working relationships between firms have been developed (Frazier 1983; Anderson 1990; Halen 1991), each of which focuses on dyadic relationships between firms. As argued by Anderson et al. (1994), developments in business practices strongly suggest that connections between a firm's dyadic relations become more interesting. In the late 1980's the idea of value added partnerships was introduced (Johnston 1988), defined as "a set of interdependent companies which work closely together to manage the flow of goods and services along the value-added chain". In the early 1990's, the idea of the "virtual corporation" was established. A "virtual corporation" can be a network of firms organized around a specific opportunity lasting only for the length of that opportunity (Byrne 1993). Based on such developments in business practices, a number of scientists suggest shifting analysis from dyads to networks.

As argued by Anderson et al., however, taking a network view also has limitations. They argue that if one regards a network as a set of connected firms (Miles 1992), or a set of connected relationships between firms (Cook 1978; Hakansson 1993), then the relationships are reduced to links within a network without providing further insights about the individual relationships and what occurs between them. Anderson et al. (1994) further conceptualize dyadic business relationships that capture the embedded context within which these relationships occur. They formulate the business network as a *focal relationship* (between two firms) that is related to other relationships. In doing so, they conceptualize networks as a set of connected relationships.

The ideas from marketing provide some interesting insights. The work of Anderson et al. (1994) provides insights that looking at dyads or networks as such might be limited and to better capture the contextual information, one needs to look at the *focal relationship* and identify the network where the focal relationship is embedded. As a consequence we conclude that in order to understand a transaction, one must understand the broader context within this *focal relationship* is embedded.
According to Anderson et al., the function of a business relationship can be characterized with respect to three essential components: activities, actors, and resources. The authors also explicitly

distinguish between primary and secondary functions. Primary functions concern only the focal dyad relationship and interactions that occur there. The secondary function, also called a network function, captures the indirect positive or negative effects of a relationship because it is directly or indirectly connected to other relationships. The authors also argue that given a focal relationship, secondary functions might be as important as the primary ones. They conclude that focal relationships are dyads, buy are also part of a network.

Achrol et al. (1983) suggest that one can come to the network of a focal dyad by studying its primary, secondary, and macro environment. The focal dyad's immediate suppliers and customers compose the primary task environment and are referred to as direct exchange network. The secondary environment captures actors indirectly related to the focal dyad through exchange relationships with actors in the primary task environment. The Macro environment is manifested through impacts on the secondary task environment. Anderson et al. (1994) suggest the concept of network context, which encompasses indirectly connected exchange relations in addition to the direct exchange network and appears to offer a natural delimited of network from environment.

The discussion bears a number of conclusions. First of all, it is important to clearly identify the focal dyad relationship under analysis. It is then important to realize that this focal dyad is embedded in a network context where the network can include both direct and indirect exchange relationships. Last but not least, the major elements to characterize a relationship are the actors, activities, and resources.

2.4 Further insights on transactions: transaction cost and transaction governance

We also identified a large number of authors who have adopted transaction cost theory when looking at transactions. A summary of major contributions in applying transaction cost theory can be found in Rindfleisch and Heide (1997).

Transaction cost theory originates from the work of Coase (1937) "The Nature of the Firm", which led to a Nobel Prize in Economics. His work represents a further conceptualization of exchange; more precisely the costs of reaching agreements as well as coordinating, controlling and implementing them. In his work, Coase starts with the assumption that first there were markets, and then tries to explain why firms exist. As explained by Wilkinson (2001) in the field of marketing, the basic assumption is the other way round: starting with firms and seeking to explain why they delegate or outsource various activities rather than doing them themselves, which is the same problem approached from a different direction.

The ideas of Coase are further developed by Williamson (1975). Williamson discusses transaction costs and the nature of costs of inter-organization governance. In the traditional approaches (Williamson; Williamson 1975; Rindfleisch 1997), two governance structures are identified: hierarchy and market. In hierarchies, transactions have a formal and bureaucratic structure, whereas transactions are characterized as independent and discrete in a market. Williamson (1991) suggested that there is also a hybrid governance structure between the market and the hierarchy. He elaborates the arguments of Coase and provides insights into the types of exchanges more appropriately considered within firm boundaries than within markets.

At this point it is important to mention that the quid pro quo notion is not always visible, especially in hierarchies. In hierarchies, compensation especially is not so easy to trace. Compensation in hierarchy can be traced to the so-called "managerial transactions" as defined by Commons; embedded to a large extent in the salaries and the budgets of the employees.

2.5 Reflection

We have explored existing theories and models, which address business transaction. During the exploration, we began with existing models and theories. We have identified theories, which look at a business transaction as economic exchange, as transaction processes, as embedded in a context, and business transaction governance.

We now present the ISO/IEC 14662, Open-edi Reference model definition of a business transaction and reflect to what extent notions concerning business transactions that we have identified during the exploration phase can be found in this definition.

According to the ISO/IEC 14662 definition, a business transaction is a "predefined set of activities and/or processes of organisations which is initiated by an organisation to accomplish an explicitly shared business goal and terminated upon recognition of one of the agreed conclusions by all the involved organisations although some of the recognition may be implicit".

In the ISO/IEC 14662 definition of a business transaction the notion of activities and or processes is explicitly included. From our exploration of existing theories we also identified that the process view on a transaction is important. The ISO/IEC 14662 definition addresses "activities and /or processes of organizations". We also recognize the involvement of multiple organizations in the execution of a business transaction. In the ISO/IEC 14662 definition the notion of an explicitly shared business goal is mentioned, though the nature of this goal is not further specified. From the theories reviewed we identified one of the main drivers for companies to enter into business transactions is the exchange of values. Additionally, the ISO definition addresses the termination of a transaction. The definition states that the termination is, "upon recognition of one of the agreed conclusions by all the involved organisations although some of the recognition may be implicit". In the exploration phase, we also identified the notion of a termination of a transaction. In some of the models termination was considered with the settlement stage (Schmid 1993), and in some models an additional stage was added after the settlements stage to account for fixing of possible problems during the execution stage (Goldkuhl 1998; Kraut 1998). We can say that the notion of a termination of a business transaction was also addressed with the theories we explored. Based on the discussion above we conclude that the theories explored capture the basic notions of a business transaction identified in the ISO/IEC 14662 definition.

Based on our exploration, we can also say that ISO/IEC 14662 definition is missing some essential elements, and is mainly process centred. It does not explicitly address the quid pro quo notion (or the principle of economic reciprocity), widely discussed in the economic literature. It seems that communication is not explicitly discussed in the definition and seen only as part of the process rather than a means for reaching agreements and discussing the outcome of the transaction with respect to these agreements. In that respect, the definition takes the agreements for granted, but excludes how one reaches the agreements and how one gets the recognition of the agreements. The communication is a very important part of the business transaction and becomes even more important if it is to be partially supported via computer systems. That is why we will continue our exploration phase with theories which would help us to better understand business communication.

3. Business communication

In the section above, we presented different theories and models which address business transaction. Within this section, we will address theories and models which describe business

communication. As we have observed in the previous chapter, business communication forms an integral part of the whole transaction. This chapter will pay special attention to analyzing business communication, since communication as a phenomenon has a very complex nature as well.

There are a number of models and theories in the IS literature which look at a business transaction from a communicative point of view. This section begins with the models and theories from IS which address business transaction from a communication point of view. We then provide some background about reference disciplines that deal with business communication and enrich the analysis based on that.

3.1 Communication

In Part one, we introduced a semiotic approach towards communication: as an ongoing process of exchanging signs. To understand the process, communication models that depict the communication process are often developed. Below we provide an example of a communication model for illustrative purposes.

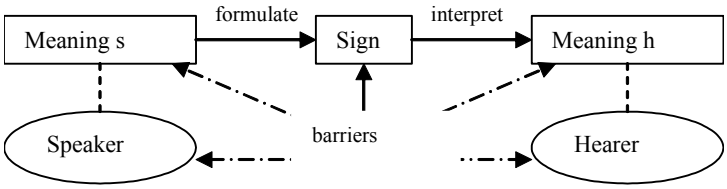

Figure 3.1 Linear communication process (Reijswoud 1996)

The model indicates that conceptions in the mind of the speaker need to be expressed in a sign before being communicated; this sign needs to be interpreted by the hearer. This is a linear communication process model. A cyclic model of communication is also available (Reijswoud 1996). Such models illustrate that signs are used during the communication, and signs need to be interpreted. In Part 1 we introduced the semiotic framework where a sign needs to be interpreted at six different levels: physical, empirics, syntax, semantics, pragmatics, and the social world. We observed that while problems at the physical, empirical, and syntactic level (to which Stamper (1992) refers as technical infrastructure) have already been widely addressed, problems at the semantic, pragmatic, and social world levels which form part of the human information function, still remain challenging. In that respect we focus on the upper three levels of the framework.

Let us now investigate the different levels of the framework. A brief description of each level is provided in the table below. Although the physical, empirical and syntactic level will not be a subject of further study within this thesis, they are included for better understanding of the semiotic framework as a whole.

Social world	Common understanding, values, norms of conduct
Pragmatics	Intentions, conversations,
Semantics	Meanings, validity of propositions
Syntactics	Structures and their manipulation
Empirics	Transmission of variety and form
Physical	Refers to media, tokens, and signals

Table 3.1 The semiotic levels

If we apply the semiotic framework to the model of Reijswoud (1996), we can say that the sign that is communicated can be further analysed at semantic (*S*), pragmatic (*P*), and social world (*SW*) levels[8].

[8] We exclude the other three levels, as they are not a subject for our analysis.

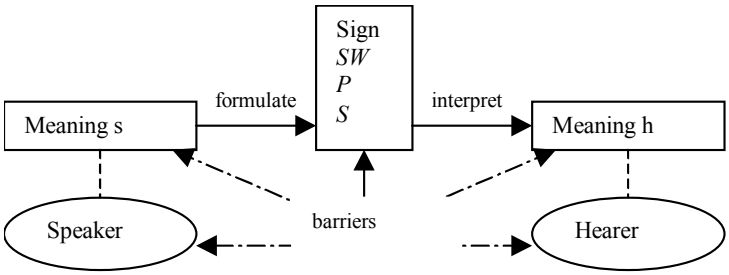

Figure 3.2 The communication models explicitly addressing the semantic, pragmatic, and the social world levels.

Now that we have introduced the notion of communication, the role of the speaker and the hearer in the process, and we have defined the focus of our interest, i.e. semantics, pragmatics, and social world level of communication as a next step we need to identify theories which will help us to understand each level. Below is a quick orientation of such available theories.

As argued by Stamper (1992) and Huang (1998), to address the semantic level one needs to address the question of meaning. It is further argued that ontological approaches can help to further address the issue of meaning. Stamper (1992) and Huang (1998) argue that to address pragmatics one needs to look at studies that deal with intentions behind the communicated information, and suggest that language action perspective can be a useful starting point for understanding pragmatics. The social world deals with norms that govern the behaviour of people within a given social context. The authors suggest that the social world level can be analyzed by studying the social norms. We will take these theories as a starting point to further explore the semantic, pragmatic, and social world levels. Below we will provide a brief introduction to theories which address semantics, pragmatics, and the social world.

Although a logical way to discuss semantics, pragmatics, and the social world would be as they appear in the semiotic framework, we follow a different order to discuss the related theories and begin with pragmatics. The reason is that during the exploration phase we found a number of models which discuss business transactions from a communication perspective. This can be seen as a logical continuation of the discussion from section two of this chapter where we saw that communication is an integral part of the business transaction. The communication models can help zoom in and provide in-depth analysis of the business conversations related to a business transaction. These models have been developed within the language action community and focus on the pragmatic level; we consider it appropriate to discuss them first.

Semantics and the social world levels are seldom addressed in the context of business transactions; we will discuss them after the pragmatic level and will illustrate how they can fit in the context of business transactions.

3.2 Language action perspective and pragmatics

The issue of pragmatics has been widely addressed in IS within the language action community. We present several models describing business conversations and then some background about the reference theories underlying the language action perspective.

The first model is the basic conversation for action schema developed by Winograd & Flores (1986) (figure 3.3). We begin with the work of Winograd and Flores, as they are the first to introduce the language action perspective in the field of IS. The model below is a generic schema from which a number of conversation scenarios that can occur during a business transaction are defined.

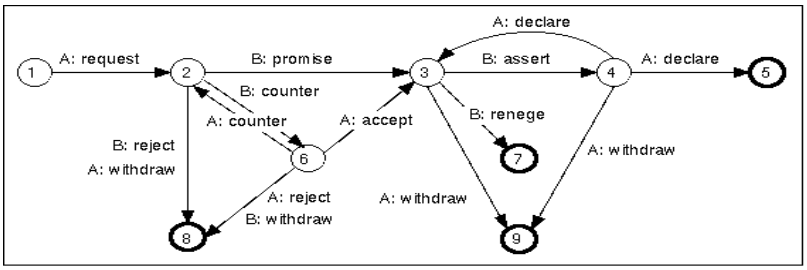

Figure 3.3 Basic conversations for actions schema, adopted from (Winograd and Flores 1986)

The schema represents a conversation between two parties (A and B), and the states that the conversation can follow. There can be different scenarios that a conversation between these two parties can follow.

One example of such a scenario derived from the schema is: party A requests something from party B (the conversation moves from state 1 to state 2). Party B promises to fulfil the request (from state 2 to state 3). After fulfilling the request, party B asserts to party A that it has fulfilled what it promised (from state 3 to state 4). If party A agrees that what was delivered to it was what was requested, party A declares this and the conversation moves from state 4 to state 5. Another scenario described in the model of Winograd and Flores is as follows: party A requests something from party B (from state 1 to state 2) and party B rejects it (from state 2 to state 8).

Rijswoud (1996) further develops the ideas of Winograd and Flores. In this model, there are two actors (although not directly visible in the model), initiator and executor, which enter into business conversations. Rijswoud defines three layers explicitly, through which a business conversation with respect to a business transaction can take place.

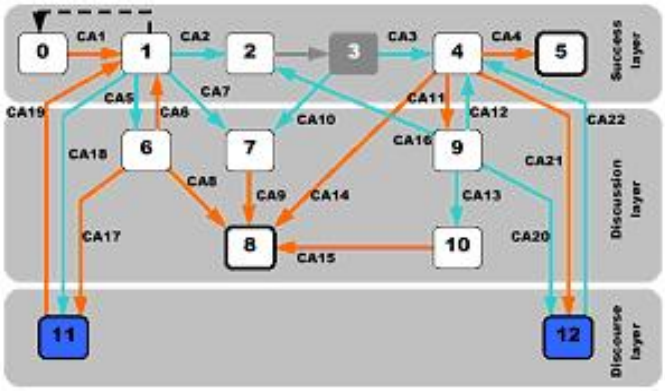

Figure 3.4 Basic transaction patterns (adopted from Rijswoud, 1996)

The first layer is the success layer: when a business transaction is successfully executed. The squares indicate the states of the conversation; the arrows indicate communicative acts (CA). CA1 means a request for an action from the initiator of the transaction to the executor of the transaction. CA2 indicates that the executer promises to fulfil the request. After that promise, the executer may take actions to fulfil the promise.

If the request is fulfilled, the executer communicates that to the initiator (CA3 means that the executor has completed his promise). Finally, the initiator may reciprocate that he agrees with the result (CA4). The conversation may also move to the discussion layer where further negotiation about the terms may take place, the executor may decide to reject the request, or the initiator may decide to reject the result. The business conversation may also be temporarily suspended. The

transaction then moves to the discourse-layer (transaction states 11 and 12). Communication in the discourse-layer is not further specified.

The language action perspective has found application in the development of methods for business modelling, DEMO being one of them (Reijswoud and Dietz 1999).

The theories underlying the language action perspective can be traced back to the work of Austin (1962). Austin is the founder of the speech act theory. According to Austin to say something is to perform three simultaneous acts: one locutionary act, one illocutionary act, and one perlocutionary act. The locutionary act is the utterance of certain words in a certain sequence with a certain meaning. When a locutionary act is performed, an illocutionary act is also performed at the same time; that is we do something by speaking (e.g. making a promise). By saying something, one also causes an effect on the hearer (e.g. changing the knowledge about something or causing the hearer to react in some way); a perlocutionary act.

Searle (1969) further elaborated the notion of locutionary act where the concept of a speech act consists of four different sub-acts: the utterance act (uttering words), the propositional act (referring or predicating), the illocutionary act (e.g. stating, questioning, promising), and the perlocutionary act (causing effect in hearers). A number of authors introduce and stress the importance of the multi-functionality of speech acts based on the work of Searle. Ågerfalk (2002) states that a single utterance can be directed towards different listeners with different illocutionary (and perlocutionary) intent, and that a single speech act can be directed towards a single listener with multiple intents. Ågerfalk represents this idea in the following chart.

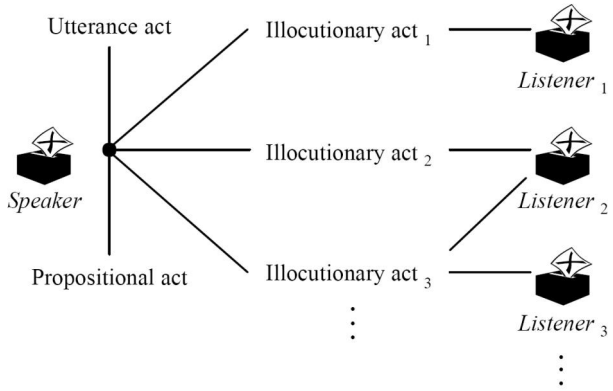

Figure 3.5 The notion of multi-functional speech act.

The figure illustrates that a speaker, by performing the same utterance act and the same propositional act, performs different illocutionary acts depending on who the listener is. The perlocutionary act is implicit in this picture.

There have been several attempts within the language-action community to identify the main building blocks of communication. They will be discussed below.

Langefors (1973) introduces the notion of the e-message as an elementary unit of analysis. According to Langefors, an e-message consists of four basic terms to give information about the property of an object: the identity of an object, the kind of property, the specification of that property for that object, and the point in time at which the information is valid. We add that an object can have multiple properties. Thus each combination of object (id), property, property value, and time can result in an e-message.

Although using the elements of an e-message is a good starting point for describing communication, it provides a limited view as it implies a purely descriptive approach toward information (Goldkuhl and Lyytinen 1982; Winograd and Flores 1986). Language can be used not only to describe things, but also to perform actions (Austin 1962; Searle 1969; Habermas 1984; Goldkuhl 1995). In order to capture the intention behind the communicated information, the notion of action elementary message (ae-message) is introduced (Agerfalk 1999; Agerfalk 2002; Goldkuhl and Agerfalk 2002). The notion of the ae-message is built upon the notion of the e-message and extended to capture the intention. An ae-message is composed of four elements: the communicator, the interpreter, the propositional content (the content that is communicated), and the communicative function (the intention behind the communicated information). Further elaboration of the notions of communicative function and the propositional content is provided below.

The propositional content is the content which is communicated. The propositional content has the role of referring and predicating with respect to the domain of interest. The other concept included in the ae-message which deserves attention, is the communicative function (synonyms are illocutionary act and action mode). The communicative function contains the intention of the speech act. Different types of communicative functions (illocutionary acts) can be identified (Searle 1969; Habermas 1984). For illustrative purposes, we provide the classification available from Searle below. Searle identifies five types of illocutionary acts (communicative functions):

- Assertive- to state how the world is (e.g. to claim, to inform, to predict);
- Commissive- to commit to do something (e.g. to promise, to offer, to accept, to refuse);
- Directive- to make the hearer do something (e.g. to request, to order, to permit);
- Declarative- to change the world through the utterance (e.g. to declare, to appoint, to approve);
- Expressive- to express feelings and attitudes (e.g. to apologize, to thank, to congratulate);

If we look back at the model of Winograd and Flores (1986), we can see that it is constructed using a number of these illocutionary acts which carry the intentions of the speaker. We will not go into further discussion about the foundations of the language action perspective. What is important is that the communicative function captures the intentions behind the communicated information.

Although describing ae-messages is a big step in describing communication, the Speech-act approaches focuses mainly on individual speech-acts rather than the whole conversation: the speech-act theory cannot be used to explain the organization of communication (Goldkuhl 2003). The research done by Winograd and Flores (1986) is an important addition to the speech-act theories, as an attempt to capture the logic in the conversation and to identify conversational patterns. The work of Flores and Winograd has influenced a number of researchers in the field of Language action perspective. A number of communication patterns have been derived based on the conversation for action scheme, though the derived patterns seem to be rather prescriptive. Although interaction patterns can be helpful in eliciting the conversation requirements, their use should be done with caution (Goldkuhl 2003).

Within this section, we provided background information for understanding the pragmatic aspect of communication. We presented theories and models which are part of the foundation for understanding the pragmatics. In the next two sections we provide further elaboration concerning semantics and social world levels.

3.3 Semantics

We have begun to look at communication at a pragmatic level, identifying models that directly present possible business conversations in a business transaction. As discussed earlier, the pragmatic level aims to capture the intentions behind the communicated information. From the point of view of the semiotic framework however, a sign needs to be correctly interpreted at a semantic level before the interpretation at a pragmatic level can take place. This section provides further insights into semantics.

The discussion that follows is based on FRISCO report (Felkenber and al. 1998), which we have already briefly introduced earlier in this chapter. We chose to use FRISCO, as it concisely provides a review of the relevant theories that discuss what meaning is.

The starting point is the distinction between signs, their meaning and their relation. This distinction can be traced back to the ancient Greek philosophy and Aristotle. A traditional way of representing this is the meaning triangle (Ogden and Richards 1972). The meaning triangle describes the relationship between objects in the real world, the concepts that people create in their mind about these objects and the representation of these objects (figure 3.6)[9].

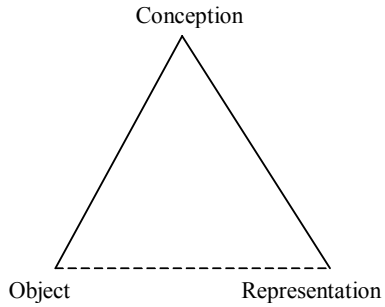

Figure 3.6 The meaning triangle.

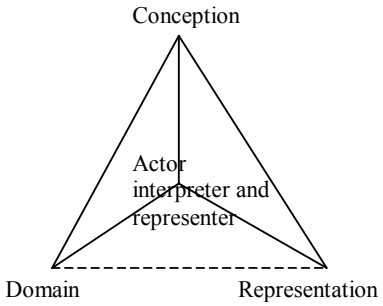

Figure 3.7 FRISCO semiotic tetrahedron

Later, Peirce (Hartshorne 1931; Moore 1982), extends the three classical (Aristotle/Ogden) categories by adding the concept of "Interpreter". These ideas have been synthesized in the so-called FRISCO semiotic tetrahedron. Here object is replaced with "Domain", where "Domain" is the part of the world under consideration. There are different views on meaning.

The objectivists' view assumes a direct relationship between the representation and the objects in the real world, and the agreement about meaning is taken for granted. The constructivists' view assumes there is no prior agreement about the meaning; that agreement is achieved via a communication process and meaning is constructed. As argued in part one Chapter 2 section 3.2.2, within this thesis we adopt the view that meaning is socially constructed.

In FRISCO it is argued that through a communication and negotiation process, actors in a given social context can reach an agreement about the domain of interest, the conception of the domain, and the representation of the domain. This process continues until an agreement is reached within a group of people. Once such an agreement is achieved, it can be accepted that the understanding of the domain, conception of the domain, and the representation remain relatively stable over time and people will share the same meaning.

[9] There are some differences between the representation and the terminology used in FRISCO to describe the meaning triangle and those used by Ogden & Richards. We will use the FRISCO terminology so that we can follow the evolution of the discussion concerning meaning.

To return to the communication model described in section 3.1 (see also figure 3.8), to be able to have a meaningful interpretation of a sign at a semantic level means that the communicator and the interpreter need to share a domain, conception, and a representation of the domain.

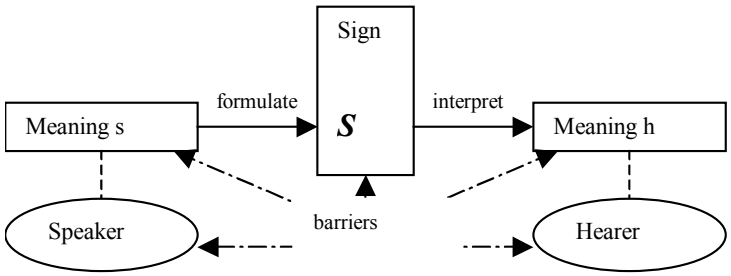

Figure 3.8 Communication from the point of view of semantics.

We now briefly discuss the three components needed to have a meaningful communication (the domain, the conception, and the representation of the domain).

3.3.1 Domain

We have defined "Domain" as part of the world under consideration. Based on our basic ontological and epistemological assumptions (see Part 1 chapter 1) we can say that we do have access to things in the real world only through our conceptions. At this level we will not go further in trying to identify concepts describing the domain. This discussion will be partially included in the next section, when we talk about the conception of the domain.

3.3.2 Conception

When we look at the area of information systems we see that conceptual modelling has been widely used for identifying, analyzing, and describing the essential concepts and constraints of a domain. "Conceptual modelling (or semantic modelling) focuses on capturing and representing certain aspects of human perception of the real world so that these aspects can be incorporated into an information system" (Wand, Storey et al. 1999). Conceptual modelling is done with the use of conceptual modelling languages; the languages define how to look at the world and what to model. Ontological modelling is concerned with capturing the relevant entities of a domain in an ontology using specific language based on a small set of basic, domain independent, ontological categories forming an upper-level ontology (Guizzardi, Herre et al. 2002). In a number of works it has been illustrated that modelling power of conceptual modelling languages can be evaluated in terms of an ontologically based set of constructs. BWW and FRISCO are examples of such upper-level ontologies[10]. We have discussed to some extent the role of the domain independent ontologies in section 2.1.2 in the context of the process of modelling formalisms as well. We will not pursue a discussion concerning the role the domain independent ontologies play with respect to processes and to capturing the domain of interest. We will return to this discussion in part 2 Chapter 4.

3.3.3 Representation

Meaning can be defined by linking a domain with a conception and the representation of that domain. We now focus our attention on representations. As discussed when introducing the meaning triangle, representations are signs that stand for something that being represented. Translation is a major issue regarding representations. The issue of translation of representations has been widely discussed in the medical domain, where issues are how to find translation mechanisms between different vocabularies and terminologies (e.g. Kornai & Stone, 2004, Zhang,

[10] The discussion here is similar to that concerning the process modelling languages; the difference being that the concepts to be used for reasoning about business processes need to capture the dynamics of the domain, while the focus is on the description of the domain and the existence of things in case of the domain model.

2002). For example, the ICD-O classification uses the code 82453 to represent the concept "adenocarcinoid tumour", while the SNOMED classification uses the code M-82453 to represent the same concept. A number of scientists argue (Zang, 2002; Patel& Kushniruk 1997; Norman, 1988) that a critical issue is the relationship between the vocabularies and external classification systems and the clarification of mental concepts inside the heads of the users.

As described in FRISCO, two situations that refer to the link between conception and representation are commonly addressed: the synonym and homonym. A synonym situation is where different representations refer to the same conception. The "adenocarcinoid tumour" example provided earlier illustrates this. A homonym situation is where the same representation refers to different conceptions.

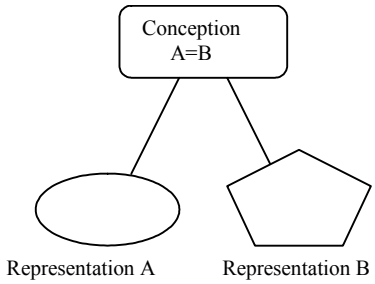

Figure 3.9 A synonym situation

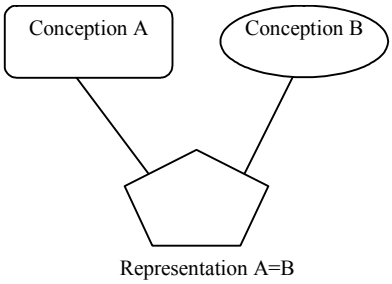

Figure 3.10 A homonym situation

There can be other situations as well, for example a direct one-to-one translation might not always be possible and the translation may be approximate. A full elaboration of translation issues is out of the scope of this thesis.

So far, we have introduced some theories and notions that can help us to understand the semantic level. What we still need to address is the social world level from the semiotic framework.

3.4 Social world

According to the semiotic framework, the social world is the highest level where signs need to be interpreted. The social world level addresses shared knowledge about the actions that people can be expected to perform and the responsibilities that people carry. The social world addresses the norms (laws, rules), which govern behaviour and co-ordinate actions within a given social context. A sign is interpreted at a social world level according to the shared norms which govern behaviour. This has been addressed by a number of research works: Stamper (1992), Huang (1998), and Stamper et al. (2000). The term "social world" is very general in nature and can capture different elements that influence social interactions, culture being one of them. The way the social world level is operationalized in the works of Stamper, is that the focus is mainly on social norms. As we are interested in capturing the context of a business transaction, within this research we are not interested in the social world in general, but rather in the rules that govern the behaviour of actors in a transaction. For the purpose of our study we limit study of the social world to the study of the social norms, which govern the behaviour of the actors in the transaction.

The operationalization of the concept of norm can be traced back to the work of von Wright (1963). Von Wright suggests that a norm has six components: the character (the effect of the norm, typically "ought to" for a mandatory norm, "may" for a permissive norm, and "must not" for prohibitive norm), the content (activity or action prescribed by the norm), the condition (the circumstance or state of affair in which the norm should be applied), the authority (the agent who

initiates the norm), the subject (the agent who can apply the norm), and the occasion (the location in space or time in which the norm is given).

In the IS literature, a number of papers focus on norm analysis and its application in the area of information systems (Stamper 1992; Stamper 1996; Huang 1998; Stamper, Liu et al. 2000). Stamper identifies different types of norms: perceptual, evaluative, denotative norms, cognitive norms, and behavioural norms. The behavioural norms (also called deontic norms) are the most interesting for this research as they govern behaviour, (e.g., an agent may be obliged, prohibited, or permitted to act in a certain way). Stamper also discusses the notion norm structure. The norm structure suggests that norms can be expressed in a structured way using the formula "if a certain condition applies, then a norm subject adopts attitude towards some proposition". The description of the norm structure provides a systematic way to reason about the norms. The ingredients in describing the norm structure are the condition (the state of affairs that triggers the use of the norm), the norm subject (any type of responsible agent), the attitude (represents variously a disposition, which can be an expectation, an obligation, an evaluation, or a perception), and the proposition (or the content of the norm, which may concern a specific concrete act, e.g., driving on the right, or a social act, e.g., acknowledge ownership). The use of norm structure has been studied and applied with respect to business processes and business modelling (Shishkov, Xie. et al. 2002).

Norms can be considered as informal implicit, informal explicit, formal, and technical. Informal norms are all the norms known to people and that people live according to. Norms are labelled informal implicit if they are available at some unconscious level of thought. People behave accordingly, without explicit awareness. The informal explicit norms are those which people are aware of and they can formulate in some way. Formal norms are expressed as explicit rules and are officially recorded in written form such as law and legislation. Technical norms are embedded in some machinery, usually computer programs.

Stamper et al. (1988) provide another interesting categorization of norms according to the tasks to be performed, in the MEASUR techniques for problem articulation. The norms are divided in three categories: substantive, communicative, and control. Substantive norms govern the subjects' performance of the essential, productivity related tasks of an organization. An example of such a norm in logistics is moving of goods from one location to another. Communication norms are about messages to be communicated; within this category are messages like orders and invoices sent between companies. Control norms direct the organizational behaviour by evaluating judgment of actions in the course of control, and assigning rewards and punishments in order to obey norms. Between organizations, it may be generated by inter-firm arrangements or contracts governed by law.

Stamper discusses the notion of social norms coming from a semiotic perspective. If we look at the theories and models discussed in section two of this chapter, we can say that when we talk about economic exchanges, business networks, and business processes, we can also implicitly or explicitly find the notion of what is commonly referred to as business rules. It seems that the notion of business rules is similar to what Stamper refers to as norms, an overlap that is not surprising. From a semiotic perspective, norms define how signs need to be interpreted correctly within a social context, so the responsible agents can take the right actions. From a business perspective, we can say that the actors in the exchanges, as well as the actors in the business network where this exchange is embedded, actually define the social context in which business transactions are carried out. They define and agree on the business rules which determine the responsibilities and the behaviour of the actors in the process of carrying out business transactions.

The notion of "norm" as discussed in semiotics seems to be similar to the notion of the "business rule" widely used in practice. As the word "norm" seems not to be as widely adopted in practice as the word "business rule", we will use "business rule" instead of "norm" for reasons of recognizability in the rest of this thesis.

There is one issue that to discuss further, namely the link between the pragmatic aspect and the business rules. As discussed in section 3.2, business utterances can carry different intentions and one can identify different patterns of conversations. These patterns can describe the path that a conversation can take in general. The business rules specify what specific behaviour an actor needs to adopt in a specific situation, and define which path to follow in the specific situation. Let us take again the model of Winograd and Flores (1986).

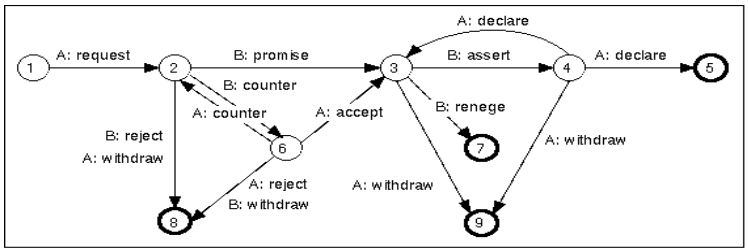

Figure 3.11 Basic conversation for action schema, adopted from Winograd and Flores (1986)

After receiving a request from Actor A, actor B has three possible options according to this pattern: to promise, to counter, or to reject the offer. The business rules, specify exactly which path the actor should follow under certain conditions and what actions (substantive, communicative, control) to take in a specific situation.

4. Linking business transaction to business communication

We have explored some existing theories and models that can help understanding business transaction and business communication, two notions that are closely inter-related. Below we discuss two models: Weigand et al. (1998), and Lind and Goldkuhl (2003), a further elaboration of the model of Weigand et al.. Both aim to provide links between business transactions and business communication. We included these two models to provide insights about how to combine the detailed levels required for analyses of the conversations (the individual speech acts), and provide a way to gradually capture the complexity of a transaction as a whole.

The first framework is the framework of Weigand et al.(1998). Weigand et al. apply the notion of patterns to electronic commerce and arrive at a layered pattern architecture consisting of five layers of meta patterns, starting from low level speech act to high-level scenario. The authors take speech act as the first layer and basis. The second layer is transactions. Transactions are units composed of speech acts, for example, a request/ commit. Transactions can be grouped in workflow loops (layer three). Each loop consists of the following speech acts: request, commit, state, and accept. The fourth layer is contract. A contract represents a reciprocal relationship and typically consists of two workflow

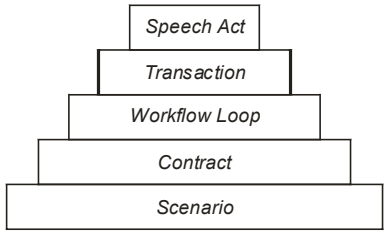

Figure 4.1 The layered pattern architecture, adopted from Weigand et al. (1998)

loops. Finally, a set of related contracts is called a scenario".[11] The value added by this model is that it provides a structured way to analyze business communication with respect to a business transaction by gradually proceeding from a speech act through each level to arrive at a scenario. Although the idea of transaction in an economic sense is implicitly present, the framework focuses mainly on business conversations and does not include the economic perspective in the sense of the transfer of goods/service for some form of compensation.

Lind and Goldkuhl (2003) modify the framework provided by Weigand et al., and try to incorporate the economic perspective of a transaction apart from the communicative perspective. The framework of Lind and Goldkuhl (see figure 4.2) consists of the following five layers: business act, action pair, exchange, business transaction, and transaction group. The authors position the business act at the lowest level. A business act can be speech act (communicative act) or a material act (e.g., delivery of a product). On the second layer, two business acts are grouped into an action pair. The third layer is the exchange layer. Within this framework the notion of exchange is not limited to economic exchange, but also includes exchange related to different kinds of communicative acts (e.g. exchange of proposal, exchange of commitment). At the next level, business transaction is defined as a "pattern built from different types of exchanges related to each other". The last layer, called transaction group, covers long-term agreements that cover a number of business transactions (i.e. transaction group).

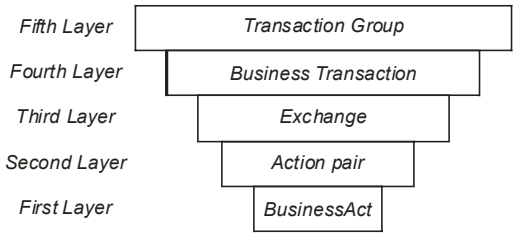

Figure 4.2 Layers of generic patterns for business modelling adopted from Lind & Goldkuhl (2003).

As discussed earlier, the value added of such models is that they illustrate how to combine the level of detail needed to describe the individual conversations and the broader context of a business transaction, in which these conversations are embedded.

5. Conclusions

The goal of this chapter was to address the exploration phase related to the construction of the system of concepts. We have reviewed available theories and models addressing business transactions and business communication and have gained initial insights of elements that may possibly be included in the system of concepts. As a result of the exploration phase we have arrived at the general observation that business transactions and business communication are complex phenomena that can be addressed from different perspectives. We are aware of the fact that there may be theories addressing business transactions and communication, which we were not able to address in our exploration. The goal of this thesis is not to make a complete review concerning these matters, but to use some of the available knowledge to construct a system of concepts. So far, we have completed the exploration phase concerning the construction of the system of concepts. In the next chapter we proceed with the focus phase concerning the construction of the system of concepts. There we will make decisions about how and which of the available theories and models to use as a basis for the system of concepts.

[11] For further clarification of terms like transaction, contract, workflow loop, and scenario in this context, please refer to Weigand et al.. (1998).

"Perhaps the greatest benefit of conducting interdisciplinary research is the opportunity to view issues from many and often very different perspectives….Today the rapidly changing intersection of science, society and management provides a persistent intellectual challenge at one of the most dynamic times in the history of the world. This means conducting good science that is not only useful but is used to resolve current and emerging issues."

Naiman, Ecosystems (1999) 2:292-295

Chapter 2. Focus

1. Introduction

The goal of part two is answering the research question formulated in Part 1 Chapter 2:

What should a system of concepts consist of in order to:

- help in analyzing the DBT situation, the specified requirements of the DBT situation, and the chosen standard;
- help in analyzing possible mismatches between the specified DBT requirements and the chosen standard, and between the DBT situation and the specified DBT requirements;
- identify potential problems with the execution of a business transaction, based on the above analyses.

In Part 1 Chapter 2 (section 5.1) we discussed the research approach for the construction of the system of concepts. We argued that the system of concepts needs to capture key elements concerning business transactions and business communication and we made the decision to follow a predominantly theoretical approach. Finally, we outlined three phases in the construction of the systems of concepts: exploration, focus, and choice.

The goal of this chapter is addressing the second phase in the construction of the system of concepts, called the "Focus" phase (figure 1.1)

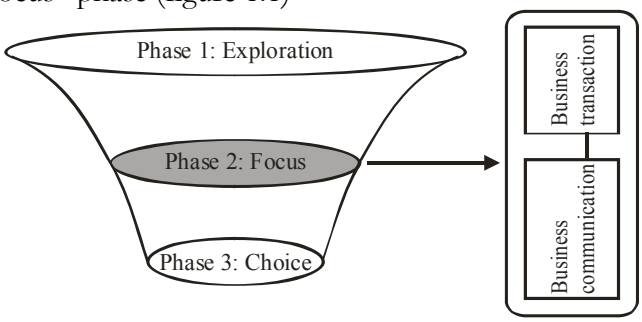

Figure 1.1 Focus phase

The purpose of this phase is to identify ideas concerning business transactions and business communication from the literature reviewed during the "Exploration phase", which may be helpful in addressing the problem at hand.

2. Mono and multi-disciplinary research

Part 2 Chapter 1 focused on the exploration phase, reviewing a number of theories and models which address elements of business transaction and business communication. Based on exploration phase findings, we arrive at a few major observations. First, there is a rich body of knowledge discussing business transaction and business communication from different perspectives. Second, to better understand the complexities related to business transaction and business communication requires following a multi-disciplinary approach.

The IS field stresses the importance of conducting multi-disciplinary research. IS involves much more than the development of computer-based business systems and, as a discipline, must be concerned with the general evolution of human communication (Mingers and Stowell 1997). Therefore it must draw upon a wide range of disciplines- technology, psychology, economics, sociology, mathematics, linguistics, semiotics- encompassing very different research traditions (Mingers 2001). One major benefit of multidisciplinary research is its ability to deal with real-world complexity, however, conducting multidisciplinary research is not without limitations (Mingers 2001). Here we focus on two major limitations in conducting multidisciplinary research: the breadth vs. depth dilemma, and the difficulty in learning to understand different languages.

2.1 The breadth vs. depth dilemma

Figure 2.1 illustrates the breadth vs. depth dilemma in the context of multi versus mono disciplinary research..

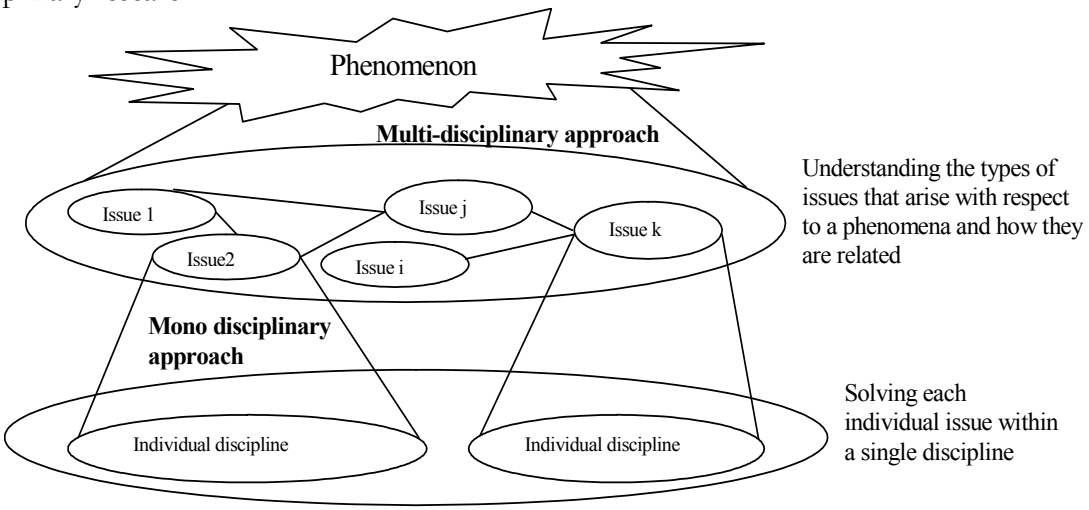

Figure 2.1 Mono vs. multi-disciplinary research

When the research goal is to understand the complexity of a phenomenon, multidisciplinary research can provide substantial benefits such as allowing multiple perspectives of the phenomenon and achieving a more thorough understanding of the types of issues that refer to the phenomenon under study. As Popper (1962) explains:

> The belief that there is such a thing as physics, or biology, or archaeology, and that these "studies" or "disciplines" are distinguishable by the subject matter, which they investigate, appears to me to be a residue from the time when one believed that a theory had to proceed from a definition of its subject matter. But subject matter, or any kind of things, do not, I hold, constitute a basis for distinguishing a discipline. We are not students of

> subject matter but students of problems. Any problem may cut right across the borders of any subject matter or discipline.

While the benefits of a multidisciplinary approach are evident, providing a holistic view of a problem, the immediate consequence is that the level of understanding gained for each individual issue will remain relatively less detailed. In contrast, mono disciplinary research has the capability to address and solve a single issue by providing in-depth analysis, with the drawback of providing a limited view on the phenomenon.

2.2 Difficulties in understanding different languages

Another major issue in conducting multidisciplinary research is "learning the jargon" of individual disciplines and investing efforts to understand the types of problems that are being addressed and solved there. Since the goal of a multidisciplinary study is to understand the complexity of the phenomenon, researchers must invest a substantive amount of cognitive effort in understanding "jargons", then abstracting the essence and reasoning of how a particular discipline can contribute to the broader picture. It is unlikely that a multidisciplinary researcher will contribute to any of the individual disciplines, or that he/she will be able to elaborate or solve a particular problem from an individual discipline in full detail.

2.3 Consequences for the construction of the system of concepts

From this discussion we conclude, first, that if we strive to understand the phenomenon holistically, we must pursue a multi-disciplinary approach. In Part 1 Chapter 2, we argued that the system of concepts seeks to provide a quick scan of the types of problems potentially occurring in a standard implementation project. A quick scan may pinpoint potential problem areas, but does not aim for an in-depth solution to a particular problem. Based on this, we find our goals for the system of concepts require pursuing breadth rather than depth. Therefore, for the further construction of the system of concepts we follow a multi-disciplinary approach.

Second, by choosing to pursue a multi-disciplinary approach we inevitably impose a number of inherent limitations. In looking at a number of different disciplines, rather than one, we acknowledge a limit in understanding any particular discipline. We must obtain basic knowledge to enable understanding the main problems addressed in a multi-disciplinary fashion. It is outside the scope of this research to bring a substantial contribution to any single discipline, as we will spend a significant amount of time understanding "jargons". Nevertheless, we find that the aim of this research, grasping issues occurring in standard implementation projects and identifying them at early stages, requires a multi-disciplinary approach. After identifying these issues, mono-disciplinary experts may be brought in to conduct in-depth analyses of specific issues and to propose possible solutions. These possible solutions may need to be reconsidered at a multi-disciplinary level again, to identify possible conflicts. We now proceed with the focus phase and the construction of the system of concepts.

3. The range of issues to be covered by the system of concepts

In the following sub-sections we address an important subject: the range of issues that need to be covered by the system of concepts.

As mentioned in Part 1 Chapter 2, the semantic, pragmatic, business rule aspects of communication are of major importance, and need to be addressed during the comparison between the communication requirements of the DBT situation and the standard. This means that the system of concepts needs to include a level of abstraction, which can help to reason

about semantics, pragmatics, and business rules. To reason about pragmatics, we must analyze individual speech acts. In Part 2 Chapter 1 we presented several models illustrating the required level of analysis (see e.g. figure 3.3 and figure 3.4, Part 2, Chapter 1). To address semantics, we must reason about the meaning of individual words and expressions (with respect to the objects in the real world they represent and conceptions about them) as well as more complex structures like the proposition of a speech act. Finally, to address the business rules, we need to look into the individual norms governing the behaviour of the actors involved in the business transaction.

As argued in Part 1 Chapter 2 the system of concepts should incorporate elements identifying potential problems with respect to the execution of a business transaction. In this research we assume the ultimate goal of a business transaction is the economic exchange of a good/service for some form of compensation[12]. We have seen in Part 2 Chapter 1 that modelling methods focusing on economic exchanges abstract all operational details and aim to capture the exchange of a good/service for compensation between the actors in the exchange. In this respect, the system of concepts needs to include elements helpful in reasoning about a business transaction at such a level of abstraction.

As we seek to analyze and compare the DBT situation, the specified DBT requirements and the standard, we must perform analysis at a level of abstraction capable of addressing semantics and pragmatics, and business rules. In that case, the system of concepts should incorporate elements capable of reasoning about semantics, pragmatics, and business rules. In addition, as we are interested in potential problems that might have an influence on the execution of the business transaction, the system of concepts should also include elements capable of reasoning about the business transaction as a whole.

The levels of abstraction, at which we need to reason about the performance of the entire transaction on one hand and the semantics, pragmatics, and business rules on the other hand are very different. This makes it difficult to establish a link between mismatches occurring on the semantic, pragmatic, and business rule level and problems with the actual execution of the business transaction. Thus, in addition to the system of concepts needing to address different levels of abstraction, it must also provide a mechanism for the smooth transition between these levels. With this in mind, the next section focuses on the extent to which the available models and frameworks describing business transaction and business communication are appropriate for the construction of the system of concepts.

4. Reflection on existing frameworks and models

In Part 2 Chapter 1 we reviewed existing models and theories addressing business transaction and business communication. In general we find a rich body of knowledge addressing different issues related to business transaction and business communication. However, the models that we identified seem limited with respect to what we aim to capture in the system of concepts. For example, language-action theories provide detailed models discussing individual utterances or business conversations, but remain incapable of capturing business transactions as economic exchange. Also note abstract transaction process models, which provide a high-level overview of the transaction processes but fail to capture the necessary details to analyze semantics and pragmatics. Even layered models like that of Weigand et al. (1998) or of Lind and Goldkuhl (2003) have limitations, remaining at more abstract levels and failing to address issues like

[12] Although as a term 'business goal' may have a broad meaning, within this research we narrow the meaning to the economic exchange of good/service for some form of compensation.

semantics, for example. In this respect we find we cannot directly adopt an existing model for use as our system of concepts.

Yet we find that the identified models and theories provide a rich ground for analyzing business transaction and business communication. We consider it important to reuse, when possible, existing knowledge as a basis for the construction of the system of concepts. However, combining these different models and theories directly into one model is not an alternative. Such a combination will lead to a highly complex model featuring concepts addressing different levels of detail. In addition, combining different approaches into one huge model can be dangerous, as the various approaches have different assumptions and paradigms.

Instead, we require a mechanism allowing us to provide different views of the problem, while also encapsulating the knowledge relevant to a specific view within the view itself. We define a view as a specific way of looking at one phenomenon (business transaction). We derive each view via a set of theories, providing a similar way of looking at a given phenomenon

The idea of using views has similarities with the concept of viewpoints. The concept of viewpoints is used in software engineering to provide multiple perspectives on the same phenomenon, to provide for a better understanding of the situation under analysis, and to identify contradicting requirements (Leite and Freeman 1991; Kotonya and Sommerville 1992). Furthermore, in system modelling, viewpoints are used to define the models to be developed, without the actual representation and in building abstractions (Motschnig-Pitrig, Nissen et al. 1997). However, the notion of viewpoints has its specifics, has been elaborated for other purposes, and may lead to misunderstandings if directly adopted. That is why we prefer to use the term "view" as defined above.

5. The role of the views in the construction of the system of concepts

Figure 5.1 elaborates the role of views in the construction of the system of concepts.

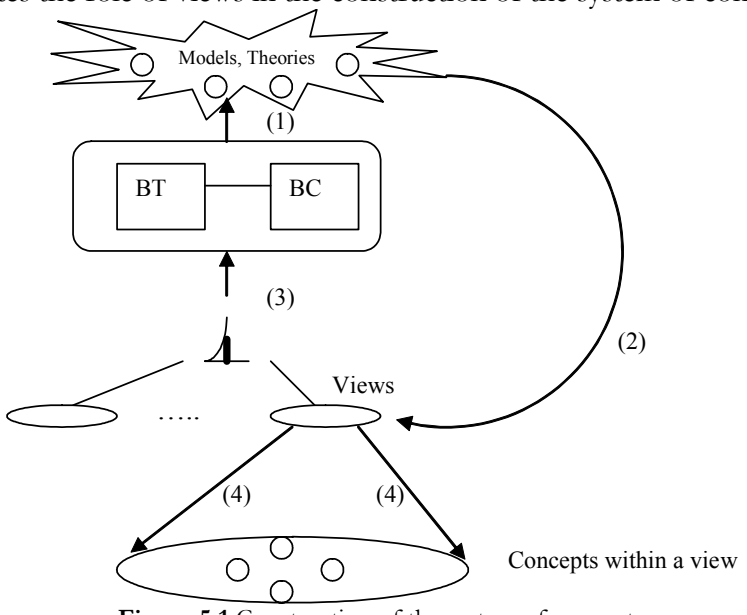

Figure 5.1 Construction of the system of concepts

During the exploration phase, we identified models and theories looking at business transactions and business communication, as represented with arrow (1) on Figure 5.1. In this chapter we will identify theories looking in a similar way at business transactions and business communication. After reviewing these theories, if we find they capture elements relevant to the system of concepts

we will include them as a view. This is illustrated with arrow (2) in Figure 5.1. Currently, we are unable to establish strict criteria for relevance, though some criteria were specified earlier in this chapter. In essence, the views need to capture on one hand the semantic, pragmatic, and business rule level and on the other hand the business transaction in terms of economic exchange. There should also be views ensuring a smooth transition between different levels of abstraction.

Once we define the views, they will provide a specific way of looking at business transactions and business communication (see arrow 3). This chapter will produce view definitions, which may be combined into a high-level system of concepts.

In the next chapter, we elaborate each view to include specific concepts. As each view includes similar theories, we will use these theories for the further derivation of concepts, as represented in Figure 5.1 with the two arrows marked (4). In this way, we achieve consistency of concepts within each view while also providing for structure within the system of concepts.

6. High-level system of concepts

6.1 In search of views

The system of concepts must cover the semantic, pragmatic, and business rule levels of communication. We have argued that as we aim at the identification of potential problems with business transaction execution, the system of concepts also needs to address business transactions as economic exchange. In the previous chapter we saw that each of these issues is addressed by a separate set of theories, and in the following four sections we argue that each of these issues should be treated separately.

6.1.1 The subject matter view

To address the issue of semantics, we have identified that ontological theories are relevant. Such theories will help to look at a business transaction in terms of what the domain of interest of a specific group of people is, and how this domain is conceptualized and represented by these people to achieve a common understanding. Since the theories and issues addressed at semantic level are different from those addressing the pragmatics, it is appropriate to define a semantic view of business transactions and business communication. We call this view "the subject matter view", as it describes the things that exist and about which people communicate in a given community. In this view, analysis will be very detailed, as one needs to go as far as looking at the individual things that exist and how they are conceptualized and represented. The theories that address semantics will be considered for further elaboration of this view.

6.1.2 The communicative act view

To address the issue of pragmatics, we have identified relevant theories in the area of language-action perspective. Pragmatics deal with the intentions behind the communicated information, and the language action perspective focuses on understanding these intentions. As the language action theories address only the intentions and do not analyze in detail the semantics, it is appropriate to include a separate view. We call this view the "communicative act view". The level of analysis at this view will refer to individual utterances and how they are related.

6.1.3 The business rule view

To address the business rules, we have identified relevant theories discussing norm analysis. The focus of the norm analysis is rules that govern behaviour. At this level, people interpret a sign with respect to specific rules which govern their behaviour. This is the level which provides the link between the sign and the actions. It is clear that the theories that address the business rules are different than the theories that deal with the other two levels (i.e. ontology and language

action), thus at this moment it is appropriate to introduce another view: "the business rule view" where the level of analysis will be individual norms[13].

6.1.4 The focal exchange view

The system of concepts will also need to capture elements that look at a business transaction as economic exchange. In Part 2 Chapter 1 we argued that this is the most abstract way of looking at a business transaction. We have identified during the exploration phase that looking at a business transaction as economic exchange is rooted in the economic theories (e.g. Commons) and this way of looking at a business transaction requires a separate view. We will call this view "the focal exchange view", as it will specify the business transaction under analysis.

So far, we have identified three views that refer to business communication and one view that addresses business transactions.

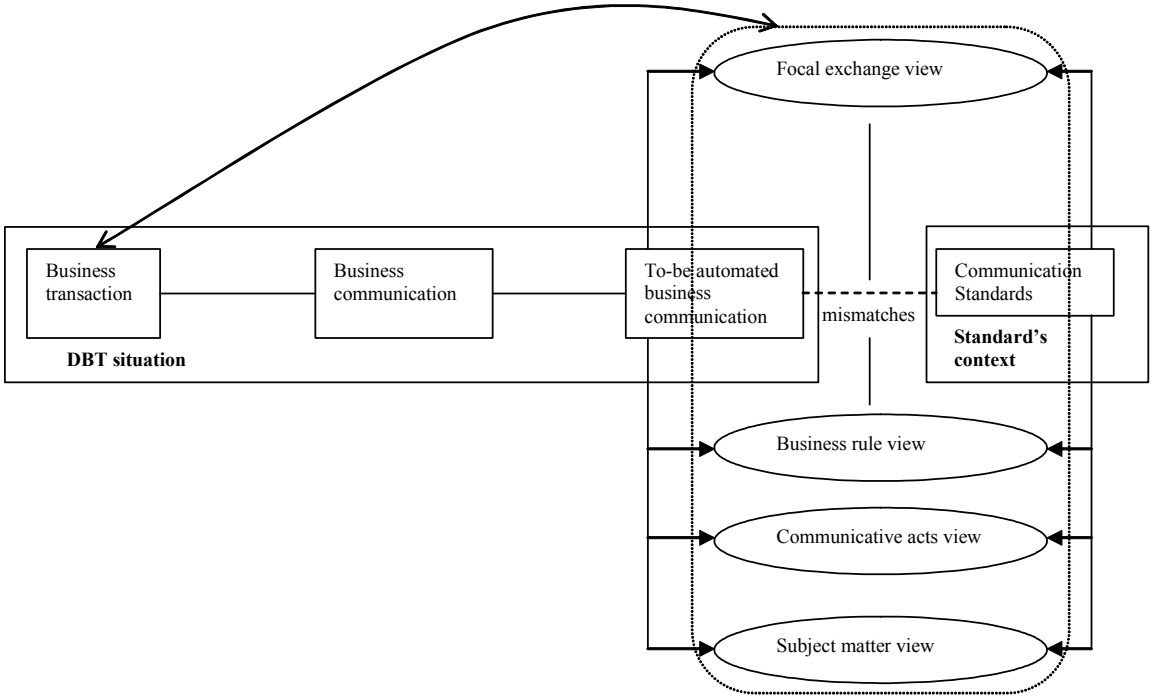

Figure 6.1 The role of the subject matter, communicative acts, business rule, and the focal exchange views

We can use the first three views to reason about business communication. As the "to-be automated business communication" and the "standard" also refer to business communication, this means that these three views and the elements of each (the result of the further elaboration of the views), can be used to compare the "to-be automated communication and the standard. This is indicated in figure 6.1 by arrows starting from both the automated business communication and the standard and leading to each view. During this comparison, possible mismatches can be identified. This is indicated by the dotted open line between "to be automated business communication" and the "communication standard".

Apart from the three views that directly relate to business communication, we have the exchange view which aims to track the ultimate consequences of possible mismatches to the execution of the business transaction. Here however, we encounter a problem. On one hand, we have the subject matter view (which will address the meaning of the individual words and expressions), the communicative act view (which will focus on analyzing individual utterances), and the business

[13] In Part 2 Chapter 1, we have discussed that for the purpose of recognizability, we will use business rule instead of norm

rule view (which will focus on the individual norms and what actions people are expected to perform if certain conditions occur). On the other hand, we have defined the focal exchange view, which focuses on the double transfer of ownership. The focal exchange view abstracts from all the operational details how this transfer of ownership is actually achieved, while the first three views provide a very detailed analysis of parts of a business communication related to a business transaction. It appears that the views defined so far are insufficient to provide for a smooth transition between the views, so that one can trace the consequences of possible mismatches on the execution of a business transaction. This requires additional views to be defined.

Before proceeding, there is one essential remark to make. Although ultimately the goal is to compare the "to-be automated business communication" and the "communication standard", we need to take into account that each of them does not exist independently but is embedded in a broader context. The "to-be automated business communication" is embedded in the context of "business communication" which in its turn is part of the context of the specific class of business transactions. The same is true of communication standards. The standardization documents contain a normative part which defines the operational standard and with which every party which decides to adopt the standard will need to comply with. It also contains an informative part which provides contextual information to help interpret and understand the normative part. In that respect, our analysis will use the views not only for direct comparison of the "to-be automated communication" and the "communication standard", but also for comparing the contexts.

6.1.5 Business process view

In the previous chapter we identified a number of models which look at business transaction in terms of processes (we have discussed models that provide high-level view on transaction processes (Kambil 1997; Gebauer 1999) and examples of models which use formal modelling techniques like Perti Nets and message sequence charts (Aalst 1999)). This perspective corresponds to the technical view on exchange as defined by economists which describes the process which leads to actual delivery of the goods/services and of compensation, or to the process viewpoint, which Gordijn (2000) defines in addition to the exchange viewpoint. The question now is whether including a process view on a transaction will provide a smooth transition between the views.

If we look at the examples of the detailed process models provided in Part 2 Chapter 1, we see that they contain activities, actors, and sequences in which the certain activities can occur. In the business rule view norms are defined which define how people need to act if certain conditions occur. The business process view seems to logically complement the business rule view, as it addresses actual actions that occur and how they are related to ensure the delivery of goods/services and compensation. Other evidence that the norm analysis is closely related to business process analysis can be found in the work of Liu and Ong (1999), where the authors illustrate how norm analysis can complement the business process analysis. We propose another view - the business process view, which actually integrates business communication within the business transaction process.

When we reviewed the transaction processes in the previous chapter, we saw that processes can be at different levels of abstraction. There are a number of process modelling techniques, which can provide modelling at different levels of abstraction, where parts of detailed sub-processes can be encapsulated into higher-level activities.

One might argue that business process includes business conversations and there is no need to study the communicative acts separately. However, although the business process view is valuable

in terms of linking conversations and norms to actions, process models contain only implicit notions about communication. They do not allow analyzing the business conversations explicitly and eliciting the full spectrum of business conversations. Thus we need a separate view to reason and analyze business conversations. By including the business process view we do not need to exclude the communicative acts view. The standards we study are communication standards, so we need the level of detail to understand standards. The standard cannot be studied from a business process point of view, especially in terms of the conversations covered. Business process specifications do not include specifications of the different possible conversations.

So far, we have defined the subject matter view, the communicative act view and the business rule view to address business conversations and facilitate the comparison of the automated business communication and the standard. We introduced the focal exchange view as a view to see the ultimate consequences for the execution of the business transaction, and the business process view which links conversations and actions and can help in tracing the consequences of a misunderstanding.

6.1.6 Business network view

In Part 2 Chapter 2 we observed that the execution of a transaction can depend on the execution of other related transactions (see the example adopted from van der Aalst (1999) as discussed in part 2 chapter 1). As we have seen in part 2 Chapter 1, the embedded nature of the focal dyad in a network is discussed thoroughly in the marketing literature. Therefore we need to include one more view in the analysis: "the business network view".

Although in Part 2 Chapter 1 we provided some argumentation concerning the importance of considering the business network, here we add some comments why we consider the business network view important and complementary to some of the other views defined so far. With respect to the business process view, the business network view can help reason about the identification of relevant actors which facilitate the execution of the focal exchange. With respect to the business process view, the direct exchange relationship to the focal exchange will be of great importance, as they directly contribute to the process which will lead to the execution of the focal exchange. With respect to the semantic, pragmatic and the business rule views, the business network view and especially the direct exchange relationships to the focal exchange, can provide a basis to reason about the different contexts to be considered in a business transaction. As argued in Part 1, each organization operates in its own context but needs to establish a shared context to communicate.

Finally, we consider the business network view, especially the indirect exchange relationships which can be very useful to identify requirements of the DBT situation that are not directly identifiable. It could help identify information and references to important actors and processes that cannot be immediately identified by analyzing only the focal exchange. One such example is in the aerospace industry where information about the production number of the parts in the airplane is exchanged throughout the supply chain, long after the parts have been sold to the airplane producer. The reason for exchanging this information can only be explained by the fact that there is a party from an indirect exchange relationship. The producer of the part will need production information in case there is ever a problem with the plane.

6.2 Overview of the views

The table below summarizes the views defined and their major focus.

The relationship and overlaps are discussed in section 6.3 and 6.4. In the table we also provide labels for each view.

View name	View focus
Focal exchange view (FE view)	Focus on the double transfer of ownership, concerning the business transaction under analysis
Business network view (BN view)	Focus on the business network including the direct and indirect exchange relationships with respect to the focal exchange.
Business process view (BP view)	Focus on the activities and the sequence of activities which lead to the execution of the focal exchange
Business rule view (BR view)	Focus on the business rules that govern the behaviour of the actors involved in the execution of the focal exchange
Communicative act view (CA view)	Focus on the business conversations that support the execution of the focal exchange
Subject matter view (SM view)	Focus on defining the part of the world under consideration, its conception and representation with respect to the execution of the focal exchange

Table 6.1 Overview of the views

Figure 6.2 is a further elaboration of the earlier discussion (see also figure 6.1). The figure illustrates the role the six views can play. The three views in the lower part of the figure (subject matter, communicative acts, and business rule view), can be used for a direct comparison between the to-be automated business communication and the standard, as they directly refer to business communication. Any mismatch between the to-be automated business communication and the standard with respect to any of these three views can be considered a potential problem directly related to the business communication.

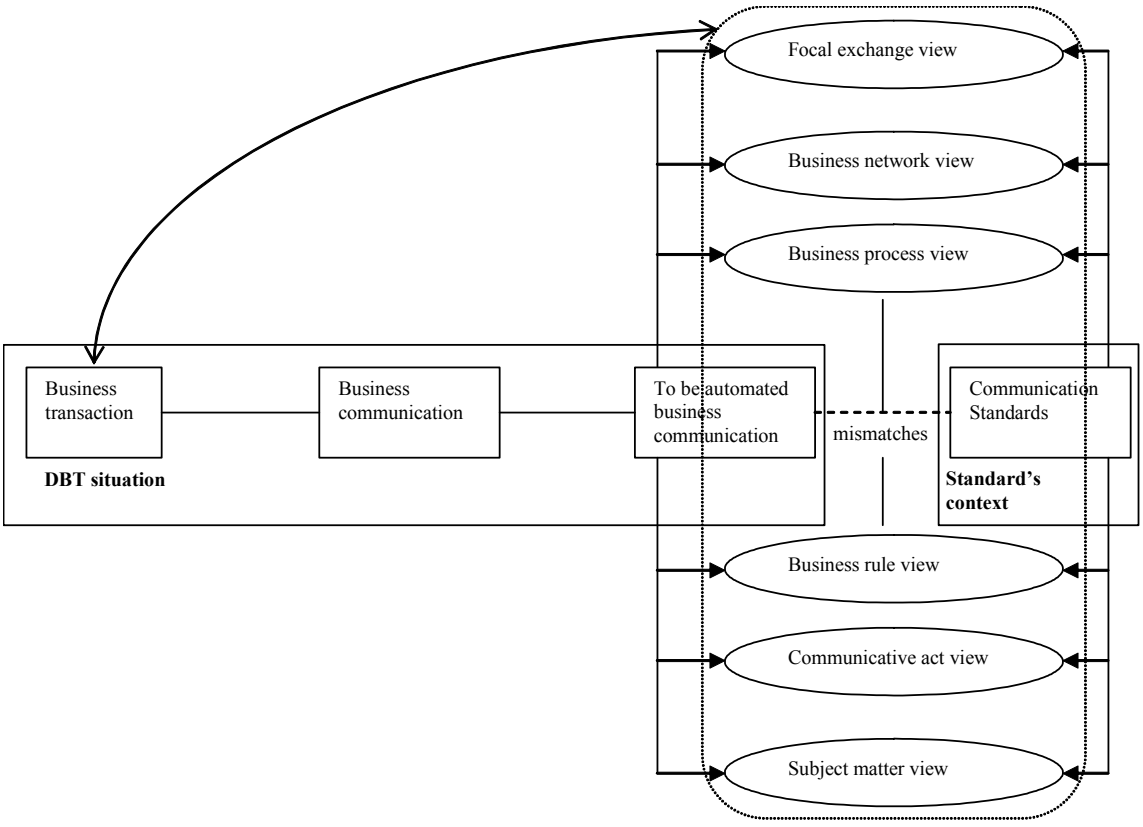

Figure 6.2 Insights concerning the use of the views

The upper three views (the business process view, the business network view, and the focal exchange view), can also be used for a comparison between the to-be automated business communication and the standard. These do not directly address business communication, but the context of the business communication. Mismatches identified using these views will be

mismatches not directly related to the business communication. These signal differences between the context of the to-be automated business communication and the context embedded in the standard. The standard might not contain contextual information concerning the upper three views though there are cases when the standard can contain contextual information in addition to the information directly related to business communication. In the healthcare industry, as we will see in Part 2 Chapter 3, such an example is the HL7 standard, which contains some information concerning the business process view. Although it is quite possible that the upper three views might not always be applicable for comparison between the to-be automated communication and the standard in practice, within this discussion we consider them important for the comparison of the contexts.

The upper three views are important not only for comparison. Their role also complements the three views that are directly related to business communication and provide a mechanism to trace the effects of possible mismatches in execution of the business transaction.

We have identified a number of views and given some idea of how they can be used. The views identified serve as a basis of the high-level system of concepts. In the next section we go a step further and provide insights of how these views are related.

6.3 Relationships and overlaps between the views

Figure 6.3 represents the high-level system of concepts. It includes the views we have specified so far and includes the relationships between the views, which we consider exist.

Each of the relationships will be briefly discussed. The views defined are not mutually exclusive; one can find overlaps between them. Although it is out of the scope of this research to make a complete analysis of existing overlaps, addressing at least the most apparent can clarify the discussion.

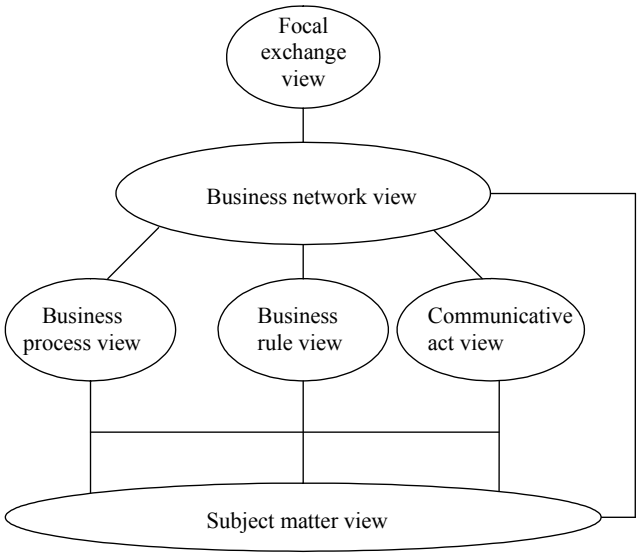

Figure 6.3 The high-level system of concepts

Further elaboration of the relationships between the views and possible overlaps will be discussed in Part 2 Chapter 3.

6.3.1 The focal exchange view and the business network view

Let us begin with the focal exchange view and its relationship to the business network view, which represents the business network in which the focal exchange is embedded (figure 6.4).

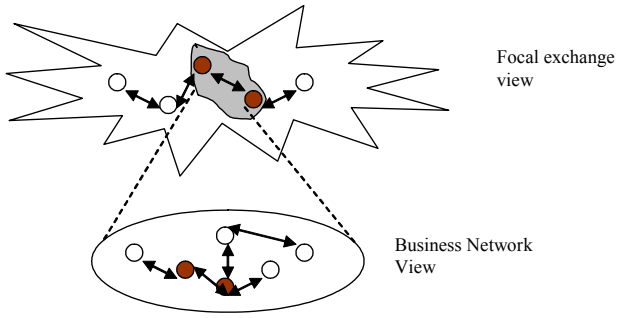

Figure 6.4 Relationship between the focal exchange view and the business network view

The upper portion illustrates how many exchange relationships might take place in real life, though from all these we single out that of interest to us and the subject of further analysis. The role of the focal exchange view is to define what the focal exchange under analysis is. As discussed earlier, the focal exchange is embedded in a business network which identifies the business network in which the focal exchange is embedded. It is important to notice that different focal exchanges can result in different business networks.

As illustrated in figure 6.4, the business network is derived from the focal exchange; when deriving the business network the focal exchange itself becomes an integral part of it. The focal exchange view and the business network view are related in a sense that the business network is derived with respect to the focal exchange.

By looking at figure 6.3 one might argue that the focal exchange view is not related to the other view (with the exception of the business network view). There are two reasons for this. The first is that the focal exchange view plays a main role in deriving the business network view. However, the elements of the exchange view will be embedded in the business network view as the business network will be built around this focal exchange. The second reason is that including these relationships will additionally complicate the model presented in figure 6.3.

It is clear that there is an overlap between the focal exchange view and the business network view. Although we are aware of this, it is still important to keep the focal exchange and the business network view separate. The first reason is for derivation purposes, as the business network view derives from the focal exchange view. The second reason is for tracking the impact potential problems related to the other views could ultimately have on the execution of the business transaction. We discuss tracking these impacts in section 8 of Part 2 Chapter 3, as well as in impact analysis of the method in Part 3 Chapter 1.

6.3.2 The Business network view and the business process view

As illustrated in figure 6.3, there is a relationship between the business network view and the business process view. While the business network identifies the different business actors involved in some respect in the focal exchange, the business process view identifies the activities in which these actors are involved and the sequence of activities which lead to the execution of the business transaction.

6.3.3 The business network view and the business rule view

Another important relationship is between the business network view and the business rule view. The business rule view describes the repertoire of actor behaviour with respect to the transaction, and the business network view identifies the organizational actors involved in the transaction. The relationship between the business network view and the business rule view will elicit the business rules relevant to the participating actors in the business network, with respect to the execution of the focal exchange.

6.3.4 The business network view and the communicative act view

The relationship between the business network view and the communicative view is important as well. Such a relationship will help analyze the business conversations between the actors in the business network. Such an analysis can help us to understand the complex business conversations that actors from the business network undertake with respect to the focal exchange.

6.3.5 The business process view and the business rule view

Let us now look at the relationship between the business process view and business rule view. Business rule view analysis can help elicit the behaviour of the different actors, while the business process view provides links between the different actions the actors undertake with respect to the execution of the business transaction. Although business rules and processes can be analyzed separately, they are related, since business rules govern the course of actions of people which in turn become part of the process. See also Liu and Ong (1999) for further elaboration on the relationship between business rules and business processes.

6.3.6 The communicative act view and the business rule view

The relationship between the communicative act and the business rule view becomes evident if we remember that these two views are derived from the pragmatic and the social world levels. The business rule view in relation to the communicative act view provides the link between the intentions of the communicated information and the rules of behaviour that link these intentions to actions.

6.3.7 The business process view and the communicative act view

The link between the business process view and the communicative view is important. The communicative act view elaborates the broad spectrum of business conversations that may take place between the actors, and the business process embeds these actions into the overall process. Similar to the discussion of the focal exchange and the business network view, there is a substantial overlap between the business process view and the communicative act view. We see the overlaps if we look at business process models discussed in figure 2.6 Part 2 Chapter 1 and compare them to the basic conversation for action schema presented in figure 3.3 of the same chapter. For illustration purposes, we repeat the two models (figure 6.5 and 6.6).

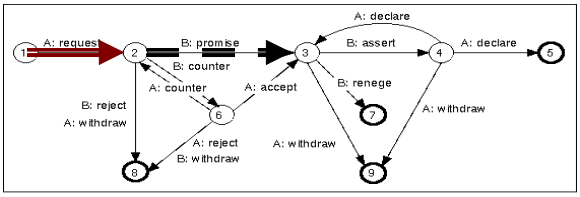

Figure 6.5 "Request" and "promise" as part of a model of business conversations

The basic conversation for action schema for example, suggests that in a business conversation, one party can request something from another party and the other party can promise to fulfil the request in return (double arrows in figure 6.5). We find these conversations in the process model in figure 6.6 as well, where the customer requests a product from the producer and the producer promises to deliver it.

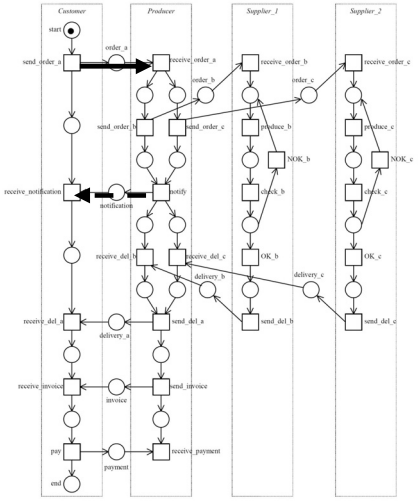

Figure 6.6 "Request" and "promise" as steps in the process

Although there are apparent overlaps between the communicative act view and the business process view, there are also differences we consider important and require two separate views.

The major difference between the views can be traced to the theoretical foundations behind them. The communicative act view is based on the language action perspective. This perspective is language-based and rooted in the speech act theories where to say something is not only to pronounce words, but also to perform an act (see also Part 2 Chapter 1 section 3.2).

The business process view stems from another set of theories where the process is viewed more from an organizational perspective. The process relates the activities, not only communicative but also substantial (substantial activity is for example the physical delivery of products), and defines how these activities can be orchestrated to achieve some organizational goals.

We can bring this discussion further and include standards as well. Communication standards are sometimes referred to as technical standards, as they aim to automate communication between computer systems. Often the goal of the communication standards is indeed limited to the communication between the computer systems which can be well addressed by the communicative act view and does not address what happens as a result of that communication and how it can lead to the achievement of organizational goals (a subject of the business process view).

We come to two important conclusions. The first is that there is indeed substantial overlap between the communicative view and the business process view. The second is that there are different theoretical bases for the existence of each and each supplements understanding of the business situation and the standard. We shall acknowledge the overlaps but keep the two views as defined.

6.3.8 The subject matter view and its relationships with the other views

To be able to identify what is relevant to a business transaction, we need to relate the subject matter view to the business process view, the communicative view, the norm view, and the business network view.

Regarding the business process, one can identify the things of interest that can become part of the subject matter view by looking at what is needed in order for an action to take place. With respect to the communicative act view, the things that are communicated in the propositional content can provide input. Concerning the business rule view, additional items of interest can be identified by analysis of the individual business rules. Finally, the business network view also provides input for the subject matter view, as it includes the parties of the network as well as the types of things are of interest to the parties in the business network with respect to the execution of the transaction.

We have introduced the high-level system of concepts in terms of views and relationships. The further development of the system of concepts will be a subject of the Part 2 Chapter 3 and the method of how to apply the system of concepts will be described in Part 3 Chapter 1. To give some initial insights about the use of the high-level systems of concepts, we provide intuitive example from the Healthcare domain in the next section.

7. Example

7.1 Background

7.1.1 The business situation

This is a description of a simple type of business situation. A patient with a medical problem visits a general practitioner. The general practitioner examines the patient; after the examination the

general practitioner finds out that he will need the assistance of a medical specialist. He refers the patient to a medical specialist in the local hospital and charges the patient with a fee for the visit.

The patient goes to the hospital and is examined by a medical specialist. The specialist needs further information to provide proper treatment. He orders a lab test to be performed on the patient. Regarding payment, depending on the type of insurance the patient has, it is possible that bills are sent directly to the insurance company.

A project is started which aims to automate communication between the general practitioner and the hospital, the hospital and the lab, and the hospital and the insurance companies.

7.1.2 The standard

Concerning the standard, for illustrative purposes let us start with a simple example, where the HL7 v 2.4 standard is used to automate the communication between the parties. While examining the example, we will gradually introduce the need for additional standards.

7.1.3 Scope of the example

Within this example we would like to provide insights concerning the system of concepts. We focus on the focal exchange and business network views and provide some insights of what we can expect from the analysis using the other views as well. In Part 2 Chapter 3, a number of additional examples will be provided with respect to each view.

7.1.4 Representation technique to be used within this example to analyze the focal exchange and business network view

To arrive at a representation that can capture the communication context of a business transaction, we use Lano matrixes (Lano 1979). The Lano matrixes are NxN matrixes, where the system elements are put on the diagonal of the matrix, and the off-diagonal matrix elements represent mutual relationships between the system elements.

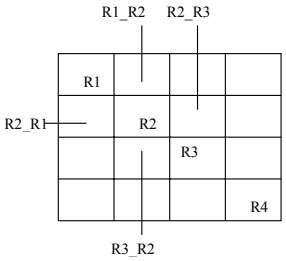

Figure 7.1 Example of a Lano matrix

For our purpose, we represent the actors that play different roles in the business transaction in the diagonal. The off-diagonal matrix elements represent the relationships between any two actors in different roles as illustrated in figure 7.1. The roles are represented in the diagonal (R1, R2, R3, R4). The off-the-diagonal boxes represent flow of objects (substantive, information). For example, R1_R2 represents a flow of object from Role 2 to Role 1 and R2_R1 represents the flow of objects from Role 2 to Role 1. To distinguish the information that is exchanged from the substantive objects, we will represent the information flows in italics.

7.2 Using the high-level system of concepts to analyze the DBT situation and the standard

Let us now use parts of the high-level system of concepts to analyze the situation described earlier. We begin by defining the focal exchange under analysis. Let us assume that we want to capture the context of the business transaction between the general practitioner and the patient. For our focal transaction we define two actors: the customer (in this case patient), and the

supplier (in this case- the general practitioner). We can also identify two types of objects- the good/service (in this case the medical service) provided by the general practitioner to the patient, and the compensation, or the payment provided by the patient to the general practitioner.

The next step is to identify the business network that supports the execution of the focal exchange. In this example, we identify three additional actors: the medical specialist, the lab, and the insurer. Here we focus the attention on the importance of the choice of the focal business transaction. This decision defines which context we are going to capture. If we choose the business transaction between the medical specialist and the lab, we would end up with a different context, and perhaps a different business network, if we want to include the payment from the medical specialist to the lab. For simplicity we focus only on the exchange relationships directly related to the focal exchange and not the indirect ones.

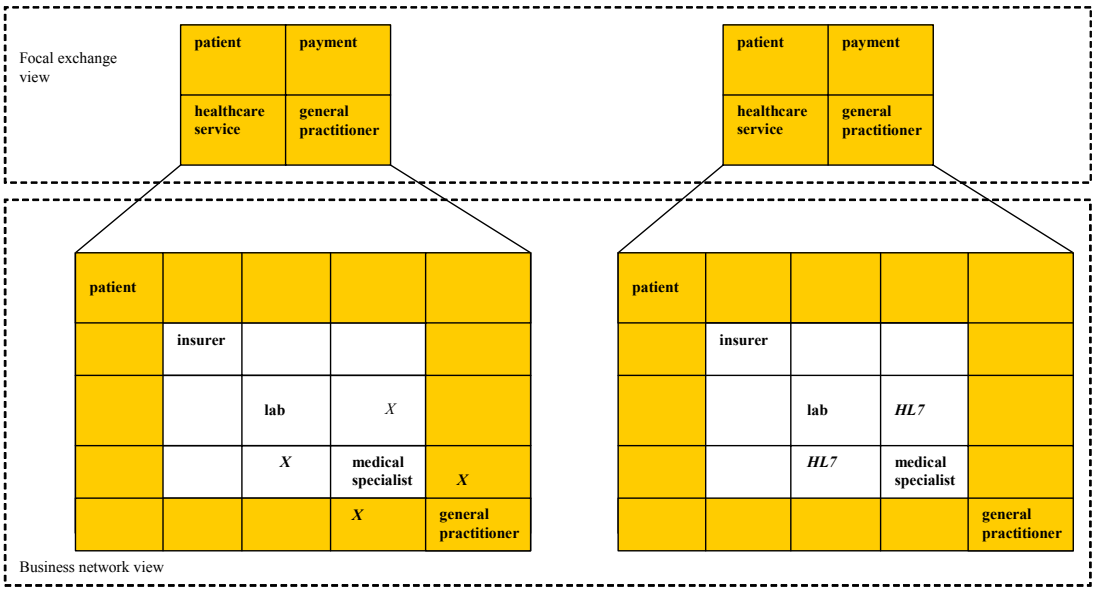

Figure 7.2 The requirements of the DBT situation

Figure 7.3 The capabilities of the HL7 v 2.4. standard

Figure 7.2 provides a high-level model of the requirements regarding the focal exchange view and the business network view. The figure does not represent decomposition, but represents elements of the focal exchange view and the business network view and the relationship between them. The upper part of the figure marked "focal exchange view", illustrates the actors of the focal exchange and the economic exchanges between these actors, without taking into account the business network involved in the execution of this focal exchange. The lower part of the figure, marked "business network view", contains the actors of the business network of the focal exchange (on the diagonal). In the off the diagonal cells we have included communication relationships[14] between the actors. The shaded part of the grid in the business network view contains the actors of the focal exchange in the corners. In that way we schematically represent how elements of the focal exchange become an integral part of the business network.

Regarding the focal exchange, we identified the patient and the general practitioner as the focal actors and healthcare service and payment as the objects of exchange. Beginning with this focal exchange, we identify the business network which facilitates the execution of the focal exchange. We identify three additional actors: the hospital, the lab, and the insurer, which also play roles. In

[14] Depending on what we want to analyze, in the off the diagonal cells we can also reveal the value exchanges between the actors.

figure 7.2, "X" marks the business communication that needs to be automated. For example, if we take the lab and the hospital we can see that we have two "*X*s", indicating that the communication from the lab to the medical specialist, as well as from the medical specialist to the lab needs to be automated.

Figure 7.3 is similar to 7.2, but instead of marking which communication is to be automated, we mark the communication, which falls in the scope of the HL7 v2.4 standard.

A quick look at figure 7.2. and 7.3 shows that the HL7 v 2.4 has the communication between the medical specialist and the lab in its scope, but does not address communication between the medical specialist and the general practitioner. By performing such an analysis, we are able to identify that HL7 alone is not sufficient to cover the to-be automated communication required by the DBT situation.

Once this is clear, the question is, "Are there other standards that address the communication between the medical specialist and the general practitioner?"

If we analyze current Dutch standards, we see that EDIFACT could communicate information from the general practitioner to the medical specialist. In figure 7.4 we again present the requirements of the DBT situation and figure 7.5 shows the other standard.

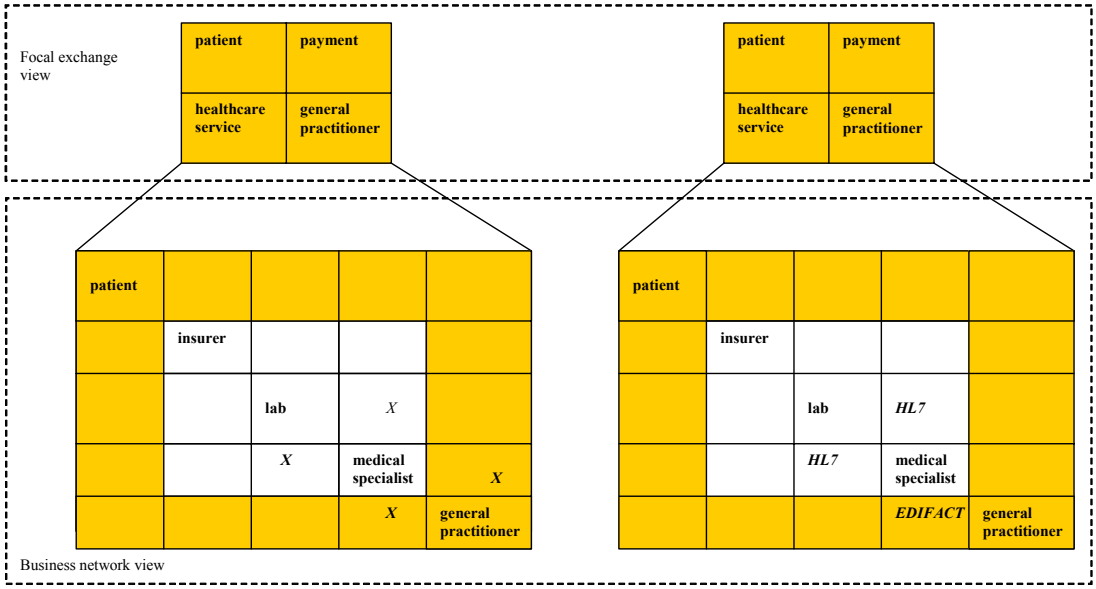

Figure 7.4 The requirements of the DBT situation

Figure 7.5. The capabilities of the HL7 v 2.4 standard

Not to complicate the discussion, within this example we did not include the communication with the insurer. If the requirements of the DBT situation demand that such communication is automated as well, one can also explore the capabilities of the HL7 standard in that direction. In the Netherlands, the communication between the medical institutions and the insurance companies is done using the VEKTIS standard and not the HL7, which points to another limitation in the scope of the HL7 standard.

The example above focused on the use of the focal exchange view and the business network view in comparing the to-be automated business communication and the standard. A number of questions can arise which would trigger a more detailed analysis relating to the communicative acts view. First, even though there might be a standard that covers elements of the

communication, one question can be "Are there examples of specific communicative acts which are required by the situation but not covered by the standard?" Another question may be "Are there examples of information needs required by the situation and not covered by the standard?"; "If yes, how to deal with these mismatches?" If mismatch between the required content and the content covered by the standard are identified this can be seen as a signal that interoperability problems may arise if additional measures are not taken to compensate for that.

The analysis could continue using the subject matter view of the system of concepts as well. In the example above, there are two standards that can be used to automate part of the business communication. However, each of these standards has been developed independently and when used in the same business transaction they need to be able to communicate in common terms. Thus, all parties in the business transaction will have to communicate about the same patient for example; however is the patient modelled in the same way in these standards? Solving such problems is still challenging today in practice.

In this example, we have shown how, at a very high level of abstraction, parts of the high-level system of concepts can be used to reason which parts of a business transaction a standard can cover and what gaps need to be filled in to ensure a smoothly running transaction. In the next chapter we continue with the construction of the detailed system of concepts and present numerous other examples to illustrate its use.

8. Conclusions

The goal of this chapter was to reconsider the theories and insights gained during the exploration phase regarding the construction of the system of concepts. After considering the theories reviewed during the exploration phase, we come to the conclusion that if we are to provide a holistic view on business transaction and business communication, we need to follow a multi-disciplinary approach. Having that in mind, we defined a number of views where each was motivated by a set of theories looking at the phenomena of business transaction and business communication. We used these views to arrive at a high-level system of concepts. During the construction , apart from the theories identified during the exploration phase, we used examples from the healthcare domain as empirical input. These examples provided us with insights, served as a relevance check, and provided us with material to illustrate the use of the views. Within this chapter, we used one example for illustration purposes only. Other examples used during the construction of the system of concepts will become visible in the next chapter. In the next chapter we elaborate each view in terms of concepts based on theory and use insights from examples from the healthcare domain. As a result we arrive at a detailed system of concepts and illustrate its use with examples.

Chapter 3: Elaboration of the views

1. Introduction

1.1 Background

As discussed in Part 1, we aim to construct a system of concepts which will aid in comparing the requirements of the DBT situation and the standard and reason about possible consequences mismatches may have on transaction execution.

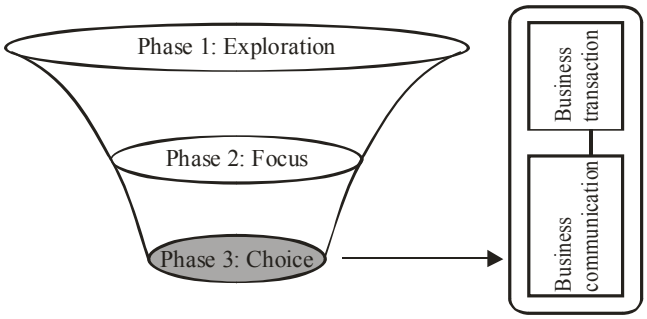

Figure 1.1 Choice phase

Up to this point we have explored existing literature related to business transactions and business communication, and we defined a number of views on how to look at both. As discussed in Part 2 Chapter 2, the views provide the foundation of the system of concepts.

We now focus on the third phase of the construction of the system of concepts: the choice phase. Within this phase we will further elaborate each view and identify a number of concepts; as a result of this process we will arrive at "the detailed system of concepts".

1.2 The choice phase

To better explain the goal of the third phase, let us summarize the results obtained in phase two, as they will serve as the base for the further construction of the system of concepts.

In Part 2 we defined a high-level system of concepts, consisting of a number of views. The views in the focus stage are: the focal exchange view, the business network view, the business process view, the business rule view, the communicative act view, and the subject matter view. These

provide high-level categories to reason about the DBT situation and the standard. It is still necessary to elaborate each view in terms of a number of concepts. This allows for a more detailed analysis and serves as a method of indicating problems regarding each view.

Figure 1.2 is similar to figure 4.1 in Part 2 Chapter 2. The difference is the inclusion of the idea about the elaboration of the views. An example of elaboration is schematically represented with respect to the subject matter view (see the dotted ellipse in figure 1.2). The circles in the dotted ellipse represent the concepts, which can be used to further elaborate the view.

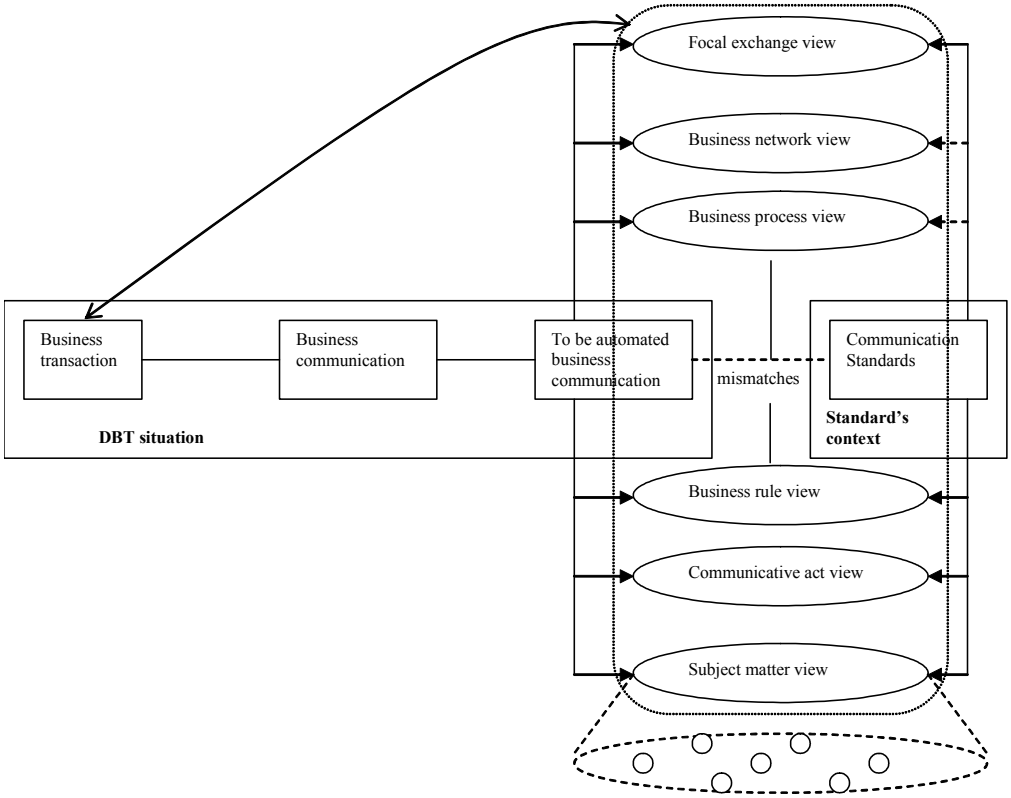

Figure 1.2 Elaboration of the views

As discussed in Part 2 Chapter 2, the goal of the subject matter, communicative act and business rules view, and related concepts is to compare the to-be automated communication and the standard. The upper three views can be used for comparison between the contexts of the to-be automated communication and the standard wherever appropriate. . The different views can also be used to trace what consequences possible mismatches can have on the execution of the business transaction.

1.3 Level of completeness

Within this section we address the issue of completeness concerning the system of concepts. Completeness can be addressed at two general levels. The first level concerns the completeness of the views; a question may be whether some important views are not covered in the system of concepts. At a second level we can discuss the completeness of the concepts included in each view. In this respect the question is whether all relevant concepts are included within a view.

Let us begin with the discussion concerning the completeness of the views. When speaking about completeness, we need to have a reference against which we can check. Regarding the defined views, we can use the semiotic framework of Stamper as a frame of reference. In Part 1 Chapter 2 we argued that problems related to the lower three levels of the framework (physical world, empirics, syntactic), have already been thoroughly addressed in theory and practice and therefore

the lower three levels of the semiotic framework were not addressed in this thesis. On the other hand, as argued in Part 1 Chapter 2, the problems related to the upper three levels of the semiotic framework (semantics, pragmatics, and social world), are more severe and difficult to solve and have not received much attention in theory. Therefore we concentrate on the upper three levels of the semiotic framework in this thesis. The subject matter view addresses the semantic level, the communicative act view addresses the pragmatic level and the business rule view addresses aspects of the social world level. Furthermore, although one part of social world level is concerning the social norms, which we address in the business rule view, the notion of social world is much broader than that. We can further say that also the business process view, the business network view, and the focal exchange view shape and address aspects of the social world as well. They define the boundaries of the social world and also some of the interactions that take place there. To come back to the question of completeness, in respect to the semiotic framework, we consider that we cover the upper three levels of the semiotic framework and we are complete in that respect.

The next step to look for completeness would be to check whether we have sufficiently covered all possible views that can be defined with respect to the upper three levels of the semiotic framework. To do that would mean that for each level we would need a frame of reference to talk about completeness. For example, if we take the social world level of the semiotic framework and would like to check to what extent we captured the different issues related to that level, we would need to have a general theory which defines what is included in this level. As we were not able to identify such a general theory as a frame of reference, we cannot address completeness regarding elaboration of the content of each of the upper three levels of the semiotic framework. To talk about the completeness of the views and to be able to say whether and which views are missing does not make sense, as there is no clear frame of reference against which we can map it.

We are aware of the fact that views exist that we do not cover. One example could be a view addressing legal matters. However, if we constantly add new views without having a clear reference frame, we risk ending up with a very complex system of concepts that is unmanageable. We feel that new views can be included in the future, if it becomes clear after thorough empirical testing that some important issues cannot be addressed. The inclusion of a new view will remain a pragmatic choice but does not mean that it will change our argument concerning completeness.

The last level at which we will discuss the issue of completeness is the completeness of the concepts within a given view. In Part 2 Chapter 2 we made the choice to pursue a multidisciplinary approach. This immediately implies that we cannot and should not strive for completeness with respect to the concepts covered in each view. The reason is that the system of concepts is intended to be used for a quick scan, not for a thorough and complete analysis.

The problem is that it is very difficult to draw the boundary of which concepts to include in a specific view. This hides the immediate danger that if we add more concepts we will move towards mono-disciplinary research. We aim to have the means to pinpoint problems. What we do not aim is to perform a thorough analysis of these problems and solve them, as we consider that mono-disciplinary experts will be needed for this task. We definitely would not like to enter mono-disciplinary analysis with our system of concepts.

We can say that ideally we strive to arrive at a minimum and sufficient set of concepts, but from the very beginning we knew that it would be extremely difficult to claim that the concepts identified are indeed minimum and sufficient. We have arrived at a preliminary set of concepts within the choice phase. This preliminary set of concepts is subjective (we made a decision which concepts to include) and reached through theory and example. By theory and example we mean

that our way of thinking and the decision process concerning the inclusion and exclusion of concepts was influenced by the theories used and the empirical material and examples from the healthcare industry. After extensive testing of the system of concepts by applying it in a number of different situations, one might be able to arrive at a more stable boundary of the concepts included. However, as discussed in Part 2 Chapter 2, extensive testing of the system of concepts is outside of the scope of this research.

1.4 Way of working

Let us now discuss how we will structure our way of working in the remaining part of this chapter. We will proceed with the elaboration of each view in a separate section, which is structured as follows. We begin with the goal of the view, and proceed with the choice of concepts and an example.

We discuss the views as follows. We begin with subject matter, communicative act and business rules views, as they refer directly to business communication and are essential for the comparison between the to-be automated communication and the standard. We will then take a top down approach and elaborate the focal exchange, business network and business process view.

After elaborating each view, we discuss the detailed system of concepts and provide one example from healthcare as an illustration.

2. Subject matter view

2.1 Goal

This section provides further elaboration of the subject matter view, i.e., we aim to identify concepts related to the subject matter view which help analyze the to-be automated communication and the standard, compare the two, and identify possible mismatches.

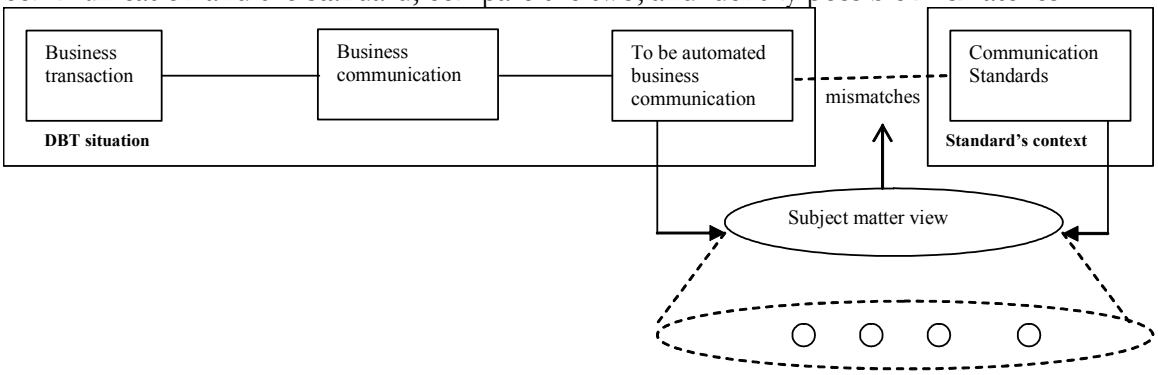

Figure 2.1 Elaboration of the subject matter view

As discussed in Part 2 Chapter 2, the subject matter view aims to address the semantics defined by the relationship between the domain, the conception of the domain, and the representation of the domain. This means that if we need to compare the to-be automated communication and the standard, we need to compare the domain, conception, and representation shared by the parties involved in the DBT situation and the domain, conception, and representation embedded in the standard. This is schematically represented by the two meaning triangles below.

This means, that to further operationalize the subject matter view we need to identify concepts which help us compare the two at the domain, conception, and representation levels.

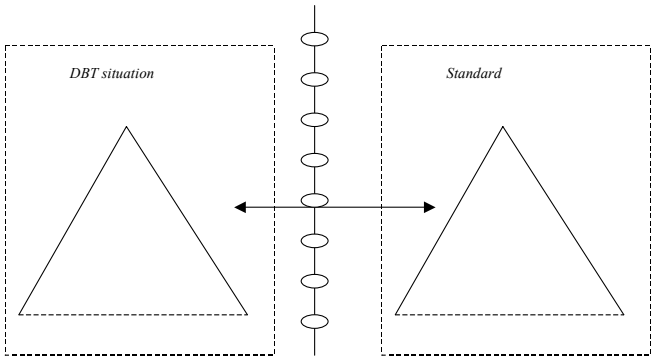

Figure 2.2 Two different contexts

2.1.1 Domain

We have defined "Domain" as part of the world under consideration. Let us now assume that we have two domains: domain A and domain B. For these two, a number of options exist. They can be totally independent (the case illustrated in figure 2.3a); they can partially overlap (see figure 2.3b); one can be a sub-domain of the other (see figure 2.3c and 2.3d); or they can completely overlap (see figure 2.3e).

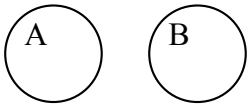

Figure 2.3a: Domain A and domain B do not have a common thing

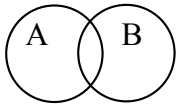

Figure 2.3b: Domain A and domain B share some but not all elements

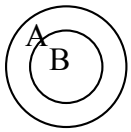

Figure 2.3c: Domain B is a subset of A

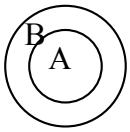

Figure2.3d: Domain A is a subset of B

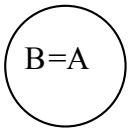

Figure2.3e: A and B are identical

If the two domains are completely separate (figure 1.3a), then there is a total mismatch between the domains and further analysis would not make sense. Analysis is useful in the remaining cases, where there is at least some overlap between the domains. Although this discussion states that to be of any use, the domain embedded in the standard should have at least a partial overlap with the domain of interest with respect to the DBT situation, based on our basic ontological and epistemological assumptions (see Part 1 Chapter 1) we can say that we do not have access to the things in the real world directly, but only through our conceptions.
We will not try to identify concepts at this level describing the differences in the domain being considered in the DBT situation and the standard. This discussion will be partially included in the next section, when we talk about the conception of the domain.

2.1.2 Conception

As we said in the section above, we consider that we do not have direct access to reality but can access it only through our conceptions. Thus we consider the conception level the most fundamental. The conception of a domain is socially constructed. Let us assume that "domain A" and "domain B" have elements in common, and that two different communities do the

conceptualization of A and B, and the result is two different conceptualizations (figure 2.4)[15]. CA is the conceptualization of domain A; CB is the conceptualization of domain B. The shaded area CCA in CA is the conceptualization of the things in common for A and B in CA and the shaded area CCB in CB is the conceptualization of the things in common for A and B in CB.

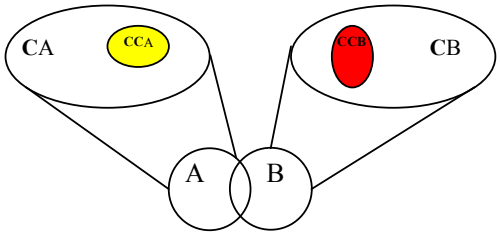

Figure2.4: Common things, different conceptualizations

As discussed in Part 2 Chapter 2, the foundational ontologies can provide concepts to reason about the conceptions of the two domains and identify potential differences.

2.1.3 Representation

To be able to reason about differences between the DBT situation and the standard, we need to consider concepts which allow us to reason about the representation as well. As discussed in Part 2 Chapter 2, two of the commonly encountered situations are the synonym and the homonym situation.

We now proceed with the identification of the concepts of the subject matter view.

2.2 Concepts

2.2.1 Domain and conception

The conception level is the most fundamental level. Part 2 Chapter 2 argued that to address the conception level, we can make use of foundational ontologies that provide the basic constructs of how to look at the world and provide a language to describe it. We also identified foundational ontologies, examples being BWW, FRISCO. One of the major choices is which ontology to choose for the further elaboration of the subject matter view.

The choice that we made in Part 2 Chapter 2, to pursue a multidisciplinary approach, immediately implies that we cannot and should not strive for completeness, but to focus on identifying a preliminary set of concepts. A comparison of the ontologies suggests that the ontologies contain a number of concepts that seem similar. They have differences at a more detailed level. As we are not striving for completeness, it is more a matter of choice with which one to proceed.

For the elaboration of the subject matter view we chose to proceed with the BWW ontology. The choice to proceed with the BWW ontology was influenced by the fact it has been widely used in the areas of information systems. Furthermore, it seemed to us that the BWW concepts were more intuitive to use for describing the subject matter, compared to those presented in FRISCO.

The next decision is which of the concepts from the BWW ontology to include and what level of elaboration to strive for. It was clear that we did not want to include all the concepts from the BWW ontology. The subject matter is only one of the views and including a complete ontology can become too complicated. As mentioned earlier, completeness was not our aim. We have

[15] Within figure 2.4 we use an example of a case when there is a partial overlap between the two domains. The reasoning illustrated however will be the same in the other cases where there is overlap (see fig. 2.3 c, d,e)

further argued that in this stage of the research we will not be able to define the boundaries of a minimum and sufficient set of concepts, especially having in mind that sufficient in one situation might mean insufficient in another. As a result, we selected a preliminary set of concepts. We included those concepts often used by a number of authors who have used the BWW ontology. Below we present the concepts chosen and provide intuitive definitions[16].

The elementary construct of the ontology is the **BWW-thing**. The world is made up of substantial BWW-things. A BWW-thing, e.g. a person or a book, possesses **BWW-properties**, e.g. name, color, weight, etc. There are no BWW-things without BWW-properties. A BWW property is a **BWW-Intrinsic property**, if it depends on only one BWW-thing and it is a **BWW-mutual property** if it depends on more than one BWW-thing. A **BWW class** is a set of things that possess a common property. BWW- properties cannot be observed directly; instead **BWW-attributes** are representation of BWW properties of BWW-thing as perceived by an observer. A BWW-attribute is a function that maps a BWW-thing onto a **BWW-value** at some point of time or other conditions. The set of BWW-attributes of a BWW thing forms a **BWW functional schema**. A restriction on the possible BWW-values of the components of a BWW-functional schema of a BWW-thing or their combination is termed **BWW-law**. The **BWW-state** of a BWW-thing is represented by a vector of all BWW-values that are associated with the BWW-functional schema of the BWW-thing. The **BWW- lawful state space** of a BWW-thing is the set of states of a thing that comply with the state laws of the thing. A **BWW-event** is a change of the BWW-state of a BWW-thing.

Table 2.1 Informal definitions of BWW concepts

2.2.2 Representation

Regarding the links between conception and representation, we decided to stick to the two fundamental situations identified in Part 2 Chapter 2, the synonym and homonym situations. There are other possible situations, but for a quick scan analysis we consider these the two most important.

The concepts we chose for the further elaboration of the subject matter view are presented in the table below.

Subject matter view: detailed	
Domain	
Conception	
Thing Intrinsic Property/attribute of a thing Mutual Property/attribute of a thing Value	Class Functional schema Law State Lawful state space Event
Representation	
Synonym situation Homonym situation	

Table 2.2 Subject matter view: concepts chosen

With respect to domain, we did not include any concepts, as we have argued that we do not have direct access to it. We have incorporated the concepts referring to the domain (i.e. thing and property of thing), as part of the concepts referring to the conception of the domain.

In the section below we provide examples of how the detailed subject matter view can be used in a number of situations.

[16] We borrowed this informal description of the BWW ontology from Fettke & Loos (2003). The authors use the abbreviation BWW before each BWW construct.

2.3 Examples

2.3.1 Example 1: Identification of potential problem within the standard itself

The first example illustrates how the subject matter view can help to reason about the chosen standard.

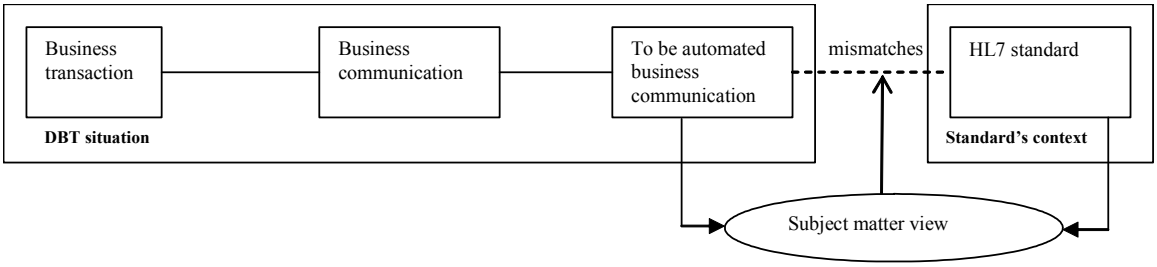

Figure 2.5 Example 1: potential problems within a single standard

Let us take a situation where the HL7 v 2.4 standard is chosen. We will illustrate how some concepts from the subject matter view can be used to identify problems within the standard itself. Let us then take one of the fundamental concepts in the subject matter view, the concept of value. The ontology says that values should always be specified.

In the HL7 v 2.4 standard, we find information about element name and a reference to tables, where the values of the element are specified. In the table below we have examples of transaction type and fee schedule and references to tables 0017 and 0024, where the allowed values of the transaction type and fee schedule are specified.

TBL	ELEMENT NAME
0017	Transaction type
0024	Fee schedule

Table 2.3 Element names and reference to tables

If we look at the content of table 0017, we see that a number of values are defined to specify the different transaction types. In this case the standard suggests what values the field could contain.

Values	**Description**
CG	Charge
CD	Credit
PY	Payment
AJ	Adjustment
CO	Co-payment

Table 2.4 Transaction type

There are cases however, where the situation is different. Let's look at the example: 'Fee schedule'. According to the standard it is suggested to standardize the data. The standard makes reference to table 0024. When we try to find the values in the standard we see the following.

Values	**Description**
	No suggested values defined

Table 2.5 Table 0024

This means that although there are hints in the standard that further standardization is needed, the HL7 standard does not always specify the values. Thus in standard implementation projects the decisions for the data values for these fields should be further defined. If this is not done, one can expect problems due to incomplete specification of values.

2.3.2 Example 2: Identification of potential problems in case a combination of standards is needed

Example 2 refers to a more complicated situation, where one standard is not sufficient to capture the requirements of the to-be automated communication and a combination of standards is needed.

Let us take a situation where the to-be automated communication requires communicating patient administration information and digital imaging information (e.g. an x-ray picture of a patient). In this case, one might decide to use a combination of standards, HL7 for patient administrative information and DICOM standard for communicating imaging information. In that case, it is important that the two standards have at least some shared domain of interest and share the conception and the representation of this common domain.

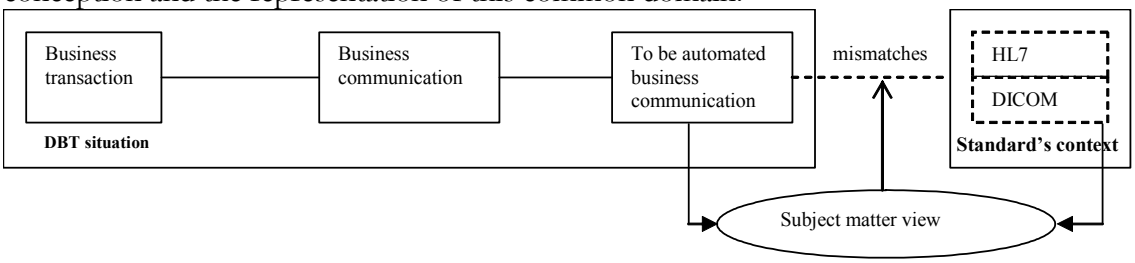

Figure 2.3.2 Example 2: potential problems when using a combination of standards

One of the concepts in the subject matter view is the "homonym situation" and the example below uses this concept to illustrate differences between the two standards.

The analysis of HL7 and DICOM shows that both standards use the term "PATIENT". A closer look at the definition of the term "PATIENT" in the two standards reveals that this is an example of a homonym situation in terms of the subject matter view, i.e., the same representation is used for different conceptualisations. In DICOM the term "PATIENT" refers only to human beings, whereas in HL7 it refers to living subjects in general. This means that the meaning of the term "PATIENT" is broader in HL7 than in DICOM.

Although the domain of "PATIENT" in HL7 is broader that of DICOM, there is also certain overlap and HL7 and DICOM can potentially communicate information for only human patients.

Now that we know the two standards have common things of interest (human patients) we can continue with the analysis of some properties of a human patient.

In HL7 a patient has the property "Administrative sex", in DICOM the property is "Patient's sex". Let us assume that the "Administrative sex" and "Patient's sex" are two different representations of the property "patient sex". In this case we assume that the difference is only in terms of representation though the difference can be conceptual as well. To be certain, one needs to look at the definitions of the two properties in the standards and analyze whether they are really the same. If such information is not available, one would need to go to the empirical world and check.

Let us continue the analysis assuming that the term "administrative sex" and "patient's sex" are conceptually the same. If this is the case, further analysis of the two standards can be performed in terms of the values that that specific property can have. Analysis of the value sets shows that the values that can be assigned for Administrative sex in HL7 are (F, M, O, U, A, N)[17], while for "Patient's sex" in DICOM the values are (F, M, O). This means that we can identify differences

[17] F (female); M (male); O (other); U (unspecified); A (ambiguous); N (not applicable)

with respect to the value sets of a property. The difference in the value sets of the two standards suggests that interoperability problems between the two standards can occur.

There are different ways to proceed once these mismatches are identified. One way is to check in the HL7 standard whether all the values specified for administrative sex are valid for people as well. If this is true, then we will indeed have a mismatch between the two standards with respect to values. It is evident that once mismatches are identified, further analysis is needed to check whether these mismatches are relevant.

2.3.3 Example 3: Identification of problems due to mismatch between the DBT situation and the standard

The third example will illustrate a mismatch between the to-be automated communication and the standard.

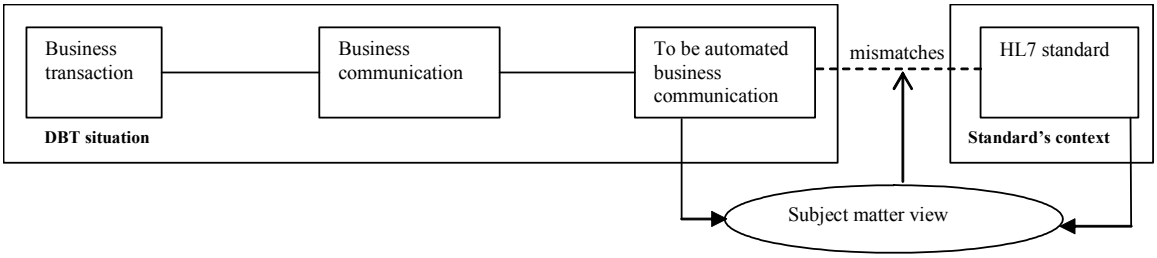

Figure 2.6 Examples of potential problems due to mismatch between the DBT situation and the standard

This example is taken from a real life project carried out in a Dutch hospital. A decision is taken to integrate the application in the Operating room (OR) and the application responsible for processing billing information (Billing application) to transfer billing data electronically by using the HL7 standard. After implementation, a number of problems were discovered which revealed mismatches between the requirements of the business situation and the standard.

When there is an operation in the OR, information such as procedures performed on a patient and duration of the procedure are collected in a case record. This information is then checked by a number of authorized persons. Once they all agree on the accuracy of the information, the case record is closed. The HL7 is originally an American standard and according to American law, once a case is closed it cannot be reopened. In the Netherlands, however, the law allows files to be reopened. This mismatch could have been discovered analytically using the concept of lawful state space. A sample question to guide the analysis could have been: "Are there examples where the required lawful state spaces are not covered by the standard?" Regarding the business situation, the value "reopened" is part of the lawful state space of a case. In the HL7 standard, the value "reopened" is not part of the lawful state space of a case file. In this case, we have a mismatch regarding the concept "lawful state space", where one of the required states is not captured by the standard.

The examples presented in this and the following sections are deliberately simplified and focus on a particular point for illustration. They are derived from more complex descriptions which we will not present here in the interest of clarity. In part four and the related annex however, we will systematically apply the system of concepts on a case concerning liberalization of the energy market.

3. Communicative act view

3.1 Goal

The goal of this section is to elaborate the communicative act view by identifying a number of concepts. The ultimate goal is to use these concepts to analyze the DBT situation, the chosen standard, and compare the two. As a result of this analysis, we aim to identify possible mismatches which may lead to potential problems.

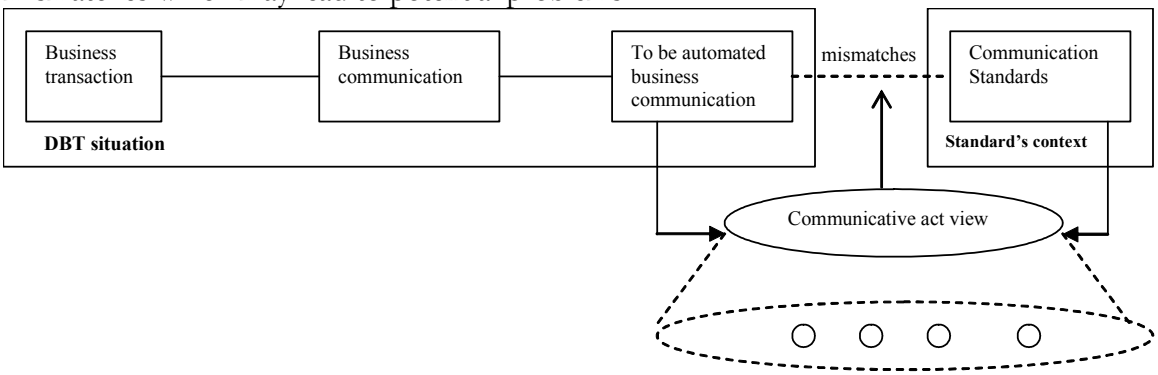

Figure 3.1 Elaboration of the communicative act view

3.2 Concepts

In Part 2 Chapter 2, we introduced the communicative act theories and a number of concepts to describe a conversation. Here we summarize some of the ideas discussed. A key concept for analyzing conversations is the action elementary message (ae-message). An ae-message consists of a communicator, an interpreter, propositional content, and a communication function. An ae-message is part of a conversation, and the conversation can be described as a sequence of utterances. We have also discussed that it is important to beginning with a real life situation when identifying sequence of utterances. Communication patterns (such as the "conversation for action" scheme of Winograd and Flores) can be used as a support tool to describe the sequence of utterances once they have been identified based on the real-life situation. Although the scheme of Winograd and Flores is powerful in expressing different possibilities a conversation can follow, there could be real-life situations where this scheme is limited. Thus, as argued by Goldkuhl (2003), the Winograd and Flores scheme, and any other patterns of conversations whenever available should be used with caution. To overcome the critique that speech acts do not focus on the content of what is communicated (see Part 2 Chapter 1), the notion of propositional content is explicitly included in our analysis. Apart from that, the elements of the propositional content can be further examined within the subject matter view. We elaborate the communicative act view in table below.

Communicative act view: detailed
Ae-message has • One communicator • One interpreter • One propositional content • One communicative function Ae-message is part of • Sequence of utterances

Table 3.1 Communicative act view: concepts chosen

Let us illustrate the use of the detailed communicative act view with an example.

3.3 Example

In the example below we will illustrate how to use the detailed communicative act view to reason about the situation and the chosen standard and identify possible mismatches (see the figure below).

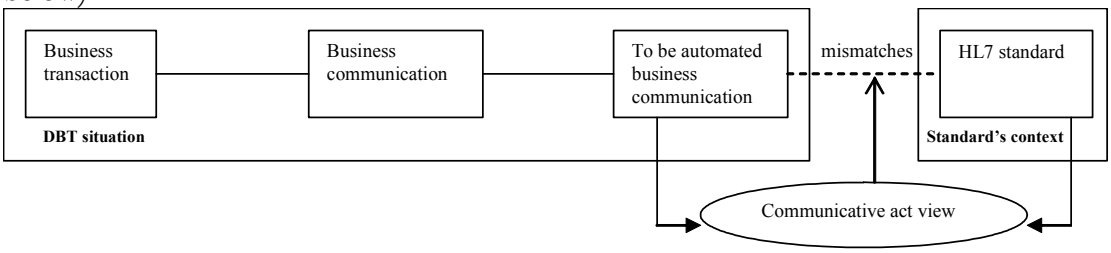

Figure 3.2 Example of analysis of the DBT situation and the standard using the communicative act view

In this section we illustrate the use of the detailed communicative act view to identify whether interoperability on a pragmatic level can be achieved. We first introduce a standard for our example, the HL7. We describe a simple business transaction to be automated using the HL7 standard. We translate the requirements of the business transaction in terms of the concepts of the communicative act view. We also translate the capabilities of the standard in terms of these concepts. Once expressed in the same terms, we are able to compare the requirements of the business transaction and the capability of the standard to meet these requirements. A mismatch will mean that there may be interoperability problems on a pragmatic level which can hinder the way of doing business.

3.3.1 The situation

We use the following business situation. A doctor sees a patient and decides to order a lab test. Thus, the doctor has to enter into a business transaction with the lab. For communication between the doctor and the lab there is a communication agreement. The doctor orders a test. The lab can accept to perform the test and confirm the order though there are cases when the lab will reject the order. One reason the lab could reject an order is if they see a pregnancy test ordered for a male patient. Another reason could be that a test cannot be performed if the patient takes certain medications.

Once the test is performed, the lab sends the observation result to the doctor and the doctor does not communicate back when he does not have objections to the test result. In this case acceptance of the test is implicit. Otherwise, the doctor asks for corrections if he thinks that there is a mistake in the test.

Currently this communication is paper-based, which is time consuming and time is critical in the Healthcare domain. Also, double entry of data is required. To reduce the time and avoid double entry of information, a decision is made to automate communication between the doctor and the lab; the HL7 v3 standard is chosen to support the electronic communication.

3.3.2 Analysis of the situation using the detailed communicative act view

Let us start the analysis using the notion of ae-message. If a message is sent from the doctor to the lab, then the doctor can be seen as a communicator in the ae-message and the lab as the interpreter of the ae-message. If the lab sends a message to the doctor, then the lab is the communicator and the doctor is the interpreter. In case the communication is electronic, these roles can be played by the applications used by the doctor and the lab.

The propositional content corresponds to the content of the paper documents exchanged between the doctor and the lab. The communicative functions used in the communication

between the doctor and the lab are: ordering of a lab test, acceptance to perform the lab test, rejection to perform the test, statement that the test is completed, and questioning of the result of the test. To visualize the communicative functions, we can again map them with the scheme of Winograd and Flores, which results in the following interactions: request (1,2), promise (2,3), reject (2,8), assert (3,4), and declare (4,3). The business conversations required by the DBT situation are marked with bold arrows on the Winograd and Flores diagram, for visualization purposes.

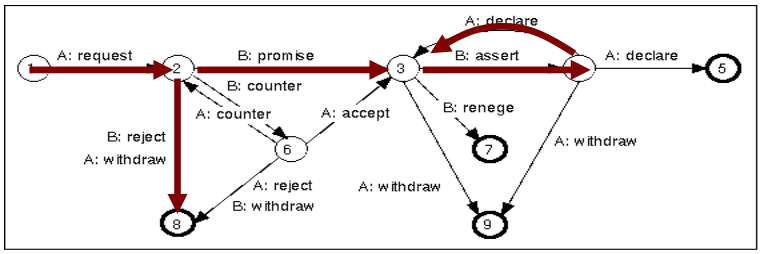

Figure 3.4 Business conversations required by the DBT situation, visualized using the basic conversation for action schema of Winograd and Flores.

3.3.3 The HL7 Standard

The HL7 v.3 standard will be used to automate communication between the doctor and the lab. In the basis of the HL7 v.3 is the HL7 Reference Information Model (RIM). The RIM describes, on a very high abstract level, major things of interest in the healthcare domain. It consists of six major classes, defines the attributes of these classes, and the relationships between them. The messages exchanged in clinical communication are derived from the RIM. However, the link between the RIM and the message actually exchanged requires intermediary steps. As the concepts in the RIM are very general, a procedure called cloning is defined. After this procedure, a domain message information model is defined (DMIM) which is derived from the RIM and provides further restrictions on the defined information (restricting the attributes of the classes for example). This domain message information model is then used to create the hierarchical message description, which defines in full detail messages later exchanged in the interactions. A central class in the RIM is the "Act". The Act represents actions executed and must be represented as the healthcare processes take place. An example of an Act is (lab) order. This is important in order to understand how interactions are defined in the HL7 standard.

The HL7 v 3 standard also includes "storyboards", which depict a story using a series of "snapshots" or events in chronological sequence. The whole series of snapshots provides a coherent description of a complete process or activity. The storyboards include interaction diagrams that show the progression of interactions between the application roles. A storyboard narrative is a description of a real-life event that provides the necessary context for the development of a specific interaction described in the storyboard. Based on the storyboards, the interactions are further defined in the standard.

In the HL7 v.3 Guide, an interaction is defined as "a unique association between a specific message type (information), a particular trigger event, and the application roles that send and receive a message type. It is a unique, one-way transfer of information." From this definition we see that an interaction is uniquely defined using four components: the sending application role (a system component which sends a message), the receiving application role (a system component which receives the message), the trigger event (the reason to send a message), and the message type (what message to send). Figure 3.5. is an attempt top model the elements of an interaction, as defined in HL7 v 3 standard. To model the interaction, we use the ORM notation (Nijssen and Halpin 1989; Halpin 1998). In ORM, the labelled ellipses represent entity types; the connecting

rectangles represent the role each entity type plays, the arrows represent uniqueness constraints, and the black dots represent mandatory constraints.

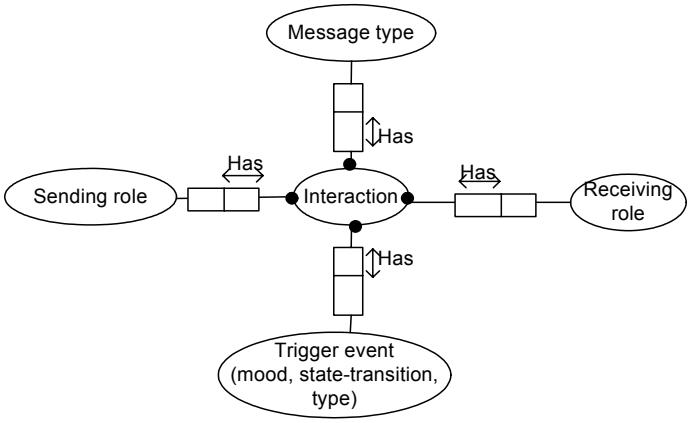

Figure 3.5: Description of the HL7 interactions

To better understand the interactions as defined in the HL7 standard, further elaboration is needed on the notion of a trigger event. According to the HL7 v.3 Guide, "a trigger event is an explicit set of conditions that initiate the transfer of information between system components (application roles). It is a real-world event such as the placing of a laboratory order or drug order." The trigger event is expressed as a combination of mood, state-transition, and type. The "mood" is a very important concept in the HL7 v.3 standard. It distinguishes between statements of facts that the ordered service (act) has been completed, or specifies the intent to perform such a service. Examples of moods as defined in the HL7 are "order" (an order of a service), "promise" (a promise that the service will be performed), and "event" (a statement that the service has been performed). Another important attribute of act is act status. The act status captures the defined state of an act. Examples of act status are "active" (the act can be performed or is performed), and "completed" (an act that has terminated normally after all of its constituents have been performed). A change in the act status can lead to a state-transition (for example an act status can go from "active" to "completed". The third element defining the event is type of which there are three types: user request based, interaction based and state-transition based trigger events.

Within this example we will not go into describing these concepts into full detail. However, it is important to say that the combination of mood, state-transition, and type can capture the intent behind the message.

Based on the analysis of HL7 concerning lab order, we found that the HL7 trigger events support the following intentions: request to fulfill an order, promise to fulfill the order, rejection to fulfill the order, and statement that the order has been fulfilled. We will come back to these elements in the next section.

3.3.4 Analysis of the HL7 Standard using the detailed communicative act view

Let us now use the communicative act view to reason about the elements covered in the HL7 v. 3 standard. From the concepts of the communicative act view we can say that an ae-message has propositional content, communicator, interpreter, and communicative function. We can say that the interactions defined in the HL7 standard correspond to the ae-messages defined in the communicative act view. The sending role and the receiving role as defined in HL7 can be translated as communicator and interpreter in terms of the communicative act view. The trigger event can be translated as communicative function in terms of the communicative act view and the hierarchical message description can be seen as propositional content. Additionally, the trigger

events defined for lab order in the HL7 standard support the following communicative functions: request to fulfill an order, promise to fulfill the order, rejection to fulfill the order, and statement that the order has been fulfilled. For illustrative purposes, we map these communicative functions using the scheme of Winograd and Flores (figure 3.6).

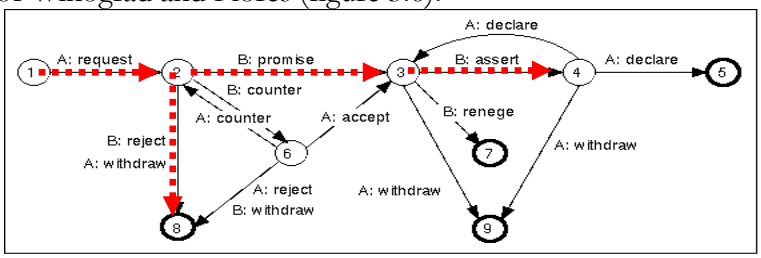

Figure 3.6 Business conversations captured by the HL7 v3 standard, visualized using the basic conversation for action schema of Winograd and Flores.

Note we have first identified the interactions supported by the standard and then check whether the interactions can be mapped to the scheme. The scheme provides a good visualization of the different interactions. From the mapping we see that the HL7v.3 standard supports the individual interactions request (1,2), promise (2,3), reject (2,8) and assert (3,4). The business conversations supported by the standard are marked with dotted arrows in figure 3.6.

3.3.5 Comparing the standard and the requirements

Table 3.2 provides a comparison of the requirements of the business transaction and the characteristics of the HL7 standard.

Communicative act view concepts	**Requirement of the Business Transaction**	**HL7 Standard Lab Order**
Specification of the propositional content	Required	Capable to cover (only for the communicative functions supported by HL7)
Identification of the communicator	Required	Capable to cover (identification of the sending application role)
Identification of the Interpreter	Required	Capable to cover (identification of the receiving application role)
Communication functions	Required: Request (1,2) promise (2,3) reject (2,8) assert (3,4) declare (4,3)	Capable to cover: Request (1-2) promise (2,3) reject (2,8) assert (3,4)
Sequence of utterances	Successful completion (1,2), (2,3), (3,4) Failure (1,2), (2,8) Questioning the outcome (1,2), (2,3), (3,4), (4,3)	Successful completion (1,2), (2,3), (3,4) Failure (1,2), (2,8)

Table 3.2 Comparing the requirements of the business transaction and the capabilities of the HL7 standard.

From the analysis it is clear that the HL7 standard concerning lab orders is a good standard to cover the communication requirements between the doctor and the lab. It has the capability to identify the communicator and the interpreter of a message, as well as the content of the message and the intention behind it. It can support both conversations that can lead to successful completion of the business transaction as well as those that lead to failure.

However, the HL7 does not support situations where the doctor can question the results of a lab test and a conversation that can lead to questioning of the outcome the propositional content for this type of interaction are not supported. This can be a problem for achieving full

interoperability between the doctor and the lab unless additional measures are taken to compensate.

The aim of this example was to illustrate how the communicative act view can be used to reason. Although we looked at a simple transaction, the principles of the analysis can be applied to analyze very complex situations. This can be done by identifying the different parties in a business transaction and by applying a separate analysis of the conversations between each two parties, as illustrated in the example.

4. Business rule view

4.1 Goal

The goal of this section is to identify a set of concepts to elaborate the business rule view. The concepts of the business rule view will be used to analyze the DBT situation and the standard, and to allow for comparison between the two.

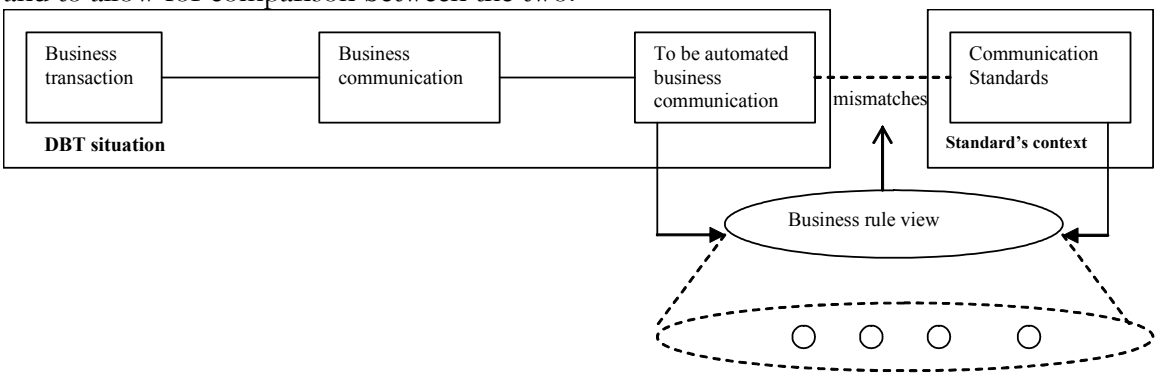

Figure 4.1 Elaboration of the business rule view

The ultimate goal is to identify possible mismatches and potential problems with respect to business rules.

4.2 Concepts

In Part 2 Chapter 2 we introduced the theory of von Wright for describing norms and discussed that similar operationalization of norms have been developed and applied by Stamper and Liu. Within this thesis, we use the components of a norm described by Stamper for further operationalizing the business rule view. These components are quite similar to those used by von Wright, so using the alternative classification will not bring major differences. The table below provides a summary of key components that can be used to describe norms. The meaning of the terms will be briefly discussed below.

Business rule view: detailed
If conditions
Then subject
Adopts attitude
Towards proposition

Table 4.1 Business rule view: concepts chosen

The *condition* specifies the circumstances or the states of affair in which the norms should be applied. The *subject* is a responsible agent to whom the norm applies. The *attitude* defines the effect of the norm, typically, "ought to" for a mandatory norm, "may" for a permissive norm and "must not" for prohibitive norm; this means that the character defines whether the subject is allowed or prohibited to do something. Finally the *proposition* of the norm defines the activity or action prescribed by the norm.

A typical example given to illustrate the structure of the norm is:
Whenever *a book is overdue*
Then *the Librarian*
Is *obliged*
To *send an overdue notice to the borrower.*

Let us now illustrate how the detailed business rule view can be used to analyze the DBT situation and the standard.

4.3 Example

The business rule view is very important, as business rules govern the behaviour of people. In case there are mismatches between the business situation and the standard with respect to business rules, this would have a direct effect on the actions performed with respect to a specific business transaction. This example illustrates how differences between the business rules required by the situation and business rules embedded in the standard can be identified.

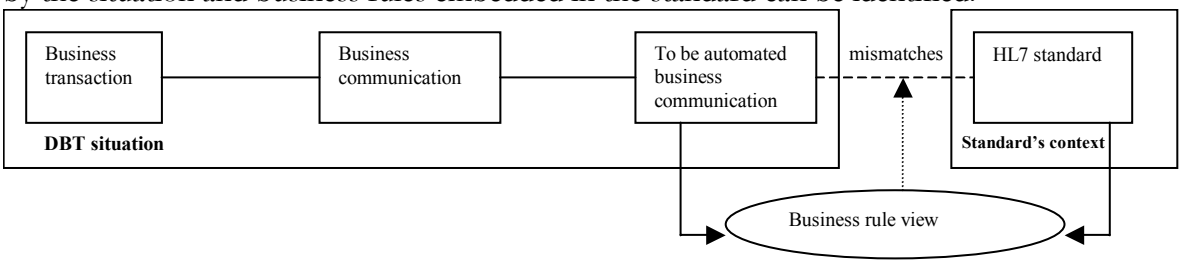

Figure 4.2 Example of analysis of the DBT situation and the standard using the business rule view

To illustrate the importance of the business rule analysis, we again use example three presented in the subject matter view. There is a reason to use the same example as it can be seen as a good illustration that there is indeed relationship between the views. We will return to this discussion at the end of the example.

As discussed earlier, a project was initiated to automate communication between the operating room and the financial department in a hospital in the Netherlands. The goal was for the operating room to communicate electronic information concerning operations to the financial department to prepare bills for the patients. The HL7 standard was used to automate that communication. The hospital in the Netherlands purchased an HL7 compliant system developed in the US. After signing the contracts with the supplier, the hospital realized that the system was not suitable for their specific situation. This particular project has a span of years, has been stopped a number of times, and at the time of the last interview it was still not possible to automate communication between the operating room and the financial department.

Some of the problems can be traced to differences in business rules. We give one example below. In the Netherlands, a case record is filled in when an operation is performed. . The case record is then checked by authorized personnel and closed. Under certain circumstances (condition)[18], an authorized person (subject) is allowed (attitude) to reopen the case (proposition) and modify some of the information.

The HL7 is originally an American standard and according to American law, once a case is closed it is not allowed (attitude) to be reopened. In this example we see differences in business rules, especially with respect to the concept "attitude" of a norm.

[18] the text in the parentheses indicates the concepts from the business rule view

In the real life situation, the differences in business rules as well as other contextual differences were identified after the contract had been signed. In terms of business rules, such a mismatch could be identified analytically beforehand if a comparison of the business rules of the situation and the business rules embedded in the standard had been analyzed. To identify such differences, questions derived from the system of concepts can be very useful. In the example described above such questions would be: "Are there business rules with respect to the business situation? Are there business rules embedded in the standard? If yes, are there examples of differences between the business rules required from the business situation and the business rules embedded in the standard?" Following such questions, one can proceed with the detailed concepts and make further analysis of the business rules required by the business situation, and those embedded in the standard. If there are examples which indicate mismatches might exist, there can be different ways to proceed. One example is that the management might decide to explore the possible mismatches. In this case, a team of experts with mono-disciplinary knowledge on business rules can be used to perform a full analysis. An alternative is to consciously take the risk and proceed with implementation and incorporate appropriate risk management procedures to mitigate the risks. In both cases, awareness of problems can be a real advantage to the managers as it will allow them to make informed decisions.

There is one important remark that we would like to make here. Sometimes it may be very costly to do a complete analysis of the business rules of the situation and those embedded in the standard. Within this thesis we do not advocate that such a full-blown analysis always need be performed. This will be explicitly addressed in the method (Part 3 Chapter 1) where we introduce the notion of different levels of analysis.

At the beginning of this example we discussed that we have used the same example presented with respect to the subject matter view in order to illustrate the relationships between the views. It is not surprising that we can pinpoint the same problem using different views, as these views define a way of looking at the same phenomenon. The business rule that we identify with the business rule view in the Dutch situation is that an authorized person is allowed to reopen a case. This business rule defines the actions allowed in this context. By defining allowed actions on things in a given domain would mean that this would also influence the allowed changes in the state of things in that domain which is addressed by the subject matter view. This means that because in the Dutch situation a case is allowed to be reopened, this would lead to a change in the state of a case and it would be allowed for a case to enter into a state "reopened". This example illustrates how a problem can be approached and identified by using different views. This means that in the quick scan there may be situations when some problems might not be easily identified with one view, but may be identified and pinpointed using one of the other views. This means that although we are aiming at a quick scan, there are mechanisms that can actually increase the probability of identification of the major problems.

5. Business process view

5.1 Goal

The goal of this section is to elaborate the business process view. The detailed business process view can be used in different directions.

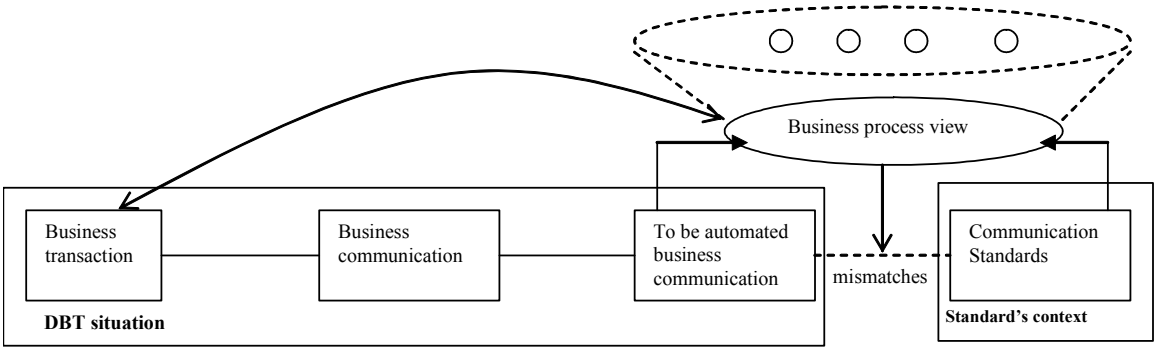

Figure 5.1 Elaboration of the business process view.

The first is the same as the views discussed so far, to analyze the DBT situation and the standard and to identify possible mismatches between the two. The second is used to reason about effects the possible mismatches identified with the other views can have on the execution of the business transaction. Finally, it may also play a role for elicitation of the requirements concerning the to-be automated communication.

In the next section we choose key concepts for further elaboration of the view and present one example to illustrate the comparison between the requirements and the standard using the detailed business process view. We will not illustrate how to use the business process view to trace the effects on the execution of the business transaction, as this will be illustrated with an example in section 9.

5.2 Concepts

In Part 2 Chapter 1 we discussed attempts in the business process community to arrive at a coherent set of business process concepts. We argued that the research in that direction is still premature. As discussed in Part 2 Chapter 1, there are several attempts to come to an ontology of business process concepts. Some of the attempts use BWW ontology as a starting point (Green and Rosemann 2000), others use FRISCO (Rukanova et al. 2005; Wohed et al. 2005). Although these attempts are premature and do not provide for a complete set of business process concepts, the concepts identified so far are sufficient for our purpose, as we are not striving for completeness in our multidisciplinary approach. The business process concepts based on FRISCO identified by Rukanova et al. (2005) and Wohed et al. (2005), seem to provide a sufficient ground for the elaboration of the business process view. As a result, we have chosen the following set of business process concepts.

Business process view: detailed	
Action	Composite action
Pre-state	Basic state-transition structures
Input actands	- Sequence
- Goal	- Choice
Actor	- Parallel
Post-state	Time
Output actands	Rule

Table 5.1 Business process view: concepts chosen.

These concepts are schematically represented in figure 5.2.

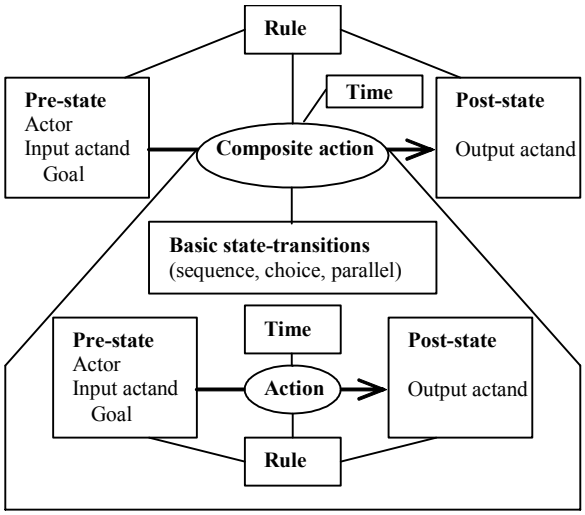

Figure 5.2 Schematic representation of the FRISCO business process concepts

These concepts are briefly introduced below. For the complete and formal definitions of the concepts, please refer to the FRISCO report itself.

Brief explanation of the concepts of the business process view (based on FRISCO)
A fundamental concept is the concept of **FRISCO-action**. An FRISCO-action is a **FRISCO-transition** from a **FRISCO-pre-state** to a **FRISCO- post-state**. **FRISCO-Actors** are mandatory part of the FRISCO-pre-state of a FRISCO-action and are responsible and capable for causing a FRISCO-transition. If not consumed or destroyed during the FRISCO-transition, they are also part of the FRISCO-post-state. Other FRISCO-things that are part of the FRISCO-pre-state of a FRISCO-action are called **FRISCO-input actands**. Other FRISCO-things that are part of the FRISCO-pos-state of a FRISCO-action are called **FRISCO-output actands**. A **FRISCO-goal** of a FRISCO-action is a special FRISCO-input actand of that FRISCO-action, pursued by the FRISCO-actors of that FRISCO-action. A FRISCO-action can form part of a **FRISCO-composite action**. FRISCO-actions can be related via a **FRISCO-state-transition structure**. Some FRISCO- basic state transition structures are **FRISCO-sequence**, **FRISCO-choice** and **FRISCO-parallel**. The allowed FRISCO-states and FRISCO-transitions are governed by **FRISCO-rule**. FRISCO defines also the concept of **FRISCO-time**. FRISCO time can be relative. The **FRISCO-relative time** presents the strict partial order on the occurrences of transitions. The **FRISCO-absolute time** may be determined by a clock, which issues regular pulses.

Table 5.2 Brief introduction to some of the FRISCO concepts.

Now that we have introduced a number of business process concepts and briefly discussed what they mean in terms of FRISCO, we can proceed with the illustration of how to apply them.

Before proceeding with the examples, we need to make one remark. With respect to the subject matter view and the business process view, we have decided to use two different ontologies. This choice is to a large extent based on our personal preferences. After performing a quick scan of BWW and FRISCO we considered that the key concepts covered in both are not so different. However, we considered that the FRISCO ontology has concepts, which more intuitively describe business process, while the BWW ontology seemed to us to more intuitive for describing the subject matter. Furthermore, we did not consider important to use one ontology because each ontology is used to address a separate view.

5.3 Example

The example below illustrates how to use the detailed business process view to analyze a business situation and a standard and identify possible mismatches between the two.

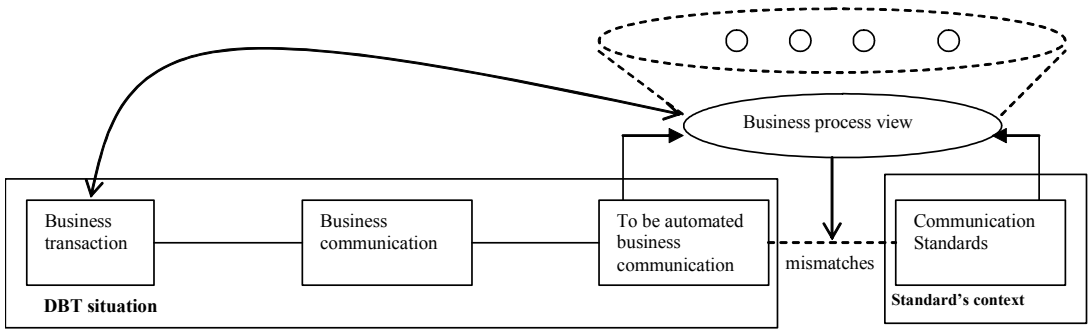

Figure5.3 Example of analysis of the DBT situation and the standard using the communicative act view.

The tracing of the consequences potential problems could have on the execution of the transaction will not be discussed in this example. It will be illustrated in section 9 of this chapter, where we present an example how a problem identified in one view can affect the other related views negatively and can ultimately hinder the execution of the business transaction.

5.3.1 Brief description of a business situation

The figure below provides a brief description of a business situation. [19]

•Adam Everyman visits his doctor for a routine check up. During the check up, Dr. Family **(actor)** discovers something that requires a specialized test, which is performed at a local diagnostic facility **(actor)**. In order for the test to be performed, the diagnostic facility must have an Authorization **(Input actand)** on file and a practitioner with specific qualifications (i.e., Dr. Family) must have registered this Authorization **(Rule)**.

•Dr. Family checks **(action)** against Mr. Everyman's insurance coverage with HC Payor, Inc **(actor)**. to see if this test is covered (eligibility check). Dr. Family determines that Mr. Everyman does indeed have coverage **(output actand)** with this insurer for this type of test.

•Dr. Family then **(sequence, time)** proceeds to register **(action)** an Authorization against Mr. Everyman's insurance policy. HC Payor, Inc. verifies that Dr. Family is indeed capable/allowed to issue this type of Authorization. Authorization is received from HC Payor, Inc. in the form of an Authorization identifier, along with an expiry date and conditions for that Authorization (e.g., dollar limit, deductibles, etc.) Note: Dr. Family can also bill for the office visit.

•Mr. Everyman proceeds **(sequence)** to the diagnostic facility **(actor)** to have the test performed. The diagnostic facility verifies that there is an Authorization on file with HC Payor, Inc. for the test for Mr. Everyman (query **(action)** Authorization Request interaction not shown on ladder diagram). They may also get the number from the patient if they have been given this identifier from Dr. Family. However, they will still verify the Authorization is on file and still active. Note: The diagnostic facility can only verify Authorizations and cannot initiate any Authorizations**(Rule)**(HC Payor, Inc. rule).

Figure 5.4 Example of a description of a business situation.

What is interesting is that the description of the business situation can be provided in lengthy textual documents. By using the business process concepts, one can walk through such documents and try to reason which business process concepts are needed to describe it. In the figure above we have underlined parts of the texts and provided some examples of which business process concepts the underlined text refers to (the concepts are put in brackets).

5.3.2 The Standard

For the purpose of this example we will again use the HL7 v. 3 standard. As we have already provided an introduction to the HL7 v. 3 standard in the example in section 3.3, we will not

[19] This example is adopted from HL7 v.3 stotyboards. The storyboards are not part of the normative standard. As the storyboards provide a rather detailed description, we will use one of them as a description of a business situation (see figure 5.4).

repeat the same description here and will continue with an illustration of how one can reason about the DBT situation and the standard using the business process view.

5.3.3 Evaluation of the Fit

In this section we illustrate how the business process concepts can be used to reason about the DBT situation and the standard. To do that, we walk through the business process concepts and provide a brief analysis.

Action
When we look at the description of the DBT situation we can say that the concept of action is addressed. Examples of actions are the performance of the medical check, the check for insurance coverage, and the request for authorization. In that sense we can say that the DBT situation covers both actions that take place in the physical world (the performance of medical check) and communicative actions (request for authorization).

If we look at the HL7 v. 3 standard, we can say that the concept of action is also covered. For example, the standard covers communicative actions like the request for authorization, and the authorization result. However, the standard is limited to capturing communicative actions and does not address substantive actions that take place in the physical world (like the examination of the patient or the performance of a test).

Composite action
The concept of a composite action is quite visible in the description of the DBT situation. If we look at the description we find that it contains activities and how they are related to achieve some goal. In this example, we can identify a number of actions (both substantive actions in the physical world and communicative actions), which are directed towards diagnosing the patient.

If we look at the HL7 standard we see that the normative part of the standard focusses on individual interactions and in some cases includes simple structures using what is called "receiver responsibility". The receiver responsibility specifies how the receiver is to act when receiving a given message. Some more complex structures of conversations can be found in the storyboards and the interaction diagrams included there. As we discussed earlier, the standard covers only communicative actions and in that respect the composite actions included in the standard will be limited to the communicative actions and do not address the issue of how communicative and substantive actions can lead to the achievement of a specific goal, the diagnosing of a patient for example. In this way, the standard has some limitations.

Basic state-transitions (sequence, choice, parallel)
Both in the description of the DBT situation and the standard we find elements of state-transition structures. For example, in the DBT situation we find the expression "Dr. Family then proceeds", which indicates sequence. Similarly, we find basic state-transition structures in the standard if we look at the interaction diagrams. We will not go into a further elaboration of which structures are covered in the DBT situation and the standard, as this goes into unnecessary detail.

Pre-state (Actors)
Let us look at the concept actor as part of the pre-state of an action. The concept of actor is covered by the DBT situation. Examples of actors are the family doctor and the insurance company. Within the standard, actors are not modelled explicitly; only sending and receiving application roles are described while the organizational actors which these applications support are not defined.

Pre-state (input actands)
If we look at the concept input actand of an action, we see that the DBT situation specifies input actands. For example, to be able to perform a test it is important to have an authorization as an input actand. As the standard is limited to capturing communicative actions, the input actands are also limited to communicative actions. In that respect the standard specifies in detail the content of the message (starting from the reference information model, proceeding to the domain message information models, and arriving at the hierarchical message description used in the communication (see the introduction to the HL7 v. 3 in section 3.3 of this chapter)).

Post-state (output actands)
If we look at the description of the DBT situation we can find examples where the output actand as a post-state of action is specified. For example, the result of the action "eligibility check" is confirmation that the patient has coverage. In the HL7 standard we also find elements of output actands as a post-state of an action. For example, the communicative action "query authorization request" would have as a result that the authorization request has been enacted and a reply is expected. The output actands in the standard will be limited to communicative actions and will not include substantive actions.

Rule
The requirements also clearly cover the concept of a rule. The rule as discussed in FRISCO governs the allowed states and transitions. If we look at the description of the DBT situation we can find examples of rules such as 'a diagnostic facility can only verify authorization and cannot initiate any authorization'. This means that the diagnostic facility can only perform actions related to verification of authorization and not related to initiation of authorization. The coverage of the concept of rule however, is limited in the standard. We can find elements of rules in the cases, where the standard defines the receiver's responsibilities. However, these rules are limited again only to communicative actions.

Time
We can look at time in absolute and relative terms. Absolute time specifies some time measures according to a clock. A relative time defines how actions occur relative to one another. Neither the DBT situation nor the standard had examples of absolute time. We found examples of relative time in both. For example, in the description of the DBT situation we see that the family doctor first checks for coverage and then proceeds to register an authorization. This indicates how the actions occur in time relative to one another. Similarly, we can find examples in the standard as well, especially in the interaction diagrams. It is important to mention again that the standard is limited to communicative actions and addresses relative time only with respect to these actions.

The concept of relative time can be seen as related to the concept of state-transition structure, as the state transition structure also implies some order of actions relative to one another.

What is illustrated so far is how the concepts from the business process view can be used to reason about both the DBT situation and the standard. One main conclusion that we can draw from the analysis is that the DBT situation requires a good understanding of both substantive and communicative actions and how they relate to achieve a certain goal. The standard however, focuses only on communicative actions. In that respect, the actors, the input and output actands, the composite actions and so on, related to the standard will always refer only to communicative actions. If there is an expectation from the standard implementation team that the HL7 standard can standardize the processes (combinations of both substantive and communicative actions) from this analysis, it becomes clear that such an expectation would be unrealistic.

The comparison described so far illustrates how the fit can be identified on a concept level without looking at the content itself. However, a second level of analysis (content level) is also possible when using the business process concepts. We will give an example with the concept of action. The questions one can ask are: "Which are the actions that need to be carried out automatically", "Which are the actions covered by the standard?", and "Are there examples of actions that need to be automated but are not covered by the standard?" One can reason then about the suitability of the content of the standard with respect to the business process requirements.

This differentiation between the concept and content levels has provided us with substantial insights to analyze and compare the DBT situation and the standard using different levels of analysis. These will be further elaborated in Part 5 Chapter 1: Method.

6. Business network view

6.1 Goal

The goal of this section is to identify concepts, which can help to further operationalize the business network view.

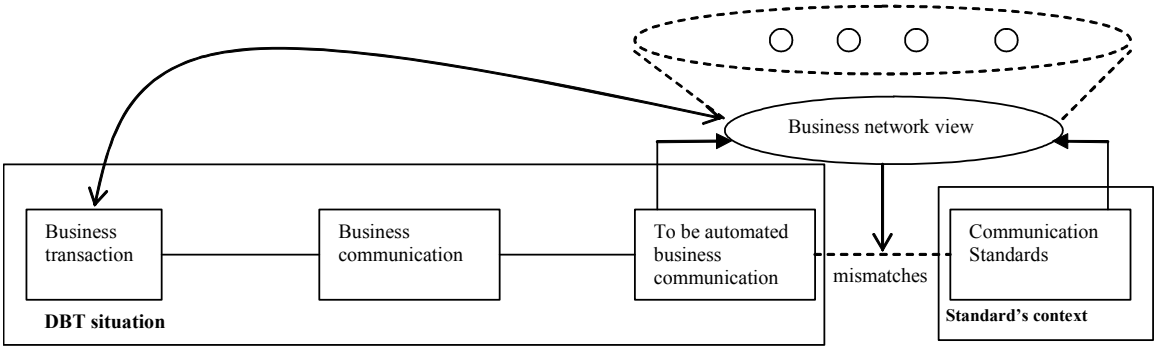

Figure 6.1 Elaboration of the business network view

The business network view can be used in three possible ways, described below.

The first use of the business network view will be to analyze the to-be automated communication and the standard in terms of the business network view and identify possible mismatches between the two. This scenario can be applicable when the standard contains some elements, which refer to the business network as well.
The second use of the business network view can be to help trace potential problems identified when using some of the views on the execution of the business transaction. A third use can be to help elicit requirements of the to-be automated communication.

Below we introduce some concepts to further operationalize the business network view and then provide an example.

6.2 Concepts

In Part 2 Chapter 2 we introduced the notion of a business network of a focal exchange by looking at some of the marketing literature. In Part 2 Chapter 3 we argued that we can derive a business network starting from the focal exchange and tracing the intermediating exchanges that facilitate either the flow of goods/services to the customer of the focal exchange or the exchanges that facilitate the transfer of compensation in the opposite direction. Apart from the

intermediary exchanges, we also argued that there are exchanges other than the intermediating exchanges, which also pose requirements and constrain the focal transaction.

In the table below we identify a number of concepts to describe a business network. The three main concepts are: focal exchange, intermediating exchange, and other related exchanges. Each exchange relationship can then be analyzed in terms of actors, objects, and related transfers. The full elaboration of the concepts of the focal exchange is not included, as it will be discussed separately in the next section.

Business network view: detailed
Focal exchange
Is supported by intermediating exchanges
Intermediating actors
Intermediating objects of exchange
Intermediating transfers
Is influenced by other related exchanges
Other related actors
Other related objects of exchange
Other related transfers

Table 6.1 Business network view: concepts chosen.

6.3 Example

Let us take an example where we have a business transaction between an emergency room and a pharmacy. When the pharmacy sends the medications, it also communicates information with the emergency room about the medications sent. Some of the information communicated from the pharmacy to the emergency room is about the production numbers of the medications sold. The information about the production number is not of direct use for the actors of the focal exchange actors or of the intermediating actors (e.g., actors that arrange the transportation of the drug). Only looking at other related exchanges however, could one identify this information requirement. In this case, such a related actor is the producer of the medication. He needs the production number of the medicines in case problems with the use of that medicine occur. This is an example how some information requirements with respect to the to-be automated communication can only be identified and explained when looking at the other related actors of the focal exchange. The identification of these requirements is important, as they will become a part of the propositional content requirements in the communicative act view or as part of the subject matter view. This example was an example of the third case of use of the business network view.

Similar to the discussion we had with respect to the business process view, we will not discuss the role of the business network view to trace the impact of potential problems in this example. We will illustrate the role of the business network view for tracking the effect of potential problems on the execution of the business transaction in section 9.

7. Focal exchange view

7.1 Goal

Within this section, we identify concepts, which operationalize the focal exchange view. The focal exchange view is the most abstract view. Similar to the business network view the focal exchange view has three functions: analysis of the to-be automated business communication, the standard and possible mismatches between the two; reasoning about possible mismatches identified with some of the views and their consequences to the execution of the business transaction; and elicitation of the requirements.

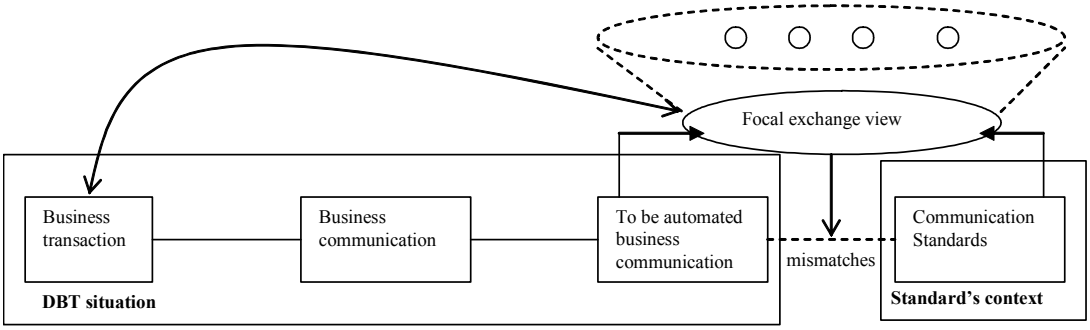

Figure 7.1 Elaboration of focal exchange view

In the next section we present a number of elements related to the focal exchange view and provide an example.

7.2 Concepts

In Part 2 Chapter 2, we identified a number of elements to describe an exchange; that an exchange has actors (buyer and seller), that it has objects of exchange (good/service, compensation), and that it has transfers involved (the good/service transfer and the compensation transfer). We have further discussed that an exchange can be governed by a government structure (market, hybrid, hierarchy). In Part 2 Chapter 1 we have argued that it is important to distinguish the exchange under analysis as a focal exchange. As a result, the table below summarizes some of the key concepts that we identified to operationalize the focal exchange view.

Focal exchange view: detailed
Focal exchange Has focal actors (Focal Buyer, Focal Seller) Focal objects of exchange (Focal good/service, Focal compensation) Has focal transfers (Focal good/service transfer, Focal compensation transfer) Has Governance structure (Market, Hybrid, Hierarchy)

Table 7.1 Focal exchange view: concepts chosen.

In the next section we illustrate how the exchange view can be used to compare the context of the to-be automated communication and the standard. An illustration of how the focal exchange view can be used in tracking consequences of potential problems will be presented in section 9 (the kitchen example).

7.3 Example

In this example, we illustrate how the focal exchange view can be used to compare the standard and the situation, and identify possible mismatches. We will use the concept of government structure for this example.

Let us take a situation of a hospital, which wants to use the services of an independent lab and the HL7 standard for the automation of the communication between the hospital and the external lab.

The HL7 standard is developed for intra-organizational transactions. When the standard was developed, it was intended for use in a hierarchy. If it is used to automate communication between a hospital and an independent lab, we are out of the context of hierarchy and in the

context of a market governance structure. In this case, there is a mismatch between the governance structure implied in the standard and the governance structure of the situation.

Questions arise: If a hospital sends an order to an independent lab, who is going to pay?, and how are the prices determined? The standard does not include information about that and additional arrangements need to be made to accommodate the additional requirements. How does it work in terms of compensation, which is different in this situation and is not covered by the HL7 standard? The new version of the standard (HL7 v 3), addresses the compensation part with payers and patients (in the older versions of the standard this is not the case), but not with third party vendors or service providers.

8. The detailed views

Figure 8.1 provides a summary of the different views and related elements, or what we call the detailed system of concepts.

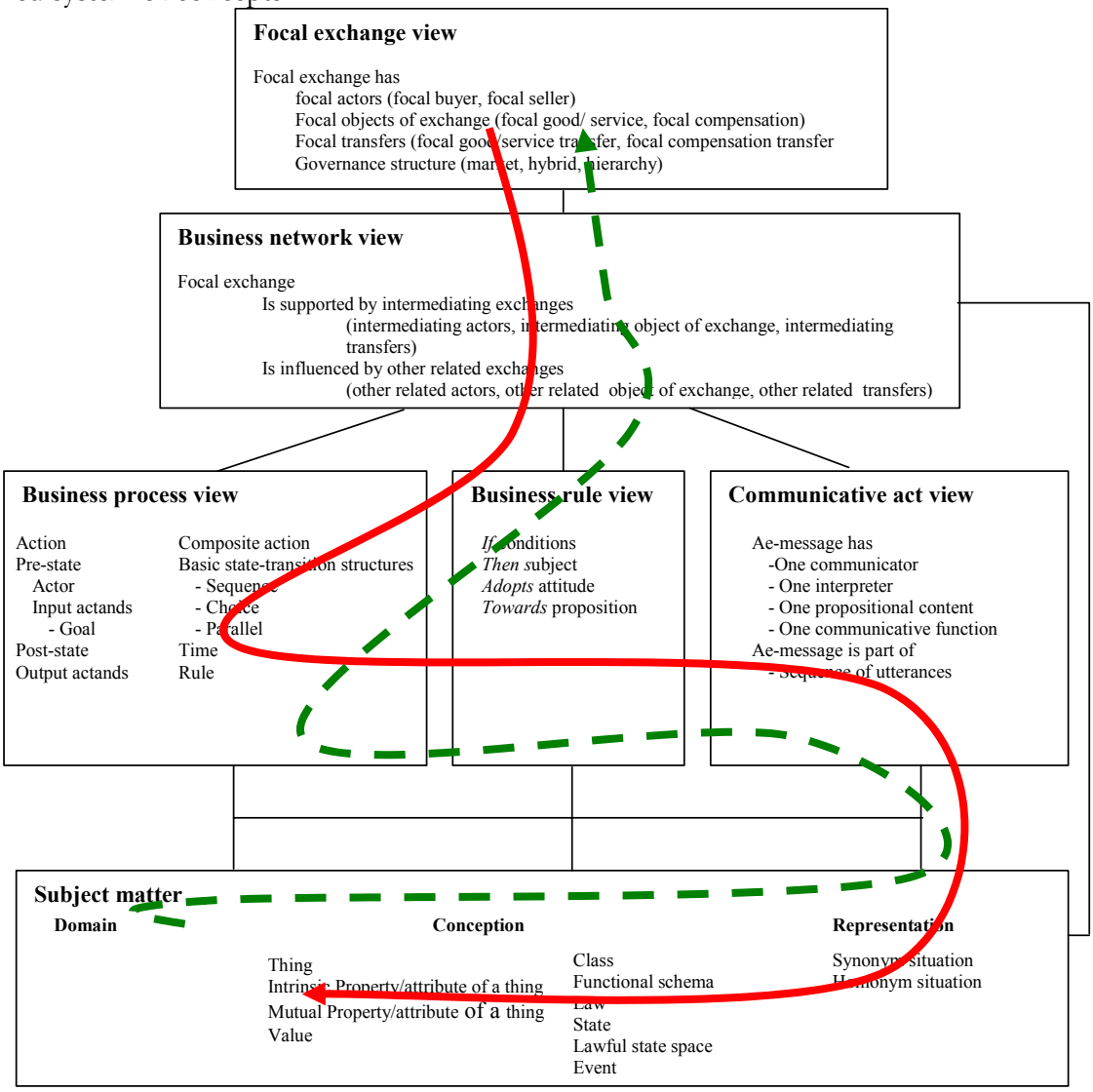

Figure 8.1 Detailed system of concepts

We discuss the limitations of the systems of concepts at the end of this chapter. In this section we discuss some of the relationships between the different views, and some of the links between the concepts of the different views.

Before discussing the relationships between the views, we would like to clarify that we will not pursue formalization of these relationships but present intuitive logic of how and why the views are related and what a relationship implies.

The relationships between the views can be seen in two directions: beginning with the focal exchange view and moving gradually though the other views (see the solid arrow in figure 8.1), helps identify key elements of the context of the focal transaction. When moving in the opposite direction (see the dashed arrow in figure 8.1), the relationships between the views can help identify a problem with respect to some of the views, and what the consequences on the execution of the focal exchange will be.

Below we briefly discuss the relationships and how they can be used to analyze the context of a business transaction. After that we present an example of how to track the consequences.

8.1 Focal exchange view- business network view

The goal of the focal exchange view is to reflect on questions such as: Which is the exchange that we actually want to analyze? Who are the actors of this exchange? What are the objects and the involved transfers? What is the governance structure? Once this is done, we can proceed with identification of the business network. The focal exchange view and the business network view are related in the sense that the focal exchange view is used as a starting point and determines the related business network. The relationship is evident if we look at the detailed views as well. We can see the notion of a focal exchange in both.

The relationship between the focal exchange view and the business network view can help identify the intermediating exchanges and the related actors which facilitate the transfer of the focal good/service from the focal supplier to the focal customer and the focal compensation in the opposite direction. The business network view also suggests that other related exchanges to the focal exchange can be identified at that point.

8.2 Business network view- Business process view

The business process view defines the actions and the sequences of actions, which lead to the execution of the focal exchange. As such, the business process view can be seen as a further elaboration of how the focal and the intermediating transfers as defined in the business network view ultimately bring the focal good/service to the focal customer and the focal compensation to the focal supplier.

We can see some similarities between the concepts defined in the business network view and the business process view. The focal and intermediating actors in the business network view can also be seen as actors in the business process view. The focal and intermediating transfers from the business network view can be seen as actions or composite actions in the business process view.

The business process view however, provides grounds for further analysis such as: What are the sequences of actions that can lead to the execution of the focal exchange? What are the necessary conditions to perform a certain action, and in particular, what information is needed to perform an action? Similar to the communicative act view, one might discover that other related actors to the focal exchange might impose conditions on the execution of some activities, even if these actors are not directly involved in the process.

8.3 Business network view- communicative act view

The relationship between the business network view and the communicative act view will help identify possible business conversations between the actors from the business network regarding the execution of the focal exchange. When conducting such an analysis, one can get a complete picture of the variety of business conversations that the involved actors in the network will need to enter into to execute the focal exchange.

The focal actors and the intermediating actors can play the roles of communicator and the interpreter as defined in the communicative act view. Whether an actor is initiator or interpreter depends on who initiates an utterance. In some cases, there might be business conversations involving other related actors.

The propositional content (defined in the communicative act view), also deserves attention when discussing the relationship between the business network view and the communicative act view. As discussed in section 6.3, some of the other related actors (actors that are not directly involved or intermediating the focal exchange), can impose information requirements, which need to be included in the propositional content of the business conversations. Thus when defining the information requirements with respect to the propositional content of the business conversations, one needs to check whether there are additional requirements imposed by the other related actors in the network.

8.4 Business process view- communicative act view

The business process view and the communicative act view are also closely related. The goal of the communicative act view is to elaborate possible business conversations regarding the execution of the focal exchange. Different conversations can lead to different business process scenarios. The communicative act view can help to reason about possible business scenarios regarding the execution of the focal exchange. The respective communicative act also become actions embedded in the different process scenarios. It is important to notice that the business process ultimately contains both communicative actions (the promise to deliver goods), and substantive actions (actual delivery of the goods). The concepts communicator and interpreter as defined in the communicative act view are similar to the concept of actor in the business process view.

8.5 Business rules view and its connection to the business network, business process and communicative act view

The business rule view defines rules of behaviour; what kind of actions can and cannot be performed by subjects under certain conditions.

The relationship between the business network view and the business rule view can help elicit the business rules to which actors in the network need to comply. The relationship between the business rule view and the communicative act view defines how actors are required to act based on the communicated information. The relationship between the business process view and the business rule view can help elicit the responsibilities of the actors involved in the process with respect to certain actions.

The concept of subject as defined in the business rule view is similar to the concept of actor (focal actor, intermediating actor) in the business network view, the concept of an actor in the business process view, and the communicator and interpreter (in the communicative act view).

8.6 The subject matter view and its relationships with the other views

The subject matter view is a fundamental view that aims to capture the domain of interest with respect to the focal exchange under analysis and its conception and representation.

The relationships between the subject matter view, and the business network view, the communicative act view, and the business process view, aim to capture information about the domain of interest including actors (focal, intermediating, other related actors), their objects and transfers of exchange, the input and output actands of actions, as well as additional things that might appear in the propositional content.

The concept of law in the subject matter view is closely related to the concept of rule in the business process view and to the business rule view as a whole. How exactly they relate depends on the individual situation. However, we can use one of the examples presented earlier to illustrate one possible way they can relate.

If we look at the operating room example discussed earlier, we see that one business rule that we discussed was that in the Netherlands it is allowed under certain conditions an authorized person to reopen a case. This is reflected in the subject matter view by defining "reopened" as a lawful state for a thing "case".

8.7 Reflection on the detailed system of concepts

So far, we have discussed some of the major relationships between the different views. We will not further burden the discussion with full elaboration of all possible links between the concepts of the views that might exist. We have introduced intuitive understanding about the ideas behind each view and major relationships.

Before continuing to section 9, where we present an example of how the different views can be used together in the analysis, we discuss here two issues related to the system of concepts as constructed so far: the possible overlap between the different views, and why we did not to merge the views and create an integrated model.

In Part 2 Chapter 2 we began this when discussing the relationships between the different views. There we discussed substantial overlaps between the focal exchange view and the business network view, as well as between the business process view and the communicative act view. What we argued was that the focal exchange view is a starting point for deriving the business network view and we treat them and analyze them separately. Regarding the business process view and the communicative act view, we stated that they have substantial overlap but provide different perspectives on the same phenomenon. While the communicative act view is rooted in language action theories and focuses on the communicative actions related to a transaction, the business process view is rooted in organizational theories and focuses on how different actions and resources are mobilized to achieve certain organizational goals.

We can find overlaps not only on the view level, but also when we look at the concepts covered in each view. If we carefully examine the detailed system of concepts, we find concepts that on the surface appear to be the same. One example is the concept of actor; in the focal exchange view we define focal actors who perform economic exchanges and in the business process view we speak of actors as capable and responsible for initiating certain actions. Another example is the concept of rule from the business process view, the concept of law from the subject matter view, and the business rule view. It would be unusual if we did not find similarities and overlaps, as the views and the concepts of each view provide a way of looking at the same phenomenon.

Indeed, as we have pointed out in the examples above, there are concepts that appear the same on the surface. However, these concepts and views are derived from different sets of theories with different underlying philosophical backgrounds. Although there seem to be similarities and overlaps between the views and concepts of the views, it would be undesirable to merge the views and create one model. By keeping the different views we can ensure that the concepts within each view are consistent with one another and are rooted in theories with the same philosophical basis.

The next section presents an example of how to use the combination of views in the analysis.

9. The kitchen example

The example in this section is a real-life example of a project carried out in a Dutch hospital. We begin with a brief description of the DBT situation and the need to automate parts of the business communication. We then discuss the standard chosen and a problem that occurred after the standard was implemented. We discuss whether we can use the system of concepts to explain such an occurrence.

9.1 The DBT situation

The DBT situation is related to the admission of a patient in the hospital. To be treated, a patient needs to be registered. When the patient arrives, he is registered as an inpatient. Some patients are admitted to the hospital, treated during the day and can go home in the evening. These patients are a special kind of inpatient, also called daycare patients. For some patients, the treatment requires a longer stay and they may need to spend several nights in the hospital.

In case an inpatient arrives, the hospital administration department needs to notify other parties responsible for patient care. One such party is the hospital kitchen. The hospital kitchen needs to know about the arrival of the patient to prepare food for that patient. Both the hospital administration department and the kitchen share the same understanding about the types of inpatients; some inpatients are daycare patients and some are overnight patients.

Both the hospital administration department and the kitchen have computer systems in place. The computer system in the hospital administration department is called hospital information system (HIS) and the computer system in the kitchen is called kitchen information system (KIS). The KIS supports the internal processes of the kitchen, but was not connected to the HIS. Communication between the two systems was paper-based. As the two applications were already in place, the hospital decided that communication between the administration department and the kitchen should be automated by integrating HIS and KIS. The expected effect from the automation was that the communication between the hospital administration and the kitchen would become faster, there would be no need for a double entry of information, and human errors from double entry of information would be reduced. As a result, there was expected improvement in the business process performance.

9.2 The standard implementation project and the problem that occurred

To integrate HIS and KIS, a project was started. The goal of the project was to integrate using a standard. A decision was made to use the HL7 v 2.2 standard (figure 9.1). During implementation, an HL7 v 2.2 interface was installed on the HIS and on the KIS. As a result of the implementation, the HIS was able to send a message to the KIS when a new patient was admitted to the hospital. The systems were in use in the process after the implementation. After a period, the kitchen noticed something strange happened quite often: the kitchen was preparing more dinners than there were patients. It took some time before the cause of the problem was

discovered. It became clear that something was wrong with the integrated computer systems. The major problem was that the meaning of "inpatient" embedded in HIS differed from the meaning of "inpatient" embedded in KIS.

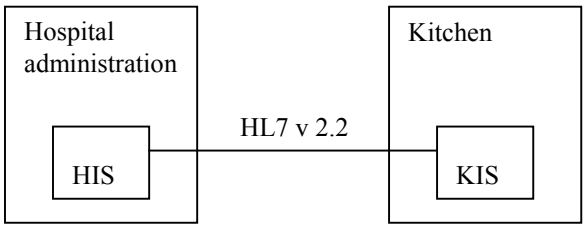

Figure 9.1 Integration between HIS and KIS using HL7 v 2.2

9.3 Our analysis

As discussed in Part 1 Chapter 2, one of the major prerequisites for meaningful communication is for the parties to create a shared context. As discussed in the DBT situation description, the Hospital administration and the Kitchen shared the same understanding about the types of inpatients (daycare and overnight), and what actions should be taken if a certain type of inpatient is admitted.

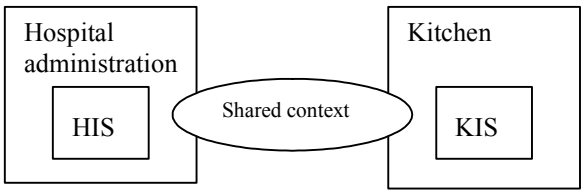

Figure 9.2 Shared context between the hospital administration and the kitchen

Part 1 Chapter 2 we also argued that in case part of the business communication was to be automated, part of the shared context which refers to the to-be automated communication needs to be captured, made explicit, and formalized, before embedding it into the computer system.

9.3.1 The shared context

In the standard implementation project, efforts to capture, make explicit, and formalize the relevant shared context were limited.

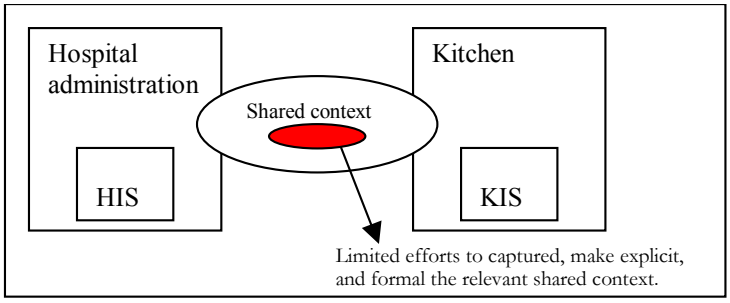

Figure 9.3 Limited efforts to capture and make explicit and formal the relevant shared context

9.3.2. The standard

Communication between the systems of the different parties was done using HL7 v.2.2, using the message "admit/visit notification (ADT^A01 for short)". KIS needed to be informed of the arrival of a patient. As a result of the standard implementation project, the Hospital information system (HIS) was able to send an admit notification to the kitchen information system (KIS).

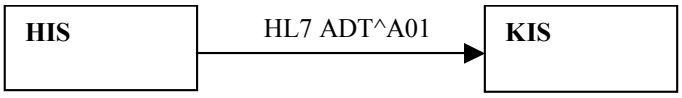

Figure 9.4 The HL7 messages sent from the HIS to KIS

9.3.3 The subject matter view

Part of the information exchanged with the HL7 message is patient class. The HL7 standard defines a table with allowed values for a patient class.

Value	Description
E	Emergency
I	**Inpatient**
O	Outpatient
P	Pre-admit
R	Recurring patient
B	Obstetrics
C	Commercial accommodation
N	Not applicable
U	Unknown

Table 9.1 Allowed values for patient class.

The value "I" was used for patient class, as the message needed to communicate information about the admission of an inpatient.

The standard also allows specifying a field "patient type" and makes reference to a table 0018, where the allowed values of a patient type are defined.

Value	Description
	No suggested values

Table 9.2 User-defined Table 0018- Patient type.

This table is left empty; the hospital administration decided to use this field and define its hospital specific codes. It was decided to use this to indicate cases where the inpatient was only a day-care patient. The hospital administration defined code "DC". The patient type with a value "DC" indicates cases where an inpatient was a day-care patient. Explicit models of the information embedded in the standard were not made.

HL7 experts, responsible for the interface on the HIS, used the field "patient type" with respect to representation in the message, and filled in the code "DC" to indicate a daycare patient. If it was an overnight patient, the field "patient type" was left empty.

Explicit domain models were unavailable but for illustration purposes we model the notion of inpatient embedded in the HIS in the figure 9.5[20].

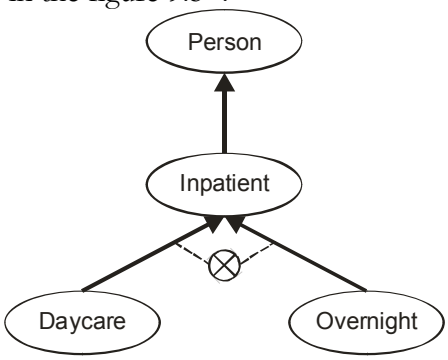

Figure 9.5 The model embedded in HIS

[20] In the models presented in figure 9.5 and 9.6, we use ORM notation (Nijssen & Halpin, 1989). The constructs that we use in these models are entity type (labeled ellipse), subtype (arrow), and exclusion constraint (circle with cross)

For the development team of the interface of the KIS, the field patient type had no meaning. As a result, every time a message containing an element patient type with a code "DC" arrived, the element patient type was ignored. Every message that arrived, regardless of whether it was a day-care or overnight patient, was interpreted as overnight.

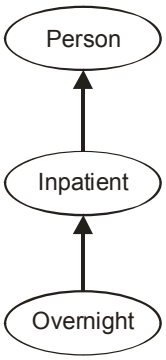

Figure 9.6 The model embedded in KIS

The 9.6 provides our interpretation of the model assumed for the incoming communication from the HL7 experts responsible for development of the interface on the KIS. From the description it becomes clear that the model of an inpatient embedded in HIS was different than the model embedded in KIS. This difference had resulted in the delivery of more dinners than were actually required.

This problem could have been identified analytically using the subject matter view by asking the questions: "Is there a shared context with respect to the subject matter view between the parties involved in the communication?"; "Is there an explicit formal model of the requirements of the relevant shared context with respect to the subject matter view", and "Is there an explicit model of the subject matter embedded in the standard". As the answer to all these question is no, the next step would be to construct models and communicate them with the parties involved in the automation of parts of the business communication. A next step would be to compare the models required by the DBT situation and those embedded in the standard and reason about possible mismatches.

9.3.4 Communicative act view

If we analyze the DBT situation using the CA view, we identify that the hospital administration needs to communicate two types of messages to the kitchen. The first is "there is a daycare inpatient"; the second is "there is an overnight patient".

In the figure below we use the model introduced in the communicative act view to reason about communication between the HIS and KIS. The figure represents the ae-message (HL7 ADT^A01). For this message it also illustrates the communicator (HIS) and the interpreter (KIS). The figure also indicates that the ae-message has a propositional content: the content of the message, in this case part of the content contains information about an inpatient. We also indicate that an ae-message has a communicative function (intention behind the communicated information).

While the communicator, interpreter, and even the content of the message may be straightforward, there can be different ways to define the communicative function, depending on the arrangements and the rules in the hospital. If it is within the responsibility of the hospital administration to order food on behalf of the patient, the intention HIS has behind the message would be either "daycare inpatient/ no dinner is required" or "overnight inpatient/ dinner is required". If the hospital administration is not responsible to order food on behalf of the patient,

the intention behind the messages would be "notification of arrival of daycare inpatient" or "notification of arrival of overnight inpatient" and the rules regarding when and when not to prepare dinner may be embedded in the KIS. Although in our example the hospital administration was not responsible for ordering dinner on behalf of the patient (only to notify about the arrival of inpatients), there may be cases when it is responsible, which may lead to a different definition of the communicative functions.

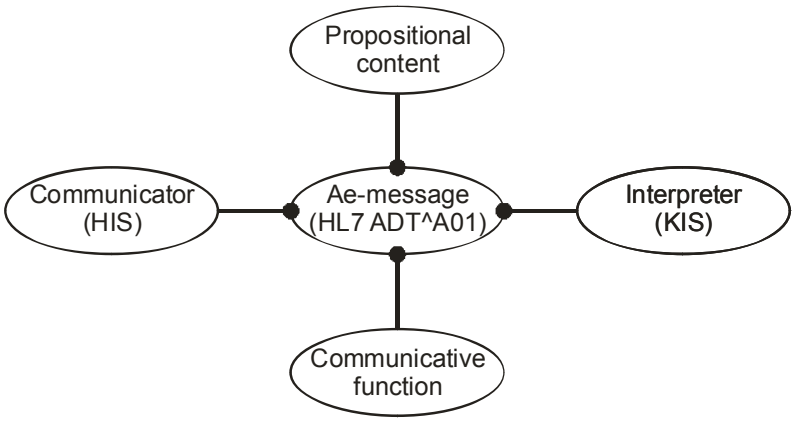

Figure 9.7 The HL7 message as an ae-message with a communicator HIS and interpreter KIS.

The problem that we see when we compare the requirements of the DBT situation and the standard is that the DBT situation requires two separate message types with two separate intentions; a message type notifying that there is a daycare inpatient and a separate message type notifying that there is an overnight inpatient. The standard uses only one message type. Furthermore, due to problems identified with the subject matter view, we can say that the HIS was sending a message type which could carry two different intentions (notification of arrival of daycare inpatient or notification of arrival of overnight inpatient), while the communication model embedded in the KIS was interpreting the incoming messages with only one intention (notification of arrival of overnight inpatient).

9.3.5 Impact analysis

What we have done was to use the subject matter view to explain the root of the problem, and have continued with the communicative act view, where we traced the consequences of this problem and identified further problems.

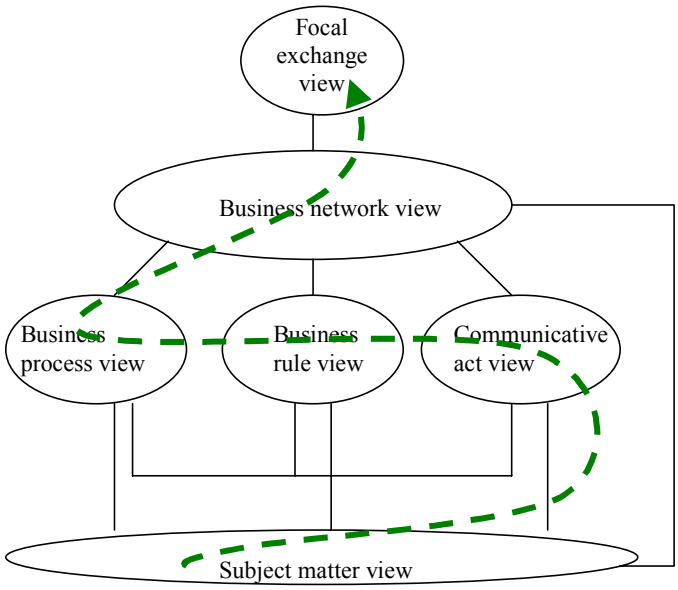

Figure 9.8 Tracing the consequences

Let us imagine that we were able to identify this mismatch before the release of the system. Now we will illustrate how we can use the system of concepts to reason about the consequences that this misinterpretation can have on the focal exchange, by tracing the consequences through the business rule view, business process view, and business network view.

If we look at the business rule view, the business rule embedded in the kitchen system states that in case there is an admitted inpatient, dinner should or should not be prepared. As a result, at the level of a business process view we can say that a set of activities which aim to prepare and deliver food to the patient will either start or not. On a business network view we can say that there is an intermediating exchange taking place between the kitchen and the patient and the delivery of dinner to the patient is only one part of the supporting exchange (mainly delivery of good/service). The other part of the intermediating exchange requires that the patient pays for the food. Last but not least, the intermediating exchange supports the execution of the focal exchange. In this case we could say that the focal exchange is an exchange between the hospital and the patient, where one of the intermediating actions for providing hospital care is providing food to the patients.
What we can argue in this case is that a problem rooted in the subject matter view will lead to misinterpretation of the intention of the message in the communicative act view. This can lead to wrong actions which will affect the business process view and have financial consequences which will affect the focal exchange view. In this case there are costs incurred by the kitchen (materials used to prepare the food as well as service costs). These costs will be charged against the account of a patient and will be a burden for the patient (as he did not consume the dinner) or will be a loss for the kitchen if the patient refuses to pay. We will not go into detail about the actual financial management of Dutch hospitals, as this would needlessly complicate matters.

What we have done so far is begin with a problem encountered in practice, and used some of our knowledge and the system of concepts (especially the subject matter view and the communicative act view) to explain the root of the problem. We have assumed that this problem could have been identified analytically before the actual implementation of the standard and illustrated how the system of concepts can be used to reason about possible consequences of the mismatch on the focal exchange. In this example, we aimed to illustrate that the system of concepts can be useful not only by looking at each view in isolation, but also by looking at the relationships between the views and reasoning how problems that occur in one view can affect others.

10. Final remarks

Within this chapter we have arrive at a detailed system of concepts and have presented multiple examples how different parts of the system of concepts can be used. However, the use of the system of concepts in the examples was done on an ad-hoc manner. In part three we provide a systematic method to use the system of concepts

Part III. Method

Chapter 1: Method

1. Introduction

1.1 Background

In Part 1 chapter 2 we outlined three research questions. The first concerned the construction of the system of concepts to analyze the DBT situation, the specified DBT requirements, the chosen standard, and identify potential problems with the execution of the business transactions. This research question was addressed in Part 2 with the result a system of concepts. The goal of Part 3 is to address the second research question:

What should a method of how to apply the system of concepts consist of in order to:

- help in analyzing the DBT situation, the specified requirements of the DBT situation, the chosen standard,
- help in analyzing possible mismatches between the specified DBT requirements and the chosen standard, and between the DBT situation and the specified DBT requirements,
- identify potential problems with the execution of a business transaction, based on the above analyses.

For visualization purposes, we include again the three figures with respect to the role of the method, discussed in Part 1 Chapter 2.

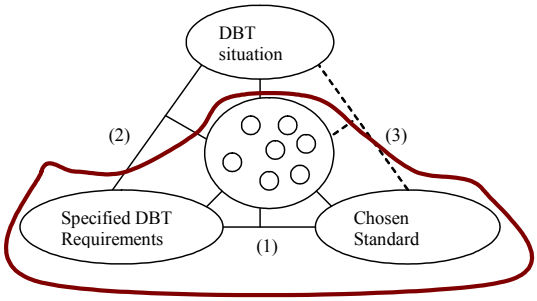

Figure 1.1 Analysis of the specified DBT requirements, the chosen standard, and mismatches between the two using the system of concepts (Fit analysis)

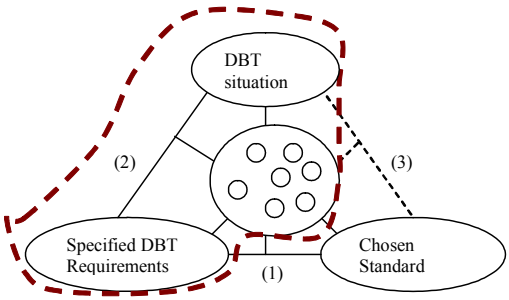

Figure 1.2 Analysis of the specified DBT requirements, the DBT situation, and possible mismatches between the two using the system of concepts (DBT analysis)

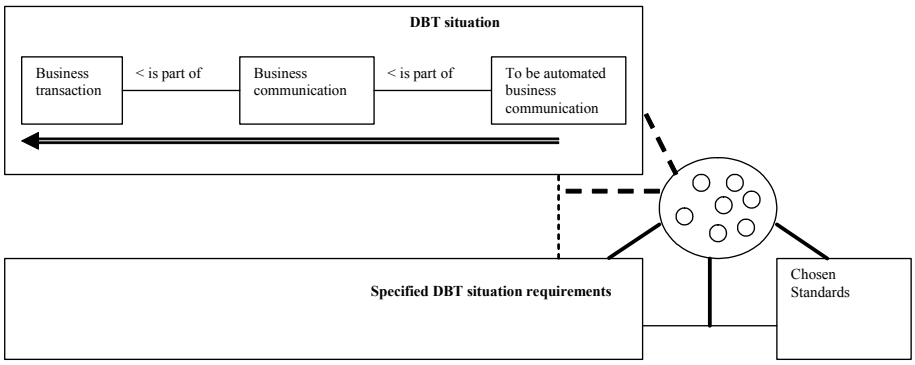

Figure 1.3 Analysis of the impact that possible consequences that problems identified with the fit or the DBT analysis can have on the execution of the business transaction (Impact analysis)

For the full explanation of the pictures, please refer to Part 1 Chapter 2. To facilitate reading the figure captions of figure 1.1, 1.2, and 1.3 we have provided a short name in brackets for the different types of analyses. These labels will appear again later in this chapter as part of the method description.

When constructing the system of concepts, we assumed that the DBT situation is fully captured in the specified requirements and that there is no distinction between the two. We have also chosen to follow a predominantly theoretical approach and derived, based on theory, concepts that describe the DBT situation. For this reason, the distinction between the DBT situation and the specified DBT requirements was not really an issue during the construction of the system of concepts.

In the method however, this distinction is crucial. In real life, people often work with specifications of the DBT situation and specifications of a standard. From a practical point of view, it is important to realize that for a quick scan analysis of a standard implementation project, the easiest way to proceed would be to conduct a document-based analysis of the specified requirements and the given standard.

Although such an analysis can be a good starting point, this alone can be very limited, as specifications in projects are sometimes poorly done and may poorly represent or completely miss some important aspect of the DBT situation. It is not our task to redo the complete requirements analysis and come to better specifications. It is our task to question the quality of the requirements specifications and pinpoint problem areas related to that.

1.2 Insights for the method construction

When constructing the method, we aimed at a structured way of working which provides a mechanism to use the system of concepts described in Part 2, in the situations illustrated above.

For the construction of the method, we had insights concerning the components of the method from the beginning, as described in Part 1 Chapter 2 (i.e., that the method needs to incorporate the system of concepts and needs to support three types of analysis as illustrated in figures 1.1, 1.2, and 1.3). We gained further insights on what we can include in the method while constructing the system of concepts and trying to illustrate the use of different parts of the system of concepts in various examples. We also looked into existing literature on methods with respect to information system development, mainly the work of Wijers (1991). In the context of methods for information system development, Wijers argues that a method needs to include a way of thinking, modelling, working, and controlling. He also argues that automated tools are expected

to support these four "ways" and are therefore part of a way of supporting. Although our goal is not to develop a method for information systems development, we can adopt ideas from this area and apply them in the context of our work.

The different insights about what the method should look like evolved over time; we used logical reasoning to integrate the different pieces into a structure, which we will discuss in the next section.

2. Components of the method

Figure 2.1 describes the key components of the method we have identified: system of concepts, types of analysis, levels of analysis, questions, and a way of working.

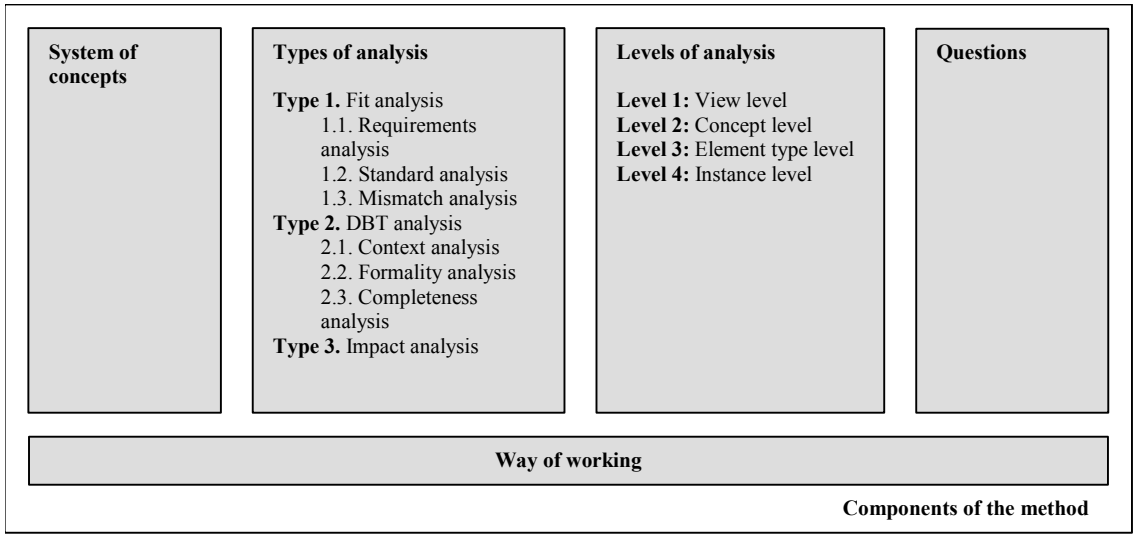

Figure 2.1 Components of the method

2.1 System of concepts

The system of concepts is a major ingredient for the method. As illustrated in figures 1.1 (fit analysis), 1.2 (DBT analysis), and 1.3 (impact analysis), the system of concepts plays a central role. The system of concepts is a focus of the discussion in Part 2 of this thesis.

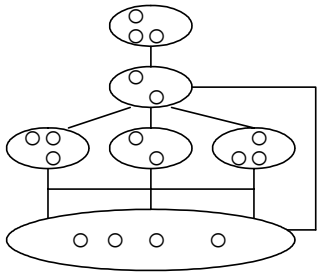

Figure 2.2 Schematic representation of the system of concepts

Figure 2.2 is a schematic representation of the system of concepts composed of views and view relationships where each view is elaborated in terms of concepts. As we have already provided in-depth discussion concerning the system of concepts, we will not go into detail in this chapter.

2.2 Types of analysis

As illustrated in the figure 2.1, we can roughly distinguish between three types of analysis: fit analysis (analysis type 1), DBT analysis (analysis type 2), and impact analysis (analysis type 3). These three types can be found in the research question itself and are illustrated in figures 1.1, 1.2, and 1.3. Each of the types will be briefly introduced below.

2.2.1 Fit analysis (analysis type 1)

The fit analysis consists of three analysis sub-types; the requirements analysis (analysis type 1.1), the standard analysis (analysis type 1.2), and the mismatch analysis (analysis type 1.3).

Requirements analysis (analysis type 1.1)
The requirements analysis concerns analysis of the specified requirements of the DBT situation. During this analysis, requirements documents will be used as a major input.

Standard analysis (analysis type 1.2)
The standard analysis concerns analysis of the standard. The main input for this type of analysis will be standard specification documents.

Mismatch analysis (analysis type 1.3)
The mismatch analysis concerns possible mismatches between the specified requirements and the standard.

The three different sub-analyses of the fit analysis are schematically illustrated in figure 2.3.

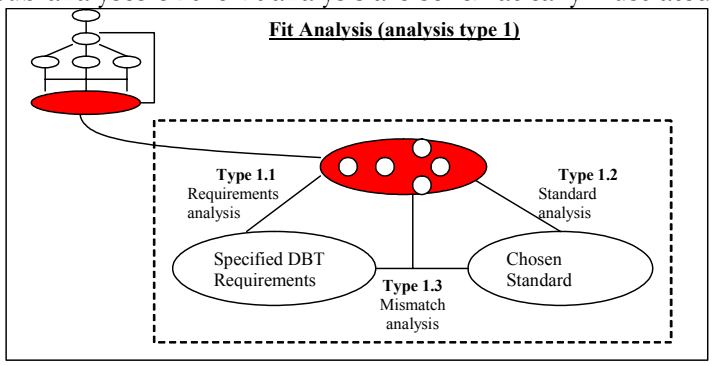

Figure 2.3 Fit analysis

One view from the systems of concepts is to be used at a time to perform the fit analysis. The steps to be followed during the fit analysis will be discussed in detail in section 3 of this chapter. Ultimately, the outcome of the fit analysis will be a list of potential problems expected with respect to the chosen view. This list will compile the results of the requirements analysis (type 1.1), the standard analysis (type 1.2), and the mismatch analysis (type 1.3.

As stated earlier, the fit analysis will be documents-based using the specified requirements and the standard as inputs.

2.2.2 DBT analysis (analysis type 2)

The DBT analysis (analysis type 2) reflects on the DBT situation and the specified requirements with respect to that situation. Unlike the fit analysis (type 1), the DBT analysis (type 2) cannot only be document based, and requires access to the empirical world or the DBT situation itself. As the analyst might have a limited knowledge about the DBT situation for analysis type 2, he will have to work together with domain experts. The role of the analyst is to make people reflect on the DBT situation and the specified requirements, and identify potential problems. It is important

to point out that the goal of analysis type 2 is not to redo the requirements analysis and to come to newly specified DBT requirements but to pinpoint possible problem areas and make people reflect on the DBT situation and the specified requirements. With respect to analysis type 2, we identify three sub-types of analysis.

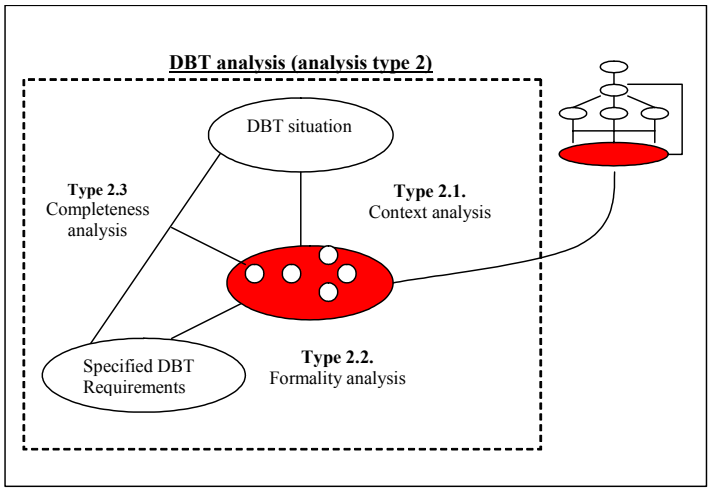

Figure 2.4 DBT analysis

Context analysis (analysis type 2.1)

The context analysis (analysis type 2.1) is directed towards the DBT situation. To explain this type of analysis, let us return to a discussion from Part 1 Chapter 2. As argued in organizational semiotics, business parties need to first establish a shared context to be able to do business together. We have argued further that in case part of the business transaction is to be automated by computer systems, this context needs to be captured and made explicit. Within this thesis, in order to reason about the DBT situation and the standard, we have worked with the assumption that the business parties have established such a shared context. In a real life situation however, such a shared context might not have been created. The existence of such a shared context is represented with the "?" in the figure below. A general question to guide this analysis with respect to a specific view, will be whether the DBT situation parties have established a shared context, especially with respect to the to-be automated business communication.

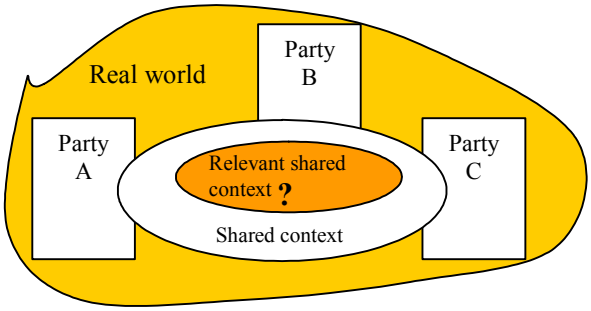

Figure 2.5 Questioning the existence of a shared context

If the parties have not established such a shared context, this would mean that one of the fundamental theoretical requirements for conducting meaningful communication is not fulfilled and can be a potential problem area. With the context analysis (analysis type 2.1), we first check whether this fundamental requirement is met within the given DBT situation.

Formality analysis (analysis type 2.2)

In Part 1 Chapter 2 we argued that the requirements of the DBT situation needed to be made explicit and formal, before being embedded in the computer system. We also argued that in a

standard implementation project the chosen standards often provide sufficient detail to be implemented directly into the computer system and due to that, explicit and formal requirements of the DBT situation might not be available. If the requirements of the DBT situation are not made explicit and formal before the standard is implemented, there will be no base on which to reason about contextual differences between the DBT situation and the standard. Furthermore, as argued in Part 1 Chapter 2, simply implementing a standard will lead only to technical interoperability not necessarily inter-organizational interoperability. A general question to guide this analysis is whether the requirements of the DBT situation have been made explicit and formal before the standard has been embedded in the computer system. If this is not the case, problems can be expected.

Completeness analysis (analysis type 2.3)
The completeness analysis (analysis type 2.3) is a quick scan to make people reflect whether some important elements of the DBT situation are not captured in the specified requirements. The system of concepts can be used to make this analysis.

The figure below provides a schematic representation of how the system of concepts can be used to reason about possible missing requirements in the subject matter view (the shaded ellipse in the system of concepts). As illustrated with the dashed curved arrow, one can walk through the different views and check whether each view provides some additional requirements with respect to the subject matter view. Then, one can reason whether there are examples when things of interest required by the focal exchange view, the business network view, the business process view, the business rule view, or the communicative act view, are not yet captured in the subject matter view.

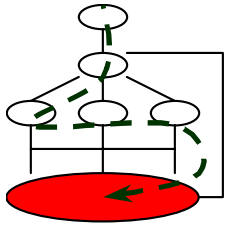

Figure 2.6 Using the system of concepts to reflect upon the completeness of the specified requirements

Further elaboration of how the completeness analysis can be performed will be provided in section 4.3 of this chapter.

2.2.3 Impact analysis (analysis type 3)

The impact analysis (analysis type 3) identifies what the consequences of potential problems (identified via the fit analysis and the DBT analysis), could be with respect to the execution of the business transaction.

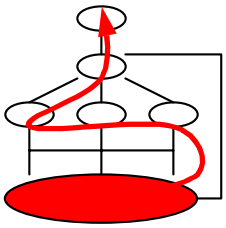

Figure 2.7 Using the system of concepts to reflect about the impact that a potential problem identified with one view can have on the execution of the business transaction.

The view where potential problems are identified is taken as a starting point. The analysis identifies which views and concepts within the views are related to this view and can be affected. This analysis can be seen as an impact analysis. This type of analysis has been partially demonstrated in the kitchen example discussed in Part 2 Chapter 3, where we have identified a

problem at the subject matter view and traced the consequences of this mismatch to the communicative act view, the business process view, and ultimately to the focal exchange view (see Part 2, Chapter 3, section 9).

2.3 Levels of analysis

If we look at the system of concepts as constructed in Part 2, we can identify different possible levels of analysis. We have identified four levels at which such an analysis can be performed. The levels provide a gradual transition from abstract analysis (level 1) to concrete (level 4).

To be able to understand how the different levels have been derived, let us first recall what the content of the system of concepts that we have constructed is. On the highest level of abstraction, the system of concepts consists of views and relationships between the views. Thus we define the level one analysis as analysis concerning the views and the relationships between the views. This level of analysis will aim to check whether a certain view is covered.

If the views are not considered black boxes, we can say that each view consists of concepts and relationships between concepts. In that sense, we define Level 2 analysis as analysis, which will deal with the concepts and the relationships, defined within the views. Level 2 analysis will use the concepts and concept relationships to allow for a finer-grained analysis.

Level 3 is where the analysis can be done at the level of intentional model. Here the discussion will be concerned with element types and relationship types. Level 4 is where the analysis is based on the extensional model. At this level, the discussion will be concerned with instances or elements and relationships. Concerning intentional and extensional models see the discussion of modelling levels in Part 2, Chapter 1, section 2.1.2).

The four levels are schematically represented in the table below. Levels 1 and 2 are directly related to the system of concepts constructed so far. Levels 3 and 4 refer to model and instance.

System of concepts	**Level 1**	Views, relationships
	Level 2	Concepts, Relationships
Model	**Level 3**	Element type Relationship types
Instance	**Level 4**	Element Relationship

Table 2.1 Levels of analysis

Levels 1 and 2 analysis are where we use the system of concepts directly as constructed so far. These two levels are essential for providing a quick scan analysis; within this method we focus on these two levels. There are several reasons to limit the analysis to these levels. The first is that this method aims to provide a quick scan at an early stage of a standard implementation project by looking at the problem from a multiple of perspectives. If during this quick scan there are obvious problems concerning Levels 1 and 2, it makes little sense to continue and make a full analysis at Levels 3 and 4 before resolving problems at the higher levels. For example, if according to the requirements, the concept "actor" needs to be captured by the standard, but the standard does not cover this concept, we can identify a mismatch at Level 2. Even if you make a full Level 3 and 4 analysis and identify all the types of actors and instances of actors that are required, this might be of no use, as Level 2 we have already identified that the concept of actor is not covered by the standard.

As suggested earlier, within this method we will not cover the full Level 3 and 4 analysis. Whenever it is necessary, we recommend that this analysis is made by a team of experts, who have domain knowledge about the DBT situation and who possess in-depth knowledge with respect to one of the potential problem areas identified.

What we propose to include in the method is a Level 2 analysis with respect to Level 3 and Level 4. In practice, when we work with standards and requirement documents, we will find out that they contain elements, which refer to the different levels. In that respect, we will work with documents where the information represented can include Levels 3 and 4. When analyzing these documents, we may discover examples at Levels 3 and 4, which pinpoint a problem at Level 2. Indeed, the examples that we saw throughout Part 2 Chapter 3 address often Level 3 analysis.

An analysis where looking at Level 3 and 4 information in the documents we find cases which pinpoint a problem at Level 2 will be labelled Level 2 analysis with respect to Level 3 and 4 or in short Level 2(3,4). The difference between this analysis and a full Level 3 or 4 analysis is that in the former case we do not strive for completeness.

To illustrate, let us take the example that we introduced in Part 2 Chapter 3 regarding the communicative act view. In this example, according to the requirements, the following conversation scenario needs to be supported: the doctor requests a lab to perform a test, the lab promises, the lab sends the result, and the doctor communicates back that the results are incorrect. The standard can cover only the first three utterances and cannot support the rejection of the results. This is an example of a mismatch at Level 3, as it refers to a type of ae-message (the rejection of the results) not supported. At Level 2 with respect to Level 3 one can identify the problem as follows: there are ae-messages covered by the requirements but not by the standard. However, no full analysis is made of all necessary ae-messages and whether they are all covered in the standard. The latter would be a prospective Level 3 analysis.

2.4 Questions

Let us now proceed with the next component of the method, the questions. In Part 2 we developed a system of concepts, though if we look at it we can see that it contains views and view relationships, and each view contains concepts. However, by only using the system of concepts it would be very difficult to work, as it does not provide sufficient insight into how to conduct the analysis.

In Part 2 Chapter 3, when discussing the different examples to illustrate the possible use of each view, we described problems in practice and we illustrated how they can relate to some of the concepts specified in the system of concepts. If we look at the examples, we can see that sometimes we intuitively used questions, which use some concepts from the system of concepts, to guide our way of thinking.

If we look at figure 2.1 in this chapter we see that we have included questions as an explicit component of the method. The reason is that questions deploy specific parts of the system of concepts and bind together elements from the system of concepts to a specific type and level of analysis. The questions can be a useful tool for the analyst. First of all, they can steer the way of thinking of the analyst in the document-based analysis (mainly covered in the fit analysis). Second, the questions can be very useful for the analyst to help in the communication with participants in the standard implementation project especially when it comes to the DBT analysis where one needs to reflect upon the DBT situation and the specified requirements.

The system of concepts, the types of analysis, as well as the levels of analysis provide the space in which the questions can be specified. Later in this chapter, as well as in the annex related to Part 4 Chapter 1, we will provide numerous examples of possible questions. We consider that it very difficult to formulate all possible questions. Instead, we provide guidelines on how to generate questions using the system of concepts, the types, and the levels of analysis.

The questions should not be seen as prescriptive but are meant to guide the analysis and facilitate the way of thinking. Depending on the specific situation, one might decide to focus on certain views and ignore others, or on certain types and levels of analysis. What we aim for is to provide tools for conducting the analysis but would like to leave the freedom for the analyst to decide which parts to use given the specific situation.

2.5 Way of working

The last component of the method is what we call "the way of working". It integrates the other four components discussed earlier: the system of concepts, the types of analysis, the levels of analysis, and the questions to provide for a meaningful analysis. Figure 2.8 summarizes the five steps followed when conducting the analysis.

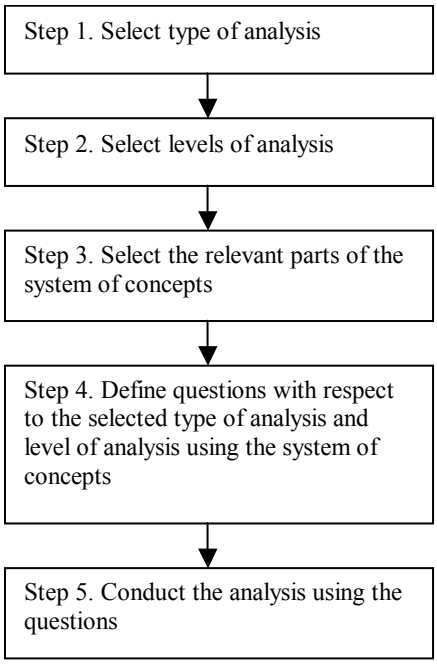

Figure 2.8 Steps which define the way of working

The first four refer to the components defined in the method. Step 1 focuses the analysis on a specific type, Step 2 focuses the analysis to specific levels, and Step 3 identifies the parts of the system of concepts relevant for this analysis. In Step 4, the relevant parts of the system of concepts are deployed to arrive at a number of questions and these questions are used to guide the analysis in Step 5.

It is not possible to prescribe the exact procedures that one need follow, as the procedure may take different forms depending on the goals of the analyst and the specific situation under analysis. However, we will provide further insights concerning different possibilities that may arise when defining the way of working. We will briefly discuss Steps 1 to 4, as they show how to move gradually from the choice of analysis type to the formulation of the questions. Step 5 is the actual conducting of the analysis and will be illustrated in a number of examples in the following sections.

Step 1. Select type of analysis
The first decision that one would need to take is to select one of the general types of analysis: the fit analysis, the DBT analysis, or the impact analysis. It is not necessary to perform all types of analysis. Depending on the goals of the project and available resources, the analyst may judge one type of analysis as more valuable than others. In any case, the fit analysis or the DBT analysis need to precede the impact analysis, as one would need an input from either the fit or the DBT analysis to be able to carry out the impact analysis.

In cases where there are available requirements documents and standards, and where the access to the DBT situation is limited, the fit analysis may be preferred as a starting point. If there is easy access to the DBT situation, a possible way to proceed is to start with the DBT analysis and proceed to the others, depending on the goals and resources available.

With respect to the fit analysis, a logical way to work is to start with the analysis of the specified requirements (the requirements analysis) and proceed with the standard analysis and the mismatch analysis. With respect to the DBT analysis, the different sub-analyses (the completeness, the formality and the context analysis), can be performed in the order preferred by the analyst. The impact analysis can be performed after the DBT or the fit analysis.

Step 2. Select level of analysis
With respect to the levels of analysis, we suggest that the selection is done gradually as follows: Level 1, if needed Level 2, and level 2 (3,4). For the quick scan analysis we do not recommend complete Level 3 and 4 analyses. If a decision is made to proceed to Level 3 and 4, we recommend a team of experts with mono-disciplinary knowledge perform these types of analyses.

Step 3. Select the relevant part of the system of concepts
The selection of the relevant parts of the system of concepts depends to a large extent on the type of analysis, the level of analysis, and the goal pursued by the analyst. For example, if the aim is to perform a fit analysis and the goal of the analyst is to check for possible mismatches between the specified requirements and the standard with respect to semantics, then the subject matter view would be a good starting point. If the goal is to reason about mismatches related to the pragmatic aspect of communication, then the communicative act view will an appropriate starting point. Once it is clear which view will be used in the analysis, one would need to consider the level of analysis. If in Step 2, one has chosen Level 1 analysis, the relevant part of the system of concepts would be only the view itself. If one has chosen Level 2 analysis then the relevant part of the system of concepts would include the view as well as concepts from the view. It is not necessary to use all concepts defined in a specific view in the analysis. Since the idea is to perform a quick scan, if potential problems are identified by using only a few concepts from the view under analysis, it would not be necessary to continue the analysis using the remaining concepts.

Step 4. Define questions
After the type of analysis, the level of analysis, and the relevant parts of the system of concepts are selected, one can proceed with the formulation of questions. To illustrate the logic of how to formulate questions, let us take an example. Let us assume that we have decided to do the requirements analysis as part of the fit analysis, at Level 1 with respect to the communicative act view. A sample question would be "Is the communicative act view addressed in the specified requirements?". The goal of this question is to check whether the specified requirements explicitly address the notion of business conversations. If there are models of business conversations included in the requirements documents, the analysis can proceed at Level 2. At Level 2, the concepts related to the communicative act view can be used to formulate questions. The goal of the questions formulated with respect to Level 2 is to analyze the specified requirements using the

concepts defined within the view. Examples of concepts from the communicative act view are: ae-message (communicator, interpreter, communicative function, propositional content). Using these concepts, a number of other questions can be generated, for example: "Are the business conversations described in the requirements documents in the form of ae-messages?, i.e., for a message, is it clear who the communicator and the interpreter are? Is the propositional content specified? Is the intention behind the message specified?"

Step 5. Conducting the analysis
The last step in the way of working is to conduct the analysis using the questions. We will not go into this step now, as it will be better illustrated by using examples discussed later in this chapter.

So far we have presented a high-level description of the method. In the next section we provide further elaboration of the method by selecting each type of analysis and providing examples for illustration. We focus mainly on Level 1 and 2 analyses. In order not to complicate the discussion, we will not address the Level 2(3,4) with respect to all the types of analysis that we will discuss. We will limit the discussion concerning Level 2(3,4) to the mismatch and the completeness analysis, as they seem to be the two types of analysis where this would be most valuable. The mismatch analysis is analysis between the specified requirements and the standard. In that respect, identification of examples of mismatches at Levels 3 and 4 and reporting them at Level 2 is relevant, as it directly relates to the fit of a standard to a situation. The completeness analysis on the other hand, uses the system of concepts to question the completeness of the specified requirements. In that respect, examples of incomplete requirements, identified at Levels 3 and 4, can be reported as problems at Level 2(3,4). In that respect the Level 2(3,4) analysis is also very relevant, as it directly relates to the quality of the specified requirements.

3. Fit analysis

The fit analysis consists of three sub analyses: the requirements analysis, the standard analysis, and the mismatch analysis. We will examine each one separately. Before going further, however, we would like to provide some further clarification concerning the Level 1 and Level 2 analyses.

With respect to the requirements analysis and the standard analysis, the Level 1 analysis aims to identify whether there is an explicit and formal model with respect to the chosen view. This is the highest level where problems can be identified. This is based on the theoretical observation that in case a part of the context of the business transaction is to be embedded in a computer system, the requirements need to be explicit and formal. As the standard will ultimately be embedded in the computer system, it needs to be checked as well for whether the models embedded in the standard are explicit and formal. As a result of Level 1 analysis, one might identify a view that is not addressed at all in the specified requirements (or in the standard), that is implicitly or explicitly specified. If a view is not addressed at all in the requirements analysis or the standard analysis, this means there is no reason to go to Level 2 analysis. In case the models are implicit in the standard, this can be considered a potential problem area (especially if the view under analysis is the subject matter view, the communicative acts view, or the business rule view, as they are directly related to the business communication). There are two possible ways to proceed- by making the implicit models explicit or continuing to Level 2 for further quick scan analysis. If the Level 2 analysis is undertaken when there are implicit models, the goal of the analysis is to pinpoint areas, which possibly indicate that the information available in the implicit models is not sufficient to arrive at explicit models. If this is the case, this will reinforce the statement that potential problems with this view can be expected. If explicit models are available, one can directly proceed to Level 2 and use the concepts of the view to check for potential problems.

For analysis type 1 and the other two types of analysis, we will use a table similar to the one presented below. The purpose is to provide the analyst with a clear idea where he is in the analysis process. The left column of the table identifies the steps in the "way of working" component of the method, i.e., choice of type of analysis, choice of level of analysis, choice of view, and formulation of questions. The analysis will be conducted using the questions.

Step 1: Type of analysis	Requirements analysis (analysis type 1.1)
Step 2: Level of analysis	Level 1
Step 3: Relevant part of the system of concepts	Subject matter view
Step 4: Question	Is the Subject matter view addressed in the specified requirements? In the specified requirements, is there an explicit (implicit/no) model of the subject matter, i.e. is there an explicit model of the domain, conception and representation of the domain of interest to the DBT situation?

Table 3.1 Indication table

The right column of the table specifies the instance of the analysis that is performed. We are conducting analysis type 1.1; an analysis of the specified DBT requirements. We are conducting a Level 1 analysis with respect to the specified requirements and will focus on the subject matter view. Step 4 requires the formulation of a question. As discussed earlier, the Level 1 analysis aims to check whether a certain view is addressed and whether explicit/implicit/no models with respect to a specific view is available (in the example above, the question is formulated with respect to the subject matter view). Finally, the outcome of the analysis depends on the specified DBT requirements under analysis. The outcome of this analysis will be one of the following: there is explicit/implicit/no model available. Let us now go through the three sub-types of analysis type 1 and provide further insights.

3.1 Requirements analysis

The requirements analysis (analysis type 1.1), focuses on the specified DBT requirements.

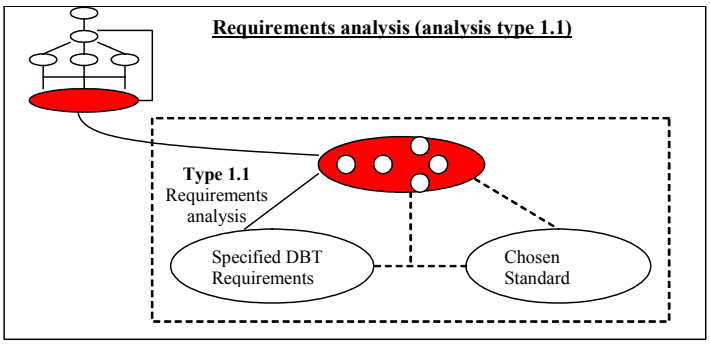

Figure 3.1 Requirements analysis: analysis of the specified requirements

To illustrate analysis type 1.1 we select the communicative act view. We will elaborate the method in detail, to illustrate the way of thinking. Similar ways of thinking can be repeated for the other views as well. We elaborate Level 1 and 2 analysis, and provide an example to illustrate the analysis.

3.1.1 Level 1 analysis

The table below illustrates that we are conducting requirements analysis (analysis type 1.1) at Level 1 and with respect to the communicative act view. Depending on the specified requirements, several outcomes of the analysis are possible. In case that there is no implicit or explicit model defined (especially if the view under analysis is subject matter, communicative or

business rule view) this can be marked as a potential problem and further analysis will be required.

Step 1: Type of analysis	Requirements analysis (analysis type 1.1.)
Step 2: Level of analysis	Level 1
Step 3: View	e.g. Communicative act view
Step 4: Question	Is the communicative act view addressed in the specified requirements? In the specified requirements, is there an explicit and formal model with respect to the communicative act view?

Table 3.2 Elaboration of the requirements analysis Level 1

In case there is implicit but not explicit and formal model, this can also be an indication that some potential problems might occur. There are then two ways to proceed. The first is to use a formal modelling method and to make the implicit model explicit and formal. During the modelling process ambiguities and gaps might be identified. The second option is to proceed to Level 2 for a quick scan of the implicit model. In case there is explicit and formal model, one can then proceed to Level 2 analysis.

3.1.2 Level 2 analysis

One can then proceed to Level 2 analysis when the outcome of analysis at Level 1 is that the requirements contain implicit or explicit models with respect to the view under analysis (in this example, the communicative act view). During the Level 2 analysis, a check will be made whether the requirements cover some of the major concepts associated with the chosen view.

The table below specifies the steps to be followed in the Level 2 analysis; we can say that it has some similarities with table 3.1. The similarity lies in the left columns of the two tables, as they comply with the way of working specified in section 2.5 of this chapter. The right side columns of the two tables differ, however, as they reflect differences in the analysis.

Table 3.3 also refers to analysis type 1.1 of the specified requirements. The level of analysis however, is Level 2.

Step 1: Type of analysis	Requirements analysis (analysis type 1.1.)
Step 2: Level of analysis	Level 2
Step 3: View, concepts	Communicative act view Ae-message has: One communicator; One interpreter; One propositional content; One communicative function Ae-message is part of Sequence of utterances
Step 4: Questions	1. Are there cases when the message specified in the requirements have no: Communicator; Interpreter; Propositional content; Communicative function 2. Are there cases when it is not clear in the requirements how the message forms part of a business conversation (or sequence of utterances)

Table 3.3 Elaboration of the requirements analysis Level 2

For this we need not only a specific view from the system of concepts, but also the concepts from the system of concepts, which belong to the chosen view. These concepts are important, as they allow formulating questions, which will guide the Level 2 analysis. We tried to formulate the questions in a way that in case there is an example where we answer some of the questions above yes, this means that one can identify potential problem. This contributes to the idea of a "quick scan", as no complete analysis of all cases needs to be carried out, at least not at this point in the process.

For example, if a message does not contain a communicative function or has more than one communicative function, this might signal ambiguities with respect to the intention behind the message.

In the section below we make reference to an example used in Part 2 Chapter 3 to illustrate the requirements analysis at Level 1 and Level 2.

3.1.3 Example of requirements analysis

In Part 2 Chapter 3 we discussed a number of examples without explicitly mentioning the method used. Now that we have introduced the elements of the method, we can go back to the examples and demonstrate the elements of the method.

As we introduced the detailed method using the communicative act view, we can also look at the example in Part 2 Chapter 3 section 3 concerning the communicative act view. In this example, we discussed the communication that takes place between a doctor and a lab. We discussed that for the communication between the doctor and the lab there is an agreement to communicate in the following way. The doctor orders a lab test. The lab can accept to perform the lab test and confirm the order. However, there are cases when the lab will reject the order. In this example, the requirements do not present an explicit formal model with respect to the communicative view though an implicit model is present.

As argued earlier in this chapter, in case of implicit models two options are possible- to model the requirements or to continue to Level 2 analysis. In the example we have decided to continue to Level 2 analysis.

During the analysis we confirmed that the elements specified in the communicative act view are covered. We argued that the propositional content is captured in the paper-based forms, and that we can identify the communicator and the interpreter of each message as well as the communicative function (or the intention behind the message). Furthermore, we have argued that in the requirements it is clear how the messages form part of a business conversation. The table below is a simplified version of the table presented in Part 2 Chapter 3 section 3, and it depicts information related only to the requirements.

Communicative view concepts	**Requirement of the Business Transaction**
Specification of the propositional content	covered
Identification of the communicator	covered
Identification of the Interpreter	covered
Communication functions	covered
Sequence of utterances	covered

Table 3.4 Concepts covered in the requirements

With respect to this example, the conclusion will be that we did not find problems when conducting the requirements analysis at Levels 1 and 2.

3.2 Standard analysis

The standard analysis is very similar to the requirements analysis, however instead of applying it to the specified requirements, it will now be applied to the standard.

As there are similarities with the two types of analysis, this section will briefly repeat the steps and provide an illustration, without providing in-depth elaboration.

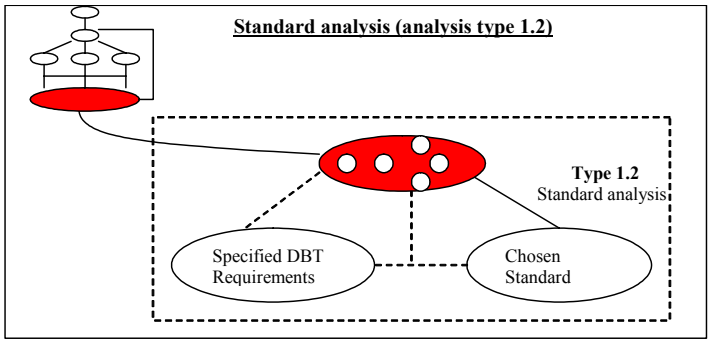

Figure 3.2 Standard analysis

3.2.1 Level 1 analysis

Similar to the requirements analysis, here we also formulated a table, which can guide the analysis of the standard at Level 1.

Step 1: Type of analysis	Standard analysis (analysis type 1.2.)
Step 2: Level of analysis	Level 1
Step 3: View	e.g. Communicative act view
Step 4: Question	Is the communicative act view addressed in the standard? In the chosen standard, is there an explicit and formal model of the communicative act view?

Table 3.5 Elaboration of the standard analysis Level 1

As Level one analysis is not substantially different to that discussed in the earlier section we will proceed with Level 2 analysis.

3.2.2 Level 2 analysis

In case the standard contains implicit or explicit models with respect to the view under analysis, the analysis can proceed to Level 2. During the analysis, a check will be made whether the standard covers some of the major concepts associated with the chosen view. The steps of the method with respect to the standard analysis at Level 2 are presented below.

Step 1: Type of analysis	Standard analysis (analysis type 1.2.)
Step 2: Level of analysis	Level 2
Step 3: View, concepts	Communicative act view Ae-message has: One communicator; One interpreter; One propositional content; One communicative function Ae-message is part of Sequence of utterances
Step 4: Questions	1. Are there cases when the message specified in the standard have no (or more than one): Communicator; Interpreter; Propositional content; Communicative function 2. Are there cases when it is not clear in the standard how the message forms part of a business conversation (or sequence of utterances)

Table 3.6 Elaboration of the standard analysis Level 2

The way we formulated the questions here is that in case a question receives "yes" as an answer, this can signal potential problems. However, a different formulation of the questions is also possible, and one needs to be careful how to formulate the questions and interpret the answers.

3.2.3 Example

We will continue with the example discussed in section 3.1.3 of this chapter, based on the example presented in Part 2 Chapter 4 section 3.

To automate communication between the doctor and the lab, the HL7 v 3 standard was chosen. In Part 2 Chapter 3 section 3 we presented a detailed description of the standard. Because the standard addresses the communicative act view, we continue the analysis at Level 2.

At Level 2 we identified that the standard covers the required concepts of the communicative act view. We illustrated that the standard specifies interactions, and for each interaction it specifies a message type, a sending role, a receiving role, and a trigger event. Through our analysis in Part 2 Chapter 3 section 3, we argued that the elements of the interactions specified in the HL7 standard can be mapped to the elements of an ae-message from the system of concepts. Furthermore, we argued that the standard can support sequences of utterances. For further elaboration, see the full description of the example in Part 2 Chapter 4 section 3.

The table below is a simplified version of the table presented in Part 2 Chapter 3 section 3. It filters the relevant information with respect to the analysis of the standard at Level 2.

Communicative view concepts	**HL7 Standard Lab Order**
Specification of the propositional content	capable to cover
Identification of the communicator	capable to cover
Identification of the Interpreter	capable to cover
Communication functions	capable to cover
Sequence of utterances	capable to cover

Table 3.7 Concepts covered in the standard

The main conclusion at Level 2 is that the implicit model in the standard covers the key elements related to the communicative acts view and therefore we are unable to identify potential problems with the standard at Level 2.

3.3 Mismatch analysis

The goal of the mismatch analysis (analysis type 1.3) is to identify mismatches between the requirements of the DBT situation and the standard regarding the chosen view (figure 3.3). The steps followed in the previous two analyses will be followed here as well.

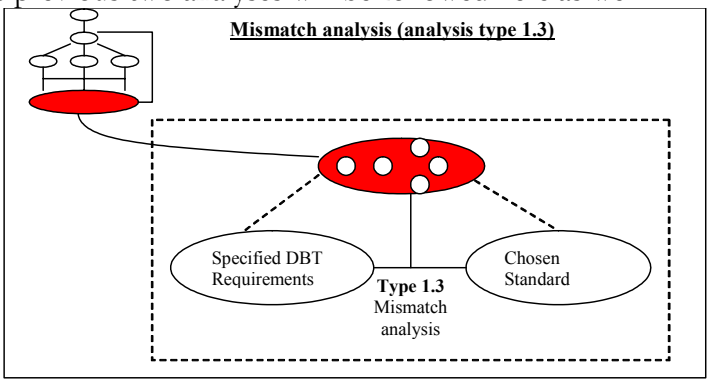

Figure 3.3 Mismatch analysis

We make the comparison at Level 1, Level 2, and Level 2 (3,4). Even if we do not find differences between the requirements and the standard at Level 2, Level 2 (3,4) analysis will allow us, to scan for differences. Each of these levels will be discussed separately.

3.3.1 Level 1 analysis

At Level 1 analysis, the goal is to identify mismatches between the requirements and the standard with respect to the view. The table below identifies the steps and suggests which questions can be asked to guide the analysis.

Step 1: Type of analysis	Mismatch analysis (analysis type 1.3)
Step 2: Level of analysis	Level 1
Step 3: View	e.g., Communicative act view
Step 4: Question	If the communicative act view is covered explicitly or implicitly in the requirements, is it also implicitly or explicitly covered in the standard?

Table 3.8 Elaboration the mismatch analysis Level 1.

If a certain view is covered in the requirements but not in the standard, this would signal a mismatch. If the mismatch is identified, especially with respect to the subject matter, communicative act, or business rules view (and whenever applicable with the other views), this is a signal for potential problems.

3.3.2 Level 2 analysis

At Level 2 analysis, the goal is to identify mismatches between the requirements and the standard with respect to concepts in the chosen view. The table below identifies the steps and suggests which questions can be asked to guide the analysis.

Step 1: Type of analysis	Mismatch analysis (analysis type 1.3)
Step 2: Level of analysis	Level 2
Step 3: View, concepts	Communicative act view Ae-message has: One communicator; One interpreter; One propositional content; One communicative function Ae-message is part of: Sequence of utterances
Step 4: Questions	Are there concepts with respect to the chosen view from the system of concepts, which are covered by the requirements but not covered by the standard?

Table 3.9 Elaboration of the mismatch analysis Level 2.

If "yes", this can be a signal of potential problems and would require further analysis.

3.3.3 Level 2 (3,4) analysis

At Level 2(3,4) analysis, the goal is to identify examples of mismatches between the requirements and the standard with respect to Levels 3 and 4, and describe the mismatches at Level 2 using the concepts of the view. The table below summarizes the steps to be followed with respect to level 2 (3,4) analysis.

Step 1: Type of analysis	Mismatch analysis (analysis type 1.3)
Step 2: Level of analysis	Level 2 (3,4)
Step 3: View, concepts	Communicative act view Ae-message has: One communicator; One interpreter; One propositional content; One communicative function Ae-message is part of: Sequence of utterances
Step 4: Questions	Examples of questions: Are there examples of ae-messages that are required to be automated by the DBT situation but are not covered by the standard? Are there examples of sequence of utterances, which are required to be automated by the DBT situation but are not covered by the standard

Table 3.10 Elaboration of the mismatch analysis Level 2 (3,4)

We will now proceed with providing an example of analysis type 1.3

3.3.4 Example

Let us continue with the example discussed in section 3.1.3 and section 3.2.3 of this chapter based on the example discussed in Part 2 Chapter 3 section 3.

As discussed in section 3.1.3 regarding the requirements analysis and in section 3.2.3 regarding the standard analysis, both the requirements and the standard address the communicative act view. In that respect we cannot identify a mismatch on Level 1.

Based on the Level 2 analysis of the requirements and the standard discussed in sections 3.1.3 and 3.2.3, we can say that both the requirements and the standard cover the concepts defined in the system of concepts with respect to the communicative view. This means we cannot identify a mismatch at Level two either.

When we continue to Level 2(3,4), we can find examples of mismatches (discussed in Part 2 Chapter 3 section 3). The table below is a copy of table 3.3.1 discussed in Part 2 Chapter 3.

Communicative view concepts	Requirement of the Business Transaction	HL7 Standard Lab Order
Specification of the propositional content	Required	Capable to cover (only for the communicative functions supported by HL7)
Identification of the communicator	Required	Capable to cover (identification of the sending application role)
Identification of the Interpreter	Required	Capable to cover (identification of the receiving application role)
Communication functions	Required: Request (1,2) promise (2,3) reject (2,8) assert (3,4) declare (4,3)	Capable to cover: Request (1-2) promise (2,3) reject (2,8) assert (3,4)
Sequence of utterances	Required Successful completion (1,2), (2,3), (3,4) Failure (1,2), (2,8) Questioning the outcome (1,2), (2,3), (3,4), (4,3)	Capable to cover: Successful completion (1,2), (2,3), (3,4) Failure (1,2), (2,8)

Table 3.11: Comparing the requirements of the business transaction and the capabilities of the HL7 standard.

The table, apart from providing analysis at Level 2 (by indicating whether a concept from the system of concepts is covered in the requirements and in the standard), also includes Level 3 information concerning the communicative functions and sequence of utterances required by the DBT situation, and the communicative functions and the sequence of utterances covered by the standard. In addition to the table, we use the model of Winograd and Flores to visualize the communicative functions required by the DBT situation (marked with solid bold arrows) and those covered by the standard (marked with dashed bold arrows).

In the table below we see that the ae-messages (and respective communicative functions) required to be covered are: request, promise, reject, assert, and declare. We see from the analysis of the standard that the HL7 standard can cover request, promise, reject, and assert. This means that we have identified an example of a mismatch at Level 3: according to the requirements the ae-

message "declare" needs also to be automated, though the standard does not cover the ae-message declare.

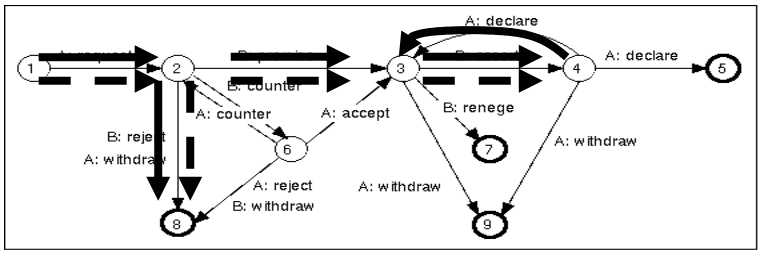

Figure 3.4. Business conversations required by the DBT situation (solid bold arrows) and covered by the HL7 v3 standard (dashed bold arrows), visualized using the basic conversation for action schema of Winograd and Flores.

A complete Level 3 analysis would mean elicit all possible business conversations required by the business situation (including for example negotiation conversations, presented in the model of Winograd and Flores with the arrows from state 2 to 6 and ftom 6 to 2); identifying all possible conversations that can be covered by the HL7 standard and identifying all possible mismatches between the requirements and the standard at Level 3. A Level 2 (3,4) analysis however, does not require a complete analysis. In this case, we can make a statement at Level 2 that we have identified mismatches at Level 2(3,4) with respect to ae-message (i.e., a certain ae-message required is not covered by the standard). Similar reasoning can be applied to the concept "sequence of utterances". If we look at the table in Part 2 Chapter 4 we can see that we have identified an example of a mismatch at Level 2(3,4) with respect to sequence of utterance as well; there is a sequence of utterances required but it cannot be captured with the chosen standard.

3.4 Summary fit analysis

What we illustrate in section 3 of this chapter is the way to reason when conducting the fit analysis (including requirements analysis, standard analysis, and mismatch analysis). With the example we followed when discussing each of the analyses, we aimed to show that one can start by looking at potential problems at a very high level and can move gradually to Level 2 and Level 2 (3,4). One can continue the analysis and perform a full level 3 and level 4 analysis, but this is not feasible if the goal is to make a quick scan.

With the example presented here we identified potential problems only when we conducted a Level 2 (3,4) analysis. We have deliberately done that to illustrate this type of analysis.

We will not go into further discussion concerning the fit analysis. In Part 4 Chapter 1, we will apply the method to a case in the energy market and in the annex of Part 4 Chapter 1 we provide a full-blown example of the use of method. We now proceed to the next section, where we will discuss the DBT analysis.

4. DBT analysis

The DBT analysis (analysis type 2) consists of three sub-analyses, i.e., the context analysis (analysis type 2.1), the formality analysis (analysis type 2.2), and the completeness analysis (analysis type 2.3).

4.1 Context analysis

The main question this type of analysis answers is whether the DBT situation parties, have established a shared context, especially with respect to the to-be automated business communication. Any indication of a lack of such a shared context will be seen as a source of potential problems.

We suggest looking for indications of such potential problems using the system of concepts and the different levels of analysis. As soon as any indication of lack of a shared context is identified, potential problems can be expected and the analysis need not proceed further. At that point, a suggestion to the parties involved in the standard implementation project would be to make sure that such a shared context is established before proceeding further.

4.1.1 Level 1 analysis

To look for possible indications pointing towards the lack of a shared context, we suggest using the system of concepts and the levels of analysis. At Level 1, we can use the high-level system of concepts and check, per view, whether there are any indications that such a shared context is not achieved. By using the different views, we can look at the context in a structured way.

For illustration, let us take the subject matter view to check for indicators of a lack of a shared context (figure 4.1)

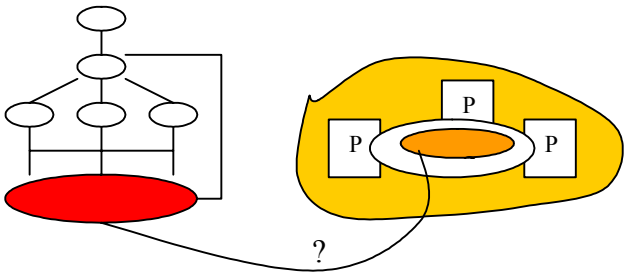

Figure 4.1 Analysis 2.1 at Level 1 using the subject matter view.

The table below defines the steps to be followed to perform this type of analysis. A similar table can be created for the other views as well. It depends on the analyst how exhaustive this analysis is. As long as some indication of lack of a shared context is identified, this is sufficient to say there are problems with the establishment of a shared context and further measures can be suggested.

Step 1: Type of analysis	Context analysis (analysis type 2.1.)
Step 2: Level of analysis	Level 2
Step 3: View	e.g. Subject matter
Step 4: Question	Is there any indication that there is lack of a shared context with respect to the subject matter view?

Table 4.1 Elaboration of the context analysis Level 1

If the lack of shared context with respect to the subject matter view is identified, this can signal potential problems and cause misunderstandings. If one cannot find indicators for a lack of a shared context with level, the analysis can proceed to Level 2.

4.1.2 Level 2 analysis

To continue to look for indications of potential problems with the shared context, one will need to use the detailed system of concepts. In the table 4.2 we use the subject matter view and combine two levels of analysis (Level 2 and Level 2 (3,4)) to simplify and shorten the presentation.

The questions formulated in the examples are general. By using the system of concepts, more specific questions can be generated. For example, if we take the concepts from the subject matter view (thing, property, and value of property), we can generate a number of questions regarding

the relevant shared context: Are there common things of interest for the parties involved in the transactions? Do the parties have the same perception about the properties of that thing? Do they share the same understanding about the values of the properties of a thing?

During the analysis if one identifies that a shared context with respect to some view does not exist, this can immediately be seen as a potential problem. As long as there is no shared context, based on theory we can say that communication failures are likely. If, as a result of the context analysis, potential problems are identified with some of the view, one can also run the analysis type 3 to trace the impact these potential problems will have on the execution of the business transaction.

Step 1: Type of analysis	Context analysis (analysis type 2.1.)
Step 2: Level of analysis	Level of analysis 2; 2 (3,4)
Step 3: View, concepts	Subject matter view Domain Conception Thing Intrinsic Property/attribute of a thing Mutual Property/attribute of a thing Value Representation Synonym situation Homonym situation
Step 4: Questions	Example questions with respect to level 2 Is there an explicit shared understanding about the domain of interest? Is there an explicit shared model about the conception of the domain and the representation of the domain? Example questions with respect to level 2(3,4) Are there examples that point out that there is not shared understanding about the domain, the conception of the domain and the representation of the domain?

Table 4.2 Elaboration of the context analysis Level 2 and Level 2 (3,4).

4.1.3 Example

Let us return to the kitchen example presented in Part 2 Chapter 3; an example of a lack of a shared context with respect to the subject matter view. In the case, the parties did not create explicit models of the subject matter or discuss and agree on these models during implementation. The people who implemented the HL7 standard in the Hospital information system (HIS) used some fields in the standard to customize the standard and embed their conception of an "inpatient" daycare patient. This conception of what an "inpatient" is and how it was embedded in the customized HL7 standard was not well communicated to the team, responsible for the implementation of the HL7 standard in the kitchen information system (KIS). As a result, the two different models defining an inpatient, were embedded in the HIS and KIS. As discussed in Part 2 Chapter 3, this led to misinterpretation of the information and wrong actions.

The context analysis can help people involved in the standard implementation project to reflect and check whether sufficient efforts have been made in creating such a shared context.

4.2 Formality analysis

The formality analysis aims to check whether the requirements of the DBT situation have been made explicit and formal, before being embedded in the computer system. The logic of the analysis is similar to the one regarding the context analysis. The goal is to look for indications that

the requirements of the DBT situation have not been made explicit and formal, before being embedded in the computer system.

This analysis was inspired by the discussion concerning technical and inter-organizational interoperability in Part 1 Chapter 2: it is not sufficient to link computer systems together, but is important to embed the automated communication in a broader context of the DBT situation. This analysis aims to check whether there are cases when technical implementation is undergone without having explicit and formal requirements concerning the to-be automated communication. In that respect, in terms of the project timeline, this analysis also aims to check whether the requirements have been made explicit and formal *before* the actual implementation in the computer systems took place.

4.2.1 Level 1 analysis

The table below defines the steps to be followed to perform this type of analysis.

Step 1: Type of analysis	Formality analysis (analysis type 2.2.)
Step 2: Level of analysis	Level 1
Step 3: View	e.g. Subject matter
Step 4: Question	Are the DBT situation requirements with respect to the subject matter view made explicit and formal, before the technical implementation of the standard in the computer systems takes place?

Table 4.3 Elaboration of the formality analysis Level 1

The availability of explicit and formal models before the actual implementation in the computer systems takes place is important in a number of ways. First of all, it will make people specify the requirements in full detail, rather than at an abstract and informal level. Furthermore, in terms of time, it is important to have these specifications before the standard is implemented in the system. If this is not done, we expect potential problems, as this would mean that a standard is implemented without the parties in the project having a clear understanding of the DBT situation where the standard is to be used.

The purpose of this analysis is to check whether explicit and formal models of the requirements were available at all and if so, whether they were available before the actual implementation of the standard on the system level. We consider Level 1 analysis sufficient for this type of analysis. This analysis is related to the requirements analysis discussed earlier. There we take the specified requirements as given and analyse them using the system of concepts. If there are no explicit (implicit) models with respect to a given view, we can detect it with this type of analysis. However, if there are explicit models, with the requirements analysis we cannot check when the explicit and formal specifications have been created, before or after the technical implementation.

4.2.3 Example

With respect to analysis type 2.2 we can again use the operating room example presented in Part 2 Chapter 3 with respect to the business rule view. As discussed, there were no explicit and formal models of the requirements of the DBT situation with respect to the business rule view. Partially such models were elicited only after the implementation of the standard, when it became obvious that the business rules embedded in the standard were different than the business rules required by the DBT situation.

We consider problems like this might be identified analytically using the formality analysis. This analysis will help people reflect on whether they have the explicit and formal specification of the DBT requirements before the technical implementation of the standard takes place.

4.3 Completeness analysis

The completeness analysis aims to identify indications in case the specified requirements do not completely capture the DBT situation requirements. The idea behind this analysis is that by walking through the different views and reflecting about the DBT situation under analysis, one might identify requirements, which have not yet been included in the specified requirements.

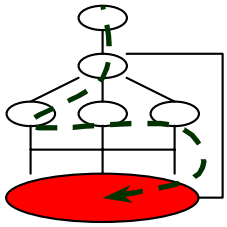

Figure 4.2. Completeness analysis with respect to the subject matter view.

What is important to notice is that in the other analyses discussed so far, we could focus on one view at a time and be able to carry out the analysis. The nature of the completeness analysis requires that we also look into the relationships between the views. As discussed in Part 2, one view may impose requirements on another. In the completeness analysis we need to take into account these interdependencies and the additional requirements that may arise due to them. The relationships between the views can serve as an additional basis to reason about and question the completeness of the specified requirements.

The completeness analysis can again be done at different levels. Here we will discuss Level 1, Level 2, and Level 2(3,4). Here we will not discuss a separate example at the end, but provide examples along with the discussions of the different levels of analysis.

4.3.1 Level 1

Level 1 analysis is the first screening of whether some important requirements are not yet specified.

Step 1: Type of analysis	Completeness analysis (analysis type 2.3.)
Step 2: Level of analysis	Level 1
Step 3: View	Subject matter
Step 4: Question	Are there views that help to capture some important requirements of the DBT situation with respect to the subject matter view, which are not yet taken into account in the specified requirements?

Table 4.4 Elaboration of the completeness analysis Level 1

There can be cases where some views are important to elicit and better capture the requirements of the DBT situation but are not taken into account in the specified requirements. This can signal potential problems due to incomplete requirements. As discussed in Part 2 Chapter 3, one such requirement can be the production number of a medicine. It will not be straightforward to identify or explain this requirement if we ignore the business network view.

4.3.2 Level 2

Level 2 analysis aims to check for each view whether there are some important concepts needed to capture the requirements but are not captured in the specified requirements.

It can be the case that the system of concepts suggests some concepts, which are not needed to capture the requirements and are thus not included in the specifications. In this case potential problems cannot be identified. If there are concepts suggested in the system of concepts, which

are needed to capture the requirements but are not covered in the specified requirements, one can identify potential problems due to incompletely specified requirements at Level 2.

Step 1: Type of analysis	Completeness analysis (analysis type 2.3.)
Step 2: Level of analysis	Level of analysis 2
Step 3: View, concepts	Communicative act view
Step 4: Questions	With respect to a chosen view, are there concepts from this view that are needed to capture requirements which are not captured in the current specified requirements of the DBT situation?

Table 4.5 Elaboration of the completeness analysis Level 2

Let us take the communicative act view for example. To describe the business conversations, the specified requirements might use message sequence charts only. The message sequence charts do not specify the propositional content of a message, but the DBT situation might require that the propositional content of a message is captured. In this case, we can identify incompleteness at Level 2,where the specified requirements are not complete with respect to capturing the propositional content of a message.

4.3.3 Level 2 (3,4)

Indications for incomplete requirements can also be found using Level 2 (3,4) analysis. One can think of questions in two directions: questions which use elements within the chosen view to reflect the completeness of the specified requirements, and questions which use the relationships with the other views to reflect about the completeness of the specified requirements.

Step 1: Type of analysis	Completeness analysis (analysis type 2.3.).
Step 2: level of analysis	Level of analysis 2 (2,3)
Step 3: view, concepts	Communicative act view
Step 4: Questions	Are there cases, where business conversation scenarios identified with the communicative act view are not embedded in the respective business process scenarios identified with the business process view.

Table 4.6 Elaboration of the completeness analysis Level 2(3,4)

Let us take a concept from the communicative act view, the ae-message. One question to check the completeness of the specified requirements is as follows: Are there examples of ae-messages required by the DBT situation to be automated, but not captured in the specified requirements?

If we use the relationships between the communicative view and the other views we can come to questions like:

- Are there examples of required conversations identified with the communicative act view, not covered in the process scenarios in the business process view?
- Are there examples of business conversations, which take place between the focal actors and need to be automated, not covered in the specified requirements?
- Are there examples of business conversations that arise between the intermediating actors as a result of the conversations between the focal actors, which need to be automated, but are not covered in the specified requirements?
- Are there examples of elements that are part of the propositional content of the ae-messages, which are not covered in the model of the domain with respect to the subject matter view?

Such an analysis will not aim at arriving at a complete requirements specification, but rather as a quick scan mechanism to identifying examples of gaps in the requirements.

5. Impact analysis

Analysis type 3 can be seen as an impact analysis. It aims to help reason what the consequences of a potential problem (identified with analysis type 1 or type 2), regarding one of the views will be for the execution of the business transaction. The figure below illustrates the path one can follow to trace the consequences when a potential problem is identified with respect to the subject matter view.

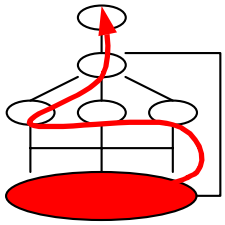

Figure 5.1. Impact analysis

This type of analysis will be applied to one view at a time, taking those views where potential problems were identified during analysis type 1 and type 2. With respect to the chosen view, the analysis will follow again the steps defined in the "way of working" component of the method. We will use again tables to systematically capture these steps for the different levels of analysis.

5.1 Level 1 analysis

The goal of the Level 1 analysis with respect to the impact analysis is taking a view where potential problems are identified, to trace the impact on the other views. Let us take a situation where a potential problem with respect to the subject matter view is identified. The table below summarizes the different steps to be followed. We add here additional step 0 to identify which is the view where potential problems have been identified.

Step 0: View with potential problems (from analysis type 1and type 2)	Subject matter view
Step 1: Type of analysis	Impact analysis (analysis type 3)
Step 2: Level of analysis	Level 1
Step 3: Relevant parts of the systems of concepts	Communicative view, business rule view, business process view, business network view, focal exchange view
Step 4: Question	Does the potential problem identified in the subject matter view affect any of the other views and if yes, which?

Table 5.1. Elaboration of the impact analysis Level 1

Depending on the level of detail with which one needs to trace the impact, one might decide to perform only Level 1 analysis and trace the views that can be affected, or one might decide to proceed with a Level 2 analysis.

5.2 Level 2 analysis

The Level 2 analysis in this case will aim to bring more transparency by also indicating for the affected views, which concepts will be affected. Note, this analysis can be performed for each of the affected views, taking one view at a time. In table 5.2 we discuss the communicative act view as a view that can be affected by the potential problems in the subject matter view. To indicate which view we discuss, we add step 3.0 to indicate the affected view, which we will further analyse.

Such an analysis can be repeated for all the affected views. It is important to mention that Level 2 analysis aims to give a possible orientation about the impact of potential problems to the execution of the business transaction. The depth of this analysis can vary, depending on the purpose. For quick orientation, Level 1 analysis may be sufficient. For detailed analysis, Level 2 analysis can bring more insights.

Step 0: View with potential problems (from analysis type 1and type 2)	Subject matter view	
Step 1: Type of analysis	Impact analysis (analysis type 3)	
Step 2: Level of analysis	Level 2	
Step 3.0. Affected view	Communicative act view	
Step 3: Relevant parts of the systems of concepts	Communicative act view Ae-message has • One communicator • One interpreter • One propositional content • One communicative function Ae-message is part of • Sequence of utterances	Subject matter view Domain Conception Thing Intrinsic Property/attribute of a thing Mutual Property/attribute of a thing Value Representation Synonym situation Homonym situation
Step 4: Questions	For the potential problems identified at the subject matter view, identify which concepts at the communicative view will be affected.	

Table 5.2 Elaboration of the impact analysis Level 2

5.3 Example

In Part 2 Chapter 3, we discussed the kitchen example, which we will reuse here to illustrate the impact analysis. In the kitchen example we argued that there was a lack of shared understanding about what the meaning of "inpatient" was and as a result, the meaning embedded in the hospital information (HIS) system and in the HL7 standard was different than the meaning embedded in the kitchen information system (KIS). We argued that this can be a potential problem with respect to the subject matter view. Now, if we perform impact analysis (analysis type 3) at Level 1, we will need to answer the question "Which other views will be affected"?

We begin by walking through the different views. We have discussed in Part 2 Chapter 3 that the communicative act view will be affected, because if the HIS sends a message saying that there is a day-care inpatient, the intention the HIS wishes to convey, is that this person is admitted but will not stay overnight. The KIS however, will interpret the message as a person admitted who will stay overnight. As a result of that interpretation, the business process view will be affected, as the kitchen will start a wrong process due to the misinterpretation. As a result, it will deliver food in cases when this is not necessary. Ultimately, either the focal exchange view will be affected, as the patient will be charged for food he did not consume, or some of the supporting exchanges in the business network will be affected.

5. Final remarks

The goal of this chapter was to answer the second research question concerning the content of the method. We defined the main components of the method and provided detailed elaboration of how these components can be used with respect to the different types and levels of analysis. We have also provided examples for illustration.

The elaboration provided here concerning the different types and levels of analysis was illustrated with partial use of the system of concepts. Most of the time, we worked in the elaboration with one view and its related concepts, and formulated a number of questions with respect to this view. To avoid repetition, we have not included all the views in the elaboration, and as a result we have not included all possible questions for each view. A more thorough elaboration can be found in annex 1, when we analyse the energy case. Even in annex 1 we were not able to illustrate and think of all possible questions that can be derived using the system of concepts, the types of analysis, and the levels of analysis. It was not our aim to generate all possible questions. What is important is to understand the way of thinking behind the different components of the method and how they can be used together.

Within this research we will not look at the usability of the method, or how clear and easy it is to apply for people not involved in its development. This as an important point to be addressed in further research, as in real life situations the potential users of the method will be analysts who have not been involved in its developments. The method in itself is not intended to be scientific method and the emphasis is placed on the knowledge and skills of the practicing information analyst having to enhance his performance based on a multi-disciplinary scientific-based system of concepts.

Part IV. Case study

Chapter 1. The Energy Case

1. Introduction

The main problem that we address in this thesis is how to identify, at an early stage of a standard implementation project, potential problems with the execution of a business transaction when deploying a standard in a specific DBT situation. So far, we have constructed a system of concepts to analyze the requirements of the DBT situation and the standard and identify potential problems. We also described a method concerning how such a system of concepts can be applied.

The construction of the system of concepts and the method are the main goal of this research. We have argued that it is not feasible to conduct a thorough testing of the system of concepts and the method and that this can be a subject of further research.

What we would like to do is to test the feasibility of the system of concepts and the method; to get initial insights into whether they can be applied in practice and whether their use will bring to meaningful results. The goal of this chapter is to demonstrate the potential of the system of concepts and the method, and to identify potential problems in standard implementation projects. By doing so, we provide an answer to the third research questions addressed in this thesis by using a case study.

We had a number of requirements concerning suitability in searching for a suitable case. Mainly we were looking for a project, which spanned multiple organizations, where there is complex communication between the different organizations, and where standards are used to automate parts of this communication. We were also looking for a project either finished or approaching its end. For practical convenience, we included a geographic limitation to the Netherlands. We were looking for cases outside of the healthcare domain, since we used insights and examples from the healthcare domain for the construction of the system of concepts and the method. From a methodological point of view it was important to see how the system of concepts and the method, developed with insights from one domain, performed when applied in a different domain. By following this strategy, we were able to gain insights into applicability in different domains.

At the time that we started looking for a suitable case, the project concerning the liberalization of the energy market in the Netherlands was approaching its end and seemed very interesting to study. It spanned multiple organizations, which had to enter in complex communication, and

standards were used to automate the message exchange between the market participants. Due to these factors, we decided to use this case for our analysis. It is important to provide background information concerning the liberalization of the energy market in the Netherlands. This information is important to provide for contextualization and to allow us to refer to it when we describe the research design.

2. Background concerning energy liberalization

2.1 General introduction

In the late 1990s, the European Union made a decision for all EU countries to liberalize their energy markets. The liberalization of the energy market meant liberalization of the electricity market and the gas market. What does it mean to liberalize the energy market? We will discuss the situation of the electricity market; the gas situation is to a large extent similar.

In the old situation, the following players were involved: the producer of electricity, the national energy grid operator, which was responsible for the national energy grid, where the energy is transported, an energy group fulfilling the function of metering, the regional grid operator, and vendors.

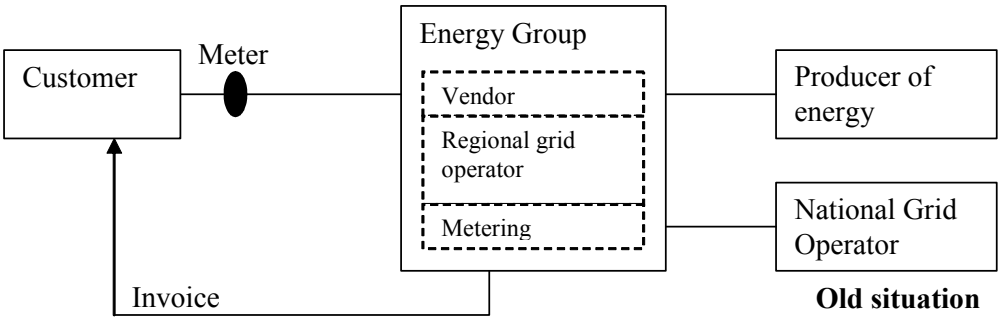

Figure 2.1 The old situation

Metering was concerned with how much energy the customer consumes, the regional grid operator was responsible for the regional network with which the energy is transported to the user, and the vendor function was concerned with sales of energy. Since the market was not liberalized, the customer was unable to choose or switch a supplier and only one invoice was sent to the customer.

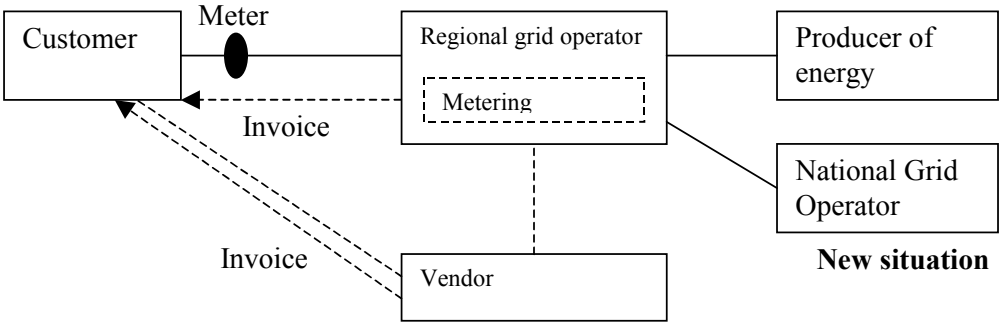

Figure 2.2 The new situation

The goal of the liberalization was to allow customers to choose their energy suppliers. The functions, previously performed by the energy group, needed to be separated; the regional grid operator, the vendor company, and in some cases the metering, needed to become independent

entities. In the new case, both the regional grid operator and the vendor needed to charge the customer.

The abstract models presented in figure 2.1 and 2.2 aim to provide some general idea concerning the difference between the old and the new situation. These models are quite simplified and hide a lot of the complexities in the real life situation. These complexities will be revealed throughout the case study and the related annex.

Energy liberalization in the Netherlands was organized in three phases: phase one concerned the liberalization of the energy supply to business consumers; phase two, concerned liberalization of the market for green energy; and phase three concerned the liberalization of the energy market for the individual consumers.

2.2 New roles

As a consequence of the liberalization there were more independent parties that needed to exchange information. The table below summarises some of the major roles the actors in the liberalized market need to play. The roles below are for electricity. Similar roles can be defined for gas as well.

Supplier	The supplier sells electricity to the end customer
Producer	Produces electricity
Program responsible party	Makes estimate how much electricity the supplier will need to buy from the producer
Regional grid operator	Transports electricity to the end customer. The regional grid operator has a key function in facilitating the liberalized market. It has major responsibilities in case the customer wants to switch a supplier or to move in/out.
Metering company	Responsible to collect the meter data. This role can be fulfilled by the regional grid operator, but can be fulfilled by an independent company as well
National grid operator	It makes sure that there is no shortage of electricity supply. If necessary, it arranges that additional electricity is imported from abroad.

Table 2.1 Key new roles (electricity market)

It is important that part of the communication between the parties in the energy market is automated using computer systems. A decision was taken to use communication standards to achieve this automated communication. To make that happen, a national project was started.

2.3 Players involved

There were several different players involved in energy liberalization. The project was initiated by the Ministry of the Economic Affairs. One important party in the energy liberalization was the Platform for Acceleration of Energy Liberalization (Platform Versnelling Energieliberalisering or PVE in Dutch). PVE was composed of representatives of different parties affected by energy liberalization. The PVE was responsible for developing codes, rules and procedures, and standard messages for information exchange. While PVE was developing the codes, rules, and procedures, another body, the Office of Energy Regulation (in Dutch called Directie Toezicht Energie or Dte) was responsible for putting these rules into law. A special organization, called EBO (EDINE Beheer Organisatie), was created which was responsible for the development and maintenance of the standard EDINE messages. Yet another organization, the Energy Clearing House (ECH) was created by some of the energy companies. The role of ECH was to facilitate the message exchange between the member organizations and between member and non-member organizations. To this end, the ECH decided to develop a proprietary ECH standard and to facilitate the message exchange of the member organizations. Other major players were the national grid operator for the Netherlands (called Tennet), and the branch organization of the energy companies (Energiened). A temporary organization called SPOED (Support Programma

Opening Energiemarkt Derde fase[21]) was also created. This organization was responsible for running tests for the message exchanges between several energy companies. It also developed a reference model based on the PVE documents and other requirements. Currently the reference model is maintained by an organization called B'con.

The energy companies were also involved in the liberalization, as they had to implement all the rules, procedures, and standards, so that they could continue to operate in the Dutch market. Representatives of the different energy organizations were participating in working groups in project organizations such as PVE, EBO, and SPOED.

2.4 The project time span

The figure below provides a rough idea of the evolution of energy liberalization.

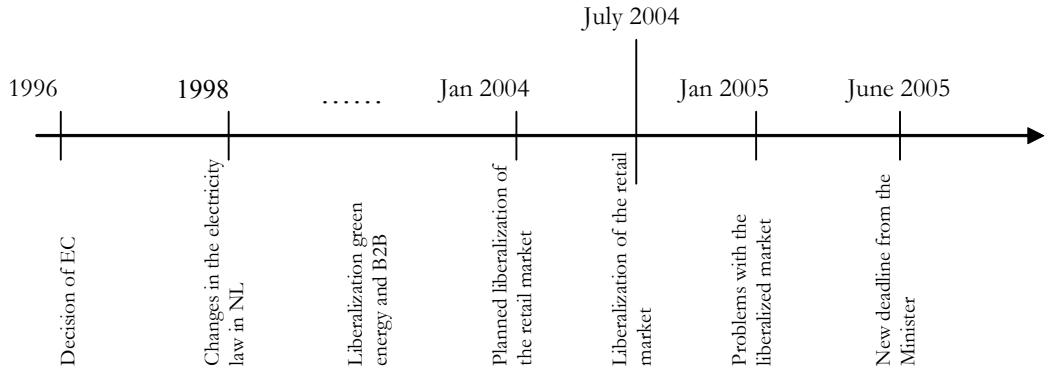

Figure 2.3 The progress of the energy liberalization.

There are several interesting things that we can say about the progress. The first observation is that liberalization of the retail market was first postponed by half a year. In July 2004 the market was liberalized and in January 2005 there was a big boom in the media, discussing major problems that some energy companies faced with respect to billing and reflecting the customer dissatisfaction. As a reaction to that, the Ministry of Economic Affairs set another deadline for the energy companies to fix their problems within half a year. Some changes were also made in the law, setting legal timelines within which the energy company needs to fulfil their obligations to the customers. Within this discussion we focussed on the last year of the liberalization of the retail market. During interviews we found that similar problems occurred in the earlier phases of the liberalization as well. This will be the subject of our further analysis.

2.5 Scope of the project

The project aimed to implement a number of administrative processes with respect to energy liberalization. Liberalization efforts focused mostly on the processes related to the establishment and the termination of contracts. Processes of concern were the switching of supplier and the customer move-in/out process. The switching of supplier is a process that takes place when a customer wants to stop his contract with the old supplier and start a contract with the new supplier. The customer move in/ move out process is a process that takes place when a customer moves from one physical location to another, which results in change of address. These processes are complicated and require complex information exchange between the parties responsible for the energy supply on the side of the old and the new supplier. Some of the major actors in these processes are: the new supplier, the program responsible for the new supplier, the old supplier, the program responsible for the old supplier, the regional grid operator, and a metering company. Processes that fall in the scope of energy liberalization are exchange of master data, end of supply,

[21] In English: Support program for the third phase of the liberalization of the energy market

change of contract, and reconciliation, to mention only a few. Some processes related to the customer- supplier relationship, for example what happens if the customer does not pay on time or if the supplier is not able to send the bills on time, were left out of the scope of the project.

Before proceeding we would like to remark about the nature of the transactions in the energy market. These transactions do not have a discrete nature, like for example providing a specific lab test and receiving compensation for it, which was the case in the healthcare industry, as discussed in part 2. In the energy case, the major part of the transaction is the establishment and the termination of a contract. The actual delivery of electricity and the subsequent payment is an ongoing relationship, conforming to the rules set in the contract. In that sense, it is not surprising that most of the efforts concerning the liberalization of the energy market were focused on the establishment and the termination of contracts.

2.6 Standards used

When we started this case, there were already two independent standards: EDINE and ECH. As the EDINE standard was required by law, we decided to focus on this standard. It is important to mention that the existence of two standards complicated matters and caused translation problems when a process crossed through parties which use EDINE and other parties which used ECH.

When we started the case, the companies were already busy preparing the third phase of energy liberalization, liberalization of the retail market for the end customers. There was already experience with using the standards for the earlier phases of the liberalization, especially in the liberalization of the market for green energy.

At the time we started the case study, the SPOED organization was busy performing additional tests with pilot companies to check whether the companies can successfully communicate. Similar tests have been performed in the earlier phases of the energy liberalization as well.

2.7 The project atmosphere

One thing important to mention is the atmosphere that existed between the participants in the project. What was interesting to observe was that competitors in the market needed to co-operate. This led to a situation where two counter forces had to co-exist. The representatives of the different energy companies needed to sit together to set procedures and standards and perform joint tests, which meant that they needed to share information. On the other hand, the energy companies wanted to reveal as little information as possible about their internal processes, as they were afraid of competition.

3. Research design

Now that we have provided background information concerning the liberalization of the energy market in the Netherlands, let us proceed with the description of the research design that we have applied to gain first insights about the feasibility of the system of concepts and the method.

3.1 Research design to illustrate the use of the system of concepts and the method

3.1.1 Types of analysis

The figures 3.1, 3.2, and 3.3 illustrate the research design adopted to gain insights about the feasibility of the system of concepts and the method. These figures provide further operationalization of the research design presented in Part 1 Chapter 2. With respect to the

chosen project, we will perform two types of analysis: theoretically and empirically driven. Each of the analyses will be discussed separately.

In the theoretically driven analysis we use the DBT situation, the specified DBT requirements, and the standard. We perform fit analysis, DBT analysis and impact analysis by using the method described in Part 3 Chapter 1. We perform only partial analysis to illustrate the way of working and the potential of the system of concepts and the method to identify problems. Providing a full analysis is out of the scope of this thesis. As a result of the three types of analysis, we identify categories of potential problems. In the empirically driven analysis we uncover actual problems encountered during the standard implementation project. As a result of the empirically driven analysis, we identify problems which have actually occurred in practice. For visualization purposes, we provide three separate figures for each type of analysis. As a final step, we compare the results of the theoretical analysis (the problems that we have analytically identified using the system of concepts and the method), and the result of the empirical analysis (the problems that have been actually observed in practice), and come to a conclusion.

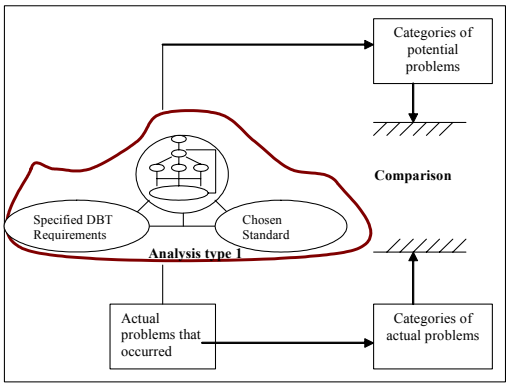

Figure 3.1: Fit analysis

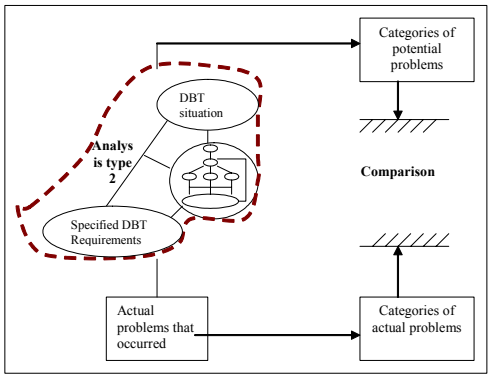

Figure 3.2 DBT analysis

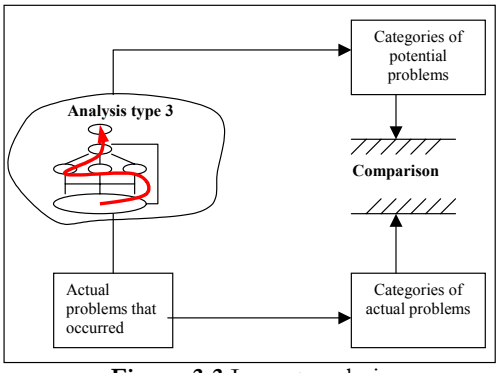

Figure 3.3 Impact analysis

It is important to clarify that although we have distinguished three main steps in the case analysis, (analysis of potential problems, analysis of actual problems and comparison between the two) in the case we had to work in a step-by-step manner. It was important, as this allowed us to reduce complexity and to carry out the actual analysis. The way of working followed in the step-by-step analysis is described in section 3.3 of this chapter.

3.1.2 Unit of analysis

When we started the case, we needed to make a decision concerning the unit of analysis. According to the case requirements, we needed situations which cross multiple organizations and involve complex communication. The switching and the move-in/move out processes seemed to be interesting in that respect. Throughout the first few interviews it became clear that these processes are of major importance and were problematic. We focused on the interactions that

took place between the companies within these processes and regarded the related internal company processes as a black box. Our initial idea was to analyze some of the internal processes as well. Due to the sensitive nature of the subject (see section 2.7), we found that it would not be feasible to analyze the internal processes that take place in the individual energy companies.

In the remaining part of section 3, we introduce the method of data collection (section 3.2), the method of data analysis (section 3.3) and the role of the researcher (section 3.4).

3.2 Method of data collection

To perform the analysis as described in figures 3.1, 3.2, and 3.3, we need different kinds of empirical materials. To explain what type of empirical material and why we need it, let us take a closer look at the tree types of analyses illustrated above.

3.2.1 Required input for the fit analysis

To define empirical material for the fit analysis, let us recall the sub-analyses of the fit analysis as defined in the method in Part 3 Chapter 1. In the method we defined the fit analysis as consisting of requirements analysis, standard analysis and a mismatch analysis.

Requirements analysis
To be able to perform the requirements analysis as defined in the method, we need to have the specified DBT requirements. In that respect, the major empirical input needed to be able to perform the requirements analysis is the documentation where the DBT requirements are specified.

Standard analysis
To be able to perform the standard analysis as defined in the method, we need to have access to the specifications of the standard used in that specific situation. In that respect, to perform the standard analysis within the case study, we needed the standard specifications as empirical material.

Mismatch analysis
To be able to perform the mismatch analysis as described in the method, we use the output of the requirements analysis and the standard analysis. No additional empirical material will be needed for this type of analysis.

3.2.2 Required input for the DBT analysis

Unlike the fit analysis, which is entirely document based, the DBT analysis as discussed in the method, cannot be performed only based on document analysis. The DBT analysis consists of the following sub-analysis: context analysis, formality analysis, and completeness analysis. Let us consider each of the sub-analyses of the DBT analysis, in order to determine what type of additional empirical material will be needed.

Context analysis
The main objective of the context analysis is to check whether the parties that take part in the transaction have established a shared context. As argued in the method, if there are any indications that such a shared context has not been established, one can expect potential problems. To be able to say whether potential problems are due to the lack of a shared context, we need to obtain empirical material showing whether such a shared context has been established in the project.

Formality analysis
As discussed in the method, the formality analysis aims to check whether the requirements of the DBT situation have been made explicit and formal, before being embedded in the computer system. In that respect, we needed empirical data to perform this type of analysis.

Completeness analysis
The goal of the completeness analysis was to use the system of concepts and the specified requirements and reflect on whether there are some important elements missing from the specified requirements. In that respect, we need empirical material for this type of analysis as well.

3.2.3 Required input for the impact analysis

The goal of the impact analysis is to trace possible effects potential problems identified with the fit or the DBT analysis can have on the execution of the business transaction. In that respect, the major input for the impact analysis will be the output of the fit and the DBT analysis and additional empirical material will not be required.

3.2.4 Required input for the analysis of actual problems

The goal of this analysis is to identify actual problems throughout the project. To reason about problems that have actually occurred in practice means we need to obtain descriptions of problems and issues throughout the project.

3.2.5 Summary of types of input needed for the different types of analyses

The table below summarizes the inputs needed for each type of analysis. We mark with "E:" those inputs which require empirical data.

	Analysis	Inputs
Fit analysis	Requirements analysis	System of concepts Method E: Data about the specified requirements
	Standard analysis	System of concepts Method E: Data about the standard used
	Mismatch analysis	System of concepts Method Results requirements analysis Results standard analysis
DBT analysis	Context analysis	System of concepts Method E: Empirical data about the existence (or lack of existence) of a shared context
	Formality analysis	System of concepts Method E: Empirical data for the formality analysis
	Completeness analysis	System of concepts Method E: Documentation of the specified requirements
Impact analysis		System of concepts Method Output of the fit analysis Output of the DBT analysis
Actual problems		E: Empirical material concerning actual problems that have occurred throughout the project

Table 3.1 Required inputs and sources of data collection

Below we will discuss those types of analysis where empirical data was needed and briefly discuss the sources of empirical data.

Data collection concerning the requirements analysis
During data collection, we used multiple sources. One source was interviews, though with respect to the specified DBT requirements, the role of the interviews was to find out what specified requirements documents exist and whether and how it is possible to get access to them. As a result, the main source of evidence was publicly available documents, project deliverables, issue lists, and official reports to the ministry of economic affairs.

Data collection concerning the standard analysis
To be able to identify the standards used in energy liberalization, we included a question in the interviews about that. As a result we identified two standards being used at that time. One of the standards (the EDINE standard) was publicly available on the Internet, so we were able to access the specifications directly. This was also the official standard required by law. We also found out that another proprietary standard (the energy clearing house (ECH) standard) existed in parallel with the EDINE standard. This standard is not publicly available though we were able to access it as well.

Data collection concerning the context analysis
To obtain this type of empirical evidence, interviews are an appropriate method of data collection, as they allow us to go in-depth and discuss the issue concerning the creation of a shared context as perceived by the project participants. In that respect, to be able to collect the necessary data to conduct the context analysis, we have used interviews. In the interviews we have aimed to find indication concerning the existence (and mainly the lack of existence) of a shared context.

Data collection concerning the formality analysis
The empirical input important for this analysis is data concerning the specified requirements, as well as the perception of the people involved in the project about the formality and timing of the specified requirements. To perform this type of analysis, we used available documents (requirements documents, reports, project documents), as well as interviews. From the documents, we aimed to find out explicit and formal representation of requirements. We also looked at the dates when these documents were created to get an idea of at which stage these requirements documents appeared. We also used interviews to triangulate our observations from the document analysis.

Data collection concerning the completeness analysis
A necessary source for conducting completeness analysis is requirements documents. To be able to perform the completeness analysis, we again used available documents (requirements documents, reports, project documents).

Data about the problems and issues encountered in practice
To be able to collect data about the actual problems, we have used the interviews as the main source of evidence. In addition to the interviews, we used material from the press and radio and television programs as anecdotal evidence.

3.2.6 Interviews as a source of empirical data

It is clear that interviews played a major part in the data collection. The interviews were used for several purposes. They provided rich material to gain contextual information concerning the projects. The first few interviews served as orientation in the scene. Furthermore, the fit analysis, formality analysis, and the completeness analysis need empirical data concerning the specified requirements and the standards used. The role of the interviews was to find which were the major documents from which the specified requirements can be derived and which standards were used.

The interviews were also used as a source for data collection concerning the context analysis and as an additional source for data collection concerning the formality analysis. With respect to the context analysis, the interviews provided insights concerning the establishment or lack thereof, of a shared context between the parties involved in the transaction. With respect to the formality analysis, interviews were used as an additional input apart from documents to check whether the formal requirements, if available, were created before the actual implementation took place.

Last but not least, the interviews played a major role in the identification of actual problems. The interviewees were asked to describe major problems encountered in the process of energy liberalization.

We interviewed 16 people in total and we conducted 17 interviews (one person was interviewed twice) in the period of January-June, 2004. The interviews were semi-structured and the duration varied between 1 to 3 hours; 12 were recorded. We had follow up e-mail communication with some of the informants.

Selection of respondents
When selecting the respondents, we first looked at the different key actors and the roles they had to play in the supplier switch and the move-in/move out processes. We identified that the energy supplier, program responsible, and the grid operator were of major importance. To get a grasp of the developments with respect to the energy liberalization, it was important to look at some of the major players involved in the energy liberalization project.

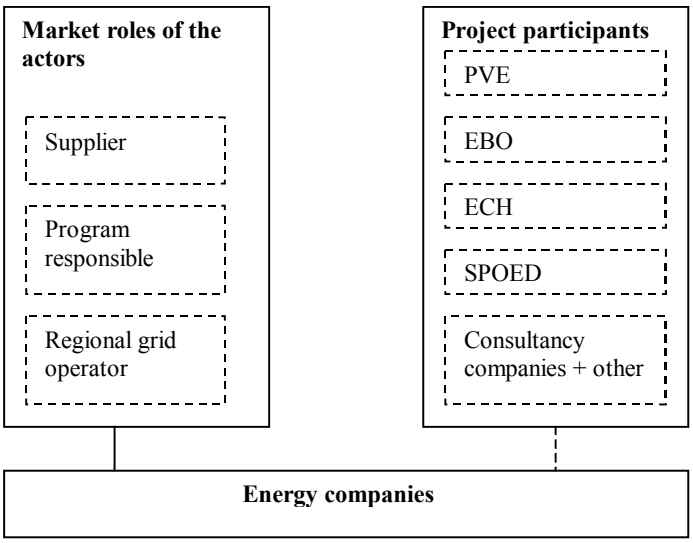

Figure 3.4 Categories to classify the types of respondents

We filtered out four organizational bodies as very important: the PVE, responsible for setting the national rules and procedures concerning the energy liberalization and for providing input for the development of the standard messages; EBO, the organization, responsible for the development of the EDINE standard which became the standard for message exchange by law; the ECH, the party which developed the proprietary message standard; and the SPOED organization, responsible for performing tests concerning the message exchange with pilot companies. What is important is that the energy companies were involved as parties that play certain roles in the energy market and as representatives of the different energy companies involved in PVE, EBO, and SPOED to provide input for the development of the procedures, the development of the standard, and testing. Not all the people working for the temporary organizations were members of an energy company. Figure 3.4 identified the types of respondents that we have interviewed.

We interviewed people from energy companies, and had respondents from energy companies that play the role of a supplier, the program responsible, and the regional grid operator. We collected data from respondents at management levels, as well as respondents busy with technical implementation. We also talked to representatives from PVE, EBO, ECH, SPOED and consultancy companies. Some of the respondents from the temporary organizations were sometimes also working for a specific energy company. They could share their experience from the point of view of the energy company and its role in the market.

Table 3.2 characterizes the interviewees according to the categories presented in the figure earlier. Four of the respondents were representative of the supplier role, one of the program responsible role, and three from the grid operator role. We interviewed only one representative of the role "program responsible", as this role has very limited involvement in the switching processes. In total, eight of the respondents were also working within an energy company. We conducted five interviews and talked to four people in total from the SPOED organization. We had interviewed five people involved in PVE, three people involved in EBO, one from ECH and five people who also work for consultancy or other companies. The sum adds up to more than 16; as seen from the table above the interviewees often played more than one role.

Interviewee No	Role			Energy Company	Project participant				
	Supplier	Program Responsible	Reg. Grid. Op.		SPOED	PVE	EBO	ECH	Consult. + other
1					X				
2					X				X
3x2					X				
4	X			X					
5	X			X		X			
6			X	X		X			
7								X	
8			X	X		X			
9	X			X	X				
10	X			X		X	X		
11		X		X			X		
12						X			
13							X		X
14			X	X					X
15									X
16									X
Total	4	1	3	8	4	5	3	1	5

Table 3.2 Categorization of the interviewees according to the different roles they played in the process of liberalization.

In the selection of the interviewees, we ensured multiple perspectives on the problem, to gain a holistic understanding of the project situation, documents used, and the issues encountered. By ensuring access to representatives of the different market roles, different energy companies, and the major project organizations involved in the process of liberalization, we created a good basis for using multiple types of respondents. This is important with respect to the validity of our findings.

The interview questions

The interviews conducted were semi-structured and data was collected for different purposes, as discussed earlier.

- Interview questions related to the analysis of potential problems

All interviews had an introduction, to gain understanding about the organization(s) in which the interviewee is involved, his role in that organization, and his involvement in the energy liberalization. Furthermore, especially with respect to the interviews conducted at the beginning

of the data collection, we included questions concerning which types of documents and standards specifications they worked with and how to gain access to these documents. These were important to ensure that we identify and access the right documents to perform the analysis of the potential problems. In later stages of the investigation, we again included questions about the documents used, though these questions were related more to the content of the documents. If, when working with the documents we were not sure what certain parts of the documents meant, we used parts of the interviews to clarify the content of the documents, so that we could proceed with the analysis of the potential problems.

Apart from the discussion for identification of documents and clarification of their content, we needed inputs from the interviews for the context and formality analysis. In that respect we have also included a question concerning the existence of a shared context with respect to the processes under analysis between the parties involved in the process. We also included a question about whether the requirements were made explicit and formal before being embedded in the computer systems.

In addition to using the interviews as sources for gaining empirical data with respect to the analysis of potential problems, one of the most important roles of the interviews was to provide empirical material concerning actual problems.

- Interview questions concerning actual problems
With respect to the identification of the actual problems, we worked in a semi-structured way during the interviews. When conducting interviews we usually started with an open question asking the interviewee to mention some of the major problems that in his opinion occurred in the process of energy liberalization with respect to the two processes under analysis (i.e. moving and switching). We tried to further clarify when and why the problems occurred whenever possible.

We aimed to map the types of problems discussed by the interviewee against the types of analysis as discussed earlier: the fit analysis (the requirements analysis, standard analysis, and mismatch analysis); the DBT analysis (context analysis, formality analysis, and completeness analysis); and impact analysis. We used the categories presented in table 3.3. We asked additional questions with respect to the categories not yet covered in the discussion with the interviewee. For example, if the interviewee did not mention problems related to standard, we included an explicit question asking whether some major issues have been encountered with the use of standards.

Analysis	**Sub-analysis**	**View**
Fit analysis	Requirements analysis	FE, BN, BP, BR, CA, SM
	Standard analysis	FE, BN, BP, BR, CA, SM
	Mismatch analysis	FE, BN, BP, BR, CA, SM
DBT analysis	Context analysis	
	Formality analysis	
	Completeness analysis	
Impact analysis		

Table 3.3 Categories used to guide the formulation of interview questions

Depending on the background of the respondents, we entered into more detailed discussions with respect to a specific type analysis, where we have used the views from the system of concepts to find out whether problems have been encountered. For example, if we talked with experts on standards, we asked more detailed questions related to the standard analysis. An example of a question related to the CA view was, "Did you encounter problems with the content of the messages as specified in the standard?" The goal of using the views was to make the interviewee reflect whether he had encountered problems in that area. Let us now continue the discussion with documents as a source of empirical material.

3.2.7 Documents as a source of empirical data

Other major sources of evidence were the requirements and standard documents. These were a major source of empirical data to carry out the analysis of potential problems. As discussed earlier, we used the first interviews to gain insights concerning the types of documents that played a major importance in defining the requirements and the types of standards used. Furthermore, we inquired where and how to get access to these documents. A large part of the documents were available on-line on the PVE, Dte, and EBO websites. The websites also allowed us to trace how these documents appeared over time. Other documents were acquired from the respondent organizations during the interviews or via e-mail in a follow up communication.

3.2.8 Timeline of data collection

Most of the data collection took place in the period January-June, 2004. During that period the interviews were conducted, and a number of major requirements documents were identified and acquired. We also obtained copies of the latest versions of the two standards at that time. More evidence was collected after this period, but this evidence came more on an ad-hoc manner.

3.3 Method of data analysis

3.3.1 Method of data analysis of potential problems

The fit analysis included analysis of the specified requirements, analysis of the standard, and analysis of possible mismatches between the two. The fit analysis requires a lot of detailed work. It is the most extensive analysis compared to the DBT analysis and the impact analysis, as these two stay at a very general level. We will not present the detailed fit analysis in this chapter, as this will unnecessarily complicate the discussion. The detailed fit analysis is presented in annex 1.

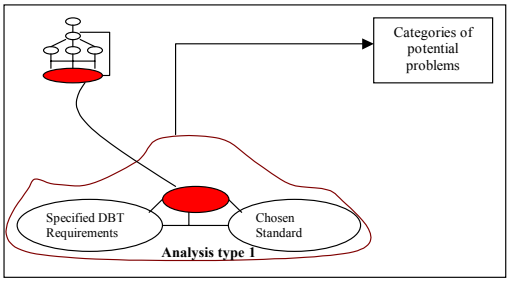

Figure 3.5 The fit analysis performed by view

When conducting the fit analysis as described in annex 1, we worked as follows. For each view from the system of concepts, we first conducted the requirements analysis at Levels 1 and 2. After that we conducted standard analysis at Levels 1 and 2. Finally, we have conducted a mismatch analysis at Levels 1 and 2. For each of the analyses we provide a summary at the end. An example is presented below.

Standard analysis (Analysis type 1.2): CA view Summary		
Level 1	(-)	
Level 2	(X)	The propositional content is left to the user to define it There are examples of messages which carry two communicative functions

Table 3.4 Summary of the Standard analysis with respect to the CA view

The table indicates a summary of the standard analysis with respect to the communicative act view. The table further indicates that at Level 1 we were not able to identify problems (marked with "-"). It also indicates that at Level 2 we identified potential problems (marked with "X"), and contains statements concerning which concepts from the communicative act view seem to relate to these potential problems.

After we performed the requirements analysis, the standard analysis, and the mismatch analysis, and summarized the results, we were able to create table summaries with respect to a type of analysis. The table below is an example. It contains the type of analysis (in this case the requirements analysis), and the different views from the system of concepts as well as the results from the analysis. It also includes markings whether we identified potential problems or points of attention concerning each view.

Requirements analysis (analysis type 1.1.): Potential problems						
	FE	BN	BP	BR	CA	SM
	(*)	(*)	(*)	(-)	(X)	(X)
	Electricity and gas not always treated separately	Explicit elaboration of the intermediating exchanges might be helpful	The structure of the process, as well as the conditions, which motivate a certain choice, seemed to be modelled only to a limited extent.		PC not always completely specified	Explicit models concerning the SM view are missing
(*) -point of attention (X) -problem (-) -problems not identified at level 1 and level 2						

Table 3.5 Summary of the requirements analysis (with respect to all views)

Working view by view was the logical way of working, as each view addressed different issues and seemed to provide grounds for a logical discussion linking the requirements analysis, the standard analysis, and the mismatch analysis.

The DBT analysis and the impact analysis stay at a general level and do not require as detailed analysis as the fit analysis. The way of working followed with respect to the DBT and the impact analysis was similar to that we followed with the fit analysis. The difference was that with the DBT and the impact analysis the analysis is at a high-level of abstraction and can be done without going into the details of the system of concepts.

3.3.2 Method of data analysis of actual problems

With respect to the empirical analysis, the method of data analysis is different, as we need to identify actual problems that occurred during the project using empirical data. The major sources of evidence for the identification of the actual problems were interview data. Below we describe the method of data analysis.

As a result of the data collection, we had empirical material describing problems that occurred in practice. Most of the interviews were recorded and detailed notes were taken for those that were not. The recorded interviews were first typed. After that, for each interview, parts of the text where a specific problem was described were copied to a separate excel sheet. As a result, for each interviewee, we created a table which contained interview data about problems as they appeared in the interview. Each was given a number, and this was used as a reference in further analysis. An example is provided in the table below. The table contains the nickname of the interviewee, the number of the problem and the problem description as it has been indexed.

This was the first filtering step. Once we had a database with problems, derived from the individual interviews, we proceeded to the next step, classifying the problems.

Daniel	
No	Problem description
1	It took some weeks to get some of the messages out of the water, but still some hundreds of messages are not discovered where they are. Of course they are not totally lost, but in this way it takes weeks, month to come to a real switch and all that time the customer receives two bills- one from the old and one of the new supplier or none- no bill at all and in this situation they are very satisfied but in the first situation they have a lot of complaints and they want to go back to the old supplier, because the new supplier was not able to switch.
2	The feedback that the IT people they gave we did not have enough time to look at the specifications that they gave us and they decided for themselves because this had to go on, so now we have a system that makes a lot of mistakes.

Table 3.6 Example from the problem description sheet of the interviewee with nickname Daniel.

To do the categorization we used the high-level system of concepts and the types of analyses as defined in the method. The categorization we used in the analysis of the problems was as follows.

Analysis	Sub-analysis	View	Piet
Fit analysis	Requirements analysis	FE	
		BN	
		BP	
		BR	
		CA	
		SM	
	Standard analysis	FE	
		BN	
		BP	
		BR	
		CA	
		SM	*17, 18, 20*
	Mismatch analysis	FE	
		BN	
		BP	
		BR	
		CA	
		SM	
DBT analysis	Context analysis		
	Formality analysis		
	Completeness analysis		
Impact analysis			

Table 3.7 Categories used for the categorization of actual problems

We analysed each problem description sheet for each interviewee separately. For each problem we first asked the question: does this problem relate to the fit analysis, the DBT analysis, or the fit analysis. If a problem did not fit any of these categories, we included it in a general category called "other problems". If a problem fit in one of the categories described, we proceeded with further analysis. Let us give an example with the fit analysis. If a problem described by one of the interviewees fit in the category "fit analysis", the next question for further categorization is "Does this problem relate to the specified requirements, the chosen standard, or does it identify mismatches between the two?" If the problem relates to the chosen standard, a next level of categorization of the problem was the high-level system of concepts. The question we asked ourselves at this stage was "Does this problem relate to the FE, BN, BP, BR, CA, or SM view". This structuring of the data analysis concerning the actual problems was important, as these categories provide us with common grounds to compare potential and actual problems.

In the table below, we marked that from the problems that interviewee 1 (with a nickname Piet) addressed, problems number 17, 18, and 20 refer to the fit analysis, the chosen standard and the subject matter view.

Once we walked through the problem lists of the individual interviewees and classified the problems (either in one of the categories of the table above or in the category "others") we proceeded as follows. We have taken one category (for example fit analysis/standard analysis/SM) and created a separate sheet. The information contained in the sheet was as illustrated in table 3.8. The table contains problems identified during the interviews which relate to the fit analysis/Standard analysis/SM. The table also contains the nickname of the interviewee, and the number of the problem which has been classified under this category (as it appears in the individual problem list). Furthermore, we added an additional column in the table labelled "concepts". The goal of this column, whenever possible, is to provide further categorization of the problem using the concepts defined in the detailed system of concepts. The further categorization in terms of concepts was not always possible, as in some cases the information was sufficient to decide whether a problem relates to a certain view or not but was not sufficient to further classify the problem in terms of concepts.

		Fit analysis/ Standard analysis/**SM view**	
Interviewee (Nick name)	No	Problem (as in the individual problem list)	Concepts
Piet	17	People often come and ask: this field, what kind of information does it contain? If you look at a segment, what does it mean or what is the relation between this element and the other element: is it one to many?	Link conception-representation, mutual properties
Piet	18	……	
David	14	If you want to find out what are the relationships between the different fields in the standard that is difficult	Things, properties, values
Michael	29	It is often not clear what a certain code means.	
		……	

Table 3.8 Examples of problems, which we classified in the category fit analysis/Standard analysis/SM view

As a result, each type of analysis generated a table similar to the one generated when conducting analysis of the potential problems. The table below is an example of such a summary of results.

Actual problems: Fit analysis/ Standard analysis						
	FE	BN	BP	BR	CA	SM
	X	(-)	(X)	(-)	X	X
	Messages developed for electricity were adopted for gas.		More and more procedures were included into the standard, and the standard became too complex		Unclear how to arrive at a propositional content Merging ae-messages	- Meaning often ambiguous and unclear - Link conception-representation, mutual properties ….
X- potential problem (-) – potential problems not identified at level 1 and level 2						

Table 3.9 Summary of actual problems, which we have considered related to the fit analysis/standard analysis

Let us now proceed with the method that we have used to compare the potential and the actual problems.

3.3.3 Method for comparison between potential and actual problems

The comparison between the potential and the actual problems is done step-by-step per analysis and is based on the summary of potential and actual problems.

Table 3.10 provides the general structure when presenting the case analysis in this chapter. We treat each type of analysis separately and present the potential problems, actual problems, and comparison between the two. For example, if we take the requirements analysis, we will discuss

the potential problems, the actual problems, and the comparison between the two with respect to the requirements analysis.

We will proceed with the types of analysis as presented in the table, i.e. requirements analysis, standard analysis, mismatch analysis, which constitute the fit analysis; the context, formality and completeness analysis which constitute the DBT analysis, and the impact analysis. We now present the results of the analysis in the order described. With respect to comparison, we aim to make the comparison at a view level (Level 1) and not go into the details of Level 2 analysis. Level 2 analysis was important in the analysis of the potential and actual problems, as it was used as a signalling mechanism to problems at Level 1.

Analysis	Sub-analysis	Potential	Actual	Comparison
Fit analysis	Requirements analysis			
	Standard analysis			
	Mismatch analysis			
DBT analysis	Context analysis			
	Formality analysis			
	Completeness analysis			
Impact analysis				

Table 3.10 Categories used for the comparison between the potential and the actual problems.

3.4 The role of the researcher

The goal of this case study was to provide insights concerning the predicting power of the system of concepts and the method. In that respect, we do not try to explain the problems (as would be the case in an explanatory case study), but predict them. Furthermore, we had to reduce the risk as much as possible, to use the actual problems as an input for our analysis of potential problems, as we were involved in the data collection and data analysis concerning both potential and the actual problems. It is impossible to fully eliminate this risk, though we took a number of measures to reduce it, discussed below.

One of the major measures was to separate to a large extent the types of data sources used for the analysis of the potential and actual problems. For the identification of the potential problems we used documents describing the specified requirements and standard specifications as empirical input, and only to a limited extent interviews with respect to the context analysis and the formality analysis. Furthermore, we extensively used the system of concepts and the method as additional input. In annex one, we illustrate in an explicit, detailed way how we worked with the requirements documents and the standard, to carry out the fit analysis (the most detailed analysis as described in the method). The conclusions in the identification of potential problems are logically derived when applying the system of concepts and the method to the requirements documents and the standard specifications. It is important to mention that these documents and specifications were created earlier than the occurrence of the problems reported by the interviewees.

Unlike the analysis of the potential problems, where the major sources of empirical data were existing requirements and standards documents, the major source for the analysis of actual problems were interviews. We have, as far as possible, used different empirical data sources for the two types of analysis. Furthermore, while in the identification of potential problems we used the system of concepts and the method to perform the actual analysis and arrive at potential problems, in the case of the analysis of the actual problems we derived the problems from the interviews. We used the system of concepts and the types of analysis only to categorize the types

of problem which seemed to fit one of the existing categories. The categorization of problems into existing categories is also subjective to a large extent. We have aimed to follow an explicit way of working and thinking to allow for transparency. We carefully selected the respondents, so that we could have representatives from the different market roles, energy companies, and project participants. We aimed to ensure a multi-view on the project and have different sources to triangulate our findings.

4. Analysis

4.1 Fit analysis

As discussed in section 2.1, the fit analysis aims to identify potential problems by applying the system of concepts and the method, and identify problems that actually occurred during energy liberalization. The goal is to confront the potential vs. actual problems.

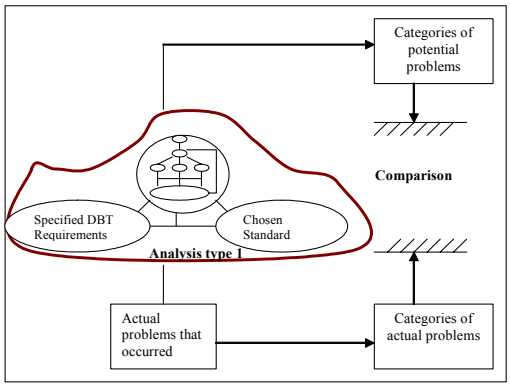

Figure 4.1 Analysis of potential and actual problems related to the fit analysis and comparison between the two.

The fit analysis consists of three sub-analysis: type 1.1, (analysis of the specified DBT requirements or requirements analysis), type 1.2, (analysis of the standard, or standard analysis), and type 1.3, (analysis of mismatches between the requirements and the standard, or mismatch analysis). For each sub-type we work in a step-by step manner. We use the system of concepts and the method to arrive at a set of potential problems. We use the interview data to identify types of problems that actually occurred in practice. We refer to only those actual problems which can be mapped in some way to the categories defined in the system of concepts. Finally, for each sub-type of analysis we compare the potential with the actual problems. We will repeat this procedure for each sub-type of analysis.

Due to the fact that the fit analysis is very detailed, we present it as an annex (Annex 1). Within this chapter, we summarise the results and the main conclusions derived by performing this analysis.

4.1.1. Requirements analysis

Potential problems identified using the requirements analysis

FE view
With respect to the focal exchange view we did not find potential problems at Level 1 or Level 2 analysis. We had some remarks concerning the focal exchanges with respect to the objects of exchange. There are two types of focal exchanges specified in the requirements documents (exchanges where the focal object of exchange is electricity and where it is gas). In some of the requirements documents it seemed that they are treated together. As there are also separate laws concerning the trade of electricity and the trade of gas, it might be dangerous if the processes and

information requirements concerning the two are not treated separately. We consider this as a point of attention, as some differences between the electricity and gas might be overlooked.

BN view
With respect to the BN view, we did not identify potential problems during the Level 1 analysis. At Level 2 the business network is thoroughly defined in terms of actors. We identified that the intermediating exchanges are not explicitly modelled. We do not consider this a potential problem, as from the requirements documents it seemed that such information can be derived. However, it is a point of attention, as an explicit elaboration of the intermediating exchanges might be useful to bring additional insights into understanding the complexity of the situation.

BP view
When analyzing the BP view we did not find potential problems at Level 1. At Level 2, it seemed that the requirements documents covered the basic business process concepts. We have identified that the structure of the process, as well as the conditions which path to follow, were captured only to a limited extent. In that respect, we have marked it as a point of attention.

BR view
With respect to the BR view, we did not identify potential problems with the specified requirements at Level 1 or 2.

CA view
We did not identify potential problems at Level 1. At Level 2, we found out that the propositional content was not always completely specified. This can be a potential problem concerning the CA view. The requirements need to be completely and explicitly specified, as they will become part of the automated communication. Failure can lead to communication problems.

SM view
We identified potential problems at both Levels 1 and 2. At Level 1 we found explicit and formal models of the domain of interest, its conception, and representation were missing. At Level 2 we found the information to arrive at such a model was dispersed in different documents, which made it difficult to capture all the essentials. As argued earlier, explicit and formal models with respect of the subject matter are necessary, as they need to define the part of the to-be automated communication. The lack of such models in the requirements would mean that problems with understanding the meaning of the information can be expected.

The table below summarizes the results of the theoretical analysis type 1.1 of the specified requirements. We use similar tables throughout the other analyses and here we would like to introduce a number of symbols. We mark with "*", the views where we have identified points of attention. Point of attention does not mean that we definitely consider that potential problems can occur, but that we have identified some elements, which bring concerns. We mark with "X" views where we expect potential problems. We mark with "-" views where we did not find substantial evidence at Level 1 or 2 that problems can occur.

With respect to the requirements analysis we summarized in the table that we expect potential problems with the CA view, especially with respect to the propositional content. We definitely expect potential problems with the SM view, as we found domain models are not available and evidence that it is not straightforward to arrive at unambiguous models. With respect to the FE, the BN, and BP views, we make some comments and marked points of attention.

Requirements analysis: Potential problems					
FE	BN	BP	BR	CA	SM
(*)	(*)	(*)	(-)	(X)	(X)
Electricity and gas not always treated separately	Explicit elaboration of the intermediating exchanges might be helpful	The structure of the process, as well as the conditions, which motivate a certain choice, seemed to be modelled only to a limited extent.		PC not always completely specified	Explicit models concerning the SM view are missing
(*) - point of attention (X) - problem (-) - problems not identified at level 1 and level 2					

Table 4.1 Potential problems identified with the requirements analysis

Let us now proceed to analysis of the empirical findings with respect to this type of analysis.

Actual problems related to the requirements analysis

When analysing the results of the interviews, we found out that most of the interviewees did not question the specified requirements. The general feeling was that the requirements were there and they had to comply with them. As George stated: "The whole model seems quite complicated. However, you have to comply with it". In that respect, we did not identify problems related to the quality of the specified requirements marked in the table below.

Requirements analysis: actual problems					
FE	BN	BP	BR	CA	SM
(-)	(-)	(-)	(-)	(-)	(-)
(-) - problems not identified at level 1 and level 2					

Table 4.2 Actual problems with the specified requirements

Although from the interviews it seemed that the general perception concerning the specified requirements was mainly in the lines: the requirements are there and we need to comply, in the completeness analysis we will see that people have indeed encountered problems with the specified requirements. Let us now proceed with the comparison between the potential and the actual problems.

Requirements analysis: potential vs. actual problems

The table below summarizes the results of the theoretical analysis of potential problems and the actual problems identified during the interviews. We can see that based on the theoretical analysis we can expect potential problems with the requirements with respect to the CA and SM views and we mark points of attention with respect to the FE, BN, BP views. From the analysis of the actual problems, we were not able to identify perceived problems related to the specified requirements.

Requirements analysis: Potential vs. actual problems						
	FE	**BN**	**BP**	**BR**	**CA**	**SM**
Potential	(*)	(*)	(*)	(-)	(X)	(X)
Actual	(-)	(-)	(-)	(-)	(-)	(-)
(*) -point of attention (X) -problem (-) -problems not identified at level 1 and level 2						

Table 4.3 Requirements analysis: potential vs. actual problems

There can be several explanations for the differences between the potential problems and the actual problems. One of the main reasons for such a difference can be traced back to the interconnected nature of the requirements and the standard. It seemed that the CA and SM view

were considered sufficiently addressed in the requirements and their full elaboration was left to be dealt with in within the standard. Furthermore, the attitude of people who had to implement the requirements was to comply with the requirements, rather than to question their quality.

4.1.2 Standard analysis

Potential problems identified using the standard analysis

In the energy liberalization, the EDINE standard was developed based on the PVE requirements documents. When analysing the standard, we found its main focus on message exchange, and mainly on the CA and the SM views. With respect to the FE, BN, BP, and BR views, it seemed that according to the standard these views were out of its scope. The standard states that it will rely on and adopt the procedures defined by PVE. As the focus of the standard is the CA and the SM views, we will start the discussion with these two views and provide some comments concerning the other views after that.

CA view

With respect to the CA view, we did not identify potential problems with the standard at Level 1. At Level 2 however, we identified a major problem with respect to the propositional content. The standard contains complex rules on how to come to the content of a message. These rules are spread all over the standard document and are fundamental for constructing the messages. At the end of the standard a number of examples are provided. These are, however, to be read only as examples, and the rules specified on how to construct a message are the core of the standard. Leaving the user of the standard to define the message content based on complex rules, rather than providing operational messages within the standard can be seen as a serious potential problem. Given the fact that many different people will need to follow the complex rules to arrive at message specifications, we expect some differences in the messages can occur. When we talk about automated communication, even slight differences can lead to communication failures.

Another issue with the CA view was that we identified examples where the same message number is used to accommodate two different communicative functions. This might cause some issues, as one would need to have mechanisms to look into the content of the message to be able to understand what the intention is.

SM view

With respect to the SM view, we identified potential problems at both Level 1 and 2. The standard does not contain explicit and formal model concerning the subject matter addressed. When analysing whether the information available is sufficient to arrive at such an explicit and formal model, we found it would be difficult to construct such a model because some of the information concerning things, properties, and values of properties was either missing or difficult to find in the document. Due to the fact that the subject matter is not explicitly and formally modelled in the standard, we expect potential problems related to understanding of what the meaning of the information is. Understanding the meaning of the information is the fundamental building block for establishing a meaningful automated communication. If this is missing we expect communication failures.

FE, BN, BP, BR views

The FE, BN, BP, and BR views seem not the focus of the standard and the standard says that it adopted parts of the specified requirements with respect to these views. With respect to the FE view, we noticed that the electricity and gas sectors are treated together in the standard even more than we observed in the requirements. Although we cannot make direct conclusions from that, we consider that if the electricity and gas sectors are treated simultaneously in the same standard, some issues might occur if some of the differences between the two sectors are overlooked.

The standard claims that it uses the procedures, business rules, and the business network already defined in PVE. However, it does not make a direct reference to the documents from which they are adopted. Instead, the standard includes information concerning parts of procedures, business rules, and business network (especially with respect to the market roles), which seem not to be directly adopted from the requirements documents. In that respect, although the standard seems to strive to exclude the FE, BN, BP, BR views out of its scope, they are to some extent included in the standard. We have marked these views with two symbols (#) (*), meaning, not in scope, according to the standard, but still deserving a point of attention according to our analysis.

The table below summarizes the results of the theoretical analysis of the standard.

Standard analysis: Potential problems					
FE	BN	BP	BR	CA	SM
(#) (*)	(#) (*)	(#) (*)	(#) (*)	(X)	(X)
Electricity and gas not always treated separately	Clear reference to documents from where the actors from the BN are adopted seems to be missing.	Clear reference to documents from where the procedures are adopted seems to be missing.	Clear reference to documents from where the business rules are adopted seems to be missing.	PC is left to the user to define; Messages carrying two communicative functions	Explicit and formal models concerning SM are missing and are not easy to derive from the standard
(x) -potential problem (#) -not in scope (*) -point of attention					

Table 4.4 Potential problems identified with the standard analysis

Actual problems related to the standard

With respect to the standard, the interviewees pointed out major challenges with respect to the CA and the SM view and to some extent the BP view and the FE view. With respect to the BN, BR views it seemed that the interviewees did not perceive major problems related to these views.

CA view

A major difficulty was encountered with respect to what actually needs to be included in the message (or the propositional content). For example, one of the interviewees pointed out: *"In the standard it was often not clear when to fill the field and when to leave it empty, what does it mean if it is filled in and what does it mean if it is empty".*

Furthermore, difficulties were related to understanding the conditions concerning the use of segments. For instance *"Problems occur on the conditional level. In message 392, you only use some segments, and for another message- other segments. It's a very complex document. It is all in one document, which makes it difficult to read."*

We also found examples, which point out that ae-messages were not always clearly defined and were merged in one message. As a consequence, it became clear during one of the interviews that it is difficult to interpret the intention behind the message and due to that can take wrong actions. For example one of the interviewees said: *"If I get a message- if it has a certain field, I will do action A, and otherwise I can do action B or action C. You can take wrong action, because the field is not filled the right way."*

SM view

We identified a number of examples where the interviewees encountered problems with the standard. The major problems were related to the meaning of fields and codes. For instance, during the interview on of the interviewees said *"In the standard often it is not clear what a certain code means."* Often it is not explicitly specified in the standard how to interpret a certain field or

segment, what kind of information it should contain, or how it relates to other fields. One of the interviewees pointed out: *"You have fields in the standard and the interpretation is not strict. It is always nice to say this is the intention, but you have to right it down in a non-misinterpretable way and if there is some room for interpretation you should say which way to go".*

It was also discussed that the current standard does not include explicit conceptual model and that it is not straightforward from the standard to arrive at such a conceptual model. For instance, it was pointed out that: *"In fact the data model has not been included in the standard. You can derive it from what you see on the conditional level… It is not easy to drive the relationships between the data elements."* We also found that such a conceptual model is under development at a European level within the ebIX initiative.

BP view

With respect to the BP view we found that problems occurred due to the fact that there were no formalized procedures and the standard gradually included also parts of the specified procedures; this led to the problem that the standard became too complex. For example, one of the interviewee pointed out: "*When you look at the development of the implementation guides, you can see that in the early implementation guides it was the description of the information and messages. When you look at the switching messages you see that more and more procedures came into the implementation guides. So it became a combination of the description of the procedure and a description of the information itself…. It became too complex, because then all kinds of details were to be added".*

FE

Some of the interviewees pointed out that problems with the standard were due to the fact that the messages for electricity were copied to a large extent also for the gas market, and that there are differences between the electricity and the gas market. *"Some of the problems we have still with the gas messages. They copied the messages from electricity. There are differences between electricity and gas."*

Standard analysis: actual problems					
FE	BN	BP	BR	CA	SM
(X)	(-)	(X)	(-)	(X)	(X)
Messages developed for electricity were adopted for gas		More and more procedures were included into the standard, and the standard became too complex		Unclear how to arrive at message content Merging ae-messages	Meaning often ambiguous and unclear
(X) -problem (-) -problems not identified at level 1 and level 2					

Table 4.5 Actual problems related to the standard

Table 4.5 summarises the results from the analysis of the interviews with respect to problems with the use of the standard. The table illustrates that in practice, problems were encountered with respect to the FE, BP, CA, and the SM views.

Standard analysis: potential vs. actual problems

The table below summarises the findings of the potential and actual problems with respect to the standard.

Based on the theoretical analysis, we expected potential problems with respect to the CA and the SM views, and we have identified the FE, BN, BP, BR views as points of attention. Based on the

analysis of actual problems, we found evidence that some of the problems indeed refer to the CA, SM, BP, and FE views.

Standard analysis: potential vs. actual problems						
	FE	BN	BP	BR	CA	SM
Potential	(#)(*)	(#)(*)	(#)(*)	(#)(*)	(X)	(X)
Actual	(X)	(-)	(X)	(-)	(X)	(X)
(X) -problem (-) -problems not identified at level 1 and level 2 (#) -not in scope (*) -point of attention						

Table 4.6 Standard analysis: potential vs. actual problems

4.1.3 Mismatch analysis

Potential problems identified using the mismatch analysis

The standard aims to cover the CA and the SM views, while the requirements address all six views. This means that the two views, which both the requirements and the standard have in common are the CA and the SM. We discuss these two views first and make remarks concerning the FE, BN, BP, and BR views as well.

CA view

As both the standard and the requirements explicitly address the CA view, we were unable to identify a mismatch at Level 1. Similarly, we did not identify major mismatches at level 2 either. In the requirements we did not find examples of messages that accommodate two communicative functions, but identified such examples in the standard. This links to problems identified in the requirements and the standard analysis. With respect to both, we identified potential problems related to the propositional content. In that respect, we may expect that on 2 (3,4) examples may be identified that point to differences between the standard and the requirements. This is a point of attention, though additional input and more detailed input will be needed from the requirements and the standard analysis to come to more definite statements.

SM view

During the requirements analysis and the standard analysis, we identified substantial problems both with the requirements and the standard at Levels 1 and 2. In that respect, we expect potential problems with the mismatch analysis as well. We identified examples of mismatches and consider further analysis of mismatches not very useful, before the problems with the requirements and the standard identified with the requirements and the standard analysis are not addressed.

Remarks concerning FE, BN, BP, and BR views

The FE, BN, BP, and BR views are not the focus of the standard itself. The standard states that it adopts procedures defined in the requirements documents and includes some contextual information based on the requirements documents.

With respect to the BP view, we noticed that the standard claims that it will adopt the procedures defined in the requirements. A closer look shows that the standard does not provide explicit reference to requirements documents from which it adopts the procedures. Although the standard claims that it adopts the procedures, it develops its own process models using its own modelling notation to present different business process scenarios. From this observation, a number of questions can occur. If the standard indeed adopts the processes and procedures defined in the requirements, why are the models specified in the requirements not directly adopted without modification? Also, if more detailed process scenarios were indeed necessary, why were they not developed in the requirements documents?

With respect to the BN and BR views, a similar remark is made in the standard that they are based on the specified requirements. Clear reference to requirements documents was missing. A systematic way of working, describing which rules to refer to in the standard and which to exclude, is also not available. This might cause issues, as the standard does not provide a systematic way in which to link to the requirements documents and systematically accommodate changes if needed.

With respect to the FE view, we do not have any remarks with respect to the mismatch analysis.

The table below summarises the results of the theoretical analysis type 1.3

Mismatch analysis: Potential problems					
FE	BN	BP	BR	CA	SM
(Δ#)(-)	(Δ#)(*)	(Δ#)(*)	(Δ#)(*)	(-)(*)(I)	(X)
Differences in scope, but potential problems are not expected	There may be differences between the business network described in the requirements and the one included in the standard	There seem to be differences between the BP in the standard and the requirements	Systematic way to link the business rules from the requirements to those in the standard is missing	No mismatch at level 1 and 2 identified. Possible mismatch at level 2(3,4) may occur due to the problems with CA view identified with the requirements and standard analysis. Additional input needed.	Both the requirements analysis and the standard analysis point to problems with SM view. In that respect, we expect also mismatches between the two. Examples of mismatches with respect to the concept of value are identified
(*) -point of attention (Δ#) -difference in scope (I) -additional input needed with respect to the requirements analysis and the standard analysis (-) -problems not identified at level 1 and level 2 (X) -problem					

Table 4.7 Mismatch analysis: potential problems

Actual problems related to the mismatch analysis

With respect to mismatches between the specified requirements and the standard, we found indications of actual problems related to the BP, BR, CA, and SM views.

BP view

From the interview we identified that problems occurred due to the fact that the standard was developed before the procedures were fully formalized; this led to problems due to differences in the final procedures and the procedures embedded in the standard. As one of the interviewee pointed out, *"Then the implementation guides were in place, and the procedures were not yet described. What happened was that the final description of the procedures differed from what was already published in the implementation guides.*" A further remark was that this led to reworks in the already implemented systems, which was costly.

BR view

We found evidence that there were differences between the business rules required by the situation and those embedded in the standard. As one of the interviewees explained: *"The problem is that the messages contain information about a month… One problem is that there are contracts where the grid*

operators has weekly contracts.…The current message has 1 maximum per month while the grid operator needs a maximum per week".

CA and SM view
We found an example of a problem which relates to both the CA and the SM views. For example, one of the interviewees explained, "*One big problem was that the message… had the assumption: if you have a connection point to the customer, there was the assumption that you could have only one. The assumption was that for each connection code there was only one meter. In practice there are situation that the customer has 2 meters. So you have two meters for one connection point. But it did not fit the message. The message has one identification, EAN code, it was the only identification put in the message. I think that message was the biggest problem".*

This points to a problem with the SM view: the conception of the domain with respect to the relationship between the connection and the meter embedded in the standard was not capable to fully capture the requirements of the DBT situation. Furthermore, this example indicates problems with respect to the CA view, especially the propositional content. Mainly, the message content, as specified in the standard, was not capable to accommodate fully the requirements of the DBT situation.

The results of the analysis of actual problems identified in the interviews are reflected in the table below.

Mismatch analysis: actual problems					
FE	BN	BP	BR	CA	SM
(-)	(-)	(X)	(X)	(X)	(X)
(X) - problem (-) -problems not identified at level 1 and level 2					

Table 4.8 Actual problems related to the mismatch analysis

Mismatch analysis: potential vs. actual problems
The table below summarises the results of the theoretical analysis of the potential problems and the analysis of actual problems with respect to analysis 1.3.

Mismatch analysis: potential vs. actual problems						
	FE	**BN**	**BP**	**BR**	**CA**	**SM**
Potential	(Δ#) (-)	(Δ#) (*)	(Δ#) (*)	(Δ#) (*)	(-)(*)(I)	(X)
Actual	(-)	(-)	(X)	(X)	(X)	(X)
(*) -point of attention (Δ#) -difference in scope (I) -additional input needed with respect to the requirements analysis and the standard analysis (-) -problems not identified at level 1 and level 2 (X) -problem						

Table 4.9 Mismatch analysis: potential vs. actual problems

From the table we can say that with respect to the BP and the BR view and CA view we identified points of attention and we found confirmation that problems related to these views have actually occurred in practice. With respect to the subject matter view, we identified potential problems based on the theoretical analysis and we have identified that problems related to this view have actually occurred in practice.

4.2 DBT analysis

In section 4.1 we discussed the potential and actual problems related to the fit analysis and the comparison between the two. Within this section, we will proceed with the DBT analysis.

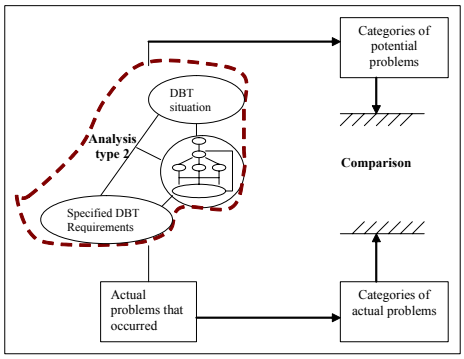

Figure 4.2 Analysis of potential and actual problems related to the DBT analysis and comparison between the two.

For each of the sub-analyses of the DBT analysis (context, formality, and completeness) we discuss the potential problems, the actual problems and the comparison between the two.

4.2.1 Context analysis

Potential problems identified using the context analysis

As discussed in the method, the context analysis aims to check the assumption whether a shared context has been established. It is hard to check this assumption on a purely analytical basis, as we did during the fit analysis when we studied the specified requirements and the standard. However, we think it is essential to question this assumption. To proceed with the analysis, we refer to a general potential problem type discussed in method. With respect to the shared context as described in the method, if the parties which take part in the to-be automated business communication did not establish a shared context, communication problems can be expected. In our case, for clarification purposes we limit the notion of context to the views defined in the system of concepts. We use the interview data to check whether problems have occurred in practice due to the lack of shared context.

Actual problems related to the context analysis

When we look at the energy case, we can say that there have been substantial efforts towards establishing such a shared context. The evidence is that the PVE was established. In PVE a wide range of representatives were included in different working groups and the requirements were openly discussed. The interview results show however, that problems with establishing such a shared context still occurred. Some of the interviewees suggested that the representatives working on establishing this shared context on a national level were not always able to communicate sufficiently the agreements back to the members of their own organizations. For example, one of the interviewees said: *"Usually the people who were busy with the liberalization within the company X and who had some problems, they communicated these problems to the representatives. However, the decisions and the solutions taken by PVE were not always communicated back"*. Furthermore, the new procedures were not well understood and not well communicated. As for example, one of the interviewee discussed *"A lot of things go wrong as new procedures are not understood well, not communicated"*.

Apart from that we found examples where problems occurred because there was not shared understanding concerning the subject matter. One such example is as follows: *"Concerning the gas, there are some boats on a corner. In one municipality they define the address of these boats in one way, in another municipality another. It is not regulated, so how to work?"*. We also found examples that there was not a shared understanding who are the actors in the network on an instance level. For example, for security reasons, keys are used in the message exchange and one of the interviewees pointed out: *"So now a new supplier is on this market, uses a new key and he has to send to all other members but he doesn't know where they are, who they are."*

Context analysis: potential vs. actual problems
In section 4.2.1 we referred to the general problem type addressed in the method that communication failures would occur if there is not an established shared context (where context is limited to the views defined in the system of concepts), between the parties involved in the to-be automated business communication. In the section above we discussed that although efforts to establish a shared context were undertaken, they remained limited. As a result, problems occurred due to the lack of shared understanding. This observation suggests that in this case we have found examples which confirm our expectations.

It is important to bring the discussion further. The context analysis presented in this thesis stays at a very general level. The context analysis, however, seems to open interesting opportunities for further research. Some insights during the analysis of the actual problems are that it would be interesting to study the different levels at which a shared context would need to be established (as we have observed in the energy case, although attempts to develop a shared context at national level were undertaken, they were not sufficient, as this context was not sufficiently shared with the members of the individual organizations, which needed to implement this context). Once different levels where a shared context needs to be established are identified, a further study can focus on what kind of mechanisms are needed to facilitate the establishment of the shared context at the different levels.

4.2.2 Formality analysis

Potential problems identified using the formality analysis
The formality analysis aims to check the assumption whether the requirements were made explicit and formal, before operational. In this case, similar to the context analysis, it is hard to check this assumption on a purely analytical basis and that is why we formulate again a general type of potential problems. With respect to the formality analysis as discussed in the method, if the requirements are not made explicit and formal before being operationalized, and implemented in the computer system, potential problems can be expected. This type of analysis aims to point to potential problems with respect the time relationship between requirements formalization and implementation.

Based on the document study, we found out that some of the documents describing formal requirements have occurred late in the process. Based on the interview data, we found also confirmation that implementation was done without having the formal requirements ready. In that respect, we expect potential problems with respect to the formality analysis.

Actual problems related to the formality analysis
Some of the major problems identified during the interviews were problems related to the process of working. A general problem that was constantly mentioned during the interviews was that the requirements were not ready when people started building the systems. Apart from that, often requirements were presented at high-levels, without being precise and formal. As one of the interviewees pointed out: "… *everybody knew that you need time to implement the system. And the mistake was that everybody thought that ok, the final description of the procedure we can do it later. Then everybody forgot that you if take your procedures seriously it has consequences for what has already been implemented or what was being implemented in systems and that it will cost a lot of money if you start changing systems".*

The standards were developed based on these high-level procedures. Although the procedures were clear at a high level, when they had to be translated to messages, it turned out that some parts of the procedures were not sufficiently specified and not formal enough. The lack of formality left room for interpretation for technical people. As the business people were not able to accommodate and react to all the issues raised by technical people, it was left up to the

technical staff to make decisions about the requirements and to continue with the implementation. For instance, one of the interviewees shared: *"At the beginning we only tried to give some structure to the market and we tried to do that by laying out in the codes the general rules. But not yet the details. And at that moment it was absolutely necessary to start building the IT systems, so the experts in the IT systems have made a lot of decisions concerning the details in the codes, so much decisions that we were not able to cover them all at a management level, and to check them and to double check them. The feedback that the IT people gave us, we did not have enough time to look at the specifications that they gave us and they decided for themselves because this had to go on, so now we have a system that makes a lot of mistakes".*

The procedures were formally defined after some of the systems were already implemented. The description above clearly indicates that systems were built without having complete and formal requirements. The complete and formal requirements were created after many of the systems were in place. As a result, systems needed to be changed, which cost a lot of money. Another example was the development of the Reference model, which provides a formal model of the procedures. This model became publicly available way after the systems were implemented.

Formality analysis: potential vs. actual problems
Based on the discussion above we can say that some of the problems encountered in practice concur with our expectations, based on the formality analysis.

4.2.3 Completeness analysis

Potential problems identified using the completeness analysis
As discussed in the method, the completeness analysis aims to check whether some obvious requirements of the DBT situation are missing in the specified requirements. To do that, one can choose a view and walk through the other views to check whether there are some requirements missing.

If we run such checks we can easily identify that the requirements documents are not complete from the point of view of a focal exchange. This was of no surprise, as in the requirements documents it was explicitly mentioned that completeness with respect of the focal exchange between the customer and supplier is not within the scope of the project.
For example, in the case of switching, the requirements documents aim to specify the minimum required information and processes which would allow a customer to switch from one supplier to another. The economic exchange that takes place between the customer and the supplier, the business network that supports it, the business processes, business rules, business conversation and subject matter, are addressed in the requirements only to a limited extent, as long as they have a direct relationship to switching.

To have a smoothly running transaction (in terms of both the flow of good/service to the customer and the flow of compensation), we need complete information. Conversely, in the requirements documents developed by the PVE, an explicit choice was made to strive for the minimum information and to leave it to the individual parties to define and maintain additional information needed to run their own processes. These minimum requirements are also embedded in the standards developed. This can be seen as justifiable decision, though from here several questions arise.

To have a smoothly running transaction, it is necessary that the related processes and information needs are taken into account. If this is out of the scope of the PVE requirements, who is going to take care of that? One easy answer could be that the supplier will take care of these processes. The problem is that the supplier's processes depend on the actors in the business network to execute its processes. The standards reflect the minimum information requirements. However,

for some of the processes related to the focal exchange, the information embedded in the standard might not be sufficient for the smoothly running processes. An interesting development is the development of the ECH standard. The ECH standard is richer in content than the EDINE standard. The ECH standard was created due to the demands of the major energy companies and this development can be seen as an indicator that to be able to carry out the business processes as a whole (not only the part related to switching), more information is required.

It is not our task within this thesis to suggest which is the best way to go, as there can be different forces and priorities influencing a decision. We do consider some potential problems can be expected due to the very limited scope of the PVE requirements and the EDINE standard respectively.

Actual problems related to the completeness analysis
Some interesting developments occurred a few months after the liberalization of the retail market. Due to the large number of customer complaints that the bills were sent too late, the Dte issued a policy document stating that the suppliers must send a bill within a maximum of 8 weeks from the moment of switching (Dte introduced business rules concerning the customer-supplier relationship). Although the customer supplier relationship related to billing and collection of payments was explicitly left out from the requirements concerning the liberalization, these requirements had to be revisited after the large number of problems that have occurred.

Apart from that, based on the analysis of the interviews, we found that in practice problems have occurred due to the incomplete requirements. According to the interviewees, the requirements were not complete at the level of detail needed for the automated communication. For example, one of the interviewees remarked: *"When we tried to implement the processes we did not have the answers to specific cases. In some processes we did not have the level of detail that was needed. That caused difficulties…The model of liberalization is very complicated. The model is difficult to implement. It is not complete at a level of detail to be implemented for automated support"*. Some requirements were discovered at a later stage, and then they were introduced in the message specifications. This meant reworks of already existing applications.

Apart from that, we have identified cases, where the standard, derived based on the specified requirements, was not able to support some required real world requirements and did not capture necessary messages for communication. Procedures for developing new messages were in place, but it took time to develop new messages. As one of the interviewees remarked: *"…and always something is overlooked, so you need a new message, but to put it in the procedure and the codes…, it has been arranged, but it takes time"*.

These examples point out incompleteness of the specified requirements. Within the case of the energy liberalization, the requirements and the standard were developed together, and the standard is based on the specified requirements. During the development of the requirements, an explicit decision was made to limit the scope of the requirements, and the processes between the customer and the supplier were considered only to the extent to support the switching and moving. This was reflected in a standard with a limited scope. We have identified that in practice problems have occurred due to the limited scope of the standard, and as the standard is derived from the requirements, we can say that problems have occurred due to the limited scope (or the incompleteness) of the requirements.

Completeness analysis: potential vs. actual problems
Based on theoretical completeness analysis, we have expressed our concerns that problems might occur due to the limited scope of the requirements. Based on the analysis of the actual problems that have occurred we have identified examples, where the specified requirements had indeed turned out to be too limited and had to be revisited.

4.2.4 DBT analysis: Potential vs. actual problems

The table below summarises the results from the theoretical DBT analysis and the analysis of the actual problems encountered in practice with respect to this analysis.

DBT analysis: potential vs. actual problems			
	Context analysis	Formality analysis	Completeness analysis
Potential	General potential problem type (X)	General potential problem type (X)	(X)
Actual	(X)	(X)	(X)
(X)- problem			

Table 4.10 DBT analysis: potential vs. actual problems

The major conclusions from the DBT analysis is that we have found evidence from practice, which confirms the general potential problems formulated with respect to the context analysis and the formality analysis. With respect to the completeness analysis, we have foreseen potential problems and identified evidence that such problems have occurred in practice.

4.3 Impact analysis

With respect to the impact analysis, similar to the fit and the DBT analysis, we proceed as illustrated in the figure below. We will analyse the potential and the actual problems related to this type of analysis and compare the two.

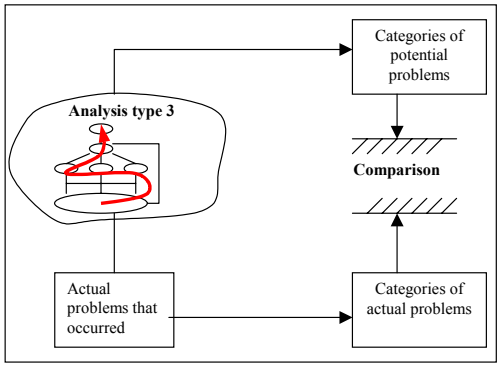

Figure 4.3 Analysis of potential and actual problems related to the impact analysis and comparison between the two

4.3.1 Potential problems identified using the impact analysis

During the fit analysis, we identified potential problems with both the requirements and the standard with respect to the subject matter view. A problem with the subject matter view suggests that there will be problems concerning the understanding of the meaning of the communicated information. This can lead to difficulties in understanding the communicated information, or misinterpretation of the information. In this case, the messages will either need to be handled manually, which can cause delays in case a large number of messages contain mistakes, or will lead to processing messages with wrong information. Ultimately, this can affect the customer, as either due to the long processing time the switch will take a long time to complete or there can be mistakes, which affect the delivery of energy or billing and payments.

We can follow similar reasoning with respect to the CA view. If the content of the message and the intention behind the message is not clear, it will either be handled manually or processed and

interpreted in a wrong way. As a result, it will either take a long time to process (in case of a manual processing and large volumes), or based on the wrong interpretation, wrong rules will be applied (BR view) and wrong actions can be taken (BP view). The ultimate effect on the focal exchange can be traced to problems either with the delivery of energy, or problems with billing and payment.

We can apply similar reasoning based on the DBT analysis. We identified potential problems due to the lack of a shared context, lack of complete requirements, or implementation done before the complete requirements are available. If there is lack of shared context, we can expect misinterpretations with respect to some the views. Every misinterpretation can be seen as a sign that problems with the focal exchange can be expected. In case a system is built before the explicit and formal requirements are available, this hides the danger that the context embedded in the system is different than the business context in which the system is supposed to operate. In that respect, we can ultimately expect that the result would be technical, rather than inter-organizational interoperability. If this is the case, problems with the execution of the focal exchange may be expected. Last but not least, if some essential real world requirements were not captured in the specified requirements, the result will be a computer system not properly embedded in the business context in which it operates. We can again argue, that it can be expected that that will ultimately have an effect on the focal exchange.
Based on the potential problems identified in analyses 1 and 2, we expect potential problems with the focal exchange in either the flow of energy or the billing and payment.

4.3.2 Actual problems that link to the impact analysis

The actual problems with respect to analysis type 3 are those problems encountered in practice, which refer directly to the execution of the focal exchange. One major issue that was encountered was delay. As one of the interviewee said, *"The main issues is delay, caused by content of messages: the values are not correct. Mainly ICT problems, you have existing systems, which are changed only to meet deadlines".*

Based on the interviews we found that other major problems occurred with respect to billing. Examples of problems are that the customers got no bill, the bill was half a year late, or the bill was inaccurate. The customers were disappointed and wanted to go back to their old supplier, because the new one was not able to switch. As one of the interviewees pointed out: *"It took weeks to get some of the messages out of the water, but still some hundreds of messages are not discovered where they are. Of course they are not totally lost, but in this way it takes weeks, month to come to a real switch and all that time the customer receives two bills- one from the old and one of the new supplier or none- no bill at all and in this situation they are very satisfied but in the first situation they have a lot of complaints and they want to go back to the old supplier, because the new supplier was not able to switch".*

The problems with billing were very serious. They first occurred after the second phase of the liberalization. As a result, the Ministry postponed the third phase. The same problem escalated in the media half a year after the third phase of the liberalization. The Ministry set another deadline to the energy companies to fix the problems with billing.

Another major impact was the large costs related to the changes to already implemented systems. Often these costs had to be covered by the energy companies. As for example, one of the interviewees discussed: *"Then you see the problem, it is nice to put something on paper, but it is not so easy to change an implemented system that costs a lot of money… Because of time pressure and everybody knew that you need time to implement the system. And the mistake was that everybody thought that ok, the final description of the procedure we can do it later. Then everybody forgot that you if take your procedures seriously it has consequences for what has already been implemented. Or what was being implemented in systems and that it will cost a lot of money if you start changing systems".*

4.3.3 Impact analysis: potential vs. actual problems

Based on the potential problems identified during analysis type 1 and analysis type 2, by performing analysis type 3, potential problems with the execution of the focal exchange with either the delivery of electricity or the billing and payment can be expected. From the analysis of actual problems, we found major problems with respect to billing. We did not identify problems with respect to delivery of energy. The fact that we did not identify problems with delivery perhaps can be explained that one of the highest priorities during the energy liberalization was to ensure that there is no problem with the flow of electricity. In fact, the energy liberalization did not bring any changes to the physical system. The changes were mainly to the administrative processes and related information exchanges.

Apart from the problems directly related to the execution of the business transaction, which are related to the quality of the project outcome, in the analysis of the actual problems we identified issues, which also relate to project execution itself, mainly the high costs of implementation.

5. Reflection and conclusions

5.1 Reflection concerning the use of the system of concepts and the method in a post-hoc manner

The goal of this chapter was to check the feasibility of the system of concepts and the method by applying it to a real life case. We selected a project approaching its end. With respect to this project, we performed a theoretical analysis using the system of concepts and the method and we identified potential problems based on that. We analysed actual problems that occurred in practice and compared the potential with the actual problems.

Our main conclusion from this feasibility test that we performed with energy liberalizations is that the system of concepts and the method provide a systematic way of reasoning about the DBT situation and the standard. We found evidence that some of the types of potential problems identified analytically, actually occurred in practice. In that respect, the system of concepts and the method have the potential to help in the analysis of the DBT situation and the standard and identify potential problems.

5.2 The possible impact of the system of concepts and the method if not used in a post-hoc manner

In this case study, the system of concepts and the method were used in a post-hoc manner. The purpose was to be able to gain first insights about the applicability of the system of concepts and the method to identify problems in real-life projects by comparing the potential problems identified theoretically and the actual problems that have occurred in practice.

The intended use of the system of concepts and the method in practice, however, is for early problem identification in standard implementation projects. Within this case study, using the system of concepts and the method, we have identified a number of potential problems, the more obvious problems being as follows. Both with respect to the requirements analysis and the standard analysis, we identified potential problems related to the CA view and the SM views. With respect to the mismatch analysis, we identified potential problems with the SM view. Furthermore, we have identified potential problems with respect to the context, formality, and completeness analysis. We also identified points of attention with respect to the requirements analysis and the standard analysis, as well as points of attention and differences in scope with respect to the mismatch analysis. We found evidence that some of the types of potential problems

identified using the system of concepts and the method actually occurred in practice. Had we used the system of concepts and the method, and pointed out to these potential problems as early stages, this may have led to awareness. By being aware of the problem, managers may have decided to follow different approaches to tackle the problem.

There may have been different ways to go. With respect to the problems related to the CA view identified with the standard analysis, one possible way to tackle this problem is to develop operational message specifications, rather than rely on the users of the standards to interpret the rules. Furthermore, the messages could have been designed in a way which unambiguously links the content of the message with the intention behind it. A more systematic way of working during the standard development could have allowed clear linkages with the procedures defined in the requirements documents, which may have kept the standard simpler and easier to use. With respect to the SM, one way to reduce the possibility for misinterpretations is to create explicit models of the domain. Regarding problems related to the lack of shared context, additional measures could have been taken to identify the levels at which such context needs to be created and how to provide the smooth transition between these levels. With respect to the problems related to the formality analysis, one option could have been to try to postpone the system implementation until the requirements were made explicit and formal. Another could have been to allocate extra resources in order to complete the formalization of the requirements on time.

We will not go into all possible scenarios what ways could have been followed to prevent the problems to occur. It is clear that the process of liberalization of the energy market was constantly under pressure of fixed deadlines. Awareness about the possible consequences of the potential problems may have provided strong arguments in negotiating realistic deadlines with government officials. When we look back at what has happened with the energy liberalization due to the numerous problems that have occurred, the fixed deadlines were at the end not really fixed, as they were shifted several times. It seems that it would have been possible to use some extra time to thoroughly consider the potential problems and their possible impact related to system implementation. This was often not done. Under the pressure of deadlines, people often preferred to react to problems rather than prevent them from happening, the result being numerous changes in the systems which ultimately turned up to be very costly for the energy companies. Further, there were numerous problems with handling of the switching processes, and this lead to angry customers.

5.3 Final remarks

Conducting this case study has been an important first step in gaining insights about the feasibility of the system of concepts and the method in practice. The system of concepts and the method provide a systematic way to reason about the DBT situation, the specified requirements, and the chosen standard and have the potential to identify problems. Furthermore, early problem identification is important for practice, as it can make managers aware of potential problems, which would allow them to reflect on possible ways to prevent such problems. This can have significant impact on the project performance and the project outcome.

It is out of the scope of this thesis to study the question of how well and efficient the system of concepts and the method work in analysing the DBT situation and the standard in identifying potential problems. This question is very important and needs to be addressed in further research, where a thorough empirical testing of the system of concepts and the method is performed.

Part V. Conclusions

Chapter 1. Conclusions and further research

1. Introduction

A number of developments, which can be generally grouped in two categories, inspired the research presented in this thesis: developments in practice and research. Although for analytical purposes we discuss these two categories separately, they are closely inter-related and influence each other.

The first development in practice influential for this research is the internal and external drivers influencing companies to integrate with their external partners and automate parts of their business transactions. Second is the emergence of new technologies, including the Internet, providing the grounds for cheap connectivity. Third is the emergence of numerous business-to-business standards, promoted on the market as solutions to business interoperability problems. Finally, failures in standard implementation projects often due to the technical view on standard implementation also inspired this research.

Apart from developments in practice, we found motivation in some research developments as well. When reviewing standards literature, we found most of the research focuses on standard development and standard adoption. At the same time we found a lack of research on standard implementation, the stage when a standard is introduced in a specific situation. Although in practice the number of new standards constantly increases, there is little understanding in the research community about effectively ordering the world of standards, evaluating the characteristics of a given standard or comparing these characteristics to the requirements of the specific situation. One final inspiration was the domain of requirement engineering, which argues for early problem identification, to prevent problems identified in later project stages that can lead to delays, increases in costs, and even project failures.

Combining inspirations from research and practice leads us to another observation. Companies want to use standards and new technology to automate parts of their business transactions in order to gain competitive advantage and become more efficient on the market. Standards and technology are means, not ends, to achieve these goals. In this respect, investments in standard implementation projects, which fail to deliver the desired result on time and within budget, are undesirable.

Often companies have little control over the choice of standard. External drivers might dictate the choice of standard and companies must adopt a given standard, in order to stay in business. Early identification of potential problems due to mismatches between the requirements of the specific situation and the characteristics of the standard will allow companies to act proactively, rather than reactively, which may ultimately result in shorter implementation time, lower implementation costs, and better fit between the requirements and the resulting solution.

Following such a line of reasoning, we formulated the research problem addressed in this thesis:
*How to identify, at an **early** stage of a standard implementation project, potential problems with the execution of a business transaction that can occur when deploying a standard in a specific DBT situation?*

2. Results and contributions

To address the research problem in this thesis, we formulated three major research questions. Each of the research questions and the related contribution will be discussed separately in sections 2.1, 2.2, and 2.3.

2.1 Results and contribution concerning the system of concepts

The first research question was formulated as follows: What should a system of concepts consist of in order to:

- help in analysing the DBT situation, the specified requirements of the DBT situation, and the chosen standard
- help in analyzing possible mismatches between the specified DBT requirements and the chosen standard, and between the DBT situation and the specified DBT requirements
- identify potential problems with the execution of a business transaction, based on the above analyses

The core issue related to research question one was the construction of the system of concepts. To construct the system of concepts, we followed a predominantly theoretical approach, including practical insights from the healthcare domain. We developed the system of concepts in three phases.

During the first phase, "exploration", we explored theories on business transaction and business communication and decided to follow a multi-disciplinary approach in the construction of the system of concepts.

During the second phase, "focus", we constructed a high-level system of concepts consisting of six views and the relationships between them. The six views are as follows: focal exchange view, business network view, business process view, business rule view, communicative act view, and subject matter view, each briefly highlighted below.

The focal exchange view addresses the focal economic exchange under analysis, abstracting from this how such an exchange is actually achieved. The focal exchange view plays a role as a starting point for deriving the context of a business transaction. Furthermore, via this view the ultimate effects of potential problems that may be detected with the other views become visible.
The idea behind the business network view is that a focal exchange does not exist in isolation, but is embedded in a network context. This network context may include intermediary exchanges, needed for the execution of the focal exchange, as well as related exchanges indirectly influencing the focal exchange. Derivation of the business network is based on the focal exchange, with

various focal exchanges resulting in a different business network. The business network view outlines the different organizational contexts involved in the business transaction. The identification of the different organizational contexts is important, especially when it comes to communication and the interpretation of the communicated information.

While the business network view provides a high-level view of the actors that participate or may influence the execution of the focal exchange, the business process view addresses the activities and sequence of activities necessary for the delivery of the good/service from the supplier to the customer and compensation in the opposite direction.

The business rule view focuses explicitly on the allowed repertoire of behaviour of actors involved in the transaction. It defines the conditions under which the actors are allowed, obliged, or forbidden to do something. The business rule view is related to the business process view, the difference being that while the business process view focuses on the progress of the activities to achieve the desired goal, the business rule view focuses on understanding the responsibilities of the actors.

The communicative act view focuses on the business conversation that takes place with respect to the business transaction. The communicative act view addresses the intentions behind the communicated information. The communicative act view is closely related to the business process view, as communicative actions are inherent part of the business process. The difference between the communicative act view and the business process view is that while the communicative act view focuses on business conversations and communicative acts, the business process view relates more to how to achieve certain organizational goals, combining and streamlining communicative and substantive actions and the required resources to carry out these actions. The communicative act view also relates closely to the business rule view. While the communicative act carries the intention behind the communicated information, the business rule view defines how the interpreter should behave.

The subject matter view is a fundamental view in business communication. It defines as a prerequisite that in order to communicate, the companies must understand the meaning of the information they exchange. This means establishing a shared understanding about the domain of interest with respect to the business transaction, the conception, and the representation of the domain. The subject matter view relates to the other views, as other views provide the input to define the domain of interest with respect to the business transaction.

The six views and the relationships between them, as briefly discussed above, provide the basis of the high-level system of concepts, the research result of the "focus phase".

During the third phase, called "choice", we arrive at the detailed system of concepts, by further elaborating each of the views in terms of key concepts. We will not elaborate on the concepts within the views, as we consider it too detailed.

As a result of the "exploration", "focus" and "choice" phases in part 2, we arrive at a high-level and a detailed system of concepts, our contribution with respect to the first research question. The constructed system of concepts alone is not sufficient to assist with early problem identification. This requires a method to describe how the system of concepts can be applied in practice to facilitate early problem identification, the subject of the second research question.

2.2 Results and contribution with respect to the method

Research question two, formulated as follows, focuses on method construction. What should a method of how to apply the system of concepts consist of in order to:

- help in analyzing the DBT situation, the specified requirements of the DBT situation, and the chosen standard
- help in analyzing possible mismatches between the specified DBT requirements and the chosen standard, and between the DBT situation and the specified DBT requirements
- identify potential problems with the execution of a business transaction, based on the above analyses

The results achieved with respect to research question two are as follows. First we defined the components of the method: a system of concepts, types of analysis, level of analysis, questions, and ways of working. Second we provided illustration and insights regarding how these components can work together and allow for different analysis.

The constructed method consists of five major components. The first component is the system of concepts constructed in Part 2. As discussed in section 2.1 of this chapter, the high-level system of concepts consists of six views and the relationships between them while the further elaboration of each view in terms of concepts constitutes the detailed system of concepts.

The second component of the system of concepts is what we call "types of analysis". We defined three major types of analyses, which will be summarized below.

Analysis type 1, fit analysis, deals with the analysis of the specified DBT requirements and the chosen standard. Fit analysis divides into three sub-analyses. Analysis type 1.1, requirements analysis, seeks to identify problems within the specified DBT requirements and checks which concepts from the system of concepts are covered in the requirements. Analysis type 1.2, standard analysis, is an analysis of the chosen standard. It aims to find problems within the standard itself and checks which concepts from the system of concepts are covered in the standard. Analysis type 1.3, mismatch analysis, aims to identify mismatches between the specified requirements and the chosen standard in terms of views and concepts.

Analysis type 2, DBT analysis, focuses on the specified DBT requirements and the DBT situation. Analysis type 2.1, context analysis, relates to the DBT situation and questions the assumption that the parties in the DBT situation have created a shared context. Analysis type 2.2, formality analysis, questions whether the specified DBT requirements capture in an explicit and formal way the DBT situation requirements before they are implemented in the computer systems. Analysis type 2.3, completeness analysis, questions the completeness of the specified DBT requirements with respect to the DBT situation requirements.

Finally, analysis type 3, impact analysis, traces the possible consequences of potential problems identified through type 1 or 2 analysis on the execution of the business transaction.

The third component of the method is called "levels of analysis". We defined four levels of analysis: Level 1 (view level), Level 2 (concept level), Level 3 (entity type level), and Level 4 (instance level). This allows moving from very abstract and domain-independent analysis, addressed at view and concept levels, to analysis of concrete models and instances of these models with the latter two levels. As the method is intended for a quick scan analysis, we focused on Level 1 and 2 analyses. To enable capturing examples of problems related to Levels 3 and 4, we introduced a Level 2 (3, 4) analysis. The value added by Level 2 (3, 4) analysis is that if during

the analysis examples of problems are identified at levels 3 and 4, these problems are formulated and reported in terms of Level 2.

The fourth component of the method is called "question". The goal of this component is to indicate the use of questions as a mechanism to guide the analysis. The operationalization of this component is limited to a number of examples. Rather than generating a complete list of possible questions, an immense task, we provide guidelines to generate questions.

The last component of the method is called "way of working" and it forms the other components of the method into a step-by-step process. Steps one through three include making a selection concerning the type of analysis, the level of analysis, and the relevant parts of the system of concepts. Step four involves defining questions with respect to the selected type of analysis and level of analysis, using the system of concepts. Step five concerns actually conducting of the analysis.

In addition to method components, in Part 3 we provide illustration of how these components can be integrated to perform the different types of analyses.

To summarize, with respect to research question one we constructed a system of concepts, while in answer to research question two we proposed a method of how to apply this system of concepts in practice in order to identify potential problems in early stages of standard implementation projects. For the construction of the system of concepts and the method we used a predominantly theoretical approach and logical reasoning. In addition we used empirical materials from the healthcare domain for inspiration and as examples.

By addressing research questions one and two we arrive at a system of concepts and a method, which were intended to be used for early problem identification. However, we still lack insight regarding whether the system of concepts and the method have the potential to deliver the intended results. It is not clear that using the system of concepts and the method will allow one to analyze the DBT situation, the specified requirements, and the standard as well as identify potential problems. Within the scope of this study it was not feasible to conduct a thorough testing of the system of concepts and the method, yet we consider it extremely important to achieve first insights about the potential to produce intended results. These first insights are the focus of research question three.

2.3 Results and contribution with respect to applicability

Research question three focuses on first insights concerning the potential of the system of concepts and the method as applied in practice and in identifying potential problems. Research question three specifically states: Can the system of concepts and the method be applied in practice and if so, do they bring any meaningful results?

To answer this research question, we conducted a case study in the energy market, selecting a project approaching its end. We applied both the system of concepts and the method, analytically identifying a number of potential problems through this analysis. In addition we selected empirical evidence concerning the types of problems actually encountered in practice during the project. As a final analysis, we compared the potential problems with the actual problems.

The case study produced several conclusions. First it was possible to take real-life requirements documents and standard specifications and, using the system of concept and the method, to systematically understand the elements covered by each document. This in itself is an interesting

result. As argued in section one of this chapter, there was a lack of a mechanism to help reasoning about the requirements of a given situation and the characteristics of a chosen standard. This case study illustrates that the system of concepts and the method provide common ground to analyze and to reason about both the specified requirements and the chose standard.

Our second conclusion is that by applying the system of concepts and the method, we were indeed able to identify categories of potential problems, some of which were actually encountered during the project execution.

We conducted the case study and the analysis of potential problems in a post-hoc manner, however the intended use of the system of concepts and the method is for problem identification at early stages of standard implementation projects. Had this not been a post-hoc analysis but an analysis at early stages of a real project, the potential problems identified may have had an impact on project execution. As discussed in Part 4 Chapter 1, section 5.2, major reworks and related costs for energy companies could have been prevented, had the recommendations based on our case analysis been followed before implementation of the systems.

As a result, the case illustrates that the system of concepts and the method can be used in a real-life situation to reason about the requirements of the DBT situation and the characteristics of the standard. Furthermore, we have found indications that the system of concepts and the method have the potential to identify potential problems. In this respect, we find that the system of concepts and the method have the potential to achieve their intended results.

3. Reflection on the research process and limitations of the research

Research is the exploration of unknown lands. As explorers, we inevitably reach crossroads requiring a decision about which direction to take. At each crossroad we must make decisions, sometimes logical, at other times based on intuition. Only at the end of our journey we can look back and reflect on the choices made.

3.1 Reflection concerning the construction of the system of concepts

3.1.1 Mono vs. multi-disciplinary research

One of the most challenging parts of this research was the construction of the system of concepts. A major difficulty was the lack of prior research, which required searching for inspiration in other research communities rather than within the research community on standards. During the exploration of possible research areas we realized that there are different ways to address the problem, necessitating a decision about how to proceed. We identified two potential roads to follow, that of a mono or multi-disciplinary approach. In Part 2 we discussed the pros and cons of these approaches, so we will not repeat the argumentation. We ultimately decided to follow a multi-disciplinary approach, as we found it more important to get a grasp of the complexity of the problem by using multiple perspectives, rather than to simplify and solve the problem from a certain perspective.

This choice represents a conscious decision to immediately imposed limitations on the research. We understand that mono-disciplinary experts have a much better grasp on the problem from their specific perspective, and that we will not be able to contribute to an individual field. We argue that these limitations should not be seen as disadvantages. The goal of this research is to provide a mechanism for a quick scan and early problem identification, and for that purpose we consider a multi-disciplinary approach more appropriate. Once the types of problems are identified, it is appropriate to deploy a mono-disciplinary team of experts to study the potential

problem in full detail and propose possible solutions. Then, the proposed possible solutions should be brought back to the multi-disciplinary level where possible inconsistencies and conflicts between the solutions, proposed by the mono-disciplinary teams may be detected.

3.1.2 The choice of views

Within this thesis we identified six views, which became the basis for the system of concepts. These views logically complement each other and allow moving from abstract to detailed analysis when moving from the focal exchange view towards the subject matter view. As the system of concepts has not been thoroughly tested, it is difficult to say if all six views benefit the analysis. May some views be skipped? or is another important view missing? This may be approached as follow-up research and will be addressed in the section "directions for further research".

3.1.3 The elaboration of the views

When constructing the detailed system of concepts, for each view, we provided further elaboration in terms of concepts. These concepts provide a finer mechanism to detect a potential problem with respect to a specific view.

From the theories addressing specific views, we derived a number of concepts, which became part of the elaborated view. One problem encountered was deciding which concepts to or to not include in the system of concepts. This difficulty relates to the discussion of multi and mono-disciplinary research. We preferred to include a set of minimum and sufficient concepts for each view. However, it is not always easy to define which concepts are minimum and sufficient and which are more specific. Including too many concepts hid the danger that we would enter the area and level of detail where a mono-disciplinary expert was needed. This means deviation from our goal to provide a mechanism for a quick scan identification of problem areas. Although we made an effort to identify these boundaries, we concluded that at this stage of the research we are unable to give a clear-cut answer about the boundary within which the minimum and sufficient concepts lie. In this respect, the current detailed system of concepts includes a preliminary set of concepts. After a thorough testing of the system of concepts one might be able to better assess the location of the inclusion/exclusion boundary. We return to this issue in the section "Further research".

3.1.4 The elaboration of the subject matter and the business process view

Elaboration of the subject matter and business process posed a challenge, as they addressed complicated issues, and these views required a significant level of detail, precision, and formality. To elaborate these two views we use ontologies, making the decision to derive concepts from two different ontologies, i.e. the BWW ontology for the subject matter view and the FRISCO ontology for the business process view.

We used two different ontologies due to personal preferences; we found the FRISCO ontology has concepts that more intuitively capture key business process concepts, while the BWW ontology appears to more intuitively capture concepts that help to describe the subject matter view. Furthermore, we did not consider important using one ontology, as each ontology is used to address a separate view.

3.2 Reflection concerning the method

With respect to the method, we identified key components and described how these components can be combined to facilitate analysis. In this thesis we defined the basic components in the method and explained the reasoning behind them. Although we provided illustration in Parts 3 and 4 of how the method can be further operationalized, the full operationalization of the method including all possible questions derived based on the key components, was outside of the

scope of this research. Full operationalization is possible, and will be necessary before constructing a commercial product based on the method (see the discussion on possible use in commercial products below). Within this thesis we did not address the efficiency of analysis using the method and how this efficiency can be improved. We also did not address the issue of the method's usability. These may provide interesting areas for further research (see the section "Directions for further research").

3.3 Reflection concerning the case study

Gaining first insights concerning the feasibility of the system of concepts and the method in practice became a challenging task. We sought a project aiming to automate the complex communication between different organizations. As we studied a process crossing multiple organizations, we needed to include several different organizations involved in the same process. It was not especially difficult to convince a given organization to participate in the study. However, the organization then had to make extra efforts to convince its external partners to participate in the case, an extremely difficult task. A faltering economy at the time we searched for a case worsened this situation, as many of the contacted companies were understaffed and personnel were working very hard to maintain daily operations. Therefore companies, which in more positive economic situations would gladly cooperate with researchers, at that time did not have the extra time and energy to commit.

One interesting conclusion derived from our experience is this: when conducting qualitative research with respect to inter-organizational business processes, one needs to be aware that it is not sufficient to have the commitment of one decision maker from one organization. In fact, extra efforts are needed to obtain the commitment of decision makers from partner organizations.

One major difficulty encountered during the energy case project was a politically charged atmosphere. The different market parties were required to cooperate, and often participated in groups working together since they were part of the same processes and needed to make sure that everything ran according to plan. In this process, a failure occurring with one of the partners affects the whole process. While the various parties needed to cooperate in setting up processes and different tests, they were also competitors in the market. Sometimes, it was extremely difficult to encourage the interviewees to reveal many of the problems actually experienced in practice, as they feared this would influence the company's image. This led to a situation featuring limited access to information. The information from empirical research was sufficient to pinpoint major problems encountered in practice and to gain first insights concerning the feasibility of the system of concepts and the method. We acknowledge that it would have been preferable to work with unrestricted access to information, which could have led to other interesting findings.

In this case study we selected a number of documents, which we used as a basis to carry out analysis type 1. We chose documents that seemed to specify a shared context on a national level and to contain sufficient detail, allowing illustration of the use of the system of concepts and the method. Similar analysis can be performed on additional documents, however we argue that repeating the same analysis on another set of documents will not add to the discussion.

One document, which seemed interesting but that we have deliberately excluded from the analysis was the "Reference model". The reference model is a formal model of the procedures of PVE plus other requirements, which came from participants in the energy market. We did not include this document in the analysis because it was created and made publicly available at a late stage of the project, when most of the systems were already in place. From interviews it became clear that

while people have seen this document and were aware of it, they did not use it during system implementation, as it was not available at that time. Another document that we did not include in our analysis was the standard created by the clearinghouse (the ECH standard). The steps to analyze this standard would be the same steps used for the analysis of the EDINE standard, and in that respect we saw little value in repeating the same steps for the ECH standard.

Wherever possible, we triangulated the results by finding evidence from different interviewees substantiating the same findings. To address the issue of personal bias, we created an explicit way of working which allowed external reviewers to see and evaluate our interpretation of the empirical findings. The findings in this case remain case-specific and need not be generalized beyond it. Further empirical research is needed to produce generalized conclusions.

4. Contribution to research

At the beginning of this thesis we pointed out that the efforts of the research community on standards are mainly focussed around the standard development and standard adoption. However, as argued by Quantz & Wichmann (2003) and Söderström (2004), little research exists concerning standard implementation, the process of introducing a standard into a specific business situation. In that respect, we consider that with this research, we bring our contribution to the research community on standards by providing insights concerning the stage of standard implementation. We consider that one of our contributions with respect to the standard implementation stage is that we emphasized the importance of achieving inter-organizational, rather than technical, interoperability. The major problem that we address is the early identification of potential problems in standard implementation projects.

To address this problem, we follow a multi-disciplinary approach and construct a system of concepts and a method. Furthermore, we provide first insights about the applicability of the system of concepts and the method in practice. We find that the system of concepts and the method can help to systematically reason about the requirements of the DBT situation, the characteristics of a chosen standard and have the potential to facilitate early problem identification. In that respect, the system of concepts and the method can be seen as a step towards better understanding the notion of interoperability and identification of inter-organizational interoperability problems.

5. Contribution to practice

Although standards are believed to be very important for companies, as they allow for automation of parts of the business transactions and ultimately lead to business improvements, standard implementation projects often result in technical solutions with unclear business benefits. As Söderström (2004) argues, business process owners lack education about standards, finding standards difficult to understand. As a result, they outsource standard implementation activities to an external solution provider. This is a dangerous step, as a great deal of business logic will be inherited in the standard-based solution without a clear understanding of what consequences it would have once introduced in a specific situation.

One contribution this thesis can bring to practitioners, namely business managers, is awareness that standard implementation is not a technical issue. It also shows business managers that if they want to ensure a solution leading to both technical and inter-organizational interoperability, they must retain control, understand to what extent the standard fits in the specific situation and if possible, what extra measures are needed to mitigate the gaps. For instance, as discussed in the healthcare example concerning communication between the operating room and financial

administration, the standard contained business rules consistent with the US healthcare system but different from the Dutch healthcare system. These differences were identified only after signing contracts with the suppliers. The implementation project has been started and stopped a number of times. Had these contextual differences been identified earlier, management could have made an informed decision, perhaps choosing an alternative path.

Finally, we provide a system of concepts and a method, which can be used as support tools by business analysts (reporting to business managers) to identify potential problems when deploying a standard in a specific situation. Although they need further validation and improvement, they currently provide a way of thinking and a frame of reference regarding how to approach the problem. Early problem identification allows for additional steps to be taken in parallel with the standard implementation, which may ultimately have an effect on the project execution (in terms of shorter implementation time and lower implementation costs) and the quality of the project outcome.

6. Directions for further research

So far we have discussed the results and contribution of this research. Furthermore, we have provided reflection on the research process and discussed the major limitations. Within this section, we would like to go a step further and outline possible directions for further research.

6.1 Establishment of a shared context

In this thesis we assumed that companies, which would like to automate parts of their business transactions have already created a shared context. In practice this might not always be the case. The issue of how to create this shared context constantly emerged throughout the energy liberalization case. This opens an interesting area for further research in the context of business-to-business transactions. Some questions to be asked are: At what level should one establish a shared context in the B2B setting (e.g., strategic, tactical, and operational), and which actors would be involved in the establishment of a shared context at each level? What mechanisms for establishment of a shared context exist and which mechanisms are appropriate for the different levels? How does one ensure consistency when translating the shared context from one level to another? This context should be shared not only with the people who are involved in business transactions, but also with the people who participate in a project aiming to bring some computer-based solutions into the business transaction context. An interesting question might be: what mechanisms exist or can be created to communicate this context to the interested parties within the project organization?

6.2 The system of concepts

Regarding the system of concepts, further research can continue in several directions, which we elaborate below.

6.2.1 Testing of the system of concepts

Thorough testing of the system of concepts was out of the scope of this research, but can be seen as an area for further research.

With respect to the high-level system of concepts, research is needed to check whether all views currently defined are really necessary and whether some other important views need to be covered. We can envisage that in case the inter-organizational process crosses organizations, which fall under different legal systems, an additional view addressing legal issues explicitly may be appropriate. Research can also be done to see whether some views are more important than

others and to provide insights about prioritizations which may ultimately result in a more efficient analysis.

With respect to the detailed system, we have argued that we have included a preliminary set of concepts for each view in the current thesis. Further empirical analysis will be needed to arrive at more stable boundaries of which concepts to include in the system of concepts. This research may result in a stable set of concepts suitable for a quick scan multi-disciplinary analysis.

Finally, we constructed the system of concepts using insights from the healthcare domain and we applied it in a case study in the energy sector. The case study indicated that the system of concepts and method can be applied in different domains. However, to be able to make a stronger statement about the applicability across domains, further empirical research is needed.

Here we will provide some examples of different methods of how to continue with the investigation. One possible method is to perform action research where the researcher would be actively involved and apply the system of concepts and method in the project to gain insights of what improvements can be made. An alternative method of investigations would be to select a number of similar projects and conduct case studies where the system of concepts is used in some of the projects and not in others.

6.2.2 Expanding the use of the system of concepts

The purpose for constructing the system of concepts was to help in the analysis of a defined DBT situation, specified requirements, and a chosen standard and identify possible mismatches between them. While conducting the research, we considered that it might be worth further investigating the applicability of the system of concepts in two other directions.

The first direction considered was that further research can be done to check whether the system of concepts is viable as a support tool for requirements elicitation. The reason is that on one hand the analysis of business situations which span multiple organizational contexts seems to be complex, and on the other the system of concepts suggests a multi-view of the situation which can be helpful to address the complexity. To be able to conduct such research, one would need to make a thorough investigation of requirements elicitation techniques, which aim to analyze complex inter-organizational processes and compare them with the capabilities of the system of concepts. Furthermore, if during this study it is found out that the system of concepts can help as a support tool for requirements elicitation concerning such complex situations, the follow up question can be what additional elements would need to be added to the system of concepts to tailor it for the purpose of requirements elicitation.

The second direction that the system of concepts can be expanded towards is a tool for evaluation and comparison of different standards. We already illustrated use for the analysis of a specific standard and this analysis can also be repeated several times on different standards. Once this is done, a comparison between standards is also possible. The comparison of standards was out of the scope of this research, but because there is still little understanding in the research community of how to compare standards, this can be an interesting area for further research.

6.3 The method

The method presented in this thesis is a first attempt to define how the system of concepts can be used to analyze the DBT situation, the specified requirements, and the standard and identify potential problems during a standard implementation project. During the case study we found that the system of concepts and method can be used to reason about the DBT situation, the

specified requirements, and the standard and have the potential to identify problems. Regarding the method, there are a number of areas where further research can be done.

6.3.1 Efficiency of the method

It was out of the scope of this thesis to evaluate the efficiency of the method and to make proposals for improvement; we consider this to be an area for further research. As the system of concepts and the method are meant to be used for a quick scan analysis, making the method efficient can be important. One way to achieve a more efficient use of the method would be to define a mechanism which would help evaluate which parts of the method are appropriate for the specific situation. This would lead to a restricted method, where the restriction can be made in terms of types of analysis, levels of analysis, and the parts of the system of concepts. As such a restriction mechanism is not explicitly included in the method, this is a potential area for further investigation.

6.3.2 Usability of the method

The method as presented in this thesis provides general guidelines and has been applied on a real-life case by the researchers who developed it, the major goal being to gain initial insights about the feasibility of the system of concepts and the method. The use of the method by people not involved in the method development was out of the scope of this research. In a long-term perspective, however, the idea is that such a method may be used in practice for early problem identification. This means that analysts uninvolved in the development process would use this method. In that respect, further research can be done in a number of directions. Experiments can be done to check whether the method is understood, interpreted, and applied in a similar way by different users and whether the results of the analysis are similar. In case there are significant differences, what additional elements need to be added to the method to reduce these? Furthermore, qualitative methods can be deployed to understand the perceived usefulness and problems the users of the method have experienced when applying it in practice.

7. Possible use in commercial products

We developed the system of concepts and the method with the idea of their application in practice for early problem identification in standard implementation projects. However the results presented in this thesis remain rather theoretical, requiring an additional step to bring them closer to practical application. One possible way to proceed would be to embed the results of this research (and possible follow-up research stemming from it) in commercial products used by business analysts. One such product could be a tool, which would suggest to the business analyst different types of analyses, generating questions that could help guide the business analyst through the process. This tool could also allow the analyst to input the results of the different analyses, generating reports based on this information.

Following results from the possible follow-up research on comparison of standards, a similar tool could be created to help in the comparison process. This tool could be used in the initial stages of a standard implementation project, when the choice of a standard is made. This tool could be useful in cases featuring a number of standards, which require criteria for evaluation to make an informed decision.

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Summary

A number of technological developments in the last decades have provided opportunities for companies to automate parts of the communication with their customers and suppliers and in that way carry out their business transactions more efficiently. These opportunities were provided more than 30 years ago with the introduction of the EDI technology. The EDI technology was mainly explored by the large companies, which were able to afford the huge start-up costs associated with EDI. For the small and medium-size companies these start-up costs were often prohibitive and the EDI technology was often not seen as a solution. The emergence of the Internet however allowed for a low cost for connectivity, which meant that also small and medium-size companies may explore the opportunity to connect with their customers and suppliers and communicate in a more efficient manner.

Although connectivity is a first important step towards automating parts of the business communication, connectivity alone is not sufficient. To be able to do business, the parties need to establish a shared understanding about what and how to communicate, about the meaning and the intentions of the communicated information, and how to act accordingly upon that information in an agreed upon manner.

One way to proceed is to define bi-lateral agreements between the parties that want to automate part of their business transaction. Practice has shown that such way of integration turns to be problematic, as companies need to implement and maintain different propitiatory agreements. Furthermore, the consequence of such proprietary agreements is that doing business with new partners becomes difficult, as the different parties often have implemented different proprietary agreements, which hinders the process of integration.

Standards provide an opportunity to overcome the barriers caused by the use of proprietary agreements. Standards are usually developed by standard development organizations and incorporate a degree of shared understanding. The idea behind the standards is that if a company decides to adopt a specific standard, it needs to implement only this specific standard and by doing so, would be able to communicate with all the other business parties, which speak the same language (i.e. use the same standard). With the emergence of the Internet, the number of standard development initiatives has drastically increased, and so have the expectations of the companies to be able to quickly set up and automate communication relationships with new business partners.

Although standards provide definite benefits compared to the use of proprietary agreements, the standard implementation and the use of standards is not as straightforward as it seems. Research on EDI standard shows that EDI standard implementation projects, in many cases, resulted in technical solutions with unclear business benefits. In this respect, although standards have the potential to bring benefits for companies, the problems encountered when implementing the standards in a specific situation often cancel out these benefits.

There is still little understanding in both the research and the business community concerning the standard implementation, or the process of introducing a standard in a specific situation. In the research community the focus so far has been on standard development and standard adoption, while standard implementation remains a largely unexplored area. In the business community, it is still very hard for companies to understand what a standard has to offer for their specific situation. In that respect, problems due to mismatch between the requirements of the specific business situation and the characteristics of the chosen standard are discovered at late stages in the project, which often leads to longer implementation time, higher implementation costs, resulting in systems which fail to sufficiently support the way of doing business and in some cases even to complete project failures.

Early identification of problems due to mismatches between the requirements of the specific situation and the characteristics of the chosen standard is important as it can bring awareness that such mismatches exist, and will allow business managers to act proactively and take timely measures to mitigate the gaps. Ultimately, this may lead to shorter implementation time, lower implementation costs and standard-based solutions that better fit the requirements of the business situation, which can allow for a more effective utilization of the opportunities provided by the standards. Currently, however, there is a very little understanding how to reason about the requirements of the specific business situation and the characteristics of a chosen standard and how to identify potential problems due to possible mismatches between the two at early stages of the standard implementation project. In that respect, the main research problem addressed in this thesis is: *How to identify, at an **early** stage of a standard implementation project, potential problems with the execution of a business transaction that can occur when deploying a standard in a specific DBT situation?*

To address this research problem, we propose to create a system of concepts and a method, which can be used for the early problem identification in standard implementation projects. For the construction of the system of concepts and the method, we formulate two research questions. The first research question was formulated as follows: What should a system of concepts consist of in order to:

- help in analysing the DBT situation, the specified requirements of the DBT situation, and the chosen standard
- help in analyzing possible mismatches between the specified DBT requirements and the chosen standard, and between the DBT situation and the specified DBT requirements
- identify potential problems with the execution of a business transaction, based on the above analyses

The second research question was formulated as follows: What should a method of how to apply the system of concepts consist of in order to:

- help in analyzing the DBT situation, the specified requirements of the DBT situation, and the chosen standard
- help in analyzing possible mismatches between the specified DBT requirements and the chosen standard, and between the DBT situation and the specified DBT requirements
- identify potential problems with the execution of a business transaction, based on the above analyses

The core issue related to research question one was the construction of the system of concepts. To construct the system of concepts, we followed a predominantly theoretical approach, including practical insights from the healthcare domain. We developed the system of concepts in three phases.

During the first phase, "exploration", we explored theories on business transaction and business communication and decided to follow a multi-disciplinary approach in the construction of the system of concepts. During the second phase, "focus", we constructed a high-level system of concepts consisting of six views and the relationships between them. The six views are as follows: focal exchange view, business network view, business process view, business rule view, communicative act view, and subject matter view, each briefly highlighted below.

The focal exchange view addresses the focal economic exchange under analysis, abstracting from this how such an exchange is actually achieved. The focal exchange view plays a role as a starting point for deriving the context of a business transaction. Furthermore, via this view the ultimate effects of potential problems that may be detected with the other views become visible. The idea behind the business network view is that a focal exchange does not exist in isolation, but is embedded in a network context. The business network view outlines the different organizational contexts involved in the business transaction. The identification of the different organizational contexts is important, especially when it comes to communication and the interpretation of the communicated information. While the business network view provides a high-level view of the actors that participate or may influence the execution of the focal exchange, the business process view addresses the activities and sequence of activities necessary for the delivery of the good/service from the supplier to the customer and compensation in the opposite direction. The business rule view focuses explicitly on the allowed repertoire of behaviour of actors involved in the transaction. It defines the conditions under which the actors are allowed, obliged, or forbidden to do something. The communicative act view focuses on the business conversation that takes place with respect to the business transaction. The communicative act view addresses the intentions behind the communicated information. The communicative act view is closely related to the business process view, as communicative actions are inherent part of the business process. The subject matter view is a fundamental view in business communication. It defines as a prerequisite that in order to communicate, the companies must understand the meaning of the information they exchange. This means establishing a shared understanding about the domain of interest with respect to the business transaction, the conception, and the representation of the domain. The subject matter view relates to the other views, as other views provide the input to define the domain of interest with respect to the business transaction.

The six views and the relationships between them, provide the basis of the high-level system of concepts, the research result of the "focus phase". During the third phase, called "choice", we arrive at the detailed system of concepts, by further elaborating each of the views in terms of key concepts. As a result of the "exploration", "focus" and "choice" phases in part 2, we arrive at a high-level and a detailed system of concepts, our contribution with respect to the first research question. The constructed system of concepts alone is not sufficient to assist with early problem identification. This requires a method to describe how the system of concepts can be applied in practice to facilitate early problem identification, the subject of the second research question.

The results achieved with respect to research question two are as follows. First we defined the components of the method: a system of concepts, types of analysis, level of analysis, questions, and ways of working. Second we provided illustration and insights regarding how these components can work together and allow for different analysis.

The constructed method consists of five major components. The first component is the system of concepts. The second component of the method is what we call "types of analysis". We defined three major types of analyses, which will be summarized below. Analysis type 1, fit analysis, deals with the analysis of the specified DBT requirements and the chosen standard. Fit analysis divides into three sub-analyses. Analysis type 1.1, requirements analysis, seeks to identify

problems within the specified DBT requirements and checks which concepts from the system of concepts are covered in the requirements. Analysis type 1.2, standard analysis, is an analysis of the chosen standard. It aims to find problems within the standard itself and checks which concepts from the system of concepts are covered in the standard. Analysis type 1.3, mismatch analysis, aims to identify mismatches between the specified requirements and the chosen standard in terms of views and concepts.

Analysis type 2, DBT analysis, focuses on the specified DBT requirements and the DBT situation. Analysis type 2.1, context analysis, relates to the DBT situation and questions the assumption that the parties in the DBT situation have created a shared context. Analysis type 2.2, formality analysis, questions whether the specified DBT requirements capture in an explicit and formal way the DBT situation requirements before they are implemented in the computer systems. Analysis type 2.3, completeness analysis, questions the completeness of the specified DBT requirements with respect to the DBT situation requirements.

Finally, analysis type 3, impact analysis, traces the possible consequences of potential problems identified through type 1 or 2 analysis on the execution of the business transaction.

The third component of the method is called "levels of analysis". We defined four levels of analysis: Level 1 (view level), Level 2 (concept level), Level 3 (entity type level), and Level 4 (instance level). This allows moving from very abstract and domain-independent analysis, addressed at view and concept levels, to analysis of concrete models and instances of these models with the latter two levels. As the method is intended for a quick scan analysis, we focused on Level 1 and 2 analyses. To enable capturing examples of problems related to Levels 3 and 4, we introduced a Level 2 (3, 4) analysis. The value added by Level 2 (3, 4) analysis is that if during the analysis examples of problems are identified at levels 3 and 4s, these problems are formulated and reported in terms of Level 2.

The fourth component of the method is called "question". The goal of this component is to indicate the use of questions as a mechanism to guide the analysis. The operationalization of this component is limited to a number of examples. Rather than generating a complete list of possible questions, an immense task, we provide guidelines to generate questions.

The last component of the method is called "way of working" and it forms the other components of the method into a step-by-step process. Steps one through three include making a selection concerning the type of analysis, the level of analysis, and the relevant parts of the system of concepts. Step four involves defining questions with respect to the selected type of analysis and level of analysis, using the system of concepts. Step five concerns actually conducting of the analysis. In addition to method components, in Part 3 we provide illustration of how these components can be integrated to perform the different types of analyses.

To summarize, with respect to research question one we constructed a system of concepts, while in answer to research question two we proposed a method of how to apply this system of concepts in practice in order to identify potential problems in early stages of standard implementation projects. By addressing research questions one and two we arrive at a system of concepts and a method, which were intended to be used for early problem identification. However, we still lack insight regarding whether the system of concepts and the method have the potential to deliver the intended results. It is not clear that using the system of concepts and the method will allow one to analyze the DBT situation, the specified requirements, and the standard as well as identify potential problems. Within the scope of this study it was not feasible to conduct a thorough testing of the system of concepts and the method, yet we consider it

extremely important to achieve first insights about the potential to produce intended results. These first insights are the focus of research question three.

Research question three focuses on first insights concerning the potential of the system of concepts and the method as applied in practice and in identifying potential problems. Research question three specifically states: Can the system of concepts and the method be applied in practice and if so, do they bring any meaningful results? To answer this research question, we conducted a case study in the energy market, selecting a project approaching its end. We applied both the system of concepts and the method, analytically identifying a number of potential problems through this analysis. In addition we selected empirical evidence concerning the types of problems actually encountered in practice during the project. As a final analysis, we compared the potential problems with the actual problems.

As a result, the case illustrates that the system of concepts and the method can be used in a real-life situation to reason about the requirements of the DBT situation and the characteristics of the standard. Furthermore, we have found indications that the system of concepts and the method have the potential to identify potential problems. In this respect, we find that the system of concepts and the method have the potential to achieve their intended results.

With this research we bring a contribution to the research community on standards, by providing further insights about standard implementation, a phase that was to a large extend unexplored so far. We further contribute to the business world, by providing a system of concepts and a method which have the potential to be used as a support tool for early problem identification in standard implementation projects.

This study opens grounds for further research in several directions. Within this thesis we took as a starting point that the business parties have already established a shared context of how to do business together. If such a shared context has not established, further research can be done on how the business parties can arrive at such a shared context. With respect to the system of concepts, we envisage areas for further research in two directions. The first one is to proceed with the thorough testing of the system of concepts. The second one is to explore the possibility to apply the system of concepts as a support tool for requirements elicitation in standard implementation projects and as a support tool for standards comparison. With respect to the method, possible areas for further research include improving the efficiency and the usability of the method. Finally, from a business perspective, an interesting direction to proceed is to embed the results of this research (and possible follow-up research stemming from it) in commercial products used by business analysts.

List of abbreviations

BC	Business communication
BN	Business network
BP	Business process
BR	Business rule
BT	Business transaction
BWW	Bunge-Wand-Weber
CA	Communicative act
DBT	Distributed business transaction
Dte	Directie Toezicht Energie (Office of Energy Regulation)
EBO	EDINE Beheer Organisatie (EDINE Administrative Organization)
ECH	Energy Clearing House
FE	Focal exchange
IS	Information systems
MIG	Message Implementation Guidelines
PC	Propositional content
PVE	Platform Versnelling Energieliberalisering (Platform for the Acceleration of the Energy Liberalization)
SM	Subject matter
SPOED	Support Programma Opening Energiemarkt Derde fase (Support program for the third phase of the liberalization of the energy market)

List of publications from this research

Book chapters

Rukanova, B. D., Slooten, C. van, Stegwee, R.A. (2005). Business Process Requirements, Modeling Technique and Standard: How to Identify Interoperability Gaps on a Process Level. In Interoperability of Enterprise Software and Applications, Springer (to appear)

Rukanova, B. D., Slooten, C. van, Stegwee, R.A. (2005). Towards a Meta Model for Describing Communication: How to Address Interoperability on a Pragmatic Level. In: Enterprise Information Systems VI, Kluwer Academic/Plenum Publishers (to appear)

Proceedings of international conferences

Rukanova, B. D., Aydin, M.N., Slooten, C. van, Stegwee, R.A. (2005). Towards a Meta Model for Business Process Concepts. In: proceedings of the International Conference on Enterprise Information Systems, ICEIS 2005, Miami, USA

Stegwee, R.A., Rukanova, B.D. (2003). Identification of Different Types of Standards for Domain-Specific Interoperability. In: Proceedings of *MIS Quarterly* Special Issue on Standard Making: A Critical Research Frontier for Information Systems: Pre-Conference Workshop ICIS 2003, Seattle, USA

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Acknowledgements

Now when I am writing the last pages of my thesis it is interesting to look back at the series of events which determined the road that I followed. Now when I think about it, it seems full of coincidences but maybe that's how life is. It all started shortly after I completed my master's degree at Sofia University "Saint Kliment Ohridski" and I was on a cross-road of where to go next. There were several tempting options: there was the possibility to go and work on an implementation project in industry. Furthermore, at that time I was involved in the Thempus-Phare European projects and I could have continued in that direction. I was also thinking that some international experience would be nice as well and as it often happens in life, opportunities do not come alone. One day Roumen Nikolov, who was my supervisor when I did my master thesis and who was responsible for the Thempus project told me that there may be an opportunity to gain some international experience and do a master abroad. I thought it may be fun, so I applied. At the same time, an e-mail arrived from one of my colleagues, Vjara, with a link to the CTIT website. This was at the time of the Internet boom and CTIT has started an entirely new program called "Electronic Process Interaction in Business and Society (EPIC)". The goal of the program was to study different phenomena related to E-commerce from a multi-disciplinary perspective. There was a long list of PhD topics and a few of them were in the area of business information systems, which I was interested in. Although it looked interesting, my first reaction was, "no". First of all, I was not sure whether I want to continue in academia, and doing a PhD project for four years seemed really long time. Second, I didn't feel leaving Bulgaria for so long. After some days I started reconsidering. The topics looked really interesting and promising and I thought I can just apply and if things go through I'd have to decide what to do. So life continued as usual until one day I received a notification that I have passed the evaluation and I was awarded with a one-year full grant to do a master in Educational and Training Systems Design at the University of Twente in the Netherlands. As the Thempus project in which I was involved was focusing on providing professional training to government agencies, this international experience seemed to fit well. The master program had to start on August 1, 2000 and I was preparing my trip to the Netherlands. One week before leaving I received an e-mail from Marian Sonneveldt that I was invited for an interview concerning the EPIC program. It seemed that somehow, all roads were leading towards Twente. As I said, things don't come alone which makes it difficult to choose and make decisions. So, I started the master program and later in August I met Rober and Kees. We discussed the focus of EPIC, the experience of working on a PhD project and it all seemed really fascinating, innovative, challenging, and I wanted to be part of it. I have already started with the master program and I wanted to fulfil my commitments there, so I had to postpone the start of my PhD project till June 2001.

Before going further, I would like to thank Roumen Nikolov and my colleagues with whom we worked together in projects at Sofia University at that time. I would like to give special thanks to Getty, Ivan, Samuil Angelov and Samuil Kunev, Julia, Vjara, Kiro, Niki, Iskra, Sergei, Dean, Lari for providing me with the inspiring environment and provoking my interest in e-business and research. With some of them, we even walked the PhD road together with all its ups and downs.

So, on June 1, 2001 I started with my PhD project at the Department of Buisness Information Systems of the University of Twente. My topic was "Business Transaction Standards for Electronic Commerce". As every new beginning, mine was also full with enthusiasm but soon after that I was lost and in despair. At that time numerous standards were emerging and I was trying to make sense out of them but I couldn't. I was drowning in XML schemas and I was desperately trying to understand what's behind them but that was difficult. I was reading white papers about ebXML and how it solves all the problems and I was wondering "if everything is already done, what am I doing then?" I was spending days and nights with the HL7 standard and it still looked complicated. This was the time when Ton Spil gave me the e-mail of Simone Mollink, an expert on HL7 implementations. I met Simone and she explained me about the standard, about the standard implementation and the problems encountered. She introduced me to some of her colleagues, we discussed their experiences and slowly, I started to get a better grasp of the situation. Simone, thank you for being so supportive till the very end of the project! At the times of my confusions I also met Tom de Jong, who spent hours explaining me the HL7 v3 standard and the modelling behind it. I really needed these insights at that time! Another important event at that time was the first HL7 congress that I attended which allowed me to get a further grasp of what's going on in the world of standards. During this event I met Frank Ploeg, who later on played a crucial role in my project. Frank, thank you so much for the long discussions that we had and the support that you provided me with throughout the project! I would like to give special thanks also to Fenno Ottes, René Spronk, Robert Kersemakers, Michael van Campen, and all the other people from the healthcare who were there for me when I really needed them.

So, step by step things started making sense, I was not scared any more, on the contrary, then the real fun began. It was clear to me how to approach the problem, and slowly the ideas of how the system of concepts and the method would look like started emerging. During this process it was extremely important to be in the right research environment, to have the right people to question you, to provoke you, to argue with you, or to pull you out of your confusions. I would like to thank my colleagues who were also working on their PhD projects and with whom we walked the winding road at the same time. I would like to thank Mehmet with whom we spent hours discussing "what is a business process", what is "business process integration", "why integration projects fail" or "whose interpretation of the Turkish-Bulgarian history was correct". I would like to thank Jeroen with whom we discovered that we kept on borrowing the same books from the library and that on a higher level the PhD projects are not that different. Jeroen, thank you for the interesting methodological discussions of what constitutes a theoretical contribution, for making me aware about Parsons and for the healthy RSI breaks. And I must confess, you were not so "asocial" after all! I would like to thank Michel for the interesting discussions on Popper and Lakatos, for the papers that I often found on my desk, for his internal drive to put people together, and of course for the picture from Klimt, which ended up on my wall. I would like to thank Adri, who brought the practitioners view and with whom we had long discussions of how research can bring value to practice; to Eveline for her strong research drive that she carries and shares with us and for her cheerful spirit; and Reza, with whom we discussed the issues of continuous replenishment and the life in Indonesia. As a result of these constant interactions, we often ended up, as Arjen jokes "confused but on a much higher level".

And while with Mehmet, Jeroen, Michel, Adri, Eveline, and Reza we were discovering what research was all about I would like to thank to the other members of our department who played a major role during my research progress. I would like to thank Arjen who put the social world on the forefront of doing research and who taught us that research must be fun. Arjen, thank you for the great atmosphere that you brought in the department, for the discussions on research and

Dante, and I must confess, I am still looking for inspiration in standardization. I would like to thank also Ton for providing me with the first contacts in the healthcare domain, for the interesting discussions on inter-organizational systems, and for his jokes, which always brought some cheerful mood in the atmosphere. I would like to thank Margreet, who helped me in finding my way in the healthcare domain and with whom it was a pleasure to work during the development of the business process integration lab; I would like to thank Fons, who often brought into the group interesting discussions on research methodology; Christiaan, who was discussing change management with a German accent, as well as to Xiuzhen, Theo, Diana, Peter, Dennis. Thank you all for the stimulating environment that you created which helped me to shape my ideas and come to my first results. I also want to thank Marian, who was always there to help me with the administrative matters, as well as to Svetlana and Tanja, who brought their input in the BB&ICT meetings and with whom we had interesting discussions during the lunch breaks. In that way, step by step, the system of concepts and the method appeared.

Having gone so far, I had another challenge ahead of me. Although the system of concepts and the method were in place, we needed to gain some first insights of how they perform in practice. We needed to find a project that crossed multiple organizations and which addressed complex communication between these organizations. Soon after we started looking for a suitable project we found out that this would not be an easy task. To be able to do a case study of a project, which crosses multiple organizations meant that we needed to acquire access and get commitment not only from one but from multiple organizations. Apart from that the economic situation at that time was not very good, which provided additional obstacles. At that moment, when we faced a very big challenge in the project, we got very strong support from several people from Deloitte. I would like to thank Wout Hofman and Pim Hengeveld, who helped me get an idea about the big projects running at that time, who came with the idea to look at the liberalization of the energy market, and made the first steps to make the case study happen. I would like to thank Jan Aan Algera, who gave his permission to continue with the project and Peter van Rotterdam who helped me in gaining initial access in the process. I would like to thank Ted van der Togt who was working at that time in KEMA who helped me to get access to several players in the energy market, and to Jan Korff from Energiened who agreed to support the research. I would like to give special thanks to Ernst Meijer, who provided me with the access to the key players in the liberalization of the energy market and supported me throughout the whole case study. Finally, I would like to thank all the people who agreed to take part in the study. I know that you were all working under the extreme pressure of deadlines but you still found time to talk to me. I really appreciate it. Thank you all for the great help!

After completing the case study in the energy market I had the different pieces of the puzzle available and the next step was to put things in writing; I knew that writing is hard but I never thought that it can be that difficult. I was drowning in details and Robert and Kees were there to help me to find the balance between the detail and the big picture. Now that the writing is finished, I am looking back at the great time that I had working with Robert and Kees! You showed me possible ways to follow, and you gave me the freedom to follow my own way. I must confess, it was hard to deal with this freedom at the beginning. and it is easier to have a predefined path. However, as time passed I appreciated this freedom and saw the real beauty of it. And although now the only visible outcome from my PhD project is this thesis, for me what I learned on the way it is much more important; it's been a great learning experience! Kees, thank you also for the key theories to which you pointed me at the beginning, which later on became a fundamental par of my thesis; for the interesting discussions, and for your great spirit for travelling! Robert, thank you for the long discussions we had, which often lasted way after the working hours and for being there for me when I needed your help! I really appreciate that!

An interesting event that occurred in the last months of the writing of my thesis was the visit of Hannu Salmela in our group. Hannu, it was a great experience having you here! Thank you for the valuable comments on the final draft of my thesis, for the discussions on inter-organizational systems, and for the interesting visit to Muenster.

I've been told once that if you want to progress with your work you need to make sure that you have a good rest and enjoy your spare time. So, I tried to adhere to this formula, as long as it was still possible. I would like to thank my Bulgarian friends in Netherlands, as well as those further away for being there for me and for the great times we had!

Now that I am at the end of my PhD project I think it was a fascinating experience cycling this road with all its ups and downs. In my long journey, I was happy to have a companion cycling next to me: to look at shadows; to tell me stories about the happy life of single molecules; to push me, when going uphill or against the wind; to enjoy with me the sceneries along the road and the feeling of speed when going downhill. I truly enjoyed this journey and I guess you are convinced now that I can keep my promises!

Накрая искам да благодаря на моето семейство: на сестра ми, която ме спасяваше в кризисни моменти; на баба ми, която ме подкрепяше с молитвите си и на родителите ми, за тяхната безкрайна любов, подкрепа и вяра в мен. Благодаря!

Annex 1.

Energy Liberalization: fit analysis

1. Introduction

The purpose of this annex is to provide a step by step illustration how the system of concepts has been used in the analysis of the requirements documents and the standard used in the energy case. This annex focuses on analysis type 1 as described in the method, as this type of analysis is most detailed and requires a step by step review of the requirements documents and the standard. A short summary of the major findings of analysis type 1 is presented in part 4 chapter 1 of this thesis.

Within each section we provide some background information about the documents under analysis to give at least some insights of what type of information was included in the documents. The remaining part of this annex is structured as follows: for each view we will perform analysis type 1.1 (i.e. analysis of the specified requirements), analysis type 1.2 (i.e. analysis of the standard) and analysis type 1.3. (i.e. analysis of possible mismatches between the two). We will perform each of these analyses at level 1 and level 2 respectively. The order of the views that we will follow is FE view, BN view, BP view, BR view, CA view and SM view. The analysis presented in this annex is based on the following requirements documents: "Retail Model of the Dutch Electricity and Gas Market", "Information Flows: a Handbook for the Message Exchange Concerning Energy Supply" "Grid Operator Electricity", developed by PVE; "The Netcode" of Dte. Further the standard that we use in this analysis is the EDINE standard UTILMD v 1.2.0. Message implementation guide developed by EBO.

2. Focal exchange view

2.1. Requirements analysis (analysis type 1.1): FE view

2.1.1. Background

One of the early documents developed by PVE was a documents called "Retail model of the Dutch electricity and Gas market. The document describes several high-level process models concerning the retail market. The processes are as follows: make available a connection, use of connection (start of a contract), stop of the use of a connection (end of contract), switching and moving, invoicing, and handling of problems. We will discuss some of these situations below for illustration. The discussion of some of these processes will also be helpful for understanding the requirements that will be discussed with respect to the other views.

The first situation that we will discuss is start of contract. The begin situation is that a customer wants a contract for supply of electricity to a new connection. The end situation is that the client has a supply contract with the supplier and the client has an agreement for transportation of energy with the grid operator via the supplier. Another situation that we will discuss is end of supply. In this case, at the beginning the customer has a supply contract with the supplier and has a transport agreement with the grid operator via the supplier. The end situation is that both the supply contract and the transport agreement are ended and a final payment is made. There are also a number of situations, which describe either switching of a supplier or moving. We will discuss only switching for illustration. The situation with switching is as follows. The customer has a supply contract with the old supplier and has a transportation and connection agreement with the grid operator via this supplier. If a customer decides to switch a supplier, a complex process can start. At the end of this process the customer has a supply contract with a new supplier and has a transportation and connection agreement with the grid operator via the new

supplier. The requirements documents also specify two different possible models for invoicing: the supplier model and the grid operator model. In the grid operator model, the grid operator periodically sends invoices to the suppliers. The supplier on the other hand periodically sends the invoice to the customer. The invoice includes both the cost of the supplied energy of the supplier and the transportation costs of the grid operator. In the grid operator model the situation is different in a sense that the customer gets two invoices (one from the supplier and one from the grid operator) instead of one, as was the case in the supplier model. So far we have provided some background information so that we can proceed with the analysis type 1.1 of the focal exchange view.

2.1.2. Level 1

The table below summarizes the steps to be followed in the analysis at level 1. We have also formulated a question to guide the analysis. It is important to mention that when we analyze the FE view it is not necessary to look for formal models. As this is the most abstract level of analysis, the complexity and the detail of information are low and intuitive informal models can be sufficient. In that respect the question that we ask we do not address the notion of formality.

Step 1: type of analysis	Requirements analysis (analysis type 1.1.)
Step 2: level of analysis	Level of analysis 1
Step 3: View	FE view
Step 4: Question	In the specified requirements, is the focal exchange under analysis defined?

Table 2.1. Requirements analysis Level 1 FE view

From the situations described above we can say that the relationship between the customer and the supplier and the grid operator are discussed. In that respect we are not able to identify potential problems at level 1. We will continue to level two to analyse more in-depth to what extent the information provided in the documents is sufficient for identifying and describing the focal exchange.

2.1.3. Level 2

The table below provided the steps to be followed during level 2 analysis. We also include the detailed concepts from the system of concepts and we formulated a number of questions[22] respectively.

Step 1: type of analysis	Requirements analysis (analysis type 1.1.)
Step 2: level of analysis	Level of analysis 2
Step 3: view, concepts	**Focal exchange view** Focal exchange has focal actors (focal buyer, focal seller) Focal objects of exchange (focal good/ service, focal compensation) Focal transfers (focal good/service transfer, focal compensation transfer Governance structure (market, hybrid, hierarchy)
Step 4: Questions	In the specified requirements, is it clear which is (are) the focal exchange(s)? For each focal exchange, is the focal exchange clear in terms of: Who are the focal actors Which are the focal objects of exchange Which are the focal transfers Which is the governance structure

Table 2.2. Requirements analysis Level 2 FE view

Based on the table above, we can now proceed with the analysis

Focal exchange

From the background information provided in section 1 we can say that that a logical way to define a focal exchange is to look at the exchange between the customer and the supplier. If we look at the models

[22] These are just examples of possible questions, not all possible questions

described above, we can see that there is a contact between the customer and supplier. Once such a contract is established, intermediating actors like the grid operator become involved. What we can say is that the processes of interest defined in the requirements documents address a number of situations, i.e. beginning and ending of the existence of a focal exchange (beginning or ending of a contractual relationship between a customer and a supplier). Further, the business requirements define a case when one focal exchange is ended due to the initiation of another focal exchange (in case of customer switch from the old supplier to the new supplier). The move in/move out refers to the case, when there is no change in the focal exchange (the supplier stays the same), but due to the relocation of the customer, either the business network is reconfigured (in case of change from one grid operator to another), or the business network remains the same but the point of delivery changes. In that respect we consider that the concept of focal exchange is covered in the requirements documents.

The focal objects of exchange
The document clearly specifies that there are two possible types of objects of exchange that go from the supplier to the customer, i.e. electricity and gas. What we can add here is that there are two different laws, the electricity law and the gas law. This indicates, that these two products cannot be treated in the same way. In that way we can conclude that the requirements documents actually discuss two types of focal exchanges: focal exchange where the object of exchange is gas and focal exchange where the object of exchange is electricity. Although it seems that we are dealing with two different types of focal exchanges, in the requirements documents the processes concerning gas and electricity are often discussed together rather than separately. This might lead to some potential problems, as some differences between the two types of situations might be overlooked and under-specified. In that respect we consider that as a point of attention. Further, the object of exchange that goes from the customer to the supplier is compensation. As we have discussed in section one, the requirements specify different ways that the compensation can be delivered (e.g. the supplier model or the grid model). We will come back to the different models related to the compensation objects in the BN view, as then we can reason about the intermediating actors and their role in the process.

The focal actors of exchange
The focal actors of exchange are also specified, that is the supplier and the customer. The supplier sells either electricity or gas to the customer and the customers provides payment in return.

The focal transfers
The focal transfers are also clearly defined, i.e. the transfer of electricity or gas from the supplier to the customer and the transfer of compensation in the opposite direction. It is important to notice is that the transfer of compensation is explicitly addressed when defining the supplier and the grid operator model. How these transfers are intermediated will be addressed in the BN view.

Governance
With respect to the governance structure we can say that the focal exchange takes place in a market.

2.1.4. Summary
From the above analysis we can conclude that the requirements documents address the focal exchange view. They specify sufficient information concerning the actors in the focal exchange, the focal objects of exchange and the focal transfers. Further, it is possible to identify the governance of the focal exchange, i.e. market. In that respect we can conclude that the requirements documents capture sufficiently the focal exchange view. With respect to the object of exchange however, we consider that the processes related to gas and electricity are discussed together, even though they need to comply to two different laws. That is why we mark this as a point of attention.

Summary Requirements analysis (analysis type 1.1.): FE		
Level 1	(-)	
Level 2	(*)	Electricity and gas not always treated separately
(-)- no potential problem identified (*)- point of attention		

Table 2.3. Summary requirements analysis FE view

2.2. Standard analysis (analysis type 1.2.): FE view

2.2.1. Background

As discussed in the introduction, the standard (UTILMD v 1.2.0.) Message Implementation Guide (MIG) will be used in this analysis. The standard describes the switching messages to be used in the process of customer move or changing of supplier in a liberalized energy market. In the standard it is stated that the procedures to be used are described by PVE. The standard focuses on describing messages. In that respect we can conclude that in terms of scope the standard will mostly address the communicative act view and subject matter view, which addresses the business conversations and the meaning of the communicated information. Further, if we take the example of UTILMD v 1.2.0. standard we can say that it is limited to switching messages that need to be used in the processes of customer move or change of supplier. Further, as mentioned in the standard, the procedures to be used are described by PVE. This means that the standard builds upon the requirements and procedures specified by PVE and does not develop its own procedures. Based on that we can say that the levels of analysis that are needed to arrive to the detailed procedures are out of the scope of the standard. In that sense, we expect that the standard covers, to a very limited extent, the FE, BN, BP view and BR view. We will however run analysis type 1.2. for all the views. The purpose is twofold. First, we would like to illustrate in detail this type of analysis and second, we will be able to reason what contextual information from the requirements is included in the standard.

2.2.2. Level 1

The table below specifies the steps to be followed during analysis type 1.2. level 1. We further specify a number of questions to guide the analysis.

Step 1: Type of analysis	Standard analysis (analysis type 1.2.)
Step 2: Level of analysis	Level 1
Step 3: View	FE view
Step 4: Question	Is it within the scope of the standard to define the focal exchange? In the standard, is there contextual information concerning the focal exchange?

Table 2.4. Standard analysis (analysis type 1.2.) Level 1 FE view

Based on the discussion in section one we can say that the definition of the focal exchange remains outside of the scope of the standard. Elements of the foal exchange view can be discovered embedded in the general part of the standard and the messages themselves. We will go further in detail in Level 2.

2.2.3. Level 2

The table below provides the steps to be followed during level 2 analysis. Further, some questions are formulated to guide the analysis.

Step 1: Type of analysis	Standard analysis (analysis type 1.2.)
Step 2: Level of analysis	Level 2
Step 3: View, concepts	**Focal exchange view** Focal exchange has focal actors (focal buyer, focal seller) Focal objects of exchange (focal good/ service, focal compensation) Focal transfers (focal good/service transfer, focal compensation transfer Governance structure (market, hybrid, hierarchy)
Step 4: Questions	In the standard, is it clear which is (are) the focal exchange(s)? Is each focal exchange treated separately in the standard? For each focal exchange, is the focal exchange clear in terms of: Who are the focal actors? Which are the focal objects of exchange? Which are the focal transfers? Which is the governance structure?

Table 2.5. Standard analysis (analysis type 1.2.), Level 2, FE view

Unlike what we have observed when analysing the requirements documents, in the standard the economic exchanges and the establishment of contracts are not a focus of the discussion.

The focal exchange(s)
In the requirements we have identified two types of focal exchanges depending on the object of exchange (electricity or gas). We can find these two types of exchanges in the standard as well.

Separate treatment of each focal exchange
The two types of focal exchanges are not treated separately in the standard, the distinction is implicitly specified in standard. This can be seen as a point of attention, as some differences between the communication requirements concerning electricity and gas might be overlooked.

Actors of exchange
We will come back to the definition of the actors in the business network view. However what we can notice that the standard explicitly includes the customer and the supplier wherever they are part of the shared context within a specific process. For example, in the UTILMD 1.2.0. which specifies the messages to be exchanged with respect to master data only the supplier is specified, and not the customer. This however is not surprising, as in the processes with respect of exchange of master data, customer is not a party. This confirms again the observation that the standard focuses on operational message exchange, rather than economic exchanges between market participants.

Objects of exchange
In analysis type 1.1 level 2 we have identified that the requirements actually address two type of focal exchanges depending on the object that is exchanged (gas or electricity). In that case, a logical way to proceed in the standard is to define separately the message exchanges and the required information to be embedded in the messages separately, as there are two different types of focal exchanges. Such an explicit distinction in the standard however is missing. This can be seen as a point of attention, as already addressed in section "separate treatment of each focal exchange".

Focal transfers
The standard focuses on the operational message exchanges rather than the economic exchanges.

Governance
As the standard builds on requirements, which are defined for a market situation, we can imply that the standard is developed with the intention to be used in a market situation as well.

2.2.4. Conclusions
When analyzing the standard with respect to the FE view, it seemed that the definition of the focal exchange itself was not within the scope of the standard. The standard however contained some contextual information concerning the objects of exchange and it seems that in the standard documents, the electricity and gas are not always treated separately. This can be seen as a point of attention, as some differences between the communication requirements concerning electricity and gas might be overlooked.

Summary Standard analysis (analysis type 1.2.): FE		
Level 1	(#)	
Level 2	(*)	Electricity and gas not always treated separately
(#)- not in scope (*)- point of attention		

Table 2.6. Summary standard analysis FE view

2.3. Mismatch analysis (analysis type 1.3): FE view
Analysis type 1.3. aims to identify whether there are substantial differences between the requirements and the standard.

2.3.1. Level 1

The steps to be followed during level 1 analysis are listed below.

Step 1: type of analysis	Mismatch analysis (analysis type 1.3.)
Step 2: level of analysis	Level of analysis 1
Step 3: View	FE view
Step 4: Question	If FE view is covered explicitly or implicitly in the requirements, is it also implicitly or explicitly covered in the standard? (If applicable)

Table 2.7. Mismatch analysis, (analysis type 1.3.) Level 1 FE view

What we have seen at level 1 in the requirements is that the FE view has been substantially addressed in the requirements. When analysing the standard, we have found out that it is out of the scope of the standard to address the economic exchanges, but rather that the standard focuses on some of the operational message exchanges needed with respect to a given economic exchange. In that case we can identify differences in the scope of the requirements and the standard. Such a difference is to be expected if the standard under analysis focuses only on the business communication. Further, as the standard is derived based on the requirements, in that case we need to see whether they are complementary to each other rather than to counterpart them. We can further continue the analysis at level two and compare the context embedded in the standard with the context embedded in the requirements.

2.3.2. Level 2

The table below summarizes the steps to be followed during analysis at level 2.

Step 1: type of analysis	Mismatch analysis (analysis type 1.3.)
Step 2: level of analysis	Level of analysis 2
Step 3: view, concepts	**Focal exchange view** Focal exchange has focal actors (focal buyer, focal seller) Focal objects of exchange (focal good/ service, focal compensation) Focal transfers (focal good/service transfer, focal compensation transfer Governance structure (market, hybrid, hierarchy))
Step 4: Questions	If a concept from the FE view is covered in the requirements, is it also covered by the standard?

Table 2.8. Mismatch analysis (analysis type 1.3) Level 2 FE view

Focal exchanges

From analysis type 1.1 and 1.2 we can say that in the requirements we have identified two types of focal exchanges. These two types of focal exchanges were implicitly present in the standard as well.

The focal actors

The focal actors were explicitly specified in the requirements. In the standard, however the focal actors were present in some of the message implementation guidelines, only when a focal actor is participating in the operational message exchanges specified in the standard. The purposeful capturing of economic actors was out of the scope of the standard.

Objects of exchange

Both the standard and the requirements have the notion of objects of exchange, i.e. gas or electricity vs. compensation. Elements of the compensation part could be found embedded in the message specifications (e.g. an indication in the message itself whether supplier or the grid model should be applied).

Transfers

While in the requirements the transfer in economic sense has been address, this is not the case in the standard, where the focus is on operational message exchanges.

Governance

With respect to the governance structure, as discussed earlier, both the requirements and the standard imply market governance.

2.3.3. Summary

With respect to analysis type 1.3. we have identified differences in terms of the scope of the standard and the requirements. As the standard builds upon the previously specified requirements we see this difference in scopes as complementary. In that respect, we do not envisage potential problems.

Summary Mismatch analysis (analysis type 1.3.): FE		
Level 1	(Δ#)	
Level 2	(-)	
(Δ#)- difference in scope (-)- problem not identified		

Table 2.9. Summary analysis type 1.2. FE view

With respect to analysis type 1.3. FE we have identified differences in terms of the scope of the standard and the requirements. As the standard builds upon the previously specified requirements we see this difference in scopes as complementary. In that respect, we do not envisage potential problems.

3. Business network view

3.1. Requirements analysis (analysis type 1.1.): BN view

3.1.1. Background

The requirements document (we refer again to the document called "Retail model for the Dutch Electricity and Gas market" discussed earlier) also defines the different players on the retail market. The players are defined in four categories: the key players (i.e. the consumer, the supplier, and the grid operator), other players (e.g. program responsible, national system operator), possible new players (e.g. metering companies), and related organizations (government). For each key player a clear definition is provided and the tasks and responsibilities are further specified. A short description concerning the other three types of players is also provided.

3.1.2. Level 1

The table below provides the basic steps of the analysis and specifies the question to lead the analysis.

Step 1: type of analysis	Requirements analysis (analysis type 1.1.)
Step 2: level of analysis	Level of analysis 1
Step 3: View	BN view
Step 4: Question	Is there a notion of a business network in the specified requirements?

Table 3.1. Requirements analysis (analysis type 1.1.), Level 1, BN view

Based on the short description provided in section 1, we can say that in the requirements there is a strong emphasis on the description of the parties involved and we will proceed with the analysis at level two.

3.1.3. Level 2

The table below summarizes the steps to be followed during analysis at level 2. In step three the concepts from the business network view are listed and in step four, a number of questions are specified to guide the analysis.

Step 1: type of analysis	Requirements analysis (analysis type 1.1.)
Step 2: level of analysis	Level of analysis 2
Step 3: view, concepts	**Business network view** Focal exchange Is supported by intermediating exchanges (Intermediating actors, Intermediating object of exchange, intermediating transfers) Is influenced by other related exchanges (other related actors, other related object of exchange, other related transfers)
Step 4: Questions	Is the focal exchange defined? Are the intermediating exchanges defined? Are the other related exchanges defined?

Table 3.2. Requirements analysis (analysis type 1.1.) Level 2 BN view

Focal exchange
Based on the review of the requirements documents, the impression is that the description of the business network was thoroughly done. With respect to the focal exchange, as we have discussed in the FE section, the focal actors, the focal objects of exchange and the focal transfers are well defined. We have discussed this already in the previous section, so we will not spend more time here on the focal exchange.

Intermediating exchanges
As discussed in part 2, the intermediating exchanges are those exchanges, which are necessary for the fulfilling of the focal exchange. In that respect these are the exchanges that are needed in order to transfer the focal good/service to the customer and the focal compensation in return. When we look at the requirements documents we can say that the intermediating exchanges have been addressed. The strong focus in the requirements documents is on describing the intermediating actors. With respect to the liberalized energy market, a strong emphasis is put on one of the intermediating actors, i.e. the regional grid operator, as it is responsible for the delivery of the electricity or gas to the end customer. In that respect, the requirements documents specify explicitly its roles and responsibilities with respect to other actors. The object of value that this actor exchanges is transport service and the compensation for this service is received directly from the customer or through the supplier, depending on which model for compensation is used (the supplier or the grid operator model).

The requirements provide similar definition of the other intermediating actors that are needed to support the focal exchange and their tasks and responsibilities with respect to the other actors are defined. For electricity, one such actor is the program responsible (PV) which is responsible for making a program concerning the transport and use of electricity. With respect to gas, a similar actor is the Shipper. There are other intermediating actors defined like the National system operator. We consider that that the intermediating actors have been extensively addressed in the requirements documents and the intermediating objects and intermediating transfers can to a large extent be deduced from the description of the tasks and responsibilities of the actors. Generally, concerning the intermediating exchanges, we can say that they are not discussed explicitly as such in terms of value exchanges. We will mark this as a minor point of attention, as the explicit elaboration of the intermediating exchanges might be helpful.

Other related exchanges
The requirements documents also explicitly address possible new players that can appear on the market. Further, they specify related organizations, like e.g. the Ministry of economic affairs and their responsibilities.

3.1.4. Summary
As a general conclusion with respect to the BN view at level 1 and level 2, we can say that it has been addressed in the requirements documents, apart from the point of attention that we have identified with respect to the intermediating exchanges. These findings are summarized in the table below.

Summary Requirements analysis (analysis type 1.1.): BN view		
Level 1	(-)	
Level 2	(*)	Explicit elaboration of the intermediating exchanges might be helpful.
(*)- point of attention (-) problem not identified		

Table 3.3. Summary Requirements analysis (analysis type 1.1.): BN view

3.2. Standard analysis (analysis type 1.2.): BN view
3.2.1. Background
As argues earlier, the focus of the standard is on the message exchanges. However, the standard also pays special attention in specifying the different roles that are relevant for the energy liberalization and especially to the situation in the Netherlands. The table below provides an overview of the roles that are relevant for the situation in the Netherlands. These roles are defined by ebIX, which is an European

organization responsible for the development and maintenance of information exchange in the energy sector.

Role	**Definition ebIX[23]**	**Switching**
Balance responsible party	A company that has a balance responsible contract providing financial security and identifying balance responsibility with the Imbalance settlement responsible of the balance area.	Yes
Balance supplier	A party that markets the difference between actual metered consumption and energy bought from firm energy suppliers to the party connected to the grid. In addition he markets any difference with the firm energy commitment and the metered production. There is only one balance supplier for each metering point.	Yes
Grid Operator	A party that operates one or more grids. This role is sometimes called Distribution system operator.	
Imbalance settlement Responsible	A party that is responsible for settlement of the difference between planned and realised quantities of energy products for the balance responsible parties in a balance area.	
Meter operator	A party responsible for installing, maintaining, testing, certifying and decommissioning physical meters.	
Metered data aggregator	A party responsible for establishment and qualification of metered data from the Metered data collectors. The data is aggregated according to market rules.	Yes
Metered data collector	A party responsible for meter reading and quality control of the reading.	Yes
Metering point administrator	A party responsible for knowing the parties linked to the metering points in a grid area and its technical specification. He is responsible for creating and terminating metering points. The metering point administrator is responsible for the grid usage agreement with the party connected to the grid.	Yes
Party connected to grid	A party that contracts for the right to consume or produce electricity at a metering point.	
Producer	A party that produces electricity This is a type of party connected to the grid	
Consumer	A party that consumes electricity. This is a type of party connected to the grid	
Profile maintenance party	A party responsible for the calculation, publication and/or distribution of category profiles in compliance with market rules.	
Reconciliation responsible party	*No formal definition yet*	
System operator	A party that is responsible for a stable power system (including the physical balance) in a main grid (highest grid level), in a geographical area. The SO will also determine and be responsible for cross border capacity and exchanges.	
Transport responsible party	*Party responsible for planning its required transport capacity.(definition not formalised yet)*	Yes

Table 3.4. Roles of the actors as specified in the standard

As we can see in the table above, each role is defined by ebIX and within the UTILMD document, the roles relevant for switching are marked with "yes" (see the table above). The specification of the roles

[23] EbIX ebIX is a European wide organization that has taken the responsibility for development and maintenance of standard information exchange in the energy sector.

seemed to be the only part of the standard, where the BN view has been addressed. In that respect, we consider that the information provided here is sufficient to proceed with analysis level 1 and 2.

3.2.2. Level 1

The table below specifies the steps to be followed within level 1 analysis

Step 1: type of analysis	Standard analysis (analysis type 1.2.)
Step 2: level of analysis	Level of analysis 1
Step 3: View	BN view
Step 4: Question	Is the business network of the focal exchange in the scope of the standard? If yes, is it specified in the standard?

Table 3.5. Standard analysis (analysis type 1.2.) Level 1 BN view

As discussed in section 1, the standard provides an overview of the roles that are relevant for the energy liberalization in the Netherlands. In that respect we can say that the business network view is present in the standard. As discussed earlier, the focus of the standard is on the message exchanges. In that respect, the roles defined within the standard aim to introduce the key parties that will need to exchange message between each other. The standard embodies some contextual information with respect to the BN view, i.e. the some contextual information concerning the business network, where messages are exchanged. In that respect we will continue to level 2 analysis. Before going to level 2 however, we would like to make one remark here. It is not trivial to have the actors from the business network specified in the standard. As we have seen in some of the examples with the HL7 standard in part 2, the business actors are not covered in the standard. HL7 only covers the parties in the communication as at the level of application roles.

3.2.3. Level 2

The table below specifies the steps to be followed within the level 2 analysis .

Step 1: type of analysis	Standard analysis (analysis type 1.2.)
Step 2: level of analysis	Level of analysis 2
Step 3: view, concepts	Business network view Focal exchange Is supported by intermediating exchanges (Intermediating actors, Intermediating object of exchange, intermediating transfers) Is influenced by other related exchanges (other related actors, other related object of exchange, other related transfers)
Step 4: Questions	Is the focal exchange defined in the standard? Are the intermediating exchanges defined in the standard? Are the other related exchanges defined in the standard?

Table 3.6. Standard analysis (analysis type 1.2.), Level 2 BN view

If we look at the table in section one we can say that a number of roles are defined that are relevant for the liberalized market in the Netherlands Further, in the UTILMD standard, those roles that are relevant for switching are marked.

Focal exchange

If we look at the specified roles in section 1 we can say that from the focal actor only the supplier is included in the actors mentioned in the standard (the name used is balance supplier). The customer as a focal actor is missing. With respect to switching for example, the communication between the customer and the supplier is not included in the standard. The messages specified cover the other related business parties, marked with yes in the table in section 1. Based on the discussion above we can make the following observation. We confirm our observation that we had during the analysis of the FE view, i.e. the

focal exchange as such is not the focus of the standard. Further, the standard includes only those focal actors that are relevant with respect to a specific process and which are involved in automated communication. In the case of switching, we can say that only the supplier is seen in the standard as a relevant actor, who participates in an automated communication.

Intermediating and other related exchanges
With respect to the intermediating and other related exchanges, we can make similar observation as with the focal exchange. The analysis of these exchanges as such are not the focus of the standard. The standard only selects those intermediating actors, which will directly participate in the automated information exchange and which will be of direct relevance for the CA view. Some of the roles and responsibilities of the actors are addressed in the definitions provided in the table in section 1. The general observation that we can make from the analysis level 2 is that the capturing the BN as such is out of the scope of the standard and the standard adopts from the BN only those actors that are relevant to the automated message communication.

The general observation concerning the BN view is that the elaboration of the BN view is not part of the standard. In the standard, a clear reference to the PVE documents prom where the actors in the business network are adopted is missing. In that respect, even though the standard says that it adopts the actors of the BN from the requirements, by including them in the standard, they become a part of the standard. This can be seen as a point of attention, as the standard seems to include elements, which it claims are out of its scope.

Summary Standard analysis (analysis type 1.2.): BN view		
Level 1	(#)	
Level 2	(*)	In the standard, a clear references to the PVE documents prom where the actors in the business network are adopted is missing
(*)- point of attention (#)- not in scope		

Table 3.7. Summary analysis type 1.2. BN view

3.3. Mismatch analysis (analysis type 1.3): BN view

3.3.1. Level 1

The steps to be followed during level 1 analysis are listed below. We have also specified a question to guide the analysis.

Step 1: type of analysis	Mismatch analysis (analysis type 1.3)
Step 2: level of analysis	Level of analysis 1
Step 3: View	BN view
Step 4: Question	If FE view is covered explicitly or implicitly in the requirements, is it also implicitly or explicitly covered in the standard? (If applicable)

Table 3.8. Mismatch analysis (analysis type 1.3) Level 1 FE view

Based on analysis type 1.1. and 1.2. we can say that the BN view has been addressed substantially in the requirements and has been elaborated to a large extent. The elaboration of the BN view however is out of the scope of the standard and the standard adopts only actors from the BN view that are relevant for the automated business communication.

3.3.2. Level 2

Table 3.9 below summarizes the steps to be followed during analysis at level 2.

Focal exchange
The analysis of the focal exchange has already been addressed in the FE view. In that respect, we will not repeat the discussion.

Intermediating exchanges and other related exchanges
With respect to the intermediating and other related exchanges, we have seen that both the requirements and the standard explicitly capture the actors. The level of elaboration of the actors in the requirements

seems to be substantial, especially when it comes to the actors who have major involvement in the processes. In the standard, the elaboration of the actors is limited.

We will not go into level 3 analysis, as this needs to be done by a domain expert. However we would like to provide some comments with respect to that at level 2. Even though the standard states that the actors in the network defined in the standard are derived from the Dutch requirements, this equivalence is not obvious. The first problem is that the requirements documents and the actors defined there are in Dutch, while the definition of the actors in the standard is in English. Further, in the standard it is mentioned that the roles are adopted from the Dutch situation, however a clear reference to the requirements document, from which they are adopted is missing. Another point for further analysis is to check whether there are substantial differences between the definition of the actors provided in the standard and those provided in the requirements and approved by law.

Step 1: type of analysis	Mismatch analysis (analysis type 1.3)
Step 2: level of analysis	Level of analysis 2
Step 3: view, concepts	Business network view Focal exchange is supported by intermediating exchanges (intermediating actors, intermediating object of exchange, intermediating transfers) Is influenced by other related exchanges (other related actors, other related object of exchange, other related transfers)
Step 4: Questions	Are there concepts from the BN view, which are covered in the specified requirements and not covered in the standard?

Table 3.9. Mismatch analysis (analysis type 1.3) Level 2 BN view

We would like to make one further remark here. The statement in the standard is that the roles that are embedded in the standard have been derived from the requirements specified for the Dutch situation. As we have mentioned in section 1, now there is an international organization ebIX, which has taken the responsibility for the development of an European standard for information exchange in the energy sector. In the UTILMD document it is mentioned that the ebIX adopted the roles defined in the Netherlands for the European standard. This is an interesting remark. In the Dutch situation the roles embedded in the standard are supposedly the same as those specified in the requirements. Contextual differences however might be expected in follow up cases, when the business network defined in the standard will reflect agreements on an European level concerning who are the important actors and not the national specific requirements concerning the composition of the business network. If this is the case, one can expect mismatches between the requirements and the standard at a BN level.

3.3.3. Summary

During analysis type 1.3. we have identified mismatch between the requirements and the standard at level 1. As BN view is not directly related to business communication and the standard does not aim to cover the BN view, we do not see this mismatch as a source of potential problems. A similar reasoning can be applied to level 2. Points of attention at level three can be to check the equivalence of the definitions of the actors in the standard and the requirements.

Summary Mismatch analysis (analysis type 1.3): BN view		
Level 1	(Δ#)	
Level 2	(*)	There may be differences in the business network as defined in the requirements and in the standard
(Δ#)- difference in scope (*)- point of attention		

Table 3.10. Summary mismatch analysis FE view

4. Business process view

4.1. Requirements analysis (analysis type 1.1): BP view

4.1.1. Background

A major part of the high-level requirements is the definition of the process model of the retail market. Some examples of processes are as follows: start of use of a connection, end of use of a connection, switching and/or moving, invoicing. For each process there is a description of the start and end state. Further, the players in the process, as well as the steps are schematically represented. Each step of the process is also explained.

We will take the switch process to illustrate the level at which the high-level processes are defined. The start and the end state of the switch process are described below:

The start state	The end situation
The customer has a supply contract with an old supplier	The customer has a supply contract with a new supplier
The customer has a connection and a transport agreement with the grid operator via the old supplier	The customer has a connection and transport agreement with the grid operator via the new supplier

Table 4.1. Switching process: start and end state

The figure below illustrates the actors (presented with shaded circles) that are involved in the switch and the steps (numbered arrows), which the process follows to go from the star to the end state. The actors that take part in the process are the customer (C), the new supplier (NL), the old supplier (OL), and the grid operator (NB).

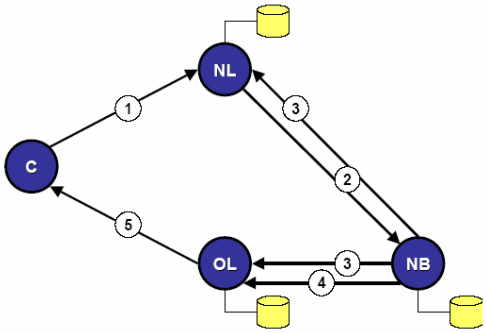

Figure 4.1. Switching process

The steps in the process are further explained in a textual description. E.g. Step 1is described as follows: the customer (c) signs new contract with the new supplier and with this signature allows him to start a switching procedure. The customer can also give the meter readings.

Another important part that defines the process model is whether the compensation is provided via the supplier model or the grid operator model. While in the exchange view we discussed these models to indicate that the flow of compensation is included in the requirements, within the business process view the two different models define the process of how the compensation is delivered.

While the requirements described in the "Retail model" are at a high level, the processes are further operationalized in detailed work procedures and related message exchanges in a document called "Information flows: a handbook for the message exchange concerning energy supply". In this document we can find a detailed timeline and how the process takes shape in terms of time. Below we provide examples how the time element is taken into consideration in the requirements documents.

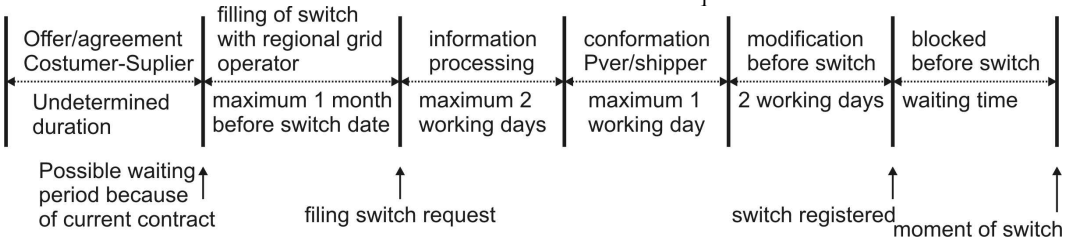

Figure 4. 2. Switching process: timeline

A similar figure is available for the moving process as well. Apart from some general principles and rules, the document describes detailed procedures concerning the processes. Further, interaction diagrams are specified. Below we present on such diagram. It presents the parties involved and the interactions that occur between the actors (the labelled arrows).

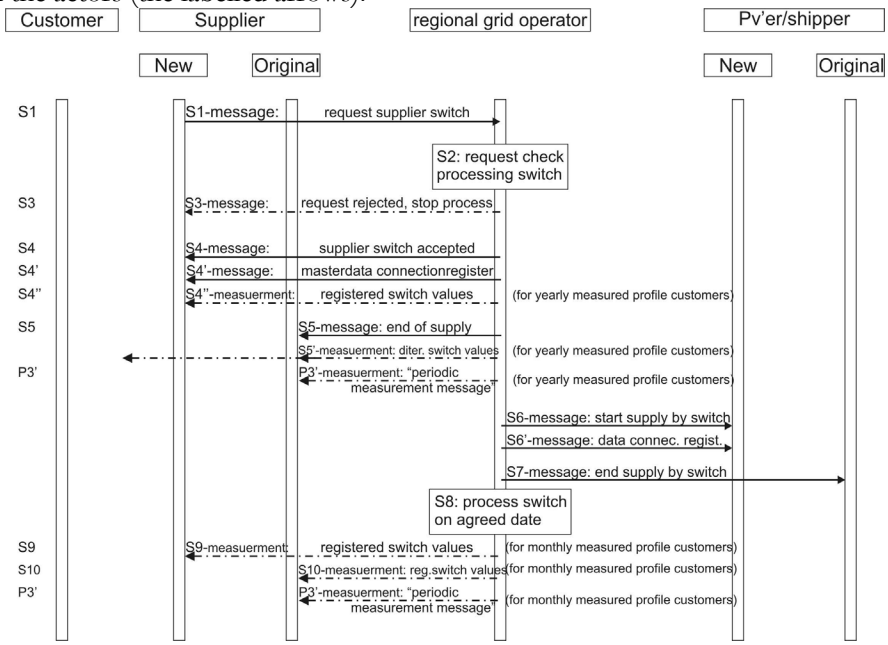

Figure 4.3. Interactions between the actors in the process

The diagrams define the actors involved, the communicative and the substantive actions (e.g. control a request to process a switch). The diagram specifies the communicative actions (or the messages exchanged between the actors). Each communicative action is presented with a labeled arrow. Further it specifies other actions (modeled with a labeled rectangle). S2 and S8 are two such actions. The diagram presented above will be discussed in detail in the communicative act view. Below we give an example to illustrate the level of detail with which each activity is described.

S2: Action "control of application and processing of suppliers switch" by grid operator. After reception of the message "switch application" the grid operator will do the following: -determine the acceptation of the switch application on the basis of the completeness and correctness of the data. -check the physical availability of the connection. -verify the stated meter readings and/or determines the meter readings at the switch moment. If the switch application is rejected the message S3 is send to the prospective supplier. When the switch is accepted the grid operator will do the following: -determine the definitive switch date (time is 0.00u) -determine the definitive meter readings at the switch moment (for yearly measured profile customers) -adding the switch data together with switch date in the connection register -informing the concerned parties (S4-S10)

Table 4. 2. Illustration of a description of an action

We will not go further in detail, however we consider that the insights provided so far are sufficient to understand level one and level two analysis.

4.1.2. Level 1

The table below specifies the steps to be followed during level 1 analysis.

Step 1: type of analysis	Requirements analysis (analysis type 1.1.)
Step 2: level of analysis	Level of analysis 1
Step 3: View	BP view
Step 4: Question	In the specified requirements, is the BP view addressed?

Table 4.3. Requirements analysis (analysis type 1.1.), Level 1, BP view

Based on the background information that we have provided in section 1 we can say that the requirements documents include explicit models that try to capture the business processes. In that respect we will continue the analysis at level 2.

4.1.3. Level 2

The table below provides the steps to be followed during the level 2 analysis. In step 3 we have included the concepts identified with respect to the business process view and we have formulated a number of questions to guide the analysis.

Step 1: type of analysis	Requirements analysis (analysis type 1.1.)
Step 2: level of analysis	Level of analysis 2
Step 3: view, concepts	Business process view Action Pre-state Actor Input actands Goal Post-state Output actands Composite action Basic state-transition structures Sequence Choice Parallel Time Rule
Step 4: Questions	Are the concepts from the business rule view covered in the specified requirements?[24]

Table 4.4. Requirements analysis (analysis type 1.1.) Level 2 BP view

Action

If we look at the interaction diagram presented in section one and the explanation following it, we can say that the actions (communicative and other actions) are explicitly modelled in the requirements.

Pre-state- actor, Input actands, goal

In section 1 we have provided examples of high-level process models (see figure 4.1) as well as examples of detailed processes (figure 4.3). In both cases, the actors involved were clearly defined. In that respect we can say that the concept of actor is also present in the business process view. Further, we consider that the concept "goal" has also been addressed. If we look at the interaction diagrams, we can find the goal embedded in the labels, accompanying each action. For example, action S2 has a label: "control the request for processing of a switch". In that respect, the goal of this action is to control the request for processing of the switch. As a result we can say that both the concept of actor and goal are addressed in the requirements. part from actor and goal, in the requirements documents we found also information as an input actand. For the different messages, it is specified what kind of information is needed for a specific action to occur.

Post-state- Output actands

From the analysis of the requirements documents we consider that the output actands of an action are implicitly defined.

State-transition structures (sequence, choice, parallel)

If we look at figure 4.3, we can say that some basic state transition structures are used. The predominant basic structure that is used is sequence.

There are some elements of state-transition structures in the models presented. It seems however that the structure of the process (including choice and parallel), as well as the conditions which motivate a certain choice, are modelled only to a limited extent via the message sequence chart. This can be seen as a point of attention, as it might hide some ambiguities in the model.

Time

In section 1, we have introduced several examples from the requirements documents, where the concept of time has been explicitly addressed (see figure 4.2). Further, the time concept is also embedded in the

[24] We can formulate a separate question for each individual concept, however as we have many concepts, we would end up with a long list of questions. In that respect, in such cases we will use only general questions

interaction diagrams. In that respect, we can say that the concept of time has been addressed in the requirements documents.

Rule
If we see the example in table 4.2, we can say that that the requirements explicitly specify the rules to be followed. For example, as illustrated, two possible post-states of the action "process request for switch of supplier", i.e. the result of the action can be reject or accept. The requirements also clearly specify the actions that can take place in each of these cases. Similar rules are formulated for the other actions as well. In that respect, we can say that the concept of rule is taken into account in the requirements documents.

Composite action
It seems that the notion of composite action is present in the requirements. If we look at table 4.1, we can say that this is a very high-level representation of composite action, explicitly describing the begin and the end state (or the pre-state and the post-state of the composite action). This composite action can be also found in the different interaction diagrams, which specify the detailed actions that need to be performed with respect to this composite action.

4.1.4. Summary

Summary Requirements analysis (analysis type 1.1.): BP view		
Level 1	(-)	
Level 2	(*)	The structure of the process, as well as the conditions which to motivate a certain choice, seems to be modelled only to a limited extent.
(*)- point of attention (-) problem not identified		

Table 4.5. Summary Requirements analysis (analysis type 1.1.): BP view

4.2. Standard analysis (analysis type 1.2.): BP view

4.2.1. Background

As discussed in the FE view, the standard explicitly specifies that it uses the procedures defined by PVE. In that respect we can say that it seems that it is out of the scope of the standard to introduce independently processes and procedures to be followed.

Although the standard includes some process elements, we can consider them as a reflection of the processes and procedures defined in the requirements, rather than independently developed processes and procedures. If we look at the standard UTILMD 1.2.0. we can say that there are several parts of the standard, where information about the processes can be found. The standard specifies a number of message scenarios for electricity and gas respectively. Below we present an example of a scenario of message exchange for change of supplier for the energy sector.

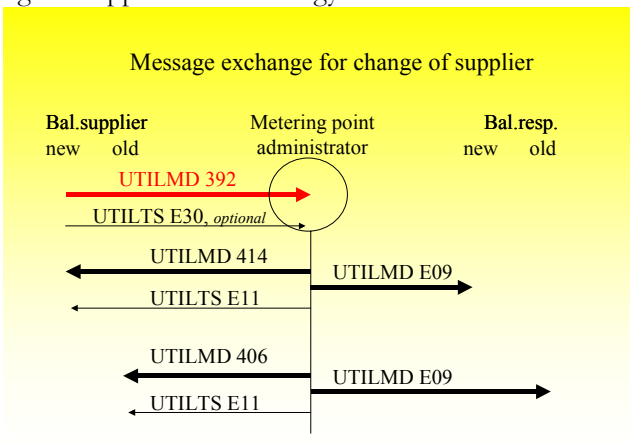

Figure 4.4. Message exchange for change of supplier

The figure presents the actors involved in the message exchange (in this example the actors are: new balance supplier, old balance, metering point administrator, new balance responsible and old balance responsible). Further, each arrow presents a communicative action. The label above the arrow defines the message to be exchanged in a specific interaction (i.e. UTILMD 392 means "Notification to metering point administrator of start of supply").
Apart from the defined scenarios, the standard also has some rules and clarifications about the procedures. See the table below for an example.

The procedures for a supplier change or customer move are designed around two basic actions: "stop" and "start". The responsible party for a metering point (the customer) who intends to move out, is expected to go to his supplier. This supplier will send a "stop" message (UTILMD 432) to the metering point administrator to which the metering point belongs. The new responsible party who intends to move in, will go to his supplier. This (new) supplier will send a "start" message (UTILMD 392). If a "start" message is sent before a "stop" message was received and processed by the metering point administrator, the request from the new responsible party will take precedence over the old responsible party (the one that is supposed to move out). This means that the metering point administrator then will not only confirm the move to the new responsible party (in fact to his supplier and balance responsible party[25]), but will also inform the old responsible party (and his supplier and balance responsible party) about the end of the contract. This is illustrated in the scenario "customer switch". In the messages the reason code used by the metering point administrator will remain the same as in the start message.

Table 4.6. Example of a procedure

Let us now proceed with the analysis of the standard.

4.2.2. Level 1

The table below provides the steps to be followed during the analysis type 1.2. level 1.

Step 1: type of analysis	Standard analysis (analysis type 1.2.)
Step 2: level of analysis	Level of analysis 1
Step 3: View	BP view
Step 4: Question	Is the BP view addressed in the standard?

Table 4.7. Standard analysis (analysis type 1.2.), Level 1 BP view

Based on the background information presented in section 1 we can say that the business process is not the focus of the standard, but rather the standard adopts the procedures developed by PVE. Although the BP view is not the focus of the standard, the standard contains contextual information and explicit models related to the BP view. In that respect we will continue to level 2 analysis.

4.2.3. Level 2

The table below summarizes the steps to be followed during the analysis. The table further includes the business process concepts from the system of concepts and a number of questions derived from them.

Step 1: type of analysis	Standard analysis (analysis type 1.2.)
Step 2: level of analysis	Level of analysis 2
Step 3: view, concepts	Business process view Action Pre-state Actor Input actands Goal Post-state Output actands Composite action Basic state-transition structures Sequence Choice Parallel Time Rule
Step 4: Questions	Are the concepts from the business rule view covered in the standard?

Table 4.8. Standard analysis (analysis type 1.2.) Level 2 BP view

[25] Where for the electricity sector the balance responsible party is mentioned, in principle the same applies for the transport responsible party in the gas sector. But there are temporary exceptions to this rule as will be pointed out later in this MIG.

Below we will discuss the standard and which concepts it covers. We will use the background information presented in section 1 to facilitate the analysis.

Action
If we look at figure 4.4. we can say that the concept of action is covered, however the actions that are covered in the standard are limited to communicative actions (or the message exchanges).

Pre-state- Input actand
With respect to the input actands, which are part of the pre-state of an action we can say that the actors are covered. If we look at figure 4.4.we can see that for each message exchange the actors are explicitly specified. The goal of the message can be found in the mane of the message exchanged. Further, the content of the message can be seen as an input actand of the action as well.

Post-state- Output actands
The output actands are implicitly defined (see the discussion of output actands in the analysis type 1.1. BP)

State-transition structures (sequence, choice, parallel)
From the model presented in figure 4.4 it is clear that sequence of actions are captured. Some of the other models presented in the standard include a concept of an optional message. This implies some kind of choice. Most of the time the conditions under which to make a certain choice are specified outside of the model, but are not explicitly included in the model itself.

Time
The concept of time is to some extent included. If we look at fig 4.4 we can see that there is some order in which the message exchange can follow. The sequential order of activities imply that the concept of relative time is addressed. The specification of absolute time is not very explicit in the standard.

Rule
In section 1 we discussed that the standard also specifies some additional rules and clarifications (see table BP3). In some cases, like for example in table BP3 the focus is on the actions and responsibilities of the actors. In other cases however, the rules are about the content of the message to be sent. These rules however are not discussed for each action separately and seem not to be very systematically defined.

Composite action
With respect to composite action, we can say that the concept "composite action" seems to be embedded in each specified scenario. For example, if we look at figure 4.4. we can say that it represents a composite action (see the example discussed in section requirements)
Some further remarks
Although the standard claims that it adopts the procedures specified in the requirements, the fact is that it respecifies them using even a different modeling notation. In that respect we can question to what extent the procedures are really adopted, given the fact that we did not find any clear reference to the requirements documents from where they were adopted.

4.2.4. Summary

Summary Standard analysis (analysis type 1.2.): BP view		
Level 1	(#)	
Level 2	(*)	In the standard, a clear references to the PVE documents from where the procedures are adopted is missing
(*)- point of attention (#)- not in scope		

Table 4.9. Summary standard analysis BP view

The general observation concerning the BP view is that the elaboration of the BP view is claimed not part of the standard. In the standard, a clear reference to the PVE documents from where the procedures are

adopted is missing. In that respect, even though the standard says that it adopts the procedures from the requirements, by including them in the standard, they become a part of the standard. The models included in the standard capture to a large extent the key business process concepts. However, we observed that the models included in the standard differ from the models we found in the requirements. This can be seen as a point of attention, as the standard seems to include elements, which it claims are out of its scope.

4.3. Mismatch analysis (analysis type 1.3): BP view

4.3.1. Level 1

The steps to be followed during level 1 analysis are listed below. We have also specified a question to guide the analysis.

Step 1: type of analysis	Mismatch analysis (analysis type 1.3)
Step 2: level of analysis	Level of analysis 1
Step 3: View	BP view
Step 4: Question	If BP view is covered (explicitly or implicitly) in the requirements, is it also implicitly or explicitly covered in the standard? (If applicable)

Table 4. 10. Mismatch analysis (analysis type 1.3), Level 1, BP view

Based on analysis type 1.1. and 1.2. we can say that the requirements clearly cover the BP view and that the BP view is out of the scope of the standard. The standard however contains contextual information about the BP view. In that respect, we will continue to level two analysis.

4.3.2. Level 2

The table below summarizes the steps to be followed during analysis at level 2.

Step 1: type of analysis	Mismatch analysis (analysis type 1.3)
Step 2: level of analysis	Level of analysis 2
Step 3: view, concepts	Business process view Action Pre-state Actor Input actands Goal Post-state Output actands Composite action Basic state-transition structures Sequence Choice Parallel Time Rule
Step 4: Questions	Are there concepts from the business process view, which are covered by the specified requirements and not covered in the standard?

Table 4.11. Mismatch analysis (analysis type 1.3), Level 2, BP view

Action

Based on the analysis type 1.1. and 1.2. we can say that both in the requirements and in the standard, the concept of action is addressed. However, while the requirements address both communicative action and other actions, the standard includes only communicative actions.

Pre-state – input actand

With respect to the actors and the goal, we have come to the conclusion that both conepts were addressed in both the requirements and the standard. With respect to other input actands however we have identified that both the standard and the requirement pay attention to information as an input actand. The difference that we have identified between the two is that it seems that in the requirements in some cases not all the required information was specified and in some cases, references to the standard were made for the complete information specification. We will come back to this observation in the discussion later in this section.

Rule

With respect to the rule concept, we have seen that it is covered both in the requirements and in the standard. The general impression when analyzing the documents however was that the rules were more systematically related to actions in the requirements than in the standard.

Time
With respect to the time concept, we have identified that in both the standard and the requirements the concept of relative time was addressed. With respect to absolute time, we have identified that it was better captured in the requirements than in the standard.

Composite action
With respect to composite action, we have seen that this concept is covered by both the standard and the requirements.

State-transition structures (sequence, choice, parallel)
Based on the analysis type 1.1.and 1.2. we can say that both the requirements and the standard capture the basic state-transition structure "sequence". They also capture "choice", however the rules which path to follow in case of a choice seem to be more structured and clearly defined in the requirements than in the standard.

Post-state- Output actands
The output actands are implicitly defined (see the discussion of output actands in the analysis type 1.1. BP)

4.3.3. Summary BP view
During the analysis type 1 (BP) a number of questions arose. The first one is, if the standard is completely based on the processes and the procedures defined in the requirements, than why the processes and the procedures were not only referred to in the standard or directly included in the standard without modifications? Why were additional models developed in the standard to reflect the different scenarios. If these models were really needed, why were they not defined in the requirements?
Why the complete information requirements were not included in the requirements documents but were completely elaborated in the standard? Further, the standard claims that it does not provide the procedures, but adopts them from other documents, the moment parts of these procedure are included in the document they become part of the standard. In that respect one needs to be careful what is included and what consequences does it have.

Summary Mismatch analysis (analysis type 1.3): BP view		
Level 1	(Δ#)	
Level 2	(*)	There seem to be differences between the business process embedded in the requirements and those embedded in the standard
(Δ#)- difference in scope (*)- point of attention		

Table 4.12. Summary mismatch analysis FE view

5. Business rule view
5.1. Requirements analysis (analysis type 1.1): BR view
5.1.1. Background
As discussed in part 2, the business rule view addresses the rules that govern the behavior of the actors with respect to the execution of the focal exchange. When reviewing the requirements documents we found out that the rights and responsibilities of the actors in the network have been extensively defined in a number of documents. Examples of such documents are the "Retail model of the Dutch electricity and gas market", and the "Grid operator Electricity", as well as the "Information flows: a handbook for the energy traffic concerning the supply of energy" developed by PVE and the "Netcode" of Dte. As the grid operator is considered to play the most important role in terms of facilitating the liberalized market, the rights and responsibilities of the grid operator are extensively discussed in these documents. The responsibilities of the other actors in the market are also extensively addressed. Below we will provide some examples to illustrate the level of detail, in which these norms are described.

Source NB Electriciteit, p. 25 2.1.6.3 The grid operator of the national high voltage network has the right to see the parts b till e and h of the other grid operators. He can request the other grid operators to hand over the complete data with respect to individual recognized program responsible. 2.1.6.6 The grid operator informs the relevant program responsible(s) at the latest one working day after a change in the connection register of one of the parts mentioned in 2.1.6.1 sub c till g, using the data communication means as mentioned in 3.8 and 4.1 of the system code. p.33, Article 4.3.1. (1) In case a party connected to the grid moves to another location and keeps the supplier, the current supplier will take care of the switch. (2) In case the party connected to the grid decides to change also the supplier, the new supplier will take care to make the switch.

Table 5.1. Examples of descriptions of business rules

5.1.2. Level 1

The table below summarizes the steps to be followed during level 1 analysis.

Step 1: type of analysis	Requirements analysis (analysis type 1.1.)
Step 2: level of analysis	Level of analysis 1
Step 3: View	BR view
Step 4: Question	Is the business rule view addressed in the specified requirements?

Table 5.2. Requirements analysis (analysis type 1.1.), Level 1, BR view

As discussed in part 2, the BR view focuses on the rules that govern the behaviour of the actors involved in the execution of the focal exchange. Based on the discussion in section 1 we can conclude that the business rules are explicitly specified in the requirements documents. In that respect, we can continue to level 2 analysis.

5.1.3. Level 2

The table below defines the steps to be followed during analysis at level 2. With respect to step 4, we have formulated a number of questions to guide the analysis.

Step 1: type of analysis	Requirements analysis (analysis type 1.1.)
Step 2: level of analysis	Level of analysis 2
Step 3: view, concepts	Business rule view Condition, subject, attitude, proposition
Step 4: Questions	In the specified requirements, are the business rules specified in terms of: Is the condition clear? Is the subject specified? Is the attitude specified? Is the proposition clear?

Table 5.3. Requirements analysis (analysis type 1.1.), Level 2, BR view

During the level 2 analysis we will use the background information provided in section 1.

The condition

The conditions are often specified explicitly. If we take the example with article 4.3.1. we can find the condition clearly specified. The condition is "In case a party connected to the grid moves to another location and keeps the supplier". In some cases, the condition is not explicitly specified, as for example in case 2.1.6.3 specified above concerning the national grid operator. The norm specifies that the national grid operator has the right to see certain information. It is not explicitly stated under which circumstances, however implicitly it can be understood that the national grid operator has the right always to see the items specified in 2.1.6.3. The general impression that we got from the requirements documents is that the conditions are usually addressed explicitly or implicitly.

The subject
If we look at the examples described above we can see that the subject is always present. The subject in 2.1.6.3 is the national grid operator. The subject in article 4.3.1. (1) is the current supplier and in article 4.3.1.(2) is the new supplier. Apart from the examples provided here, the general observation when reviewing the requirements is that the "subject" is thoroughly addressed in the requirements.

Attitude
If we look at the examples presented in section 1 we can say that the "attitude" is defined. In the example with the national grid operator, the character is "has the right", in the other two examples the character is defined by "will". Similarly to the discussion concerning the subject of the rule, the general observation when reviewing the requirements was that the character of the rule was thoroughly addressed as well.

Proposition
The proposition of the rule specifies the actions that the subject is allowed (not allowed) to perform. In the examples presented in section 1 the content of the rule is also explicitly specified. In the case of the first example, the content of the rule is as follows "to see the items b to h (including h) from the connection registers administered by the other grid operators". In the other two examples the content is "take care of the switch". Generally, if we look at the requirements documents we can say that the content of the rule is also substantially addressed.

5.1.4. Summary
The general observation that we can make as a result of analysis type 1.1. (BR) is that the business rule view is thoroughly addressed in the requirements at level 1 and level 2.

Summary Requirements analysis (analysis type 1.1.): BR view		
Level 1	(-)	
Level 2	(-)	
(-) problem not identified		

Table 5.4. Summary Requirements analysis (analysis type 1.1.): BR view

5.2. Standard analysis (analysis type 1.2.): BR view
5.2.1. Background
As discussed in some of the earlier analysis, the standard adopts the procedures developed by PVE and the focus of the standard is on describing the messages to be exchanged. As we have seen in the previous section, PVE extensively defines the business rules. As the standard steps on the PVE requirements, it is out of the scope of the standard to define business rules.

When reviewing the standard we have identified that some business rules have been included in the standard. These business rules, however, are claimed to be to a large extent adopted from the PVE requirements. Below we give such examples.

Source UTILMD 1.2.0. p. 8 **Procedures for "trigger"-messages** The procedures for a supplier change or customer move are designed around two basic actions: "stop" and "start". The responsible party for a metering point (the customer) who intends to move out, is expected to go to his supplier. This supplier will send a "stop" message (UTILMD 432) to the metering point administrator to which the metering point belongs. The new responsible party who intends to move in, will go to his supplier. This (new) supplier will send a "start" message (UTILMD 392).

Table 5.5. Example of a procedure

There are only several business rules included. Further, when reviewing the standard there was the impression that there was not a clear structure which business rules are included and which excluded. Let us now proceed with analysis level 1 and level 2.

5.2.2. Level 1

The table below provides the steps to be followed during the level 1 analysis.

Step 1: type of analysis	Standard analysis (analysis type 1.2.)
Step 2: level of analysis	Level of analysis 1
Step 3: View	BR view
Step 4: Question	Is the BR view specified in the standard

Table 5.6. Standard analysis (analysis type 1.2.) Level 1 BR view

As discussed in part 2, the goal of the business rule view is to define the possible rules governing the behavior of the actors in accordance with the communicated information.

As argued earlier, the definition of the business rules is out of the scope of the standard. The standard uses previously defined procedures by PVE and some of these procedures are included in the standard documents. Within these procedures, one can identify business rules, which are embedded there.

In this case we see a similar situation as those discussed with the analysis of the earlier views. Although the business rule view is not within the scope of the standard, elements of the business rule view are present in the standard as an indication of the context in which the message exchange will take place. In that respect, we will continue to level 2 analysis.

5.2.3. Level 2

The table below specifies the step to be followed during the level 2. We further specify a number of questions to guide the analysis.

Step 1: type of analysis	Standard analysis (analysis type 1.2.)
Step 2: level of analysis	Level of analysis 2
Step 3: view, concepts	Business rule view Condition, subject, attitude, proposition
Step 4: Questions	In the standard, are the business rules specified in terms of: Is the condition clear? Is the subject specified? Is the attitude specified? Is the proposition clear?

Table 5.7. Standard analysis (analysis type 1.2.) Level 2 BR view

During the level two analysis we will look at the business rules that were found in the standard.

Condition

Let us take the first example of a rule specified in section 1. In the first rule "The responsible party for a metering point (the customer) who intends to move out, is expected to go to his supplier", the condition is t*he intent of a customer to move out*. The second rule "This supplier will send a "stop" message (UTILMD 432) to the metering point administrator to which the metering point belongs" can be seen as a follow up rule of the first rule. In this case, the condition is not explicitly specified in the rule, but can be inferred from the outcome of the first rule. The implied condition can be formulated as follows: *when a customer goes to his supplier and declares his intent to move out*. We can perform a similar analysis to the other rules as well. The general observation is that the condition is covered.

Subject

If we continue with the examples discussed above we can say that the rules explicitly specify the subject of the rule. In the first rule described above, the subject of the rule is the *customer* (who intends to move). In the second rule, the subject is the supplier. If we look at the other rules specified in section 1 we can identify the subjects of the rules as well. We had a similar impression when we reviewed the other rules in

the standard as well. In that respect we can say that the concept of subject is addressed in the rules included in the standard.

Attitude
If we use again the examples discussed earlier, we can easily identify the "attitude" in the rule. In the rule one discussed earlier, the rule says "the customer *is expected*", where "is expected" captures the character of the rule. In the second example it says "the supplier *will* send", where will captures the "attitude". Similarly to the subject, the "attitude" of the rules seems also to be covered in the rules included in the standard.
Proposition
The proposition of the rules can also easily be identified in the examples above. If we look at the rules described above, we can say that they include the basic elements of a business rule. In the first example, the content of the rule is *"to go to his supplier";* in the second example, the content of the rule is "send a "stop" message (UTILMD 432) to the metering point administrator to which the metering point belongs". Performing a quick scan to the other rules defined in the standard, it seems that the proposition of the rule is also addressed.

4.2.4. Summary
Similar to the BN and the BP views discussed earlier, the elaboration of the BR view is claimed not to be part of the standard. In the standard, a clear reference to the PVE documents from where the business rules are adopted is missing. This can be seen as a point of attention, as the standard seems to include elements, which it claims are out of its scope.

Summary Standard analysis (analysis type 1.2.): BR view		
Level 1	(#)	
Level 2	(*)	In the standard, a clear references to the PVE documents from where the business rules are adopted is missing
(*)- point of attention (#)- not in scope		

Table 5.8. Summary standard analysis. BR view

5.3. Mismatch analysis (analysis type 1.3): BR view
5.3.1. Level 1

Step 1: type of analysis	Mismatch analysis (analysis type 1.3)
Step 2: level of analysis	Level of analysis 1
Step 3: view, concepts	Business rule view
Step 4: Questions	If the BR view is covered in the specified requirements, is it also covered in the standard? (if applicable)

Table 5.9. Mismatch analysis (analysis type 1.3), Level 1, BR view

Based on the analysis type 1.1. we can say that the business rule view has been the focus of the requirement and has been substantially addressed there. Based on analysis type 1.2. we can say that the BR view is not the focus of the standard, but the standard includes some business rules adopted from the requirements. This means that we have differences between the scope of the requirements and the standard at level 1. The standard however included some business rules to provide contextual information for the messages exchanged. In that respect we will continue to level 2.
5.3.2. Level 2

Step 1: type of analysis	Mismatch analysis (analysis type 1.3)
Step 2: level of analysis	Level of analysis 2
Step 3: view, concepts	Business rule view Condition, subject, attitude, proposition
Step 4: Questions	Are there concepts from the business rule view which are covered by the specified requirements and not covered by the standard?

Table 5.10. Mismatch analysis (analysis type 1.3), Level 2, BR view

Based on the analysis type 1.1. and 1.2. concerning level 2 we can say that both the rules specified in the requirements and the standard cover to a large extent the condition of the rule, the subject of the rule, the character of the rule, and the content of the rule. In this case we can say that we are not able to identify mismatches between the requirements an the standard at level 2 (BR). It is not very surprising that we cannot identify differences at level 2, as the standard basically adopts some of the business rules specified by the requirements.

5.3.3. Summary

Summary Mismatch analysis (analysis type 1.3): BR view		
Level 1	(Δ#)	
Level 2	(*)	Systematic way to link the business rules from the requirements to those in the standard is missing
(Δ#)- difference in scope (*)- point of attention		

Table 5.11. Summary mismatch analysis (analysis type 1.3), BR view

6. Communicative act view

2.1. Requirements analysis (analysis type 1.1): CA view

6.1.1. Background

The requirements documents are quite extensive in describing the communication between the parties. With respect to the supplier switch process, for example, the communication between the actors involved in the switch is explicitly presented using interaction diagrams. With respect to the switch, three different interaction models are presented. The first interaction diagram deals with the communication between the customer and the new supplier before the switch; the second one deals with the communication between the new supplier, old supplier, grid operator, new program responsible and old program responsible with respect to the switch. The last one describes the communication between the old and the new supplier with the client. For illustration purposes, below we present the second interaction diagram, which illustrates the interaction with respect to the switch.[26]

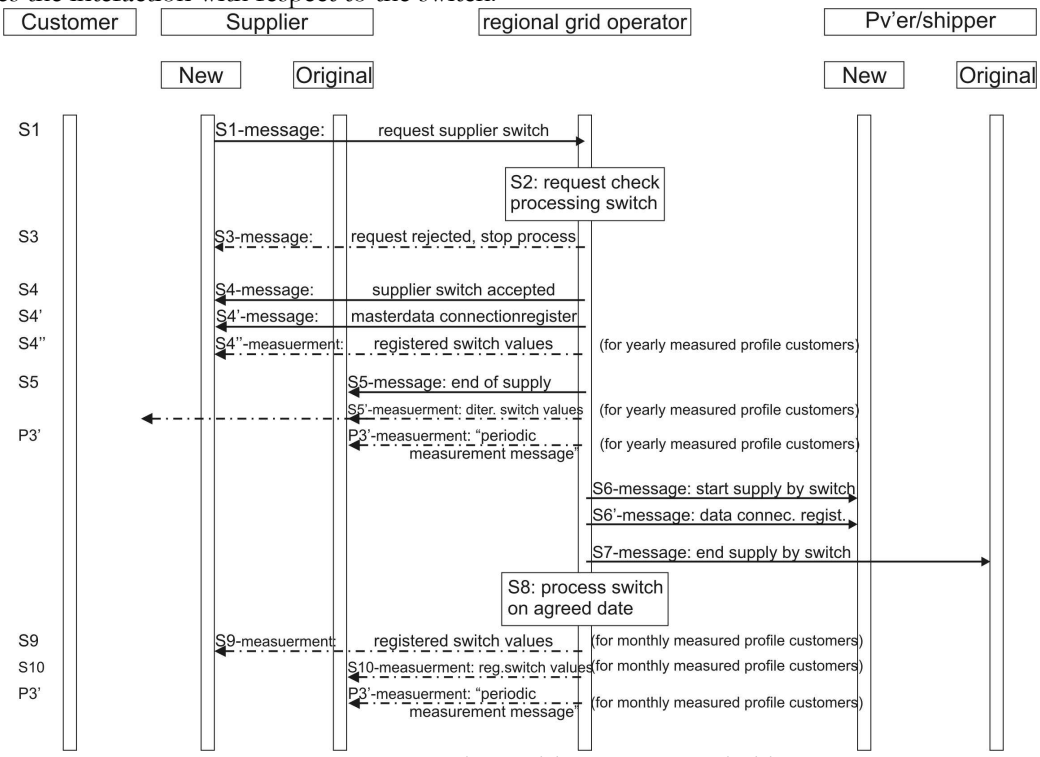

Figure 6.1. Interactions with respect to switching

[26] BP view and CA view are very related, as business conversations are coherently embedded into the process. In that respect, we use the same interaction diagram to analyze it from a BP view and from a CA view perspective.

The interaction diagram identifies the actors, and the messages that the actors exchange. Each message is represented with an arrow, where the arrow points from the sender to the receiver of the message. Each message has a message number. For example, message S1 means "request for switch of supplier".

Apart from the interaction diagrams, for each message additional explanation is provided in the document. As an example, below we provide the explanation that is provided with respect to message S1.

S1: Message "request switch of supplier" sent from the new supplier to the grid operator From a contract with the client the supplier fills in a standard message "repot switch". Per switch and per product, an unique message will be generated. The sending of this message means that the grid operator is granted the permission to initiate a switch. The content of the message: "report switch" contains: EAN code of the connection of the client The task content of the message: switch of supplier Choice of product (electricity- gas) Starting date Settlement of the transportation costs via (supplier or grid operator model) Responsible /program responsible/ Shipper Optional: meter readings and origin of these meter readings. This message can be entered with the grid operator at earliest one month before the intended switch date. The last possible entry date is five working days before the intended switch date.

Table 6.1. Example of the information provided with a message (in this case S1)

Now that we have provided some background information concerning the requirements, we can proceed with level 1 and level 2 analyses respectively.

6.1.2. Level 1

The table below summarizes the steps to be followed during the analysis. We have also formulated a question to guide the level 1 analysis.

Step 1: type of analysis	Requirements analysis (analysis type 1.1.)
Step 2: level of analysis	Level of analysis 1
Step 3: View	CA view
Step 4: Question	Is the CA view addressed in the specified requirements?

Table 6.2. Requirements analysis (analysis type 1.1.) Level 1 CA view

If we look at specified requirements, we can say that explicit models describing the communication between the parties are available. As we have illustrated in the section above, the requirements documents include explicit interaction diagrams to describe the communication. As an explicit model is present, we cannot identify potential problem at level 1 and we will continue to the level 2 analysis.

6.1.3. Level 2

Concerning the communicative act view, we again will use a table (see table 6.3) defining the key concepts related to that view and key questions to guide the analysis.

Communicator and interpreter

To illustrate the analysis using the communicative act view, let us look at the diagrams in figure 6.1. What we see there is that for each message (illustrated with a labelled arrow) it is specified which is the communicator, which is the interpreter (the sending and the receiving actors are marked with labelled rectangles)

Communicative function

For each message, the communicative function is defined as well. The communicative function is embedded in the name of the message, e.g. message s1 is a request for change of supplier.

Sequence of utterances
If we look again at the sequence diagram, we can say that from it, possible sequence of utterances can be derived. In that respect we can say that the requirements also address the concept of sequence of utterances.

Propositional content
As far as it concerns the propositional content, we consider that the requirements are limited. For some messages, it seems that the requirements specify the required information (see the example of S1 specified in table 6.1). In other examples, however it becomes clear that the propositional content is not always completely specified. One such example is the message specification of S3 "rejection of a switch of supplier" from the potential supplier (see the interaction diagram). In the requirements document it is specified that the message should contain *at least* the following items (EAN code of the connection of the client; the intention of the message: reject change of supplier; unambiguous reason for the rejection). The words "at least" however indicate that the complete propositional content might not be specified. This however can be seen as a potential problem. The reason for that is that the specified message exchange will be supported by computer systems and the content of the information carried out in the message exchange will need to be embedded in the computer system. However, if the information in the requirements is not complete, this incomplete information will become parts of the computer-based communication and as a result can lead to potential problems.

Step 1: type of analysis	Requirements analysis (analysis type 1.1.)
Step 2: level of analysis	Level of analysis 2
Step 3: view, concepts	**Communicative act view** Ae-message has One communicator One interpreter One propositional content One communicative function Ae-message is part of Sequence of utterences
Step 4: Questions	For a-message, are the following concepts defined? Communicator Interpreter Propositional content Communicative function Is it defined how an ae-message forms part of a sequence of utterances Are there cases when two ae-messages are merged into 1 message?

Table 6.3. Requirements analysis (analysis type 1.1.) Level 2 CA view

Merging of ae-messages
From the requirements documents we did not identify cases when two ae-messages were combined.

6.1.4. Summary

Summary Requirements analysis (analysis type 1.1.): CA view		
Level 1	(-)	
Level 2	(X)	PC is not always completely specified
(-)- problem not identified (X)- problem		

Table 6.4. Summary requirements analysis: CA view

Let us now proceed to analysis type 1.2.

6.2. Standard analysis (analysis type 1.2.): CA view

6.2.1. Background

Before proceeding with analysis type 1.2., let us first provide some background information about the part of the standard that is relevant to the CA view. As it was argued earlier, the standard focuses on defining messages. In that respect the CA view is the most relevant one with respect to the scope of the standard. In that respect, we will provide the level of detail that we consider sufficient to be able to understand the basic elements of the standard and to continue with the further analysis.

The standard includes messages scenarios. The scenario below is an example of a message exchange for change of supplier.

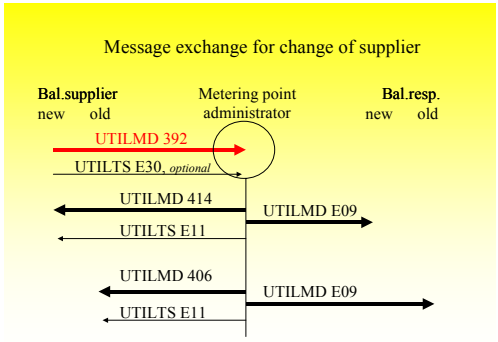

Figure 6.2. Message exchange for change of supplier

Further, the standard provides an overview of message types and their particular application. Two examples of message types are provided in the table below.

EDI Message		Information	From	To
UTILMD	392	Notification to the metering point administrator for start of supply	New balance supplier	Metering point administrator
	414	Confirmation or rejection of start of supply	Metering point administrator	New balance supplier

Table 6.5. Examples of message types

The remaining part of the standard deals with the structure and the content of the messages. The structure of the message implementation guideline of the UTILMD in the Netherlands is derived from the Edifact UTILMD message. The EDIFACT UTILMD message is a message for communicating "Utility master data". In the table below we provide parts of the EDIFACT UTILMD message. The grey areas are part of the original EDIFACT message which are not used in the Dutch situation.

```
0010  UNH Message header                          M   1
0020  BGM Beginning of message                    M   1
0030  DTM Date/time/period                        M   9
0040  MKS Market/sales channel information        C   9
0050  FTX Free text                               C   9
0060     ----- Segment group 1  ----------------- C   9----------+
0070  RFF Reference                               M   1         |
0080  DTM Date/time/period                        C   9----------+
0090     ----- Segment group 2  ----------------- C   99---------+
0100  NAD Name and address                        M   1         |
0110  RFF Reference                               C   1         |
0120  FII Financial institution information       C   1         |
                                                                |
0130     ----- Segment group 3  ----------------- C   9---------+|
```

0140	CTA Contact information	M	1	||
0150	COM Communication contact	C	9----------++	
0160	**----- Segment group 4 ----------**	**C**	**99999-------+**	
0170	**IDE Identity**	**M**	**1**	**|**
0180	**LOC Place/location identification**	**C**	**9**	**|**
0190	PIA Additional product id	C	9	|
0200	**IMD Item description**	**C**	**9**	**|**
0210	**DTM Date/time/period**	**C**	**9**	**|**
0220	PRC Process identification	C	9	|
0230	**STS Status**	**C**	**9**	**|**
0240	**TAX Duty/tax/fee details**	**C**	**9**	**|**
0250	**PTY Priority**	**C**	**9**	**|**
0260	**FTX Free text**	**C**	**9**	**|**
0270	**AGR Agreement identification**	**C**	**9**	**|**
0280	**INP Parties and instruction**	**C**	**9**	**|**
				|
0290	**----- Segment group 5 ----------**	**C**	**99---------+|**	

Table 6.6. The EDIFACT message

Each message structure consists of segments. An example of a segment is a segment called BGM or Beginning of message (see below).

02 BGM Beginning of Message 1 M

Data-element		**Type**	**Description**	
C002	DOCUMENT/MESSAGE NAME			
1001	Document/Message Name, coded	an..3	*392 Notification to metering point administrator of start of supply *414 Confirmation (or rejection) of start of supply *406 Information or confirmation (or rejection) of end of supply *432 Notification to metering point administrator of end of supply *E07 Master data metering point *E09 Master data balance responsibility *E10 Request for update master data *E36 Master data transport responsibility	R
1131	Code list qualifier	an..3		N
3055	Code list responsible agency	an..3	*260 Ediel	D
1000	Document message name	an..35		N
1004	DOCUMENT/MESSAGE NUMBER	an..35	Unique ID for the message, given by the sender	R
1225	MESSAGE FUNCTION, CODED	an..3	*5 Replace of previously sent message *9 Original message	R
4343	RESPONSE TYPE, CODED	an..3	*AB Message acknowledgement is required *NA No acknowledgement required	R

Table 6.7. Example of a segment

This segment consists of data elements like message name, message number, message function, and response code. It is possible that a data element is described using other data elements. For example, the message name can be described using data elements "message name, coded, code list qualifier, code list responsible agency, and document message name". We will go one step further and describe one data element concerning document name, mainly document name, coded. Each possible message name is given a code. The possible message names are listed in the standard and each message is linked to a code. Example of a message name is "notification of a metering point administrator of start of supply" (message number *392), or "confirmation (or rejection) of a start of supply" (message number *414). The message number is a unique number for the identification of the message. The codes are maintained by a code responsible agency, in this case Ediel. What is also interesting to notice is that one EDIFACT message, a number of other messages are defined (see the description of the data element 1001).

Concerning the message function, two functions are defines (either the message is an original message, or a message is sent to replace a previously sent message). The response type means that either an acknowledgement is required to that message or that such an acknowledgement is not required.

What is important to notice is that a message segment can be mandatory (M), required (R), or conditional (C), and each data element can be required (R), dependant (D), or not required (N). What is also interesting to notice is that under each segment description there are remarks. Below we present an example of the segment "Agreement notification" and the remarks accompanying it.

11 AGR Agreement identification 9 C

Data-element		**Type**	**Description**	
C543	AGREEMENT TYPE IDENTIFICATION			M
7431	Agreement type qualifier	an..3	*11 Grid connection contract	M
7433	Agreement type description code	an..3	*E01 Contract directly between Grid Operator and Customer *E03 Contract between Grid Operator and Customer through Supplier	R
1131	Code list qualifier	an..17		N
3055	Code list responsible agency	an..3	*260 Ediel	R

Remarks

Segment to exchange master data about the contract relation between customer on the one hand and the balance supplier and grid operator on the other. Specification of the contract relation has to be included in UTILMD 392 (and has to confirmed in UTILMD 414).

Bilateral agreement between the supplier and the grid operator is not supported by the PVE procedures, and can therefore not be specified in standard Edine messages.

7431: code is an official Edifact code.

7433: these codes are being maintained by Ediel.

For the use of the segment and the codes see annex A.2.

Table 6.8. Example of a segment and the accompanying it remark

In this example, we see that there are some explanations when to use a certain segment and when not. Further, there is a reference to annex A.2. for further information concerning segments and codes. Apart from that, the standard specifies several annexes and below we will discuss some of them. In some of the annexes, the standard further specifies combinations of allowed codes in a specific segment. E.g. in annex A1 the allowed combinations of codes concerning status (the segment STS)

Overview of combinations of codes allowed in segment STS09
Change of supplier

BGM	STS C601	STS C555	STS C556	Information flow
392	7		E03	Change of supplier
414	E01	39	E03	Confirmation
414	E01	41	E10 …..E22	Rejection
406	7		E03	Contract termination, reason change of supplier
E09	7		E03	Start new contract balance resp., reason change of supplier

Table 6.9. Example one of allowed combinations of codes

A similar example can be found in annex A.5. specification of the address.

A5. Specification of address in SG11 NAD23
In this NAD-segment the following address information is included:

Purpose	Message type	Status[27]		Condition	EAN-code	Party name	Street name (incl. house number)	City name	Post code
		E	G						
Specify balance supplier	E07	R	R	None	Yes	No	No	No	No
Specify balance responsible	392 414 E07	R	N	For electricity only.	Yes	No	No	No	No
Specify shipper	392 414 E07	N	R	For gas only.	Yes	No	No	No	No
Indicate more than one shipper (gas only)	E07	N	O	For gas only. Only if there is more than one	No	No	No	No	No
Metered data collector	E07	N	O	For gas only.	No	No	No	No	No
Specify invoice address [28]	392 414	O	O	Only for AGR with code E01 (DE7433) "tussenvorm"	Yes	No	No	No	No
	392 414	O	O	Only for AGR with code E01 (DE7433)	No	Optional	Yes	Yes	Yes
Specify address for metering point	E07	R	R	None	No	No	Yes	Yes	Optional (not always available)
Specify name customer for metering point	392 414	R	R	None	No	Yes	No	No	No

E- electricity, G-gas;R-required

Table 6.10. Example two of allowed combinations of codes

[27] R: required, O: optional
[28] The invoice address is only relevant in case of "netbeheerdersmodel" (code E01 in AGR). The invoice address may be specified as the EAN-code of the supplier (tussenvorm), or the physical address of the customer. Only one invoice address shall be given. The procedures described by PVE wg04 and wg09 do not require the specification of the physical invoice address by the supplier because the customer is supposed to be in direct contact with the grid operator. Only the specification of the supplier as invoice address (by using the EAN-code) is supported by PVE procedures.

What we want to illustrate with this example that there are complex rules which combination of segments are allowed and not allowed and that the rules can be found in different places in the document. Further, the standard has additional complexity, as it defines simultaneously the messages for gas and electricity.

At the end of the standard, a number of message examples are included.

Example of an UTILMD-message: update of register balance responsibility (start and/or stop contract) (E09)

Edifact segments UTILMD-message			**Contents and clarification**
UNH		UNH+NR001+UTILMD:D:01C:UN:E4NL20’	EDIFACT-message type (UTILMD) and EDIEL version 4 national version 2.0
BGM		BGM+E09::260+ZZ200104110017+9+AB’	Message number, original message, acknowledgement required
DTM		DTM+137:200104261643:203’	Message date and time: 26th of April 2001
DTM		DTM+735:?+0200:406’	UTC offset is 2 hours
MKS		MKS+23+E01::260’	Electricity
NAD		NAD+MR+873333300001c::9’	Message to the old balance responsible
NAD		NAD+MS+871234699999c::9’	Message from the metering point administrator
IDE		IDE+24+00004’	Transaction ID
	LOC	LOC+172+87123470000012345c::9’	Metering point ID
	DTM	DTM+93:200105010000:203’	Contract stop date: 1rst of May 2001
	STS	STS+7++E03::260’	Reason: supplier change
IDE		IDE+24+00005’	Transaction ID
	LOC	LOC+172+…….. etc etc	Metering point ID
	DTM	DTM+92: ……. etc	Contract start date:
	STS	STS+7++ ….. etc etc	Reason:
IDE		IDE+ ……..etc	Etc.
	LOC		
	DTM		
	STS		
UNT		UNT+123+NR001’	

Table 6.11. Example of a message

With this example, we have completed the introduction of the standard. Although the information presented so far might seem too detailed, we need this level of detail to create an impression about the standard and to provide for further analysis.

6.2.2. Level 1

Step 1: type of analysis	Standard analysis (analysis type 1.2.)
Step 2: level of analysis	Level of analysis 1
Step 3: View	CA view
Step 4: Question	Is the CA view addressed in the standard?

Table 6.12. Standard analysis (analysis type 1.2.), Level 1 CA view

Let us now proceed with the communicative act view. As we have discussed in part 2, the communicative act view deals with business conversations. If we look at the standard, we can say that this view is to some extent modelled. The standard includes explicit models of what kind of conversations the different parties in a process can enter into. An example of such a conversation is presented in figure 6.2 earlier in this chapter. Apart from that, the standard provides further specification of the content of the messages. Based on that discussion, we can conclude that we can continue the analysis of the standard with respect to the communicative acts to level two as well.

6.2.3. Level 2

As argued in part 2, the communicative act view deals with business conversations. The table below outlines the steps to be followed. Further we have derived a number of questions to guide the analysis.

Step 1: type of analysis	Standard analysis (analysis type 1.2.)
Step 2: level of analysis	Level of analysis 2
Step 3: view, concepts	Communicative act view Ae-message has one communicator, one interpreter, one propositional content, one communicative function Ae-message is part of Sequence of utterences
Step 4: Questions	For a-message, are the following concepts defined? Communicator, interpreter, propositional content, communicative function? Is it defined how an ae-message forms part of a sequence of utterances? Are there cases when two ae-messages are merged into 1 message?

Table 6.13. Standard analysis (analysis type 1.2.) Level 2 CA view

We will now proceed with the analysis of the standard. As mentioned earlier, the standard includes tables, where UTILMD messages are definer. Each message is given a number, information, as well as who is the sender and who is the receiver. We have discussed this earlier in this chapter (see Table 6.5). For the purpose of this example we will repeat the table again

EDI Message		Information	From	To
UTILMD	392	Notification to the metering point administrator for start of supply	New balance supplier	Metering point administrator
	414	Confirmation or rejection of start of supply	Metering point administrator	New balance supplier

Table 6.14. Example of two message

To analyze the standard we will use the concepts and the questions above, mainly whether for each message it is clear who is the communicator, the interpreter, what is the content and what is the intention.

Communicator and interpreter

From the table above we can see that for each message number, the communicator and the interpreter are specified.

Communicative function
If we look at UTILMD 392 message we can say that the intention (or the communicative function) is to a large extent clearly defined. With this message the new balance supplier requests the metering point administrator to consider him as a new supplier for this metering point.

Merging of ae-messages
If we look at the UTILMD 414 message however we can say that the same message number (UTILMD 414) can carry two different communicative functions- confirmation of a start of supply or rejection of a start of supply. It is clear that the parties will need to look further into the content of the message to understand what is the intention, however the content would differ in case of confirmation and rejection. This means that message UTILMD 414 is not an ae-message but tries to combine two ae-messages. This might lead to ambiguities.

Propositional content
Now let us continue with the propositional content or the question "is the propositional content of an ae-message clearly defined?" As discussed earlier in this chapter, the standard provides the segments and data elements to be used in constructing the messages and rules how to come to these messages. At the end the standard also provides examples of messages. If these examples are only to be read as examples it seems that the standard provides the components (rules and segments) on how to arrive at a propositional content of a message, rather than providing the propositional content itself.

When looking at the standard one can find rules, which segment to use (or not use) in which message in the remarks specified after each segment. Further, which combination codes are allowed for each message and some other rules are provided in annexes. This means that the derivation of the propositional content is left to the users of the standard does not provide fully described operational messages. We consider that this can be a serious cause for potential problems. Some of the messages to be exchanged contain complex information. If the propositional content is not unambiguously specified but left to the user to come up to a correct message following complex rules, we expect to have differences in the message specifications done by different users of the standard.

Sequence of utterances
Concerning the question how a message is embedded in a business conversation, the standard provides a number of scenarios, which a conversation can follow depending on the process. E.g. it specifies scenarios concerning the message exchange for change of supplier, and message exchange for customer move in. An example of these scenarios was presented earlier in this chapter (see figure 6.2). In that respect at level two we cannot identify potential problems with the standard with respect to the sequence of utterances.

6.2.4. Summary
Based on the analysis of the standard with respect to the CA view, we consider that potential problems can be expected. Our observation is that the PC of the messages is left to a large extent to the user to define it. We consider that this can be seen as a serious problem, as the standard leaves room for interpretation what the content of the message should be. As these messages will be directly embedded in the computer system, we foresee that this can cause communication failures.

We have also found an example of message with the same number, which carries two communicative functions, which we consider can lead to ambiguities. The table below summarizes our findings.

Summary Standard analysis (analysis type 1.2.): CA view		
Level 1	(-)	
Level 2	(X)	PC is left to the user to define it There are examples of messages, which carry two communicative functions
(-) problem not identified (X)- problem		

Table 6.15. Summary standard analysis. CA view

6.3. Mismatch analysis (analysis type 1.3): CA view

The analysis type 1.3. aims to identify whether there are differences between the requirements and the standard with respect to the CA view. We will follow the method and perform level 1 and level 2 analysis respectively.

6.3.1. Level 1

At level one analysis, the goal is to identify mismatches between the requirements and the standard with respect to the view.

Step 1: type of analysis	Mismatch analysis (analysis type 1.3)
Step 2: level of analysis	Level of analysis 1
Step 3: View	CA view
Step 4: Question	If the CA view is covered (explicitly or implicitly) in the specified requirements, is it covered in the standard?

Table 6.16. Mismatch analysis (analysis type 1.3), Level 1, CA view

If we go back to analysis type 1.1 and 1.2. we can conclude that the CA view has been addressed both in the requirements and the standard. In that respect, we cannot find difference between the two at level 1.

6.3.2. Level 2

At level two analysis, the goal is to identify mismatches between the requirements and the standard with respect to concepts in the chosen view.

Step 2: level of analysis	Level of analysis 2
Step 3: view, concepts	Communicative act view Ae-message has One communicator, one interpreter, one propositional content, one communicative function Ae-message is part of Sequence of utterances
Step 4: Questions	Are there concepts with respect to the CA view, which are covered by the specified requirements but not covered by the standard?

Table 6.17. Mismatch analysis (analysis type 1.3), Level 2, CA view

During analysis type 1.1. and 1.2. we have seen that both the requirements and the standard cover the concepts specified in the communicative act view. In that respect, we were not able to identify concepts from CA view which were covered by the requirements but not by the standard. In that respect, with analysis type 1.3. we did not identify differences between the requirements and the standard at level 1 and level 2 respectively. With respect to both the standard analysis and the requirements analysis we have identified potential problems related to the propositional content. In that respect, we may expect that on 2 (3,4) examples may be identified that point to differences between the standard and the requirements, however for that additional input and more detailed analysis will be needed from the requirements and the standard analysis.

6.3.3. Summary

Summary Mismatch analysis (analysis type 1.3): CA view		
Level 1	(-)	
Level 2	(-)(*)(I)	There may be mismatches between the requirements and the standard (due to the fact that with respect to CA view problems with the PC were identified with both the requirements and the standard). Additional input from the standard and requirements analysis is needed.
(*)- point of attention (-) problem not identified (I)-additional input needed with respect to the requirements analysis and the standard analysis		

Table 6.18. Summary mismatch analysis (analysis type 1.3): CA view

7. Subject matter view

7.1. Requirements analysis (analysis type 1.1): SM view

7.1.1. Background

The subject matter view aims to define the domain of interest with respect to the DBT situation, its conception and representation. In the requirements document we can find some implicit model of the subject matter view in tables, describing the content of some registers. We have identified different documents, from where it can be deduced which is the domain of interest, its conception and representation. We will discuss examples from several documents, to give an impression about the type of information that we are referring to.

One such document is PVE-werkgroep 2E, netbeheer electriciteit", versie 2.6, 16 juli 2003. There we find for example information that need to be contained in different registers. One such example is the connection register. The description below describes the elements of the connection register. [29].

2.1.6.1. The grid operator administers for his own grid a register, called a connection register, where for the connection, identified by an EAN code is recorded: Indication of the product to be delivered via this connection (electricity in the case of the grid code) The name, address, location- data concerning the connection point Identification of the current program responsible (company – EAN code) Identification of the current supplier (company EAN code) The actual values of the contracted transportation capacity of connection, i.e. the actual throughput of the connection The current profile that is applicable for this connection. The current standard yearly usage applicable for this connection

Table 7.1. Elements of the connection register

Information relevant from the subject matter view can be found in other documents as well. Example is the "Information flows.". This document has already been discussed in the context of the business process view and the communicative act view (see figure4.3 or 6.1). For each of the interactions discussed earlier, additional information about the content of the message is available". Below we give an example of a message S1: "request switch of supplier".

S1: Message "request switch of supplier" sent from the new supplier to the grid operator From a contract with the client the supplier fills in a standard message "repot switch". Per switch and per product, an unique message will be generated. The sending of this message means that the grid operator is granted the permission to initiate a switch. The content of the message: "report switch" contains: EAN code of the connection of the client The task content of the message: switch of supplier Choice of product (electricity- gas) Date of entry Settlement of the transportation costs via (supplier – grid operator model) Responsible (program responsible/ Shipper) Perhaps: meter readings and origin of these meter readings. This message can be entered with the grid operator at earliest one month before the intended switch date. The last possible entry date is five working days before the intended switch date.

Table 7.2. Example of message S1

From the information contained in the message one can also identify elements of the subject matter view.

A third example of a document where we can find elements of the subject matter view is the "list of concepts" of Dte, where the major concepts used with respect to the energy liberalization are defined.

[29] PVE-werkgroep 2E, netbeheer electriciteit", versie 2.6, 16 juli 2003, p. 24

We will not go further in listing all the possible documents describing information concerning the subject matter. What is interesting to notice is that explicit and formal models with respect to the subject matter seem not to be available.

7.1.2. Level 1

To conduct analysis type 1.1. with respect to the subject matter view, we will follow the steps described in the method and we will analyze separately level 1 and level 2 analysis.

Step 1: type of analysis	Requirements analysis (analysis type 1.1.)
Step 2: level of analysis	Level of analysis 1
Step 3: View	SM view
Step 4: Question	Is the SM view addressed in the specified requirements?

Table 7.3. Requirements analysis (analysis type 1.1.), Level 1, SM view

If we recall from part 2, the subject matter view aims to describe which is the domain covered by the requirements, and what is the conception and the representation of that domain. When we look at the specified requirements, we can say that an explicit model of the domain is not available and that the model is implicitly embedded in the specified requirements. In section one we have provided a number of examples, where we can find elements of the subject matter.

From these examples we can see that although elements of the subject matter view can be found in the requirements documents, an explicit model is not present.

As discussed in part 2, as well as in the method, the subject matter view and the communicative act view are the two views, which go into high level of detail. These two views need to be explicit and formal, as the information specified there will be embedded in the computer systems. What we have found out with respect to the requirements is that such an explicit and formal model with respect to the subject matter is missing. We consider this as a serious sign that potential problems might occur.

It was further discussed that in case of implicit models, two possible directions to follow are possible. One is to proceed and construct a model and identify on a detailed level potential problems during the modeling process. The other way is to proceed to level two analysis and make a quick check whether there are some apparent problems. For illustration purposes we will continue with the level 2 analysis.

7.1.3. Level 2

Within this section we will illustrate how the analysis type 1.1. of the requirements at level 2 can be done with respect to the subject matter view. The table below summarizes the type and the level of analysis, as well as the concepts of the subject matter view. In case we identify that some problems occur already by applying the some of the concepts, we will stop the analysis and advise to revisit the requirements.

In the table below we generated a number of questions. If we do not find potential problems using these questions we will generate other possible questions using the other concepts and consecutively we might need to generate questions using the other concepts if needed.

If we look at the examples specified in level 1 analysis and we walk through the questions specified, we can notice that not always the properties are represented in terms of things and values.

Step 1: type of analysis	Analysis type 1.2.
Step 2: level of analysis	Level of analysis 2
Step 3: view, concepts	**Domain** / **Conception** / **Representation** Thing Intrinsic Property/attribute of a thing Mutual Property/attribute of a thing Value Class Functional schema Law State Lawful state space Event Synonym situation Homonym situation
Step 4: Questions	Is it clear from the requirements which are the things of interest? Are the intrinsic properties of things modelled in the requirements ? For each thing in the requirements, is it clear which are its intrinsic properties? Are the mutual properties of things modelled in the requirements? Are the values of a property of the things specified in the requirements? For each thing, specified in the requirements, is it clear which are its mutual properties? If a mutual property is specified, is it clear in the requirements, which are the things, to which it is a property? Are the properties specified in the requirements always presented in terms of things and values?

Table 7.4. Requirements analysis (analysis type 1.1.) Level 2 SM view

Let us take the example specified in section 1 concerning the connection register

2.1.6.1. The grid operator administers for his own grid a register, called a connection register, where for the connection, identified by an EAN code is recorded: Indication of the product to be delivered via this connection (electricity in the case of the grid code) The name, address, location- data concerning the connection point Identification of the current program responsible (company – EAN code) Identification of the current supplier (company EAN code) The current values of the contracted transportation capacity of connection, i.e. the current throughput of the connection The current profile that is applicable for this connection. The current standard yearly usage applicable for this connection.

Table 7.5. Information in the connection register

Things, properties, values

If we look at the information required for the connection register, we can try to construct an ontological model. For some things of interest, the allowed valued that a property can take are described. Such an example is connection code and the allowed values for a connection code are EAN coded values. If we look at "location" and "address" however, the allowed values seem not to be specified.

Further, if we look at table 7.5. we can see that for some other properties, like "profile" and "standard yearly usage", the allowed values for these properties are not specified in the table. The "profiles" and the "standard yearly usage" are discussed in anther part of the requirements document, however in the table describing the requirements for the grid, no explicit reference to the allowed values was mentioned. What we can say is that in some cases the requirements documents contain information, which can be used to build up an explicit model of the subject matter, however this information is dispersed all over the documentation and as we have seen in the example with the table above, not always complete. This can be seen as potential problem, as one will need to search for the relevant information in different parts of the requirements documents and will sometimes encounter incomplete information, to be able to come to an explicit model of the subject matter.

As in this case we have identified problems already at the stage of using the fundamental concepts, we will not continue the analysis including the additional concepts like e.g. state and law.

7.1.4. Summary

As a result of analysis type 1.1. with respect to the subject matter view, we have identified problems at both level 1 and level 2. The level 2 analysis confirmed the observation of the level 1 analysis that explicit models of the SM are missing. The general observation is that the relevant information is spread in different documents and it is not straightforward to bring this information together and to arrive at an unambiguous model of the domain.

Summary Requirements analysis (analysis type 1.1.): SM view		
Level 1	(X)	Explicit models concerning the SM view are missing
Level 2	(X)	
(X)- problem		

Table 7.6. Summary requirements analysis (analysis type 1.1.): SM view

7.2. Standard analysis (analysis type 1.2.): SM view

7.2.1. Background

Information about the subject matter covered in the standard can be found on several places in the standard specification document. To be able to give an idea about how this is done, we will discuss one part of the standard (the part about exchange of master data) and we will introduce the different parts of the standard, where we can find indication about the subject matter. We have identified the following sources for information, which we can use in analysis 1.2. (SM).

At the beginning of the message specification we find a table specifying the master data that needs to be specified for a connection. Within the standard, the master data concerning a connection specifies only the relevant data to be able to make a switch process. The standard provides an overview of the set of master data for a metering point for both gas and electricity. The table below provides some examples concerning the type of master data.

Item	Electricity	Gas
ID metering point	Required	Required
Physical location: address, house number, postal code and country code of metering point	Required	Required
ID balance responsible	Required	Not required
ID profile	Dependant	Dependant

Table 7.7. Example of types of master data

SG4	**IDE-LOC**-*PIA-IMD*-**DTM**-*PRC*-**STS-TAX**-*PTY-FTX*-**AGR-INP**-*SG5*-**SG6-SG7**-*SG10*-**SG11**	**99999**	**R**
08	DTM	Date/time/period	9	C

Data-element		**Type**	**Description**	
C507	Date/time/period			M
2005	Date/time/period, qualifier	an..3	*92 Contract start date *93 Contract end date *157 Validity start date *752 Planned next meter reading (month)	M
2380	Date/time/period	an..35	Date/time/period	R
2379	Date/time/period, format qualifier	an..3	*203 CCYYMMDDHHmm *610 CCYYMM	R

Remarks

- Time zone is defined in DTM03.
- Contract start date is the date when the delivery by the new supplier begins. Contract end date is the date when delivery by the old supplier stops.
- Electricity: Contracts are supposed to start or end at 00.00 hrs *(is beginning!!)* of the given date.
- Gas: Contracts are supposed to start or end at 06.00 hrs of the given date.
- Planned meter reading month (code 752 in DE2005) is specified using the format CCYYMM (code 610 in DE2379).

Table 7.8. Example of a segment

Apart from that the standard specifies a number of segments (see table 7.8 as an example). These segments are used as a building block for arriving at messages (this will be discussed in section CA). However the segments also contain information, which refers to the things of interest covered in the standard and their conception and representation.

Although the standard contains information, which refers to the subject matter view, an explicit model of the domain of interest, the conception, and the representation of that domain is missing. Let us now continue to level 1 and level 2 respectively.

7.2.2. Level 1

The table below outlines the steps to be followed with respect to the subject matter view.

Step 1: type of analysis	Standard analysis (analysis type 1.2.)
Step 2: level of analysis	Level of analysis 1
Step 3: View	SM view
Step 4: Question	Is the SM view addressed in the chosen standard?

Table 7.9. Standard analysis (analysis type 1.2.), Level 1, SM view

When we look at the standard, we can say that an explicit model of the domain is not available and that the model is implicitly embedded in the standard. As discussed in part 2 and well as in the Method, if an explicit and formal model with respect to the subject matter view is missing in the standard, this can be seen as a substantial source of potential problems.

As discussed earlier, in this case we identify a potential problem with the standard at level 1 with respect to the subject matter view and we will proceed to level two for further analysis.

7.2.3. Level 2

The table below summarizes the steps of the process to be followed in the analysis. With respect to concepts, we again use the concepts identified in the SM view. Further, similar to analysis type 1.1. level 2 we formulate a number of questions using the fundamental concepts.

Step 1: type of analysis	Standard analysis (analysis type 1.2.)
Step 2: level of analysis	Level of analysis 2
Step 3: view, concepts	Subject matter view **Domain** — **Conception** — **Representation** Thing, Intrinsic, Property/attribute of a thing, Mutual Property/attribute of a thing, Value Class, Functional schema, Law, State, Lawful state space, Event Synonym situation, Homonym situation
Step 4: Questions	Is it clear which are the things that are part of the domain covered in the standard Are the intrinsic properties of the things modelled? For each thing from the standard, is it clear which are its intrinsic properties? Are the mutual properties of things modelled in the standard? Are the values of a property of things specified in the standard? For each thing specified in the standard, is it clear which are its mutual properties? If a mutual property is specified in the standard, is it clear which are the things, to which it is a property? Are the properties of things always presented in terms of things and values in the standard? Are there cases that the same representation links to different conceptions? Are there cases when different conceptions refer to the same representation?

Table 7.10. Standard analysis (analysis type 1.2.) Level 2 SM view

Things, properties, values
If we look at table 7.2.3.1.(metering point connection), we can say that from the required information, some of the things of interest can be deduced.

Item	Electricity	Gas
ID metering point	Required	Required
Physical location: address, house number, postal code and country code of metering point	Required	Required
ID balance responsible	Required	Not required
ID profile	Dependant	Dependant

Table 7.11. Metering point connection

From example, from the required information "ID metering point" and "ID balance responsible" we can deduce that metering point and balance responsible are two things of interest of the domain. However, from other pieces of information it is harder to deduce which are the things of interest in the domain, to which this information refers to.

Another example that we identified is the specification of date in one of the segments.
What is specified in the standard is Date/time/period qualifier and the following options are listed:
Contract start date
Contract end date
Validity start date

The first question that arises is to what date/time/period relates to? From the specified options we can see that date relates to start and end of a contract, or to validity. The next question is validity of what. Validity does not have a meaning on its own but it is not straightforward from the standard to what it relates. *Thus, we can say that the property is specified but the things, which relate to that property are not very obvious.*

e.g. Contract start date and the contract end date
The contract start date and the contract end date also provide for an interesting example. As we have discussed earlier, contract depends on the existence of parties of the contract. As in the previous example, the parties of the contract are not immediately clear. Further, as we discussed earlier, under the specification of the data elements, the standard provides remarks. If we read the definition of the contract start date it says that the contract start date is the date when the delivery of the new supply begins. Contract end date is the date when the delivery of the old supply ends. *What we see here is an example of a* same representation "contract" is used to refer to two different conceptions (i.e. the contract with the old supplier and the contract with the new supplier).

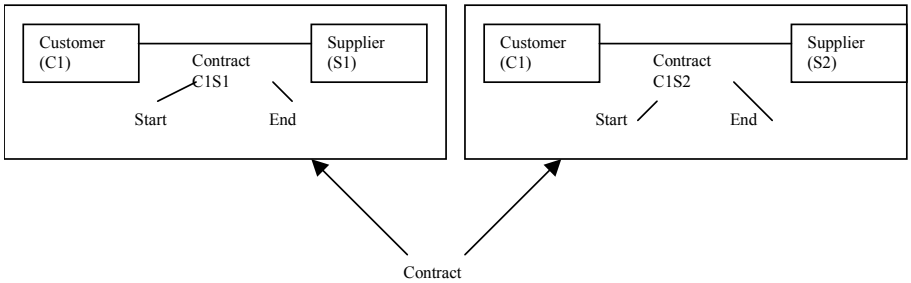

Figure 7.1. E.g. with contract start and contract end date

We will not do a thorough analysis of the standard with respect to the subject matter view. However what becomes obvious from the analysis is that there are parts of the standard, where properties are specified, without making clear how they relate to things.

7.2.4. Summary

Analysis level 1 suggested that in case explicit model with respect to the subject matter view is missing, potential problems can be expected. When we proceeded with the quick scan level two analysis, we identified examples, which point to potential problems, even when we use the fundamental concepts. Without making a complete analysis, by using the simple ontological checks on parts of the standard, we were able to identify ambiguities and incompleteness. This suggests that problems can be expected with respect to the subject matter view mainly due to incomplete specification of the conception of the domain. This on its turn suggests that the subject matter is not sufficiently specified, which hides the danger that there might be different interpretations concerning the meaning of the information. With respect to representation, we have identified one homonym situation.

Summary Standard analysis (analysis type 1.2.): SM view		
Level 1	(X)	
Level 2	(X)	Explicit and formal models concerning the SM are missing and are not easy to derive from the standard.
(X)- problem		

Table 7.12. Summary analysis type 1.2. SM view

7.3. Mismatch analysis (analysis type 1.3): SM view

Analysis type 1.3. aims to identify mismatches between the requirements and the standard with respect to the subject matter view. The case of the energy liberalization is an example how the requirements specifications and the standard were developed at the same time, and the requirements of the situation were taken as a starting point for the standard development. This is different than the situation that we discussed in Part 2, where the HL7 standard was developed independently from the situation it was applied. In that respect, in the energy case we do not expect to have big differences and mismatches between the requirements and the standard. We will however continue with analysis type 1.3.

7.3.1. Level 1

The table below summarizes the steps to be followed. Further, we have defined a question which is specific for this type of analysis.

Step 1: type of analysis	Mismatch analysis (analysis type 1.3)
Step 2: level of analysis	Level of analysis 1
Step 3: View	SM view
Step 4: Question	If the SM view is addressed in the specified requirements, is it also addressed in the standard?

Table 7.13. Analysis type 1.3. Level 1 SM view

Both the specified requirements and the standard address the SM view implicitly. As explicit models of the SM are not available and due to the fact that the SM view requires great detail, conducting level 2 analysis may be of little value.

7.3.2. Level 2

Analysis type 1.3. at level 2 aims to identify gaps between the requirements and the standard at a concept level. In table 7.14 below we have formulated a question to guide the analysis.

With respect to the subject matter view, during the requirements analysis and the standard analysis, we have identified substantial problems both with the requirements and with the standard at level 1 and level 2. In that respect, we expect potential problems with the mismatch analysis as well. We have identified examples of mismatches. For example, in the standard values are most of times defined, while this is not the case in the requirements. This however only points us to a problem that we have identified earlier, rather than bringing substantial new insights. We consider that further analysis of mismatches is not very useful, before the problems with the requirements and the standard identified with the requirements and the standard analysis are not addressed.

Step 1: type of analysis	Mismatch analysis (analysis type 1.3)
Step 2: level of analysis	Level of analysis 2
Step 3: view, concepts	Subject matter view **Domain** **Conception** **Representation** Thing, Intrinsic, Property/attribute of a thing, Mutual Property/attribute of a thing, Value; Class, Functional schema, Law, State, Lawful state space, Event; Synonym situation, Homonym situation
Step 4: Questions	Are there mismatches between concepts covered in the requirements and concepts covered in the standard?

Table 7.14. Mismatch analysis (analysis type 1.3), Level 2, SM view

7.3.3. Summary

Summary Mismatch analysis (analysis type 1.3): SM view		
Level 1		
Level 2	(X)	Both the requirements analysis and the standard analysis point to problems with SM view. In that respect, we expect also mismatches between the two. Examples of mismatches with respect to the concept of value are identified
(X)- problem		

Table 7.15. Summary Mismatch analysis (analysis type 1.3), SM view

When con ducting the analysis type 1 with respect of the subject matter view, we came to the following conclusions. The analysis at level one of both the requirements and the standard identified that explicit models with respect to the subject matter view are not available. We have concluded that this can be seen as cause for potential problems related to both the standard and the requirement. During the analysis at level for both the requirements and the standards we have identified examples, where some key concepts from the system of the subject matter view were not covered. This observation can be seen as a reinforcement of the observation of analysis at level 1 and mainly that the information available in the standard is partially not sufficient to come to a complete and explicit model. All these observations can lead us to the conclusion that problems and ambiguities at semantic level can be expected, when the standards are embedded in the system.