Development of a Subject-Oriented Reference Process Model for the Telecommunications Industry

André Nursinski-Stolberg[1], Kiritharan Gangatharan[2] und Christian Czarnecki[3]

Abstract: Generally the usage of reference models can be structured top-down or bottom-up. The practical need of agile change and flexible organizational implementation requires a consistent mapping to an operational level. In this context, well-established reference process models are typically structured top-down. The subject-oriented Business Process Management (sBPM) offers a modeling concept that is structured bottom-up and concentrates on the process actors on an operational level. This paper applies sBPM to the enhanced Telecom Operations Map (eTOM), a well-accepted reference process model in the telecommunications industry. The resulting design artifact is a concrete example for a combination of a bottom-up and top-down developed reference model. The results are evaluated and confirmed in practical context through the involvement of the industry body TM Forum.

Keywords: Subject-oriented Business Process Management, Reference Process Model, eTOM, Telecommunications Industry.

1 Introduction

The design and improvement of business processes supported by reference process models are intensively researched topics that are influenced by a broad variety of methodical approaches (e.g. Becker and Schütte 2004; Malinova et al. 2013; Houy et al. 2014). The emerging digital age has a significant impact on business processes in order to remain competitive with respect to fast changing market and innovation requirements (Schmiedel and vom Brocke 2015). Flexibility and agility (Richter and Esswein 2014), collaborative modeling concepts combined with increased involvement of stakeholders (Krumeich et al. 2013; vom Brocke 2015), and the direct execution of process models (Börger and Fleischmann 2015) are demanded.

A common way of structuring the work is a hierarchical decomposition from a high-level process framework to detailed operational processes (Rammler and Ramias 2010). According to this hierarchical process structure, two different starting points can be distinguished. Firstly, the performance of current processes is measured on an operational level to identify weaknesses that are improved in an incremental way, like e.g. proposed by Six Sigma (Harmon 2010). Secondly, future (target) processes are

[1] Detecon International GmbH, Sternengasse 14-16, 50676 Köln, andre.nursinski-stolberg@detecon.com
[2] Detecon International GmbH, Sternengasse 14-16, 50676 Köln, kiritharan.gangatharan@detecon.com
[3] Hochschule für Telekommunikation Leipzig, Gustav-Freytag-Straße 43-45, 04277 Leipzig, czarnecki@hft-leipzig.de

completely re-designed starting with a high-level understanding of the value chain, like e.g. proposed by Business Process Reengineering (Hammer and Champy 1994, Harmon 2010). Hence, according to the starting point those approaches can be differentiated into top-down and bottom-up.

With respect to bottom-up design and implementation of business processes, there is currently a discussion about the subject-oriented Business Process Management (sBPM) (Fleischmann 2013). sBPM offers a process modeling notation that focuses on the process actors and their interactions combined with a process modeling tool that allows a direct execution (Fleischmann 2013). As sBPM starts with a bottom-up approach on an operational level with direct involvement of the process actors, an advantage is seen in a fast organizational implementation (Hübner 2015). The practical usage of sBPM is described in various case studies by different authors. The case studies underline the benefits of a bottom-up approach with respect to higher acceptance of the process design as well as to fast implementation in the organization (cf. Section 2.1). However, the sBPM usage described in these cases focuses on a small amount of operational processes that are improved through design workshops with process actors (e. g. Augl and Stary 2015; Lederer et al. 2015). The restriction to a small amount of operational processes can be seen as a limitation of the bottom-up approach proposed by sBPM.

Therefore our paper offers a combination of the well-accepted top-down reference process model *enhanced Telecom Operations Map* (eTOM) with a bottom-up reference process modeling approach, i.e. for both the development as well as the usage. In the telecommunications industry the reference process model eTOM is widely used and confirmed as a de facto standard (ITU 2007; TM Forum 2015) as well as discussed in scientific research (Kelly 2003; Holschke et al. 2009; Czarnecki et al. 2013). We have researched the question how a combination of the sBPM bottom-up approach with the top-down reference process model eTOM could be realized. We have structured this question as follows: (1) the development of a general method for combining sBPM with a reference process model and (2) the application of this method in order to design concrete sBPM artifacts.

The results presented in this paper are based on the work of the TM Forum eTOM working group[3] that is an industry organization consisting of telecommunications companies, vendors, and consulting companies worldwide. We have developed the results in an iterative manner over two years considering practical requirements and feedback of the TM Forum. The results are presented here in a generalized and summarized form. The developed artifacts are an extension of the existing reference process model eTOM following the design science approach (Hevner et al. 2004). As an industry-specific reference model the results support telecommunications companies to address their transformational needs of the emerging digital age in an agile manner. From a general perspective, it contributes to the combination of inductive, bottom-up development with top-down reference models based on a practical example.

[3] The authors are part of this working group and have developed the presented results.

The paper is organized in the following way. Section 2 provides a short overview of reference process modeling, the concrete reference process model eTOM, and the bottom-up process design approach sBPM. In section 3, the development of our subject-oriented reference model for eTOM is described. The results are illustrated with the example of the customer-centric *Request-to-Answer* process. Furthermore, the evaluation of the results is discussed. Conclusion and limitations are presented in section 4.

2 Related Work

2.1 Reference Process Modeling

The design and improvement of processes can be supported by reference process models (e.g. Becker and Schütte 2004; Malinova et al. 2013; Houy et al. 2014). The usage of reference process models is related to cost and quality benefits (Fettke and Loos 2007; Fettke et al. 2006), widely accepted in practice, and often organized in a top-down manner (Becker and Schütte 2004; vom Brocke 2015). As a reference process model should be applicable for a range of situations, the generalization from a concrete implementation is necessary. In this context, reference process modeling is structured in (1) the development of a reference process model in order to support its reuse in various similar problem domains, and (2) the usage of an existing reference process model in order to develop a so-called application model customized to the requirements of a specific situation (Becker and Schütte 2004; vom Brocke 2015). The development of reference process models can be either organized top-down or bottom-up. While deductive development of reference process models starts top-down based on general theories and concepts (Becker and Schütte 2004; vom Brocke 2015), inductive development of reference process models derives generalizable content bottom-up from individual process models (Ardalani et al. 2013, Martens et al. 2015, Yahya et al. 2012). There is an intense discussion about the inductive development of reference process models in the research community that is mainly related to heuristic methods (Martens et al. 2015). So far, the usage of existing reference process models is typically organized in a top-down manner starting with a process framework followed by its decomposition to an operational level combined with a customization according to company-specific requirements. (Rosemann 2003; Rummler and Ramias 2010; Malinova et al. 2013).

2.2 The Reference Process Model eTOM

In the telecommunications industry the reference process model *enhanced Telecom Operations Map* (eTOM) is widely used and confirmed as a de facto standard (ITU 2007; TM Forum 2015) as well as discussed in scientific research (Kelly 2003; Holschke et al. 2009; Czarnecki et al. 2013). eTOM was developed and is continuously updated by the non-profit industry organization TM Forum. eTOM supports telecommunications companies in their transformational needs, e. g. caused by major changes in the value chain and harmonization efforts of processes and information systems (Bub et al. 2011, Czarnecki et al. 2013). It consists of a high-level reference structure for processes in the telecommunications industry and their hierarchical decomposition on different levels of detail (Kelly 2003). Hence, originally eTOM offers a hierarchical definition and structuring of processes without any logical process flow. This point was addressed by Czarnecki et al. (2013) by describing the extension of eTOM through reference process flows in three process domains, namely customer-centric domain, network domain and product domain. The eTOM sub-processes are connected and arranged in 18 process flows.

The customer-centric domain captures the following seven end-to-end reference process flows and act as a basis for the development of our subject-oriented reference process model: (1) Request-to-Answer, (2) Order-to-Payment, (3) Usage-to-Payment, (4) Request-to-Payment, (5) Termination-to-Confirmation, (6) Problem-to-Solution, (7) Complaint-to-Solution. eTOM is a valid example for a well-accepted top-down reference process model. The application of sBPM to eTOM was proposed by the authors as a new development to the TM Forum eTOM working group which has accepted this topic. The results of this extension are described in this paper.

2.3 Subject-Oriented Business Process Management

Subject-oriented Business Process Management (sBPM) is a process modeling approach based on a communication view between the involved actors (subjects) within a process (Schmidt et al. 2009). It is based on the idea that business process descriptions in natural language are complete sentences composed of subject, predicate and object (Schmidt et al. 2009). It is argued that in commonly applied approaches the focus is more on the predicate and object and less on the subjects. Therefore, sBPM focuses on the involved subjects within a process (Fleischmann et al., 2009).

It follows a short explanation of the subject-oriented approach according to Fleischmann et al. (2009): The focused subjects within a process can be concrete persons, roles, or machines that exchange messages among each other and thereby represent the process at hand. Within the first step of sBPM modeling the subjects and their interactions are covered, leading to a *Subject Interaction Diagram* (SID). The SID demonstrates the exchanged messages among the subjects. The second step, the behavior of the subjects is modeled by sequencing the activities of the respective subject using three states and transitions, namely *Send*, *Receive* and *Function*. The result of this step is captured in a *Subject Behavior Diagram* (SBD).

Since 2009 the usage of sBPM is discussed by practitioners and researchers on a yearly conducted dedicated sBPM conference[4]. Also various practical case studies of the sBPM usage were presented there, and published by Fleischmann et al. (2015). Please see Table 1 for a summary of relevant case studies.

[4] Please see www.s-bpm-one.org for further information.

Source	Case Scope	sBPM Usage
Lederer et al. (2015)	optimization of customer support process, monitoring of product development process	workshops with process actors for as-is analysis and to-be design, detailed modeling of existing BPMN diagrams, implementation in monitoring tool
Augl and Stary (2015)	process analysis and development at a university clinic for radiotherapy-radiation oncology	workshops with process actors for modeling as-is situation and developing model variants
Sprogies and Schmidt (2015)	design of the software deployment process for an IT service provider	workshops with process actors for modeling the as-is situation, bottom-up validation and optimization
Hübner (2015)	standardization of an IT hardware procurement and allocation process across subsidiaries	workshops with subsidiaries for as-is modeling
Lorbacher (2015)	digitalization of contract performance process	Scrum-based process modeling workshops, implementation based on sBPM tool and existing ERP system

Table 1. Cases describing the sBPM usage

All these case studies are focused on a small amount of operational processes, e. g. Lederer et al. (2015) describe the detailing of selected existing process diagrams through sBPM. They all describe bottom-up workshops for as-is analysis and/or incremental process optimization, e. g. Hübner (2015) emphasizes the bottom-up approach of sBPM, and Augl and Stary (2015) provide a detailed illustration of the as-is design workshops. All cases describe advantages in the acceptance of the process design as well as the fast implementation which confirms the benefits of a bottom-up approach with respect to agile and flexible processes. However, none of the cases describe a company-wide process design or the usage of a reference model.

The need for using reference models with sBPM is discussed by some authors. Forbrig (2015) identifies the requirement to reuse certain modeling parts in sBPM and proposes the concept of generic components. Garon et al. (2014) propose a sBPM reference implementation of the ITIL change management process. Piller (2015) suggests a sBPM representation of a reference process for maintenance. Mesbahipour et al. (2014) discuss how architecture planning on business, application, and data is achieved using the concepts of sBPM in rapid architecture cycles, creating greater agility. Hence, in all these papers sBPM is used for the detailing of single operational processes. In contrast, our paper describes the application of sBPM to a whole reference process model by combing the bottom-up and top-down perspectives.

3 A Subject-oriented Reference Process Model for eTOM

In our research we adhere to the principles of the design science research methodology (Hevner et al. 2004): after the initial problem identification, we developed a method for combining the bottom-up approach of sBPM and the top-down perspective of eTOM (cf. Section 3.1), and we have designed concrete sBPM artifacts based on this method (cf. Section 3.2). We have conducted both in an iterative way with input from real-life implementation projects. A reference model is a point of reference for a whole range of situations (Fettke and Loos 2007). Therefore a major part of our work is a generalized structure of process subjects that is independent from a concrete organizational structure. We have based this structure on a generalized job profile database that was successfully implemented in various projects. Furthermore we have studied the applicability of our sBPM artifacts in expert discussions and workshops (cf. Section 3.3). We have also undergone the evaluation by the TM Forum that has agreed the publication of our work.

3.1 Development of the sBPM Reference Process Model for eTOM

Our work is structured into (1) the development of a general method for combining sBPM and eTOM and (2) the application of this method in order to design concrete sBPM artifacts as an extension of eTOM.

The method is organized in the following four steps (cf. left part of Fig. 1):

1. *Identification and detailing of relevant processes*: Due to the bottom-up approach of sBPM detailed process definitions are required.
2. *Definition of generalized subjects*: The reference model eTOM is independent from a concrete organizational structure. The definition of subjects as a general reference is required.
3. *Mapping of subjects to sub-processes and tasks*: sBPM starts in a bottom-up manner with the interaction between the subjects involved in a process (cf. Section 2.1). Therefore, a mapping between the reference model eTOM and the generic subjects is a prerequisite for the design of sBPM artifacts.
4. *Development of Subject Interaction and Subject Behavior Diagrams*: The sBPM diagrams provide a concrete reference for the interaction and behavior of subjects as a process definition according to the sBPM concept.

We have applied the above method for the design of concrete sBPM artifacts as an extension of the existing reference model eTOM (cf. right part of Fig. 1). We have conducted the whole development in an iterative manner including regular expert discussions in the TM Forum working group and real-life data from projects in the telecommunications industry. The scope for our development of a subject-oriented process model is based on the eTOM domains (cf. Section 2.2). Mainly due to higher use and application in practice as well as the availability of valuable input from prior transformation projects, we focus in the current work on the customer-centric domain, covering all activities related to sales, production, logistics, and after-sales initiated by the customer (Czarnecki et al. 2013). According to our scope, the seven reference process flows of the customer-centric domain were used as input from the existing eTOM model. Those were analyzed with respect to their sub-processes and the involved tasks performed by the particular organizations and their representatives. Fig. 2 shows an example of the sub-processes and tasks of the reference process flow *Request-to-Answer* that were used as input for our development.

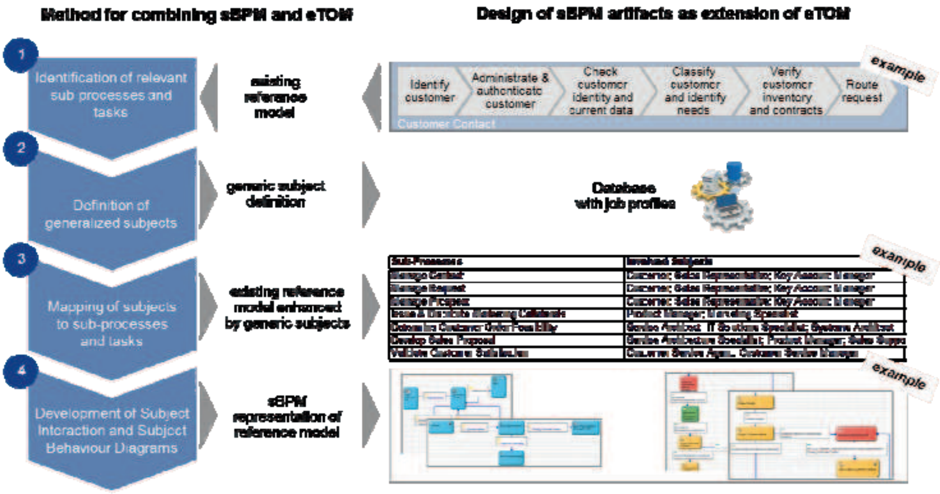

Fig. 1. Development of a subject-oriented reference process model for eTOM

According to our aim of a bottom-up development, in the next step insights from completed transformation projects in the telecommunications industry were used. On the one hand, real-life data of organizations that have successfully implemented those customer-centric processes were studied with the goal to identify the involved subjects that are part of these processes in their day-to-day business. On the other hand, job profiles and descriptions of the individual organizations and their subjects were screened with respect to the above mentioned sub-processes and their related tasks. The job titles of those representatives that were involved in the mentioned tasks to a strong extent were extracted in a bottom-up manner. However, in order to ensure that the retrieved job titles do not carry any specifics of the concrete company, they were generalized by comparing the individual job titles across organizations and reducing their nomenclature to their core functions based on the standardized definition of the eTOM model.

Afterwards the bottom-up collected and thereafter generalized subjects are mapped to the tasks and sub-processes of the seven reference process flows from the customer-centric domain of eTOM. The boundaries of the activities assigned to the individual subject are based on the same logic as they were extracted. The tasks are allocated to the subjects based on their job profiles and from observations how the responsibilities are defined in practice within the analyzed organizations. The company-specific insights used in this work are derived from a long established and regularly updated internal database that consists of retained results from multiple, international transformation projects in the telecommunications industry. The database contains samples of successfully implemented customer-centric processes, organizational structures, and job profiles from the respective companies. Actually in this database more than 500 entries are listed categorized in 40 job families.

Sub-Processes of Request-to-Answer:

- Manage Contact
- Manage Request
- Manage Prospect
- Issue & Distribute Marketing Collaterals
- Determine Customer Feasibility
- Develop Sales Proposal
- Validate Customer Satisfaction

Tasks related to Request-to-Answer:

- Presentation of portfolio
- Inform about products
- Customer access to product portfolio
- Handle customer retention and loyalty
- Handle customer data
- Offer management
- Handle product request
- Provide status information
- Provide consultation
- Trigger to perform cross- or up-selling activities

Fig. 2. Detailed sub-process and tasks of the reference process flow "Request-to-Answer"

With the aim to add the subject view to the eTOM model for each sub-process of the high-level process flow, detailed process models were designed based on the sBPM notation (Fleischmann et al., 2009). Firstly, the subject-oriented communication flows were modeled in Subject Interaction Diagrams. In combination with the generated generic subjects according to the above described approach, the process flows are the basis for the Subject Interaction Diagrams. The Subject Interaction Diagram shows the sent and received messages between the involved subjects. Secondly, for every subject of the Subject Interaction Diagram, the internal behavior was captured in Subject Behavior Diagrams that summarize the activities of each subject from its point of view within that particular process. Moreover, the messages that the subjects receive and send by interacting with other actors involved in the process are illustrated.

3.2 Illustration of the Results

The complete subject-oriented process reference model for the customer-centric processes of eTOM contains a Subject Interaction Diagram and a Subject Behavior Diagram for 97 individual subjects. Due to the limited space, we present within this paper an exemplary extract from the process flow *Request-to-Answer*.

Comparing the implemented *Request-to-Answer* process at various telecommunication companies, we identified the generic subject *Sales Representative* as the first subject involved in managing the customer contact and requests. He is the first touch point for the customer. The *Sales Representative* receives the request and either performs the tasks related to the sub-process *Manage Contact* himself or involves the *Key Account Manager* who is another generic subject. This particular interaction among those subjects illustrates an exemplary extract from the whole *Request-to-Answer* process (cf. Fig. 3).

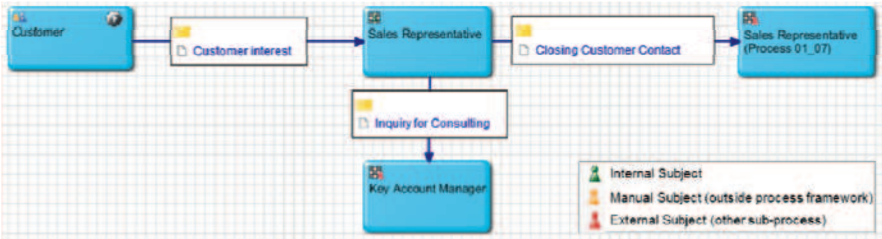

Fig. 3. Extract of Subject Interaction Diagram for "Request-to-Answer" process

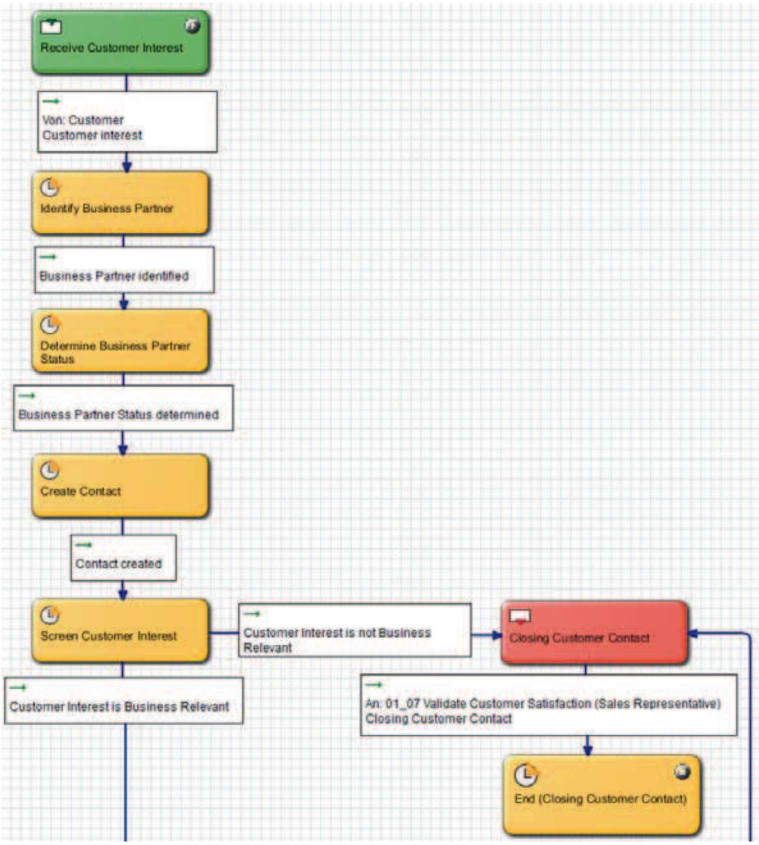

Fig. 4. Subject Behaviour Diagram for the generic subject "Sales Representative"

This extract also shows how the different sub-processes are connected to each other. In this example the *Sales Representative* forwards the task *Closing Customer Contact* to himself in the sub-process *Validate Customer Satisfaction*. Fig. 4 illustrates an example of the Subject Behavior Diagram for the subject *Sales Representative*. At first, the *Sales Representative* receives a request from the customer. Thereafter, he identifies the business partner and his status. Then he creates a contact after confirmation followed by screening the customer need. If it is not relevant for the concrete business, it is closed by the *Sales Representative*. Otherwise the *Sales Representative* verifies and updates the existing customer request and proceeds with the subsequent tasks. In this manner, we have designed the Subject Interaction Diagrams and the respective Subjective Behavior Diagrams for all seven reference process flows from the customer-centric domain.

3.3 Evaluation of the Results

In design science the development of an artifact is an iterative process that requires evaluation and refinement, e. g. based on case studies, analytical argumentations, or field studies (Hevner et al. 2004). A reference model is developed for various model users that could apply the reference model in a comparable problem domain (Fettke und Loos 2007). Both the applicability for different real-life scenarios as well as the anonymity of the possible model users makes the evaluation of a reference model a difficult task (Frank 2007).

In our context, the developed sBPM reference process flows are an extension of the existing reference model eTOM. Hence, the development is based on content that was already evaluated and confirmed by the industry organization TM Forum. The evaluation of our designed sBPM artifacts can be structured into the following two parts:

1. Evaluation of the generalized subject structure
2. Evaluation of Subject Interaction Diagrams and Subject Behavior Diagrams

For the generalized subject structure we have used an own organizational database that contains the organizational structure of various telecommunication companies worldwide. Those organizational structures were generalized in job profiles defining organizational entities that are commonly used in telecommunication companies. Those job profiles were again used as a reference in various reorganization projects (cf. Table 2) which confirm our generalized subject structure.

Our results are illustrated as detailed Subject Interaction Diagrams and Subject Behavior Diagrams. Those diagrams are the outcome of two years iterative development including workshops with worldwide experts and possible users in the telecommunications industry. In addition, we have presented and discussed our design artifacts in the eTOM working group as responsible body of the TM Forum. The TM Forum has agreed the official publication of our sBPM artifacts. This is an additional evaluation of our sBPM reference process model by an industry organization.

Project	Case Scope
Reorganization of North African telecommunication company	Development of a target organizational structure, including comprehensive job descriptions
Restructuring of South African telecommunication company	Development of new target structure and organizational detailing (business tasks and job descriptions)
Process design for Asian telecommunication company	Development of detailed target processes based on eTOM and mapping to organizational structure
Process management for Asian telecommunications company	Implementation of eTOM-based process management, mapping to target organization

Table 2. Real-life implementation projects of our generalized job profiles (extract)

4 Conclusion and Limitations

In this paper, we provide a concrete example for a combination of a top-down reference process model with a bottom-up process modeling approach. Our model is derived from real-life organizational data and applies the subject-oriented process notation (sBPM). Our development is related to the well-recognized reference model eTOM and the industry body TM Forum. Our results are based on real-life implementations and are confirmed by industry experts. Furthermore, the TM Forum has accepted its publication after presentations and discussion in the eTOM working group.

By working in accordance with the design science paradigm (Hevner et al. 2004), we have developed a subject-oriented reference model for the customer-centric domain of eTOM. Major challenge was the definition of a generic subject structure in order to define the subject behavior and interaction. In this paper, we first explain the general development process. Hereby, generic subjects are created based on a wide range of real-life transformation projects at international telecommunications companies. Based on our detailed job profile database, we have performed a mapping between the sub-processes and tasks to generic subjects. Furthermore we explain the concrete results of our sBPM artifacts based on an example of the customer-centric process *Request-to-Answer*. The Subject Interaction Diagram and the related Subject Behavior Diagram for the subject *Sales Representative* are illustrated in this paper. Our results are evaluated and confirmed by experts, possible users, and the TM Forum.

Our contribution to theory and practice is twofold. Firstly, we illustrate the integration of an inductive, bottom-up reference modeling approach with the top-down approach of an existing reference model. We contribute a concrete, practical example to the discussion of inductive reference modeling. Secondly, we have extended the well-accepted reference process model eTOM by developing a subject-oriented reference model with generic subjects and their interactions. With our sBPM extension we support telecommunication companies to implement eTOM in a more efficient way. The sBPM extension identifies concrete subjects (functions and roles) with their respective duties and responsibilities in the selected process. However, the analysis of concrete benefits (e.g. less effort) would require further practical project implementations.

Although we have derived our reference model from real-life organizational data, the design process was a consensus-based, iterative development with the involvement of the TM Forum working group and various experts. The development could be further improved by applying heuristic methods of inductive reference modeling. As we have now convinced the TM Forum to integrate eTOM with a bottom-up approach, this could be the starting point for further research.

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