Towards a Reference Model Management System for Business Engineering

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ABSTRACT
The central idea in reference modeling is the reutilization of the business knowledge contained in reference models for the construction of specific models. The orientation on the content of a reference model can increase the efficiency of processes in business engineering projects. Despite this, the use of reference models in the field of business engineering has not established itself in practice. This is due to the field of conflict between research and practice, in which reference modeling is at home. There is still a deficit in knowledge about the use and problems inherent in the implementation of reference models despite the array of theoretical concepts. Accordingly, in the past years the supply-sided development of reference models predominant in the science world has distanced itself from their demand-sided use in business practice. The article analyses this problem and presents an approach to the management of reference models. The task to be mastered using the proposed approach will be conceptually concretized with a framework and prototypically implemented in the form of a reference model management system.

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General Terms
Management, Documentation, Design

Keywords

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1. REFERENCE MODELING AS AN INSTRUMENT OF BUSINESS ENGINEERING

1.1 From Business Engineering to Business Process Management

The field of “business engineering” emerged at the start of the 1990ies as a management trend that was to enrich the approaches existing at the time with respect to the development of operational information systems with considerations on strategy and process design [6; 15; 16; 18; 19]. From today’s perspective, business engineering can be understood as the method and model-based design theory for businesses in the information age [17, p. 7]. Using the methods and models made available by business engineering, businesses and strategic fields of business were to be redesigned—taking advantage of the potentials in information technology (IT)—from the bottom up with the help of engineering principles.

Nowadays, business processes have established themselves as the organizational objects of design for this task [8; 11]. Thus, the design of business processes and the analysis of the demands to their IT-support with regard to corporate strategy are of enormous importance in business engineering projects. Business process design must follow a comprehensive approach which encompasses the planning and control, as well as the management of operational workflows.

1.2 From Business Process Management to Reference Modeling

Information modeling has proved to be useful in supporting a systematic procedure in process design [10; 12; 14; 26]. Modeling languages such as, for example, the event-driven process chain (EPC) [13], serve as operationalized approaches for the construction of models (cp. Figure 1). Software tools for business process modeling, such as the ARIS-Toolset from IDS Scheer, can support the business engineer by way of system components for the collection, design, analysis and simulation of business process models [1].

Due to the possibility of their being reutilized, in many cases the construction of information models is connected to the demand to abstract from enterprise-specific characteristics. One must therefore distinguish between enterprise-specific information models and reference models. While enterprise-specific models...
The management of reference models can be conceived as a process. This process is characterized by creativity and is highly complex due to its multifariousness and dependency on human judgment. Procedure models can be used in reference modeling to help make this complexity controllable. These procedure models—an overview can be found in [25, p.131–142]—emphasize the developmental phase of a reference model on the one hand and, on the other, the phase of creation of enterprise-specific models based on a reference model, i.e. its use. In both cases, one must go to a process of construction and this process can be supported by operationalizable approaches to the creation of models.
The process of development and use of a reference model are, however, usually chronologically, as well as contextually and organizationally separated from one another:

- **Chronological separation:** A model can be referred to as a reference model when used to support the construction of other information models. Thus, the construction of a reference model always precedes the construction of specific models.

- **Contextual separation:** Usually, the reference model constructor does not know the demands regarding the content of future reference model adaptations. He must therefore, try to foresee them.

- **Organizational separation:** The model provider and customer, resp. constructor and user are usually different people, departments or companies.

This separation of the processes “reference model development” and “reference model usage” regarding time, content and organization, is seen here as a problem of integration. Thus, we can identify the development, usage and integration of reference models as the core functions of reference model management (cp. Figure 2) [22; 23; 24]:

**Figure 2. Reference Model Management—Core Functions**

- **Reference model development:** The planning and realization of reference model construction. The development of reference models encompasses the acquisition of and search for relevant information sources and context, as well as the explication and documentation of employee's application system knowledge resp. organizational knowledge. The development of reference models refers to the development of new reference models, as well as the modification and continual improvement of existing reference models.

- **Reference model usage:** The planning and realization of the construction of information models using reference models. The usage of reference models comprises the search for and navigation of the reference models relevant for the use case, their selection and distribution to the persons concerned, the presentation of knowledge content, as well as the support of the reference model adaptation. It also comprises the retroactive evaluation of the reference models used and associated information.

- **Reference model integration:** The fusion of the chronological, contextual and organizationally separated processes in the development of reference models and the use of reference models for the construction of enterprise-specific models in the sense of the (re) creation of a whole.

### 2.2 IT-Support

Due to the magnitude of the information models in business engineering projects, their economic construction and use can only be guaranteed with the help of IT-tools. IT-support can considerably increase the efficiency of processes in business engineering projects. Therefore, there is no need to debate whether it makes sense to economically develop a computer-aided information system for the management of reference models from the research perspective, as well as from the practice perspective. This question has long been answered by the economic success of modeling and analysis-tool providers [21].

On the contrary, we must investigate the question of how an information system should be designed so that it can support reference model management adequately. With emphasis on the aim of business information systems—in the sense of the planning, construction and modification of operational reality and supportive information systems—the goal to be achieved cannot be found in design alone, but rather also in the realization of an information system which can support the management of reference models. This information system will be referred to here as a reference model management system (RMMS).

### 3. REFERENCE MODEL MANAGEMENT SYSTEM

#### 3.1 Framework

The framework shown in Figure 3 illustrates the most important components of an RMMS, as well as their functional interactions.

**Figure 3. Framework of a Reference Model Management System [22]**

On the tool layer, the core functions of the management of reference models form the main functionalities of the information system for the support of reference model management. The link between the elements “reference model development” and “reference model usage” is created by the element “reference model integration”.

![Diagram of Reference Model Management System](image-url)
The information model for reference model management, derived from the technical-conceptual layer, can be seen as the core component for the organizational framework. It is a semantic data-model which is used to clarify relevant terms, as well as to define a uniform terminology.

The RMM-information model forms the technical basis for the functionality “reference model integration” of the RMMS on the tool layer. It is however, also the basis for the logical database structure of the RMMS on the physical layer (repository). An excerpt of the RMM-information model, which is modeled in Unified Modeling Language (http://www.uml.org/) is shown in Figure 4.

Because established products exist in the field of information and, especially, business process modeling and analysis [21], the complete new development of an RMMS is not necessary, but rather only the extension of existing systems. Thus, on the modeling layer, professional tools could be used for the design of the component “modeling and analysis”. The functionalities necessary for the development and usage of reference models which, for example, require a model modification have already been implemented in corresponding systems. Functionalities which, however, serve the documentation of a construction process or a certain procedure in the usage of reference models in business engineering, may require a new implementation.

In addition to human judgment, the user interface of the RMMS (interaction layer) represents a large bottleneck in the implementation of computer-aided information systems. Great importance must therefore be attributed to its design. This has been done in the following.

3.2 Prototype
The RMMS-prototype presented in the following was developed over a period of a year at the Institute for Information Systems (IWi) at the German Research Center for Artificial Intelligence (DFKI), Saarland University, Saarbrücken. The development of the system was supported by the “Deutsche Forschungsgemeinschaft” (German Research Foundation) within the framework of the project “Reference Model-Based Customizing with Vague Data”. The ARIS-Toolset from the IDS Scheer was used as the basis modeling tool for the RMMS. The following factors regarding the research project resources were decisive for the decision to use the ARIS-Toolset as the RMMS-basis modeling tool:

- Both IDS Scheer and the Institute for Information Systems (IWi) are located in Saarbrücken; IDS Scheer with its head office and the Institute for Information Systems (IWi) at the University of Saarland in Saarbrücken. This allows an intensive dialogue between employees and software developers in the field of reference modeling, especially regarding reference modeling-support using tools from the user perspective. The proximity of these institutes to one another results in extremely low travel costs.

- Since 1994 IDS Scheer has provided diverse reference models created using the ARIS-Toolset [2]. These were made available by the company and could be used for testing purposes within the framework of this research project.
The graphic user interface of the RMMS is illustrated in Figure 5. The prototype—implemented in the platform independent programming language Java (http://java.sun.com/)—distinguishes between a project and a model view. The project view has been selected in the screenshot in Figure 5.

The RMMS work space is divided up into an explorer and a viewer which are connected logically with each other, i.e. a project selected in the explorer is displayed in detail in the viewer and can be manipulated there.

The project active in Figure 5 is called “reference model for event management” and serves to develop a reference model for the domain “event management”. The title, the project’s customer segment and information concerning the project period, progress and type were selected by the project manager while setting up the project with the help of an assistant (project wizard). This information can, in addition, be modified using the buttons “project” and “subject”.

A detailed representation of the customer assigned to the activated reference modeling project, i.e. his or her address, branch of business, turnover, number of employees, range of products, etc. can be reached using the button “customer”. This functionality also allows you to call up information such as customer description, goals or requirements. While this assignment in the use of reference models pertains more to individual customers, projects in reference model development are usually assigned an entire customer segment, as reference models are constructed for a whole class of use cases.

The viewer is divided up into index cards which can be selected using their respective tabs. The index card “overview” (Figure 5) basically characterizes the modeling projects. The elements in this card form important criteria according to which the projects stored can be sorted or searched.

The index card “activities” contains tasks or activities necessary for the realization of the targeted reference modeling project. Furthermore, descriptions of the above, activity plans and hierarchies are also stored here. These tasks are individually assigned to project members (link to the index card “members”), as well as to project documents, such as for example, meeting minutes or the presentation of results (link to the index card “history”).

The creation of the team, which will work together in realizing the reference modeling project, takes place using the index card “members”, which contains the name, position, location, organizational unit and contact information for each member of the team, as well as the respective tasks assigned to them.
In addition to the project activities and employees involved in business engineering projects, one should also document information about the progress of the tasks, the problems met, as well as possible and ultimately selected measures for solving these problems. The history of the reference modeling project is therefore documented in a project history ("history"). This can be used by the project members as a source of information regarding the project history and can support the user in planning future projects.

The cooperation between employees in different departments and at different locations is also customary in the development and use of reference models. The RMMS thus has functionalities which support cooperation during reference modeling projects. To this purpose, an asynchronous communication medium (discussion) is offered on the "collaboration"-card. The user is also given the possibility of reviewing project documents.

The workspace in the RMMS-model view is also divided up into an explorer and a viewer (cp. Figure 6, screenshot in the background). In the model-explorer, all of the information models managed by the RMMS are displayed. This pertains to reference models constructed in development projects, as well as enterprise-specific models created in projects, in which reference models are applied.

The index card system in the "model viewer" is used to manage the most important model related information for the management of reference models. Information models managed by the RMMS are characterized on the index card "overview" of the model view. This is similar to the corresponding card in the project view. The elements of the card "overview" provide criteria, similar to that in the project view, according to which the information models stored can be sorted or searched. Potential sorting criteria which can be selected in the corresponding pull-down-menu in the upper part of the "model explorer" are: branch of trade, model name, application domain, model developer, period of development, modeling progress and modeling language. In the screenshot in Figure 6 the criteria "economic activity" is selected. The selected reference model, referred to due to its form as "Event-E", is assigned to the branch "marketing".

Figure 6. Interactive-Design between RMMS and ARIS-Toolset
The card “graphic” makes a graphic representation of the model to be constructed in the modeling project possible. Figure 6 illustrates the connected requirements clearly, as well as the resulting interactive-design between the RMMS and the modeling tool ARIS-Toolset. The example illustrates that it is possible for the user to make modifications on a version of the reference model framework for event-management. To do so, he must open the ARIS-Toolset by clicking the button “edit”. In addition to reading, editing or deleting models and model elements, the modeling tool gives a business engineer further functionalities.

The subject of the dialogue which can be reached using the button “versions” on the “graphic”-card (cp. Figure 6), is the management of the models and model element versions (model history) created in the course of the reference modeling project. In addition to the most important model data, such as name, type or creation and modification dates, other data such as time, responsibility (link to the card “members”), description, reason, priority and status of the model modifications, as well as the corresponding project activities (link to the card “activities”) are recorded. The structure of this dialog is based upon the findings on the configuration management of information models [5].

The display of characteristic information, with which certain information models can be recognized, can be viewed on the index card “attributes”. Similarities and differences between the models are emphasized and used for other activities (for example: similarity analyses, searches).

The RMMS provides diverse functionalities for the support of distributed reference modeling [25]. In the project view, these referred to the support of administrative project tasks, complemented by the asynchronous communication medium of the discussion forum. These functionalities have been extended by way of a synchronous communication medium on the index card “collaboration”, a shared whiteboard for the interactive viewing and annotation of graphic data.

4. CRITICAL DISCUSSION OF THE RESULTS AND FURTHER RESEARCH

The rationale for the approach, “reference model management” selected here is based on an analysis of the state of the art in reference modeling, whereby potentials were seen in two respects. First, we have shown that the contributions at hand comprehensively address the design of construction results but however, disregard the corresponding construction processes which makes the retraceability and thus, the reuse of the results difficult. On the other hand, results pertaining to the design of the construction processes are available, concentrate however, either on the development or the use of the reference models or they do not sufficiently reduce the chronological, contextual and organizational separation between both processes. Reference model management was therefore formulated explicitly with the purpose of recreating the connection between the separated processes in reference model development and usage.

The knowledge won in this analysis can be used as a starting point for more detailed research work. Thus, for example, empirical studies could be made to investigate whether the insights won more or less deductively coincide with the reality of business practice. One could also investigate how the use of the RMMS affects efficiency in modeling projects. The investigation of the effects of this prototype in operational business reality is seen as a future challenge for the authors in their research activities.

5. RMMS AS ENRICHMENT FOR THE TOOLBOX OF A BUSINESS ENGINEER

Leading providers of IT-solutions, such as for example, IBM, Microsoft or SAP have recognized the necessity of integrated business process management. Products such as WebSphere, .NET and NetWeaver are consequently geared to business processes. Modeling tools, which provide functionalities for the collection, analysis and implementation of business processes, offer one the chance to enrich architectures with components for process configuration and visualization. This makes it possible to link the modeling of business processes with their physical configuration and execution in a software platform. The knowledge stored in reference models concerning the design of business processes will thus gain considerably in importance in the future. The RMMS is a prototype for the support of the development and use of these reference models and should be seen as enrichment for the toolbox of any business engineer.

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7. REFERENCES


