Association for Information Systems
AIS Electronic Library (AISeL)

AMCIS 2010 Proceedings

Americas Conference on Information Systems (AMCIS)

8-2010

Towards a structured application of IT governance best practice reference models

Stefanie Looso
Frankfurt School of Finance and Management, s.looso@frankfurt-school.de

Towards a structured application of IT governance best practice reference models

Stefanie Looso
Frankfurt School of Finance and Management
s.looso@frankfurt-school.de

ABSTRACT

The perceived importance of the topic IT governance increased in the last decade. Best practice reference models (like ITIL, COBIT, or CMMI) promise support for diverse challenges IT departments are confronted with. Therefore, the interest in best practice reference models (BPRM) grows and more and more companies apply BPRM to support their IT governance. But there is limited knowledge about how BPRM are applied and there is no structured method to support the application and lift the full potential of BPRM. Therefore, this paper proposes a structured method for the application of BPRM. Intention of this research is to reduce the inefficiencies caused by inconsistent and ad-hoc use of BPRM. The scientific adequacy as well as the practical applicability is critically discussed by using practical experiences out of an ongoing research project.

Keywords

Method Engineering, Design Science Research, Best Practice, Reference Models, IT Governance.

INTRODUCTION

As a central instrument for the design of corporate information systems within the field of information systems research, information models have traditionally been used for decades. A reference model is defined as a generic model which is useful when developing an individual information model of a specific class. It formally presents state-of-the-art and best practice knowledge and is considered as an example for a corporate model (Fettke and Loos, 2003; Rosemann and van der Aalst, 2007).
Best practice models in the research field IT governance, like COBIT (Control Objectives for Information and related Technology), ITIL (IT Infrastructure Library) or CMMI (Capability Maturity Model Integrated), are used to assess, build or manage information model. (Co-) produced by practitioners these models also contain profound and consolidated knowledge based on experience in the field of IT governance and tend to become quasi-standards (PWC, 2006; Alter and Goeken, 2009). That means that the models of IT governance focused on herein could be defined as reference model. But these models are conceived as structured compilations of best practice rather than conceptual reference model as known in scientific literature. Therefore, in order to avoid misleading terms and misconceptions, reference models of IT governance will be referred to as best practice reference model (BPRM) in this paper.

Those BPRM have reached a certain degree of commonness in practice. Their application is still growing, but seems to be inconsistent. The study "IT Governance in Practice - Insight from leading CIO's" quotes one participant on the application: „I use frameworks and standards for inspiration, and we use what we think is useful and relevant for our organization" (PWC, 2006, p. 18). Other companies use BPRM even more holistic and with a higher degree of obligation. The application of BPRM, for instance the derivation of corporate specific models out of BPRM, is often ad-hoc and individual (see qualitative empirical research findings presented in Looso and Goeken, 2010). This is clearly opposed to the nature of reference models since the construction of corporation-specific models based on reference model promises positive effects on effectiveness and efficiency (see Fettke and Loos, 2002, p. 9; Becker, Delfmann and Knackstedt, 2004, p. 1). To reduce inefficiencies and to lift their full potential this paper presents a method for the methodical and structured application of IT governance BPRM.

This method is a part of a research project. The research project starts with explorative expert interviews in addition to a literature review to broaden the understanding of BPRM application (Looso and Goeken, 2010). Figure 1 shows the position of the research project in the well known conceptual framework of Hevner, March, Park and Sudha (2004). According to their framework the knowledge base "provides the raw materials from and through which IS research is accomplished. The knowledge base is composed of foundations and methodologies" (Hevner et al., 2004, p. 80). Following this definition the knowledge base for this research project includes research on reference models and modeling, method engineering and IT governance but also on research methods like interview techniques, qualitative analysis etc.

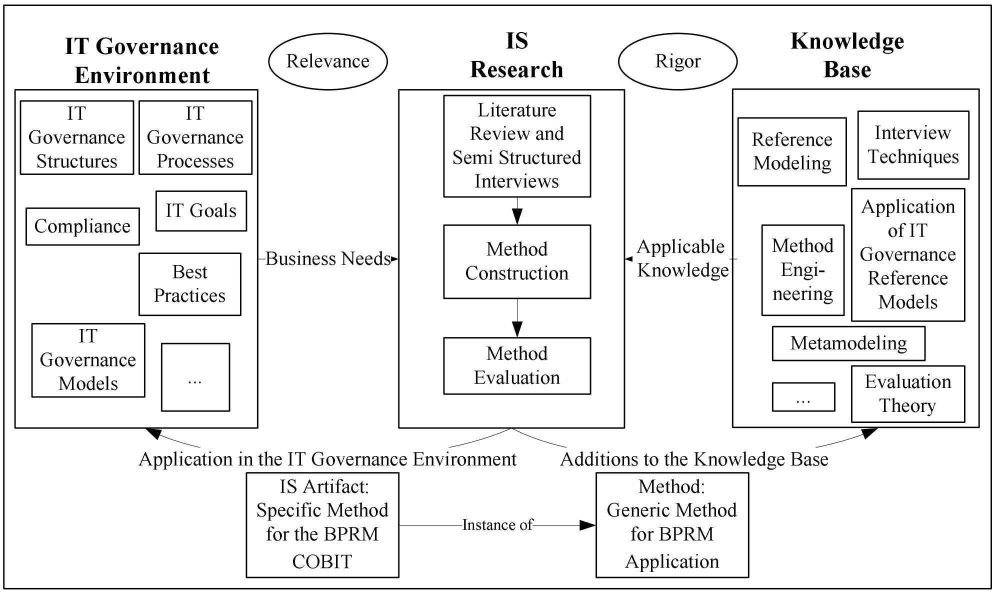

Fig. 1. Research project (according to Hevner et al., 2004)

The environment includes the phenomena of interest. „In it are the goals, tasks, problems, and opportunities that define business needs as they are perceived by people within the organization“(Hevner et al., 2004, p. 79). For research on the BPRM of IT governance this environment is composed of IT employees, IT organization, IT goals, processes and the existing best practices and standards.

Outcome of this research is a generic method for BPRM presented in section 2. The construction process of the generic method follows a rigor research design by using the existing and proved knowledge of IS research. Section 3 shows the application of this method for the specific BPRM COBIT. The various possible specific methods (for COBIT, ITIL, CMMI, etc.) are instances of the generic method and represent relevant IS artifacts which provide support for practical problems. That means the practical application of the specific method is an application for the IT governance environment whereas the generic method is a contribution to the knowledge base of IT governance research. Section 4 draws a conclusion and discusses the research findings.

METHOD CONSTRUCTION

Preliminaries: Method Engineering

Methods describe a systematic approach to the solving of problems. A problem is defined as a discrepancy between actual and desired state (Becker, Knackstedt, Pfeiffer and Janiesch, 2007). Focused on the creation of methods, the research area of method engineering (ME) is a commonly accepted and frequently debated concept in construction-oriented IS research. Brinkkemper (1996, p. 276) defines: “method engineering is the engineering discipline to design, construct and adapt methods, techniques and tools for the development of information systems“.

Basically, there are two tendencies within ME. Some approaches of method construction emphasize aspects of the construction process and project management (Kaschek, 1999). In contrast, the approach of a language-based construction of method elements focuses on the artifacts created. In recent years the latter approach has been focused on in the field of methods engineering (Brinkkemper, 1996; Ralyté and Rolland, 2001; Karlsson and Wistrand, 2006). Language-based ME defines a method primarily as a tupel of a type of exercise and a number of rules. It requires a formalized documentation of method elements (Becker, Knackstedt, Holten, Hansmann and Neumann, 2001, p. 6). The St. Gallen description model of method engineering (Heym, 1993; Gutzwiller, 1994; Becker, 1998) includes a schematic composition of the elements: *meta model*, *result*, *activity*, *technique*, and *role* (Figure 2). According to its language-based interpretation, the description of these elements offers a possibility to develop a method systematically.

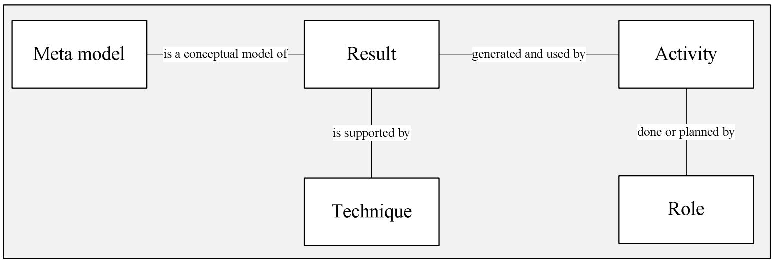

Fig. 2 St. Gallen model of method elements (Heym, 1993, p. 13)

In contrast to the St. Gallen model this approach understands technique as a supporting detail for activity. That means the method concept presented herein presumes a relation between *activity* and *technique*. Because of the limited space the presentation of the element *role* is not a part of this first paper. Due to the generic character of the method the following subsections describe generic types of the different method elements instead of concrete method elements.

Method Element: Result Type

Results of the suggested method are several different models. They belong to certain result types which can be divided by two dimensions. The first division is between two abstract levels, the meta level and the model level. The second dimension distinguishes between reference layer and corporate layer.

The result types are depicted in the meta model shown in Figure 3. Hence, result type *best practice reference model* is defined as a model on model level and reference layer. A possible instantiation of this type would be the BPRM COBIT 4.1. Result type *company model* stands for a BPRM that has been adjusted to corporate-specific conditions. An exemplifying instantiation is a COBIT 4.1 subset which only some parts of the BPRM. Additionally, the method is familiar with various forms of other *company models* (i.e. company's IT process models). All of them are associated with the lower right section of the matrix, but a company specific COBIT could be applied to parts of an existing IT process model. This relationship is also shown in figure 3. Building a company model it could be necessary to change the meta model the model is based on. These changes of the *best practice reference meta model* result in a *company specific best practice meta model*. These two abstract result types complete the result types used for the presented method.

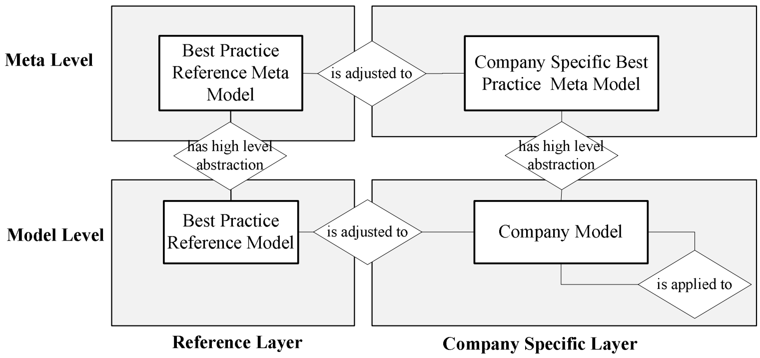

Fig. 3. Meta classification of result types of the generic method

Method Element: Technique Type

A technique is defined as "a procedure, possibly with a prescribed notation, to perform a development activity" (Brinkkemper, 1996, p. 276). Applied on this approach techniques are used to support activities transforming models to other models. Therefore, techniques used in this method are defined as mechanisms to support the activities which transform a reference model step by step to a company model. These techniques could be derived from available research on reference model application. Conclusions from research on reference models can be included especially if the methods themselves are formally represented by models (shown in section 2.2). Thus, the concepts of reference model application provide important information about the design of techniques within the presented method.

Becker et al. (2004) provide two types of adaptation mechanisms for reference models: The *mechanisms of generative adaptation* describe all modes of a reference model's configuration, given the existence of rules which determine how to adjust the reference model depending on mechanisms of configuration. These rules should be included in the reference model. As mentioned, best practice reference models of IT governance are conceived as structured compilations of best practice rather than conceptual models. Therefore, BPRM do not usually contain explicit rules for model configuration.

Apart from configuration, Becker et al. (2004) describe four *mechanisms of non-generative adaptation*. What generally characterizes mechanisms of non-generative adaptation is "that while they support the creation of specific model variants, they leave room for variety to be filled by the user of the reference model" (Becker et al., 2007, p. 1). As this matches the situation in the area of BPRM, the four non-generative adaptation mechanisms will be concisely described and integrated into the method as technique types. *Aggregation* requires the reference model to be divided into its components which are recomposed by aggregation for new solutions. Combinations can be limited by defined joints. *Instantiation* ultimately describes the existence of deliberately vague formulations or blank spaces as placeholders to be specified by users. In order to develop a BPRM into an explicit model system, placeholders have to be filled in a corporation-specific way. A BPRM is more freely and individually adaptable through instantiation than through aggregation. *Analogy construction* and *specialization* are very free forms of adaptation in which prescriptions for adjustment are mostly absent.

The use of these adaptation mechanisms of reference models within the area of method construction has been accomplished several times. For instance (Harmsen, 1997) or (Brinkkemper, 1996) use the mechanism aggregation, whereas (Baskerville and Stage) or (Patel, de Cesare, Iacovelli and Merico, 2004) use specialization. A broad overview is given from (Becker et al., 2007, p. 5). To sum up, to a certain degree adaptation mechanisms of reference models could be used for BPRM as well. These techniques support the activities presented in the following section.

Method Element: Activity Type

A possibility to distinguish activities is presented by Schütte (1998, pp. 316–319). Firstly, compositional activities mean that individual parts of a model are erased, altered, or added in order to improve a reference model's fit. Secondly, generic adaptation activities means explicitly described rules of adaptation. These rules are defined explicit within the model to be observed for adjustment of the reference model. But these generic adaptation activities are not usually employed since most BPRM do not contain rules for adaptation.

The herein presented activities structure a method by combining techniques, results and roles. Our generic method has three different activity types: *subset selection*, *adjustment and application* (see figure 4). If a BPRM is not entirely used, it is limited by selecting a BPRM subset which is relevant for a corporation (Gammelgard, Lindstrom and Simonsson, 2006). This decision is not necessarily based within the model itself but can be entirely strategic (Bowen, Cheung and Rohde, 2007). Hence activity type subset selection is take place before activity type adjustment. During the subsequent adaptation, the chosen subset is continuously adjusted to the corporation. The activity type *application* completes the generic activity types. In the following, all three activity types will be described in detail jointly with their proposed techniques.

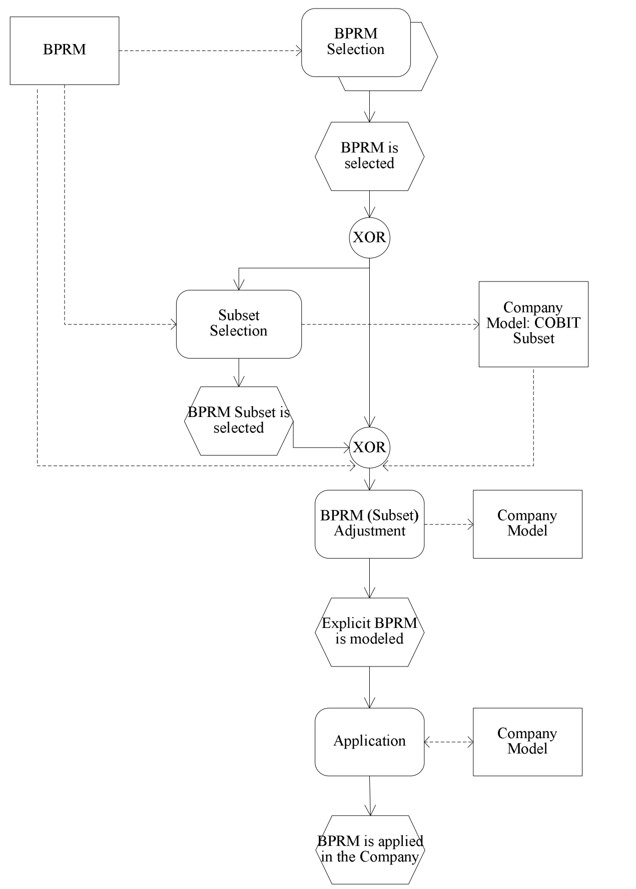

Fig. 4. Event-driven-chain the proposed method

Activity 1: Subset Selection

By selecting a subset the BPRM is transformed to first company model: the BPRM subset. The process of selection itself with its internal organizational and communicative aspects is not addressed in this paper. However, possible categories of this subset are interesting for this research. The chosen criterion to classify subsets is completeness. Two cases occur in the first place, complete and partial use. The former makes the result type subset obsolete as the BPRM and the subset are identical. But if some parts are selected while others are not, the following applies to the contents described within the model: BPRM subset < BPRM.
For detailed specification, further classification criteria are required. These criteria can be derived by abstraction of BPRM into a best practice reference meta model. A meta model created by semantic abstraction can show possible sub divisions of the case "partial application" by means of content and structure (Alter and Goeken, 2009).

A model's structure is defined by its meta model components. A limitation of the applied meta model components is typical for a reduction of a model's range, for instance a COBIT subset which only contains the COBIT meta model component *COBIT control objectives* (Simonsson and Johnson, 2008; de Haes and van Grembergen, 2008). It turns out that this activity changes the structure of the model.

The second case to be regarded is defined by reduction of the model's depth. Accordingly, all meta model components are employed in respect to the BPRM but not all model components (e.g. not all processes, see Gammelgard et al., 2006 or Tuttle and Vandervelde, 2007). Thus the content is reduced. These subsets leave the model's structure unchanged. The reduction of model components results in different problems than the reduction of meta model components does. This is due to interconnections of content, such as predecessor-successor-relations, which can cause successors to be left without any input or the output of a process to remain unused. Hence, model components have to be aggregated on a model level as well.

Models Range **Models Depth**	**All Meta Model Components**	**Some Meta Model Components**
All Model Components	Subset Type 1	Subset Type 2
Some Model Components	Subset Type 3	Subset Type 4

Table 1: Subset types

Table 1 shows the possible types of the BPRM subset. We believe that most companies use subsets from type 4, that means structure and content based connections of the models elements could be broken. In this case the (re)-combination of the chosen elements is an essential step in this activity. Hence a meta model of a BPRM offers possibilities for the combination of both meta model components and model components to a coherent BPRM subset. A coherent COBIT-subset does not, for instance, allow the use of metrics of the COBIT processes unless the goals of the process are used as well. This is because only the component goal links the component process with the component metric. Hence, the quality of meta models in best practice reference models is essential for this research project (Alter and Goeken, 2009, Goeken and Alter, 2009).

To sum up, the activity subset selection results in a BPRM subset. It includes only these components of a BPRM which are relevant for a specific company. This result is an instantiation of the result type company model. In a next step the BPRM subset needs further adjustment to the corporate conditions.

Activity 2: Adjustment to Corporate Conditions

Once the relevant BPRM subset has been selected, the next step is the transformation into the explicit model particular to one specific BPRM and one specific corporation. During this activity the user specifies those model sections which formerly remained deliberately vague. However, it usually remains unclear for BPRM which model sections have remained vague on purpose and require instantiation. Order and design of the model component "metric of process x" in the COBIT model allow the assumption that metric is a components which requires further adjustment.

Exemplary in character, the metrics of a COBIT process should be completed with individual metrics. Along with the mechanism of adaptation in the presented example, Figure 5 depicts the instantiation of the metric placeholder for a number of corporate-specific metrics. Other mechanisms are applied during the development of the explicit model as well. Supporting the instantiation both specialization and analogy construction should be primarily used in the following third step. This is due to the relation between the BPRM and the company model. Here, the company model is taken as an altered part of the BPRM, which should basically remain recognizable in this intermediate result. Control by IT auditors is thus facilitated in case of COBIT. This can change due to the more variable mechanisms of model adaptation, which is why too much room for variation in adaptation mechanisms should be avoided in this activity.

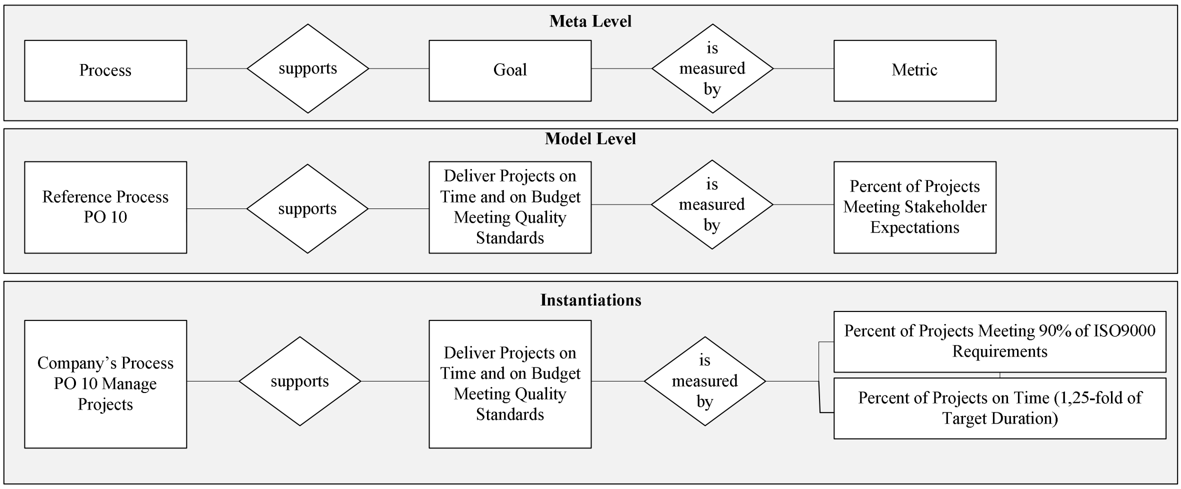

Fig. 5 Instantiation of a COBIT metric

Activity 3: Application to the Company

The activity application to the company combines at least two results of the method. The adjusted company model derived from the BPRM includes the relevant and adjusted components of the reference model. These components should be applied to a second company model. Depending on the BPRM this company model can consist of either the process model of IT processes or a smaller part such as a model of IT project management.

These models will be change with regard to adjusted BPRM subset of the company. For instance the COBIT process AI6 "Manage Changes" requires a separate change management procedure for emergency changes (IT Governance Institute, 2007, p. 94). If this process is chosen during the activity subset selection the process model of the company possibly needs to be change. But how emergency changes differ from other changes is not described in COBIT. Thus specialization and analogy construction are important mechanisms during this activity since BPRM of IT governance usually specify *what* to do rather than *how* to do it. Those challenges of establishing have to be fulfilled by means of analogy construction in which the explicit model serves as a state-to-be and to inspire ideas. „Analogies can be drawn from any aspect of the reference model which can be indicated by the annotation of analogy construction advices"(Becker et al., 2007, p. 3).

PRACTICAL APPLICATION OF THE METHOD DURING A RESEARCH PROJECT

The rigorous evaluation of the research results is an important topic in design science research (DSR). Vaishnavi and Kuechler (2004) state that designed artifacts must be analyzed as to their use and performance as possible explanations for changes in the behavior of systems, people, and organizations. Hevner et al. (2004) propose five kinds of evaluation methods (observational, analytical, experimental, testing, and descriptive) but they not provide support for choosing a concrete evaluation method. Pries-Heje, Baskerville and Venable (2008, p. 2) provide concrete strategies for DSR evaluation. Following their approach 1) an ex ante strategy and 2) an ex post strategy has to be discussed for the evaluation of our method. Ex ante evaluation means the evaluation of candidate methods before they are chosen and applied. In our case there are no competitive methods against which our method could be tested. But companies apply BPRM without using structured methods. This unstructured, creative process could be a competitor during the ex ante evaluation. Following Harter, Mayuram S. Krishnan and Slaughter (2000) we believe that any structure process has advantages against unstructured application of BPRM.

Ex post evaluation means an evaluation after the method is applied. The approach of Yang and Padmanabhan (2005) suggests four categories for ex post evaluation methods (table 2).

		Setting	
		Real Setting	Abstract Setting
Computation of Quality Measures	Automatic	1. Experimental Designs	3. Historic Data Experiments
	Human Subjects	2. User Opinion Studies	4. Opinions Analysis of Historical Data

Table 2: Categories of ex post evaluation methods (adapted from Yang and Padmanabhan, 2005)

The ex post evaluation of our method includes two steps due to the characteristics of the artifact. As the method described has a generic character, it is indirectly evaluated in a first step by application to a specific case, in which its general usability is proven. Therefore a specific method for the application of COBIT is derived from of the presented generic method. For this COBIT method we choose user opinion studies to evaluate practical usefulness. This is part of an ongoing research project and the following paragraphs show a short insight in our current work.

The research project aims to support the application of BPRM. By using semantic technologies we are developing a tool named SemGoRiCo. This tool is based on the presented generic method. SemGoRiCo supports the three generic activities (section 2) adjusted to the specific characteristic of the COBIT framework. Figure 6 shows the derived COBIT method and some tool components as implementations of the previously described activities.

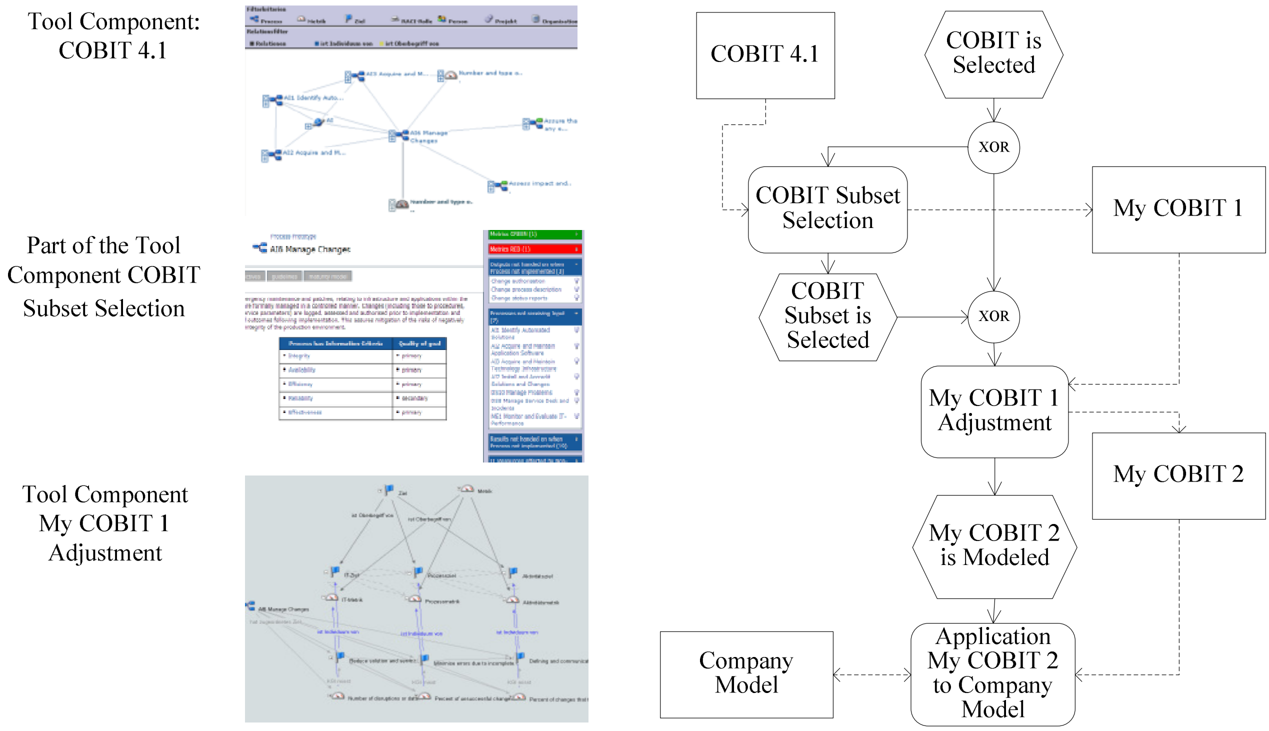

Fig. 6: COBIT application method and tool support

Using this tool supports the structured BPRM application according to the presented method. The associate partners of the research project will test this tool and thereby we could ex post evaluate the specific applicability of our proposed generic method with a user opinion study.

CONCLUSION

To conclude we constructed and partly developed a method for BPRM application. This approach follows the language-based method engineering concept by presenting formally described static method element types and their instantiations. Furthermore the presentation includes dynamic aspects by describing processes and procedures concerning the transition between various instantiations of the method element types. This method aims to be an addition to the knowledge base of IT governance research and a practical solution for challenges IT departments are confronted with. To show its practical use we instantiated the presented generic method to a specific method for COBIT. In an ongoing research process we refine and extend the specific COBIT method. These research findings should be a sound basis for the construction of methods for applying BPRM. To prove the general applicability of our generic method several other specific methods have to be derived (ITIL, CMMI etc.) and tested ex post by using user opinion studies, but this is future research.

Reference List

Alter, S. and Goeken, M. (2009) Konzeptionelle Metamodelle von IT-Governance-Referenzmodellen als Basis der Kombination und Integration in einer Multi-Model-Umgebung, in Hansen, H.R., Karagiannis, D., Fill, H.G. (Ed.), *Business Services: Konzepte, Technologien, Anwendungen.: 9. Internationale Tagung Wirtschaftsinformatik, Band 1,* Wien.

Baskerville, R. and Stage, J. Accommodating Emergent Work Practices: Ethnographic Choice of Method Fragements: IFIP TC8/WG8.2 Working Conference on Realigning Research and Practice in IS Development: The Social and Organisational Perspective, Boise, ID, 2001, 12.28.

Becker, J., Delfmann, P. and Knackstedt, R. (2004) Konstruktion von Referenzmodellierungssprachen: Ein Ordnungsrahmen zur Spezifikation von Adaptionsmechanismen für Informationsmodelle. *Wirtschaftsinformatik, 46*(4), 251–264.

Becker, J., Knackstedt, R., Holten, R., Hansmann, H. and Neumann, S. (2001). *Konstruktion von Methodiken: Vorschläge für eine begriffliche Grundlegung und domänenspezifische Anwendungsbeispiele*. Westfälische Wilhelms-Universität Münster, from http://www.wi.uni-muenster.de/inst/arbber/ab77.pdf.

Becker, J., Knackstedt, R., Pfeiffer, D. and Janiesch, C. (2007) Configurative Method Engineering: On the Applicability of Reference Modeling Mechanisms in Method Engineering, in *Proceedings of the 13th Americas Conference on Information Systems (AMCIS 2007).*

Becker, M. (1998). *Umsetzung betrieblicher Prozesse: Methode, Fallbeispiele, Workflow-Technologie.* Dissertation, Universität St.Gallen, St.Gallen.

Bowen, P., Cheung, M.-Y. and Rohde, F. (2007) Enhancing IT governance practices: A model and case study of an organization's effort. *International Journal of Accounting Information Systems, 8*, 191–221.

Brinkkemper, S. (1996) Method engineering: engineering of information systems development methods and tools. *Information & Software Technology, 38*(4), 275–280.

Fettke, P. and Loos, P. (2002) Methoden zur Wiederverwendung von Referenzmodellen – Übersicht und Taxonomie, in J. Becker & R. Knackstedt (Eds.), *Arbeitsberichte des Instituts für Wirtschaftsinformatik WWU: Vol. 90. Referenzmodellierung 2002 Methoden – Modelle – Erfahrungen,* 9–30.

Fettke, P. and Loos, P. (2003) Classification of reference models—a methodology and its application. *Information systems and ebusiness management, 1*(1), 35–53.

Gammelgard, M., Lindstrom, A. and Simonsson, M. (2006) A reference model for IT management responsibilities, in . *EDOCW '06: Proceedings of the 10th IEEE on International Enterprise Distributed Object Computing Conference Workshops,* Washington, DC, USA: IEEE Computer Society, 26-26.

Goeken, M. and Alter, S. (2009) Towards Conceptual Metamodeling of IT Governance Frameworks: – Approach – Use-Benefits, in . *HICSS 2009 - Proceedings of the 42th Hawaii International Conference on System Sciences.*

Gutzwiller, T. (1994). *Das CC RIM-Referenzmodell für den Entwurf von betrieblichen, transaktionsorientierten Informationssystemen.* Heidelberg, Physica-Verlag.

Haes, S. de and van Grembergen, W. (2008) An exploratory Study into the design of an IT Governance Minimum Baseline through Delphi Research. *Communications of the Association for Information Systems, 22*(Article 24), 443a.

Harmsen, A. (1997). *"Situational Method Engineering.* Utrecht.

Harter, D., Mayuram S. Krishnan and Slaughter, S. (2000) Effects of Process Maturity on Quality, Cycle Time, and Effort in Software Product Development. *Management Science, 46*(4), 451466.

Hevner, A., March, S., Park, J. and Sudha, R. (2004) DESIGN SCIENCE IN INFORMATION SYSTEMS RESEARCH. *MIS Quarterly, 28*(1), 75–106.

Heym, M. (1993). *Methoden-Engineering - Spezifikation und Integration von Entwicklungsmethoden für Informationssysteme.* Disseration, Universität St.Gallen, Hallstadt.

IT Governance Institute (2007). *COBIT 4.1.* o.O.

Karlsson, F. and Wistrand, K. (2006) Combining method engineering with activity theory: theoretical grounding of the method component concept. *European Journal of Information Systems, 15*(1), 82–90.

Kaschek, R. (Ed.). 1999. *Entwicklungsmethoden für Informationssysteme und deren Anwendung: EMISA '99, Fachtagung der Gesellschaft für Informatik e. V. (GI).* Stuttgart, Leipzig.

Looso, S. and Goeken, M. (2010) IT Governance: Application of Best Practice Reference Models, in *Proceedings of the 18th European Conference on Information Systems (ECIS 2010).*

Patel, C., Cesare, S. de, Iacovelli, N. and Merico, A. (2004) A Framework for Method Tailoring: A Case Study, in *2nd OOPSLA Workshop on Method Engineering for Object-Oriented and Component-Based Development,* Vancouver,

Pries-Heje, J., Baskerville, R. and Venable, J. (2008) Strategies for design science evaluation, in *Proceedings of the 16th European Conference on Information Systems (ECIS 2008).*

PWC (2006). *IT Governance in Practice - Insight from leading CIOs.* PricewaterhouseCoopers Johannesburg, South Africa, IT Governance Institute Rolling Meadows, USA.

Ralyté, J. and Rolland, C. (2001) An Assembly Process Model for Method Engineering, in *Lecture notes in computer science: . 13th International Conference on Advanced Information Systems Engineering (CAiSE 2001)* (267–283).

Rosemann, M. and van der Aalst, W. (2007) A configurable reference modelling language. *Information Systems, 32*(1), 1–23.

Schütte, R. (1998). *Grundsätze ordnungsmäßiger Referenzmodellierung: Konstruktion konfigurations- und anpassungsorientierter Modelle* (Vol. 233), *Neue betriebswirtschaftliche Forschung, 233,* Gabler, Wiesbaden.

Simonsson, M. and Johnson, P. (2008) The IT Organization Modeling and Assessment Tool: Correlating IT Governance Maturity with the Effect of IT, in . *HICSS 2008 - Proceedings of the 41st Annual Hawaii International Conference on System Sciences,* Washington, DC, USA: IEEE Computer Society, 431.

Tuttle, B. and Vandervelde, S. (2007) An empirical examination of COBIT as an internal control framework for information technology. *International Journal of Accounting Information Systems, 8*, 240–263.

Vaishnavi, V. and Kuechler, W. (2004). *Design Science in Information Systems.* Retrieved February 12, 2009, from http://desrist.org/design-research-in-information-systems/.

Yang, Y. and Padmanabhan, B. (2005) Evaluation of Online Personalization Systems: A Survey of Evaluation Schemes and a Knowledge-Bases Approach. *Journal of Electronic Commerce Research, 6*(2), 112–122.