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SELECTED PAPERS BOOK

A number of selected papers presented at ICSOFT 2006 will be published by Springer, in a book entitled Software and Data Technologies. This selection will be done by the conference chair and program co-chairs, among the papers actually presented at the conference, based on a rigorous review by the ICSOFT 2006 program committee members.

FOREWORD

This volume contains the proceedings of the first International Conference on Software and Data Technologies (ICSOFT 2006), organized by the Institute for Systems and Technologies of Information, Communication and Control (*INSTICC*) in cooperation with the Object Management Group (*OMG*), sponsored by Enterprise Ireland and the Polytechnic Institute of Setúbal and hosted by the School of Business of the Polytechnic Institute of Setubal.

The purpose of this conference is to bring together researchers, engineers and practitioners interested in information technology and software development. The conference tracks are "*Software Engineering*", "*Information Systems and Data Management*", "*Programming Languages*", "*Distributed and Parallel Systems*" and "*Knowledge Engineering*".

Software and data technologies are essential for developing any computer information system, encompassing a large number of research topics and applications: from programming issues to the more abstract theoretical aspects of software engineering; from databases and data-warehouses to management information systems and knowledge-base systems; Distributed systems, ubiquity, data quality and other related topics are included in the scope of ICSOFT.

ICSOFT 2006 received 187 paper submissions from more than 39 countries in all continents. To evaluate each submission, a double blind paper evaluation method was used: each paper was reviewed by at least two internationally known experts from ICSOFT Program Committee. Only 23 papers were selected to be published and presented as full papers, i.e. completed work (8 pages in proceedings / 30' oral presentations), 44 additional papers, describing work-in-progress, were accepted as short paper for 20' oral presentation, leading to a total of 67 oral paper presentations. There were also 26 papers selected for poster presentation. The full-paper acceptance ratio was thus 12%, and the total oral paper acceptance ratio was 35%.

In its program ICSOFT includes a panel to discuss the future of software development, by six distinguished world-class researchers; furthermore, the program is enriched by one tutorial and six keynote lectures. These high points in the conference program, involving top researchers worldwide, experts in different knowledge areas, have definitely contributed to reinforce the overall quality of the conference.

The program for this conference required the dedicated effort of many people. Firstly, we must thank the authors, whose research and development efforts are recorded here. Secondly, we thank the members of the program committee and the additional reviewers for their diligence and expert reviewing. I would like to personally thank the Program Chairs, namely Boris Shishkov and Markus Helfert, for their important collaboration. The local organizers and the secretariat have worked hard to provide smooth logistics and a friendly environment, so we must thank them all and especially Mónica Saramago for her patience and diligence in answering many emails and solving all the problems. Last but not least, we thank the invited speakers for their invaluable contribution and for taking the time to synthesize and prepare their talks.

A successful conference involves more than paper presentations; it is also a meeting place, where ideas about new research projects and other ventures are discussed and debated. Therefore, a social event including conference banquet was organized for the afternoon and evening of September 13 (Wednesday) in order to promote this kind of social networking.

We wish you all an exciting conference and an unforgettable stay in the lovely city of Setúbal. We hope to meet you again next year for the 2nd ICSOFT, in Barcelona (Spain), details of which will be shortly made available at http://www.icsoft.org.

Joaquim Filipe

INSTICC/Polytechnic Institute of Setúbal, Portugal

(Conference Chair)

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MDE FOR BPM
A Systematic Review

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Keywords: Business process management, Model driven engineering, Model driven architecture, Systematic review.

Abstract: Due to the rapid change in the business processes of organizations, Business Process Management (BPM) has come into being. BPM helps business analysts to manage all concerns related to business processes, but the gap between these analysts and people who build the applications is still large. The organization's value chain changes very rapidly; to modify simultaneously the systems that support the business management process is impossible. MDE (Model Driven Engineering) is a good support for transferring these business process changes to the systems that implement these processes. Thus, by using any MDE approach, such as MDA, the alignment between business people and software engineering should be improved. To discover the different proposals that exist in this area, a systematic review was performed. As a result, the OMG's Business Process Definition Metamodel (BPDM) has been identified as the standard that will be the key for the application of MDA for BPM.

1 INTRODUCTION

There is a need for today's business to create and modify value chains rapidly. This brings about continuous growth and change in business processes. The goal of Business Process Management (BPM) is to help business people to manage these changes.

Business process management is defined as the capability to discover, design, deploy, execute, interact, operate, optimize and analyze process in a way that is complete, doing it at the business design level and not at the technical implementation level (Smith, et al., 2002).

BPM offers numerous benefits to organizations such as improving the speed of business, giving increased customer satisfaction, process integrity and accountability. It promotes process optimization, at the same time eliminating unnecessary tasks. It also includes customers and partners alike in the business processes and provides organizational agility.

BPM represents a "third wave" in business process engineering. The first wave was guided by process papers that reorganized human activity. The second wave focused on reengineering of business processes and the use of Enterprise Resource Planning (ERP). The third wave centers on formal business process models and the ability to modify and combine those models so as to align business process with organizational needs (Frankel, 2003).

BPM starts with process modeling. Process modeling is a business-driven exercise in which current and proposed process flows are documented in detail, linked to quantifiable performance metrics, and optimized through simulation analysis. Standards for process modeling languages are the key to the attaining of BPM's goal as well as in achieving the platform independence of the process models. Platform independence is one of the principles on which Model Driven Engineering (MDE) is based. The combination of both concepts, MDE and BPM, is the target of this systematic review.

MDE was conceived in an effort to solve several problems that have arisen in the last decade. On one hand, the growth of platform complexity, there being thousands of classes and methods with very complicated dependencies. On the other hand, we

can observe the continuous technological evolution of the systems, forcing programmers to modify the system code every time a new requirement is given.

In the MDE paradigm, every concept must be modeled. Thus, any change in the system must be shown in the model that represents that system. To model the systems, MDE proposes using Domain-Specific Modeling Languages (DSML). By means of these languages, different modeling notations for each kind of system are achieved. Thus, the software engineer has specific tools for modeling all kind of systems.

Another important concept in MDE is model transformation. By transforming models, the evolution of the systems is facilitated. A model could be transformed to another model or to a XML specification as well as to the source code that implements the model functionality.

The OMG group has developed Model Driven Architecture (MDA) as an example of MDE. MDA emerged with the established idea of separating the business logic specification of a system from the platform specific details in which the system is implemented (Miller, et al. 2003).

MDA adds some concepts to the MDE philosophy. MDA defines three level of abstraction. The Computational Independent Model (CIM), the Platform Independent Model (PIM) and the Platform Specific Model (PSM).

The key technology in MDA is MOF, as it is as in the definition of metamodels, which are MOF instances (figure 1) (Bézivin, 2003). The transformations among these models are the basis of MDA philosophy.

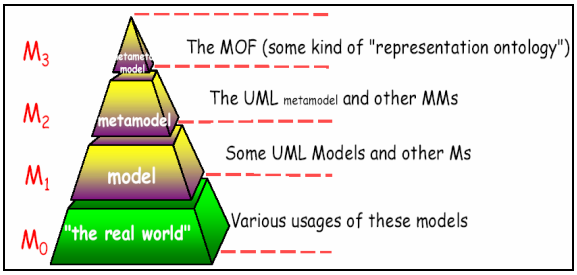

Figure 1: MOF metamodels structure (Bézivin, 2003).

The structure of this paper is as follows. In section 2, systematic reviews are introduced. In section 3, the carrying out of the review is shown in part, presenting the selection of studies and the classification of these. The information analysis is described in section 4 by summarizing the different authors' proposals about the MDE for BPM application. Section 5 presents the conclusions extracted from the systematic review along with future work, taking into account the different views found.

2 SYSTEMATIC REVIEWS

A systematic review of the literature is a means of identifying, evaluating and interpreting all available research relevant to a particular research question, or topic area, or phenomenon of interest (Kitchenham, 2004).

Systematic review is a scientific methodology that can be used to integrate empirical research on software engineering (Travassos, 2005).

Some of the characteristics that make the above methodology different from a conventional review are that a systematic review starts by defining a review protocol that specifies the research question, along with the methods and the criteria to drive the review. Added to all this, a systematic review is based on a search strategy that aims to detect as much relevant literature as possible. Moreover, performing a systematic review is needed in order to document the whole search strategy so that another researcher can replicate the same review with identical results.

There are three main phases that organize the different stages of the review process.

The phase called "planning the review" has as its purpose to identify the need for this study and to see through the development of a review protocol. A researcher may need a systematic review to be able to draw more general conclusions about a phenomenon or as a prelude to further research activities.

The protocol specifies the methods that will be used to undertake a specific systematic review. A pre-defined protocol is needed to avoid the possibility of researcher bias. Without a protocol, the selection of individual studies might possibly be driven by the expectations of the researcher.

When the whole planning is done, the review can start. This is the second phase, called "conducting the review". This phase lies in the identification of research, the selection of primary studies, the quality assessment study, data extraction and monitoring, together with data synthesis.

Firstly, the researcher must search the documents by using the strings specified in the protocol. When a first potential set of primary studies is obtained, the researcher must perform a selection by assessing

Table 1: Studies Selection.

Author, date	Study name	Source
Roser and Bauer (2005)	A Categorization of Collaborative Business Process Modeling Techniques	IEEE Digital Library
Zeng, et al. (2005)	Model-Driven Business Performance Management	IEEE Digital Library
Pfadenhauer, et al (2005)	Comparison of Two Distinctive Model Driven Web Service Orchestration Proposals	IEEE Digital Library
Rosen (2004)	SOA, BPM and MDA	ACM Digital Library
Frankel (2005)	BPMI and OMG: The BPM Merger	Business Process Trends
Harmon (2004)	The OMG's Model Driven Architecture and BPM	Business Process Trends
Frankel (2003)	BPM and MDA: The Rise of Model-Driven Enterprise Systems	Business Process Trends
Smith (2003)	BPM and MDA: Competitor, Alternatives or Complementary	Business Process Trends
Kano, et al. (2005)	Analysis and simulation of business solutions in a service-oriented architecture	Wiley Digital Library
MEGA & Standard Bodies (2004)	Business Process Modeling and Standardization	bpmg.org

the studies' actual relevance. Quality assessment must be done over the selected studies. As the result of assessing the information quality, according to the criteria defined in the protocol, a new set of studies is generated.

Finally, the data synthesis provides researchers with the results of the systematic review. The synthesis may be either quantitative or descriptive.

The last phase lies in the communication of the results. Usually the systematic review is reported in at least two formats: In a technical report or in a section of a PhD thesis as well as in a journal or conference paper.

3 REVIEW RESULTS

This section presents the selected works in the searches performed in the digital libraries, journals and internet sites related to the issue in hand. Moreover, a classification of studies is given. This has used aspects which are of relevance to the goal of the review as a basis for this classification

3.1 Studies Selection

The first step was to search in the predefined information sources. Those sources are: ACM digital library, IEEE digital library, Science Direct Digital Library, Business Source Premier, Wiley InterScience, www.BPTrends.com, www.bpmg.org.

The result of this search was a first set, composed of 22 studies. With the aim of tuning the set of studies, the selection criteria were applied. The studies had to contain information about the application of model driven engineering or model driven architecture in business process management. The issue of the systematic review is MDE for BPM, but because MDA is currently so widespread in the model engineering world, MDA was included in the selection criteria.

As the result of the application of selection criteria, the new set of studies was composed of 10 works (Table 1).

3.2 Classification of Studies

The selected studies have been classified according to several aspects that have been chosen to satisfy the goal of the systematic review (Table 2).

First of all, the author's opinion about the issue of systematic review is the most important aspect to take into account in classifying the studies. Another important aspect is whether the study offers a proposal about the use of CIM, PIM and PSM (MDA models) within the business process context. This means that the author suggests a specific utilization of MDA models, pointing out the possible modeling standards used in each model. Finally, the different standards proposed by authors for modeling business process are also aspects that are taken into account.

Table 2: Classification of the selected studies.

Author, date	MDE for BPM	Propose CIM, PIM, & PSM	UML	BPML	BPMN	BPDM	BPEL	J2EE	Others
Roser and Bauer (2005)	Yes	Yes		X	X	X	X	X	ebXML, AIRIS, WS-CDL
Zeng, et al. 2005	Yes	No	X					X	
Pfadenhauer, et al. (2005)	Yes	Partially	X			X	X		
Rosen (2004)	Yes	Yes		X	X	X	X		
Frankel (2005)	Yes	No	X		X	X	X		SBVR
Harmon (2004)	Yes	Yes	X	X	X	X	X		SBVR
Frankel (2003)	Yes	No	X	X	X		X		
Smith (2003)	No	No		X	X				
Kano, et al. (2005)	Yes	Yes	X				X	X	
MEGA & Standard Bodies (2004)	Yes	No		X	X	X	X		XPDL

4 FINDINGS AND ANALYSIS

This systematic review goal is to identify studies that can provide an approach for the application of the MDE paradigm to business process management. Note that from here on in the text, MDA will be the modeling approach that will always be mentioned, whereas MDE will not. This is because MDA is the most widely-seen example of MDE application, and because all the papers deal specifically with MDA, and not with MDE in general.

The article "BPM and MDA: Competitors, Alternatives or Complementary" (Smith, 2003), does not share the optimism of the rest of the authors. In Smith's opinion, BPM and MDA are very different. He declares that MDA must be used by software engineers and that BPM must be used by business people. He also affirms that the latter are not interested in a new approach for developing more software, but rather in a design-driven architecture based on processes and on a business process management system (BPMS) that interprets such designs, in the same way that RDBMS interprets a relational model. Although he does not deny the possibility that in the future the two philosophies may work together, at the moment he advocates the separation of both approaches.

The work "Model-Driven Business Performance Management" (Zeng, et al., 2005) proposes a technical approach for developing a complete application related to the BPM context. This study presents a relation between the two important concepts of this systematic review, using a model-driven approach to build the solution. The technical approach is based on the observation metamodel and its transformations. When the models are transformed, the approach suggests compiling the operational aspects of the model and finally developing a runtime engine that interprets the model and executes the generated code.

The study "Comparison of Two Distinctive Model Driven Web Service Orchestration Proposals" (Pfadenhauer, et al., 2005) focuses on the way to generate a set of web services that implement the organization business processes. By applying the MDA approach, and using some of the business process standards, the final solution is generated. This document mentions the BPDM standard as the MDA BPM connection.

The article "Analysis and simulation of business solutions in a service-oriented architecture" (M. Kano, 2005), offers a four-layer model architecture, in which the first two layers, when viewed together, are similar to the CIM layer in MDA from the business point of view rather than from the software

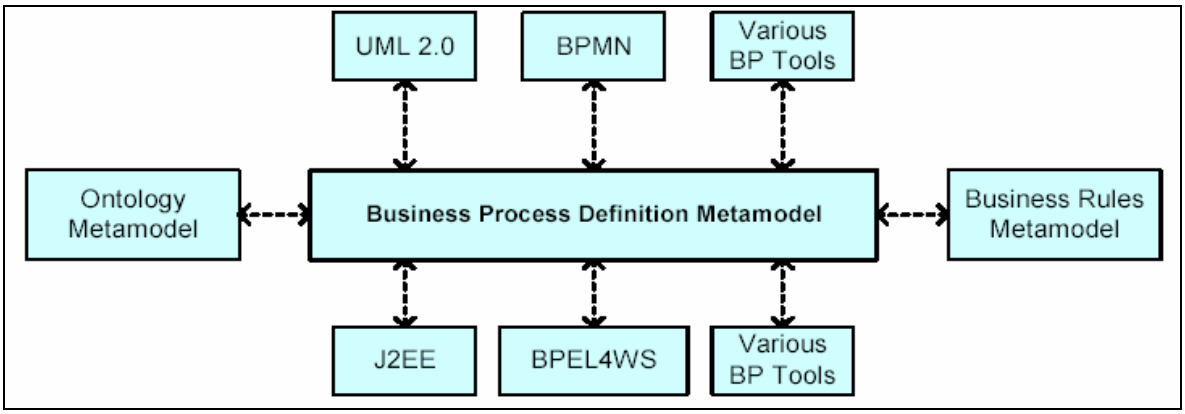

Figure 2: Use of OMG BPDM (Harmon, 2004).

system point of view. The last two layers correspond directly to the MDA PIM and PSM layers. By separating the independent platform concerns of a solution from the specific platform concerns and their associated code by means of MDA, the reuse of solution components is supported. Furthermore, the system is more flexible and adaptable to the changes in business requirements.

The work "A Categorization of Collaborative Business Process Modeling Technique" (Roser, et al. 2005), provides a proposal for applying MDA within the collaborative business process framework. Collaborative business processes are performed among different enterprises, which could have different business process development methodologies. Therefore, the creation of a common framework in which the organizations could communicate to each other in terms of business process would be ideal. The authors have spoken about MDA as the common framework for integrating business process from different organizations. They propose to create the business process CIMs, PIMs and PSMs in every organization, by using their own model language for each kind of model. These model languages must be MOF metamodels. Thus, transformations among metamodels can be done. The communication among the enterprises in terms of business process will be done by means of the common CIMs, PIMs and PSMs. These common models are written by using a common metamodel (one for each kind of model) and contain a view for the models of each organization from their CIMs, PIMs and PSMs. Thus, the common framework is well-known for all the organizations.

The study "Business Process Modeling and Standardization" (MEGA & Standard Bodies, 2004), is a review concerning all of the standards existing around business process, from languages to modeling notations. It provides a whole view of the state of standards (as it stood on September 2004), as well as their coverage within the BPM context. Moreover, it reports on the capacities of versions of new standards that are about to come out.

The study "SOA, BPM and MDA" (Rosen, 2004) does not offer a specific proposal for using MDE within some business process management areas, but provides an abstract vision about the role that both MDE and BPM play. The article points out how MDA can help business process automation, reuse and maintenance.

The two works by Frankel selected in the systematic review, concerning MDA and BPM, (Frankel, 2003 and Frankel, 2005), point to the use of MDA as the methodology that guides business process design, implementation, maintenance and management. Frankel's theory is that BPM joined to MDA is stronger than BPM alone, and MDA together with BPM is stronger than MDA alone. Moreover, he gives a wide classification of the different business process standards that currently exist. He aims at the aligning of the business process modeling notation (BPMN) with the OMG metamodel BPDM. This would provide portability utility by means of the XMI format and the power of the MDA transformations, in line with the well-known BPMN standard. Although Frankel is optimistic about the application of MDA in BPM, he also warns us about the wide gap that exists between the abstraction represented by a business process model and the specific models that represent the implementation of the business process.

The study "The OMG's Model Driven Architecture and BPM" (Harmon, 2004), has as its goal the use of MDA within the BPM. Harmon puts BPDM at the centre of business process modeling (Figure 2). The rest of business process modeling standards should be transformed directly to BPDM,

even BPMN. He proposes a way to use the different kinds of MDA models (CIM, PIM and PSM) for business process design and implementation. Thus, CIM will be specified in terms of business process by using BPDM; the business rules by means of business rules metamodel (BRM). These models are used by business analysts. PIM are a transformation from previous CIM, specified in a software system metamodel, for example UML. These models are used by software architects. Finally, PSM are built by transforming PIM to the platform specific language in which the business process will be implemented, for example the J2EE UML Profile.

5 CONCLUSIONS AND FUTURE WORK

The systematic review performed provides a complete view of the proposals and opinions existing in the recent literature about MDE paradigm application in business process management.

Most of the works found point to the use of model driven engineering as a valid approach for business process management. There are proposals for the use of MDA in the context of collaborative business process management, where the model driven plays the role of integration standard and allows different organizations to cooperate from a business process point of view. It is also suggested, on the other hand, that MDA is the methodology that drives the organization business process design, implementation, maintenance and management.

Although most authors are in favor of the use of MDE in business process management, there is some rejection of this idea, throwing into relief how far apart both concepts are, and how difficult it is to obtain cooperation to achieve better results.

Business process modeling standards become the key issue for the MDA application in the context of BPM. These standards must be metamodels, which are instances of meta-metamodel MOF. OMG propose the business process definition metamodel (BPDM) as the standard for business process modeling, which has no final version yet (OMG, 2003). BPDM is a semantic description of the logical relations among several elements of any business process description. It is not a notation. Its advantage is that it is a MOF metamodel. Thus, any other notation language, such as BPMN, can be transformed to BPDM. As BPDM is a MOF metamodel, this can be transported via XMI to any business process tool that knows such a metamodel. The companies only have to define MDA transformations from the BPDM metamodel to executable languages like J2EE or BPEL.

BPMN is the notation standard most frequently used to define business process at a high level. So some authors are quite adamant in their assertions that the next version of BPDM will take on the BPMN standard. Thus, any high level BPMN model will be able to be shared via XMI and transformed to follow the MDA methodology.

In future research, we will monitor the evolution of BPDM and its convergence with the BPMN standard. We will propose a QVT transformation from BPMN to BPDM, as well as from BPDM to a web services metamodel. To do this, the model management framework MOMENT will be used (Boronat, et al. 2005).

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