A Pattern-Based Approach for Business Process Modeling

Thesis presented in partial fulfillment of the requirements for the degree of Doctor of Computer Science.

Prof. Dr. Cirano Iochpe
Advisor

Porto Alegre, November 2006.
Thom, Lucinéia Heloisa


94 f.: il.


With love to my parents...
AKNOWLEDGMENTS

To God, who gave me healthy to develop this work.

To my parents Ivone and Lautério, for their love, motivation and support during all moments of my life. To my sister Márcia and my lovely nieces Amanda and Eduarda. Thank you for everything.

To my advisor Cirano Iochpe, for the knowledge and experience that I gained working with him. Thanks for all the advices and opportunities on this work. To Professor Bernhard Mitschang, who co-supervised my research during my stay (Sandwich Program) at the Institute for Parallel and Distribute Systems (IPVS) of the University of Stuttgart (Germany). Thanks for the support and suggestions on this work. To all colleagues from the IPVS. Thank you for the help you gave me.

To iProcess. A special thanks to Vinicius Amaral for the important contribution on this work.

To all researchers who collaborated with this work. In special to Prof. Manfred Reichert from the University of Twente and Jan Mendling from the University of Vienna. Thank you for the useful comments and guidance on this work.

To all my friends and colleagues at the UFRGS. In special to Felipe Formiga and Guillermo Nudelman Hess. Thanks a lot for the friendship.

To all friends I did during the time I spent in Germany. In special: Alessandra Schimitt, Daniela Nicklas, Hyon Hee Kim, Jing Lu, Valdeci Mariano de Souza, Uwe Heinkel, Vanessa and Rodrigo Salvador Monteiro and Wolfgang Wagner. Thank you all for the support, friendship and good memories of this important period of my life.

To the UFRGS. In special to the Informatics Institute for providing the structure and good environment for learning and researching. To all professors of this Institute. Thanks for the knowledge I gained with you and for the help on my research.

To CAPES, who financially supported my studies during the Ph.D. and especially for the sandwich scholarship. To DAAD who financially supported the period I spent in Mannheim (Germany) learning German.

I also would like to thank all of those who have somehow collaborated with the development of this work.
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<td>BPEL4WS</td>
<td>Business Process Execution Language for Web Services</td>
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<td>BPM</td>
<td>Business Process Management</td>
</tr>
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<td>BPMI</td>
<td>Business Process Management Initiative</td>
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<td>BPML</td>
<td>Business Process Modeling Language</td>
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<td>BPMN</td>
<td>Business Process Modeling Notation</td>
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<tr>
<td>CIMOSA</td>
<td>Computer Integrated Manufacturing Open System Architecture</td>
</tr>
<tr>
<td>EER</td>
<td>Enhanced-Entity-Relationship</td>
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<td>EBNF</td>
<td>Extended Backus-Naur Form</td>
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<td>EPC</td>
<td>Event-Driven Process Chains</td>
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<tr>
<td>IT</td>
<td>Information Technology</td>
</tr>
<tr>
<td>MIT</td>
<td>Massachusetts Institute of Technology</td>
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<tr>
<td>OASIS</td>
<td>Organization for the Advancement of Structured Information Standards</td>
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<tr>
<td>OMG</td>
<td>Object Management Group</td>
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<tr>
<td>RUP</td>
<td>Rational Unified Process</td>
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<td>TMBP</td>
<td>Transactional Metamodel of Business Process</td>
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<td>TMWP</td>
<td>Transactional Metamodel of Workflow Process</td>
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<td>UML</td>
<td>Unified Modeling Language</td>
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<td>Workflow Management Coalition</td>
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<td>Workflow on Intelligent Distributed database Environment Model</td>
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<td>WSFL</td>
<td>Web Service Flow Language</td>
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ABSTRACT

Modern organizations have demands related to the automation of their business processes since such processes are highly complex and need to be efficiently executed. Within this context, the workflow technology has shown to be very effective, mainly in the business process automation. However, as it is an emergent technology and in constant evolution, workflow presents some limitations.

Though several workflow (meta) models have been proposed in recent years, their sub-models for organizational structure aspects representation show limited power of expression. On the other hand, most of the current workflow modeling tools do not provide functionalities that enable users to define, query, and reuse workflow patterns properly. One of the main problems is the non-availability of a consolidated mapping between patterns based on recurrent functions found in business processes (e.g., request for activity execution, notification, decision, or approval) and workflow (meta) models or workflow modeling tools.

Relying on these problems, the first contribution of this thesis is a Transactional Metamodel of Business Process (TMBP) with support to organizational structure aspects. The metamodel makes feasible to create business (sub-)processes from the reuse of organizational –based workflow patterns. An additional feature of TMBP supports the generation of business (sub-)processes through the Business Process Execution Language for Web Services (BPEL4WS).

Other important contribution of this thesis is a set of workflow patterns represented as block activity patterns. Each pattern refers to a recurrent business function frequently found in business processes. The mining of 190 workflow processes of more than 10 different organizations has evidenced the existence of the set of workflow patterns with high support in the workflow processes analyzed. Moreover, it became clear through this study that the set of patterns is both necessary and enough to design all 190 processes that were investigated. As a consequence of the mining process, a set of association rules was identified too. The rules not only help to better define specific workflow patterns, but also combine them with existent control flow patterns. These rules can be useful for building more complex workflows.

Keywords: business and workflow process modeling, organizational structure aspects, workflow (meta) model, workflow pattern, block activity, workflow process mining, association rules.
Uma Abordagem Baseada em Padrões para Modelagem de Processos de Negócio

RESUMO

Organizações modernas apresentam demandas relacionadas à automação dos seus processos de negócio devido à alta complexidade dos mesmos e à necessidade de maior eficácia na execução. Neste contexto, a tecnologia de workflow tem se mostrado bastante eficiente, principalmente para a automatização dos processos de negócio. No entanto, por ser uma tecnologia emergente e em evolução, workflow apresenta algumas limitações.

Ainda que diversos (meta) modelos de workflow tenham sido propostos nos últimos anos, seus sub-modelos para representação dos aspectos estruturais da organização apresentam baixo poder de expressão. Além disso, a maioria das ferramentas para modelagem de workflow não provêm funcionalidades para definição, consulta e reuso de padrões. Um dos principais problemas é falta de um mapeamento consolidado entre padrões de funções recorrentes em processos de negócio (ex: solicitação de execução de atividade, aprovação de documentos) e (meta) modelos e/ou ferramentas para modelagem de processos de negócio e workflow. Além disso, a maioria das abordagens em padrões de workflow não exploram a completude e necessidade dos seus padrões para modelagem de workflow.

A primeira contribuição desta tese é um Modelo Transacional de Processos de Negócio (MTPN) com suporte aos aspectos estruturais da organização. O metamodelo possibilita a criação de (sub-)processos de negócio a partir do reuso de padrões, principalmente com base nestes aspectos. Adicionalmente, o metamodelo sugere a geração automática de padrões através da Linguagem de Execução para Web Services (BPEL4WS).

Outra importante contribuição da tese é um conjunto de padrões de workflow representados como atividades de bloco. Cada padrão descreve uma função recorrente em processos de negócio. A mineração de 190 processos de workflow de mais de 10 organizações diferentes provou a existência dos padrões com alto suporte nos processos de workflow analisados. Além disso, o estudo mostrou que o conjunto de padrões é suficiente e necessário para modelar todos os 190 processos investigados. O estudo também resultou em um conjunto de regras de associação. As regras não apenas contribuem para uma melhor definição dos padrões de atividade de bloco, mas também para a combinação destes com padrões de controle de fluxo.

Palavras-Chave: modelagem de processos de negócio e workflow, aspectos estruturais da organização, (meta) modelo de workflow, padrões de workflow, mineração de processos de workflow, regras associativas.