

Lecture Notes in Business Information Processing

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Evaluations of Process Modeling Grammars

Ontological, Qualitative and Quantitative Analyses
Using the Example of BPMN



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To Laura and my family

Foreword

Business processes have emerged as a well-respected variable in the design of successful corporations. However, unlike other key managerial variables such as products and services, customers and employees, physical or digital assets (e.g., data, information), the conceptualization and management of business processes are in many respects in their infancy. One of the issues in this context is the appropriate, consistent, valid and reliable description of business processes by means of business process modeling.

This book explores on an extraordinary high level of conceptualization and scientific rigor the current capabilities of the most prominent process modeling grammar BPMN. In particular, it aims to explain and predict how process analysts arrive at an opinion about the quality of a process modeling grammar, and thereby ultimately why they would continue working with the grammar.

An established theory of ontological expressiveness provides the foundation and sensitizing device for the identification of a number of issues with the BPMN grammar. Jan Recker set out to empirically test these issues via a set of 19 interviews as well as a thoroughly designed survey instrument. The subsequent consolidation of over 500 responses of process modeling professionals does not only provide the study outcomes with high statistical significance, but also clearly demonstrates the great interest in this type of research. Theories of technology acceptance and continued usage allow linking the outcomes of the ontological analysis with predictions about how the identified and confirmed issues with the modeling grammar impact important usage beliefs, which ultimately inform the ongoing use of the grammar. As the main research outcome, this leads to a new, comprehensive and tested theory that for the first time integrates design features of a process modeling grammar with its likely impact on user behavior.

Beyond its tremendous academic contribution to the domain of process modeling, this book is also a benchmark study for scientific innovation that can be derived from the creative and well-executed integration of two large, but so far independent, theories. The research approach described by Jan Recker is hopefully inspirational for many researchers as it convincingly shows the magnitude of outcomes that can be derived from such large-scale theory integration.

I am confident that this book will leave its mark on the future development of process modeling in two ways. First, the identified and confirmed issues with the current process modeling grammar, and their impact on ease of use and usefulness, will help to channel the attention of the community developing and adopting BPMN toward topics of high relevance. This will facilitate a demand-driven approach to the future design of process modeling standards and in return increase the significance of the related contributions. Second, and even more

important, I trust that the benefits of the rigorous analyses demonstrated in this book will encourage the related academic and professional communities to put an increased emphasis on solid foundations for their future work.

Jan Recker delivers with this book an impressive example of his outstanding talent as an information systems researcher who can conduct sound scientific work on topics of high practical relevance. His doctoral dissertation work that is captured within this book will for many years be a recommended reference thesis on how to design and execute theory-guided and empirically informed research of world-class standard.

November 2010

Michael Rosemann

Preface

This book is an extended and revised version of my dissertation “Understanding Process Modeling Grammar Continuance: A Study of the Consequences of Representational Capabilities,” which I submitted to the Queensland University of Technology in partial fulfillment of the requirements for the degree of Doctor of Philosophy in April 2008. The doctoral thesis was honored with the *ACPHIS Information Systems Doctoral Thesis Award 2008*, given to the best doctoral dissertation in information systems within the Australasian region. The thesis was further commended as runner-up to the *ICIS 2008 ACM SIGMIS Doctoral Dissertation Award*, the global dissertation competition in the information systems field.

This book consolidates the main findings from the doctoral dissertation work, and enhances it with several related, complementary research findings I established between 2005 and 2009 on the ways to evaluate the quality of business process modeling grammars. These studies together with the work that found its way into my doctoral dissertation provide a comprehensive and contextualized overview about the quality of process modeling grammars and the approaches that can be used to evaluate such quality.

Abstract

The graphical modeling of processes is of growing popularity and high relevance to organizations that seek to document, analyze and improve their business operations. To model processes, analysts use so-called process modeling grammars that provide them with graphical constructs and grammatical rules, and therefore define how business processes can be modeled.

This book investigates the notion of the quality of business process modeling grammars. It focuses on three approaches that incorporate established theoretical frameworks as well as empirical methods, namely, *ontological analysis*, *qualitative analysis* and *quantitative analysis*. The three presented evaluation approaches are applied to the case of the Business Process Modeling Notation, a widely used business process modeling grammar and the current industry standard for process modeling. Through the application, first, ontological shortcomings of process modeling grammars are revealed; second, it is shown how these shortcomings manifest in actual process modeling practice; and third, it is shown how such shortcomings influence usage behaviors by process modeling practitioners.

Contributions

This book presents contributions to the scholarly areas of process modeling and model quality research on at least four accounts.

First and foremost, it presents a consolidated view of state-of-the-art research in the important area of process modeling grammar quality. This is the first attempt to report on, and discuss, three rigorous and extensive evaluation approaches and to describe important guidelines in their application.

Second, specifically, it showcases the application of ontological theory to the evaluation of process modeling grammars. In doing so, comprehensive procedural guidelines are advanced that assist fellow scholars in repeating the analysis for other types of grammars.

Third, it also describes design, conduct and analysis of qualitative empirical data on the use of process modeling grammars in industry practice. Aside from the results, the book also describes the design of appropriate data collection protocols and gives a comprehensive example of how such data can be appropriately analyzed.

Fourth, the book reports on a quantitative, statistical examination of the theoretical predictions about the quality of process modeling grammars. In doing so, it reports on the first attempt to quantify the impact that theoretical grammar quality metrics have on the usage quality beliefs that process modelers develop when working with the grammar. The book describes measurement design, study execution and also provides an example of a rigorous statistical data examination.

In terms of contributions to industry practice, this book presents the first thorough theoretical and empirical analysis of the shortcomings of the current industry standard for process modeling, the Business Process Modeling Notation, and its use in actual process modeling practice. Thereby, the book offers confirmed insights into the usage experiences of process modelers using the Business Process Modeling Notation and also a detailed account of the shortcomings of the grammar. These findings assist organizations significantly in developing a modeling environment where analysts can work effectively and efficiently with a grammar through extensive knowledge of pitfalls and potential workarounds.

Through developing these contributions, the book details a successful attempt of how rigorous research can be performed on relevant topics, and how research insights can be uncovered that have a direct and relevant impact on industry practice. Thereby, this book is a successful example of a boundary-spanner between academia and industry, and serves both worlds well.

Structure

This book is organized in six chapters, which span three parts:

1. **Part 1 – Foundations:** In this part, an introduction to the problem area and scope of the book is provided in Chap. 1. Next, Chap. 2 provides a general overview of business process modeling and introduces important related terms and concepts.
2. **Part 2 – Quality Evaluations of Process Modeling Grammars:** In this part, three approaches to evaluating the quality of process modeling grammars are presented. In Chap. 3, ontological analysis is introduced as a theoretical

measurement approach for the goodness of process modeling grammars, and it shown how such an analysis can lead to specific predictions about the weaknesses of the grammar. In Chap. 4, an empirical evaluation approach is introduced on the basis of qualitative empirical data. It is described how such data collection can be organized and how the qualitative data can be examined to reveal insights about the usage of process modeling grammars in practice. In Chap. 5, a quantitative, statistics-based approach to grammar quality evaluation is discussed that is able to examine the direct impact of theoretical quality notions on the usage behaviors of grammar users.

3. Part 3 – Finale: In this part, the book concludes in Chap. 6 with a review of the contributions offered in Part 2, the resulting implications for the area of process modeling and the involved stakeholders. Chapter 6 concludes with an outlook to future research opportunities.

Relevant Published Literature

This book consolidates my research on process modeling grammar quality conducted between 2005 and 2009. Many of the individual studies that are discussed, consolidated and integrated in the book have been published as stand-alone articles in refereed scholarly journals. At stages, they provide some details about research processes, relevant theoretical foundations or study findings that, in the interest of brevity, are not reported in this book. The following list, therefore, details a number of follow-up readings to the discussions in this book, arranged in chronological order. Every effort has been made in this book to reference material from these publications, but if any references have been inadvertently overlooked we will be pleased to make the necessary amends at the first opportunity.

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List of Acronyms

AGFI	Adjusted Goodness of Fit Index
ANCOVA	Analysis of Covariance
ANOVA	Analysis of Variance
ARIS	Architecture of Integrated Information Systems
AVE	Average Variance Extracted
BPD	Business Process Diagram
BPEL	Business Process Execution Language for Web Services
BPM	Business Process Management
BPML	Business Process Modeling Language
BPMN	Business Process Modeling Notation
BPSS	Business Process Specification Schema
BTP	Business Transaction Protocol
PCD	Perceived Construct Deficit
PCE	Perceived Construct Excess
CELRD	Comparison of Early and Late Respondent Differences
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
PCO	Perceived Construct Overload
PCR	Perceived Construct Redundancy
ebXML	Electronic Business using eXtensible Markup Language
EFA	Exploratory Factor Analysis
EPC	Event-driven Process Chain
ERD	Entity-Relationship Diagram
ERM	Entity-Relationship Modeling
ERP	Enterprise Resource Planning
GFI	Goodness of Fit Index
GLS	Generalised Least Squares
IDEF	Integrated Definition
IS	Information System
ISAD	Information Systems Analysis and Design
IT	Information Technology
MG	Modeling Grammar
MIS	Management Information System
ML	Maximum Likelihood
MOC	Maximal Ontological Completeness
MOO	Minimal Ontological Overlap
NFI	Normed Fit Index
NNFI	Non-Normed Fit Index

OLS	Ordinary Least Squares
OMG	Object Management Group
PEOU	Perceived Ease Of Use
PLS	Partial Least Squares
PU	Perceived Usefulness
RMR	Standardized Root Mean Square Residual
RMSEA	Root Mean Square Error of Approximation
SEM	Structural Equation Modeling
SEQUAL	Semantic Quality Framework
SOAP	Simple Object Access Protocol
TDM	Tailored Design Method
UML	Unified Modeling Language
WfMC	Workflow Management Coalition
Wf-XML	Workflow XML
WS	Web Service
WSCI	Web Service Choreography Interface
XML	Extensible Markup Language
XPDL	XML Process Definition Language