More information about this series at http://www.springer.com/series/7409
Preface

BPM 2015 was the 13th International Conference on Business Process Management. It provided a global forum for researchers to meet and exchange views over research topics and outcomes in business process management. BPM 2015 was hosted by the University of Innsbruck and took place August 31 to September 3.

We received 125 full submissions. After a review process involving 17 senior Program Committee (PC) members and 75 PC members, we accepted 30 papers in total, 21 full papers (17% acceptance rate), seven short papers and two industrial papers, for an overall acceptance rate of 24%.

This year, we encouraged in particular two types of submissions. First, research that attests to the interdisciplinary nature of BPM and connects to disciplines such as information systems, management and organizational science, data and knowledge management, operations management, service-oriented computing, social computing, cloud computing, big data, and others. Second, research that explicitly examines emerging BPM areas and novel applications of BPM concepts and methods. Out of the submissions on these and the existing traditional subject areas of BPM research, we selected a range of papers addressing topics ranging from process discovery, modeling, and monitoring, to emerging and practical areas of BPM, runtime process management, and process performance aspects.

The selection of this scientific program would not have been possible without the dedicated combined efforts of the PC and the entire reviewer community. We are most grateful to all those involved and in particular to the senior PC members for leading the review process and preparing recommendations to the PC chairs. Of course, all these efforts would have been futile if not for the entire community of BPM researchers that authored submissions to BPM and that led to the enjoyable yet difficult task of selecting papers from the vast set of submissions.

The scientific program in 2015 was complemented by three keynotes, selected to provide a perspective from within the BPM community (Marlon Dumas, University of Tartu), from BPM industry (Gustavo Gomez, Bizagi) and from adjacent areas to the core BPM research community (Munindar Singh, North Carolina State University).

Finally, we would like to thank the BPM 2015 Organizing Committee and in particular the General Chair, Barbara Weber, for their efforts in making this conference possible, and we thank the sponsors, Bizagi, Prologics, Minitlabs, IBM Research, Signavio, Exformatics, and SAP, for their generous support.

We hope that you will enjoy reading the papers that comprise the scientific program of BPM 2015 and we hope that you will be inspired to contribute to the next edition of BPM in 2016.

September 2015

Hamid R. Motahari-Nezhad
Jan Recker
Matthias Weidlich
Organization

BPM 2015 was organized in Innsbruck, Austria, by the University of Innsbruck.

Steering Committee

Wil van der Aalst (Chair)  
Boualem Benatallah  
Jörg Desel  
Schahram Dustdar  
Marlon Dumas  
Mathias Weske  
Michael zur Muehlen  
Barbara Weber  
Eindhoven University of Technology, The Netherlands  
University of New South Wales, Australia  
University of Hagen, Germany  
Vienna University of Technology, Austria  
University of Tartu, Estonia  
HPI, University of Potsdam, Germany  
Stevens Institute of Technology, USA  
University of Innsbruck, Austria

Executive Committee

General Chair

Barbara Weber  
University of Innsbruck, Austria

Program Chairs

Hamid R. Motahari-Nezhad  
Jan Recker  
Matthias Weidlich  
IBM Research, USA  
Queensland University of Technology, Australia  
Humboldt University of Berlin, Germany

Industry Chairs

Jan Mendling  
Jan vom Brocke  
Vienna University of Economics and Business, Austria  
University of Liechtenstein, Liechtenstein

Workshop Chairs

Manfred Reichert  
Hajo Reijers  
University of Ulm, Germany  
VU University Amsterdam, The Netherlands

Tutorial and Panel Chairs

Jakob Pinggera  
Pnina Soffer  
University of Innsbruck, Austria  
University of Haifa, Israel

Demo Chairs

Florian Daniel  
Stefan Zugal  
University of Trento, Italy  
University of Innsbruck, Austria
Doctoral Consortium Chairs
Stefanie Rinderle-Ma University of Vienna, Austria
Mathias Weske HPI, University of Potsdam, Germany

Local Organization Chairs
Cornelia Haisjackl University of Innsbruck, Austria
Ilona Zaremba University of Innsbruck, Austria

Web and Social Media Chairs
Cornelia Haisjackl University of Innsbruck, Austria
Jakob Pinggera University of Innsbruck, Austria
Stefan Zugal University of Innsbruck, Austria

Publicity Chairs
Amin Beheshti University of New South Wales, Australia
Henrik Leopold VU University Amsterdam, The Netherlands
Lucineia Thom Federal University of Rio Grande do Sul, Brazil
Lijie Wen Tsinghua University, China
Michael zur Muehlen Stevens Institute of Technology, USA

Senior Program Committee
Florian Daniel University of Trento, Italy
Jörg Desel University of Hagen, Germany
Marlon Dumas University of Tartu, Estonia
Avigdor Gal Technion, Israel
Akhil Kumar Penn State University, USA
Marcello La Rosa Queensland University of Technology, Australia
Hajo A. Reijers Eindhoven University of Technology, The Netherlands
Stefanie Rinderle-Ma University of Vienna, Austria
Michael Rosemann Queensland University of Technology, Australia
Pnina Soffer University of Haifa, Israel
jianwen Su University of California at Santa Barbara, USA
Farouk Toumani Blaise Pascal University, France
Boudewijn van Dongen Eindhoven University of Technology, The Netherlands
Jan vom Brocke University of Liechtenstein, Liechtenstein
Mathias Weske University of Potsdam, Germany
Roel Wieringa University of Twente, The Netherlands
Michael Zur Muehlen Stevens Institute of Technology, USA
Program Committee

Mari Abe            IBM Research, Japan
Alistair Barros    Queensland University of Technology, Australia
Seyed-Mehdi-Reza Beheshti University of New South Wales, Australia
Boualem Benatallah University of New South Wales, Australia
Christoph Bussler Oracle, USA
Jorge Cardoso      University of Coimbra, Portugal
Fabio Casati       University of Trento, Italy
Anis Charfi        SAP Research, Germany
Sarah Cohen-Boulakia University of Paris-Sud, France
Francisco Curbera  IBM Research, USA
Ernesto Damiani    University of Milan, Italy
Nirmit Desai       IBM Research, India
Remco Dijkman      Eindhoven University of Technology, The Netherlands
Schahram Dustdar   Vienna University of Technology, Austria
Johann Eder        University of Klagenfurt, Austria
Dirk Fahland       Eindhoven University of Technology, The Netherlands
Marcelo Fantinato  University of São Paulo, Brazil
Hans-Georg Fill    University of Vienna, Austria
Luciano Garcia-Bañuelos University of Tartu, Estonia
Christian Gerth    University of Paderborn, Germany
Claude Godart      Loria, France
Sven Graupner      Hewlett-Packard Laboratories, USA
Paul Grefen        Eindhoven University of Technology, The Netherlands
Daniela Grigori    University of Paris-Dauphine, France
Thomas Hildebrandt IT University of Copenhagen, Denmark
Rick Hull          IBM Research, USA
Arno Jacobsen      TU Munich, Germany
Leonid Kalinichenko Russian Academy of Science, Russia
Gerti Kappel       Vienna University of Technology, Austria
Dimka Karastoyanova University of Stuttgart, Germany
Rania Khalaf       IBM Research, USA
Ekkart Kindler     Technical University of Denmark, Denmark
Agnes Koschmider   Karlsruhe Institute of Technology, Germany
Jochen Kuester     University of Applied Sciences Bielefeld, Germany
Geetika Lakshmanan IBM Research, USA
Henrik Leopold     VU University Amsterdam, The Netherlands
Frank Leymann      University of Stuttgart, Germany
Chengfei Liu       Swinburne University of Technology, Australia
Peter Loos         Saarland University, Germany
Heiko Ludwig       IBM Research, USA
Shahar Maoz        Tel Aviv University, Israel
Massimo Mecella   Sapienza University of Rome, Italy
Jan Mendling      Vienna University of Economics and Business, Austria
### Additional Reviewers

<table>
<thead>
<tr>
<th>Name</th>
<th>Name</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andrews, Kevin</td>
<td>Rodriguez, Carlos</td>
<td>Pichler, Horst</td>
</tr>
<tr>
<td>Awad, Ahmed</td>
<td>Santos, Ario</td>
<td>Rasouli, Mohammad Reza</td>
</tr>
<tr>
<td>Beheshti, Seyed-Mehdi-Reza</td>
<td>Athanasopoulos, George</td>
<td>Rogge-Solti, Andreas</td>
</tr>
<tr>
<td>Bill, Robert</td>
<td>Barukh, Moshe Chai</td>
<td>Schobel, Johannes</td>
</tr>
<tr>
<td>Botezatu, Mirela Madalina</td>
<td>Bhiri, Sami</td>
<td>Shepherd, John</td>
</tr>
<tr>
<td>Chiao, Carolina Ming</td>
<td>Bork, Dominik</td>
<td>Skvortsov, Nikolay</td>
</tr>
<tr>
<td>Claes, Jan</td>
<td>Busany, Nimrod</td>
<td>Slominski, Aleksander</td>
</tr>
<tr>
<td>Debois, Søren</td>
<td>Chituc, Claudia-Melania</td>
<td>Sun, Yutian</td>
</tr>
<tr>
<td>Elgammal, Amal</td>
<td>Conforti, Raffaele</td>
<td>Tsagkani, Christina</td>
</tr>
<tr>
<td>Falkenthal, Michael</td>
<td>Dumont, Tobias</td>
<td>Ul Haq, Irfan</td>
</tr>
<tr>
<td>Gaaloul, Walid</td>
<td>Eshuis, Rik</td>
<td>Wagner, Sebastian</td>
</tr>
<tr>
<td>Hahn, Michael</td>
<td>Feinerer, Ingo</td>
<td>Weiß, Andreas</td>
</tr>
<tr>
<td>Hake, Philip</td>
<td>Görlach, Katharina</td>
<td>Wolters, Dennis</td>
</tr>
<tr>
<td>Huma, Zille</td>
<td>Hajimirsadeghi, Seyed Alireza</td>
<td>Yin, Peifeng</td>
</tr>
<tr>
<td>Kammerer, Klaus</td>
<td>Huemer, Christian</td>
<td>Yu, Jian</td>
</tr>
<tr>
<td>Knuplesch, David</td>
<td>Ishakian, Vatche</td>
<td>Skouradaki, Marigianna</td>
</tr>
<tr>
<td>Kourtouli, Eleni</td>
<td>Kleinert, Thomas</td>
<td>Slaats, Tijs</td>
</tr>
<tr>
<td>Kusen, Ema</td>
<td>Kolb, Jens</td>
<td>Stupnikov, Sergey</td>
</tr>
<tr>
<td>Leotta, Francesco</td>
<td>Kucza, Timo</td>
<td>Thaler, Tom</td>
</tr>
<tr>
<td>Lübbecke, Patrick</td>
<td>Köpke, Julius</td>
<td>Tsarfaty, Reut</td>
</tr>
<tr>
<td>Marengo, Elisa</td>
<td>Lu, Xixi</td>
<td>Vanwersch, Rob</td>
</tr>
<tr>
<td>Mayerhofer, Tanja</td>
<td>Mach, Werner</td>
<td>Wang, Zhaoxia</td>
</tr>
<tr>
<td>Mehdiyev, Nijat</td>
<td>Marrella, Andrea</td>
<td>Wen, Lijie</td>
</tr>
<tr>
<td>Neubauer, Patrick</td>
<td>Mazak, Alexandra</td>
<td>Wynn, Moe</td>
</tr>
<tr>
<td>Pittl, Benedikt</td>
<td>Mundbrod, Nicolas</td>
<td>Yongchareon, Sira</td>
</tr>
</tbody>
</table>
Sponsors
Keynotes
From Models to Data and Back: The Journey of the BPM Discipline and the Tangled Road to BPM 2020

Marlon Dumas
University of Tartu, Estonia
marlon.dumas@ut.ee

Keynote Abstract

It has been over two decades since the first research articles on Business Process Management (BPM) saw light. Much ink has been spilled meantime to build up a discipline out of what is essentially a vision of how work in organizations can be effectively conceptualized and analyzed for the purpose of performance improvement. There is by now a relatively well-established body of methods and tools to instill "process thinking” in organizations and to manage business processes throughout their lifecycle.

A considerable subset of these methods and tools rely on business process models, be it for understanding processes, for preserving and communicating process knowledge, for analyzing, redesigning or automating processes, and even for monitoring them. It is thus not surprising that a lot of research and development in the field of BPM has concentrated on modeling languages, tools and methods, to the extent that the early evolution of the discipline is sometimes associated with the development of modeling languages. Along this line, the discipline has gone through a long convergence and standardization process, starting from proprietary notations such as Event-driven Process Chains (EPCs), moving on to standardization attempts such as UML Activity Diagrams and the XML Process Definition Language (XPDL), followed by a parade of standardization proposals and associated acronyms in the early ’00s (WSFL, XLANG, BPML, WSCI to name a few), the rise and fall of the Business Process Execution Language (BPEL), the broad adoption of the Business Process Model and Notation (BPMN), and the somehow failed struggle to reach a standard case management notation (cf. CMMN).

The overwhelming volume of these developments calls for two questions: What have we fundamentally learned from the development of modeling languages, tools and methods? And perhaps more importantly, what have we so far failed to fully comprehend?

Another significant subset of methods and tools in the BPM field rely on data, specifically data collected during the execution of business processes. As processes become increasingly digitized, data is moving from being a (necessary) side-product of the execution of business processes, to becoming a central asset that can be
leveraged across all phases of the business process lifecycle. This prospect has fueled a stream of research and development on business process data analytics, starting from dashboards, cockpits and process data warehouses, to the era of process mining methods and tools. Along this line, we have seen emerge a number of methods and tools to summarize process execution data, to generate or enhance models using these data, and to understand how the recorded execution of a business process diverges from its modeled behavior or vice-versa.

Again, the overwhelming volume of developments in this field calls for two questions: What have we fundamentally learned from the development of process mining tools and methods? And perhaps more importantly, what have we so far failed to fully comprehend?

This talk will argue that answers to the above questions can be summarized with two concepts: variation and decisions, be them offline (e.g. design-time) or online (runtime). Many if not most developments and open challenges in the field boil down to comprehending, analyzing, executing and monitoring business processes with inherently high levels of variation and with complex decisions. Indeed, the discipline has learned to analyze, optimize and automate routine work that involves well-structured data objects and simple choices, even on relatively large scales. But we are yet to learn how to manage large-scale variation, unstructuredness and complex decision spaces. The emergence of the Internet of Things and cyber-physical systems is likely to only heighten the challenge, as in a world where the number of connections increases exponentially, so does the complexity of options and variations that ought to be accounted for. The coming of age of automated decision making, the maturation of natural language processing as well as advances in heterogeneous data analytics, create significant opportunities to address the challenges that lie ahead for the BPM discipline.

For a while, the trend in BPM has been to simplify by standardization, at different levels. Now it's time to learn how to embrace variation and the manifold decisions that arise thereof. One thing for sure: A tangled road lies ahead towards BPM 2020.
NoBPM: Supporting Interaction-Oriented Automation via Normative Specifications of Processes

Munindar P. Singh
Department of Computer Science
North Carolina State University
Raleigh, NC 27695-8206, USA
singh@ncsu.edu

Keynote Abstract

Business and business processes are centuries old social constructions that underlie human society. Business process management or BPM is a modern construction in information technology. The objective of BPM is to support business processes: it has partially succeeded, especially in regards to improving the efficiency of process enactment.

However, BPM embodies a number of restrictive assumptions treated as dogma in current research that limit its applicability. First, BPM is almost entirely characterized in operational terms, that is, describing the steps to be taken and constraints on their ordering and occurrence. Usually, these characterizations are procedural, though occasionally they may be declarative, such as in temporal logic. The underlying modeling primitives in operational characterizations, especially, the procedural forms, are little different from the primitives of any programming language.

Second, BPM is usually treated from a central viewpoint, even when the enactments of the concerned business process are physically distributed. That is, BPM’s focus is on technical rather than business aspects. In essence, BPM does not so much support a business process as redefine it in operational terms. That is, it omits a standard of correctness but provides a means to an implementation as an alternative to a standard.

Although BPM has proved effective in IT practice, I claim that it has run its course. I claim that BPM is inadequate for dealing with modern challenges such as processes that incorporate humans and organizations as well as diverse services and devices that reflect the autonomy of humans and organizations.

If we were to rethink the foundations of business processes from first principles, we would understand them as social constructions just as they are—and have been through history. We would establish new computational foundations for business processes that place them as elements of a sociotechnical system. In particular, we would

- specify them via normative (not operational) standards of correctness—indeed independent of implementation;
– describe how to verify correctness properties of specifications and evaluate implementations with respect to specifications; and
– enact and govern them in a decentralized manner.

I term this new perspective NoBPM. NoBPM is about a computational approach—or, rather, a family of computational approaches—to business processes that seek to, first, capture the essence of what a business process is meant to accomplish for its various participants and, second, to support provably most flexible enactments.

The vision of NoBPM brings forth a number of major research questions.
– What does it mean for a normative process specification to be sound?
– How can we learn such specifications from observations of humans and organizations and their services and devices?
– What does it mean for an autonomous participant to comply with a normative process specification?
– How can we define and ensure a suitable notion of alignment of the various parties involved in a business process?

I describe recent and ongoing research [1–13] that hints at how we may approach the above questions. I offer some suggestions for how the considerable research strength of the BPM community can be directed toward these questions and invite researchers to participate in NoBPM.

Acknowledgments Thanks to Matteo Baldoni, Cristina Baroglio, and Amit Chopra for helpful discussions about this research.

References

Adaptability, Architecture and CX: The Bizagi Way

Gustavo Ignacio Gomez
Bizagi, UK
Gustavo.Gomez@bizagi.com

Keynote Abstract

Business Process Management Systems (BPMS) have put processes at the centre of the universe. This focus has enabled the creation of formal practice and theories from which IT solutions have benefited enormously during the last 15 years.

By delivering the right information to the right person at the right time, information workers have been empowered by systems that truly understand what they intend to do. And by doing this in a model-driven way whereby the technology adapts itself to this business model - and not the other way around - these new systems have enabled continuous improvement and adaptability: capabilities indispensable to achieving much-desired business agility. Yet despite this, the user experience is often counter-intuitive to the business objectives. Knowledge workers may find themselves asking questions such as:

– Do I really know which process I want to start when I enter my BPMS application?
– Do I need to carry out some analysis before I start?
– Are all process combinations known to me beforehand?
– How smart is the solution at suggesting processes that actually make sense?

Furthermore, what if we wanted to create modern applications that resemble sophisticated web sites such as amazon.com or hotels.com? Could we build them with a BPMS? If not... why not? What's missing?

Customer experience (CX) is quickly becoming the hottest buzzword in business and industry. How is CX related to BPMS? What makes a great CX anyway?

In this talk, we will explore how by marrying process and data and extending current process technologies with few new concepts we can create fundamentally new, context-sensitive applications that empower knowledge workers like never before, and redefine the boundaries of what a BPMS can do.
# Contents

## Runtime Process Management

Improving Business Processes: Does Anybody have an Idea? .......................... 3  
Rob J.B. Vanwersch, Irene Vanderfeesten, Eric Rietzschel, and Hajo A. Reijers

Inspection Coming Due! How to Determine the Service Interval of Your Processes! ................................................................. 19  
Jonas Manderscheid, Daniel Reißner, and Maximilian Röglinger

Data-Driven Performance Analysis of Scheduled Processes .......................... 35  
Arik Senderovich, Andreas Rogge-Solti, Avigdor Gal, Jan Mendling, Avishai Mandelbaum, Sarah Kadish, and Craig A. Bunnell

## Process Modeling

Specification and Verification of Complex Business Processes - A High-Level Petri Net-Based Approach ................................. 55  
Ahmed Kheldoun, Kamel Barkaoui, and Malika Ioualalen

Concurrency and Asynchrony in Declarative Workflows ............................ 72  
Søren Debois, Thomas Hildebrandt, and Tijs Slaats

Detecting Inconsistencies Between Process Models and Textual Descriptions ............................... 90  
Han van der Aa, Henrik Leopold, and Hajo A. Reijers

## Process Model Discovery I

Mining Invisible Tasks in Non-free-choice Constructs ............................... 109  
Qinlong Guo, Lijie Wen, Jianmin Wang, Zhiquiang Yan, and Philip S. Yu

Incorporating Negative Information in Process Discovery .......................... 126  
Hernan Ponce-de-León, Josep Carmona, and Seppe K.L.M. vanden Broucke

Ensuring Model Consistency in Declarative Process Discovery ..................... 144  
Claudio Di Cicco, Fabrizio Maria Maggi, Marco Montali, and Jan Mendling
Business Process Models and Analytics

Avoiding Over-Fitting in ILP-Based Process Discovery ..................... 163
   Sebastiaan J. van Zelst, Boudewijn F. van Dongen, and Wil M.P. van der Aalst

Estimation of Average Latent Waiting and Service Times of Activities from Event Logs. ..................... 172
   Takahide Nogayama and Haruhisa Takahashi

A Structural Model Comparison for Finding the Best Performing Models in a Collection ............................. 180
   D.M.M. Schunselaar, H.M.W. Verbeek, H.A. Reijers, and W.M.P. van der Aalst

Context-Sensitive Textual Recommendations for Incomplete Process Model Elements ............................. 189
   Fabian Pittke, Pedro H. Piccoli Richetti, Jan Mendling, and Fernanda Araujo Baião

Extracting Configuration Guidance Models from Business Process Repositories ..................................... 198
   Nour Assy and Walid Gaaloul

BPM in Industry

Web-Based Modelling and Collaborative Simulation of Declarative Processes ........................................... 209
   Morten Marquard, Muhammad Shahzad, and Tijs Slaats

Case Analytics Workbench: Platform for Hybrid Process Model Creation and Evolution ............................. 226
   Yiqin Yu, Xiang Li, Haifeng Liu, Jing Mei, Nirmal Mukhi, Vatche Ishakian, Guotong Xie, Geetika T. Lakshmanan, and Mike Marin

A Clinical Pathway Mining Approach to Enable Scheduling of Hospital Relocations and Treatment Services ..................................... 242
   Karsten Helbig, Michael Römer, and Taïeb Mellouli

A Framework for Benchmarking BPMN 2.0 Workflow Management Systems ........................................... 251
   Vincenzo Ferme, Ana Ivanchikj, and Cesare Pautasso

Process Compliance and Deviations

Visually Monitoring Multiple Perspectives of Business Process Compliance ................................. 263
   David Knuplesch, Manfred Reichert, and Akhil Kumar
Managing Controlled Violation of Temporal Process Constraints. 280
   Akhil Kumar, Sharat R. Sabbella, and Russell R. Barton

Complex Symbolic Sequence Encodings for Predictive Monitoring of Business Processes 297
   Anna Leontjeva, Raffaele Conforti, Chiara Di Francescomarino, Marlon Dumas, and Fabrizio Maria Maggi

Emerging and Practical Areas of BPM

   Patrick Lohmann and Michael Zur Muehlen

BPMN Task Instance Streaming for Efficient Micro-task Crowdsourcing Processes 333
   Stefano Tranquillini, Florian Daniel, Pavel Kucherbaev, and Fabio Casati

Goal-Aligned Categorization of Instance Variants in Knowledge-Intensive Processes 350
   Karthikeyan Ponnalagu, Aditya Ghose, Nanjangud C. Narendra, and Hoa Khanh Dam

Process Monitoring

Process Mining on Databases: Unearthing Historical Data from Redo Logs 367
   Eduardo González López de Murillas, Wil M.P. van der Aalst, and Hajo A. Reijers

Log Delta Analysis: Interpretable Differencing of Business Process Event Logs 386
   Nick R.T.P. van Beest, Marlon Dumas, Luciano García-Bañuelos, and Marcello La Rosa

Fast and Accurate Business Process Drift Detection 406
   Abderrahmane Maaradji, Marlon Dumas, Marcello La Rosa, and Alireza Ostovar

Process Model Discovery II

Mining Project-Oriented Business Processes 425
   Saimir Bala, Cristina Cabanillas, Jan Mendling, Andreas Rogge-Solti, and Axel Polleres