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Fabiana Fournier · Jan Mendling (Eds.)

Business Process Management Workshops

BPM 2014 International Workshops, Eindhoven
The Netherlands, September 7–8, 2014
Revised Papers

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Preface

Business process management (BPM) is an established research domain for computer science, information systems, and management scholars. The International Conference on Business Process Management (BPM 2014) was the 12th conference in a series that provided the most distinguished and specialized forum for researchers and practitioners in BPM. The conference has a record of attracting innovative research of the highest quality related to all aspects of BPM, including theory, frameworks, methods, techniques, architectures, and empirical findings.

It is a tradition that topical workshops accompany the main BPM conference in order to allow groups to coalesce around new research topics, to present emerging research issues, or focus in-depth on a particular area of research. BPM 2014 was accompanied by ten workshops – some new, some well-established ones. In addition, a doctoral consortium took place at which young researchers could present and further develop their doctoral research lines. The workshops attracted 84 submissions, out of which the respective Program Committees selected 38 as full papers. This made a full paper acceptance rate of 45 %. In addition to these full papers, the proceedings for the LNBIP volume also included short papers, invited papers of key notes and tutorials, and the position papers of the doctoral consortium.

The following workshops of the BPM 2014 conference were held on September 8, 2014 on the campus of the Technical University of Eindhoven, The Netherlands:

- The 7th International Workshop on Process-oriented Information Systems in Healthcare (ProHealth 2014)
- The 3rd Workshop on Security in Business Processes (SBP 2014)
- The 4th International Workshop on Process Model Collections: Management and Reuse (PMC-MR 2014)
- The 1st International Workshop on Business Processes in Collective Adaptive Systems (BPCAS 2014)
- The 3rd International Workshop on Data- and Artifact- centric BPM (DAB 2014)
- The 10th International Workshop on Business Process Intelligence (BPI 2014)
- The 2nd International Workshop on Business Process Management in the Cloud (BPMC 2014)
- The 3rd International Workshop on Theory and Applications of Process Visualization (TaProViz 2014)
- The 7th Workshop on Business Process Management and Social Software (BPMS2 2014)
- The 2nd Decision Mining and Modeling for Business Processes (DeMiMoP 2014)
- In addition, the Doctoral Consortium was held on September 7, 2014 in the city center of Eindhoven.

We would like to express our sincere gratitude to the organizers of each workshop and of the doctoral consortium for arranging entertaining, high-quality programs that

were well received by all attendees. We are grateful to the service of the countless reviewers who supported the Workshop Chairs and provided valuable feedback to the authors. Several workshops had invited keynote presentations that framed the presented research papers and we would like to thank the keynote speakers for their contribution to the Workshop Program. We would like to thank Ralf Gerstner, Viktoria Meyer, and the team at Springer for their support in the publication of this LNBIP volume.

December 2014

Fabiana Fournier
Jan Mendling

Preface to the 7th International Workshop on Process-Oriented Information Systems in Healthcare (Prohealth 2014)

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Introduction

Healthcare organizations and providers are facing the challenge of delivering high-quality services to their patients, at affordable costs. High degree of specialization of medical disciplines, prolonged medical care for the aging population, increased costs for dealing with chronic diseases, and the need for personalized healthcare are prevalent trends in this information-intensive domain. The emerging situation necessitates a change in the way healthcare is delivered to the patients and healthcare processes are managed.

BPM technology provides a key to implement these changes. Though patient-centered process support becomes increasingly crucial in healthcare, BPM technology has not yet been broadly used in healthcare environments. This workshop elaborates both the potential and the limitations of IT support for healthcare processes. It further provides a forum wherein challenges, paradigms, and tools for optimized process support in healthcare can be debated.

We bring together researchers and practitioners from different communities (e.g., BPM, Information Systems, Medical Informatics, E-Health), who share an interest in both healthcare processes and BPM technologies.

The first ProHealth workshop took place in the context of the 5th Int'l Conference on Business Process Management (BPM) in 2007. The next three ProHealth Workshops were also held in conjunction with BPM conferences (BPM 2008, BPM 2009, and BPM 2011). The next two ProHealth workshops brought together researchers from the BPM and the Medical Informatics communities, as joint ProHealth/Knowledge Representation for Healthcare (KR4HC) workshops held in 2012 and 2013. The success of the previous six ProHealth Workshops demonstrated the potential of such an interdisciplinary forum to improve the understanding of domain-specific requirements, methods and theories, tools and techniques, and the gaps between IT support and healthcare processes that are yet to be closed.

The ProHealth 2014 workshop focused on IT support of high-quality healthcare processes. It addressed topics including modeling and enactment of clinical guidelines and healthcare processes.

The workshop received nine papers from Germany (3), Israel (1), Italy (1), Chile (1), and the UK (1), a paper by authors from Israel, Italy, The Netherlands and Spain, and a paper by authors from Canada and Poland (1). Papers had to clearly establish their research contribution as well as their relation to healthcare processes. Five full papers and one position paper were selected to be presented at the workshop according to their relevance, quality, and originality.

In his keynote paper “On Measuring, Modeling and Analyzing Healthcare Systems in Real-Time: From Small Measurements through Big Data to Analytics,” Prof. Avishai Mandelbaum from the Faculty of Industrial Engineering and Management at the Technion – Israel Institute of Technology discusses his platform for real-time creation of data-based models – simulation and analytical, which is based on modeling a service system as a processing network from event logs, and inferring model primitives, structure, and protocols.

The following three papers focus on modeling.

The paper “Modeling and Monitoring Variability in Hospital Treatments: A Scenario using CMMN” by Herzberg et al. addresses the problem of how to transfer a hospital-specific clinical pathway modeled in BPMN to another hospital. The authors use a questionnaire to capture practices in other hospitals and derive a generally valid case plan.

The paper “Recommendations for Medical Treatment Processes: The PIGS Approach” by Marcin Hewelt et al. introduces a BPMN-based knowledge management approach for multi-morbid patients. The authors formally introduce the concept of Treatment Cases (TCs) and explain how recommendations for the next treatment steps within a TC can be derived from multiple BPMN process models.

The paper “Modeling and Implementation of Correct by Construction Healthcare Workflows” by Papapanagiotou and Fleuriot proposes an approach for constructing healthcare workflows based on the “proofs-as-processes paradigm.” The generated workflows have a number of guaranteed properties such as type correctness and freedom of deadlocks and livelocks.

The next three papers focus on execution.

The paper “MET4: Supporting Workflow Execution for Interdisciplinary Healthcare Teams” by Wilk et al. describes an agent-based approach for maintaining a healthcare team. In particular, the paper focuses on the specific support for the team leadership, team maintenance, and patient participation features.

The position paper “Enhancing Guideline-based Decision Support with Distributed Computation through Local Mobile Application” by Shalom et al. introduces the need for a distributed guideline-based decision support (DSS) process, describes its characteristics, and explains how this process was implemented within the European Union’s MobiGuide project (www.mobiguide-project.eu).

The paper “Storlet Engine for Executing Biomedical Processes within the Storage System” by Rabinovici-Cohen et al. proposes expanding the storage system from only storing biomedical data to directly producing value from the data by executing computational modules — storlets — close to where the data is stored. Their paper

describes the Storlet Engine, an engine to support computations in secure sandboxes within the storage system.

We would like to thank the invited speaker as well as the members of the Program Committee and the reviewers for their efforts in selecting the papers. They helped us to compile a high-quality program for the ProHealth 2014 workshop. We would also like to acknowledge the splendid support of the local organization and the BPM 2014 Workshop Chairs.

We hope you will find the papers of the ProHealth 2014 workshop interesting and stimulating, and look forward to seeing you at the next ProHealth workshop.

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Preface to the 3rd International Workshop on Security in Business Processes (SBP 2014)

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Introduction

Despite the growing demand for business processes that comply with security policies, security and privacy incidents caused by erroneous workflow specifications are regrettably common. The third edition of the Workshop on Security in Business Processes (SBP 2014) seeks to bring together researchers and practitioners interested in the management and modeling of secure business processes in process-aware information systems. The major goal is to obtain a deeper understanding of a rapidly maturing, yet still largely under-investigated field of business process security, audit and control, including both thorough security requirements formalization, secure process modeling, and mechanisms for verification, monitoring, and auditing. Besides the “technical” intent to substantially advance the current state of the art, SBP 2014 aims to identify active research areas in academia and industry, current approaches in industry, and existing tool-support; encourage approaches and techniques that combine formal foundations with industrial applicability; and highlight new research directions and challenges.

The SBP 2014 program included one keynote, one long and two short papers, and a tutorial. The keynote speech by van Geffen gave the audience a coherent view on the importance of the process mining and its influence on the security solutions. The second presentation given by Lu *et al*, considers conformance checking and more specifically on the use of the partially ordered traces and partially ordered alignments. In the first short paper presentation by van der Werf and Verbeek, online compliance monitoring is analyzed. The authors suggest using some golden configuration to discover process inconsistencies from the process logs. The second short paper presentation by Guanciale and Gurov considers how privacy is preserved in the virtual enterprises. The authors illustrate how to implement privacy preserving fusion of business processes using bounded Petri nets. In the tutorial presentation, based on the running example, Matulevičius has illustrated how to elicit security requirements from the business process models using security risk management method.

We wish to thank all those who contributed to making SBP a success: the authors who submitted papers, the members of the Program Committee who carefully

reviewed and discussed the submissions, and the speakers who presented their work at the workshop. In particular, we thank the keynote speaker for their enthusiastic and insightful presentation. We also express our gratitude to the BPM 2014 Workshop Chairs for their support in preparing the workshop.

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Security Requirements Elicitation from Business Processes (Extended Abstract)

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Nowadays, *information systems* (IS) are the cornerstones upon which the vast majority of mission-critical *business processes* are executed in modern organizations. Because of their mission-criticality, ensuring *security* is a central concern during IS development. Organizations strive for confidentiality, integrity, and availability of their vital business information. However, security concerns are commonly overlooked when working with business process management. The reason is that while business analysts are expert in their own domains, they have limited knowledge about the security domain.

In this tutorial we discuss how security risk management process could help to understand and elicit security requirements from the business processes. We base our presentation on the domain model for *information systems security risk management* [1]. This domain model defines security risk management concepts at three interrelated levels. *Asset-related* concepts (i.e., *business assets*, *IS assets*, and *security criterion*) explain the organization and business values that need to be protected. The needed protection level is defined as the security needs, typically in terms of confidentiality, availability, and integrity. *Risk-related* concepts (i.e., *risk*, *impact*, *event*, *vulnerability*, *threat*, *attack method*, and *threat agent*) define the risk itself and its components. Risk is a combination of threat with one or more vulnerabilities, which leads to a negative impact, harming some assets. An impact shows the negative consequence of a risk on an asset if the threat is accomplished. A vulnerability is a weakness or flaw of one or more IS assets. An attack method is a standard means by which a threat agent executes a threat. *Risk treatment-related* concepts (i.e., *risk treatment decision*, *security requirement*, and *control*) describe how to treat the identified risks. A risk treatment leads to security requirements mitigating the risk, implemented as security controls.

Based on the running example, this tutorial illustrates how to define the security-oriented context and assets from the business models and how to systematically introduce and reason for security requirements. Once one determines security objectives (e.g., confidentiality, integrity, and availability), the risk analysis and assessment results in potential risks and their impacts. After risk assessment, risk treatment decision should be taken. This would result in security requirements definition. Security requirements should potentially be implemented into security controls. Such a risk management

process is iterative, because new security controls suggested for securing business processes might open the possibility for new (not yet determined) security risks.

Systematic security requirements elicitation from the business processes, potentially, might envision the security threats, their consequences, and countermeasures, before developing software systems to support these business processes. Therefore in collaboration with the business analyst, security analysts could identify and discard alternative design solutions that do not offer a sufficient security level or even re-scope or cancel a project if the cost of treating security risks is too high. Potentially, security requirements discovered from the business processes can help business analysts to understand security trade-off within the business context.

Reference

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From Early Experiments to a Company-Wide Process Mining Success (Extended Abstract)

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One of the main challenges nowadays is to match and satisfy the customer needs of tomorrow. The speed and complexity of today's changes require a different approach to process improvement. Process mining, or automated business process discovery, is a BMP technique that helps in gaining insight into how processes are actually performed, how systems are used, and how people work together. Through the explosive growth of data and significant advances in analysis and visualization technology it is possible to unlock valuable process information by analyzing transaction data. The use of automated business process discovery techniques yields new valuable insights. Process analysis done this way becomes fact based, full, for real, and fast.

This keynote speech presented the experience with introducing the process mining technology and highlighted its value at Rabobank. The main focus was placed on the trade-off between rapid and continuous innovation and security aspects of processes.

Preface to the 4th International Workshop on Process Model Collections: Management and Reuse

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Introduction

Nowadays, as organizations reach higher levels of Business Process Management maturity, they tend to collect and actively use large numbers of business process models. It is quite common that such collections of industry-strength business process models include thousands of activities and related business objects such as data, applications, risks, etc. These models are used for a variety of business needs, including requirements analysis, communication, automation, and compliance.

Such large collections of process models introduce both new challenges and opportunities to the area of business process management. On the one hand, it may not come as a surprise that many organizations struggle to manage such volumes of complex process models. This problem is exacerbated by overlapping content across models, poor version management, process models that are used simultaneously for different purposes, the use of different modeling notations such as EPCs, BPMN, etc. On the other hand, the process models in the collection provide a valuable source of information, which can be reused to facilitate the development of new process models. This reuse will lead to more efficient development of models that are of higher quality and better integrated with the existing models in the collection.

Against this backdrop, the aim of the workshop is to discuss novel research in the area of business process model collections, their management, and reuse. To this end, four papers were selected for presentation and a keynote speaker was invited.

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Preface to the First International Workshop on Business Processes in Collective Adaptive Systems

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Introduction to Business Processes in Collective Adaptive Systems

Collective Adaptive Systems (CAS) are heterogeneous collections of autonomous task-oriented systems that cooperate on common goals forming a collective system. To be robust, each constituent system must be able to dynamically adapt its behavior to changes in the environment while trying to reach their goals. At the same time, the different system adaptations must not be controlled centrally but rather administrated in a decentralized fashion among the systems. These aspects, collectiveness, adaptability, and decentralization are particularly relevant in businesses that wish to develop and deploy context-aware mobile applications that need to interact with pervasive and mobile technologies as well as cloud services.

BPCAS aims to provide a forum for researchers to discuss the challenges and results in the theory, design, implementation, and evaluation of collective adaptive systems.

The workshop was sponsored by the EU's Fundamentals of Collective Adaptive Systems program initiative (<http://focas.eu/about-focas/>) that aims to integrate, coordinate, and help increase visibility for research in all fields related to collective adaptive systems.

We want to thank Manfred Reichert from University of Ulm for giving an informative and interesting keynote talk titled: "Collective Adaptive Process-Aware Systems: Challenges, Scenarios, Techniques." We also want to thank the members of the Program Committee for very constructive reviews, which helped authors in improving their papers.

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3rd International Workshop on Data- and Artifact-Centric BPM (DAB 2014)

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Introduction to DAB 2014

The DAB workshop is aimed at bringing together researchers and practitioners whose common interests and experiences are the study and development of *data- and artifact-centric approaches* to Business Processes Management. Traditionally, both researchers and practitioners in the BPM community have studied data and control flow aspects of business processes, more or less in isolation. Such separation of concerns between the data and control perspectives turned out to be very fruitful and led to significant advances in both data and process management fields.

However, now that techniques and tools in both perspectives have matured, the *integration of data and control* is receiving increasing attention. In recent years, various approaches have emerged that emphasize integration of data and control as key aspects of flexible and rich business processes specification. These approaches range from *making classical BPM approaches data-driven* to more advanced approaches where the classical separation between process and data disappears, as for instance in *case management* or *artifact-centric BPM* to name a few prominent examples. From the scientific as well as the practical point of view it is critical to study the fundamental relationships, characteristics, and properties of the integrated perspective where data and process are considered together.

We invited researchers from the BPM field as well as from the related fields to submit papers that *investigate the tight interplay between data and control flow aspects of BPM*. We received 10 submissions with authors from 10 different countries. The peer-reviewing process with at least three reviews per paper selected five papers for presentation. The accepted papers were presented on September 8, 2014 in Eindhoven, The Netherlands.

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No external reviewers have been asked for reviews. We thank Program Committee for their careful and constructive reviews.

Preface to the 10th International Workshop on Business Process Intelligence (BPI 2014)

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Business Process Intelligence (BPI) is a growing area both in industry and academia. BPI refers to the application of data- and process-mining techniques to the field of Business Process Management. In practice, BPI is embodied in tools for managing process execution by offering several features such as analysis, prediction, monitoring, control, and optimization.

The main goal of this workshop is to promote the use and development of new techniques to support the analysis of business processes based on run-time data about the past executions of such processes. We aim at bringing together practitioners and researchers from different communities, e.g., Business Process Management, Information Systems, Database Systems, Business Administration, Software Engineering, Artificial Intelligence, and Data Mining, who share an interest in the analysis and optimization of business processes and process-aware information systems. The workshop aims at discussing the current state of ongoing research and sharing practical experiences, exchanging ideas, and setting up future research directions that better respond to real needs. In a nutshell, it serves as a forum for shaping the BPI area.

The 10th edition of this workshop attracted 23 international submissions. Each paper was reviewed by at least three members of the Program Committee. From these submissions, the top nine were accepted as full papers for presentation at the workshop.

The papers presented at the workshop provided a mix of novel research ideas, evaluations of existing process mining techniques, as well as new tool support. *Botezatu*, *Voelzer*, and *Dijkman* use the information recorded in event logs to improve the scheduling of workflow activities according to resource load and performance. *Verbeek* and *van der Aalst* introduce a decomposition framework that speeds up process discovery and replay by doing them on separate clusters. *Pufahl*, *Bazhenova*, and *Weske* use queueing theory to study the cost advantage of executing certain activities in batch mode rather than separately for each process instance. *Van Eck*, *Buijs*, and *van Dongen* improve the genetic mining algorithm by working with a population of models that are aligned with the actual behavior in the event log. *Leemans*, *Fahland*, and *van der Aalst* discuss the features that process mining tools should possess in order to facilitate user exploration of process models and deviations. *Pizarro* and *Sepúlveda* present an approach for the interactive discovery of event data using multiple perspectives and

levels of granularity, inspired by OLAP techniques. *Raichelson* and *Soffer* describe an approach for merging separate but related event logs, where there may be many-to-many relationships between the cases in those logs. *Depaire* focuses on the problem of whether a discovered model is likely to be the true model given that there might be an amount of unobserved behavior in the event log. Finally, *Wakup* and *Desel* use process mining techniques to analyze and discover a network protocol from the TCP/IP packets exchanged between a server and a client application.

As with previous editions of the workshop, we hope that the reader will find this selection of papers useful to keep track of the latest advances in the BPI area, and we are looking forward to keep bringing new advances in future editions of the BPI workshop.

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Preface for the 2nd International Workshop on Business Process Management in the Cloud (BPMC)

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Introduction

Cloud computing is a paradigm for the on-demand delivery of infrastructure, platform, or software as a service. Cloud computing enables network access to a shared pool of configurable computing and storage resources as well as applications that can be tailored to the consumer's needs. Cloud resources can be rapidly provisioned and released, and are billed based on actual use, thus reducing up-front investment costs. Not only can individual services be hosted on virtual infrastructures but also complete process platforms. Further, besides benefits to run-time Business Process Management (BPM), cloud-based services can enable collaboration between geographically dispersed teams during design-time and assist the design process in general – amongst others, process modeling as a service removes the need for installation of software, and is thus more attractive for the occasional user.

A cloud-based architecture for BPM may provide important benefits:

- **Elasticity:** process engines or process tasks can scale up/out or down/in depending on the actual load to reduce investment cost and manage load peaks.
- **Flexibility:** processes can be assembled with more flexibility as service selection can not only include the software but also the platform or infrastructure for it to run on.
- **Measurement:** as service applications in the cloud are individually metered, detailed measurement data is available and can be used to provide additional services such as process monitoring.

The research directions of core interest to the 2nd International Workshop on Business Process Management in the Cloud (BPMC 2014) are summarized by three questions:

- How can BPM benefit from the cloud?
- What should BPM in the cloud look like?
- What can BPM bring to cloud computing practices?

Among a number of challenges, there is a lack of conceptualization and theory on BPM with respect to cloud computing. For the most part, the topic of cloud computing has

only been implicitly regarded in BPM research when discussing design-time tools. Few works have addressed workflow enactment in the cloud to date. However, a detailed research agenda which covers theory, design-time, run-time, and use cases is missing. The goal of the 2nd International Workshop on Business Process Management in the Cloud is to lay the foundation for such a research agenda.

Submissions from the scientific community were invited for the above-mentioned problem domain as well as related issues. Hence, the main areas of interest to the workshop were

- Cloud and BPM: concepts and theory
- Design-time BPM in the cloud
- Run-time BPM in the cloud
- Use cases for BPM in the cloud

Unfortunately only few papers were submitted this year, out of which only one was accepted after review based on quality, relevance, and originality. The paper is titled “YAWL in the Cloud: Supporting Process Sharing and Variability.” It describes an approach and tool for collaborative BPM in the cloud: using configurable process models to support the variations of processes, as encountered in different Dutch municipalities. The paper highlights the benefits of using a cloud-based approach at different stages of the BPM lifecycle, introduces the approach and tool, and presents a proof-of-concept scenario.

Furthermore, Gero Decker from Signavio gave an inspiring keynote talk at the workshop. The title of the talk and the corresponding paper is “BPM in the Cloud – Trends and Challenges.” Gero Decker is a co-founder and co-CEO of Signavio, a BPM vendor and BPM Software as a Service provider. In his keynote, he discussed the differences between cloud-based and traditional BPM solutions and their respective clientele, and structured the space of BPM in the cloud.

The keynote sparked a lively debate which was moderated by Ingo Weber. He took up some of the aspects mentioned in the keynote and combined them with prevalent topics of the upcoming BPM conference as well as observations from the general mind shift toward a more service-oriented, cloud-based environment not only for BPM. The discussion continued long after the workshop. The result is the following list of open topics:

- *Process Mining in the Cloud.* Process Mining is a very hot topic in BPM, yet there are few approaches to take this success to the cloud. What would be required to achieve this, and for which parts of process mining is that a sensible approach? As it stands, process mining is an expert method, and even tools with a streamlined user experience require deep understanding of background concepts. But are there aspects of process mining that are of interest for large-scale adoption, and hence should be moved to the cloud?
- *Fragmentation.* The complexity that comes with the fragmentation of using many small, focused cloud offerings poses a challenge to traditional IT management. How can this fragmentation be managed effectively? Can BPM contribute, or is that solely a task for enterprise architecture?

- *Continuous BPM Deployment.* New cloud-based approaches that enable less specialized users to create (executable) process models will drastically reduce cycle times and frequencies. Just as with the software engineering advances of continuous integration (CI) and continuous deployment (CD), the time for designing a changed model and deploying it to production will shorten, and the frequency will increase sharply. In software engineering, release frequency has been reduced from a few times a year to many times per day. If BPM takes a similar turn, this leads to several challenges:
 - *Process model testing.* Automatic testing of process models should become prevalent. The area seems heavily underdeveloped, compared to its likely future importance, since works on process model testing are few and far between.
 - *Process model drift.* High frequency of deployments will lead to drift in process model collections: there will be many versions of each model, and the management and storage of these becomes more challenging. A particular issue is that of tracing interacting processes in the face of drift: Which versions of models A and B are integrated with version X of process C?
- *Cloud services governance.* One trend in the cloud is that individual teams start using cloud services, often without governance through their organization, and pay for it out of their team budget. A question for the BPM, services, and compliance communities is: How can targeted, mass-scale governance over cloud service usage be implemented, without imposing massive overheads?
- *Technical questions* include:
 - *Client-side data processing.* Cloud applications often implement a different data handling paradigm, where data is kept at the source and computation is moved to the data. How can BPMSs pick up this development? For instance, should process execution move in part to the UI, such as a browser interface, to process data stored locally on a user's machine directly?
 - *Open APIs.* Many cloud applications offer and use open APIs over the web. Is there enough support from BPM for this trend, both from the ease-of-use side and from the API offering side? Is lightweight integration sufficiently supported by BPMSs, will it be, or will that be a competing technology?
 - *Mobile & BPM.* Do BPMSs offer mobile access to analytics and to control over process execution?

Although only few papers were submitted, a strong audience at the conference confirmed the interest of the community in the topic. The cloud is a huge trend, and the BPM field cannot afford to miss it. In addition to the above list, a summary of the state of the art and challenges in Elastic Business Process Management authored by Schulte, Janiesch, Venugopal, Weber, and Hoenisch is currently in press at Future Generation Computer Systems. We hope the collective set of open questions will help to stimulate and guide more research in this area.

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BPM in the Cloud – Trends and Challenges (Extended Abstract)

Gero Decker, Signavio

Abstract. The cloud is the future and has an impact on IT support for business processes. This leads to an increased importance of BPM. On the other hand, BPM software in the cloud (like cloud-based modeling tools, integration platforms, and workflow products) brings new possibilities in the areas of collaboration, mobile access, and integration.

IT is getting more and more “cloudy”: Gartner predicts that by 2016 cloud computing will be the bulk of new IT spend. IDC forecasts that cloud services will have an annual growth rate of 23.5% until 2017, five times that of the IT industry as a whole. Given this trend, it is interesting to investigate how cloud computing impacts the area of Business Process Management (BPM).

At first glance, it might seem that cloud services are simply alternative deployment options for the same old software from the on-premise world. Especially, web-based systems with a client/server architecture can be offered both in a classic on-premise model as well as in a Software-as-a-Service (SaaS) / Platform-as-a-Service (PaaS) model. However, it is interesting to observe that vendors with successful on-premise offerings often have a hard time catching up with the new breed of cloud-native vendors entering the same market segment. With cheap and well-understood hosting infrastructure available, it cannot be the pure delivery over the Internet that makes the difference. Obviously, there must be more to “the cloud”. So what is different now?

Three major topics can be observed in the cloud age: collaboration, ease-of-use, and simplicity. Due to their technical architecture, cloud services are inherently more accessible to more people, enabling them to work together more easily. Also, as software users are more and more used to great-looking and intuitive applications from their private life, they rather pick and choose those applications they love to use. This has a heavy impact on how products are built, delivered, and sold. Finally, the relationship between customer and vendor has changed quite significantly: Rather than asking for the full attention of the software vendor and expecting a highly individual solution, customers are more and more interested in a fast delivery cycle for the best practices derived from the user community of the cloud service.

These observations apply to cloud services in general, but which impact does “cloud” have on BPM in particular?

Here, we have to distinguish between (i) the impact of cloud for business processes on the one hand and (ii) cloud software directly supporting BPM activities (“BPM software”) on the other.

(i) Cloud is one of the disruptive trends in enterprise IT these days. Together with new possibilities of mobile computing, adoption of cloud services can lead to even faster change and innovation of business processes. Long implementation and upgrade

cycles of on-premise applications are replaced by “consumerization” of IT: business users choose appropriate cloud services themselves, often introducing major changes to processes on-the-fly. Process design and implementation become more and more decentralized. Offering the right guidance and governance from a process and IT perspective becomes a major challenge in this age of democratization.

An interesting side effect of cloud computing is the increasing fragmentation of IT portfolios. While previously, many companies tried to consolidate around big on-premise installations/vendors (e.g., SAP), the cloud comes with many fine-grained, special purpose services used for individual tasks or process fragments. This in turn increases the need for integration when aiming for ideal process support. Therefore, iPaaS and bpmPaaS offerings (see below) are even more interesting than classical Enterprise Application Integration platforms from the on-premise world.

(ii) BPM software: Cloud-based offerings for process analysis, modeling, governance, execution, monitoring, and so on are gaining more and more momentum in the market. Apart from the general impact of cloud, what does this mean for each area and which are the main challenges?

- Cloud-based modeling tools (e.g., IBM Blueworks, Signavio) allow for easier collaboration. Also, they lower the entry barrier to BPM by adopting a self-service paradigm rather than promoting extensive user training. This helps to reach a broader adoption of process-oriented thinking within organizations and creates bigger involvement in process initiatives than previously observed. This also makes process modeling tools applicable to smaller organizations.

Making process modeling self-explanatory is probably the biggest challenge. Speeding up the graphical modeling is only a small part of the story. This can be easily achieved by avoiding typical tool “glitches” and providing shortcuts for typical usage patterns. The bigger challenge is to guide people in process modeling. What is the right level of documentation? Which processes do I need to focus on? What is the fastest way to reach a shared understanding of a process? Not all of these questions can be solved by a tool alone but maximum effort should be undertaken to turn process modeling tools from pure content-structuring to something that really empowers users to reach improved processes.

- Cloud-based integration platforms (iPaaS, covering “system workflows”, e.g., Boomi, IFTTT) enjoy huge uptake in the market. The reason behind that is quite simple: Why would I connect cloud applications through an on-premise integration platform? Especially, lightweight services like IFTTT make it extremely easy to set up simple point-to-point connections, even without coding. A main enabler for this is the fact that cloud services typically come with relatively simple to use APIs, most often following REST principles. Cloud integration platforms then provide connectors to hundreds or thousands of these services, considering not only the individual data structures but also the authentication mechanisms required.

The challenge for cloud integration is the huge number of APIs to be covered and interconnected. Smart matchmaking of data structures (e.g., done through schema matching) can be enhanced by taking the process context into account. Also, the question of data governance and quality moves into the center of attention. If data is spread over multiple cloud services, how can I make sure there is consistent data available in my process context?

- Cloud-based process workflow frameworks (Gartner calls this “bpmPaaS”, e.g., RunMyProcess, Effektiv) are becoming more and more popular, too. Here, the typical pattern is to enable non-technical users to build their own “process apps”, combining human tasks, simple data collection, and prebuilt system connectors.

Partly, these cloud workflow platforms have a similar challenge like cloud integration platforms. For the long tail of APIs out there, simple cloud integration platforms like IFTTT are sometimes leveraged for larger process settings. In terms of connecting multiple cloud services, an additional challenge arises from the fact that integration not only happens in the form of automatic tasks (“service tasks” in BPMN). Other forms of integration become relevant, too: for instance, “virtual objects” with smart caching behavior replace the old data copying paradigm. Most prominently, integrations on the user interface level are desired as well. A simple example would be to display and edit a Google doc inside of a task. Or imagine a form field for a customer name, which fetches additional contact info about this customer from the CRM system when hovering over it.

- Cloud-based process analytics frameworks are on the rise, too. They typically provide process-oriented performance dashboards to management staff. Again, a major benefit of a cloud solution in this area is mobile access to dashboards. Off-the-shelf apps are provided that connect to the cloud service over the Internet – without having to set up a VPN connection to some internal system behind the firewall.

To sum up, the cloud comes with a range of new possibilities, e.g., regarding collaboration, mobile access, and integration. Especially, the fragmentation that comes with the rise of cloud increases the value proposition and adoption of BPM out there.

Gero Decker is co-founder and co-CEO of Signavio, a Germany and USA-based BPM vendor. Signavio is also a majority shareholder in Effektiv. Before starting Signavio, he worked as BPM consultant and completed his PhD in Business Process Management at the Hasso-Plattner-Institute in Potsdam, Germany.

Preface to the 3rd International Workshop on Theory and Applications of Process Visualization

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Introduction

This is the third TAProViz workshop being run at BPM. The intention this year is to consolidate on the results of the previous successful workshops by further developing this important topic, identifying the key research topics of interest to the BPM visualization community. We note this year the continuing interest in the visualization of process mining data and resultant process models.

Submitted papers were evaluated by at least three Program Committee members, in a double blind manner, on the basis of significance, originality, technical quality, and exposition. Three full and one position papers were accepted for presentation at the workshop. In addition, we invited a keynote speaker, Dafna Levy, a process mining practitioner from Nool, an Israeli process mining initiative. The papers address a number of topics in the area of process model visualization, in particular:

- Visualizing Differences between Process Models
- User Friendly Visualization of Process Models
- Dynamic Visualization of Process Movies in Process Mining
- Process Model Syntactical Sonification

The keynote *Intelligent Process Management and Visualization Technologies*, by Dafna Levy, was a presentation of a live process mining demonstration with real-life scenarios showing how various process analysis and monitoring techniques can be applied to process mining projects, and what kind of insights and added value can be gained with the visual deliverables generated.

Carsten Cordes, Thomas Vogelgesang, and Hans-Jürgen Appelrath presented their full paper, *A Generic Approach for Calculating and Visualizing Differences between Process Models in Multidimensional Process Mining*. This paper presents the challenges of differencing process models in multi-dimensional process mining and proposes a generic approach to deal with these challenges.

Markus Hipp, Achim Strauss, Bernd Michelberger, Bela Mutschler, and Manfred Reichert presented their full paper, *Enabling a User-Friendly Visualization of Business Process Models*. This paper presents four different concepts aiming at a user-friendly

visualization of large-scale process models to deal with problems of model comprehensibility and aesthetics.

Andrea Burattin, Marta Cimitile, and Fabrizio Maria Maggi, presented in their full paper, *Lights, Camera, Action! Business Process Movies for Online Process Discovery*, a method for the graphical visualization of the evolution of a process model over time. They described a graphical visualizer for process models extracted from an event stream through a declarative process discovery approach they have previously developed.

In his position paper, *Toward a generalized notion of audio as part of the concrete syntax of business process modeling languages*, Jens Gulden presented preliminary work seeking to establish how to include audio, and other sensual impressions, into the concrete syntax of modeling languages. Part of this work is a reconceptualization of concrete process syntax as an interaction process between a tool and a user.

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Intelligent Process Management and Visualization Technologies (Extended Abstract)

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Abstract. While process visualizations are perceived by many as very cool technologies, companies are not yet willing to embrace them as warmly and quickly as expected. Managers still demand more convincing and significant added value. Another issue might be with offering process visualization technologies as somewhat detached solutions, or not taking into account Business Intelligence solutions which might already exist in the company. The keynote aims to demonstrate how process and data visualization tools can be combined and applied to various business domains in order to increase process awareness which will lead to *intelligent process management*.

Keywords: Process mining, visualization technologies, intelligent process management

Summary

In the keynote, a live demo with real-life scenarios will show how various process analysis and monitoring techniques can be applied, and what kind of insights and added value can be gained with the visual deliverables generated.

The use cases discussed will cover analysis and monitoring of running processes (e.g., purchasing, service calls, warehouse management), inspection and fine-tuning of a new ERP implementation, discovery of work orders flow among machines on the production floor and extending Business Intelligence (BI) to Process Intelligence (PI). Insights will be shared about process visualization topics such as: who are the “beholders” (users vs. customers), the challenges in “deciphering” visual deliverables, offering tools versus services, integration with IT systems versus stand-alone solutions, the roles of the software providers, how to handle rejections and barriers and ideas for future developments and extensions.

Background

In many organizations, business performance is measured in terms of financial data such as revenue, profits, cash flow, etc. However, it is not generally possible to manipulate the values of these financial indices directly; rather, they reflect the results

of operational activities derived from the organization's standard business processes. Hence, addressing financial data only, without considering current business processes, significantly impairs an organization's ability to improve their business performance.

Process intelligence essentially combines automatic process discovery (APD) with advanced business discovery technology. Briefly, automatic process discovery looks at historical event log data and analyzes these data to generate visual models of an organization's business processes and establish patterns linking external and internal events. The results of these analyses can be used to improve operational efficiency. In parallel, business discovery technology allows management to monitor operations and key performance indicators in real-time and alerts management of any anomalies.

Advanced process discovery analyzes log data captured by existing IT systems and provides answers to specific questions such as: Where are the bottlenecks in this process, when and why do people deviate from the defined process, are all requirements (e.g., SLA terms) being met, why does performance vary from one employee/department to the next, which business rules and alerts are actually in use, what are the actual costs of this process?

The analysis yields deliverables such as: operational data (throughput time, costs, quantities), **visual** models and animation of the actual processes, discovery of anomalies, performance benchmarking, and deviation from business rules (times, quantities).

Significant benefits of advanced process discovery for a company are gaining a multidimensional and objective view of how their organization was performing in the analyzed period, and defining or refining their operational goals.

In order to keep track of how these goals are achieved, as a process is being executed, process dashboards can be used. These dashboards enable managers to proactively and continuously adjust business processes for optimal performance at a very fine resolution, instead of taking action only after a problem has been discovered. Adding gauges to process dashboards can visually alert about deviations from desired goals. In order to reveal and analyze the possible root causes for such deviations, a process discovery tool can be used. Data of the process in question are exported directly from the dashboard in the requested format.

Some benefits of such solutions are: maintaining and managing the process data in the BI database, enriching process data (i.e., event logs) with business data for an extended analysis, fine-tuning goals and KPIs, and, last but not least, creating a common language among business and process managers who can share the visual deliverables and gain better insights in a collaborative manner.

All these benefits help a company to replace "crisis-management" with a proactive approach and achieve intelligent process management.

Preface to the Seventh International Workshop on Business Process Management and Social Software (BPMS2 2014)

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Introduction

Social software is a new paradigm that is spreading quickly in society, organizations, and economics. It enables social business that has created a multitude of success stories. More and more enterprises use social software to improve their business processes and create new business models. Social software is used both in internal and external business processes. Using social software, the communication with the customer is increasingly bidirectional. For example, companies integrate customers into product development to capture ideas for new products and features. Social software also creates new possibilities to enhance internal business processes by improving the exchange of knowledge and information, to speed up decisions, etc.

Social software is based on four principles: weak ties, social production, egalitarianism, and mutual service provisioning.

- Weak ties

Weakties are spontaneously established contacts between individuals that create new views and allow combining competencies. Social software supports the creation of weak ties by supporting to create contacts in impulse between non-predetermined individuals.

- Social Production

Social Production is the creation of artifacts, by combining the input from independent contributors without predetermining the way to do this. By this means it is possible to integrate new and innovative contributions not identified or planned in advance. Reputation-based mechanisms assure quality following an a posteriori approach.

- Egalitarianism

Egalitarianism is the attitude of handling individuals equally. Social software highly relies on egalitarianism and therefore strives for giving all participants the same rights to contribute. This is done with the intention to encourage a maximum of contributors and to get the best solution fusing a high number of contributions, thus enabling the wisdom of the crowds. Social software realizes egalitarianism by

abolishing hierarchical structures, merging the roles of contributors and consumers, and introducing a culture of trust.

- Mutual Service Provisioning

Social software abolishes the separation of service provider and consumer by introducing the idea that service provisioning is a mutual process of service exchange. Thus both service provider and consumer (or better prosumer) provide services to one another in order to cocreate value. This mutual service provisioning contrasts to the idea of industrial service provisioning, where services are produced in separation from the customer to achieve scaling effects.

Up to now, the interaction of social software and its underlying paradigms with business processes have not been investigated in-depth. Therefore, the objective of the workshop is to explore how social software interacts with business process management, how business process management has to change to comply with weak ties, social production, egalitarianism and mutual service, and how business processes may profit from these principles.

The workshop will discuss three topics. Social Business Process Management, Social Business, and Big Data in Social Business. Social Business Process Management is the use of social software to support one or multiple phases of the business process life cycle.

1. Social Business Process Management (SBPM)

- Which phases of the BPM lifecycle (Design, Deployment, Operation, and Evaluation) can profit the most by social software?
- Do we need new BPM methods and/or paradigms to cope with social software?
- Is there an influence of weak ties, social production, egalitarianism, and mutual service provisioning on BPM methods themselves?
- How are trust and reputation established in business processes using social software?
- How do weak ties, social production, egalitarianism, and mutual service provisioning influence the design of business processes?
- How does social software interact with WFMS or other business process support systems?
- What is the impact on conceptual models for those categories of business processes which are not well-defined ?

2. Social Business: Social software supporting business processes

- Which new possibilities for the support of business processes are created by social software?
- Are there business processes which require sociality, especially when they are not predictable (as production workflows) but collaborative or ad hoc?
- How can we use Wikis, Blogs, etc., to support business processes?
- Which types of social software can be used in which phases of the BPM lifecycle?
- What new kinds of business knowledge representation are offered by social production?

3. Big Data in Social Business

- Which data created with social software can be used to support business processes?
- Which categories of business processes can profit from big data ?
- Are there any similarities or relationships with process mining techniques and also with workflow control and role patterns?

Based on the successful BPMS2 2008, BPMS2 2009, BPMS2 2010, BPMS2 2011, BPMS2 2012, and BPMS2 2013 workshops, the goal of the workshop is to promote the integration of business process management with social software and to enlarge the community pursuing the theme.

Five papers have been accepted for presentation.

In their paper “Tagging Model for Enhancing Knowledge Transfer and Usage during Business Process Execution,” Reuven Karni and Meira Levy present two tagging models. The first one combines structured, automatically generated metadata, with manually inserted unstructured tagging labels. It facilitates the annotation of content and thus enhances knowledge transfer and usage. The second tagging model describes a tagged knowledge cycle. It allows process performers to create and tag their knowledge and experiences during process execution.

David Gruenert, Elke Brucker-Kley, and Thomas Keller introduce with Opportunistic Business Process Modeling (oBPM) a new paradigm for modeling and executing business processes that is both user- and document-centric, adequate for bottom-up modeling, agile process modification, opportunistic task scheduling, and process mining.

Rainer Schmidt, Alfred Zimmermann, Michael Möhring, Dierk Jugel, Florian Baer, and Christian Schweda show in their paper “Social-Software-based Support for Enterprise Architecture Management Processes” the application of social-software-based support for enterprise architecture management processes. A cockpit provides interactive functions and visualization methods to cope with complexity and enable the practical use of social software in enterprise architecture management processes.

Nick Russell and Alistair Barros review in their paper “Business Processes in Connected Communities” the implications of digital connectedness between human actors in a process-oriented context, surveys potential community archetypes, and outlines core characteristics of connected communities and their significance in a broader BPM context.

Michael Möhring, Rainer Schmidt, Ralf Härting, Florian Baer, and Alfred Zimmermann provide in their paper “Classification Framework for Context Data from Business Processes” a foundation for the methodical exploitation of context data. Context data consists of two base classes intrinsic and extrinsic data. The paper gives a foundation to leverage context data for business process management.

We wish to thank all authors for having shared their work with us, as well as the members of the BPMS2 2014 Program Committee and the Workshop Organizers of BPM 2014 for their help with the organization of the workshop.

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Preface to the Second International Workshop on Decision Mining and Modeling for Business Processes (DeMiMoP 2014)

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Introduction

Most processes and business process models incorporate decisions of some kind. Decisions are typically based upon a number of business (decision) rules that describe the premises and possible outcomes of a specific situation. Since these decisions guide the activities and workflows of all process stakeholders (participants, owners), they should be regarded as first-class citizens in Business Process Management. Sometimes, the entire decision can be included as a decision activity or as a service (a decision service). Typical decisions are: creditworthiness of the customer in a financial process, claim acceptance in an insurance process, eligibility decision in social security, etc. The process then handles a number of steps, shows the appropriate decision points, and represents the path to follow for each of the alternatives.

Business decisions are important, but are often hidden in process flows, process activities, or in the head of employees (tacit knowledge), so that they need to be discovered using state-of-the-art intelligent techniques. Decisions can be straightforward, based on a number of simple rules, or can be the result of complex analytics (decision mining). Moreover, in a large number of cases, a particular business process does not just contain decisions, but the entire process is about making a decision. The major purpose of a loan process, e.g., or an insurance claim process, etc., is to prepare and make a final decision. The process shows different steps, models the communication between parties, records the decision, and returns the result.

It is not considered good practice to model the detailed decision paths in the business process model. Separating rules and decisions from the process simplifies

the process model (separation of concerns). The aim of the workshop is to examine the relationship between decisions and processes, including models not only to model the process, but also to model the decisions, to enhance decision mining based on process data, and to find a good integration between decision modeling and process modeling.

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Doctoral Consortium of the 12th International Conference on Business Process Management (BPM-DC 2014)

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Introduction to BPM-DC 2014

The Doctoral Consortium (DC) of the BPM conference provides a venue specifically open for young researchers in the domain of business process management, who are working on their doctoral research projects. PhD students are offered a forum to present their entire project to a larger expert audience outside of their home universities. The aim of the DC is

- to provide valuable feedback on students' research methods and plans;
- to provide helpful guidance on students' research directions and topics;
- to promote the development of a community of scholars that will help students in their future careers; and
- to provide students with opportunities to meet and interact with other researchers (senior and junior) in the area of BPM.

The DC received 9 submissions out of which 6 were accepted for presentation on September 7, 2014 in Eindhoven, The Netherlands. The submissions covered a wide range of topics from classical BPM topics, such as process model matching and process mining, to highly relevant topics that are currently less in focus of the main conferences, such as adoption of BPM in practice and handling data inaccuracies.

Organizers

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The Netherlands (*BPM-DC Co-chair
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Stefanie Rinderle-Ma

University of Vienna, Austria (*BPM-DC Co-chair
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Sander Leemans

Eindhoven University of Technology,
The Netherlands (*Local Organizer*)

Experts Participating in BPM-DC 2014

The following senior researchers of the BPM community attended the Doctoral Consortium as shepherds participating in the discussions and providing feedback to the students.

Avigdor Gal	Technion – Israel Institute of Technology, Haifa, Israel
Raimundas Matulevicius	University of Tartu, Estonia
Jan Mendling	Vienna University of Economics and Business, Austria
Hajo A. Reijers	Vrije Universiteit Amsterdam, The Netherlands
Pnina Soffer	University of Haifa, Israel
Barbara Weber	University of Innsbruck, Austria

We thank the shepherds for the rich discussions and feedback provided during the Doctoral Consortium.

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