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Special section on business process analytics

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1 Introduction to the special section

The area of business analytics has received much attention recently in both the computer science and business management research disciplines. With the increased digitization of business processes in organizations combined with the advancements in computer processing power and data storage capacity, researchers have sharpened their focus on developing new process mining techniques and software systems that take advantage of the increased availability of business process data, which are typically generated and captured automatically as business processes are executed in an online operational environment. Thus, *business process analytics* has emerged as an important subarea of business analytics that is specifically concerned with the analysis of business process data to generate new process-related insights to support decision-making in organizations. It is increasingly being recognized that decision-making based on evidence and data rather than experience and intuition is associated with better decision quality and fundamentally changing modern business management (Brynjolfsson and McAfee 2012). Business analytics is one such approach of data-driven decision making and the industry is making efforts to systematically develop and introduce methods and tools in this area (IEEE-TFPM 2012).

Business process analytics refers to the family of process-centric methods and tools that integrate process modeling, process data management, and process mining and data analysis with data-driven decision making that aims at process enhancement (zur Muehlen and Shapiro 2015). Business process analytics provides a conceptual and computational framework to guide organizations in systematic, focused efforts to increase the efficiency of business process design and the effectiveness of business process management. It may focus on studying process behavior over time, diagnosing current process instances, or predict future process behavior. Business process models, the development of formalized representations of the steps (tasks, activities), resources (human and software agents), and information flows that are organized by firms to achieve specific business goals, are the basis for conducting business process analytics projects. Examples of standard business processes include, for example, loan approval processes, travel reimbursement processes, sales process, organizational problem solving process, and so on. Taking advantage of modern information technologies businesses have made great strides over the recent years in automating business process execution. Aside from cost and time savings, businesses have recognized that the computer-supported operation of business processes also enables them to easily generate and capture valuable process data from which they can derive actionable process insights that can help them with improving business process management, if they develop the capabilities that are necessary to properly manage and analyze the process data.

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Process data are typically sets of structured and unstructured data from different sources (transactional systems, online platforms, data bases, workflow management systems, external data feeds, etc.) that are automatically generated as business processes are executed. When businesses scale up a business process, the resulting data sets can quickly get large in volume and their handling may require the use of big data management tools (Vera-Baquero et al. 2013). Specific process mining techniques are available to support the extraction of information and automatic discovering of process, control, data, organizational, and social constructs from event logs of business process management systems. Event log data document activities and record events in production systems and include data about resource usage, activities, attributes of process elements and time stamps. Event logs can be generated, for example, from communication and collaboration processes on social technology platforms, audit trails from a workflow management system, transactions from enterprise systems, and from working with business documents. They are analyzed to uncover patterns and relationships in the data that can be used to better understand businesses processes and enhance their performance.

Process mining is concerned with automatic discovery of process models from historical corporate data sets, conformance analyses that compare events prescribed by a pre-defined process model with the actual occurring events, as well as process enhancement (van der Aalst 2012). Business process analytics, on the other hand, focuses specifically on developing tools and methods for process enhancement and usually analyzes flow times, resource utilization, costs, and other indicators to aid process refinement, redesign and continuous improvement. In order to achieve the full potential of business process analytics the results from process mining analyses need to be repeated, tracked and aggregated over time and further analyzed in order to derive actionable recommendations for process improvement.

In this ISF special section, we include five papers that contribute novel methods of business process analytics with applications in real-world settings, deepening our understanding of how organizations can successfully employ the ideas and methods of business process analytics in practice. Each paper focuses on a particular business process in an organizational setting, discusses and analyzes process data, and offers specific recommendations for business process management. We feature two papers that present new process mining algorithms and show how to apply them to create new business process analytics capabilities. We then offer two empirical papers that analyze knowledge sharing process data from two different online communities of practice. We conclude our special section with a paper that looks at organizational workflow process models and develops a novel system that incorporates attention tracking. The five papers were selected from the best papers presented at the AIS-SIGBPS workshop on business processes and services that was held on December 15, 2012, in Orlando, Florida, during the 33rd annual international conference on information systems (ICIS). Business process analytics was a topic of particular interest at the workshop. The authors of the invited papers were asked to use the feedback they received during their presentations at the workshop and prepare substantially extended and improved versions of their original conference papers. Subsequently, all papers underwent a rigorous, multi-round, developmental review process that ensured that the final papers met the standards that are expected for publications in a high quality research journal.

We start off our special section with the paper "An Intelligent Approach to Data Extraction and Task Identification for Business Process Mining" by Li et al. (2015) that proposes an automated approach to data extraction and task identification from large-scale event log databases, which presents a key challenge in process mining. Extracting relevant process data for task identification requires extensive domain knowledge as well as advanced technical skills it is usually be very labor-intensive and difficult. The authors formalize a process model for data extraction and task identification as a problem of extracting attributes as process components and relations among process components, leveraging information obtained by text mining process documents. They demonstrate how their approach can reduce error and increase the process efficiency of data extraction and task identification using a business expense imbursement case. Their framework is quite general can be applied and customized to many different business settings.

The second paper, "Semantics-based Event Log Aggregation for Process Mining and Analytics" by Deokar and Tao (2015) presents an overall computational framework for event log pre-processing and develops a novel computational method and prototype implementation to support event log aggregation. The authors' approach to event log pre-processing differs from conventional, syntax-based approaches by using a semantics-based method to extract information and organize process knowledge in the form of process ontologies. Based on an experimental evaluation, the paper offers some promising results that suggest that ontological learning based event-log preprocessing at the lower level can be an effective way to simplify event-log analysis and advance process mining and analysis at the higher level.

Wang et al. (2015), in their paper entitled "Examining Micro-Level Knowledge Sharing Discussions in Online Communities" observes knowledge sharing processes in online communities of IT professionals in order to uncover communication patterns that could explain the effectiveness of knowledge sharing. They propose a computational framework to examine individual knowledge sharing processes at the micro-level from a business process perspective. With a

five-step procedure for data gathering, metadata extraction, communication process modeling, structural network analysis, and communication pattern mining, the paper shows how insights about communication patterns can be derived from analyzing knowledge sharing process data. They find that effective knowledge sharing processes exhibit distinct structural characteristics and communication network patterns. These results can be used by online community practitioners to help them improve the design of the knowledge sharing process model and to enhance process quality.

Next, the study "The Classification of Hackers by Knowledge Exchange Behaviors" by Zhang et al. (2015) similarly analyzes knowledge sharing process data collected from another online community of practice, using a hacker community as their case in point. They are interested in finding out how users' posting behaviors evolves over time. They offer a longitudinal study that covers 3 years of hacker communication exchanges, focusing on knowledge transfer patterns between knowledge seekers and knowledge providers. They develop an automated message analysis system that classifies posts and categorizes their contributors into four types: guru hackers, casual hackers, learning hackers, and novice hackers. They find that users join hacker communities mainly to acquire technical skills. The key implication of the study is that the hacker community is a diverse group, where there are different types of users playing different knowledge sharing roles in the community. Overall, the authors argue that hacker communities very much represent learning communities where meritocracy is in place.

Our last paper, "Workflow-Aware Attention Tracking to Enhance Collaboration Management" by Fan et al. (2015) is concerned with work flow management systems and argues that it is difficult for managers to track how much time is actually spent on a particular task if multiple tasks are performed concurrently. In order to facilitate collaboration management in multitasking environments, the authors propose a novel workflow-aware attention tracking framework that conceptualizes attention as a unique cognitive resource of actors that is necessary for performing activities in workflow tasks and incorporates attention tracking in the workflow process model. They design a UML-based process model of workflow-aware attention tracking, derive rules for attention tracking in multitasking collaboration using the Object Constraint Language, develop a procedure for attention rule verification, and present a basic system architecture for workflow-aware attention tracking systems. Using a software development project as an example, the paper demonstrates how their attention-aware workflow management system helped business managers to better monitor task progress, detect violations of attention tracking rules, and accurately accounts for individual effort.

Collectively, these five papers contribute useful new business process analytics frameworks, models, methods, applications. empirical findings, and system prototypes that advance the emerging research area of business process analytics and provide us with new insights that help us to better understand how to effectively apply data analytics to business process management.

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