Preface

In today's dynamic and competitive business environments, organizations are challenged to meet customers' expectations, reduce time-to-market, optimize resource allocation and improve efficiency. By modeling and analyzing their business processes, enterprises can reduce the time and cost of carrying out important activities, improve effectiveness and conform to regulations. A business process is the configuration by which an organization carries out activities across units or departments to produce value for its customers. Activities are generally ordered across time and place, with a beginning, an end, and clearly defined inputs and outputs. Since business processes are the fundamental building blocks of an organization's success, information technologies that focus on process management and improvement have been good candidates to help organizations to fulfill their corporate visions and to improve their competitive positions. In the past two decades, a special interest has been given to Business Process Modeling (BPM) to leverage the computational power of modern information systems to enable organizations to document, model, understand and improve their business processes. The focus on BPM has resulted in the development of workflow management systems, dedicated analysis tools for verification, simulation, and process mining, and various process standards ranging from BPMN to BPEL.

While BPM is not new, it is still a novel paradigm for many of us and for many people it entails a new mindset to ensure a successful outcome and benefit for organizations. Managers and professionals are looking for literature that guides them in the development of end-to-end applications based on process-aware information systems. A key aspect is re-thinking the approach to process modeling. After many years of experience with BPM and associated systems, we have decided to compile a handbook which will help students, researchers and practitioners to exploit BPM and turn promises into tangible results. With the support and contribution of more than 50 academics and practitioners around the world, the Handbook on Business Process Modeling was shaped having in mind the objective to lay the foundations for understanding the concepts and technologies behind BPM.

This book provides valuable answers to frequent problems that people in both academia and industry commonly face when studying and executing BPM undertakings. In each chapter a key concern of business process modeling is discussed. A variety of relevant topics and solutions are discussed in 25 chapters structured in six sections:

- Advanced modelling methodologies
- Modern business process languages
- Process models in dynamic environments
- Enriching process models and enactment architectures
- Business process management in organizations
- Improving business processes

Section I introduces advanced modeling methodologies. Three approaches are presented. The first approach was designed to overcome the classical communication hurdles between application experts and the various levels of IT experts. It relies on the eXtreme Model-Driven Design (XMDD) and the jABC framework for service-oriented and model-driven development. The second methodology introduces a view-based, model-driven approach for process-driven, service-oriented architectures. This view-based approach separates these concerns into a number of tailored perspectives at different abstraction levels. On the one hand, the separation of process concerns helps reducing the complexity of process development by breaking a business process into appropriate architectural views. On the other hand, the separation of levels of abstraction offers appropriately adapted views to stakeholders, and therefore, helps to quickly react to changes at the business level and at the technical level as well. The last methodology presents a process modeling approach for holistic process management. The main idea behind this methodology is that domain specific process models are required both to capture the contents of a process based application and to present a process model in a user-friendly way. Therefore, the chapter presents how perspective oriented process modeling supports domain specific process model.

Section II presents modern business process languages. The first language presented is YAWL. YAWL (Yet Another Workflow Language) is a novel and formally defined workflow language based on the well-known workflow patterns and Petri nets, thus leveraging on both practical and theoretical insights in the field of BPM. This chapter provides an overview of this language and its corresponding open source support environment. The second chapter explains that a key aspect of the future of Business Process Management is to combine graphical modeling with a precise specification of an executable business process. The chapter describes how the Business Process Modeling Notation (BPMN), the Service Component Architecture (SCA) and WS-BPEL can be used jointly and combined to model, deploy and execute business process choreographies. Based on these specifications, the dichotomy between modeling and execution can be addressed efficiently. The third chapter clarifies that workflow patterns should not be interpreted as a list of constructs that a modeling notation or workflow language should have. Rather, they show what needs to be expressible by a construct or by a combination of constructs. The chapter discusses modeling constructs with a new focus: minimality and orthogonality. Minimality tries to minimize the number of constructs that are needed for expressing all the necessary patterns. Orthogonality means that the constructs are as independent from each other as possible. The last chapter in this second section introduces the basic concepts of Information Control Net (ICN) and its workflow models. The chapter presents the graphical and formal representations of ICN-based workflow model and its advanced models—role-based model and actor-based model—which can be automatically transformed from an ICN-based workflow model in order to improve their verifiability, maintainability and usability.

Section III studies the use of process models in dynamic environments. In dynamic environments it must be possible to quickly implement new business processes, to enable ad-hoc deviations from the defined business processes on-demand (e.g., by dynamically adding, deleting or moving process activities), and to support dynamic process evolution (i.e., to propagate process schema changes to already running process instances). These fundamental requirements must be met without affecting process consistency and robustness of the process-aware information system. The first chapter presents how these challenges have been addressed in the ADEPT2 process management system. The overall vision is to provide a next generation technology for the support of dynamic processes, which enables full process lifecycle management and which can be applied to a variety of application domains. The second chapter introduces techniques for representing variability in the context of reference process models, as well as techniques that facilitate the individualization of reference process models with respect to a given set of requirements. A reference process model represents multiple variants of a common business process in

an integrated and reusable manner. It is intended to be individualized in order to fit the requirements of a specific organization or project. The third chapter illustrates the concept of repairable processes and self-healing functionalities and discusses their design requirements. Self-healing processes are able to monitor themselves, to diagnose the causes of a failure and to recover from the failure, where a failure can be either the inability to provide a given service, or a loss in the service quality. Repair mechanisms are thoroughly described by distinguishing between mechanisms applicable at design time and at run time. The last chapter discusses the adaptation of Web processes and provides an overview of adaptation with respect to control theory and how it is applied to other contexts. Specifically, the focus is on open loop and closed loop adaptation. The chapter shows how the current Web process standard WS-BPEL supports open loop adaptation and shows support for closed loop adaptation using METEOR-S, an academic research framework.

Section IV explores how process models can be enriched with additional elements and how enactment architectures can be extended to support new concepts. The first chapter discusses the role of time in workflow management systems. It enumerates some of the main advantages achievable in managing temporal aspects in process models, in exception definition, in the architecture of a workflow management system, and in the scheduling of tasks and their assignment to agents. The second chapter discusses the challenges associated with integrating work performed by human agents into automated workflows. It briefly recounts the evolution of business process support systems and concludes that although the support for people integration continues to evolve in these offerings, in broad terms it has not advanced markedly since their inception several decades ago. The chapter explores the requirements associated with modeling human integration and examines the support for people integration offered by WS-BPEL, which (together with its WS-BPEL4People and WS-HumanTask extensions) currently represents the state of the art when defining and implementing business processes in a service-oriented environment. The third chapter identifies a gap between the business people expertise and the IT knowledge required to carry out a suitable and accurate process modeling. One solution to close the gap is to use technologies developed for the Semantic Web and ontologies. The chapter explains how these technologies help automate the transition between the inherently separate/detached business professionals' level and the IT level without the burden of additional knowledge acquisition on behalf of the business professionals. The fourth chapter presents how model transformation and refinement techniques can be applied to produce executable code out of business process models. Once a business process has been modeled using some language, there are two main alternatives to be considered in order to run the process model using a workflow execution engine. The first involves the direct interpretation of the model. The second alternative is the compilation of the model into a lower-level representation amenable to more efficient execution. The chapter shows how model-driven architecture (MDA) techniques have been applied with success to the domain of business process modeling. As an example case study, the chapter shows how the idea of compiling business process models has been driving the design of the JOpera for Eclipse workflow management tool. The last chapter illustrates how workflow management systems can be extended to support unstructured activities. Workflow systems are based on the premise that procedures are able to define the details of the work carried out in organizations. Original systems were biased by the rationalistic view that organizations follow procedures on a rigid way to achieve their goals. However, organizations also require flexibility when performing their daily operations and procedures since they do not necessarily have all the required information to accomplish their work. This chapter describes a solution developed to address the problem that traditional workflow systems have while coping with unstructured activities. It makes the assumption that there will always be situations where users should be able to decide on what are the most suited activities to fulfill organizational goals, with or without restrictions imposed by the workflow system.

Section V exemplifies how business process management can be used in organizations. The first chapter introduces the notion of business process engineering and the role of a business process engineer. It enumerates the necessary competencies to define, simulate, analyze and improve business processes. A process engineer is considered a person who holistically uses principles of business process engineering, enterprise integration engineering, and associated tools to build business models that identify elements such as information sources involved, the roles which use and transform the information, and the processes that guide end-to-end transformation of information along the business. The second chapter introduces the application of process management to business-to-business (B2B) integration and enterprise application integration (EAI). It introduces several integration examples and a complete conceptual model of integration with a focus on process management. Several specific process-oriented integration problems are introduced that are process-specific in nature. The goal of this chapter is to introduce B2B and EAI integration, to show how process management fits into the conceptual model of integration and to convey solution strategies to specific process-oriented integration problems. The third chapter is devoted to automated support for inter-organizational business process management, that is, formation and enactment of business processes that span multiple autonomous organizations. A treatment of intra- and inter-organizational business processes is included to provide a conceptual background. It describes a number of research approaches in this area, including the context of these approaches and the design of systems. The approaches are described from early developments in the field relying on dedicated technology to current designs based on standardized technology from the service-oriented context. The fourth chapter introduces the concept of business process governance. Process governance provides enterprises with approaches and toolkits to enhance business process management regarding strategy, infrastructure, and enterprise people. Business process governance can be seen from four points of view: business process alignment with its environment, controls and leverages to reach enterprise objectives, business process maturity assessment, and enterprise organizational structure. These perspectives, when analyzed correctly, allow enterprises to retain competitiveness, improve their business processes and make an efficient use of their human resources, and infrastructures. The last chapter addresses the topic of business process compliance. The chapter provides a solution to one specific problem that arises from the lack of mechanisms to check whether business processes are compliant with business contracts. The chapter begins by defining the space for business process compliance and the eco-system for ensuring that process are compliant. The key point is that compliance is a relationship between two sets of specifications: the specifications for executing a business process and the specifications regulating a business. The central part of the chapter focuses on a logic based formalism for describing both the semantics of normative specifications and the semantics of compliance checking procedures.

Section VI of this book studies available solutions to improve business processes. The first chapter explores an emerging area that is getting increasingly popular for enterprises: Business Process Intelligence (BPI). BPI refers to the application of business intelligence techniques to business processes and comprises a large range of application areas spanning from process monitoring and analysis to process discovery, conformance checking, prediction and optimization. This chapter provides an overview of BPI and its application areas and delivers an understanding of how to apply BPI in one's own setting. In particular, it shows how process mining techniques such as process discovery and conformance checking can be used to support process modeling. The second chapter introduces the principles of sequence clustering and presents two case studies where the technique is used to discover behavioral patterns in event logs. In the first case study, the goal is to understand the way members of a software team perform their daily work, and the application of sequence clustering reveals a set of behavioral patterns that are related to some of the main processes being carried out by that team. In the second case study, the goal is to analyze the event history recorded in a technical support database in order to determine whether

the recorded behavior complies with a predefined issue handling process. The third chapter describes a design methodology for business processes and workflows that focuses first on the key data objects to be manipulated by the workflow along with their macro life-cycles, and then incorporates the individual workflow services that will operate on those objects and the association of the services to the artifacts. The resulting workflow is specified in an artifact-centric workflow model, which is introduced using an extended example. The last chapter introduces the notion of process maturity. Process maturity is the degree of explicit definition, management, measurement, control and effectiveness that a process has. The chapter describes the current proposal for a Business Process Maturity Model, from OMG, which is based on the principles, architecture and practices from software engineering. A second topic addressed by this chapter is the notion of process measures. The use of measures makes it possible for organizations to learn from the past in order to improve performance and achieve better predictability over time. Therefore, measurement activities are fundamental for the improvement of process, product and service quality, since they provide objective information that can be used for decision making.

This book represents a valuable contribution to the available literature on Business Process Modeling. Thanks to the efforts of the leading experts in the field we managed to compile a comprehensive handbook. The book also shows that there have been many breakthroughs in recent years and highlights the enormous potential of BPM and its supporting systems. Therefore, we invite you to be part of the exciting BPM community and we are looking forward for your comments, ideas and suggestions for upcoming editions.

Jorge Cardoso, SAP Research, Germany
Wil van der Aalst, TU/e, The Netherlands
December 2008