

HANDBOOK OF RESEARCH ON

COMPLEX DYNAMIC PROCESS MANAGEMENT

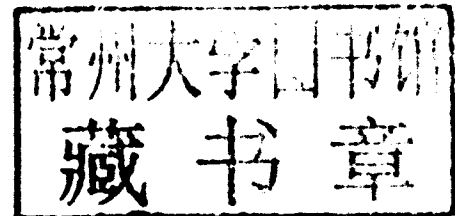
Techniques for Adaptability
in Turbulent Environments



Handbook of Research on Complex Dynamic Process Management: Techniques for Adaptability in Turbulent Environments

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Foreword

The concept of *business process* goes back to Adam Smith and the origins of economic theories. However, the concept was adopted and exploited in areas outside manufacturing only in the past 20 years, thanks to the rise of a cluster of IT-based technologies that could support business process automation, optimization and reengineering.

Today, business processes constitute the centerpiece around which organizations structure their operations, measure their performance, and base their competitiveness. Business processes have also become a core concept for organizational information systems in the sense that they define the operational environment and many of the requirements for such systems.

The organizational world is evolving at an ever-faster pace to meet global challenges such as the environment, increased regulatory control, and global competition. In this context, business processes have to adapt as well, along with the information systems that support their operations, in order to continue to fulfill their mission. Business process adaptation, and the mechanisms by which it can be supported, constitute today a major research challenge for researchers spanning the Management/Technology landscape.

The edited collection herein constitutes a timely and welcome edition to the literature on business processes. The volume offers a comprehensive, interdisciplinary state-of-the-art overview of research on the topic, covering the research of leading groups around the world. I look forward to reading it!

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March 29, 2009

Preface

INTRODUCTION

Businesses around the world are paying more attention to process management and process automation to improve organizational efficiency and effectiveness. *This has led to business process management being increasingly recognised as a critical factor in business success.* Business Process Management (BPM) refers to activities performed by organizations to design, implement, operate, manage, and improve their business processes by using a combination of methods, techniques, and tools. Most approaches to BPM use information technologies to support or automate business processes, in whole or in part, through building process-oriented information systems. These technology-based solutions help coordinate and streamline business transactions, reduce operational costs, and promote real-time visibility in business performance.

Traditional approaches to building and implementing BPM systems have used workflow technologies to design and control the business process. Workflow-based systems follow highly structured and predefined workflow models; they are well suited to applications with standard inputs, processes, and outputs. In recent years, business environments have been changing from centralized-and-closed to distributed-and-open. Business processes are becoming increasingly complex and dynamic as they seek to cope with a wide range of internal and external interactions and changes. Real-world processes are often much messier than the input-transformation-output view might suggest. The processes usually evolve and change over time due to complex interactions, resource competition, breakdowns and abnormal events, and other sources of uncertainty. A business process displays complexity as a result of multiple interactions of its internal components and interaction between the process and its environment. Traditional approaches and technologies for process management are often inadequate for complex and dynamic situations due to lack of flexibility and adaptability.

Against this background, business process flexibility and adaptability at an operational and strategic level has shown its significance. Given the limitation of traditional approaches, organizations are facing the challenge of managing complex dynamic business processes in the following aspects ways:

1. Dealing with increased changes and interactions arising from turbulent environments: current research is attempting to support the continuously changing nature of business processes by developing flexible BPM solutions using various technologies and tools. Design and development of adaptive systems for dynamic process management have become the focus of a great deal of research in recent years.
2. Creating and maintaining a fit between the requirements and supporting technologies for process management: most studies on technology development for flexible process management are experience-driven and ad-hoc; they often lack a systematic analysis of the rationale for the technology

support. Little work has been done on examining the roots of the complexity of business processes, the need for effective approaches for flexible process management, and how this need affects the requirements and technology solutions of process management.

3. Integrating technological, organizational, and managerial perspectives into process management: given that business processes operate in an organizational context, it is important to pay more attention to organizational and managerial aspects of business processes, such as business requirement, organizational structure, worker autonomy, decision making, business strategies, knowledge management, and human involvement, which have been oversimplified in current BPM solutions. This may be linked to soft thinking of business process management, that is, how a process management system can be strategically designed, not only to execute the logic of workflow, but also to satisfy organizational and managerial needs.
4. Managing complex and interactive processes across multiple organizations: the rise of Internet-mediated businesses has given rise to the era of quickly connected global business relationships. A business process can be dynamically established at run-time by connecting services from different organizations through alliances, partnerships, or joint ventures. In this context, attention to business processes should go beyond task and procedure and take other elements into consideration such as resources discovery, selection, integration, and coordination.

This book aims to address these challenges by providing an in-depth understanding of business processes and investigating advanced solutions to complex process management. The book has been prepared in close cooperation with active scholars and experts from the area of business process/workflow management and other related areas including business management, finance, and marketing, as well as from various industrial sectors such as banking, insurance, manufacturing, logistics, and telecommunication. It is a compilation of contributed chapters from 33 universities and nine companies over 20 countries or regions. Recent findings on complex dynamic process management have been collected, including observations, analyses, perspectives, strategies, architectures, models, methodologies, techniques, tools, and case studies.

This book combines both a managerial and a technical view of business process management, providing advanced analysis and concrete approaches for relevant problems, as well as implications for further studies and practices. It may benefit professionals, researchers, and practitioners working in business process and workflow management from various disciplines, including information technology, industrial engineering, management information systems, organizational management, business administration, supply chains, customer relationship management, and so forth. The book will introduce the reader to various issues, trends, and problems faced by researchers and practitioners in business process management, together with principles, approaches, and tools for solving the problems.

BOOK ORGANIZATION

This book is organized into five sections comprising 25 chapters: the first section includes four chapters discussing approaches and tools for conceptual modeling of business processes or process management systems in complex situations; the second section consists of six chapters presenting technologies and solutions for adaptive process management in turbulent environments; the third section comprises six chapters focusing on collaboration issues in business process management; the fourth section contains five chapters addressing a number of practical issues in developing BPM systems; and finally, the fifth

section includes four chapters discussing the application of business process management to practical situations, together with the challenges involved.

Section 1. Conceptual Modeling for Business Process Management

Conceptual modeling is the fundamental issue of business process management. In Chapter 1, Minhong Wang and Kuldeep Kumar analyze the complexity of business processes and the technologies for modeling and constructing complex BPM systems. Based on the complexity of business processes and modular theory for complex systems, the chapter presents the DCAR architecture for complex process management, which includes decomposition of complex processes (D); coordination of interactive activities (C); awareness of dynamic environments? (A); and resource selection and coordination (R). On the other hand, modular computing technologies, such as object-oriented programming, component-based development, agent-oriented computing, and service-oriented architecture have been widely applied in developing complex systems. However, there is considerable ambiguity involved in differentiating between these overlapping technologies and their use in developing BPM systems. No explicit linkage has been established between the requirement of BPM and the supporting technologies. This study uses the DCAR architecture as the foundation to identify the BPM requirements for employing technologies in developing BPM systems. Based on an examination of both sides (BPM requirements and supporting technologies), the study presents a clear picture of business process complexity with a systemic approach for designing and developing complex BPM systems by using appropriate computing technologies.

In Chapter 2, Steen Brahe describes an approach for enterprises to use their own domain concepts to model their business processes. Conventional BPM tools often provide a standardized business process modeling language and implementation technology. This makes the tools inflexible and difficult to use for individual enterprises. This chapter provides a tool-based framework that allows an enterprise to customize BPM languages and tools to its specific needs instead of developing them from scratch. It applies the basic model driven development principles for direct representation and automation of BPM tools through a tool experiment in Danske Bank. BPM tools are developed to capture Danske Bank's specific modeling concepts and use of technology, and automate the generation of the code. The empirical evaluation has revealed the remarkable advantage of the approach in development productivity and code quality.

Chapter 3, by Claudio Petti and Mark Klein, presents a methodology for redesigning and inventing new business processes that relies on a handbook of process models. It focuses on a practical approach for dealing with business process changes by connecting IT experts with business people. The methodology is the fruit of a decade-long MIT research effort known as the Process Handbook project. It is based on acquiring an abstract model of core activities and dependencies in the existing process, and then engaging in a structured and systematic exploration of process alternatives, where a large repository of best-practice business process models, that is, a Process Handbook, can be used for inspiration. The chapter uses the case of a real-life risk management process to illustrate the steps of the methodology and demonstrates how its concepts such as inheritance and exception handling can be used to design more effective and robust IT-based processes by enabling easier and more structured gathering of software requirements; in this way reducing the possibility of misunderstandings between IT experts and business people, and reducing software bugs.

In Chapter 4, Ilia Bider and Erik Perjons turn their attention to the selection of an appropriate approach for business process modeling by means of a simplified classification of business process modeling approaches. To ensure the "right" choice of modeling approach, three factors are addressed for

consideration: (a) properties of the object to be modeled; (b) characteristics of the environment in which the model is being built; and (c) intended use of the model. Their study analyzes the factors involved in the domain of business process modeling. It lists the most essential properties of business processes, classifies modeling environments, and discusses practical tasks where a business process model can be used. Based on the analysis, practical recommendations on what modeling approach to choose are given, dependent on the type of the process under consideration, the task at hand, and the environment in which the model is being built and verified.

Section 2. Adaptive Technologies for Business Process Management

In Chapter 5, Michael Adams, Arthur ter Hofstede, Nick Russell, and Wil Van Der Aalst provide a comprehensive examination of the principles that underpin business process technologies in order to derive a novel approach that moves beyond the traditional assembly-line metaphor. Their study provides an overview of approaches to exception handling and flexibility in process-aware information systems, investigates theoretical foundations of process adaptation, and proposes a comprehensive framework for exception handling in work practices. Using a set of principles derived from activity theory, a system Worklet Service has been implemented, using a service oriented architecture that provides support for dynamic and extensible flexibility, evolution, and exception handling in business processes.

Chapter 6 enters into a specific but critical aspect of adaptive process management during run-time and in distributed systems. Manfred Reichert, Thomas Bauer, and Peter Dadam present the concepts and techniques for enabling ad-hoc workflow changes in distributed workflow execution. The focus is placed on minimizing the communication costs among workflow servers, while ensuring correct execution behavior as well as correctness of ad-hoc workflow changes. To achieve this, it is crucial to identify the workflow servers that are involved in the synchronization of an ad-hoc change. These active servers need to know the schema and state of a changed workflow instance in order to correctly control its execution. In addition, it should be decided whether, when, and how a changed workflow instance schema has to be transmitted to other workflow servers.

In Chapter 7, Mair Allen-Williams and Nicholas R. Jennings address two challenges to computing technology in complex distributed systems: decision making in uncertain and partially-observable environments, and coordination with other agents in such environments. The authors have developed an approach to this problem using a Bayesian learning mechanism, extending previous work on learning models of other agents, and have demonstrated its effectiveness in a scenario from the disaster response domain. The novelties in this work lie in an extension of online model-based learning techniques into partially observable domains using finite automata.

Chapter 8, by Dickson K. W. Chiu, Thomas Trojer, Hua Hu, Haiyang Hu, Yi Zhuang, and Patrick C.K. Hung, describes a Workflow-based Information Integration (WII) approach for dynamic and adaptive workflow management in inter-organizational business collaboration and service provision. The implementation framework comprises five layers: semantic, application, workflow, service, and message. The chapter focuses on the workflow layer for providing adaptiveness based on various types of flows such as control-flows, data-flows, security-flows, exception-flows, and semantic-flows. The issues of data-integration, semantic-referencing, and exception-handling assertions are discussed in order to achieve dynamic and adaptive workflow-based information integration.

In Chapter 9, Mati Golani presents a flexible approach to ad-hoc exception handling by using forward stepping, backtracking, and alternative paths. The chapter provides an analysis of a workflow model based on which, backtracking and forward stepping can be evaluated and implemented. The algorithms

for alternative route identification and forward stepping are proposed to allow dynamic modifications to workflows at design time or run time. The meta-process, that is, the mechanism for automatic activation of the proposed algorithms, is demonstrated, which includes: functional block detection; alternative paths detection; process parameter analysis; and exception handler construction.

Chapter 10, by Mingzhong Wang, Jinjun Chen, Kotagiri Ramamohanarao, and Amy Unruh, describes another specific approach to exception handling in BPM by using a multiple-step backtracking mechanism. This study aims to maintain a tradeoff between re-planning and rigid backtracking for exception handling and recovery. The concept of the BDI (belief, desire and intention) agent is applied to model and construct the BPM system to inherit its advantages of adaptability and flexibility. Then, the flexible backtracking approach is introduced by utilizing the beneficial features of event-driven and means-end reasoning of BDI agents. Finally, the study incorporates an open nested transaction model to encapsulate plan execution and backtracking to gain the system level support of concurrency control and automatic recovery. With the ability to reason about task characteristics, this approach enables the system to find and commence a suitable plan prior to, or in parallel with, a compensation process when a failure occurs.

Section 3. Collaborative Business Process Management

In recent years, business environments have been changing from centralized-and-closed to distributed-and-open. More attention should be paid to situations where dynamic collaboration and soft-connection between business partners is playing an increasingly important role in BPM. Chapter 11, by Bart Oriens and Jian Yang, presents a rule-based approach for collaboration development and management of business processes. The proposed approach allows organizations to capture the requirements for their business collaborations in an explicit, manageable, and uniform manner in the form of rules. These rules can then be used to drive and constrain the development and management of needed collaboration models. In this way, collaborative business process design becomes a runtime activity, where the business collaboration shapes itself to its specific circumstances by applying the appropriate rules. The feasibility of the approach is demonstrated in the context of a complex insurance claim scenario using prototype tooling.

In Chapter 12, Xiaohui Zhao and Chengfei Liu introduce a service oriented relative workflow model to help organisations create flexible and privacy-safe virtual organisation alliances. An organisation centred design method and a visibility mechanism are proposed to deal with the challenges of temporary partnership and low trustiness between collaborating organisations. Contracts are not only used to define and regulate business service collaborations, but also to assist developing the visibility constraints for the business process integration. A visibility control mechanism is applied to remove potential authority violation, and guarantee the safety of privacy between collaborating organisations.

Chapter 13, by Hyerim Bae, provides a specific account of inter-workflow in logistic processes. A logistic process is considered as a combined process that manages the flow of materials among the partners. It consists of multiple sub processes, each of which is managed by a single partner. This study proposes a set of inter-workflow patterns that represent the relations among the separate processes in logistic environments. Based on the patterns, ECA (Event-Condition-Action) rules are generated to control the execution of the logistic process by the rule engine.

Trust is an important issue in collaborative business process management. In Chapter 14, Zhaohao Sun, Jun Han, Dong Dong, and Shuliang Zhao discuss intelligent techniques for trust management in electronic commerce. The chapter examines the engineering of experience-based trust in e-commerce systems, as well as the interrelationships among experience-based, knowledge-based and inference-based

trust. A knowledge-based model of trust management in e-commerce, together with a multi-agent system architecture for experience-based trust engineering in e-commerce are presented.

In Chapter 15, Jude Fernandez and Jyoti Bhat discuss the specific issue of process harmonization in global businesses. Process Harmonization is a complex initiative carried out by large companies seeking to standardize the process variants being executed by different business units across several countries or regions. Motivations for this exercise include cost pressures, mergers and acquisitions, customer satisfaction, the need for agile and flexible processes, and risk reduction in outsourcing processes. The complexity of this exercise is inherent as it involves multiple regions with special needs and characteristics, existing process and IT systems evolved over time, and organizational dynamics around different business groups. This chapter examines the drivers of process harmonization, identifies the challenges and constraints associated with the initiatives, and finally proposes a methodology to execute process harmonization initiatives.

Chapter 16, by Pethuru Raj, focuses on composition oriented architecture for establishing extended, connected, adaptive, and on-demand business processes. As next-generation IT is presumed to thrive on spontaneous and seamless collaboration among systems, services, and servers by sending messages as well as sharing a wider variety of connected and empowered resources, there arises a distinct identity and value for progressive composites. This chapter discusses how rapidly and smoothly services enable business-aligned and process-centric composition, with respect to composition paradigms, patterns, platforms, processes, practices, products, perspectives, problems, and potentials.

Section 4. Practical Issues in BPM Technology Development

Chapter 17, by Jon Espen Ingvaldsen and Jon Atle Gulla, introduces semantic business process mining of SAP transaction logs. SAP is the most widely used Enterprise Resource Planning (ERP) system, which contains transaction logs linked to large amounts of structured data. However, the core of SAP systems was not originally designed from the business process management perspective. The business process layer was added later without full rearrangement of the system. As a result, system logs produced by SAP are not process-based, and cannot be directly used for process mining. This chapter shows how data available in SAP systems can enrich process instance logs with ontologically structured concepts. The authors introduce and value three techniques for mapping executed transactions with the standard business process hierarchies in SAP.

In Chapter 18, Semih Cetin, N. Ilker Altintas, and Ozgur Tufekci address the problem that traditional techniques for modeling and executing business processes are too generic to support diverse business environments. Most BPM tools are not scalable enough for typical business cases, lack architectural coverage to manage the tradeoffs between dynamism and other business quality issues, are insufficient to support integration with legacy business processes, and are without a balanced guidance between “primary” and “supportive” processes. This chapter aims to refrain from using generic approaches and techniques for process modeling by partitioning the big picture into domain specific parts. The authors use the “Domain Specific Kit” for abstraction and composition of primary and supportive processes in an organization. This approach has been put into action for the implementation of central operations management of a mid-scale bank in Turkey.

In Chapter 19, Hajo A. Reijers presents an approach that is opposite to the direction of most developments in the workflow field: lightweight workflow. Lightweight workflow management systems are workflow management systems that only provide the most basic functionalities and are characterized by a relatively small and non-intrusive effort to implement and adopt them. The underlying idea is that

in many situations, especially when flexibility and application integration are not big issues, a “lighter” workflow system provides a better proposition to arrive at a successful and satisfactory workflow implementation. This chapter introduces the essential features of lightweight workflow, and reflects on the application of lightweight workflow in practice.

Chapter 20, by Krishnendu Kunti, Bijoy Majumdar, and Terance Bernard Dias, draws attention to the testing of business process management systems. One of the aspects of managing complex and dynamic business processes is to make sure that the process delivers what is required of it at all times. This chapter identifies the aspects of business processes that need to be tested and the capabilities that the testing tool should have in order to perform such testing. V-model, a commonly used software testing methodology is applied to BPM for provisioning of structured mechanism for business process systems development and testing.

In Chapter 21, Jian-Xun Liu and Yiping Wen discuss the issue of batch processing in workflow in order to dynamically improve the execution efficiency of business processes. The employment of batch processing in workflow is to model and enact the batch processing logic for multiple cases of a workflow to optimize business processes execution. Inspired by workflow mining and functional dependency inference, this chapter proposes a method for mining batch processing patterns in workflows from process dataflow logs. According to batch dependency discovered by techniques, the activities that merit batch processing and their batch processing features are identified. Based on batch processing features, the batch processing areas in workflow are recognized for process optimization.

Section 5. Business Process Management in Practice

Chapter 22, by Arla Juntunen, presents a case study on business process management in a Finnish telecommunication company from 1990 to 2007. This study focuses on the R&D process development and changes from in-house development to a multi-partner R&D network, with respect to the company’s competitive advantage; organizational structure; and product and service portfolio. It discusses how a competitive advantage in mobile and multimedia business has been created by efficient process changes and network management capabilities, during which information and communication technology (ICT) acts as a strategic catalyst and enabler of business process reengineering (BPR).

In Chapter 23, Diana Heckl and Jürgen Moormann analyze the challenges of operational process management for banks and insurance companies. The financial services industry faces significant competitive pressures as a result of economic and political influences, incessant regulation, and fast changing markets. Banks and insurance companies are forced to permanently improve their performance, and raising process performance represents one of the biggest levers for success. The involvement of customers in service processes of financial institutions make final processes not as easy to be managed as production processes. In response to the challenges, a general framework for operational management of service processes is required. This chapter presents a framework for structuring service processes which allows the combination of operational process management with influences by the customers.

In Chapter 24, Rajiv Khosla, Mei-Tai Chu, Shinichi Doi, Keiji Yamada, and Toyooki Nishida discuss business process management in the context of knowledge flow network (KFN) and communities of practice (CoPs). This chapter focuses on knowledge flow that occurs between knowledge workers and transcends business functions and organizational boundaries. Knowledge flow is dynamic phenomena; a dynamic model for analysing knowledge flow activities like knowledge sharing, knowledge discovery, and knowledge creation is thus needed. This chapter develops a CoPs Centered KFN model in a multinational organization context, by taking into account four organization performance evaluation

dimensions and sixteen criteria. Fuzzy multi-criteria decision making and cluster analysis techniques are employed for evaluation of the model.

Finally, Chapter 25, by LtCol Carl L. Oros and Mark E. Nissen, discusses Edge, an organizational form receiving considerable attention for designing organizations as complex adaptive systems in dynamic environment. The Edge distributes knowledge and power to the “edges” of organizations, and enables organizational members and units to self-organize and self-synchronize their activities. However, the dynamics of such self-organization and self-synchronization are extremely complex, and balancing the flexibility and adaptability inherent in the Edge with sufficient control to avoid chaos is very challenging. This chapter informs the understanding of complex organizational design and management. The state-of-the-art POWer environment is employed for dynamic organizational representation and emulation to develop and experiment with models of competing organizational forms.

Minhong Wang
Zhaohao Sun
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