

SPECIAL ISSUE ON INTELLIGENT AND INNOVATIVE COMPUTING IN BUSINESS PROCESS MANAGEMENT

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1. Introduction. Continued advances in Internet computing technology powered by the recent cloud computing and Social Network Service (SNS) innovations have revolutionized the Information Technology (IT) industry in various ways [1,2]. First, according to the pay-as-you-go utility-based computing model, many IT services and IT models are being integrated as utility components at cloud-based data centers [1]. Second, the demand for automated IT process management continues to grow, both horizontally and vertically, in terms of IT and Business Process Management (BPM) functionality [3]. Third, making IT more intelligent and agile has been a constant and continuing emphasis for better responsiveness to changes in business management [3].

Currently, a Business Process Management System (BPMS) is considered a core technology in business environments, and its popularity continues to grow and its functionality continues to be perfected for the delivery of services to customers. On the one hand, BPMSs provide business users with a simple set of tools with which they can model processes and easily “orchestrate” them to improve the efficiency and quality of business operations [3,4]. On the other hand, to effectively respond to on-demand business changes and adaptations, BPMSs need to be made more flexible, self-adaptive and self-tuning through the minimization of impact due to code-level modification and human intervention, especially in a business environment where continued customization⁴, data updates, and business process evolution are required.

Many business process management techniques and functions are directly related to and benefit from innovative computing, information and control (ICIC) concepts in the areas of process modeling, process mining and discovery, process automation, process testing

and validation, and workflow management. Consequently, the application of ICIC concepts to BPM enables an effective management of business processes in Service Oriented Architecture (SOA) environments.

This special issue of the *International Journal of Innovative Computing, Information and Control* (IJICIC) is dedicated to applying ICIC concepts to the development of advanced BPM techniques and functionality, ranging from business process (BP) modeling, execution, mining, all the way to domain-specific case studies. Based on a review process of two rounds, we have accepted a total of 12 papers, including 3 papers in BP modeling, 3 papers in BP configuration, 3 papers in BP execution, and 3 papers in BP mining for domain-specific case studies. Figure 1 sketches the issues pertaining to each domain.

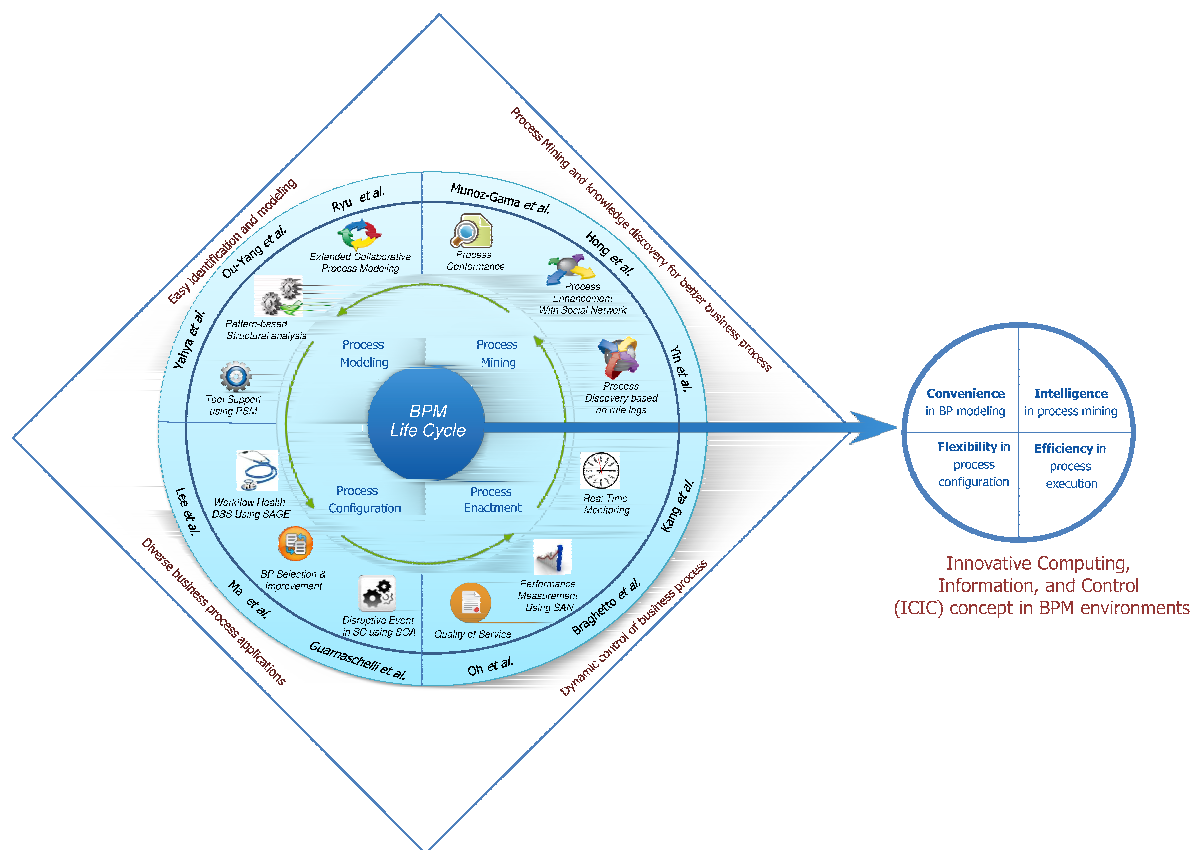


FIGURE 1. Framework of intelligent and innovative BPM

2. Business Process (BP) Modeling. The modeling of BPs has long been a major issue in BPM research. Many BP design techniques have been introduced since the beginning of the 20th century, such as flow charts, functional flow block diagrams, control flow diagrams, Gantt charts, PERT diagrams and IDEF. A fair amount of recent efforts have attempted to enhance process definition languages to meet process requirements in a real world environment. The most common notations in the BPM environment are Petri Nets (PN), Yet Another Workflow Language (YAWL), XML Process Definition Language (XPDL), Event-driven Process Chain (EPC), Unified Modeling Language (UML), and Business Process Modeling Notation (BPMN).

The three papers selected as BP modeling contributions to this special issue have studied a number of hot topics, including BP structural analytics, BP flexibility, as well as BP similarity, reference models, versioning and collaborative BP modeling, among others.

Ou-Yang and Cheng propose a structural-analytics-based scheme to transform a PN model into a pattern-based process diagram (PBPD) that analyzes structure-related flaws, such as deadlocks and improper nestings. The main contribution of this research is the reduced complexity of a PN model and the enhancement of its analytical efficiency and process flexibility.

Ryu *et al.* introduce an extended version of collaborative process modeling (CPM), referred to as exCPM. By underpinning the concepts of tokens in Petri Nets and ICOM in integrated definition (IDEF), exCPM represents complex and collaborative processes more comprehensively than CPM. Through case studies, the authors demonstrate the modeling and verification capabilities of exCPM.

Yahya *et al.* suggest a proximity score measurement (PSM) tool that supports process modeling by novice designers. PSM measures the degree to which an activity is related to another activity in a BP repository, and calculates homogeneity among process models in order to find a process reference model.

One commonality among these three papers is that they all facilitate convenient process modeling by enabling a simple identification and modeling of BPs.

3. Business Process (BP) Configuration. For flexibility in BPM, it is essential to determine and understand the effects of the selection and implementation of various BPM systems. Certainly, the introduction of BPM in the fields of e-business, e-commerce, e-learning, e-procurement, e-applications, e-health systems, supply chains, and product development can further extend BPM by enabling a consideration of unique frameworks and features of new applications. In this special issue, we have selected three papers from the BP configuration domain, with topics ranging from a health decision support system and a BP selection method considering usability-ROI, to an SOA approach to collaborative management of disruptive events in supply chains.

Lee *et al.* highlight a new workflow-based decision support system that integrates clinical workflow and knowledge processing. In this system, diagnostic-activity and clinical-event-handling procedures are integrated with knowledge processing that involves the use of an open-source workflow engine, called SAGE, for rule-based inference-derived decision making.

Ma *et al.* introduce a BP assessment methodology that ensures a BPMS's usability and its returns on investment. The authors developed their methodology by means of both statistical testing and its application in a case study within a South Korean public agency.

Guarnaschelli *et al.* provide a service-oriented approach to the implementation of collaborative BPs. Collaborative BPs that specify a set of decision making activities and information on internal and external changes are required for the prediction of disruptive events that can affect schedule execution and the feasibility of activities in a supply chain environment.

All three research papers have developed effective ICIC approaches to highly diverse BP applications.

4. Business Process (BP) Enactment. BP Enactment, as a concept, commonly relates to automated control by a system, and relates to concepts such as Business Rule Engine, Workflow Enactment, Process Execution, Workflow Engine, and Workflow application. Many studies on BP Enactment have been published, especially regarding scheduling, optimization, planning, dispatching, rule engine, event-condition-action, monitoring, and analysis. This special issue covers the topics pertaining to execution planning, performance evaluation, and real-time BP monitoring.

Oh *et al.* present an approach to fault-tolerant execution planning for collaborative BPs by considering the cost, time and reliability of web services. Their genetic algorithm for a reliable execution addresses the NP-hardness problem encountered in dynamic execution planning.

Braghetto *et al.* introduce a new framework that allows for the generation of analytical performance evaluation models from BP models annotated with resource management information. Their proposed method uses resource constraints to convert BP specifications into Stochastic Automata Networks (SAN). They show that their proposed framework helps to identify bottlenecks in the model as well as other performance-related aspects of the BP.

Kang *et al.* consider a real-time, early warning BP monitoring strategy. By incorporation of a decision tree algorithm, one can estimate the probability that the ongoing process will accomplish the targeted final result upon its completion, thereby preventing (not just reacting to) probable losses.

These three papers all contribute to the development of ICIC in BP enactment environments, each suggesting new methods of dynamic and self-adaptive BP control.

5. Business Process (BP) Mining. There are three known categories of process mining techniques [5]. *Discovery* considers an event log and produces a model without using any a-priori information (i.e., the model is produced using an α -algorithm). *Conformance* compares an existing process model with an event log of the same process to determine if the reality, as recorded in the log, conforms to the model, and vice-versa. *Enhancement* extends or improves an existing process model using information on the actual process recorded in an event log. In this special issue, we include three papers on process mining.

Yin *et al.* offer a new process discovery perspective that contrasts with the traditional, event-log-based view. They discuss a case study on process discovery through rule-flow-based mining over the relations of traces in logs.

Hong *et al.* propose a methodology that enhances organizational performance by deriving an organizational structure that is suitable for the BPs performed in a certain organization. The methodology considers the organizational units as nodes, and the work transfers (in the form of BPs) between two organizational units as arcs and utilizes various social network analysis techniques.

Munoz-Gama and Carmona present a scheme for the measurement of conformance between a log and a process model. The approach incorporates new and important aspects of conformance checking: the measurement of precision metric confidence, and multi-factored assessment of imprecision severity.

These three papers make valuable contributions to process mining intelligence by offering new knowledge-processing methods for enhancing BPs in innovative ways.

6. Final Remarks. This special issue invited research contributions in the forms of novel ideas and techniques on applying ICIC in the domain of BPM. A total of twelve papers have been selected that cover a wide spectrum of BPM research, ranging from convenience in process modeling to the flexibility on process configuration, and from efficiency in process execution to intelligence in process mining.

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