A Computer Scientist's Introductory Guide to Business Process Management (BPM)

by Ryan K. L. Ko

Abstract

Computers play an integral part in designing, modelling, optimizing, and managing business processes within and across companies. Although business process management (BPM), workflow management (WfM), and business process reengineering (BPR) have been IT-related disciplines with a history of about three decades, there is still a lack of publications clarifying definitions and scope of basic BPM terminologies, such as business process, BPM versus WfM, workflow, BPR, etc. Such a myriad of similar-sounding terminologies can be overwhelming for computer scientists and computer science students who may wish to venture into this area of research. This guide aims to address this gap by providing a high-level overview of the key concepts, rationale, features, and the developments of BPM.

Introduction

Every human endeavor, from planning a holiday to managing complex manufacturing processes, is governed by processes. Processes can be optimized by either experience (e.g., planning a holiday) or by prudent scientific investigations (e.g., manufacturing processes). Likewise, there are business processes in business. **Business processes** (e.g., purchase orders, price negotiations, shipping management, request for quotations, merger-and-acquisition procedures, etc.) are commonly found in business organizations and across organizations. There are many types of business processes. Fundamentally, business processes are either private or public business processes. **Private business processes** are those internal to the enterprise and can be at the strategic, management, or operational level. **Public business processes** involve external organizations, e.g., delivery of goods, ordering of materials, etc. Public business processes are also commonly known as **collaborative business processes** (**cBPs**). With intensified globalization, cBPs are becoming more important because of:

1. The rise in frequency of goods ordered.
2. The need for fast information transfer.
3. The need for quick decision making.
4. he need to adapt to changing demands.
5. A larger pool of international competitors.
6. Shorter cycle time.

In a bid to deal with these challenges, Information Technology (IT) was harnessed to manage business processes. Previously manual hand-filled forms are increasingly being replaced by their "paperless" electronic counterparts. This eventually gave rise to business process management (BPM). According to prominent BPM researcher van der Aalst [33], BPM is defined as "supporting business processes using methods, techniques and software to design, enact, control and analyze operational processes involving humans, organizations, applications, documents and other sources of information." Software tools supporting the management of such operational processes became known as business process management systems (BPMS).

At the end of 2006, the BPMS market reached nearly $1.7 billion in total software revenue [14] and began to exhibit the characteristics of an early mainstream software market, i.e., proven technology, stable vendors, vendor consolidation, and rapid user adoption. The BPMS market is also the second-fastest-growing middleware (a type of integrative software) market segment. Gartner estimates that the BPMS market will have a compound annual growth rate of more than 24% from 2006 to 2011 [14]. Interest in BPM from among practitioners and researchers grew rapidly. A wide variety of paradigms and methodologies from organization management theory, computer science, mathematics, linguistics, semiotics, and philosophy were adopted, making BPM a cross-discipline "theory in practice" subject.

Background and Objectives

Perhaps because it is cross-disciplinary, BPM practice and research are fraught with duplication and possible misunderstandings. This does not help the computer scientists who are trying to understand this field. A common problem in BPM is the absence of universal terminologies [8, 23, 30, 34, 37]. Terms are used loosely to represent distinct scope and feature differences [15]. One example is the interchangeable reference between business processes and Web services. Another example is the confusion between business process reengineering (BPR), workflow management (WfM) and BPM. Such confusion has led to mismatched (or worse, wrong) BP solutions being implemented. The frequent mention of BPM in many information systems research such as the Semantic Web and Service Oriented Architectures may also be rather overwhelming to a beginner in the field and may be mistakenly passed off as another buzzword.

Therefore, it is always good to begin the introduction with an overview of BPM fundamentals. Although it may seem unbelievable for a discipline with a history of about three decades, there is still a lack of publications clarifying definitions and scope of basic BPM terminologies, such as business process, business process management versus workflow management, workflow, and business process reengineering. The objectives of this guide are two-fold:

- To serve as an introduction for computer scientists to key terminologies and developments in the e-Business field, Business Process Management.
- To address the current knowledge gap in BPM research by clarifying and distinguishing between key concepts and developments of business process management.

Let us begin with definitions of business processes.

Definitions of Business Processes

Barring the traditional process views of Frederick W. Taylor in the area of scientific management, modern and explicit definitions of the term business process can be traced back to the definitions by proponents in the area of business process re-engineering (BPR) in the early 1990s. The seminal works of Hammer and Champy [9] defined a business process as "a collection of activities that takes one or more kinds of input and creates an output that is of value to the customer. A business process has a goal and is affected by events occurring in the external world or in other processes." This definition is strong due to its comprehensiveness, despite its generic form, and it effectively sums up all possible realistic permutations of business process flows. However, instead of viewing business processes as a "collection of activities," there is a need to view business processes as a systematic, ordering of specific work activities across time and place. With this structure, the areas needing optimization in business processes will easily be revealed.

According to another seminal work by Davenport [5], this structure and an emphasis on the study of how work is done to fulfill the goals of BPR must be implemented with the support of information technology. Hence, in his book, a business process is defined as "a structured, measured set of activities designed to produce a specified output for a particular customer or market. It implies a strong emphasis on how work is done within an organization, in contrast to a product focus's emphasis on what. A process is thus a specific ordering of work activities across time and place, with a beginning, an end, and clearly identified inputs and outputs: a structure for action."

Although the first two definitions defined the goals, temporal, location, and the flow structure of a business process, there were two other important elements still missing in their definitions: the actors of the specific work activities and the collaborative nature of these actors. According to Ould [27], a business process can be viewed as:

- Containing purposeful activity.
- Carried out collaboratively by a group (of humans and/or machines).
- Often cross functional boundaries.
- Invariably driven by the outside world.

This description of business process introduced the elements of (1) actors/roles and (2) collaboration between the actors/roles involved. Hence, it is important to note that a business process, being a structured sequence of specific activities, is not only carried out by a single individual or department, but also involves many people/machines/systems from different organizations, working together to achieve a common business goal. Hence, in the author's own words, business processes would be "a series or network of value-added activities, performed by their relevant roles or collaborators, to purposefully achieve the common business goal."

Types of Business Processes

To my best knowledge, there is no agreed academic or industrial classification or taxonomy of the different types of business processes. From a higher-level viewpoint, there are two main perspectives of business processes: the level perspective and the core competency perspective.

Level Perspective

The **level perspective** classifies business processes into levels like those of traditional organization charts. This perspective is mainly influenced by Robert N. Anthony, who defines three levels of management activities [2, 3]:

1. **Operational control**, which is "the process of assuring that specific tasks are carried out effectively and efficiently."
2. **Management control**, which is "the process by which managers assure that resources are obtained and used effectively and efficiently in the accomplishment of the organization's objectives."
3. **Strategic planning**, which is "the process of deciding on the objectives of the organization, on changes in these objectives, on the resources used to obtain these objectives, and on the policies that are to govern the acquisition, use, and disposition of these resources."

In my opinion, these three levels respectively form what is known today as operation-level business processes, management-level business processes, and high-/strategic-level business processes, as shown (in a high-level fashion) in Figure 1.

The three business process levels in Figure 1 focus on internal business processes. However, in my opinion, the very need for the formation of these three levels is usually triggered by an external business process, namely, collaborative business processes (cBPs). Computer scientists must understand that it is via cBPs that trade and the economy exist. Hence, cBPs define the business collaborations across entities and enterprises. Some examples are purchasing requests, shipments, outsourcing of services, etc.

Core Competency Perspective

The level perspective focuses on the breakdown of responsibilities. The **core competency perspective** of business process groups business processes by their function, or more specifically, their core competencies [29]. There are mainly three groups:

- **Core Business Processes**—These are the revenue-generating processes (e.g., the Software Development Department in IBM or Microsoft).
- **Management Business Processes**—These include the processes that ensure efficiency, corporate compliance, and governance (e.g., Requests, notifications, etc.).

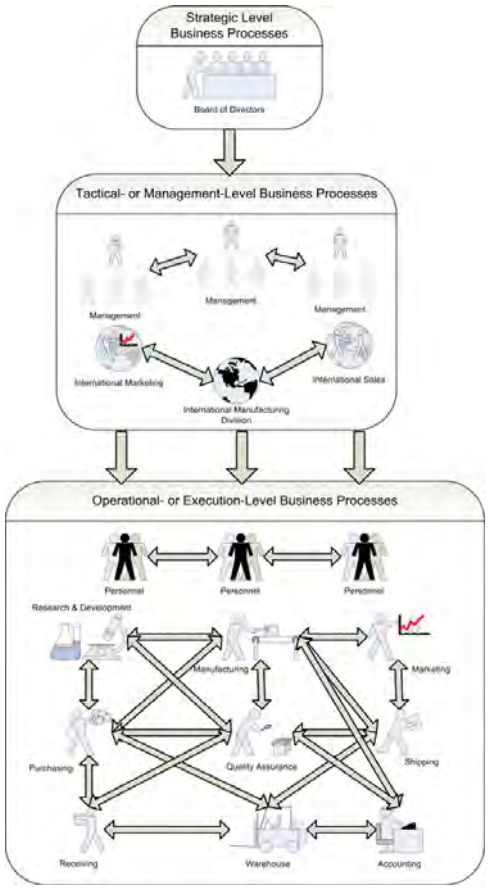

Figure 1: Examples of strategic, management, and operational business processes.

- **Support Business Processes**—These are non-revenue-generating cost components that are nevertheless crucial to the fulfillment of business goals (e.g., the transportation business processes of a manufacturing firm, the IT Department in a retail outlet chain).

Why is Business Process Management Necessary?

As the main people who design and maintain information systems to support BPM within and across companies, it is also beneficial for the computer scientist and practitioner to understand the rationale and benefits behind the BPM discipline.

Benefits of Adopting Business Process Management

It is an intrinsic characteristic for humans to understand an object or a phenomenon through models. Through models, one will be able to visually identify the problems, and they can even point out previously-unaware improvements needed to optimize the situation. The same applies for business processes. The modelling of the processes going on in a business, or even across businesses, can bring about instant problem identification and is an important tool for the simulation of efficiencies of certain processes. Some of the prominent benefits of analyzing and modelling business processes are as follows:

1. Increased visibility and knowledge of company's activities.
2. Increased ability to identify bottlenecks.
3. Increased identification of potential areas of optimization.
4. Reduced lead-times.
5. Better definition of duties and roles in company.
6. Good tool for fraud prevention, auditing, and assessment of regulation compliance.

Such practical benefits are well-suited for real-life applications, such as conformance audits and the increasingly important Sarbanes-Oxley (SOX) audits of corporate IT processes, following the infamous frauds detected in the WorldCom and Enron incidents.

Overlooking BPM: Barings Bank

Perhaps a classic example of the failure of business processes is the Barings Bank debacle [19]. The 233-year-old UK Barings Bank went bankrupt in February, 1994 after it sustained losses of $1.4 billion, incurred in a matter of days, by a single young futures trader, Nicholas Leeson, in the Singapore branch of the bank. Because of inadequate process controls and other business process failures, Leeson's unauthorized futures trading went undetected by the headquarters until the very end.

Reaping the Benefits of BPM

Case #1: Toyota Motor Corporation.

In the Toyota Motor Corporation, right manufacturing and service processes produce the right results. According to Toyota, business processes hide inefficiencies because few people are aware whether a business process takes a few hours or a few days. In fact, Toyota claims that business processes are 90% *waste* (*muda*) and 10% *value add*! Consider the work of a typical design engineer in a company. We cannot measure value-added productivity just by looking at what he or she does. One has to follow the flow of information as the design evolves into the finished product. At certain points in time, tests or analyses are conducted that help engineers make decisions. The trouble is that these results of tests and analyses sit and wait in an information warehouse (inventory) until someone picks them up. Following this, the results could go through several more people and departments, adding to the delay. One can easily see that the problem is not unlike traditional batch-and-queue manufacturing, and that the answer is *flow*.

The ideal workflow, processing a customer order as though it were the only order, pre-supposes a continuous flow of information and materials. Although a one-piece order is idealistic, small lots are not. In small lot manufacturing, by keeping the processes close together, the materials keep moving, and waste is minimized. Toyota identified seven non-value-adding wastes:

- Over-production.
- Waiting.
- Unnecessary transport/movement.
- Excess inventory.
- Defects.
- Unused employee creativity.

As a result, no one produces anything before it is needed by the next person or step in the process (i.e., no waiting, minimum over-

production and transport/movement). Where idealized one-piece flow is not possible, inventory buffers are judiciously introduced (no excess inventory). This is Toyota's secret, which enables its engineers to make a car in one year, when its competitors take two.

Case #2: Ford

Another good example of the benefits of BPM is the classic Ford case, from Hammer and Champy's seminal work [10]:

> *When Ford's purchasing department wrote a purchase order, it sent a copy to accounts payable. Later, when material control received the goods, it sent a copy of the receiving document to accounts payable. Meanwhile, the vendor sent an invoice to accounts payable. It was up to accounts payable, then, to match the purchase order against the receiving document and the invoice. If they matched, the department issued payment. The department spent most of its time on mismatches, instances where the purchase order, receiving document, and invoice disagreed.*
>
> *One way to improve things might have been to help the accounts payable clerk investigate more efficiently, but a better choice was to prevent the mismatch in the first place. To this end, Ford instituted 'invoice-less processing'. Now when the purchasing department initiates an order, it enters the information into an on-line database. It doesn't send a copy of the purchase order to anyone. When the goods arrive at the receiving dock, the receiving clerk checks the database to see if they correspond to an outstanding purchase order. If so, he or she accepts them and enters the transaction into the computer system. (If receiving can't find a database entry for the received goods, it simply returns the order.)*

According to Hammer and Champy, by choosing this solution, Ford opted for radical business process change, and it achieved dramatic improvement. To illustrate this, it was mentioned that initially there were 500 people working in the accounts payable department and that a 75% reduction in this figure was achieved after the solution had been implemented.

Clarifying BPM Terminologies

Having understood the rationale of BPM and the fundamental reason for its discipline, I will now clarify BPM terminologies. BPM is mainly a cross-discipline "theory in practice" subject involving knowledge from organization management theory, computer science, mathematics, linguistics, semiotics, and philosophy. Because of its multi-disciplinary nature, it is often easy to find business process research materials across many subjects' databases. To understand the terminologies and features of BPM, one must always start from an appreciation of the BPM life cycle.

The BPM Life Cycle

Figure 2: Van der Aalst et al.*'s BPM life cycle* [13].

There are many views of the generic BPM life cycle [33, 8, 36, 11], but I will adopt that of van der Aalst *et al.* (see Figure 2) because of its succinctness and relevance. According to them, the BPM life cycle consists of [33]:

1. **Process Design**—In this stage, fax- or paper- based as-is business processes are electronically modelled into BPM systems (BPMS).
2. **System Configuration**—This stage configures the BPMS and the underlying system infrastructure (e.g., synchronization of roles and organization charts).
3. **Process Enactment**—Electronically modelled business processes are deployed in BPMS.
4. **Diagnosis**—Given appropriate analysis and monitoring tools, the BPM analyst can identify and improve on bottlenecks and potential fraudulent loopholes in the business processes.

BPM vs. BPR

Before the 1990s, almost all practitioners and researchers were using the term workflow management (WfM) for what we call BPM today. However, in today's context, many information system practitioners and researchers erroneously use these two terms interchangeably without consideration of their definitions and scope [8].

The influence of IT in managing of business processes can be traced back to Hammer and Champy's BPR paradigm [9, 12] and Davenport's book [5] on how process innovation can facilitate BPR. However, BPM and BPR are not the same. Whereas BPR calls for a radical obliteration of existing business processes, BPM is more practical, iterative, and incremental in fine-tuning business processes.

BPM vs. WfM

Two other terminologies often used loosely are WfM and BPM. There are mainly two differing viewpoints. One viewpoint by Gartner Research views BPM as a management discipline with workflow management supporting it as a technology [15]. According to Gartner [15]: "Business process management (BPM) is a process-oriented management discipline. It is not a technology. Workflow is a flow management technology found in business process management suites (BPMS's) and other product categories. "

Perspectives on Workflow and WfM

In an attempt to distinguish the differences between the two terms, M. Havey defines **workflow** as "a flow of work, encompassing the exchange and enrichment of information" [12]. In the past, workflow meant passing paper from person to person. Workflow technology improved things not only by managing the flow of work, but also by digitizing the information, thereby making the process as automated and paperless as possible [38].

The Workflow Management Coalition (WfMC) defines **workflow management** as: "The automation of a business process, in part or in whole, during which documents, information or tasks are passed from

one participant to another for action, according to a set of procedural rules" [38]. In simple words, one can interpret this definition as a backing to the earlier argument of workflow as automation software packages, enabling the office documents and business transactions to go from stage to stage of a business process in a "paperless" fashion.

In a highly-cited review paper on workflow management systems in 1995, Georgakopolous et al. [6] describe how workflow facilitates business enterprises' dealing with global competition, reduction of costs, and the rapid development of new services and products by "providing methodologies and software to support (i) business process modelling to capture business processes as workflow specifications, (ii) business process reengineering to optimize specified processes, and (iii) workflow automation to generate workflow implementations from workflow specifications." The list of features in Georgakopolous *et al.*'s workflow is shown in Figure 3.

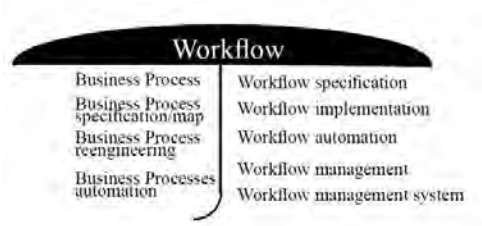

Figure 3: The workflow umbrella [6].

Table 1 shows another viewpoint by van der Aalst et al. is that the features stated in WfM, as defined by [36], are a subset of BPM, as defined by [33], with the diagnosis stage of the BPM life cycle as the main difference. To my best knowledge (and industrial experience), many BPMS are still very much workflow management systems (WfMS) and have not yet matured in the support of the BPM diagnosis. From the above categorizations in Table 1 and Figure 4 below, it is now obvious that workflow management is a logical subset of business process management.

Figure 4: Van der Aalst et al.*'s use of the BPM life cycle to compare workflow management and business process management* [33].

In order to ascertain the differences between WfM and BPM, one must always take into context the historical developments of IT advancement and organization theories, being careful not to view workflow management as a poor cousin of business process. Furthermore, workflow remains a useful word and is, in fact, more expressive than the term business process management [38]. Rather, we should view business process management as a progressive extension of the workflow management scope.

In recent years, I have observed that many software vendors have updated their products' names from "WfM" to the more contemporary "BPM." One example is Metastorm's product name change from Metastorm E-Work version 6 to Metastorm BPM version 7 in 2005 [22]. Noticeably, the change of name was not accompanied by a maturity of the diagnosis portion of its suites (i.e., WfM to BPM). Instead, the visible changes from version 6 to 7 are its system's adaptation of Microsoft SQL Server 2005, the obsolescence of simulation features, and an aesthetically appealing GUI. In my work experience and observations from technical forum contributors, many of these WfMS-turned-BPMS have yet to offer rich diagnosis features. Although many software suites offer **business activity monitoring** (**BAM**) dashboards (i.e., ready-made user interface programs), the creation of useful audit trails and the churning of meaningful reports displaying process trends still requires external specialized reporting tools, such as Microsoft Reporting Server or Crystal Reports.

Limitations of "Workflow"

So why is the term "workflow" no longer in fashion in the industry? Across most arguments [13, 22, 36, 38], WfMS are viewed to have the best ability to increase the efficiency of business processes in a confined domain (e.g., within a company) and have traditionally been based on the WfMC's idea of a centralized enactment engine.

However, this architecture restricts the integration capabilities of workflow systems across companies, or even across sites of a multinational company. This inability to provide an easily integrated solution to the urgent needs of an Internet-savvy and globalized business climate proved costly, and WfMS soon lost favor to BPMS, many of which capitalize on the contemporary distributed environments of Web services and service-oriented architectures (SOA).

Another main gap in the workflow technology was the overlooking of the diagnosis portion in the entire BPM cycle. Despite their robust centralized engines and ease-of-use in their business process designers, many WfMS packages in the industry (e.g., Metastorm e-Work, Savvion, Ultimus, etc.) often lack inherent reporting and diagnostic tools that enable analysts to churn real-time reports in order to pinpoint process bottlenecks and business process flaws.

With new research interests in the BPM diagnosis sub-topics business process analysis (BPA) and BAM, the diagnosis component of the BPM life cycle is starting to gain more attention from software vendors. This paves the way for the development of "true" BPM.

BPM Life Cycle Stage	Workflow Management (WfM)	Business Process Management (BPM)
Process Design	Yes	Yes
System Configuration	Yes	Yes
Process Enactment	Yes	Yes
Diagnosis	Weak	Yes

Table 1: WfM and BPM compared.

Limitations of the Contemporary BPM Definition

So far, the definitions of BPM by [4, 8, 13, 22, 26] have emphasized on operational processes and not on *strategic-*, *tactical-*, or *collaboration-level* processes.

This initial focus on solely the operational processes is a prudent and very achievable one. However, in many business transactions in the current globalised business climate, we have business processes not only at the operational level, but also across all levels!

In recent years, there has been a fervent increase in the interests of collaborative business processes. This has mainly been triggered by the need to model and optimize business processes in business-to-business (B2B) collaborations [32].

BPM Theory vs. BPM Standards and Languages vs. BPM Systems

At the time of writing, there are more than 10 formal groups working on BPM standards [39], seven of which are dedicated to modelling definitions [7]. Hence, it is no surprise that the BPM landscape became fragmented from the late nineties onward. The confusion was so bad that even theory was confused for standards and standards for BPMS, when the three are in a nested relationship, as shown in Figure 5.

As shown in Figure 5, BPM standards and specifications (e.g., Business Process Execution Language (BPEL) [1]) are based on established BPM theory (e.g., pi calculus [24, 25] and Petri nets [28]) and are eventually adopted into software and systems (e.g., Intalio Designer [17], KAISHA-Tec ActiveModeler [18], etc.). BPM standards and BPM systems are also what Gartner [16,36] describes as "BPM-enabling technologies." The heterogeneity of business process modelling techniques is a notorious problem for BPM [23]. Table 2 attempts to simplify this by outlining, for each modelling technique or standard, its applicability (BPM, B2B, or SOA), background, usage (e.g., execution), current status, and standardization status.

Figure 5: The relationship between BPM theory, standards, and systems.

BPM vs. SOA

In the industry, there is a growing awareness of the emerging Service-Oriented Architecture (SOA). For example, SAP AG has migrated from the traditional ABAP-based R/3 system's SAPGUI front-end to the Java-based SAP NetWeaver Portal, which is supported by SAP Web Dynpro technology in the design, configuration, and the linkage of Web services.

However, there is also widespread usage of the terms BPM and SOA interchangeably. Thus, it is important to note that BPM is a process-oriented management discipline aided by IT, and SOA is an IT architectural paradigm. According to Gartner [13], BPM "organizes *people* for greater agility," while SOA "organizes *technology* for greater agility." In other words, processes in SOA (e.g., linked Web services) enable the coordination of distributed systems supporting business processes and should never be confused with business processes.

	BPM/ SOA/ B2B	Background	Theory/Graphical/ Interchange/Execution Diagnosis/ B2B Info Exchange	Standardized?	Current Status
BPDM	BPM	Industry	Interchange	Yes	Unfinished
BPEL	BPM	Industry	Execution	Yes	Popular
BPML	BPM	Industry	Execution	Yes	Obsolete
BPQL	BPM	Industry	Diagnosis	Yes	Unfinished
BPRI	BPM	Industry	Diagnosis	Yes	Unfinished
ebXML BPSS	B2B	Industry	B2B Info Exchange	Yes	Popular
EDI	B2B	Industry	B2B Info Exchange	Yes	Stable
EPC	BPM	Academic	Graphical	No	Legacy
Petri Net	All	Academic	Theory/Graphical	N.A.	Popular
Pi-Calculus	All	Academic	Theory/Execution	N.A.	Popular
Rosetta-Net	B2B	Industry	B2B Info Exchange	Yes	Popular
UBL	B2B	Industry	B2B Info Exchange	Yes	Stable
UML AD	BPM	Industry	Graphical	Yes	Popular
WSCI	SOA	Industry	Execution	Yes	Obsolete
WSCL	SOA	Industry	Execution	Yes	Obsolete
WS-CDL	SOA	Industry	Execution	Yes	Popular
WSFL	BPM	Industry	Execution	No	Obsolete
XLANG	BPM	Industry	Execution	No	Obsolete
XPDL	BPM	Industry	Execution/Interchange	Yes	Stable
YAWL	BPM	Academic	Graphical/Execution	No	Stable

Table 2: Prominent BPM standards, languages, notations, and theory and their status.

The Business Process Modelling Process

With an understanding of the terminologies, the reader can now appreciate the business process modelling process usually occurring in the industry. This process is usually undertaken by IT specialists within the company. From my work experience in business process modelling, BP modelling is a six-stage process (shown in Figure 6), which aligns to the aforementioned BPM life cycle's stages of process design, system configuration, and process enactment.

Of these six stages, two of them are currently manual, and the other four are currently supported by tools from BPM software vendors (see Figure 6). The BP modelling process can be

best described by the example of the purchasing request business process in fictitious company A.

Figure 6: The business process modelling process: from goals, to diagrams, to executable processes.

Explanation of the BP Modelling Process via an Example

Company A recently purchased a BPM system and would like to automate its internal business processes. The management decided to pilot it in the Procurement Department and identified the purchase request (PR) business process as the most suitable BP to be modelled and implemented with the new system. The reason is that the PR BP is currently handled by the passing and signing of paper forms that are often lost or misplaced in the process. Also, it is currently the most-utilized business process in the department.

Step 1: Business Needs. With the identification of the need for the PR BP to be modelled, the management has triggered step 1. The high-level business goal would be "to raise a PR."

Step 2: Business Goal Definitions. Next, step 2 will take place. The management will present its requirements along with a high-level overview of the steps in a PR process to a business analyst. This stage is still manually practiced in the industry, and it involves meetings and discussions in order for the business analyst to fully grasp the requirements of his client.

Step 3: Detailed Business Process Diagrams. With a reasonable understanding of the client's requirements, the business analyst will model the business processes in an easily interpretable graphical standard (e.g., BPMN). The graphical details are aided by the BPMS' designer tool. Specific details adhering to the company's standard operating procedures (e.g., layout of the PR request form, different approving authority based on request amount, etc.) are also inputted.

Step 4: Translate Diagrams to Executable Code. With the BPMN diagrams in place, the business analyst will use a tool that supports interchange standards like XPDL to automatically translate the PR business process's graphical model in BPMN standard into the very technical, executable code in BPEL standard.

Step 5: Execution Code. An IT specialist will check the code, make necessary adjustments, or add in more logical details into the BPEL standard code. Next, the IT specialist will demonstrate a prototype of the business process to the management. Upon testing and approval, the PR BP code will be published into the BPMS.

Step 6: Executable Business Processes. The BPMS contains a component called the engine, which is software that manages the proper routing and running of all PR BP instances to the correct stages and persons. Once step 6 is it, company A's employees can now raise PRs electronically via the BPMS.

Further Reading

With this guide, readers should have a basic and fundamental grasp on the subject of BPM. For readers who may be interested in further study, they may refer to the following works:

1. Georgakopolous *et al.*'s review on WfM and WfMS in [6].
2. van der Aalst's reviews on definitions and perspectives of BPM concepts in [33, 35].
3. Ko, Lee, and Lee's [20] survey on BPM standards.
4. Koskela and Haajanen's [21] and Recker and Mendling's [31] identification of conceptual mismatches between BPELs and business process graphical modelling notations.

Conclusion

This guide has introduced to computer scientists and computer science students key terminologies and developments of the eBusiness field known as business process management. Some notable terminologies clarified included definitions of business processes, workflows, workflow management, the difference between WfM, BPR, and BPM, and a clarification of the key differences between BPM and SOA. Perspectives of viewing business processes, the effects of neglecting BPM, and common ways of business process modelling were also evaluated.

Together, these clarifications and definitions aim to reduce the current situation (in both industry and research) where many BPM concepts and terminologies were mistakenly used interchangeably and without regard for their scope and developments. As a result of this guide, readers looking to explore BPM information systems research should now have a clear and fundamental grasp on the background and overview on the subject of BPM.

References

1. Andrews, T., Curbera, F., Dholakia, H., Goland, Y., Klein, J., Leymann, F., Liu, K., Roller, D., Smith, D., and Thatte, S. 2003. Business process execution language for web services, version 1.1. Specification by BEA Systems, IBM Corp., Microsoft Corp., SAP AG, Siebel Systems.
2. Anthony, R. N. 1965. *Planning and Control Systems: A Framework for Analysis*. Harvard Business School, Cambridge, MA
3. Anthony, R. N., Dearden, J., and Bedford, N. M. 1995. *Management Control Systems*. Irwin Homewood, IL.
4. BPMI. 2005. Business process modelling initiative. **http://www.bpmi.org/** (accessed Sept. 23, 2007).
5. Davenport, T. H. 1993. *Process Innovation: Reengineering Work Through Information Technology*. Harvard Business School, Cambridge, MA.
6. Georgakopoulos, D., Hornick, M., and Sheth, A. 1995. An overview of workflow management: From process modelling to workflow automation infrastructure. *Distrib. Parall. Datab. 3*. 119-153.
7. Ghalimi and D. McGoveran, D. 2005. Standards and BPM. BPM.COM.
8. Havey, M. 2005. *Essential Business Process Modelling*. O'Reilly Media, Inc., Sebastopol, CA.

9. Hammer, M. and Champy, J. 1993. *Reengineering the Corporation: A Manifesto for Business Revolution*. Harper Business, New York, NY.
10. Hammer, M. 1990. Re-engineering work: Don't automate, obliterate. *Harvard Bus. Rev*. 104-112.
11. Hammer, M. and Champy, J. 1992. What is reengineering? *InformationWEEK*. 10-24.
12. Havey, M. 2005. *Essential Business Process Modelling*. O'Reilly Media, Inc., Sebastopol, CA. 16-17.
13. Hill, J. B., Sinur, J., Flint, D., and Melenovsky, M. J. 2006. Gartner's position on business process management, 2006. In *Business Issues*. Gartner, Inc.
14. Hill, J. B., Cantara, M., Deitert, E., and Kerremans, M. 2007. Magic quadrant for business process management suites. Gartner Research.
15. Hill, J. B., Pezzini, M., and Natis, Y. V. 2008. Findings: Confusion remains regarding BPM terminologies. ID no. G00155817. Gartner Research (Mar. 10, 2008).
16. Hill, J. B., Kerremans, M., and Bell, T. 2007. Cool vendors in business process management. Gartner Research.
17. Intalio. 2007. Intalio designer. **http://www.intalio.com/products/designer/** (accessed Feb. 2, 2008).
18. J. KAISHA-Tec Co. Ltd. 2008. ActiveModeler advantage. **http://www.activemodeler.com** (accessed Feb. 2, 2008).
19. Klein, M. and Dellarocas, C. 2003. Designing robust business processes. In *Organizing Business Knowledge: The MIT Process Handbook*. Malone, T. W., Crowston, K., and Herman, G. A, Eds. MIT Press, Cambridge, MA. 434-438.
20. Ko, R. K. L., Lee, S. S. G., and E. W. Lee, E. W. 2009. Business process management (BPM) standards: A survey. *Bus. Process Manage. J. 15*, 5. To appear.
21. Koskela, M. and Haajanen, J. 2007. Business process modelling and execution: Tools and technologies report for the SOAMeS project. VTT Technical Research Centre of Finland.
22. Metastorm Inc. 2007. Metastorm Inc. corporate website. **http://www.metastorm.com** (accessed Feb. 2, 2008).
23. Mendling, J. and Neumann, G. 2005. A comparison of XML interchange formats for business process modelling. In *Workflow Handbook*.
24. Milner, R. 1982. *A Calculus of Communicating Systems*. Springer-Verlag, Berlin, Germany.
25. Milner, R. 1999. *Communicating and Mobile Systems: The Pi Calculus*. Cambridge University Press, Cambridge, UK.
26. OASIS. 2008. Web services business process execution language (WSBPEL). **http://www.oasis-open.org/committees/tc_home.php?wg_abbrev=wsbpel** (accessed Sept. 14, 2008).
27. Ould, M. A. 1995. *Business Process: Modelling and Analysis for Re-engineering and Improvement*. John Wiley & Sons, New York, NY.
28. Petri, C. A. 1962. Kommunikation mit automaten. PhD thesis. Rheinisch-Westfälisches Institut f. instrumentelle Mathematik an d. Univ.
29. Prahalad, C. K. and Hamel, G. 1990. The core competence of the corporation. *Harvard Bus. Rev. 68*. 79-91.
30. Pyke, J. 2007. XPDL—The silent workhorse of BPM. BPM.COM.
31. Recker, J. C. and Mendling, J. 2006. On the translation between BPMN and BPEL: Conceptual mismatch between process modelling languages. In *Proceedings of the 18th International Conference on Advanced Information Systems Engineering*. 521-532.
32. Tan, P. S., Goh, A. E. S., Lee, S. S. G., and Lee, E. W. 2006. Issues and approaches to dynamic, service-oriented multi-enterprise collaboration. In *Proceedings of the IEEE International Conference on Industrial Informatics* (*INDIN'06*). 399-404.
33. van der Aalst, W. M. P. , ter Hofstede, A. H. M., and Weske, M. 2003. Business process management: A survey. In *Proceedings of the Business Process Management: International Conference* (*BPM'03*).
34. van der Aalst, W. M. P. 2003. Don't go with the flow: Web services composition standards exposed. *IEEE Intell. Syst. 18*. 72-76.
35. van der Aalst, W. M. P. 2004. Business process management demystified: A tutorial on models, systems and standards for workflow management. *Lecture Notes in Computer Science vol. 3098*. (Lectures on Concurrency and Petri Nets). 1-65.
36. van der Aalst, W. M. P. 2004. Business process management: A personal view. *Bus. Process Manage. J. 10*.
37. van der Aalst, W. M. P. 2005. Pi calculus versus Petri nets: Let us eat "humble pie" rather than further inflate the "Pi hype." Unpublished paper. **http://is.tm.tue.nl/reserach/patterns/download/pi-hype.pdf**.
38. WfMC. 1993. Workflow management coalition. **http://www.wfmc.org/** (accessed Feb. 1, 2008).
39. zur Muehlen, M. 2007. Tutorial—Business process management standards. In *Proceedings of the 5th International Conference on Business Process Management* (*BPM'07*).

Biography

*Ryan K. L. Ko (**ryanko@acm.org**) is a final-year PhD candidate at Nanyang Technological University, Singapore. Prior to his current research, he was a Systems Engineer from a Singapore MNC, specializing in SAP Enterprise Portal, NetWeaver, ERP, and BPM systems. In the course of his previous employment, he designed, implemented, and managed more than 50 business processes for his company. He holds a Bachelor of Engineering (Computer Engineering, Hons.) from Nanyang Technological University. His research interests are business process management, ontologies, dynamic enterprise collaboration, and artificial intelligence.*