Factors and Competences for Business Process Management Systems implementation

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Factoren en Competenties met betrekking tot de Implementatie van Business Process Management Systemen

(met een samenvatting in het Nederlands)

PROEFSCHRIFT

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Preface

Ever since I finished my bachelor study in Industrial Management in 1999 I wanted to keep on learning and studying. Even though I immediately started with a fulltime job as a trainee at the Baan Competence Centre of the Hogeschool Utrecht, it was just four months later when I also started the part-time Masters of Science in General Management at Nyenrode University, which at the time had a duration of three and a halve years. During the period 1999 – 2002 I expanded both my theoretical knowledge on how organizations are structured, managed and controlled and my knowledge and skills on how Information Technology – more specifically Enterprise Resource Planning (ERP) – can help organizational processes to be executed more efficient and effective.

It was during this time that I noticed the many problems with which ERP implementation projects are faced. The most common problem being misalignment between the processes in an organization and the functionality offered by the ERP system. Baan Company was one of the first who tried to solve this problem, by using graphical representations of organizational processes and linking these directly to the functionality of the software, during the implementation of the ERP package. This one-to-one coupling of processes and functionality was done in the Dynamic Enterprise Modeling module of Baan IV. Colleagues of mine developed course material to be able to teach university students these principles and for this I was asked to review these materials. Thus I got acquainted with the combination of process modeling and ICT as a means to managing software implementation and business improvement. Although at that time it only worked within the Baan ERP software and couldn't be used to implement process activities that were supported by other IT systems. Still my passion for this topic has never left me and it grew over the years as this concept evolved and state-of-the-art Business Process Management Systems were developed.

So after my Masters (and a year in which I studied Italian at the Italian Consulate) when I got the opportunity to start a PhD study the area of study was immediately clear to me: *'How to successfully implement Business Process Management Systems'*.

Above I have only described the start of a journey that will hopefully continue for a long time to come and in which this dissertation is an important milestone. Along the road I have met many people who have supported me. Some have traveled with me for just a short period while others have been with me for quite a while. However, I would like to thank everyone for there insights, discussions, comments, support, motivation and critic.

Contents

Introduction

1.1 Motivation

During the past twenty years the world has seen rapid changes such as globalization, the adoption of the Internet, mobile communications, and the rise of China and India as important economies. These developments make it possible and in many cases necessary for organizations to change their business models. No longer is it possible to cater for the wishes of customers and consumers as stand-alone companies. Many organizations are outsourcing or offshoring part of their processes, which enables them to focus on their core competences. By collaborating in ever growing and changing alliances -virtual organizations or extended enterprises- companies are better adapted to cope with increasing competition. To realize such adaptability organizations need to increase control of their processes in order to be able to continuously improve them.

Another force driving the need for control and transparency in processes is legislation which has been accelerated after financial scandals at large organizations. As a result many organizations turn their attention towards the field of Business Process Management (BPM) which has "*a focus on end-to-end process improvement, through the digital management of the entire business process lifecycle: the discovery, design, deployment, execution, operation, analysis and optimization of business processes*." (BPMI.org, 1999).

Yet many organizations implementing BPM are hindered by their current Information System and Information Technology (IS/IT) architecture. Most large organizations have invested heavily in enterprise systems such as Enterprise Resource Planning (ERP), Customer Relationship Management (CRM), and Supply Chain Management (SCM) and now find that these applications are not fully integrated and therefore do not provide an end-to-end view on their processes, let alone that they are able to control them. This is where vendors and resellers of Business Process Management Systems (BPMSs) come into play. They claim that the implementation of a BPMS will enable an organization to increase grip on its processes by creating transparency (via the modeling of processes), integration of supporting information systems, and continuous improvement opportunities via real time measurement of process performance. Whether the future will show if this claim is fully true is unlikely or at least complex as practice shows (Ernst & Young, 2009) that only one-third of IS/IT projects are classified as a complete success (success being defined as on time, within budget and delivering the predefined requirements). As International Data Corporation (IDC) predicts that the revenue for the BPM market will climb from $1 billion in 2005 to US $3.8 billion

by 2012 (Zhao, Liu & Li, 2008) the chances on failed BPMS implementation projects increase dramatically and therefore the research presented in this dissertation has a clear practical relevance.

1.2 Research Domain: Business Process Management

Depending on the view on the BPM research domain it has either been around for a long time or it is quite young. One of the first persons to really analyze (manufacturing) workflows with the aim to improve them was Frederick Winslow Taylor in the early 1880s. Based on his experiences he wrote 'The Principles of Scientific Management' (Taylor, 1911). However the term BPM as a label to a specific research area has not been around for more than about two or three decades, though the idea of process orientated design and analysis of organizations and supporting this with information systems has a long history starting with Ellis (1979) and Zisman (1977). In this dissertation the BPM research domain is traced back to one of the pillars: Total Quality Management (TQM). TQM can be traced back to around the second World War (Juran, 1945; 1951) and really started to gain attention during the eighties (Deming, 1982; Ishikawa, 1986). TQM is founded in statistical research and proclaims that measurement is the key in optimizing manufacturing processes in such a way that goods produced are of high quality while the means for production costs as little as possible. As many Japanese organizations adopted this quality movement they were subsequently possible to enter the American and European markets with low cost and high quality goods during the eighties (Womack et al., 1990). They rapidly acquired market share and left American competitors perplexed. Research by universities and consultancy organizations alike suggested that American companies had too much slack and overhead to be able to compete with their Japanese counterparts, and suggestions were made on how organizations could redesign themselves. This was the start of the Business Process Reengineering (BPR) research and practice (Davenport, 1993; Hammer and Champy, 1993), which can be regarded as another important predecessor of the BPM domain. However an important difference with the current BPM domain is that both TQM and BPR can be considered management disciplines, and while BPR did perceive the possibilities of IS/IT to automate redesigned processes it did not propagate an integrated approach by management and information systems disciplines in managing processes. At that time this could not be realized anyway due to a lack of maturity in IS/IT (Al-Mashari and Zairi, 1999; Juopperi et al, 1995).

It was not until the mid- and late-nineties before BPM started to emerge as a separate field of research that aimed at integrating the best elements of both TQM and BPR (Lee and Dale, 1998; Zairi, 1997; Elzinga et al., 1995). Although IS/IT was seen as an important enabler to process management it took until the beginning of this century before an integrated business and IS/IT approach to process management was envisioned (Fremantle et al., 2002; Aalst et al., 2003a).

Nowadays there is a vast amount of BPM research available. Below we give a brief overview of research in the BPM domain. For this we have classified research in this area according to the four subsequent phases of the iterative BPM lifecycle (Weske, 2007): design & analysis, configuration, enactment, and evaluation (figure 1.1).
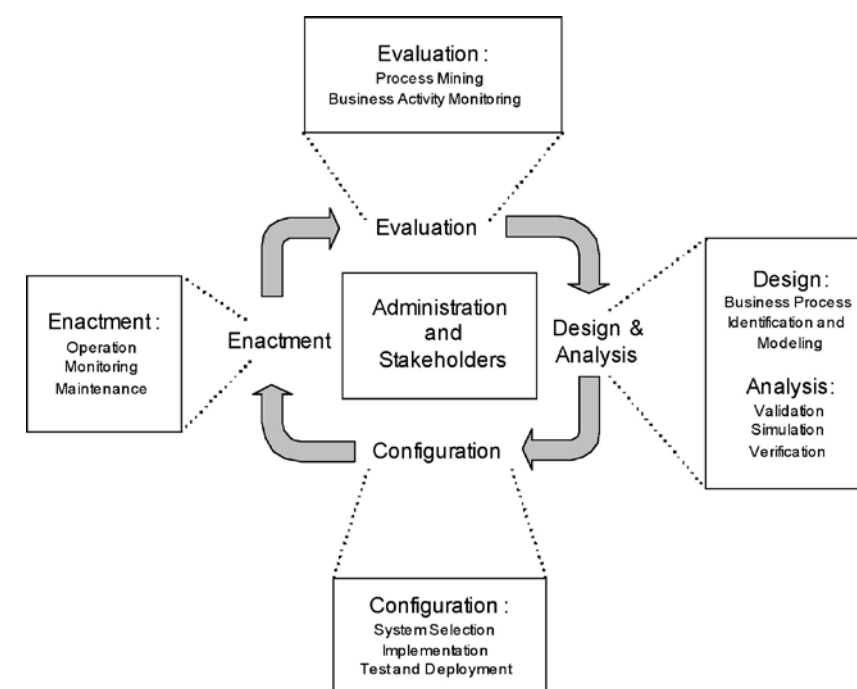
Figure 1.1 BPM Lifecycle (Weske, 2007)

Much of the research within the BPM domain is related to design & analysis which consists of research into business process identification and modeling, as well as the simulation and validation/verification of processes. Studies in this domain either focus on analyzing and comparing different methods, techniques and tools that are used for process improvement and in business process reengineering (BPR) projects (e.g. Kettinger et al., 1997) or center on the use of process modeling techniques. Research into process modeling can be divided in studies that concentrate around a specific process modeling language and how to apply

it in a correct manner, and research on the ease of use and understandability of process models. A focus on a specific modeling language can for instance be found in Van der Aalst (1998) who describes the application of Petri Nets as a means to design and validate complex workflows. This is further detailed in Van der Aalst and Van Hee (2002), who in their book provide a basic overview on workflow management and a detailed discussion on how Petri Nets can be used for modeling workflows. Based on their earlier research Van der Aalst and Ter Hofstede (2005) proposed a new language (Yet Another Workflow Language - YAWL) for modeling workflows. Examples of studies on use and understandability of process models are Mendling et al. (2007) who studied the understandability of process models and how to improve the competence of modeling processes, and Recker et al. (2009) who did a comparative analysis on the ease of use of different process modeling techniques.

In the *configuration* domain we categorize research that focuses on the selection and implementation of IS/IT that supports processes. Our study of BPMS implementation belongs to this category of research. Other research in this category is for example the vast amount of research on enterprise systems implementation, a lot of which is focused at Enterprise Resource Planning implementation (Strong and Volkoff, 2004; Bhatt and Troutt, 2005) but also consists of research on business process improvement initiatives (Bhatt and Stump, 2001) and the implementation of workflow management systems and BPMSs (Brahe and Bordbar, 2007; Fitzgerald and Murphy, 1996; Jennings et al., 2000; Rajagopal 2002).

Research in the domain of *enactment* focuses mainly on the operation, day-to-day monitoring and consequently maintenance of processes. Important research topics that are found in this domain are for instance process performance methods such as Six Sigma and Lean (Kane, 1986; Womack et al., 1990; Benner and Tushman, 2003, Shah and Ward, 2007).

Finally the *evaluation* domain studies performance analysis of processes and continuously improving process performance. Examples of publications in this domain are Wynn et al. (2007) on Business Intelligence and Verner (2004) who states that Business Activity Monitoring is a major challenge when using a BPMS. Also research on process maturity can be grouped in this domain as maturity models provide organizations the possibility to evaluate organizational processes and identify opportunities for optimization. Some publications in this domain are for instance Rosemann et al. (2004) and Rosemann and de Bruin (2005) on BPM maturity models, Curtis and Aalden (2006) on business process improvement guided by maturity models.

The classification described above (and shown in figure 1.1) here is not complete and might change over time. For example Process Mining is part of the Evaluation phase of the BPM lifecycle however based on the research done by

the research group of Van der Aalst at the Technical University of Eindhoven this topic could just as well be part of the design and analysis phase of the lifecycle (Van der Aalst, 2007). Also in Business Process Automation (Ter Hofstede, Van der Aalst, Adams and Russell (Eds.), 2010) and the Handbooks on Business Process Management (Vom Brocke and Rosemann (Eds.), 2010) integrated overviews are provided that don't focus on a specific BPM lifecycle phase.

As is described above the amount of research in the BPM domain is vast and we choose to start the research in this dissertation from the BPMS implementation (system configuration) domain. The goal of the research is: *to identify the main situational factors and competences that are relevant when implementing Business Process Management Systems*. The scientific relevance of this research is the addition of knowledge on the implementation of BPMS whereas currently there is relatively (i.e. compared to for example ERP) little knowledge on how to achieve implementation success. However, we add that we do not entirely limit the focus on the system configuration domain. A BPMS should typically enable and support the entire BPM lifecycle and therefore it is to be expected that factors influencing the implementation can be related to any of the domains in the BPM lifecycle.

As discussed above research in the BPM domain is done from different perspectives. This is also reflected in the number of definitions and views on Business Process Management. During our research, different definitions of BPM have been found. We could, however not find a clear definition for Business Process Management System that takes into account the recent developments. Therefore we formulated a definition ourselves (chapter 4, pg. 48). In this dissertation BPMS is defined "as a (suite of) software application(s) that enable the modeling, execution, technical and operational monitoring, and user representation of business processes and rules, based on integration of both existing and new information systems functionality that is orchestrated and integrated via services" (Ravesteyn and Versendaal, 2007).

1.3 Research Description

1.3.1 Research Questions

Above the motivation, the goal and the relevance of this research is described. Based on this the main question this dissertation tries to answer is:

Which situational factors and competences determine the success of Business Process Management Systems implementation?

To answer this question we first looked at how researchers tried to answer a similar question for Enterprise Resource Planning (ERP) implementations. In this

domain we see a focus on research determining the critical success factors of such implementations (Hong and Kim, 2002; Umble, Haft and Umble, 2003; Botta-Genoulaz, Millet and Grabot, 2005; Moon, 2007). Furthermore one of the success factors of ERP implementation that is widely recognized is 'education and training' (Umble, Haft and Umble, 2003; Kim, Lee and Gosain, 2005; Kamhawi, 2007; Moon, 2007) which in itself has lead to a number of studies on how to educate the ERP concept to help future professionals attain the right competences for implementing or working with ERP (Jennings et al., 2000; Hawking, McCarthy and Stein, 2005; Seethamraju, 2007). Based on these earlier findings, research questions 1 and 2 (see below) were formulated. In addition, a third research question is formulated, based on the idea that an overview of success factors, and having the right set of competences available during a BPMS implementation, is not enough to improve the success of the implementation. This research question is based on the notion that methods for BPMS implementation should be part of a method or framework that can be used as guideline to determine the implementation phases, activities and process. In their research on BPR methods and techniques, Kettering, Teng and Guha (1997) stated that depending on the project characteristics the method should be customized to help select those project activities and techniques that need to be emphasized. This notion of situationality also sets the rationale for addressing research question 3.

In summary the following research questions were formulated:

1. *What are the success factors of Business Process Management System implementations?*
2. *What are the competences needed in Business Process Management System implementations projects?*
3. *How can an implementation method for Business Process Management System implementation be made situational?*

In the remainder of this section these research questions are elaborated. Then the research approach followed is described, as well as the research methods used.

1.3.1.1 Research question 1

RQ1: What are the success factors of Business Process Management System implementations?

The starting point underlying research question 1 is that knowledge of the factors that determine implementation success is important to increase the chance of a successful BPMS implementation project. However before these factors can be defined it should be clear what a Business Process Management System is and therefore the following related question is defined:

RQ1.1. What are Business Process Management Systems and can they be related to existing and earlier concepts?

As an answer to this question a definition of BPMS is provided together with a structured overview of the history and corresponding domains of BPMS. This can then be used to identify factors that are influencing the success of a BPMS implementation. The following related question is defined:

RQ1.2. Which factors determine the success of Business Process Management Systems implementation?

Since factors that determine the success of BPMS implementation can be perceived differently by stakeholders it is relevant to have an understanding of the position and interest of these different groups of professionals. For instance, do people with different roles (e.g. end user or consultant) have a different opinion on what is important when implementing BPMS? Or, do professionals from different countries perceive the success factors differently? And do people with many years of experience in the BPMS domain have a different perspective compared to a novice? To address these questions the following related question was formulated:

RQ1.3. How are BPMSs success factors perceived by stakeholders in the BPM industry?

As an input to RQ1.3 the list of factors that is found as part of the research done to answer RQ1.2 is used. Based on the combined results of the research related to the three questions above it is possible to construct a list of the success factors of BPMS implementation, thus answering RQ1.

1.3.1.2 Research question 2

After exploring the factors related to BPMS implementation success from a business perspective, our research also explores the competences that are needed in BPMS projects. The knowledge and skills that are needed or requested by people participating in these types of projects should contribute to a successful implementation. To get insight into these competences the following research question is defined:

RQ2: What are the competences needed in Business Process Management System implementation projects?

We propose two approaches to determine the competences. The first approach is to research the needs demanded by stakeholders in relation to BPMS implementation projects. Consequently the following related question is formulated:

RQ2.1. According to the stakeholders of the BPM industry what are the competences needed for BPMS implementation?

A second approach is to study courses in Business Process Management as offered by universities. When academic curricula are driven by market demand, competences taught in BPM courses should be aligned to those needed in practice. Based on this the following related question is defined:

RQ2.2. What competences are addressed in academic Business Process Management curricula?

The answers to RQ2.1 and RQ2.2 are interrelated and jointly provide an answer to RQ2.

1.3.1.3 Research question 3

In the introduction to this research it is stated that to have a better chance on success in implementing BPMS the methods that are used in implementation projects should be made more specific to the situation at hand, in other words context sensitive. Since organizations are different when it comes to size, process maturity, organizational structure, type of processes and its products or services, BPMS implementation projects are different and situational. This means that an implementation method should include different implementation activities that take into account these organizational variations. Therefore the third research question is:

RQ3: How can an implementation method for Business Process Management System implementation be made situational?

After this question is answered, it is possible to construct a situational BPMS implementation method based on the identified success factors. The proposed method is customizable and helps organizations in selecting specific project activities and techniques during the implementation to enhance the chance on success.

When all research questions are answered, the scientific deliverable of this research consists of a systematic list of success factors and a set of competences that are relevant when implementing a BPMS. The practical deliverable is a concept of a situational method that can be applied by project managers and consultants during BPMS implementations.

1.3.2 Research Approach

There are different types of theory in the domain of IS/IT. Gregor (2006, pp. 611) proposes a taxonomy "that classifies information systems theories with respect to the manner in which four central goals are addressed: analysis, explanation,

prediction, and prescription." Based on this she distinguishes five types of theory: " (1) theory for analyzing, (2) theory for explaining, (3) theory for predicting, (4) theory for explaining and predicting, and (5) theory for design and action."
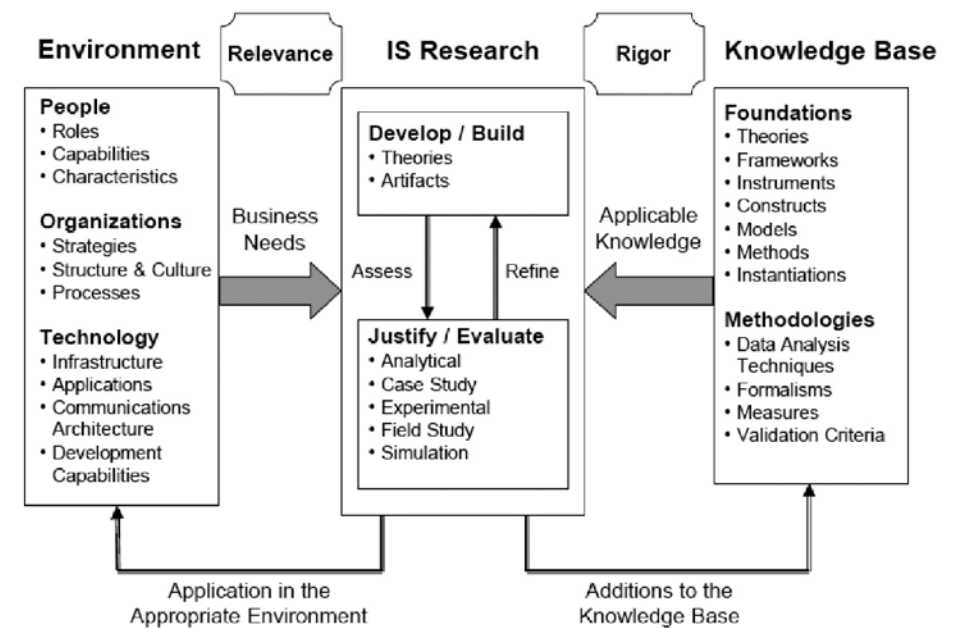
Figure 1.2 Information Systems Research Framework (Hevner et al. 2004)

Our research is based on the theory for design and action. This theory "is about the principles of form and function, methods, and justificatory theoretical knowledge that are used in the development of IS." (Gregor, 2006, pp. 628). However this research is not about developing a complete new theory, but rather it is about the development of a method for BPMS implementation. The notion of the development of an artifact being central to design science is elaborated by Hevner, et al. (2004) in their Information System Research Framework (figure 1.2). They state that "The design-science paradigm seeks to extend the boundaries of human and organizational capabilities by creating new and innovative artifacts." (Hevner et al., 2004, pp. 75). Furthermore they propagate that studies in the IS/IT research domain are both about descriptive and prescriptive research. The descriptive part of the research (knowledge-producing activity) aims to understand, explain and predict why certain phenomena in IS/IT are occurring, while the prescriptive approach (knowledge-using activity) aims at improving performance to meet the business need (Hevner et al., 2004; March and Smith, 1995).

Although the framework of Hevner et al. primarily focuses on IS/IT design, the model can also be used for other practices than IS/IT design approaches. This holistic approach with its clear boundaries and guidelines enables the framework to serve as a basis for this research.

The motivation of this research is based on developments in the business *Environment*. Due to the rise of the Internet and mobile communications organizations face an increasing globalizing world in which competition and customers change quicker than ever before (Smith and Fingar, 2003; Friedman, 2005; Tapscott and Williams, 2006). Therefore organizations need highly transparent and adaptable processes. While enterprise systems like ERP have tried to realize this within organizational boundaries, organizations are now looking towards BPMSs in support of both their intra- and inter-organizational processes. Furthermore in a reaction to the financial scandals in the past decade, legislation is developed that holds individual people (all the way up to the CEO) responsible if anything goes wrong because they are not in control of the organizations processes. Many developers and resellers of BPMSs see implementing governance, risk management and compliance as a major opportunity to sell their systems and services. However, this requires an integrated BPMS implementation approach.

The existing *Knowledge Base* that holds information that can be studied and reused for this research is large. While the domain of BPMS in itself is not extensive there is over twenty years of research on ERP and implementation of enterprise systems (Botta-Genoulaz, Millet and Grabot, 2005; McGaughey and Gunasekaran, 2008). Further research is available in BPR (Kettinger et al., 1997), TQM (Deming, 1982), workflow management (Stohr and Zao, 2001), business process management (Ho, Jin and Dwivedi, 2009), software development and implementation, and so forth. The foundation of this research is based upon studies determining the critical success factors during implementation of a specific approach or technology. Here critical success factors can be defined as those areas where 'things have to go right' for a BPMS implementation to succeed (Ward and Peppard, 2002). In addition many existing methodologies are used for the gathering and analyzing of data and the validation of results found in the different projects that are part of this research. More information on the methods used is given in the next section.

"In the design science paradigm knowledge and understanding of a problem domain and its solution are achieved in the building and application of the designed artifact." (Hevner et al., 2004, pp. 75). Consequently in this *IS Research* there are two deliverables: (1) the context-sensitive implementation method based on critical success factors of BPMS implementation and (2) a set of competences needed in BPM projects. The BPMS implementation method is based on success factors which were validated in surveys and interviews and the complete method itself

was evaluated using case studies. While the set of competences is justified as relevant since it is both recognized in the business and educational environment.

1.3.3 Research Methods

This dissertation has several iterations through the Information Systems Research Framework of Hevner et al. (2004) that was described above. Firstly, the reason for doing this research is due to developments found in the business environment. To study the BPM domain the existing knowledge base is used to define what BPMSs are, which is consequently validated in the business environment. This is described in chapters 2 and 3. The process of constructing a validated list of success factors for BPMS implementation starts with studying the literature found in the knowledge base followed by the development of a concept list with factors which is then validated in the business environment. These activities are described in chapters 4, 5 and 6. The framework is used in a same manner to determine the competences needed in BPMS implementation (chapters 7 and 8). The existing scientific knowledge base together with experiences and know-how from both the business and educational environments are used to develop and validate the set of competences. Finally, a similar process is followed in developing a context-sensitive (situational) implementation method as is described in chapter 9.

During the different research processes described above both qualitative and quantitative research techniques have been used, such as literature study, interviews, case study and surveys. Also different theory types as described by Gregor (2006) can be distinguished. In this dissertation we applied three theory types: analysis, explanation, and design research. Table 1.1 provides an overview of the theory types and techniques applied in this dissertation – the numbers in the cells correspond with the different chapters.

Technique used ↓	Theory Types		
	Analysis	Explanation	Design & Action
Literature study	2, 3, 7	4, 5, 6	8, 9
Expert Interview	2, 3	4	
Survey	3, 7	4, 5, 6	8
Case Study			9
Tool evaluation	2, 3		

Table 1.1 Overview of applied research methods

In chapters 2 and 3 current and future characteristics of BPMSs are determined based on tool evaluation. In both chapters tool documentation provided by the developers and research analysts was studied and supplemented with interviews. The interviews that were conducted were semi-structured to allow for flexibility during the interview and thus be able to customize the interview to the situation at hand (Neuman, 2003; Nicholson and Kiel, 2007).

In Chapters 4 and 5 a mixed method research design was adopted in which a qualitative study into success factors of BPMS implementation was conducted first after which a quantitative study was performed to confirm the results (Tashakkori and Teddlie, 1998), among 39 Dutch consultants, developers and end-users of BPMSs that vary in BPM experience. Following these studies chapter 6 describes an international quantitative study that is performed to test whether the results could be generalized to other countries and cultures (Sekaran, 2003).

Chapter 7 is based on the same survey as described in chapter 5 but focuses on the part that was developed to determine the competences needed in BPMS implementation projects.

In chapter 8 the design, implementation and evaluation of a BPM course at two universities is described over a period of 5 years. The study made use of the "cyclical process model for action research that consists of five stages: diagnosis, planning, intervention, evaluation and reflection." (Davison, Martinsons, and Kock, 2004) as to help assure both the rigor and the relevance of the research.

Finally, the context-sensitive method for BPMS implementation of which the development and evaluation is described in chapter 9 is based on design research using the research framework of Hevner et al. (2004). For the evaluation of this method case studies were used because in case study research it is possible to use multiple sources of evidence, such as interviews, questionnaires, observations and secondary sources, so that it can increase the internal validity of the results (Eisenhardt, 1989; Yin, 2003). Both retrospective and explanatory case studies were done. Retrospective case studies allows us to test if implementation projects would have been executed differently if the method was used, while explanatory case studies focus on theory and/or hypothesis testing (McCutcheon and Meredith, 1993; Yin, 2003).

1.4 Dissertation Structure

The thesis outline is as follows. In chapter 1 the topic of BPMS is introduced together with the relevance of the research, the research questions, the approach followed and the methods which are used.

In chapter 2 (Ravesteyn, P. (2007). Business Process Management Systems: Hype or New Paradigm. *Proceedings of the 18th conference of the International Information Management Association*, Beijing, China, pp. 147-157.) the history of BPMSs is described. Concepts, features and characteristics of such systems are traced back to business and IS/IT concepts from the past, like BPR, TQM, ERP systems and Workflow Management (WFM) systems. While much of what BPMSs entail comes from earlier business and IS/IT innovations we conclude that the combination of functionality, concepts and characteristics in BPMSs make new applications in IS/IT possible. Chapter 3 (Ravesteyn, P., & Zoet, Z. (2011). A BPM-Systems Architecture that supports dynamic and collaborative processes. Accepted for publication by the *Journal of International Technology and Information management*), identifies a trend towards an information and service economy in which the ratio of knowledge workers is rising dramatically and describes the consequences for the architecture for BPMSs, which in the future needs to include (more) functionality to support knowledge workers in their dynamic and collaborative activities and processes. In these chapters RQ1.1 is answered.

Chapters 4 to 6 explore if there is a common ground for the definition of BPM and BPMSs, as well as the Critical Success Factors (CSFs) for BPMS implementation. In Chapter 4 (Ravesteyn, P., & Versendaal, J. (2007). Success Factors of Business Process Management Systems Implementation. *Conference proceedings of the 18th Australasian Conference on Information Systems 2007*, Toowoomba, Australia) a list of 55 success factors of BPMS implementation is identified of which 14 are deemed to be critical according to a qualitative validation in the Netherlands. In chapter 5 (Ravesteyn, P., & Batenburg, R. (2010). Surveying the Critical Success Factors of BPM-systems Implementation. *Business Process Management Journal*, vol 16, no. 3, pp. 492-507) a BPMS Implementation Framework is proposed that classifies the CSFs in distinctive domains that can be used for BPM project management and organization. Finally in chapter 6 (Ravesteyn, P., & Batenburg, R. (2010). Cultural Differences in Implementing Business Process Management Systems. *Conference Proceedings Americas Conference on Information Systems 2010*) the results of an international comparative research is presented that was conducted through a web survey, i.c. an online 'game' to internationally rate and classify CFSs for BPMS implementations. Chapter 6 specifically tries to determine whether the BPMS success factors are perceived differently by professionals from different countries and if there are also differences based on other characteristics such as level of experience within the BPM domain. Significant differences were found between respondents from Northern European versus Anglo-American countries, and between respondents with different levels of experience with BPMS implementations. Research question RQ1 together with related sub-questions RQ1.2 and RQ1.3 are answered in these chapters.

The competences that are needed in BPMS implementation projects are explored in chapters 7 and 8. Based on a survey among Dutch consultants, developers and end-users of BPMSs chapter 7 (Ravesteyn, P., Batenburg, R., & De Waal, B. (2008). In Search of Competencies Needed in BPM Projects. *Communications of the International Information Management Association*. Vol. 8, no. 2, pp. 23-30) investigates what the relevant competences for BPMS implementation are. In addition, in chapter 8 (Ravesteyn, P., & Versendaal, J. (2010). Design and Implementation of Business Process Management Curriculum: A Case in Dutch Higher Education. In N. Reynolds and M. Turcsányi-Szabó (Eds.): KCKS 2010, IFIP AICT 324, pp. 310-321) a case study is described in which two educational and scientific institutes together designed a BPM course that not only transfers theoretical knowledge but in which students also experience real life BPMSs and implementation issues. The competences on which the developed module is based are described and an indication of the modules success is given. Research question RQ2 and related sub-questions RQ2.1 and RQ2.2 are answered in these chapters.

In chapter 9 (Ravesteyn, P., & Jansen, R.L. (2009). A Situational Implementation Method for Business Process Management Systems. *Conference Proceedings Americas Conference on Information Systems 2009*) a method for the integrated implementation of BPMS is described which takes into account the specific situation of the organization in which the system is to be implemented. The method that is provided is based on the success factors that were found in the chapters 4 to 6 and also explores situational factors and their influence on implementation methods. The provided method enables a more successful implementation project, as the project team can create a more suitable implementation method for business process management system implementation projects. This chapter answers research question RQ3.

Finally in chapter 10 the conclusions of this research are provided as well as discussion and considerations for further research.

Business Process Management Systems: Hype or New Paradigm[1]

Business Process Management Systems (BPMSs) are increasingly implemented in and across organizations. There is much talk on BPMSs, and software vendors and IT-consultancy companies are leveraging this. In this paper we provide an investigation on the originality of BPMSs. We identify concepts, features and characteristics of such systems, and trace them back to business and IT concepts from the past, like Business Process Reengineering (BPR), Total Quality Management (TQM), Enterprise Resource Planning (ERP) systems and Workflow Management (WFM) systems. We conclude that much of what BPMSs entail comes from earlier business and IT innovations. However, the combination of functionality, concepts and characteristics in BPMSs make new applications in IT possible. We end our paper with a research agenda for BPMSs.

2.1 Introduction

Lately, Business Process Management (BPM) and Service Oriented Architectures (SOAs) receive much attention from practitioners and scholars alike. Software vendors use the fuzz and provide new labels on new and existing software products; IT-consultancy companies increase their services with BPM and SOA consultancy and implementation. BPM and SOA are considered as promising IS/IT strategies.

From the eighties and nineties, we identify two major business trends that seem to relate to BPM: Total Quality Management (TQM) and Business Process Reengineering (BPR) (Deming 1982, Hammer and Champy 1993). In the same period there was a rise in the implementation and use of new types of information systems like Enterprise Resource Planning (ERP) systems, Workflow Management (WFM) systems, advanced planning systems and more. What started as the automation of a company's internal processes soon focused on digitization of supply chains (Davis and Spekman 2003). Among others the Internet and associated network standardization made this possible.

Since the year 2000 all these trends seem to converge into new types of information systems, that some (Smith and Fingar 2003) call Business Process Management Systems (BPMSs). A BPMS can be defined as "a generic software system that is driven by explicit process designs to enact and manage operational business processes" (Weske et al. 2004). From a scientific perspective it remains unclear what concepts are really new, and what are existing concepts. Therefore, in this

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paper we address the question to what degree current BPMSs are based on existing and earlier concepts, and what is new in BPMSs?

In the following section we elaborate on the roots of BPMSs from the business domain and IS/IT domain respectively. In the next section, we identify concepts and features of current BPM systems and their architectures. Thereafter we categorize those characteristics and trace them to earlier business and IT innovations. After the analysis and the identification of possible new concepts in BPMSs, we indicate resulting IS/IT scientific research areas for BPMSs.

2.2 Business process management systems related innovations from the past

2.2.1 Business Domain Innovations (1980-2000)

Research in the business domain has been around for a long time but attention for processes is relatively new starting with amongst others Ellis (1979) and Zisman (1977). In this section an overview is given of relevant innovations in the business domain that can be found in current BPMSs.

On of the most important innovations in business has been Total Quality Management that can be defined as "an integrated management philosophy and set of practices that emphasizes, among other things, continuous improvement, meeting customers' requirements, reducing rework, long-range thinking, increased employee involvement and teamwork, process redesign, competitive benchmarking, team-based problem-solving, constant measurement of results, and closer relationships with suppliers" (Ross 1993). In BPMSs we do not only see the constant focus on process (re)design but also the possibilities to constantly measure results and generate reports, graphs and alerts. The management reporting functionalities can also be seen as an implementation of part of the knowledge management or business intelligence concepts that have had a lot of attention during the later part of the nineties. The possibility to integrate information contained in many different systems within the organization and with suppliers and customers enables far-reaching partnerships.

As an answer to TQM – and the success it brought Japanese companies – organizations in the United States started to implement business process reengineering. "BPR is the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance (such as cost, quality, service, and speed). The key words in this definition are fundamental, radical, dramatic and process" (Hammer and Champy 1993). The continuous focus on the concept of process is very important and is also something that can be found in BPMSs.

If we compare the characteristics of TQM to those of BPR (see table 2.1) it is clear that although there are many similarities, such as for instance their focus on processes and the support needed by management and employees to change a company's culture, there are still important differences. Total quality management has a more continuous process improvement perspective (Armistead, 1996; Hackman and Wageman, 1995) with a focus on learning (Jarrar and Aspinwall, 1999) were as business process reengineering is rule-breaking and radical, aimed at the development of entirely new processes (Hammer and Champy, 1993; Kettinger et al., 1997), and with a focus on added value for the external customer (Kettinger et al., 1997).

Number	Total Quality Management	Business Process Reengineering
1	Process orientation	Process orientation
2	Customer focus (internal and external)	Customer focus (mainly external)
3	Support and commitment of employees and management	Support and commitment of employees and management
4	Requires cultural change	Requires cultural change
5	Cross-functional teams to analyze and resolve quality problems	Cross-functional teams to redesign processes
6	Improve existing work processes	Develop entirely new processes
7	Continuous change	One-time project
8	Evolutionary change	Project causes radical changes
9	Focus on individual process activities	Focus on core processes
10	Use of statistics to measure improvements	Creative use of IT to enable new processes
11	'Self-renewal learning' culture with all employees involved	As few people as possible should be involved in the performance of a process

Table 2.1 TQM and BPR compared

We can conclude that TQM and BPR are the two most influential management concepts of the last two decades. An integration of these two can be found in Business Process Management (BPM). In table 2.2 the characteristics of BPM are shown. As can be seen many characteristics have their root in one of the two earlier management concepts. Distinct features of BPM in comparison to the other concepts are those related to the use of IT/IS.

Root	Characteristic
BPR	Focus on external customers
BPR	Process descriptions (graphical)
TQM	Measurement and control of process performance
TQM	Continuous optimization of processes
BPR	Implementation of automated processes across functional departments
TQM / BPR	Culture change
BPM	Support the design, enactment, management, and analysis of business processes in alignment with the strategic business processes
BPM	Systematic automation of core business processes by integrating all software applications that support these processes

Table 2.2 Characteristics of Business Process Management

The start of business process management can be found in a discussion that started (Zairi, 1997; Hill, 1999) among scholars about whether it is better to gradually improve processes, as is prorogated with TQM (Valentine and Knights, 1998), or to radically change them as is proposed by BPR evangelists (Davenport, 1993; Hammer and Champy, 1993). It has taken a while before both these methodologies started to get integrated and added to by both science (Jarrar and Aspinwall, 1999) and business.

In their review and evaluation of Business Process Management Lee and Dale (1998) found that BPM is intended to align the business processes with strategic objectives and customers' needs, which requires a change in a company's emphasis from functional to process orientation. Zairi (1997) on the other hand states that BPM is a structured approach to analyze and continually improve fundamental activities such as manufacturing, marketing, communications and other major elements of a company's operations. This definition is more comparable to TQM than to BPR, something which is also true for the definition given by Elzinga et al. (1995): 'A systematic, structured approach to analyze, improve, control and manage processes with the aim of improving the quality of products and services'.

If we look at the given definitions we see a clear evolution from TQM and BPR although later definitions take a more Information Technology related perspective. For example Fremantle et al. (2002) defines BPM as the systematic automation of ongoing business processes by integrating core systems (with a focus on integration of processes). This needs a different perspective on software applications, from monolithic to a set of components and services that are then assembled into new processes. Van der Aalst et al. (2003) find that Business Process Management includes methods, techniques, and tools to support the design,

enactment, management, and analysis of business processes. In this way it can be considered as an extension of classical Workflow Management (WfM) systems and approaches. In these two definitions BPM clearly is influenced by the advancement of developments in the software industry. Based on this we could state that BPMSs are the IT application to implement the BPM management concept, but is this really the case? Before answering this question lets examine the changes in the IS and IT domain.

2.2.2 IS/IT Domain Innovations (1980-2000)

Just like management concepts have evolved rapidly during the last twenty to thirty years, we can also see large changes in Information Technology (IT) and Information Systems (IS) innovations. From the 1950s, when organizations were dependent on computers for a few critical functions, to the present day were IS has become a supply chain wide information utility, has been a huge step forward. In this section we will give a high-level overview of the most important developments in IT and IS during roughly the same period as the use of the management concepts mentioned before.

One of the first important innovations is that of Database Management Systems (DBMS). A DBMS is software that permits an organization to centralize data, manage it efficiently, and provide access to the stored data by application programs (Laudon and Laudon 2000). The feature of being able to store and access data efficiently made it possible during TQM projects to make statistic calculations on large available data sets. DBMS were also one of the key enablers behind the development of ERP systems during the late eighties and early nineties.

The essence of an ERP system is to automate all the business processes (e.g. the sales order to cash process) within an enterprise by storing and accessing all data via one database. The data and application layer of ERP systems are separated to be able to easily configure the application to the customers needs, thus making ERP more flexible. While Hammer and Champy (1993) saw ERP as a key-enabler to successfully changing processes and others find that BPR is a key success factor to the implementation of ERP (Koedijk and Verstelle, 1999), it turned out that in practice this is a one time effort. After the implementation of ERP it is very difficult to change or adapt processes. This is why after separating the data and application layer the next step was to separate the business process from the application (Van der Aalst and Van Hee, 2004), which finally resulted in a new type of software product called Workflow Management Systems (WfMS) that aims at the automation of business processes (Jablonski, 1995).

An early Forrester Research report (McCarthy and Bluestein, 1991) characterized WfMS as "proactive computer systems that manage the flow of work among participants, according to a defined procedure consisting of a number of tasks.

They coordinate users and systems participants, together with the appropriate data resources […]. The coordination involves passing tasks from participant to participant in correct sequence, ensuring that all fulfill their required contributions." In this definition it is already clear that process is the central theme to workflow management. In later characterizations this point is made even more explicit by starting with the process design (or business process modeling), which is then used for system configuration and process enactment (execution). It must be said however, that most WfMS only provide an editor for the design phase that has limited or no capabilities for analyses and execution of the processes (Van der Aalst et al., 2003). Important to note is that in contrast to ERP systems, which are basically one application that integrate many functionalities, WfMS have always aimed at the integration of multiple applications and users that may be geographically distributed (Jablonski, 1995; Grefen and De Vries, 1998; Juopperi et al., 1995; Georgakopoulos et al., 1999). Some state-of-the-art BPMSs have evolved from WfMS (e.g. Savvion and Fuego, the latter is acquired by BEA Systems which in turn has been taken over by Oracle) and have a strong emphasis on the automation of human involved processes instead of automated processes. Process diagrams in these type of systems are originally exchanged using the XML Process Definition Language (XPDL). XPDL is a standard that is used to store and exchange process diagrams and to allow different tools to model, read, edit or "run" a process diagram. Instead of the Business Process Execution Language (BPEL), which is discussed later, XPDL is not an executable programming language, but a process design format that is specifically meant to be used for the "drawing" of the process definition (WfMC, 2007).

BPMSs that are strong in supporting automated processes across applications and organizations have mainly evolved from application integration service providers (such as Tibco and Webmethods). Application integration today is becoming more and more necessary due to the fact that Internet enables customers to look into suppliers processes of which the underlying applications should be seamlessly integrated (Linthicum, 2000). Also large organizations that are leaders in their supply chain, demand that their suppliers or customers provide near real-time information directly to their own information systems.

To aid in this rising need for application integration, a lot of different techniques and standards have been developed by several vendors, which can all be captured under the name of Enterprise Application Integration (EAI). Examples are amongst others CORBA, MOM and JMS. The common object request broker architecture (CORBA) is a standard that is defined by the Object Management Group (OMG) and is used to enable communication between software applications that are written in different languages. Key to the exchange of information is the Interface Definition Language (IDL) that specifies the interfaces between the different software applications or components thereof. By means of mapping from the IDL to a more specific software development language, like for instance .Net or Java, the information is translated and can be used across different systems. Message-oriented middleware (MOM) is a type of software that enables communication between applications by passing messages in a asynchronous manner. In most cases this is combined with a message queue system. The Java Message Service (JMS) is an application programming interface developed under the Java community process and is a language specific MOM that is used for communication between different applications. The most important players in the enterprise application integration domain that are providing the tools for integration are IBM, Microsoft and Sun Microsystems.

Currently work is also been carried out by independent groups like the earlier mentioned Object Management Group (OMG) and the Business Process Management Initiative (BPMI, which merged with OMG in 2006) to develop common standards. Currently the most important initiatives are the Business Process Modeling Notation (BPMN) and the before mentioned Business Process Execution Language. An important influence in the development of integration standards is the eXtendible Markup Language (XML) that enables communication between middleware solutions based on different standards. XML is also the language on which the Business Process Execution Language is based. BPEL enables the execution of modeling efforts according to the BPMN standard. For the near future the most important integration technology is that of web services (Krafzig et al., 2004), these can be combined to create a service architecture. A service oriented architecture (SOA) unlocks the business logic embedded in (legacy) applications for use and reuse in (changing) processes within a company and between companies. One of the main benefits of the service architecture as seen by Fremantle et al. (2002) is "the separation between the interface and the implementation. The outcome of this separation is that it encourages the separation of the business logic of the application from the implementation and infrastructure details."

All these developments in standardization and different integration techniques can be found back in the differences between the available BPMSs. Depending on the background of the BPMS developer the architecture of the application differs. In the next section these different concepts and features are briefly described and a general BPMS architecture is given.

2.3 BPMS concepts and features

Business Process Management Systems are not new. One of the first definitions of a BPMS is by Karagiannis (1995) who defines BPMS as "information systems dealing with the definition, administration, customization and evaluation of tasks

evolving from business processes as well as from organizational structures". Karagiannis sees workflow management as first generation BPMS and focuses mostly on the way in which a company's entire information system deals with the tasks in the organization, for this the process modeling functionality is important. During the early nineties BPMS is not seen as an individual software application but more as a management concept (based on BPM as described earlier). At that time one of the main issues for the future that is identified by Karagiannis was integrating data from different software applications into the process.

If we look at a more recent definition of a business process management system by Van der Aalst et al. (2003) "a generic software system that is driven by explicit process designs to enact and manage operational business processes", it is clear that BPMS is a software application that is strongly based on the BPM management discipline. Based on the current status of many BPMSs and the innovations in both management and IS/IT concepts it is possible to conclude that a BPMS solution needs to be able to analyze and model processes within and across organizational boundaries, execute the modeled processes, measure their performance and use this as an input to optimization. This means that a BPMS should be able to use and integrate information from different applications and present this via one user interface.

Based on (Hill et al., 2006; Silver, 2006; Hill and Sinur, 2006) we have done a comparative evaluation of the following state-of-the-art BPMSs: Adobe, Cordys, Feugo (acquired by BEA Systems), FileNet, Global360, IBM (with Websphere), Pegasystems, SAP (netweaver), Savvion, Seebeyond, Tibco Software and Webmethods (acquired by AG Software). The features these systems provide were analysed with interviews (held at Cordys, SAP, Seebeyond, Tibco Software and Webmethods) and an Internet study (Adobe, Feugo, FileNet, Global360, IBM, Pegasystems and Savvion). The main questions to be answered were (1) what the background of the company and its offering was (2) how does the application architecture looks like (3) which standards (if any) are followed and (4) what is the main use of the BPMS.

The background of the company and its BPMS is important to determine if the final solution consists out of one tightly and seamlessly integrated application or whether different products are used to offer a BPMS solution. This information is also used in analyzing the applications architecture. What are the main components? There should at least be functionality for process modeling, application integration and the handling of human and automated workflow steps. However depending on the product history the offered functionality will be more or less mature. Standards used in both the development of the BPMS itself as in the functionality it offers have been analyzed. For instance there are only a few products that have been developed completely according to the SOA paradigm and its

related standards. This means that these products are probably better equipped for BPM and SOA projects than others. Also the use of modeling standards and functionality is quite different. There are still many companies that offer modeling functionality of third party software and use a import function to enable the use of these models in their own products. Even though all companies that were analyzed have different backgrounds they do promise basically the same BPMS functionality. To determine if all the offered functionality is used by customers the main purpose of use of the products was analyzed. This showed that generally speaking a BPMS offering that originated from a application integration background is still used mainly to integrate different IT applications while a document management oriented BPMS product is mostly used for the workflow handling of documents. Added functionality to provide a complete BPMS offering is in most cases still in its infancy and will need several new product releases before it is mature.

The companies that were interviewed were also asked to propose a solution for a hypothetical supply chain problem. The problem was described as a supply chain in which computers are manufactured and then sold to wholesalers who in turn sell and deliver to retailers. The processes should be optimized in such a way that when a customer enters an order online it will automatically trigger an order at the wholesaler (in an out of stock situation), where in turn a production order can be triggered at the manufacturer (again if there is an out of stock situation). Within this supply chain the retailer works with a web shop, the wholesaler has SAP R3 implemented and the manufacturer is running Baan 4c. Except for Webmethods all companies proposed a possible solution and Cordys did a proof of concept. Based on the evaluation done across the 12 products mentioned it is possible to derive some basic groups of functionality that each BPMS application should offer:

- Process modeling functionality; capturing the design of a process is the central theme to any BPMS (also according to Fremantle et al. 2002) it should be possible to specify the process by modeling the flows, states, and activities involved in the process after which it should also be possible to execute the process.
- Integration and Orchestration functionality; every BPMS has to be able to integrate data from different sources (e.g. documents or applications) that are needed as part of a process. This means being able to define, create, assemble and maintain (web) services that can be linked to the process model. The use of (web) services based on business rules that are defined by the process is called orchestration, and is an integral part of a BPMS. When integrating different applications the use of the Enterprise Service Bus (ESB) paradigm

is almost a necessity, therefore most vendors have ESB functionality in their BPMS offering. Although the debate on what an ESB is precisely, is still going on, we mean in this context that functionality must be offered that enables communication between different software application and languages. Thus it is a set of middleware products that supports invocation, routing, mapping, event processing, security, logging etc.

- Management information; to continuously measure the performance of a process and to be able to improve the process on a continuous basis, requires management information. For this reason a BPMS has business intelligence or business activity monitoring functionality. Based on the process that is executed a user has access to important graphs, alerts and key performance indicators, and is able to define new ones, to monitor his daily operations. The information can be generated in batches or in real-time according to the users demand.

- Portal functionality; all information that is part of tasks belonging to a process and that are relevant to an employees function should be presented in a personalized manner via one entry (i.e. the internet browser). Also via the same screen it should be possible to enter data without having to start a different underlying application. This means that via one employee portal both structured and unstructured information is presented and accessible.

The key functionalities mentioned here are high-level and based on the research of BPMS offerings as mentioned above. More detailed functionality can be added based on a more in-depth evaluation and comparison of the software applications themselves, this however is out of the scope of this chapter.

Based on the main concepts that we have found we now define BPMS as (a suite of) software application(s) that enable the modeling, execution, technical and operational monitoring, and user representation of business processes based on integration of both existing and new information systems functionality that is orchestrated and integrated via services.

2.4 Categorization of BPMS functionality and concepts

Most of the developments that have been described so far are summarized in figure 2.1.

As we can see the management concepts and IT innovations are coming more and more together and are currently being integrated by software vendors in what is called a BPMS. The main functionalities that should be part of any BPMS: Process modeling, Integration and Orchestration, Management information and

Portal functionality can almost all be traced to earlier independent management or IT/IS innovations. Process modeling has been an integral part of Business Process Management and its predecessor BPR, and also of WFM. Management information functionality has always been an important part of Enterprise Resource Planning systems and is the key reason for both Business Intelligence (BI) and Business Activity Monitoring (BAM) implementations. Integration of different applications has a history of its own before becoming part of the BPMS offering. Table 2.3 categorizes the main functionalities of BPMS according to whether they can be traced back to the management domain, the Information Technology domain or both.
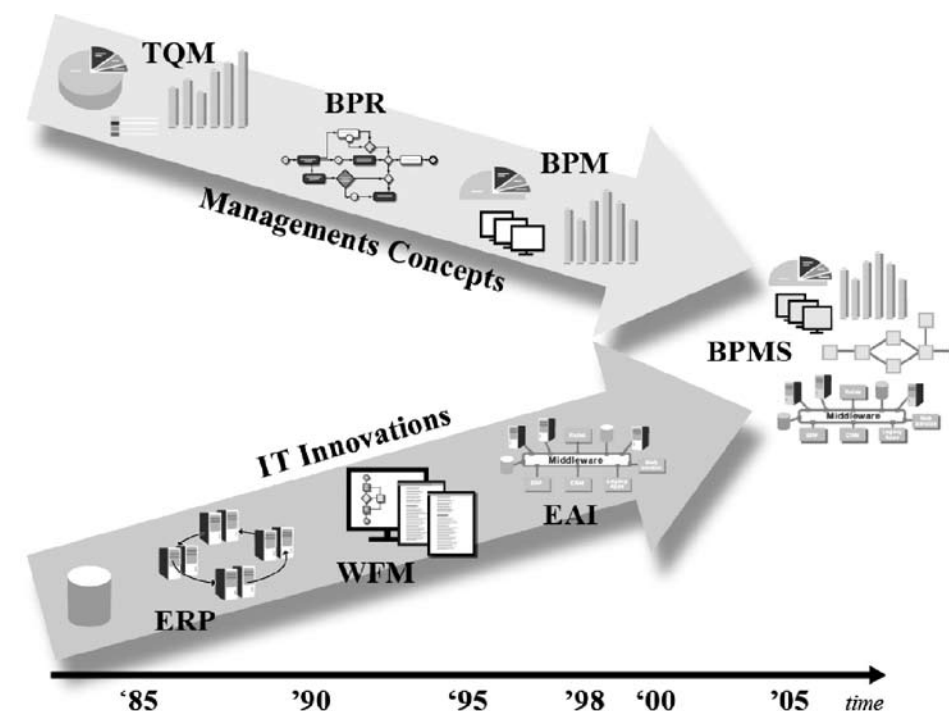
Figure 2.1 Emergence of Business Process Management Systems

Functionality	Management	Information Technology
Process Modeling	Can be traced back to both domains with origins in both the business and academic world. Specific tools and standards have been broadly developed such as for instance Petri nets and event-driven process chains. The latter being support by the tool ARIS. Within BPMS process modeling is almost always based on the business process execution language (BPEL) and a notation standard such as BPMN or XPDL.	
Integration		Different techniques and standards for integrating IT systems have been around since before the client/server infrastructure. The type of integration functionality offered in a BPMS can differ widely but is based on techniques as described earlier in the section IS/IT innovations.
Orchestration		This functionality is needed as part of the effort of automating processes across different applications with (web)services. It originated in the IT domain and was identified first as part of the Object Orientation and Component Based Development paradigms. In that time the term orchestration was not familiar, only since the growing interest in SOA has the term become widely known.
Management Information	Since the existence of the first organizations management information is needed. Its roots are mainly in the financial domain. In BPMS two sorts of information can be distinguished: (1) Information regarding the function of the process (e.g. production capacity or sales figures) (2) Information regarding the functioning of the BPMS application itself (e.g. transaction per seconds, number of services executed etc.)	
Portal functionality		The representation of different software applications via one personalized entrance is typically an IT innovation. TopTier (later acquired by SAP) was one of the first to market in this segment. In most of today's BPM-systems Xforms (a XML format) is used to develop web forms.

Table 2.3: Categorization of BPMS Functionality

Although most of the underlying concepts of BPMS are not new, it is not possible to state that Business Process Management Systems are proven technology.

The combination of different management concepts such as continuous process optimization (as part of BPM), measuring performance (both found in TQM and knowledge management) with IS/IT innovations (such as the use of services based on widely accepted standards to integrate or develop functionality) can be considered completely different. First of all management concepts have never been so radically automated, which means that the business should have a better understanding of the implications of a BPMS implementation. Secondly the implementation or integration of information systems has almost always been a one-time effort while a BPMS implementation is aimed at continuously optimizing processes and activities based on the performance of those processes. Finally a BPMS uses the service oriented architecture paradigm for the integration and development of information systems and this is hardly a proven technology. Taken together we can conclude that Business Process Management Systems cannot be regarded as hype but should be seen as a new paradigm that is neither purely a management concept nor a regular software application.

What does this mean for organizations that want to start using a Business Process Management System? First of all the organization should realize that the use of a BPMS is only feasible if the organization is organized around processes instead of a functional organization. If this is not the case the BPMS implementation should be part of a strategy to make the organization process oriented only then is it possible to make an optimal use of the BPMS. Although the implementation of the BPMS can be considered as a project it is by no means a one-time project. Ideally a organization will start the implementation with one or two identified processes where a combination of process optimization or redesign with fully aligned IT will deliver quick results. Because of the learning curve involved with the use of BPMS it is not wise to start with large implementation projects that involve strategic processes. As soon as the new processes are up and running it is important to measure the performance and keep optimizing the processes where necessary. This requires that key performance indicators are defined during the design phase. A crucial part in the use of BPMS is the way in which existing software applications are reused by integrating them or by developing services based on the existing functionality, and how new functionality is developed. A part of almost all BPMS projects will be software development. An organization that starts with BPMS should realize that BPMS requires a different way of software development (preferably based on the SOA paradigm) that begins with modeling the processes and information that needs to be automated. A BPMS is able to make processes that are designed by business people executable but this

requires that both business and IT work with the same models. Both business and IT people have to acquire knowledge of each others domains to be able to work together in BPMS projects. Common mistakes are not giving the models the right level of detail so programmers are not able to deliver fully automated processes or for developers to disregards the models all together and start programming outside the BPMS. To prevent these problems it is crucial that an organization has a clear architecture with different views, of the same object that is being modeled, that can be understood by all stakeholders. For example business process architecture shows the processes of the company with corresponding roles and organizational departments while information architecture shows where information is used and stored. A extensive overview on how an architecture should be set up is given by Lankhorst et al. (2005).

Summarizing we can state that companies that are going to use a BPMS should have three pillars in place (1) a clear vision and strategy of the business process management concepts it wants to implement (2) an architecture of all processes, information and applications involved together with rules and guidelines for future developments and (3) a clear understanding of the way in which BPMS should be used for application integration and development based on service orientation.

2.5 Research agenda for BPMS

The emergence of BPMS as a new paradigm is based on two lines of observations; first the discussion and progress of insights into different management concepts by both science and business, and secondly successive IT innovations that are basically supporting the implementation of the management concepts and that are mainly described in business journals. Because of this gap between the scientific literature available on management concepts and that on IT innovations and specifically BPMS, the described vision lacks support from an IT science perspective. To further strengthen this vision we propose that more research should be done to further describe the functionality and architecture of a BPMS. Specifically the concept of the Enterprise Service Bus and its use within a BPMS should be investigated. Also the necessity of using the service oriented approach is still widely debated both in regard to building a BPMS as in how to implement a BPMS. Currently this debate is practiced mostly in the business domain between analysts, consultants and developers and this is done without many scientific contributions.

A second area where research efforts are valuable is the implementation of BPM-systems. Although much research is available on the implementation of for instance BPR (Harrington, 1995; Kettinger et al., 1997) and ERP (Botta-Genoulaz,

2005; Jacobs and Bendoly, 2003) it seems that these approaches do not lend themselves for a BPMS implementation. Maybe a combination of the implementation approaches of the underlying management concepts together with software development approaches is needed.

Finally the research done in business and IT alignment could also focus on how to measure the fit between a BPMS and an organization that is planning to adopt it. The work done on maturity models for business process management (Harmon, 2003; Fisher, 2004; Rosemann and de Bruin, 2005) should be validated and maybe adapted for BPMS.

In conclusion we can say that due to the fact that BPMS is only currently emerging from a large diversity of software applications aimed at the analyses and design of processes, the integration of applications, the deliverance of management information and the presentation of task-related information via web forms, means that there will be a large research effort needed to get a validated insight into the possibilities of such systems and how to use them.

A BPM-Systems Architecture that supports dynamic and collaborative processes[2]

Business Process Management Systems (BPMSs) are increasingly implemented in and across organizations. There is much talk on BPMSs, and software vendors and IT-consultancy companies are leveraging this. However, the combination of functionality, concepts and characteristics in BPMSs is very much based on the agricultural- and industrial-based view of the economy. Currently western economies are rapidly moving towards an information and service economy in which the ratio of knowledge workers is rising dramatically. Compared to the 'old' type of worker the knowledge worker is typically highly educated, used to collaborating with other knowledge workers and less likely to be sensitive to a controlling style of management in the execution of his or her work. While many organizations are initiating business process improvement projects to improve their processes, this is done with BPM-systems that are based on an old paradigm and therefore unable to support dynamic and collaborative processes. In this chapter we propose a new architecture for BPM-systems that includes functionality to support knowledge workers in their dynamic and collaborative activities and processes.

3.1 Introduction

Lately, Business Process Management (BPM) and Service Oriented Architectures (SOAs) receive much attention from practitioners and scholars alike. Software vendors use the fuzz and provide new labels on new and existing software products; IT-consultancy companies increase their services with BPM and SOA consultancy and implementation. BPM and SOA are considered as promising IS/IT strategies.

From the eighties and nineties, we identify two major business trends that seem to relate to BPM: Total Quality Management (TQM) and Business Process Reengineering (BPR) (Deming, 1982; Hammer and Champy, 1993). In the same period there was a rise in the implementation and use of new types of information systems like Enterprise Resource Planning (ERP) systems, Workflow Management (WFM) systems, advanced planning systems and more.

What started as the automation of a company's internal processes soon focused on digitization of supply chains (Davis and Spekman, 2003). Among others the Internet and associated network standardization made this possible. Since the year 2000 all these trends seem to converge into new types of information systems, that some (Smith and Fingar, 2003) call Business Process Management Systems

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(BPMSs). A BPMS can be defined as "a generic software system that is driven by explicit process designs to enact and manage operational business processes" (Weske et al., 2004). While Van der Aalst et al. (2003) find that Business Process Management includes methods, techniques, and tools to support the design, enactment, management, and analysis of business processes. In this way it can be considered as an extension of classical Workflow Management (WfM) systems and approaches. In these definitions BPM clearly is based on the industrial-based view of the economy in which activities and processes are clearly defined and standardized as much as possible. Based on the current status of many BPMSs it is possible to conclude that a BPMS solution needs to be able to analyse and model processes within and across organizational boundaries, execute the modelled processes, measure their performance and use this as an input to optimization. This in essence means that support of processes by a BPMS starts in design-time.

However in the past century, there has been a shift from the agricultural- and industrial-based economy to a more service- and knowledge-based economy (Takala, Suwansaranyu and Phusavat, 2006). This has led to a dramatic increase of the proportion of knowledge workers in the workforce. The first author who refers to the term knowledge workers is Drucker (1959). He defined knowledge workers as "workers that work with intangible resources". Besides the definition of Drucker, there are more authors that refer to knowledge workers. An example is the definition of Bennet (2003): "knowledge workers are individuals whose work effort is centered around creating, using, sharing and applying knowledge". In 1994 Drucker rephrased his definition of knowledge workers as: "high level employees who apply theoretical and analytical knowledge, acquired through formal education, to developing new products or services". In other words, knowledge work is human mental work performed to generate useful information and knowledge (Davis, 2002).

Based on the above it can be stated that the nature of knowledge work is more complex than the type of work that was typical to the industrial age and therefore also more difficult to manage and control.

Although knowledge work has been an important topic in both practice and science many organizations are still focusing on creating more efficient business processes by trying to automate tasks, activities and processes with BPM-systems based on the old paradigm. However as Fingar (2006) stated: "Processes don't do work, people do". Today the missing link in many process improvement initiatives is more attention for the role of knowledge workers within processes. A clear case for more awareness for the way that knowledge work is carried out is made by Harrison-Broniski (2005) in his seminal work 'Human Interactions: The Heart and Soul of Business Process Management'. In this book Harrison-Broninski states that organizations should be actively engaged in managing the collaboration

between knowledge workers within and outside of the organization. The term that he uses for this is Human Interaction Management (HIM).

However because almost all of the BPM-systems on the market today don't offer functionality to support HIM many organizations are not able to manage, support and control the collaboration between knowledge workers. Therefore in this paper we answer the following research question: What functionality should be added to BPM-systems to support knowledge workers in their dynamic and collaborative activities and processes?

3.2 Research Approach

At the start of this research we looked at different types of research approaches as described in literature. This was done to determine which activities should be undertaken to be able to answer our research question. First we looked at analytic theories that analyze 'what is'. "These theories are the most basic type of theory. They describe or classify specific dimensions or characteristics of individuals, groups, situations, or events by summarizing the commonalities found in discrete observations" (Fawcett and Downs, 1986; Gregor, 2006). The 'analysis and description' theory could be applicable because we want to describe the phenomena of knowledge workers whom collaborate and whose actions cannot be supported by the current BPM-systems offering. But because our research goes beyond analysis and description and also explains how and why BPMS does not cover the needed functionality this research could also be labeled as 'theory for explaining' (Gregor, 2006). Finally we also present a preliminary overview of functionality needed to support collaborative work. In other words we state how to do something and that is part of the 'theory for design and action'. This type of theory is about methods and justificatory theoretical knowledge that are used in the development of information systems (Gregor, 2002a; Gregor and Jones, 2004; Walls et al., 1992). Hevner et al. (2004) in their seminal work on design science state that the design-science paradigm seeks to extend the boundaries of human and organizational capabilities by creating new and innovative artefacts which are then validated by applying them in practice. Because we are not planning to immediately applying our findings in practice we only partially adhere to design science research.

Based on the literature analysis on scientific research we decided that our research will be based on two major activities. First a literature study is done to explain why the BPM-systems that are currently on the market are not capable in supporting collaborative work. This is done by describing the architecture of BPM-systems (section 3) and the characteristics of collaboration between knowledge workers (section 4). The second activity consists of describing how interaction between knowledge workers could be supported (by information systems) in

such a way that organizations get more in control (section 5). This is needed to be compliant with governance regulations but also gives business the opportunity to increase productivity of their employees and the organizational processes.

3.3 Current BPM-Systems Architecture

Organizations that want to actively engage in managing collaboration between knowledge workers need to create an (or adjust their) organizational design that is able to support knowledge workers in a proper manner. The scientific discipline within the information systems domain that focuses on designing organizations is enterprise architecture (Robinson and Gout, 2007). An enterprise architecture describes in an systematic way the structure of an organization from various perspectives. Perspectives that can be distinguished are (Robinson and Gout, 2007): activity architecture, information architecture, data architecture, software architecture and technical architecture. The first view elaborates on the activities and processes of an organization whereas the information architecture describes the information required and generated during the execution of the activities. Supporting the activities, process and information gathering are the software and data architecture; the latter storing the data in such a manner that it can be used by the software, information and activity architecture. An overview of the technical solution making all of this possible is shown in the technical architecture.

A BPM-system is a collection of information system technologies to improve the efficiency, effectiveness and governance of business processes (Shaw, 2007). Information systems in this perspective are defined as the combination of the software-, data- and technical architecture. Analysis and research with respect to current, and to be developed, BPM-System Reference Architecture can be conducted in two ways: single system architecture analysis or reference architecture analysis (Yourdon, 1989; Rumbaugh et al., 1991; Kazman et al., 1993). Scholars have defined preferable ways for conducting research with regards to both situations. Single system functionality is primarily analyzed by object oriented or structured analysis of the actual system while reference architectures are often the result of a domain analysis (Kazman et al., 1993). In this paper the focus is on the reference architectures therefore domain analysis is the preferred way of conducting research leading to a reference architecture which supports knowledge workers. The domain analysis executed adheres to Arango's (1988) methodology by first studying existing BPM-system reference architectures after which the bottlenecks/gaps and the sources of these gaps are recognized. The last step is to identify which of the existing architectures can be reused and which additional architecture is needed to close the identified gaps. Reviewing current literature on BPM-systems architecture leads to the identification of three focus areas:

service oriented architectures (Baina et al., 2003; Costa et al., 2004; Brahe, 2007), specific process architectures (Anzbock and Dustdar, 2004; Danial and Ward, 2006) and BPMS reference architectures (WFMC, 1999; Sheer and Nuttgens, 2000; Shaw et al., 2007; Weske, 2007).

Service Orientated Architecture (hence SOA) is an overall architecture approach which has not been specifically designed for BPM-systems. It advocates the use of small and reusable information system elements such that software applications can be deployed and maintained in a more agile and flexible manner (Brahe, 2007; Weske, 2007). Research conducted around SOA within the BPM field focuses on making processes flexible and agile and to bridge a gap between BPM technology and service-oriented architecture with the use of service composition (Weske, 2007). As SOA is an overall architecture approach which in the BPM domain mainly focuses on the technical architecture layer it is left out of the scope of the domain analysis. Also out of scope of this review is literature focusing on the technical architecture of business processes for specific domains. Examples of such literature is Anzbock and Dustdar (2004) which described an architecture for modeling medical e-services, Maanmar (2006) who focuses on an technical architecture for mobile devices and Danial and Ward (2006) who elaborate on an architecture for e-government solutions.

The last, and with regards to the domain analysis most important, category is literature discussing overall BPM-systems reference frameworks. According to Shaw et al. (2007) there is a limited amount of research available that in a sophisticated manner analyzes BPM-systems reference architectures, the authors concur with this. In the same paper Shaw et al. (2007) propose a BPM-systems reference framework: the BPMS pyramid architecture. Existing out of twelve different building blocks the framework indicates three different components within a BPM-system. Layer one representing the top of the pyramid (one building block): the enactable process model. An enactable process model is a model that is designed in a specific language which allows it to be executed by a BPM-system (Warboys et al., 1999). Layers two and three both represent a specific part of the BPM-system namely the logic underlying the process model (five building blocks) and the information system support (six building blocks). The five building blocks representing the logic of the process model describes the formal model, the modeling language used, the modeling grammar, the abstraction level and the real world subjects modeled. Additionally the information system pillar describes the software and technical infrastructure needed to model and execute the business processes.

Based on a knowledge management view of business processes Jung et al. (2007) propose a reference framework consisting out of six elements. The six elements of the architecture are based on the lifecycle phases of a business process

(model): creation, modeling, pre analysis, enactment, post analysis and evolution. Data created and/or modified in one of the components is stored in one of three repositories which represent the central part of the architecture. Repository one, see table 3.1, stores the information with regards to the actual process model, example are: creation date, author, goal, and version but also the roles, flow, activities and gateways drawn within the process. Actual execution data of a specific process model e.g. participants, data, throughput time, resources used is stored in the instance knowledge repository. Additional information about the execution of a specific process retrieved from users is stored in the knowledge repository. Generating information about the process models must happen in a chronologic order meaning that before the enactment part of the architecture can execute a business process it must be modeled such that the repository contains template information.

Components of process template knowledge			
Structural elements		Detail elements	Description
Basic Process Elements	Process Header Information Composing Activities, Flow & Condition	Creation Date, Author, Description, Goal, Version etc. Activities, Transition, Condition	Meta data and description for the process model Information about activities, the components of process model, flow information among activities, and conditions required to execute the process
Elements Required for Reusing Process as Knowledge	Participant Related Data Resource Static Analysis & Simulation Parameter / Result Evaluation Information	Role, Organizational Unit, Human, System Relevant Data, Application Data Application Static Analysis Result, Cost Estimation, Time Estimation (waiting time, working time, duration) Simulation Result Criteria, Value	Activity performers List of data required to perform activities List of resources required to perform activities Static analysis results of process model Simulation input parameters and simulation results Evaluation criteria for process instances, aggregated process performance measure value

Table 3.1 knowledge of an enacted business process model (Jung et al., 2007)

A third general reference framework is proposed by the Workflow Management Coalition (hence WFMC) which consist out of five components: process definition tools, workflow engine, administration and monitoring tools, workflow client applications and invoked applications (WFMC, 2010). Orchestrating the communication between the four components, the workflow engine is the central part of the architecture. It receives the modeled processes from the definition tools after which is uses the client applications and other workflow engines to monitor and exchange activities. The workflow engine can also invoke third party applications such as business rules engines (WFMC, 2010).

The three reference frameworks discussed but also the specific process architectures examined (Anzbock and Dustda, 2004; Danial and Ward, 2006; Maanmar, 2006) have a common denominator in their architecture: an enactable business process model. As stated before an enactable process model is a business process modeled in a specific language such that it can be executed by a BPM-system (Warboys et al., 1999). To create enactable process models knowledge is needed about various aspects of the process such as flow, activities, roles etc, see table 3.1. When knowledge workers execute a process many elements of this information is not know upfront for example which activities are executed, the flow in which they are executed and who will participate. The question thus is: "*Can the current reference architectures function without the enacted process models?*" For the analyzed architecture the answers to this question is no. All of the architectures will not properly function without the enacted model. This unfolds the main bottleneck with current BPM-system reference architectures and their support of work executed by knowledge workers: the architectures are not able to support the ad-hoc activities and therefore processes in which knowledge work is performed. An additional but similar bottleneck is that all architectures assume that the applications used are known upfront.

3.4 Business processes and Knowledge Workers

The previous section elaborated on existing BPM-system reference architectures and the bottlenecks that exist regarding the support of knowledge workers. In this section the different concepts realizing these bottlenecks are elaborated on.

3.4.1 A Business Process ≠ A Business Process

Within scientific and professional literature many different definitions of business processes exist (Davenport and Short, 1990; Hammer and Champy, 1994; Jeston and Nelis, 2006; Weske, 2007). Although the many differences in the definitions used, four characteristics reappear in all of them: *(1) the execution of*

task(s), (2) in a certain sequence, (3) to reach a certain goal (4) thereby creating value. Depending on the author(s) one or multiple elements are either defined very loosely (Jeston and Nelis, 2006) or very strict (Bulletpoint, 1996). If every process exist out of the execution of tasks in a certain sequence to reach a goal delivering value what is/are the characteristic(s) that distinguishes a traditional process from a dynamic process?

The characteristic separating traditional business processes from dynamic processes is: value creation; more specifically the manner in which value creation is realized. Based on the old paradigm of managing business processes, value is delivered by creating more efficient and effective processes by automating and reordering tasks and creating interlinked chains of processes (Davenport and Short, 1990; Hammer and Champy, 1994; Stabell and Fjledstad, 1998). An additional value realized by this approach is consistency of products / services delivered to customers. To achieve this manner of value creation organizations create business processes which are translated to enacted models used by BPM-systems to execute and monitor the process (Hammer and Champy, 1994; Kettinger et al., 1996; Jeston and Nelis, 2007). The possibility of creating enacted business process models is achieved by the fact that the information about the execution of individual tasks, the sequence of tasks, the goals and perceived value is already know before the process is executed. Davenport (2005) indicated that this information was available for 70 percent of the processes in 1920. By 1980 this information was available for only 30/40 percent of the processes (Takala et al., 2006). Although no specific numbers are available it is estimated that currently this information is only available for 20 percent of the processes executed in organisations (Fingar, 2006). For the remaining 80 percent of the processes organizations are not able to produce enough information to create an enacted business process model upfront. These processes are executed by knowledge workers which have to make decisions about the activities to execute, in which order, which resources to use and very important with who to collaborate to achieve the most value (Gregerman, 1981; Stabell et al., 1998; Glomseth et al., 2007). Examples of processes and occupations with these characteristics are developing new products and services, designing marketing programs, creating strategies, law, engineering, architecture and research (Stabell et al., 1998).

If knowledge workers decide themselves upon the activities that they are going to execute and which resource to use, does this then mean that we can say nothing about the execution of the process? From the paradigm of traditional business process we cannot but from the paradigm of value shops, knowledge management and interaction management, insights can be given into the process knowledge workers use to solve challenges / issues. Five high level iterative steps can be distinguished in this process namely: problem-finding and acquisition, problem-

solving, choice, execution, control and evaluation (Stabell et al., 1998; Harrison-Broninski, 2005; Glomseth et al., 2007). During the first step the problem is formulated and overall approaches to solve the problem are formulated. After the overall approach has been formulated alternative solutions are evaluated; from the solutions an actual choice is made which is executed. The last step is to measure and evaluate the solution implemented and if needed to go back to problem finding. The activities executed during the five steps are not predefined and the intensity of a step depends on the actual case to be solved. The same applies to the resources used in the different steps (Stabell et al., 1998; Harrison-Broninski, 2005; Glomseth et al., 2007). To illustrate this imagine a complex medical case in which the patient already has been misdiagnosed and the right diagnose has not yet been established. In this specific case a medical specialist is consulted who takes over the case (Abbott, 1988). The specialist looks at the charts, orders additional blood tests (traditional 'standard' processes) and consults with colleagues about the best approach. After the solutions have been proposed a choice is made about the actual treatment. After the treatment has started the patient conditions get worse and the medical specialist starts consulting more colleagues but also his colleagues start consulting other colleagues starting the process of problem formulation again. The cycle will stay iterative until the patient receives a treatment that cures him.

3.4.2 Characteristics of Collaboration between Knowledge Workers

The previous paragraph described the difference between the old paradigm (hence value chain) and new paradigm (hence dynamic processes). This paragraph will elaborate on the differences between the two by discussing the following characteristics: communication, kind of knowledge, optionality and modality.

Communication is defined as the activity of expressing information (to people). Within value chains communication is initiated by the BPM-system, the receiving party in this case are the employees that have to execute the tasks assigned to them by the system (Weske, 2007). Although sometimes communication between employees is possible and maybe necessary the act of communication is still initiated and structured by the BPM-system based on the process model. Communication in dynamic processes is initiated by the knowledge workers executing the process. The information systems used to facilitate the act of communication is of secondary importance (Stabell et al., 1998; McDermott, 1999; Harisson-Broninski, 2005). Whereas communication between BPM-systems and employees in a value chain is about procedures and work routines communication between knowledge workers has additional functions. During communication between knowledge workers unwritten work routines, personal tools, stories and wisdom about case-effect relationship are exchanged, thereby facilitating the creation of new knowledge which can be used to solve work related issues (McDermott,

1999). Communication and working with other knowledge workers therefore improves the performance of the individual worker and eventually the team (Gregerman, 1981; McDermott, 1999). From a business process management view it is desirable to capture the (electronic) communication between knowledge workers with regards to a specific case (a story). Reasons for this are the development of best practices, compliance and management/governance of business processes.

Explicit versus tacit knowledge is the second characteristic that differs between the two types of business processes. Within the knowledge management community this distinction is very familiar and many papers discuss the difference and codification of the two types (McDermott, 1999; Wegner and Snyder, 2000; Binney, 2001). Traditional BPM-system architectures are designed to use and manage explicit knowledge by codifying the information into enacted process models. Dynamic processes on the other hand rely far more on tacit knowledge and therefore cannot be codified upfront. An architecture dealing with processes that mainly consist out of human interaction needs to be able to codify real-time information related to the process executed, for example documents, time stamps, email traffic, communication, internal and external employees involved.

The last distinction between value chain and dynamic processes is the optionality and modality of system use (Biney, 2001). BPM-systems supporting value chains do not provide employees with the choice which software to use when executing a task. In addition they also have limited options available for presenting information to the employees. With regards to dynamic processes the modility and optionality in choice of information representation and system use increases. Knowledge workers often have a preferred way of working and data & information presentations (Binney, 2001; McDermott, 1999). This leads to the use of personal tools and information representations thereby decreasing the predictability of software use. A typical example of this is a knowledge worker that gets sales data from a central system copies this to an excel file, runs the numbers and sends the sales forecast to the management.

3.5 Stories and The Human Collaboration Bus

So far we have described how organizations and their environment are rapidly changing and that the old industrial era paradigms are becoming less able to support, manage and control the activities and processes of companies. As a consequence the attention for process orientation has grown considerably in the last decade, and also the market for software companies offering information systems to analyze, model, execute and control processes is maturing quickly. However even these concepts are still very much based on the notion of being able to

determine upfront which tasks, roles and processes are needed in an organization. In this view workers are still little more than part of a engineered system without a free will and with no room for their own interpretations and adaptation of the tasks they are assigned to do. This however will not be tolerated by a growing highly educated workforce that sees work no longer as just a means to pay for the bills but also as part of their way of living, their social environment and thus their identity. Moreover also managers realize that to attain agility in their organizations employees should be more empowered to work in a more flexible manner without 'old' organizational structures and hierarchies hindering the work. In short, the number of knowledge workers is rapidly rising and the way in which they work is totally different and no longer restricted to the boundaries of their company.

To support this new way of working in a manner that realizes both a higher effectiveness of knowledge workers and keeps the organization in control we propose to add extra functionality to (or on top of) the current business process management systems architecture as described in section 3. Central to the added functionality is the concept of story telling. Our lives are filled with stories, as a kid we grew up in a world of stories whether they were out of books or our own (make-believe) stories, and as grown-ups we are constantly part of stories that we also try to capture and record. For example, who doesn't have family albums filled with pictures of lives events such as births, weddings, birthdays, Christmas, thanksgiving etc. And while sometimes we can't choose our stories (such as our family) we often actively create our stories. For instance holidays are planned well in advance and everybody knows their role in the story and its final goal. So while stories are very normal in every day life this all of a sudden seems to end when we work because then we enter a process that is designed and controlled based on an engineering perspective. However putting stories in the middle of our concept to support knowledge workers who engage in their dynamic collaborative processes (see figure 3.1), helps us to understand various notions (Loggen, 2009, p. 44) such as:

- The story in which knowledge workers participate usually has goals and when met, the story ends (or the story is abandoned earlier).
- Knowledge workers each play certain roles while collaborating and in these roles they interact in various ways and perform activities to develop the story (and reach the goals).
- There are rules (and if people don't play by the rules a quick reaction can be expected).
- There is power - somebody controls the roles assignments and the evolution of the story.

- Communication within the story has a specific context with a specific language, where specific terms are related to the specific concepts. However this communication and thus the story can be harshly broken by other emergent events (the financial crises all of a sudden broke a lot of the rules in business financing and thereby disrupted a lot of collaborations in networked organizations, thus changing the patterns of many stories).

Figure 3.1 The concept of story in relation to collaborative processes (Loggen, 2009)

As can be seen in figure 3.1 there are a lot of aspects surrounding our story concept. Not only does a story have objectives that need to be reached by the people that are participating and which are set in a specific context, there also has to be a lead character or group of lead characters and during the story information is used but also created. There are many different ways of supporting a real life collaboration story between knowledge workers but the most important part of this new paradigm is that organizations can no longer push the technologies that are to be used in these dynamic processes. Even if the collaboration is part of a project within one organisation, knowledge workers will want to use the means that they are comfortable with and that they also use in other stories. This concept of modality (see section 4) means that a large part of the story may be enacted in online environments like Facebook, Google docs, LinkedIn, the Process Factory, Zimbra, Jive, and Zoho, while for information that is part of a specific organization an ERP or BPM system could be used together with Microsoft office and different legacy systems. All these different systems need to be able to interact

and support the story and at the same time there should be some type of controlling method that enforces the rules of the story, creates a history for auditing and governance purposes, that stores the context of the story and the general storyline. For this control method we propose the concept of the Human Collaboration Bus (HCB) as depicted in figure 3.2.
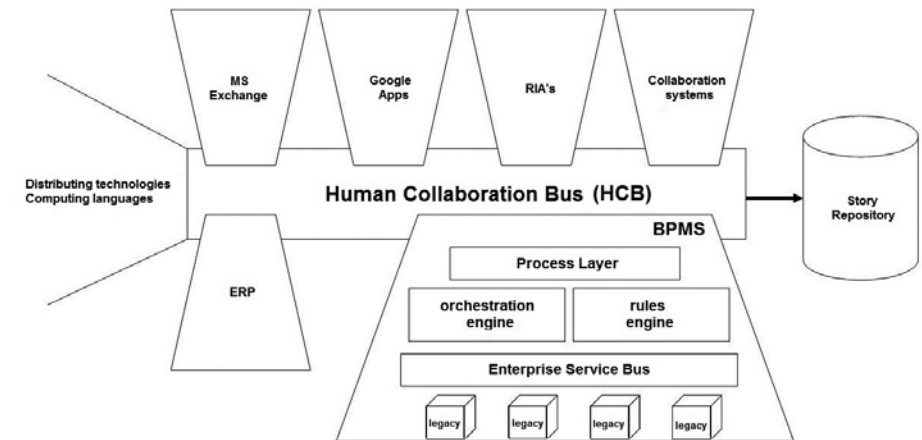
Figure 3.2 The Human Collaboration Bus concept

The HCB should not be seen as another software application but as a concept that contains technologies that will be different depending on the story that is told. The only constant in the HCB is the story repository. The story repository is the central storage of all stories that have been told, are told and will be told. Preferably third parties will offer a story repository in the Cloud that can be used by any organization or person that has a role in a specific story (and also other providers of story repositories when different stories connect and interact), however a single organization or a network of organizations could also provide a private story repository in support of their knowledge workers collaborating in dynamic processes.

The HCB is central to the integration of all technology and semantic communication between all participants in a story. As we explained participants in a collaborative story typically will use different tools in communicating and will also typically communicate in terms that are specific to their context (educational level, work domain, country etc.), the HCB connects the tools used and stores the communication and context. A HCB can also (re)use information from systems such as ERP, CRM and others if the story requires so. Depending on the situation the HCB concept can be an add-on to a BPM-system but it can also be provided

separate from it, for instance in the Cloud by a third party. However the HCB will only give full added value if functionality offered by BPM-systems can be used, this is because BPM-systems give access to the structured processes which will almost always have a role in a story. Also it is practical to reuse functionality that BPM-systems contain to integrate legacy systems, realize orchestration and choreography, monitoring and control, enforce rules etc. Just keep in mind that the flexibility of the collaboration is paramount and that using a BPM-system should not lead to efforts to structure and control the story in design time.

3.6 Tool Evaluation

The functionality that we envisioned in the last paragraph for the HCB doesn't yet exist (as far as the researchers know). However it could be that there are already software solutions that may offer part of the functionality. To determine if this is the case we performed a scan of available software in the domains of Enterprise Resource Planning (ERP), Customer Relationship Management (CRM), Workflow Management (WfM) / Business Process Management, Project Management, and Collaboration tools. These are all software packages that might already offer functionality that is part of our HCB concept.

For the market scan we designed a five step research approach which consisted of the following steps:

- The construction of a long-list of possible software solutions that might contain parts of HCB functionality; this was done by studying professional literature, websites (of suppliers & consultancy firms), blogs on collaboration, and short interviews with two Capgemini consultants that specialized in collaboration processes. The result of these activities was a list of 54 software packages (the complete list is available upon request to the authors).
- Based on the Human Collaboration Bus concept as described in the last paragraph a detailed overview of characteristics of collaboration among knowledge workers and supporting IT functionality was developed and used as input for the construction of a survey. The survey questions were then validated by the consultants that were also involved in step 1.
- The developed survey (consisting of yes & no questions) was sent to all 54 suppliers on the long list. If no response was received or if the surveys returned were missing information we contacted the suppliers with the request to participate or deliver the missing information. As some suppliers choose not to participate they were left out of the next steps of our research. Furthermore we also decided not to include those suppliers that didn't have at least 50%

of the characteristics / functionality mentioned in the survey. This reduced the long list to 16 possible software solutions.
- For the remaining 16 solutions a more detailed study was performed on the supported characteristics and offered functionality. Each supplier was asked to rate the characteristics / functionality in their software on a scale of 1 to 4 (bad, lacking, sufficient, good). Each package was rated on 31 items that were divided in four categories (the first 3 measuring characteristics of collaboration among knowledge workers and the fourth looking at specific software functionality) which were labelled: collaboration, work processes, management of work, software functions. Based on the responses we calculated a score for each of the 16 suppliers.
- The 10 highest scoring solutions from step 4 were the studied in more detail. For this we tried to get a trial version of the software to perform life testing. The test consisted of letting bachelor students use the software in their collaborations as part of performing projects for different courses. At the end of their project we had them report their experiences. Although this last step did provide us with interesting information we decided that the final top 10 should be based on the more objective scores calculated in step 4 instead of using the more subjective input of the student's experiences.

Based on the market scan we found the following 10 software solutions that in part provide HCB functionality (between brackets the final calculated score is stated, the complete list of characteristics and the scores are available upon request to the authors):

1. Cordys Process Factory (119)
2. Action Base (116)
3. Zoho (109)
4. JIVE (109)
5. eGroupWare (102)
6. Above IT – Zimbra (101)
7. Contact Office (98)
8. HumanEdj (96)
9. Instant Business Network (95)
10. Group Office (93)

Although the software packages mentioned in this top 10 provide some functionality that is needed to support knowledge workers in collaborative processes, none provide all the functions needed. So in conclusion this market scan has

shown that there are still many opportunities for software companies to develop new functionality in support to human interaction management.

3.7 Conclusions and further research

In this paper we have shown that organizations who want to increase the productivity of their knowledge workers and make collaboration more effective and efficient need to change the way they support, manage and control these types of processes. The current industrial paradigm in which processes are structured in design time including their control mechanisms is giving way to a new paradigm coined Human Interaction Management in which humans and their interactions are central.

To support this new paradigm we propose the concepts of story telling and the Human Collaboration Bus (HCB). Stories are central to our everyday way of life and consist of (lead) characters, roles, rules and goals which all play a part in a specific context during a certain amount of time. To manage and control the knowledge workers that are embedded in collaborative stories we created the concept of the HCB which provides a story repository that stores all the characteristics of a specific story (including interactions between stories) and that offers functionality to interact between different systems as part of human interactions and which manages the dynamic processes. Ideally the HCB concept is offered via the Cloud by independent third parties but closed solutions are also possible.

The concepts proposed in this paper are based on conceptual research and have not yet been tested in practice. Therefore we have defined two follow up projects. First a market research to determine which services and applications are currently available and could be used as part of our HCB concept. And secondly a proof of concept by applying stories and the HCB in one of our Universities research projects. Because these projects typically have knowledge workers across organizations collaborating on a project and therefore adhere to the HIM characteristics.

Success Factors of Business Process Management Systems Implementation[3]

In this research (critical) success factors for Business Process Management Systems implementation are identified and qualitatively validated. Furthermore a list of critical success factors is constructed. Based on the identified factors a BPMS implementation approach is suggested. Future research consists of situationally considering the success factors in relation to phases in the implementation approach.

4.1 Business Process Management Systems

Today, interest in Business Process Management (BPM) and Service Oriented Architecture (SOA) is rapidly rising. Many software development and consultancy firms sell and/or implement Business Process Management Systems (BPMS) that are based on the concepts of BPM and SOA (Smith and Fingar, 2003; Hill, 2006). Yet, most vendors and resellers largely seem to neglect the specific implementation aspects of BPMS, and instead use existing software development methodologies or project management principles during implementation. In many cases the implementation of a BPMS is regarded as yet another software development project, which is not fully true (Krafzig et al., 2005). Using software development methodologies such as the waterfall method, rapid application development (RAD) or Rational Unified Process (RUP) ignores the business side of a BPMS implementation such as process analysis, performance measurement and continuous (quality) improvement.

At the same time, in professional journals and forums the discussion is mostly about what BPM and SOA concepts are and why organizations should start projects in this area, merely neglecting the how. How should a business process management system be implemented to realize business value? In this paper we identify (critical) success factors and implementation approaches for BPMS.

Business Process Management Systems are based on developments in both the business and IT domain (Ravesteyn, 2007). The most important influences in BPMS from a management perspective are Total Quality Management (TQM) and Business Process Reengineering (BPR) (Deming, 1982; Hammer and Champy, 1993). We can also identify different types of information system concepts that have influenced BPMS as it is currently used, like Enterprise Resource Planning (ERP) systems, Workflow Management (WFM) systems, advanced planning systems and more. What once started as the automation of a company's internal processes has now become the digitisation of supply chains (Davis and Spekman,

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[3] Orginally published as: Ravesteyn, P., & Versendaal, J. (2007). Success Factors of Business Process Management Systems Implementation. *Conference proceedings ot the 18th Australasian Conference on Information Systems 2007*, Toowoomba, Australia

2003). One of the key contributors to this has been the Internet, associated network standardization, and web services orientation.

In this paper we address the definition and origin of BPMS, and we continue to construct a framework of success factors with respect to BPMS implementation, which will be validated through qualitative analysis. We end with conclusions and future research.

4.2 Identifying Success Factors for BPMS Implementation

Several definitions of BPMS are available (Van der Aalst et al., 2003; Fremantle et al., 2002; Weske et al., 2004). Taking into account these definitions we propose a more detailed definition that is based on the latest developments. In this paper we define BPMS as a (suite of) software application(s) that enable the modelling, execution, technical and operational monitoring, and user representation of business processes and rules, based on integration of both existing and new information systems functionality that is orchestrated and integrated via services.

In order to identify the most important factors that influence the success of BPMS implementation, a literature study of 104 articles and books was conducted. For each article or book the domain and type of research approach was registered. The different domains used to categorize the literature follow the influences of the evolution of BPMSs and are total quality management (TQM), business process reengineering (BPR), business process management (BPM), workflow management (WFM), enterprise application integration (EAI), business activity monitoring (BAM), business process management systems, and a category others. An overview of the types of research approaches used to categorize the papers is depicted in figure 4.1.
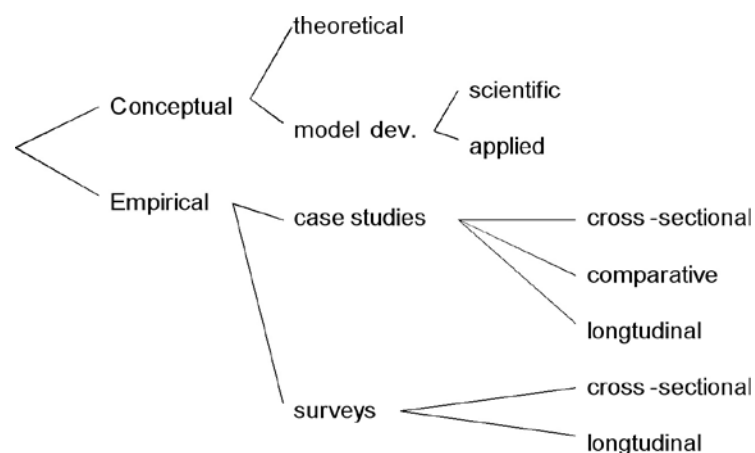
Figure 4.1 Type of Research Approaches

With the categorization of the literature a list was compiled with over 337 success factors from the different books and articles. This list was derived from the different domains in which the literature was categorized according to the following composition: 3.86% of the factors came from TQM, 17.51% from BPR, 29.97% BPM, 11.57% WFM, 12.76% EAI, 2.08% BAM, 12.17% from the BPMS domain and 10.08% from various other related areas. Factors relating to SOA were not listed as a separate domain but as part of the EAI domain.

Based on the list of success factors and their background domains, a distinction could be made between factors that are mentioned in only one domain, and factors that are common among more domains. For example, quantitative measuring and use of statistics to control the effectiveness of improvement actions is only mentioned in relation to TQM, while the importance of top management support is mentioned throughout almost all domains. This gives a first indication of the importance of some factors. To shorten the list the number of times a factor was mentioned was recorded. This reduced the total number of factors to 55 unique success factors. Accordingly the factors are categorized based on business/IT-alignment principles (Henderson and Venkatraman, 1993) and the identified main aspects when implementing BPMSs (1) management and organisation (2) architecture and (3) IT integration (Ravesteyn, 2007). The clustering that is made (see section 4.7 'appendix') contains five dimensions, which include both IT and non-IT categories.

As a first validation the factors that were found in the literature study can be compared to success factors relating to other types of management or IT implementation projects therefore in table 4.1 a comparison is made with factors found in related research such as the implementation of Enterprise Resource Planning systems or Business Process Management (the latter from a management perspective).

Based on this comparison we can conclude that the factors that are specific to the implementation of a BPMS are typically the factors relating to the development and use of services together with the related data such as granularity of services, integration of existing applications via services, and availability and quality of data. The use of services as a means to leverage the outcome of BPM implementations is largely unexplored and moreover, it is hard to compare BPMS implementations with other types of implementation projects. For this reason dedicated research into BPMS implementation is necessary.

ERP	BPM	BPMS
Technical fit	Organizational & Cultural change	Management involvement
Organizational fit	Aligning the BPM approach with corporate goals and strategy	Strategic alignment
Strategic fit	Focus on the customer and their requirements	Understanding the process
Business process reengineering	Process measurement and improvement	Quality of project management
Project planning	Top management commitment	Involving the right people
Training	Benchmarking	Defining performance metrics
Ease of use	Process aware information systems	Quality of modeling technique
Resistance	Infrastructure and realignment	Organizing for continuous optimization
Competitive pressures		Understanding the BPMS concept
		Availability of data
		Quality of data
		Granularity of services
		Integration of existing applications via services
Based on: Kamhawi (2007), Hong and Kim (2003), Bradford and Florin (2003)	Based on: Armistead and Machin (1997), Elzinga et al. (1995), Harrington (1995), Lee and Dale (1998), Zairi (1997), Rosemann et al. (2004)	

Table 4.1 A Comparison of Success Factors

4.3 Validation Methodology

To validate the complete list of success factors that were identified a multi method research approach was used consisting of three techniques: open interviewing, measuring the necessity of the success factors using a 5-point Likert-scale (direct validation – scale construction), and measuring the factors by creating and measuring constructs that relate to a factor (indirect validation – create constructs). By gathering data from different angles a clearer picture of the real world can be modelled and validated (Baarda et al., 2001).

In the open interviews several questions were formulated concerning the difficulties of implementing business process management systems to get the con-

versation started. During the interviews two people made notes that were compared afterwards. From the notes the success factors mentioned were matched with the earlier identified factors, while other important aspects or factors that had not yet been identified previously were listed separately. The second validation technique consisted of statements that directly related to the identified factors and in which a respondent indicated whether he or she agreed or disagreed with the statement. In the third survey technique several items per factor were constructed and a respondent could agree or disagree with the items, in this way a success factor was measured indirectly.

The different validation techniques were used in all of the five areas in which the factors were clustered. We used a different set of respondents per cluster with special knowledge of the topic at hand. For instance respondents with development skills do not necessarily have knowledge about process architecture therefore a different group of people with architecture design skills were asked to participate in that area of the research. In table 4.2 an overview is given of the research methodology that was used, the type and number of companies that participated in the research, and between brackets the function of the respondent, the size of the company and the level of BPM knowledge of the respondent.

Cluster	Research Methodology	Type & no. of companies
Management of Organisation & Processes	Create Constructs	3* IT Consultancy: (BPM consultant, 40.000, medium), (bus. Consultant, 5.000, medium), (marketer, 5.000, medium); Software Development: (solution consultant, 900, high)
	Scale Construction	5* IT Consultancy: (proj. manager, 1300, high), (proj. manager, 1200 medium), (consultant, 1500, medium), (engineer, 500, low), (consultant, 550, very low); Solar Shading: (Soft. Developer, 175, high)
	Qualitative (interview)	IT Consultancy: (BPM manager, 8500, low); Software Development: (program manager, 550, high)

Architecture Design	Create Constructs	2*Software Development: (solution arch., 1500, very high), (solution arch., 1500, high); Global Business Services: (backup & restore operator, 4800, medium); Navigation: (proj. manager, 700, medium); Timber: (marketing director, 199630, low); Industrial (buss. dev. Manager, unknown, medium); Software outsourcing: (systems arch., 1000, high); Marketing: (operations manager, 80000, medium)
	Scale Construction	Global Business Services: (proj. manager, 4800, medium); 2*Software Development: (consultant, 550, high), (consultant, 550, medium); 3*IT Consultancy: (SOA arch., 75000, high), (software arch., 6000, medium), (delivery man., 6000, very low); Industrial: (Procurement man., 4500, medium)
	Qualitative (interview)	6*IT Consultancy: (procurement man., 300, medium), (chief arch., 70, high), (proj. leader, 500, medium), (proj. leader, 70, high), (spokesman, 6000, high), (account man., 1400, high)
Measurement & Control	Create Constructs	IT Consultancy: (tester, 300, medium); Healthcare: (developer, 2500, low); 2*Pharmaceutical: (SAP cons., 19000, very low), (administrator, 19000, very low); Finance: (director, 45, high); Fashion: (application man., 450 very high); 2*B2B Wholesaler: (marketing intell. Specialist, 250, medium), (purchaser, 250, low)
	Scale Construction	2*IT Consultancy: (application dev., 30, medium), (management cons., 59000, medium)
	Qualitative (interview)	2*IT Consultancy: (CEO, 9, very low), (sr. programmer, 9, very low); Online Travel & Advertising: (IT manager, 30, medium)

Management of Implementation & Change	Create Constructs	2*Business Consultancy: (sr. consultant, 60, low), (sr. consultant, 60, very low); 4*Finance: (proj. manager, 40000, medium), (proj. manager, 40000, medium), (manager packaged sol., 40000, low), (director, 45, high)
	Scale Construction	4*IT Consultancy: (programmer, 146000, low), (consultant, 146000, very low), (project man., 1200, medium), (consultant, unknown, very low); Finance: (manager IT dept., 220, medium); Manufacturing: (programmer, 175, medium)
	Qualitative (interview)	IT Consultancy: (business & IT cons., 13, low); Real-estate: (bus. analyst, 100, low)
Development of an IT Solution Based on SOA	Create Constructs	IT Consultancy: (partner, 5000, high); Finance: (manager design & arch., 3000, very high); Manufacturing: (IT manager, 10000, medium)
	Scale Construction	3*Software dev.: (solution cons., 900, high), (solution cons., 62255, high), (solution cons., 62255, very high)
	Qualitative (interview)	Software dev.: (technical arch., 62255, high); Finance: (CEO, 45, high)

Table 4.2 An Overview of Research Participants

Besides the different techniques and questions per area, a set of meta-questions was developed that had to be answered by all respondents. In this way the organization typologies, size, knowledge level on SOA / middleware / BPMS etc. was measured. In total 76 respondents from 45 different companies were interviewed or filled in the survey. Due to the low number of respondents per cluster it is not possible to do detailed quantitative analyses, therefore our validation is considered qualitative.

4.4 Validation Results

Most of the companies in this research are from the domains of software development, (IT) consulting and finance. Sectors like manufacturing, wholesale and healthcare form a small minority of the research population. Although a large part of respondents work in the IT (or related) domain and could potentially be

biased, a comparison of the answers has not produced any evidence for this. Not all respondents completed the meta-questions correctly so for the results on those questions only 68 respondents were taken into account. From this list 81% of the respondents said they had an enterprise architecture in place (an overview of the most important processes and information systems). 67% of the respondents claimed they were either experimenting or actively engaged in SOA projects, while of the remaining respondents 8 persons didn't know whether their company was using SOA and 1 person said the company (active in the IT sector) had stopped their SOA project after encountering problems. Of all respondents 54% stated that they had a Business Process Management System in place, of this group 4 respondents said that BPMS projects were done both internally at their own company as externally at customers. When asked if their company was using middleware software to integrate different IT systems 72% answered this was indeed the case. The vendors that were mentioned most as suppliers of middleware are Oracle (11 times), SAP (10 times) and IBM (10 times). Other vendors that were mentioned were amongst others Microsoft (3), Cordys (3) and Webmethods (2). Besides this 11 respondents answered their company used more than one middleware supplier.

When we look at the relation between the use of a BPMS, being engaged in SOA and having an enterprise architecture, we found that 4 out of 37 respondents that said their company was using a BPMS also said they did not have an enterprise architecture and were not engaged in any SOA project. Besides this 2 respondents said they didn't use SOA while their company did have a BPMS and an enterprise architecture. This leaves a majority of 31 respondents, which have all three in place together. This seems to support the notion that there is a relationship between BPMS, having an enterprise architecture and being engaged in SOA.

In the remainder of this section the results of the different research types that were applied per cluster are discussed. The results from the open interviews were determined by taking the transcripts of the interviews, checking whether the text contained the proposed success factors, and listing factors that were mentioned by the interviewee but not defined earlier. As for the direct validation type the outcomes are determined by taking the means of all Likert-based scores of the success factors, after which they are prioritized based on these mean values. Lastly, as for the indirect validation type the outcomes are determined by taking the scores for the constructs (also on a Likert scale), which are redirected to the success factors; subsequently the factors were prioritized based on their calculated mean values. Table 4.3 shows the outcomes of our validation versus the initial literature study. From the literature study all factors mentioned more than one time are listed while from our validation only those factors are mentioned that were considered of high importance.

	Literature Study	Validation Research
Cluster A	Project management Change management Understanding the BPM concept, Management involvement, Strategic Alignment Governance & accountability Training Culture	Project Management Culture Change Management Understanding the BPM Concept
Cluster B	Understanding the process Use the 'best' modeling standards & techniques Organizing the modeling 'design' phase Maintenance and control - including quality - of the models is important Interdependencies and Integration of Data sources Discovery of Information Process orientation Defining (web) services Understanding the BPMS paradigm Business & IT divide Use of Business Rules	Organization of the modeling design phase Understanding the process Use the 'best' modeling standards & techniques Interdependencies and Integration of Data sources
Cluster C	Integration of processes and data (Use of) Web services IT infrastructure is not aligned to the developed solution Embedded business logic within communications networks	"Remark: in this research no clear ranking or difference in importance of the success factors was found for this cluster."
Cluster D	Project management Change management Involving the right people in the project	Involving the right people in the project Change management Project management
Cluster E	Performance measurement Continuous optimization An organization and culture of quality	Continuous optimization Performance measurement An organization and culture of quality

Table 4.3 Validation results and ranking

According to the outcomes of the different research types in the Management of Organization and Processes cluster all factors that are found during the literature study seem valid. However the ranking that was found during the literature study does not coincide with the findings from this research. Based on the interview data, project management is the most important success factor followed by an organizations culture, which was not ranked high in the literature study, and finally change management together with understanding the BPM concept. Besides the factors already in the research, respondents also mentioned some previously unmentioned factors such as the influence of the outside world (for example laws and competitors) and the need for a critical trigger. As one respondent mentioned, "without a critical trigger the implementation of BPM won't be successful. A burning platform is needed to be able to make such a radical change".

Based on the respondents that were questioned for the Architecture Design cluster we found that all success factors are recognized. However the priority that the respondents gave to the different factors is different. According to the outcomes the organization of the modeling design phase is the factor that has the most impact next to understanding the process. Respectively using the 'best' modeling standards & techniques and the interdependencies and integration of data sources are deemed less important.

In the Developing an IT Solution Based on SOA cluster the results showed diverse support for the factors based on services. Some respondents identify these factors as critical while others say they are not defined clearly. Managing process integrity is deemed valid with no clear judgment about the importance. Based on the results of this research it is not possible to state which success factors in this cluster should be deemed critical. This 'vagueness' among the respondents might be due to the many discussions in the field of SOA (both by science and business people) that do not result in a clear vision on what success factors for SOA actually are.

For the Management of Implementation and Change cluster our research showed that involving people is identified as most important factor while the quality of the project management method was least important. This might be because respondents focusing on this specific cluster are taking project management for granted. Also here no factors were stated as missing.

Finally for the Measurement and Control cluster it was suggested that organizing for continuous optimisation appeared to be the most important success factor, immediately followed by defining performance metrics. The third most important factor according to this research is creating an organization with a culture of quality. All factors that were found in the literature study were found to be valid, only the found ranking is different.

After analysing all results we can conclude that the entire list of 55 success factors found in the literature study is recognized and agreed upon by the respondents. Only a few new factors were proposed by the respondents such as the importance of the influence of the environment and the need for a critical trigger when starting a BPMS implementation. In our domain, critical success factors can be defined as those areas where 'things have to go right' for a BPMS implementation to succeed (Ward & Peppard, 2002). Based on both the literature study and the discussion above one can consider the success factors identified in table 4.4 as most important, and thus critical.

Cluster	*Critical* Success Factors
A. Management of Organization and Processes	1. Project Management 2. Change Management 3. Understanding the BPM Concept
B. Architecture Design	4. Organization of the modelling design phase 5. Understanding the process 6. Using the 'best' modelling standards & techniques 7. Understanding interdependencies and integration of data sources 8. Maintenance and control - including quality - of the models is important
C. Developing an IT Solution Based on SOA	9. Integration of processes and data 10. (Use of) Web services
D. Management of Implementation and Change	11. Change management 12. Involving the right people in the project 13. Project management
E. Measurement and Control	14. Performance measurement 15. Continuous optimisation 16. An organization and culture of quality

Table 4.4 Critical success factors for BPMS implementation (random order)

One final remark in relation with table 4.4 should be made. For cluster C this research did not give any clear results on which factors can be considered more important than others. However we do consider the two factors mentioned critical based of the number of times we found them in literature (respectively 14 and 5 times). In the next section a BPMS implementation approach is suggested based on the defined clusters and critical success factors that have been validated in this research.

4.5 BPMS Implementation Approach

As identified earlier, the success factors of a BPMS implementation can be classified according to five areas: the organization and processes, architecture design, development of an IT solution based on SOA, the management of implementation and change, and measurement/control. The five areas can be seen as phases in a BPMS implementation. The first is the ongoing domain of the business organization itself. It is here where any BPMS project is either conceived or approved and where the goals, budgets and timeline are decided. In almost all cases a business that wants to start a BPMS project will already have an established organization with running processes, which will be the starting point for the implementation. In this phase it is critical that an organization understands the BPM(S) concept and realizes that a project management organization and a change management strategy are necessary.

The second and third phases of a BPMS implementation, the 'architecture design' phase and the 'development phase' will deliver a process and information architecture that can be used in the realization of the technical infrastructure (including the integration interfaces) and creation of service oriented business applications. The developed solution will then be implemented in the organization, which is both the start and the end point of any project. During these phases it is key that the right people are involved in the project team so that they are able to take into account all the different critical success factors.

Furthermore two aspects can be distinguished that either support the organization, the project or both: (1) the measurement and control function and (2) the project and change management function. A business that is already in operation will have some type of measurement and control function. For small businesses this will probably only be the accounting function. For medium and large organizations other functions will provide information about the organization and processes, such as a quality department etc. To succeed in implementing a BPM and SOA there should be sufficient measurement information available about the processes that are going to be modelled and executed. If this is not the case, the implementation should not be started. Metrics on processes are important to be able to continuously measure the effects of any changes.

The project phases (architecture design and development phase) are supported by project and change management simultaneously because applying the BPM and SOA paradigm implies that while working on a project there can already be changes in processes and IT applications. A BPMS implementation can be regarded as a project or series of small projects and therefore it should be understood that both the organization and business processes, and the measurement and control function are in fact just a small part of the project.

In executing a BPMS implementation, an organization can now use these five BPMS implementation aspects as a starting point and take the (critical) success factors per domain into account, based on their priority.

4.6 Conclusion

This article describes the outcomes of a multi method research approach that was done to validate the success factors when implementing BPMS. The list of factors, that was initially based on a literature study, is recognized and agreed upon by the respondents in this research and therefore seems valid. However we did receive some suggestions to add factors to the list, which could mean that the current list may not be regarded as complete. Finally a BPMS implementation approach is suggested that takes into account all (critical) success factors that are divided in five different project phases or areas.

Although the current list of factors seems valid there are some comments we must make. The number of the respondents in the different research types is not large enough to do any profound quantitative analysis and therefore this research must be regarded as a qualitative validation. A larger population of respondents is needed to be able to draw conclusions on basis of quantitative analysis. Besides three of the respondents all are situated in the Netherlands, which makes that the findings of this research are not necessarily applicable in other countries or regions. Finally the clustering that is done was merely subjective and should be further tested and validated by research.

While the attention for BPMS is growing rapidly the amount of research done on BPMS implementation is still limited. The success factors found in this research need further validation. First an extensive quantitative validation is needed that is done on a broad scale. This research can than be extended to other regions to test whether there are any cultural differences. Also in-depth studies are needed to determine whether factors are different depending on the type of organization (for instance in specific sectors) or change during the life of a project.

This paper suggests an implementation approach that has not been tested or validated and neither has there been any research to compare this method to existing implementation approaches for software applications or management projects. Research in this area is needed, we suggest taking into account the many research initiatives that are currently done in the SOA domain.

When the success factors are validated thoroughly and the implementation framework is finalized we want to determine whether it is possible to link specific implementation activities and success factors together. This will then make it possible to quickly suggest a custom-made implementation approach to an organization based on situationality. For this we suggest using method engineering

(Harmsen et al., 1994) to develop implementation fragments that can be linked to the (critical) success factors.

4.7 Appendix

The following is an overview and clustering of all 55 success factors.

Cluster	Success Factors
A. Management of Organization and Processes	1. Project management
	2. Change management and involving people
	3. Understanding the BPM concept
	4. Management support and involvement
	5. Strategic Alignment
	6. Governance & accountability
	7. Training
	8. Culture
	9. Take into account the customers, industrial partners and the target environment
	10. Create challenging roles and new job perspectives after the project
	11. Establishing a support organization because ongoing maintenance and management is very difficult
	12. Treat value as realizable by all stakeholders, irrespective of geography or organizational boundaries
	13. Build a knowledge base around processes
	14. Implementation guide: follow an "inside-out" strategy, this means first prioritize the integration of internal systems and applications, defining and institutionalizing your business processes then the company is better suited for integration with external systems
	15. Use of best practices
B. Architecture Design	16. Understanding the process
	17. Use the 'best' modeling standards & techniques
	18. Organizing the modeling 'design' phase
	19. Maintenance and control - including quality - of the models is important
	20. When altering private processes, which modifications are allowed without jeopardizing the correct operation of the overall workflow
	21. Strategic objectives and functional objectives should be identified and linked to process model
	22. Lack of documentation of embedded processes in application systems
	23. Multi process adaptation alternatives should be present, and also a contextual adaptation process
	24. Underestimating the difficulty in integrating offshore-supplier employees into the processes and work flows of their companies
	25. Modeling interfaces related to software systems
	26. Pre-determined collaboration choreography of participating organizations (ad hoc changes are not possible)
	27. Interdependencies and Integration of Data sources
	28. Discovery of Information
	29. Process Orientation
	30. Defining (web) services
	31. Understanding the BPMS paradigm
	32. Business & IT divide
	33. Use of Business Rules
	34. Sometimes information-processing work is subsumed into the real work that produces the information
	35. For global inter-operability, transparency to the end user is needed which has consequences for the information availability

C. Developing an IT Solution Based on SOA	36.IT infrastructure is not aligned to the developed solution
	37. Embedded business logic within communications networks
	38. Integration of processes and data
	39. (Use of) Web services
	40. Transformation of design models into implementation models
	41. Delay the technology evaluation until process reverse engineering is finished
	42. SOA (currently) works best when working with applications from large IT vendors
	43. Reliability of Internet (standards)
	44. The process manager might get direct access to the application server where connections are running
	45. Testing prototypes and the final solution
	46. The inflexibility of IT application systems
D. Management of Implementation and Change	1. Project management (repeated)
	2. Change management (repeated)
	47. Involving people the right people
E. Measurement and Control	48.Performance Measurement
	49. Continuous Optimization
	50. An organization and culture of Quality
	51. Use multiple data gathering approaches
	52. The availability of data within the Supply Chain is critical
	53. Both formal and informal monitoring and reporting activities should be taken into account
	54. Capture information once and at the source (tasks are performed wherever it provides the most value)
	55. Granularity and visibility control (information is not available or private information is made public)

Surveying the Critical Success Factors of BPM-systems Implementation[4]

This chapter explores if there is a common ground for the definition of BPM and BPM-systems, as well as the Critical Success Factors (CSFs) for BPM-system implementation. A BPM-system Implementation Framework is validated that classifies the CSFs in distinctive domains that can be used for BPM project management and organization.

A meta-analysis of literature was performed to develop a set of statements with regard to the definition, benefits and CSFs of BPM(-system) implementation. Then a survey was conducted among 39 Dutch consultants, developers and end-users of BPM-systems that vary in BPM experience. Through a web-questionnaire the shared view of the respondents was measured with respect to the definition, benefits and the BPM-system Implementation Framework.

It appeared that different respondent groups share a common view on the definition and benefits of BPM and BPM-systems, regardless their role in the value chain of BPM deployment within organizations. In addition, there was consensus on the CSFs of BPM-system implementation. In particular it was supported that communication, involvement of stakeholders and governance is critical. Hence, organizations should realize that BPM-system implementation is not mainly an IT-project, but should preferably be initiated by top management.

This research was limited to representatives from Dutch organizations. Future research can be done in other countries to explore if BPM-systems and its CSFs differ across regions and cultures. Furthermore, the BPM-system Implementation Framework can be specifically validated by (comparative) case study or project research.

While BPM is commonly accepted as a concept, the CSFs for BPM-system implementation are hardly validated. This study shows, by empirical validation, if these CSFs from literature are supported by different groups of professionals. Furthermore, the CSFs for implementing BPM are modeled and classified in a framework build up from five areas. Analysis of the internal coherence of different survey items sets, supports that we can define the goals and CSFs when implementing BPM-systems.

5.1 Introduction

While Business Process Management (BPM) has achieved a certain standing among both academic and practitioners as a management concept, the knowledge about IS/IT (i.e. BPM-systems) to support the implementation of BPM is still

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premature. Since several years BPM-systems – and software that enable BPM by using the Service Oriented Architecture (SOA) paradigm – is getting more attention (Hill et al., 2006). Since Smith and Fingar published their seminal book 'Business Process Management: the Third Wave' a rise in both scientific and professional publications on BPM-systems has taken place (Smith and Fingar, 2003). In addition, a growing number of software developers and consultants enter the domain by providing their products and services for BPM-systems.

BPM-systems are the typical result of developments in both the business and IT-domain (Ravesteyn, 2007a). The most important influences from the business domain are Total Quality Management and Business Process Reengineering (cf. Deming, 1982; Hammer and Champy, 2001). At the IT-domain different types of IS/IT influenced BPM-systems as it is currently used, like Enterprise Resource Planning systems, Workflow Management systems (Van der Aalst, ter Hofstede and Weske, 2003), advanced planning systems and more. Along with this general development, BPM started as the automation of a company's internal processes and then became more externally oriented towards the digitization of supply chains (Davis and Spekman, 2003). Obviously, one of the basic conditions for this has been the explosive development of Internet technology and applications, the associated network standardization, and a significant change towards web services orientation.

Presently, BPM-systems are sometimes regarded 'just another' software application, while others consider it as the basis for a new paradigm (Ravesteyn, 2007a). As a consequence there is not a lot of scientific work available on the underlying architecture of a BPMS. The most apprehensive work has been done by Shaw et al. (2007) whom propose a pyramid architecture based on two legs. The first is the subject that is modeled while the second is the relating information system. Related to this distinction is the question whether the process of selection and implementation of BPM-systems can be done using available implementation methodologies and techniques, or that a new or adjusted method is needed as is concluded in (Ravesteyn, 2007b). Quite remarkable, most IT vendors and resellers seem to neglect the specific implementation aspects of BPM-systems as they tend to use existing software development methodologies and project management principles during BPM-implementations. Hence the implementation of a BPM-systems is mainly regarded as a standard software development project (Krafzig, Banke and Slama, 2004). Standard software development methodologies however – such as the waterfall method, Rapid Application Development (RAD) or Rational Unified Process (RUP) – ignore the business or organizational aspects.

These are aspects of particular importance for BPM-system implementations as it implies deep and enterprise-wide process analyses, and the inclusion of process performance measurement for continuous process (quality) monitoring and improvement. Also, contributions to academic and professional journals are more focused on what the BPM concepts is, and why organizations start BPM-projects (Van der Aalst, ter Hofstede and Weske, 2003; Fremantle, Weerawarana and Khalaf, 2002; Karagiannis, 1995; Weske, Van der Aalst and Verbeek, 2004). While there is research on the maturity level of organizations that are using BPM (Rosemann,, de Bruin and Hueffner, 2004; Harmon, 2004; Rosemann and De Bruin, 2005; Lee, Lee and Kang, 2007; Hammer, 2007), the question how a BPM-system can be implemented, and what business value it can bring, continues to be a white-spot. Next to this, the number of quantitative research available on BPM implementation is very limited. For example of all the articles in the Business Process Management Journal between 2000 and 2007 there are only 33 articles that are based on a quantitative research methodology and of these articles, 3 are about business process implementation (Wells, 2000; Al-Mashari et al., 2001; Davenport et al., 2004) while 7 articles are slightly related to this topic (Woon, 2000; Osuagwu, 2002; Crowe et al., 2002; Kim, 2005; Bhatt and Trout, 2005; Mansar and Reijers, 2007; Lee et al., 2007).

As the number of completed BPM-systems implementations in organizations is rather scarce, we decided to execute a consultation among BPM-practitioners in the Netherlands. In this paper we present the results of a survey among three main parties that represent the supply or value chain of the deployment of BPM-systems. We first consulted a group of developers of BPM-systems, secondly a group of BPM-implementers and finally end-users of BPM-systems. All three groups were questioned in a similar vein to investigate if there is a common understanding on (1) what is BPM and what are BPM-systems, and (2) what are critical success factors for implementing BPM-systems. In the next section the details on research methodology and the survey are presented, followed by a section with the results. Following a typical inductive approach, we subsequently describe from these results a framework for BPM-system implementation. We end with conclusions and some discussion and future research.

5.2 Research Methodology

In 2007 a survey has been developed, basically from scratch as earlier consultation or survey research on BPM implementation in the Netherlands is scarce or omitting. To enable a field consultation on the potential definitions and implementation approaches for BPM and BPM-systems, the survey had a broad scope and consisted of several parts. The survey structure was:

- General questions. Some open questions concerning the respondent's role, type of company, number of employees, industry.
- Questions on the definition of BPM. Two definitions were provided, as well as six Likert-items related to BPM and BPM-systems.

- Questions on the perspectives for BPM. Some open questions on models and tools used in relation to different BPM-perspectives, i.e. the strategic, operational, design, change perspective, et cetera.
- Questions on the architecture for BPM. Some closed and open questions concerning the software architecture of a BPM-systems.
- Questions on the implementation of BPM-systems. In total 26 Likert-items related to BPM-systems implementation (and its critical success factors).
- Questions on competencies for BPM. Some open questions about the knowledge, skills and attitude required for BPM(-system) implementations.

The original questions and items will be described in detail in the next sections, as for this paper we mainly focus on the questions that were answered on the definition and implementation of BPM-systems. The complete questionnaire (in Dutch) is available upon request.

The survey was sent out to the contact persons of in total 925 organizations based in the Netherlands. These organizations were divided in two groups: a first group of 700 companies were member of the Dutch 'BPM Forum', a second group consisted of 225 companies whose managers follow professional courses at the University of Applied Sciences Utrecht. This division enabled us to recruit both companies with a (relatively) high and lower of knowledge on BPM. The BPM Forum members are assumed to have a different view on the BPM-domain compared to the second group of companies. As stated above, the sample was also specifically stratified to recruit respondents from (1) developers of software tools for BPM-systems, (2) consultancy organizations, and (3) end-user organizations. The survey was provided through a personal e-mail with a link to a web questionnaire tool, to ease its completion and processing. Two reminders were sent out during the field work. Of the first group 6 e-mail addresses turned out to be invalid and of the second group 23 people responded that they didn't have the level of knowledge that is needed to fill out the questionnaire. The final response consisted of 39 fully completed questionnaires. This response rate of 4.2% (or 6,7% including the 23 responses that did not fill out the questionnaire) is below expectations, but not exceptional for surveys among respondents that are not directly related or acquainted to the sender (Sivo et al., 2006; Grover et al., 1993). It should also be noted that the survey took a considerable time to complete the questionnaire, i.e. about 40 minutes.

Despite the limited size of the response group, we were able to achieve sufficient variation on two important criteria. As table 5.1 shows, our respondents were equally divided over BPM forum membership and their professional role with regard to the BPM vale chain.

	Professional BPM position			Total
	BPM developer	BPM consultant	BPM End-user	
Member of the BPM Forum	6	15	3	24
None BPM Forum member	0	6	9	15
Total	6	21	12	39

Table 5.1 The survey response group by membership of the BPM forum and BPM supply chain position

5.3 The definition and benefits of BPM and BPM-system: a validation

As stated earlier there are many different definitions for BPM and BPM-systems. It can therefore be expected that there is disagreement or confusion on what BPM is among different groups of practitioners. To find out whether this is the case, we proposed our stratified group of respondents the following definition of BPM, first as a management concept:

Business Process Management is "a field of knowledge at the intersection between Business and Information technology, encompassing methods, techniques and tools to analyze, improve, innovate, design, enact and control business processes involving customers, humans, organizations, applications, documents and other sources of information" (Van der Aalst, ter Hofstede and Weske, 2003).

The respondents largely agreed with this description of the management concept BPM. On a 7-point scale (ranging from 1=fully disagree with this definition until 7=fully agree with this definition) the mean score was 5.15 with a standard deviation of 1.33 indicating a high level of consensus also. Differences between respondents by membership or professional BPM role (see table 5.1) were small and non significant (two-tailed t-test).

Secondly, we proposed the following definition of BPM systems, to explore the opinions on the IS/IT technology of BPM implementation:

Business Process Management Systems is "as a (suite of) software application(s) that enable the modeling, execution, technical and operational monitoring, and user representation of business processes and rules, based on integration of both existing and new information systems functionality that is orchestrated and integrated via services" (Ravesteyn and Versendaal, 2007).

Again, the 39 respondent largely agreed with this definition; mean score is 5.0 and standard deviation is 1.47. Also, differences between the respondent groups were small and non significant.

We can conclude that a potential discussion or disagreement about the definition of BPM and BPM systems is not recognizable from the two survey questions

analyzed. An open question to comment on the two definitions was not used by the respondents at all, which supports this conclusion.

Based on these definitions, we subsequently asked respondents to rate six items on BPM and BPM-systems on a 7-point Likert scale. The items presented in table 5.2 below (translated from the original Dutch version) are formulated to measure how innovative and promising the respondents believe BPM is. The items originate from a meta-analysis of BPM literature (Ravesteyn, 2007b). Note that items 3 and 4 are formulated deviant from the others, to place variation within the item list and trigger respondents to carefully read and answer the different statements. Item 1 refers to a figure presented to the respondents that shows a brief historical overview of how BPMS evolved from different management concepts and IT innovations during the past two decades. Current BPM-systems aim at supporting the different management concepts by offering an integrated suite of functionality that is based on IT developments such as workflow management and integration capabilities. In itself, a BPM-system is not meant to replace existing (legacy) systems in an organization. Instead, it uses the information in these systems and adds a new process and integration layer to make the entire information system more flexible and adaptable so the business is able to be more agile. The figure as presented in the questionnaire is depicted below as figure 5.1.
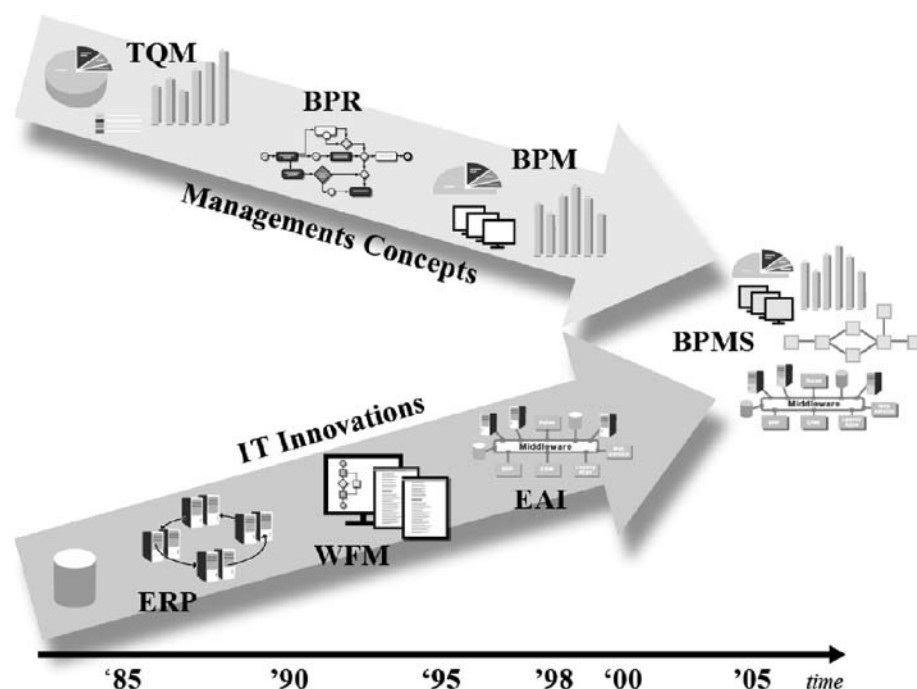
Figure 5.1 Historical Roadmap to BPMS

#	Item	Mean	Standard Deviation
1	Figure 5.1[see text above this table] shows how, according to us, management concepts and IT innovations have evolved into BPM-systems	4.58	1.58
2	The BPM-systems that are currently on the market can be considered a new type of software application	4.07	1.75
3	BPM is being hyped as a new management concept but it has been around for a long time and can therefore not be considered as new.	4.18	1.62
4	BPM-systems are nothing more than a combination of long existing IT applications and functionality	4.15	1.59
5	The essence of BPM is the continuous measuring and improving of operational processes	4.79	1.79
6	By applying BPM an organization is able to make its processes and supporting information systems more flexible and adaptive to change	5.28	1.29

Table 5.2 Judgment of the statements on BPM and BPM-systems

On average, respondents agreed with all statements as averages are 4.0 or higher (on a similar 7-point agreement scale as presented above). So the formulated innovative and adaptive potentials of BPM are recognized, although some were more supported than others. Flexibility and adaptation to change was agreed upon most prominently (average 5.3) while the newness of BPM systems was less supported. For all statements standard deviations are relatively low, indicating consensus within the group of respondents, while no significant differences between the respondents groups were found either.

Based on these results, we tested the interrelations and (one-dimensional) consistency of the set of items by applying exploratory factor analysis (table 5.3). It appears that the six items load on two factors (eigenvalue are 2.48 and 1.58 respectively, cumulative explained variance is 68%). As could be expected, the first factor consists of the four items (#1, 2, 5 and 6) that are 'positively' oriented towards BPM, while the second (# 2 and 3) comprehends the two critically formulated items.

#	Item	Factor 1	Factor 2
1	Figure 5.1 [see text above table 5.2] shows how, according to us, management concepts and IT innovations have evolved into BPM-systems	0.78	-0.09
2	The BPM-systems that are currently on the market can be considered a new type of software application	0.79	-0.46
5	The essence of BPM is the continuous measuring and improving of operational processes	0.84	-0.01
6	By applying BPM an organization is able to make its processes and supporting information systems more flexible and adaptive to change	0.64	0.33
3	BPM is being hyped as a new management concept but it has been around for a long time and can therefore not be considered as new.	-0.18	0.76
4	BPM-systems are nothing more than a combination of long existing IT applications and functionality	0.13	0.87

Table 5.3 Factor analysis results (after Varimax rotation) on 6 statements on BPM and BPM-systems

A Cronbach's of .77 proofs reliability of the first 4-item scale, while the two items of the second dimension significantly correlate as well (r=+.43, p=.00).

Further analysis is conducted on the differences between the subgroups within our sample, i.e. BPM forum membership and the professional BPM role of the respondent. As can be seen from table 5.4, between-group differences exist but in most cases these were not significant. On item 6, the BPM-forum members agreed highly (5.62), while the average for non-members was moderate (4.73). A (two-sided) t-test for independent groups (significance level p<.05) supported that this difference was significant. Also, statement 1 (that refers to figure 5.1) was rated higher by the end user organizations (5.67) than by the developers and consultancy organizations (a mean of respectively 4.33 and 4.05). From ANOVA-analysis however, it appears that these differences are non-significant. It is worth noting though, that the BPM Forum members commented more frequently on how to improve this figure while there were no comments whatsoever by the non-member group.

		BPM forum member			Professional BPM position			
#	Item	No	Yes	Diff.	Consultant	Developer	End-user	Diff.
1	Figure 5.1 [see text above table 5.1] shows how, according to us, management concepts and IT innovations have evolved into BPM-systems	4.46	4.80	ns	4.05	4.33	5.67	Sig**
2	The BPM-systems that are currently on the market can be considered a new type of software application	4.27	3.96	ns	3.95	4.17	4.25	ns
3	BPM is being hyped as a new management concept but it has been around for a long time and can therefore not be considered as new.	4.60	3.92	ns	4.05	4.00	4.50	ns
4	BPM-systems are nothing more than a combination of long existing IT applications and functionality	4.27	4.08	ns	4.33	3.50	4.17	ns
5	The essence of BPM is the continuous measuring and improving of operational processes	5.47	4.38	ns	4.48	4.67	5.42	ns
6	By applying BPM an organization is able to make its processes and supporting information systems more flexible and adaptive to change	4.73	5.62	Sig*	5.33	6.17	4.75	ns

Table 5.4 Factor Scores on the 6 statements on BPM and BPM-systems[5]

5.4 The critical success factors for BPM-system implementation: a framework

Now that we have found that the most-mentioned definitions and benefits of BPM and BPM systems (which were derived from an earlier meta-analysis of literature, Ravesteyn, 2007b) are confirmed by our respondents, we take the next step to investigate their opinions about the Critical Success Factors (CSFs) for

[5] *: Significant based on two-sided t-test (t=2.13, df=37, sig.=0.35).
  **: Significant based on F-test (F=4.92, df=36, sig.=0.31).

implementing BPM-systems. In order to identify the most important CSFs of BPMS implementation, another literature study (cf. Ravesteyn, 2007b) of 104 articles and books was performed. For each article or book, the domain and type of research approach was coded and classified. The different domain categories are based on the main evolutionary drivers behind BPMSs, i.e. Total Quality Management (TQM), Business Process Reengineering (BPR), WorkFlow Management (WFM), Enterprise Application Integration (EAI), Business Activity Monitoring (BAM) and others (see figure 5.1 presented in the previous section). Next to this, CSFs were classified accoriding to the CSFs that are knowns from Enterprise Resource Planning (ERP) implementations (cf. Hong and Kim, 2002; Bradford and Florin, 2003; Kamhawi, 2007). Combining both classifications, we see that CSFs that are specific to the implementation of a BPMS typically relate to the development and use of services, together with data about granularity of services, integration of existing applications via services, and data quality. Together with its categorization, a long list was compiled with over 337 different CSFs. From this list, the SCFs were selected that were found three or more times in the literature base. This reduced the total number of factors to 55 prominent SCFs for BPMS implementations.

The 55 CSFs were then categorized in two ways. First into a business or IT domain, based on the principles of strategic and business/IT alignment (Henderson and Venkatraman, 1993; Luftman, 2000). Secondly, they were allocated along the three main dimensions of BPMS projects: (1) management and organization, (2) architecture, and (3) IT integration. Jointly, the CSFs can be clustered into five areas of BPMS implementation that build a BPMS implementation framework:

1. the ongoing domain of the business organization itself,
2. the measurement and control function within the organizational domain,
3. the BPMS implementation project domain,
4. architectural issues within the project domain,
5. development activities within the project domain.

This framework is presented in figure 5.2 below. It shows the areas that are assumed to be a crucial part of a BPMS implementation methodology. It also depicts that a BPMS implementation is a continuous process to go from the "as is" to the "to be" situation through different project steps.

The framework in figure 5.2 shows that the BPMS implementation project domain consists of two phases, the 'architecture design' phase and the 'development phase'. In the first phase a process and information architecture should be developed, i.e. the BPM part. Subsequently, this can be used in the realization of the technical infrastructure and creation of service-oriented business applications,

both part of the second phase. The two phases, that are part of any BPMS project, are supported by project and change management simultaneously. Applying the BPM and SOA paradigm both imply that changes in processes and IT-applications occur while working on a project. The BPM-system implementation can be regarded as a project or series of small projects, while the organization, the measurement and control function are in fact just a small part of the project.
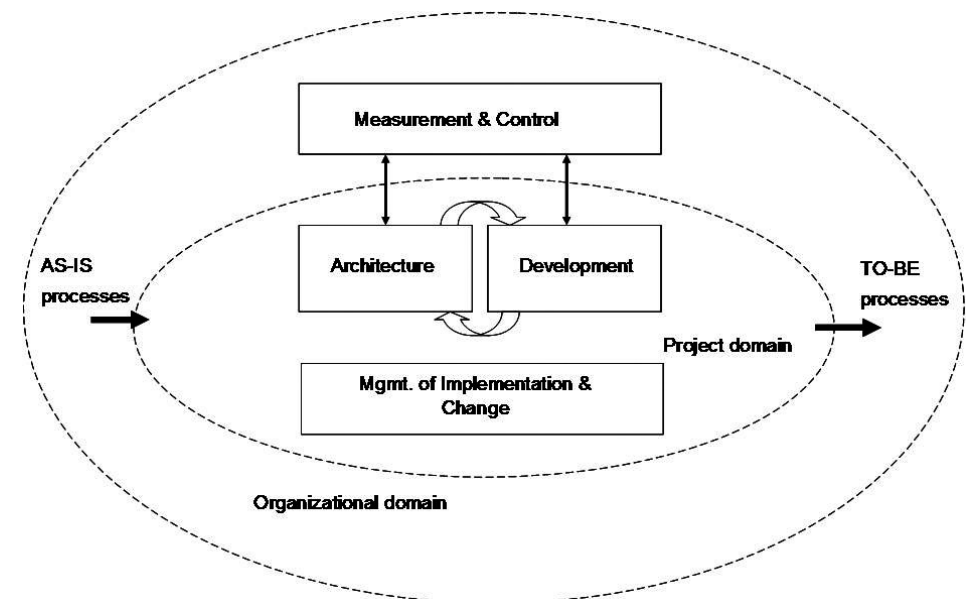
Figure 5.2 BPMS Implementation Framework

In applying the BPMS Implementation Framework, it should be noted that in most cases, an organization that wants to implement BPMS will already have an standing organization structure with running processes, which will be the starting point ("as is") for the implementation. Likewise, any organization that is already in operation will have some type of measurement and control function. For small businesses, this will probably be the accounting function only. For medium and large organizations, other functions will provide information about the organization and processes, such as the quality department etc. To succeed in implementing BPMS, there should be sufficient measurement information available about the processes that are going to be modeled. If this is not the case, the assumption behind the framework is violated and the implementation should not be started.

Metrics on processes are therefore important to be able to continuously measure the effects of any changes.

Based on the BPMS Implementation Framework and the CSFs found through the literature study and meta-analysis a list of 26 statements was constructed to use the respondents for validation. We confronted the respondents with a list of Likert-items and asked them to indicate if they agreed to the statements, i.e. to rank if the CSF at stake is indeed relevant as suggested by literature and our BPMS Implementation Framework. Table 5.5 shows the answers of our 39 respondents on the items that are ordered according to the five areas of the framework.

#	BPMS Implementation Framework area	Description	Mean	Std. Dev.
1	Management of Organization and processes	To implement BPMS processes have to be optimized	3.97	2.00
2		Top management support is crucial when implementing BPMS	6.38	0.88
3		Implementation of BPMS should be a mandatory part of an organizations strategy	3.41	1.83
4		The implementation of BPMS should be aligned to the organizations strategy	5.87	1.00
5		Both IT employees, line-management and process owners should be members of the BPMS implementation project team	6.23	1.04
6		When implementing BPMS, governance should be one of the project goals from the start	6.28	1.15
7	Architecture (development of process and information architectures)	Before starting a BPMS implementation a process and information architecture should be available	5.74	1.35
8		In the modeling phase of a BPMS implementation project it is possible to use any modeling standard or technique	4.18	1.78
9		During a BPMS implementation the process architecture is always leading	5.10	1.68
10		When implementing a BPMS the quality, control and maintenance of processes is crucial	5.95	1.08
11		Before starting with a BPMS implementation there should be an architectural overview of any integration issues between processes and information / data	5.18	1.57

#	Area	Description	Mean	Std. Dev.
12	Development (of service oriented business applications and adapting the IT infrastructure)	In the BPMS implementation we used information from existing information systems and databases	5.33	1.33
13		Integration of different software applications was done via web services	4.46	1.48
14		During the implementation of BPMS the processes and information systems are aligned to each other	5.10	1.50
15		As part of the BPMS implementation the IT infrastructure was adapted to fit the outcomes of the project	4.64	1.72
16		In the BPMS implementation project we reused as many existing information systems as possible	4.90	1.41
17	Measurement and Control	An organization should have experience with quality programs / projects before being able to successfully implement BPMS	4.00	1.70
18		In the BPMS project we set baseline KPI's to measure the success of the project when it is finished	4.77	1.66
19		The availability of real-time management information is one of the main goals of the BPMS implementation	4.79	1.87
20		Business process improvement with BPMS has become a continuous effort due to the implementation	4.62	1.77
21		The BPMS implementation enabled us to implement management concepts like TQM and Six Sigma	3.87	1.84
22	Project- and change management	When implementing BPMS it is of vital importance to work according to a project management methodology (e.g. Prince 2)	5.23	1.83
23		A BPMS implementation will change processes and work procedures	5.36	1.76
24		There is a lot of resistance due to changing tasks and roles as part of the BPMS implementation	4.82	1.19
25		Communication throughout the entire BPMS project is a crucial factor to succeeding	6.69	0.77
26		To be able to implement BPMS a lot of support and effort from top management was needed	5.51	1.12

Table 5.5 Judgment of the BPMS implementation items by area of the BPM Implementation Framework

From table 5.5 we see that item 25: "*Communication throughout the entire BPMS project is a crucial factor to succeeding*" holds the highest mean value (6.69). Other items that are very much agreed upon are items 2, 5 and 6. Item 2 and 5 are about involving the right people in the project and making sure that there is support from top management. Item 6 is governance-related and fits with the current attention for the business/IT governance issues as for example in COSO and Cobit (ITGI, 2006). Item 3, which states that BPMS should be a mandatory

part of an organizations strategy, is rated lowest (3.41) but its standard deviation is also relatively high. The same applies for items 1 and 21.

If we oversee the complete set of items, most statements were agreed upon by the respondents (average as 3.97 on a 7-point scale) with a relative high level of consensus (i.e. low standard deviations). We performed scale analysis to explore the one-dimensionality of the set of 26 items. This resulted in a Cronbach's Alpha of 0.781, showing that all items are relevant indicators of the BPMS Implementation Framework.

In a second step of analysis we determine if the different groups we used for sample stratification rated the 26 items differently. As in the previous section, t-tests were performed to see if there were statistical significant differences between the BPM-Forum members and the other group. The result was that we did not found any significant difference between how the two groups rated the items in table 5.5. In addition we tested the distances between the answers of respondents from (BPM) developers, consultancy and end-user organizations. In three cases, ANOVA-analysis showed significant differences between three groups. Respondents from the developers rated items 4 and 12 significantly higher as the respondents from the other two groups, while the developers' respondents also rated item 8 significantly lower than the consultancy and end-user respondents. So the items "*the implementation of BPMS should be aligned to the organizations strategy*" and "*in the BPMS implementation we used information from existing information systems and databases*" was particularly agreed upon by the developers group, while the item "*in the modeling phase of a BPMS implementation project it is possible to use any modeling standard or technique*" was strongly disagreed by respondents from the developers group. With regard to these items the respondents from the consultant and end-user organizations do not differ in their opinion.

5.5 Conclusions

In this paper we presented the results of a survey among a group of 39 Dutch consultants, developers and end-users on how they view the concept of BPM, BPM systems and its CSFs for implementation. The three groups were randomly selected from two separate populations with a high and low level of knowledge about BPM. A first interesting result is that these different groups mostly share a common view on BPM and BPM-systems, regardless their role in the value chain of BPM deployment within organizations. Distinctive is, that developers and consultants with a specific BPM-experience more strongly believe that applying BPM enables organizations to improve processes and IS/IT in a more flexible and adaptive way. This outcome can be understood from the fact that these respondents are actually involved with the design and deployment of BPM-systems.

Through a list of 26 items the survey also validated that our BPMS Implementation Framework has a strong internal coherence and covers the main CSFs that have to be considered when implementing a BPMS. Most prominently supported by the respondents are the CSFs regarding communication, involvement of stakeholders and governance. This is expressed by the high agreement on statements as "*Communication throughout the entire BPMS project is a crucial factor to succeeding*", items with regard to the level of support from top management, making governance one of the project goals and involving the right people during the project. In this analysis, the different respondent groups agreed largely to the same extent on the items, although developers seemed to have a stronger opinion on some items. This group most strongly agreed with the statements that aligning software tools to the organizations strategy, and reusing existing information systems and applications when implementing BPMS is of high importance.

From a normative perspective (but based on our survey results) we suggest that organizations that start implementing BPMS should realize that it is not mainly an IT-project. A BPMS should support the goals of the business and therefore this BPMS projects are of strategic importance. They should preferably be initiated by top management within the organization, although small bottom up BPMS projects could function as a 'built up experience'. The CSFs as validated by our survey basically advocate that no major BPMS projects should be under taken without a top down approach.

5.6 Discussion and Future Research

Some important limitations should be recognized with regard to the results of this research. Most prominent, the results are limited to the Netherlands, i.e. the views of Dutch BPM practitioners. An obvious extension of this research is to apply the survey within other countries, and to subsequently explore the validity of our BPM definitions, implementation framework and accompanied item list. A very interesting step for further research is to see if the definition of the BPM-domain differs between countries and/or cultural regions. This could be specifically investigated by surveying enterprises with international locations.

A second point of extension is in the practical usability of the BPM implementation framework. A profound claim to be tested is to see from case or project studies whether applying the framework actually improves the success of BPM-projects and BPM-system implementations. The question here, in other words, is about the added value of the framework and the extend to which it needs more or less level of detail. Currently the framework is theory-based, while a next step needs to be set to support the actual project management of BPM(-system) implementations.

Cultural Differences in Implementing Business Process Management Systems[6]

In this chapter we present the results of an international comparative research conducted through a special web survey, i.e. an online 'game' to rate and classify Critical Success Factors (CFSs) for BPMS implementations. The survey was completed by 39 respondents from 11 different countries. Central to the research was the question how BPM-systems success factors are perceived by professionals from different countries (i.e. cultural backgrounds) and how this is related to other characteristics such as their level of experience within the BPM domain. The respondents judged a total of 55 factors in two ways: (1) by allocating them to one of the five domains of BPMS implementation, and (2) by ranking their importance for BPMS implementations. Significant differences were found between respondents from Northern European versus Anglo-American countries, and between respondents with different levels of experience with BPMS implementations.

6.1 Introduction

After the term Business process management systems (BPMS) was already introduced in the mid nineties (Karagiannis, 1995), it has generally been described as a standard application for process improvement, execution, control and monitoring for both organizations and inter-organizational systems (cf. Chen et al., 2007). After reviewing a number of definitions, Ravesteyn and Versendaal (2007) define a BPM-system in a more elaborated way as "a (suite of) software application(s) that enable the modeling, execution, technical and operational monitoring, and user representation of business processes and rules, based on integration of both existing and new information systems functionality that is orchestrated and integrated via services." From this extended definition it becomes clear that a BPMS cannot be regarded as a regular or standard enterprise system. Although a BPMS is in essence process centric, it also comprises functionality to integrate existing information systems and enable the development of service oriented architectures (Krafzig et al., 2005; Weske, 2007). Consequently, existing implementation methods for enterprise systems cannot be directly applied to the implementation of a BPMS. Hence, existing implementation methods should be adapted or a new method should be developed. A first step in recognizing the activities that should be part of a BPMS implementation is creating an overview of factors that contribute to the success or failure of such an implementation. While there have been many studies on the critical success factors (CSFs) of enterprise systems (i.e.

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[6] Originally published as: Ravesteyn, P., & Batenburg, R. (2010). Cultural Differences in Implementing Business Process Management Systems. *Conference Proceedings Americas Conference on Information Systems 2010.*

ERP) implementation (Bradford and Florin, 2003; Botta-Genoulaz, Millet and Grabot, 2005; Hong and Kim, 2002; Kamhawi, 2007), studies on the CSFs for BPMS implementation are still scarce.

In this paper we built on the work by done by Ravesteyn and Versendaal (2007) and Ravesteyn and Batenburg (2008) who identified 55 success factors of BPMS implementation in the Netherlands. The first study consisted of a multi method research approach to discover and validate success factors when implementing BPMS. The success factors found through literature study were validated by 68 respondents in a qualitative research conducted in the Netherlands. The second study presented the results of a survey among a group of 39 Dutch consultants, developers and end-users. It describes their view on the concepts of BPM, BPM-systems and success factors for implementation. In this study a set of 26 success factors (a subset of the 55 factors of the first study) was validated by conducting a survey. While the list of 55 success factors seems valid for the Dutch market, both studies mention that the research results are not necessarily applicable to other countries or regions. From this, the trigger emerges to explore whether there are differences across different countries in the perceived importance of CSFs for implementing BPMS. To put this trigger into an empirical study, a number of factors need to be taken into account, most important the level of experience organizations and professionals in different countries have in the domain of BPMS implementation. In this paper we present the design and result of such an international study aiming to answer the following research question: *How are BPM-systems success factors perceived by professionals from different countries (i.e. cultural backgrounds) and how is this related to other characteristics such as the respondents level of experience within the BPM domain?*

In the following section the research design is described. Section 3 presents an overview of the data analysis and results. Finally sections 4 and 5 give preliminary conclusions regarding the research question and suggestions for further research.

6.2 Research Design

To conduct an empirical study that can answer the central research question, an international web survey was developed for BPM(S) professionals. The survey consisted of three parts. The first part contained six general questions in which information about respondents was gathered concerning nationality, gender, organization sector, function, level within the organization (e.g. executive, middle management, operational etc.), and years of experience within the BPM domain. The list of nationalities was based on the ISO 3166-1-alpha-2 code from which we omitted countries with a population less than 500,000. The sectors or industry

of employment that respondents could select are based on the International Standard Industrial Classification of All Economic Activities of the United Nations (ISIC Rev. 3.1, 2002). Level of experience with BPM(S) was queried by five categories: 0-2, 2-5, 5-10, 10-15 and >15 years of experience. In the final part of the survey, two questions asked respondents to leave their e-mail address and comments or remarks. The main part of the survey consisted of 55 questions concerning 55 CSFs for BPMS implementation (the appendix (6.8) provides the full description of all CSFs). For each CSF respondents were asked to (a) give an importance score between 1 to 7 on a Likert scale (1=very insignificant to 7=very important) and, (b) assign the CSF to one of five different domains:

1. The domain of the business organization and its processes, labeled 'Management of organization and processes';
2. The measurement and control function within the organizational domain, labeled 'Measurement and Control';
3. The BPMS implementation project domain, labeled 'Implementation and change management';
4. Determining the architecture that the BPM-system implementation should enable, labeled 'Architecture';
5. Software and service development activities within the project domain that are part of the BPMS implementation, labeled 'Solution development'.

The list of 55 CSFs when implementing BPM-systems is based on an earlier literature study that was subsequently validated at several Dutch organizations as described by Ravesteyn and Versendaal (2007). From this study we also apply the five domains described above. These domains represent important aspects of BPM-systems implementation that can be found in many other implementation methods (Ravesteyn and Jansen, 2009). In total, the constructed survey consisted of 116 pre-structured questions and 2 open questions.

The part of the survey by which the respondents were asked to rate and allocate the 55 CSFs was developed as a 'game'. Instead of asking respondents 110 questions, the 55 success factors were showed on a webpage as 'playing cards' that can be placed on a 'allocation board' (i.e. matrix) consisting of seven by five fields which represent the five domains on the one hand, and the 7 importance scores on the other. In this way, the respondents were able to quickly allocate these 55 CSFs to the cells of the matrix by dragging and dropping. Each 'factor-card' can be allocated to each of the 35 cells on the board, thereby actually assigning two values to each factor. figure 6.1 shows the architecture of the developed 'digital game' (to be found at www.bpm.hu.nl/bpmgame).

Garbage bin	1	2	3	4	5	6	7
Management of organization and processes							
Measurement and Control							
Implementation and change management							
Architecture							
Development							

Figure 6.1 Architecture of the allocation board of the BPM game

Testing showed that the time needed to categorize the success factors was approximately 15 minutes. In addition, the possibility was added to the application to drop a CSF in a 'garbage bin' if a respondent believed that it was not relevant, i.e. unrelated to BPMS implementation. The web survey was designed in such a way that respondents had to answer the six general questions about their background before they were invited to 'play the game'.

The web survey and its game/allocation tool were tested by a group of 10 students that followed a BPM course as part of the Master of Informatics at the HU University of Applied Sciences. During testing, some bugs were found and fixed. The web survey, including the tool linked to an initiated database, was launched in October 2009 via the Internet. By posting messages in 15 BPM related LinkedIn groups (such as BPM Guru, Business Process Improvement, BP Group, BPM Professionals Group and others) the research was put under the attention of BPM interested professionals. The first messages that were posted in each group reached approximately around 26 thousand persons. Because many join several groups, and most of them do not participate actively, it is not possible to estimate the number of unique persons that was reached with the posted messages. After posting two reminders, each after one month, a total of 109 professionals have visited the website and started the survey. From these, 59 respondents only answered the first six questions and quit the survey after they reached the 'game' allocation board. Of the 50 respondents that started the 'digital game' by dragging and dropping CSF cards, another 11 stopped before 10 cards were allocated. These persons were regarded as non-respondents as well. Finally, a total of 39 participants (36 men and 3 women) finished the web survey completely. These respondents were included in the analysis.

Due to the limited size of the response group, respondents with different nationalities were clustered into three 'cultural' groups of countries. Respondents from the United Kingdom, United States and Canada were clustered in a group labeled 'ANGLO' (23%). A second group labeled 'NORDIC' consists of respondents from Norway, Sweden, Finland, Denmark and the Netherlands (41%). The third and final group was labeled 'OTHER' and contains respondents from other

countries (36%). This clustering can be related to the cross-national study by Hofstede (1982). In his highly cited study, Hofstede has developed country scores on the four cultural dimensions: power distance (PDI), individualism (IDV), masculinity (MAS), and uncertainty avoidance (UAI). Following Hofstede, it can be assumed that all countries in the ANGLO group particularly score high on individualism and masculinity, while countries in the NORDIC group score high on individualism but low on masculinity. From this, it can be expected that these countries differ in assertiveness as well as in competitiveness, i.e. ANGLO countries score high, NORDIC countries score low on these dimensions. Hence we expect that this influences the opinions of professionals that are employed in these countries, and consequently has an effect on how CSFs for BPM-systems implementation are perceived by professionals.

The levels of respondents' experience were also categorized from five levels to three levels to achieve a sufficient number of cases within each category to perform split analysis. Most of respondents had less than 5 years of experience (44%), 28% had 5 to 10 years of experience, while 28% over 10 years of BPM(S) experience.

Finally, there is relevant variation between the respondents in terms of their sector of employment and position within the organization. Most respondents categorized themselves as manager (38.5%), consultant (28.2%) and business analyst (15.4%). Respondents are mostly employed in the IT sector (36%), scientific and technical services (20%), and finance and insurance (15%).

6.3 Data analysis

The data available for analysis is based on the answers of 39 respondents. Some indication on data validity can be derived from their answers and scores. Only eight of the respondents left comments or questions after finishing the web survey. Two commented that the formulation of some of the CSFs while three stated that at the start of the 'game' it was not clear that it was possible to drop more than one success factor in a particular cell of the matrix. Given this limited number of comments, it can be concluded that among the participants who completely finished the 'game' there was little confusion about the formulation of success factors or the working of the 'game'. Also, respondents dropped on average 2.07 success factors in the garbage bin. This means that overall the participants agree that the list of 55 CSFs is indeed relevant when implementing a BPM-system. The two factors that were allocated to the bin most often were:

- *'Information-processing work should be subsumed into the real work that produces the information' (7 times) and*

- *'For global inter-operability, transparency to the end user is needed where this has consequences for the information availability'* (5 times)

An explanation can be that respondents found these items too vague or simply too obvious to clearly judge them on importance or allocate them to a BPM domain.

To be able to answer the research question we performed ANOVA-analysis to determine if there are significant differences between (a) professionals from the three different cultural groups of nations and (b) professionals with different levels of experience, with regard to their importance rating and allocation of the SCFs to the domains.

6.4 Differences Between Professionals from the Three Country Clusters

The first ANOVA-analysis (not shown here) shows no significant differences (significance level $p<.05$) between the three cultural groups on how respondents allocated all CSFs over the five domains. It is worth nothing however, that respondents from the NORDIC group allocated more CSFs (12.31) to the BPMS implementation project domain compared to respondents from the ANGLO (8.11) and OTHER countries (8.85). It might be the case that respondents from the NORDIC group of countries believe that more CSFs should be specifically taken into account during project and change management activities.

	Country cluster			
	ANGLO	NORDIC	OTHER	Total
-1- Know-how and experience with Project Management	6.11	6.38	**4.23**	5.58
-2- Experience with Change Management	6.33	6.13	**5.08**	5.82
-3- Understanding the Business Process Management concept	4.89	**6.38**	5.31	5.66
-4- Strong management support and involvement is needed	6.00	**6.69**	5.50	6.10
-11- Establishing a support organization is vital to ensure ongoing maintenance and management of processes	5.78	5.75	**4.15**	5.21
-14- The BPM(S) implementation should start within the organization before external processes and systems are included	3.25	**5.25**	3.92	4.36
-38- Understanding how processes and data are linked together	5.33	**6.19**	4.57	5.41
-50- Creating a culture of attention to quality within the organization	5.89	6.19	**5.07**	5.72
N	9	16	14	39

Table 6.1 Eight CSFs that were rated significantly different on their importance for BPMS implementation, by respondents from three country clusters

The second ANOVA-analysis did show significant differences between respondents from the three cultural groups, with regard to their importance scores on 8 out of 55 CSFs for BPMS. Table 6.1 gives an overview of these CSFs and the (significant) differences between the three groups.

As can be seen, respondents from the NORDIC group rated factors 3, 4, 14 and 38 significantly higher as the respondents from the other two groups while the group OTHER rated factors 1, 2, 11 and 50 significantly lower than the other groups. If we analyze the differences between the ANGLO and NORDIC groups, factors like '*understanding the BPM concept*', having *strong management support and involvement*, the need for *the BPM(S) implementation to start within the organization before external processes* and *systems are included and understanding how processes and data are linked together* are judged to be more important by professionals from Northern European countries compared to the professionals from the United States, United Kingdom and Canada. Alternatively the respondents from the OTHER group have a lower rating for factors *such as experience with project management, change management, establishing support within the organization to ensure ongoing maintenance and management of processes, and attention to creating a culture of quality within the organization* compared to the other two groups.

6.5 Differences Based on the Experience Level of the Respondents

A third ANOVA-analysis was performed to determine if respondents with different levels of BPM(S) experience differ in how they assigned the CSFs to the five different domains (not shown here). Contrary to the previous analysis on country clusters, significant differences in experience were found, in particular with regard to the allocation of CSFs to domain 3: *Aspects concerning the project management of the implementation of a BPM-system*. Respondents with more than 10 years of experience assigned significant more factors (on average 13.36) to that domain than the other groups (5 years or less experience: 8.47, 5-10 years: 9.36). From this, it can be concluded that the most experienced respondents believe that many CSFs are part of managing the implementation of a BPM-system and any changes that occur due to this. The domain to which the most experienced respondents allocated most other CSFs was domain 5: *Software and service development activities that take place as part of the project*. This further supports that professionals with much experience on BPMS implementation believe that these mostly fail due to either insufficient project management or mistakes at the IT part of the project (i.e. development of (web) services or integration of information systems as part of the project).

In the final ANOVA-analysis, we found three CSFs with significant differences in how the three groups assigned an importance rate to the success factors (see table 6.2).

	Experience levels			
	< 5 years	5-10 years	>10 years	Total
-5- The BPM(S) effort should be aligned to the organizations strategy	**5.69**	6.82	6.73	6.32
-8- An organizations culture will influence the success of the BPM(S) project	**5.19**	6.27	6.91	6.00
-55- Granularity and visibility control should be managed (to rule out that information is not available or private information is made public)	**6.06**	4.36	5.36	5.38
N	17	11	11	39

Table 6.2 Three CSFs that were rated significantly different on their importance for BPMS implementation, by respondents with three levels of BPM experience

As can be seen, respondents with lesser experience rate CSF5 and 8 significantly lower compared the other respondents, while they rate CSF 55 significantly higher than the other groups. The fact that respondents with more than 5 years of experience find CSF5 (*alignment of a BPMS implementation to the organizations strategy*) and CSF8 (*an organizations culture will influence the success of a BPMS project*) significantly of more importance, confirms that typically these factors are 'seen' by professionals who have experience and knowledge about more and different BPMS projects. If we look at the absolute scores of the CSFs in table 6.2, it is remarkable to see that factor 55 is the highest rated factor by those with 5 years or less experience. The respondents with between 5 to 10 years experience rate CSF5 (*the BPMS effort should be aligned to the organizations strategy*) as the highest of all factors, followed by CSF4 (*strong management support and involvement is needed* and then CSF8. The most experienced respondents have rated CSF8 highest of all factors. This confirms the notion that professionals that are involved in BPMS implementations tend to pay more attention to technical factors when they are less experienced. Throughout the years, when professionals experience project failures, insufficient project and change management, or misalignment with the organizational strategy are experienced as more important and critical factors. This explains that the most experience professionals judge as the most important CSF when implementing a BPMS the fact that an '*organizations culture which will influence the success of a BPMS project*'. As a consequence, we also need to conclude that it is very hard to predict the success of a BPMS

implementation at the start of the project because changing an organizations culture is a long term and very difficult effort (Kotter, 1996).

6.6 Conclusion

In this paper we presented the results of an international research conducted through a web survey and an online 'game' to judge CSFs for BPMS implementations. The survey was completed by 39 professionals from 11 different countries. Via the 'game' application, respondents were asked to place 55 cards, each holding a description of a CSF for BPM-systems implementation, onto a two-dimensional 'board' containing 35 cells. By placing a card, a CSF was simultaneously assigned to (1) one of the five domains that can be distinguished for BPMS implementation, and (2) their importance or significance for BPMS implementations (ranging from very insignificant to very important).

Based on the collected data it was possible to make a distinction between the different cultural areas the respondents are employed in, and their level of experience within the BPM domain. A first interesting result is that overall these different groups mostly share a common view on the five domains to which CSFs belong. Only respondents with a high level of experience deviated from the average, as they believe that the aspect of project management during a BPMS implementation is significantly more important than other aspects. Furthermore, if we look at the importance rating of the CSFs, depending on the national/cultural background or the level of experience of the respondents some significant differences can be found. A first interesting finding is the differences between the professionals from the Anglo- and Nordic countries on factors like: *understanding the BPM concept, having strong management support and involvement, the need for the BPM(S) implementation to start within the organization before external processes and systems are included and understanding how processes and data are linked together*. These CSFs seem to be more important for BPM professionals that act in Northern European countries compared to those in the United States, United Kingdom and Canada. It remains difficult to say whether this can be explained by the different scores that these regions have on the cultural dimension as determined by Hofstede, although this is worth exploring further. A second finding is that respondents with more experience in BPMS implementations tend to find the 'soft' or intangible CSFs more important than others, in particular the CSFs *alignment of the implementation to the organizations strategy, strong project management and the influence of culture on the success of a BPMS project*. This implies that organizations that start implementing BPMS, in the longer run, will be confronted with the fact that it is not mainly an IT-project but a project that should be aligned to the strategic goals of the business. It also implies that BPMS projects

are of strategic importance and should preferably be initiated and constantly supported by the top management within the organization. Finally, the answers of the most experienced BPM professionals support the notion that organizational culture plays a vital role in the success of a BPMS implementation as BPM coincides with fundamental changes within an organization. In conclusion, this research supports BPM consultants and project members to specify the critical success factors for BPMS projects and anticipate on these.

6.7 Discussion and Further research

The objective of this research was to find how BPM-systems success factors are perceived by professionals from different countries and with different levels of experience within the BPM domain. Although in this research significant differences were found between cultural backgrounds, as well as between levels of experience, the number of respondents is quite limited to draw ultimate or generic conclusions. Therefore this research can primarily be considered as explorative. To generate as much input as possible it was decided to keep it open online, not using any type of sampling.

We suggest that future research can focus on professionals from other cultural groups, such as Asian and South American countries. Also, it can be useful to analyze whether there are differences between different sectors or between different groups of functions/roles of the respondents. Finally, the list of 55 CSFs can be revalidated and investigated on validity, reliability and multicolinearity. This can result in a shorter and more effective list of CSFs for BPMS implementations.

6.8 Appendix

CSFid	Description	Sig. Culture differences	Sig. Years of experience
1	Know-how and experience with Project Management	**0.000**	0.189
2	Experience with Change Management	**0.018**	0.146
3	Understanding the Business Process Management concept	**0.021**	0.135
4	Strong management support and involvement is needed	**0.050**	0.051
5	The BPM(S) effort should be aligned to the organizations strategy	0.157	**0.034**
6	Taking into account governance & accountability is crucial	0.624	0.541
7	Training BPM(S) project members and end users is essential	0.072	0.317
8	An organizations culture will influence the success of the BPM(S) project	0.064	**0.017**
9	The customers, industrial partners and the target environment should be involved in the project	0.342	0.198
10	Challenging roles and new job perspectives should be created for after the project	0.160	0.896
11	Establishing a support organization is vital to ensure ongoing maintenance and management of processes	0.014	0.079
12	The project should aim at creating value for all stakeholders, irrespective of geography or organizational boundaries	0.226	0.152
13	The BPM(S) effort should build a knowledge base around processes	0.208	0.056
14	The BPM(S) implementation should start within the organization before external processes and systems are included	**0.009**	0.506
15	A BPM(S) project should use best practices	0.166	0.777
16	Understanding the processes of the company	0.106	0.365
17	Using the 'best' modeling standards and techniques	0.735	0.723
18	A well organized design (modeling) phase	0.414	0.549
19	Well organized maintenance and (quality) control of the process models	0.672	0.704
20	When activities / (sub)processes are changed, the correct operation of the overall process should be tested	0.496	0.613
21	Strategic objectives and functional objectives should be identified in the BPM(S) project and be linked to process models	0.407	0.860
22	Availability of documentation of embedded processes in application systems is important	0.407	0.128
23	A BPM(S) project should offer multi process adaptation alternatives, and also a contextual adaptation process	0.252	0.810
24	Take into account the difficulty in integrating offshore-supplier employees into the processes and the workflows of their companies	0.517	0.800
25	The software systems interfaces should be modeled	0.703	0.208
26	Pre-determine the collaboration choreography of participating organizations and rule out ad hoc changes	0.644	0.287
27	Understanding interdependencies and integration of data sources	0.417	0.776
28	Finding process related information	0.183	0.470
29	The organization needs to be process orientated	0.599	0.358
30	Knowledge on defining and using (web) services needs to be available	0.448	0.690
31	The organization and people involved should fully understand the BPM(S) concept	0.666	0.424
32	The business and IT departments need to work closely together	0.236	0.622

33	A BPM(S) project should also use/involve business rules	0.084	0.794
34	Information-processing work should not be subsumed into the real work that produces the information	0.491	0.668
35	For global inter-operability, transparency to the end user is needed where this has consequences for the information availability	0.116	0.152
36	The IT-infrastructure should be aligned to the developed solution	0.526	0.104
37	Embedded business logic within communications networks need to be taken into account	0.878	0.220
38	Understanding how processes and data are linked together	**0.010**	0.411
39	Understanding how to use the concept of (web) services	0.926	0.896
40	A 1-on-1 transformation of design models into implementation (runtime) models is important	0.836	0.867
41	First finish the process analyses and engineering before evaluating technology to be used	0.625	0.246
42	The service orientated architecture should be based upon applications from large IT vendors	0.622	0.241
43	Reliability of Internet (standards) should be taken into account	0.592	0.846
44	Process managers/workers should not get direct access to the application server where connections are running	0.567	0.570
45	Testing of prototypes and the final process solutions should be performed	0.264	0.960
46	The inflexibility of IT application systems should be taken into account	0.321	0.918
47	Involving the right people in the project	0.166	0.466
48	Having a set of key performance indicators and measuring the change (improvement)	0.500	0.445
49	Ensuring that the BPM project is part of a continuous optimization effort	0.818	0.161
50	Creating a culture of attention to quality within the organization	0.047	0.216
51	Use multiple data gathering approaches	0.596	0.661
52	The availability of data within the Supply Chain is critical	0.603	0.934
53	Both formal and informal monitoring and reporting activities should be taken into account	0.401	0.294
54	Capture information once and at the source (tasks are performed wherever it provides the most value)	0.056	0.233
55	Granularity and visibility control should be managed (to rule out that information is not available or private information is made public)	0.121	0.011

In Search of Competencies Needed in BPM Projects[7]

Business Process Management (BPM) and supporting BPM-systems are increasingly implemented within organizations and supply chains. However a common accepted definition of the BPM-concept is omitted and the same is true for the competencies (knowledge, skills and attitudes) that project members need during a BPM-implementation. In this chapter we present the results of a survey among Dutch consultants, developers and end-users of BPM-systems. The survey is designed to investigate whether there is a shared view among different disciplines with regard to the definition of BPM and the relevant competencies for BPM implementation. After presentation and interpretation of the results of this survey, we propose an international study to explore if BPM definitions and its relevant competencies differ across regions and cultures.

7.1 Introduction

Gordon B. Davis organized the first course on Management Information Systems at the Management Information Systems Research Center (MISRC), University of Minnesota, in 1969. The course was accompanied by the book Management Information Systems: Conceptual Foundations, Structure, and Development (Davis, 1974). Since then, the academic field of Information Systems (IS) is constantly growing and changing. New domains are added or disappear every year. One of the domains that is associated to Information Systems more and more is Business Process Management (BPM).

BPM originates from existing domains as Business Process Re-engineering and Quality Management and is also closely related to Service Oriented Architecture (Ravesteyn, 2007). This latter linkage is one of the reasons that recently the market for BPM and supporting technologies has changed rapidly. Analysis reports of Gartner, Forrester and similar research firms show an increasing number of companies that enter the market for BPM systems and solutions. Quite remarkably, many of these solutions appear to be combinations of different BPM tools and concepts from different solution providers. A prominent example is the combination of SAP Netweaver with the modeling tool ARIS of IDS Scheer. Also, the roots of the suppliers in the BPM domain differ a lot. As a consequence, inherently different software solutions that support for instance Workflow Management and Enterprise Integration Application are also positioned as Business Process Management Systems (BPMS). The functionality of these systems obviously varies to a large extent. The same holds for the consultancy organizations that are active in the BPM domain. They originate from various fields of expertise

such as logistics, marketing and IS development. Furthermore, the market for BPM is going through a phase of takeovers and consolidation. In 2007, Webmethods was acquired by AG Software, BEA Systems bought Feugo, and in 2008 BEA Systems was by turn taken over by Oracle. Considering all these developments, it can be concluded that BPM is a very difficult and complex area in which many different types of organizations and stakeholders are active. It appears that all parties involved in the BPM domain have there own vision about future developments and how to compete.

Within this complex environment, Universities and other higher educational institutions globally develop and teach courses on BPM that basically need to fulfill the needs and demand from the market. This paper reports about a Dutch research project that illustrates how this challenge is taken up by the University of Applied Sciences Utrecht in cooperation with the Dutch BPM-Forum.

7.2 Related literature

Much research has been conducted in the field of BPM during the last decade. This ranges from general theory on BPM (Elzinga et al., 1995; Zairi and Sinclair, 1995; Van der Aalst et al., 2003; Indulska et al., 2006; Shaw et al., 2007) to more specific topics such as:

- BPM maturity (Rosemann and de Bruin, 2005)
- Strategic alignment of BPM (de Bruin and Rosemann, 2006)
- Business process modeling (Bandara et al., 2006; Ami and Sommer, 2007)
- BPM and webservices (Van der Aalst et al., 2007)
- BPM implementation issues (Alavi and Henderson, 1981; Sultan and Chan, 2000; Dumas et al., 2005; Ravesteyn and Versendaal, 2007).

Despite the extended research agenda on BPM, studies that specifically address education on BPM are limited. The discussion on this topic was initiated by a column of Peter Fingar (2006) in which he stated that the curricula of MBA-courses at business schools are too focused on administration, not on innovation. He suggests to launch a Master of Business Innovation in which a core of MBA topics (such as finance and accounting, quantitative analysis, economics, marketing and organizational behaviour) is integrated with modules on BPM, business activity monitoring, process modeling and simulation. After this, a paper in BPtrends by Michael zur Meuhlen (2008) reveals a more detailed view on the skills that different BPM constituents need. Zur Meuhlen distinguishes four different groups that are involved in BPM-projects: (1) executives, (2) business analysts, (3) systems analysts, and (4) vendors or systems integrators. Each group has different respon-

sibilities and therefore needs diverse skills. For example, executives need to ensure process performance and compliance, and hence need skills in process analysis, governance and portfolio management. In contrast systems analysts are responsible for the implementation of the process and its corresponding information systems and therefore need skills in process modeling, workflow implementation, user interface design and systems integration. In his paper zur Meuhlen does not only provide good insight in BPM skills, he also presents a list of universities specialized in BPM courses. Finally, we mention the study conducted by Bandara et al. (2007). She analyzed which business process modelling skills were mentioned in 300 online job vacancies found globally across the most prominent online recruitment sites. Subsequently she organized a focus group representing potential BPM recruiters to validate and contextualize the findings. It should be noted however, that the study of Bandara et al was focused on business process modelling, not business process management skills, and the vacancies analyzed were geographically limited to Australia, England and the United States.

Building on the previous contributions, the goal of this paper is to present the specific market demands in the Netherlands concerning competencies in the field of BPM. In the next section our research methodology and survey are presented. Then the survey results concerning the definition of BPM and BPM-systems are discussed. In the subsequent section we present our findings regarding competencies needed in BPM-projects. We end the paper with conclusions, discussion and future research.

7.3 Research methodology

As earlier consultation and survey research on BPM is nearly non-existent, we developed our survey basically from zero. The goal was to conduct a field consultation on the definitions, implementation approaches and competencies for BPM and BPM-systems. Because of its explorative aim, the survey was broadly designed and consisted of several parts:

- General questions. Some open questions concerning the respondents' role and company (number of employees, industry).
- Questions about the definition of BPM. Two definitions and six Likert-items related to BPM and BPM-systems were queried.
- Questions about the perspectives on BPM. Some open questions on models and tools related to different BPM-perspectives (i.e. the strategic, operational, design, change perspective, et cetera).
- Questions about the BPM-architecture. Some closed and open questions concerning the software architecture of BPM-systems.

- Questions about the implementation of BPM-systems. In total 26 Likert-items related to BPM-systems implementation and its critical success factors were queried.
- Questions about competencies for BPM. Some open questions about the knowledge, skills and attitude required for BPM(-system) implementations.

For this chapter, we focus on the questions regarding the definitions and competencies for BPM-projects. In 2007 the survey was sent to contact persons from 925 Dutch organizations. These organizations were recruited from two groups: one group of 700 companies were member of the Dutch 'BPM Forum', another group consisted of 225 companies whose managers follow professional courses at the University of Applied Sciences Utrecht. These two groups ensure that companies with both (relatively) high and low BPM knowledge are recruited. Also, BPM Forum members are assumed to have a different view on the BPM-domain compared to the other group of companies. In addition, our sample was specifically stratified to recruit respondents from three groups according to what can be seen as the BPM value chain: (1) developers of software tools for BPM, (2) consultancy organizations, and (3) end-user organizations. After sending out the (web-based) surveys and reminders, the response consisted of 39 fully completed questionnaires. This response rate of 4.2% is obviously below expectations, but not exceptional for surveys among respondents that are not directly related or acquainted to the sender. It should also be noted that completion of the survey was quite time consuming, i.e. 40 minutes on average.

Despite the limited size of the response group, we were able to achieve a relevant variation on the two main stratification criteria, i.e. the two target groups and the three different backgrounds. Table 7.1 presents an overview of the response.

	BPM developer	BPM consultancy	BPM End-user organization	Total
Members of the BPM Forum	6	15	3	24
None BPM Forum members	0	6	9	15
Total	6	21	12	39

Table 7.1 The survey response group by membership of the BPM forum and BPM supply chain position

7.4 The definition of BPM and BPM-systems

There are many definitions for BPM and BPM-systems. It can therefore be expected that there is disagreement (or: confusion of tongues) between different groups of practitioners on BPM. To find out whether this is truly the case, we proposed our respondents the following two definitions that partly overlap, but also stress different aspects of BPM:

- *Business Process Management is: "a field of knowledge at the intersection between Business and Information technology, encompassing methods, techniques and tools to analyze, improve, innovate, design, enact and control business processes involving customers, humans, organizations, applications, documents and other sources of information" (Van der Aalst, ter Hofstede and Weske, 2003).*
- *Business Process Management Systems is: "a (suite of) software application(s) that enable the modeling, execution, technical and operational monitoring, and user representation of business processes and rules, based on integration of both existing and new information systems functionality that is orchestrated and integrated via services" (Ravesteyn and Versendaal, 2007).*

Measured on a 7-point scale (from 1=fully disagree to 7=fully agree) the 39 respondents largely agree with both definitions of BPM and BPM-systems – the average score was 5.15 and 5.00 for definition 1 and 2 respectively. An open question provided respondents the opportunity to comment on the two definitions. This was not used however, which indicates that both definitions are recognized by the respondents.

Next, we asked respondents to rate six items on BPM and BPM-systems on a similar 7-point Likert scale. These items are presented in table 7.2 below (translated from the original Dutch version). They are designed to measure how innovative and promising the respondents believe BPM is. Note that items 3 and 4 are formulated in a deviant way for reasons of reliability.

#	Item	Mean	Standard Deviation
1	Figure 1 [see below this table] shows how, according to us, management concepts and IT innovations have evolved into BPM-systems	4.58	1.58
2	The BPM-systems that are currently on the market can be considered a new type of software application	4.07	1.75
3	BPM is being hyped as a new management concept but it has been around for a long time and can therefore not be considered as new.	3.82	1.62
4	BPM-systems are nothing more than a combination of long existing IT applications and functionality	3.84	1.59
5	The essence of BPM is the continuous measuring and improving of operational processes	4.79	1.79
6	By applying BPM an organization is able to make its processes and supporting information systems more flexible and adaptive to change	5.28	1.29

Table 7.2 Judgment of the statements on BPM and BPM-systems

Figure 7.1 below was presented to the respondents:
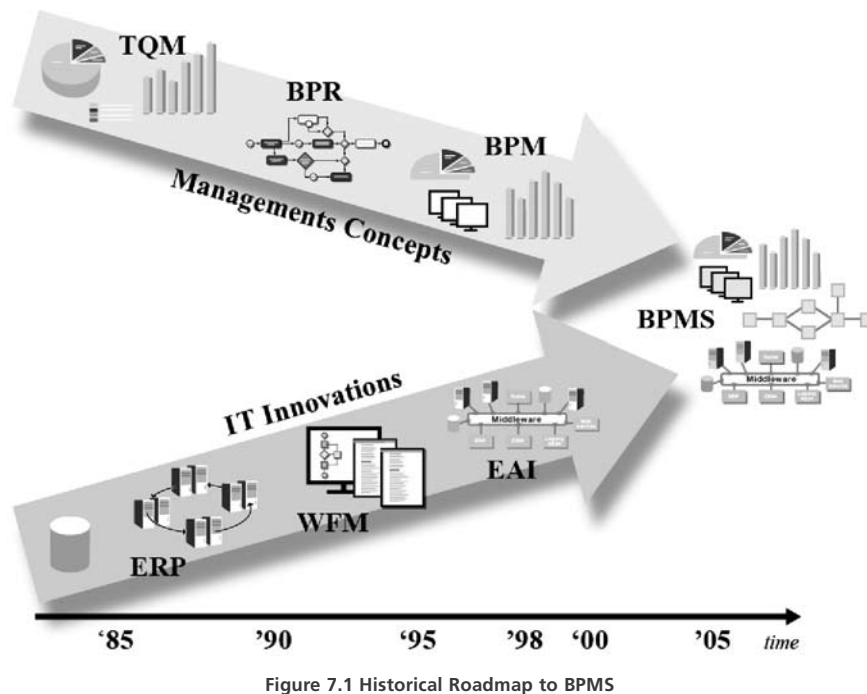

Figure 7.1 Historical Roadmap to BPMS

Table 7.2 shows that respondents agreed with the statements 1, 2, 5 and 6 (averages are 4 or higher), and consistently rated item 3 and 4 lower (average about 3.8). The relative low standard deviations indicate consensus within the group of respondents. A reliability check on the consistency of the 6 six items was calculated by Chronbach's Alpha (Nunnally, 1979; Peter, 1979). The resulting Alpha of 0.68 confirms that the set of 6 items form an acceptable scale to measure a manager's vision on BPM as a innovating and improvement concept.

There are some interesting differences between items however. For instance, item 5 ("The essence of BPM is the continuous measuring and improving of operational processes") not only has one of the highest means but also the highest standard deviation. So while many respondents seem to highly agree with this statement, further analysis of the individual responses reveals that 6 respondents do not agree at all (scores of 2 or lower). Therefore, it is not possible to conclude that BPM is mostly about measurement and improvement of operational processes.

Further analysis showed some differences between the respondent groups the sample was stratified on (i.e. BPM forum member and BPM job position). For instance, the BPM-forum members highly agreed with item 6 (5.63), while the average for non-members on this item was moderate (4.73). A t-test for independent groups did not support the conclusion that this difference in opinion was significant however. Also, statement 1 (that refers to figure 7.1) was rated much higher by the end user organizations (5.67) than by the developers and consultancy organizations (4.33 and 4.05). From an ANOVA-analysis (Bonferroni-test) these differences were not significant either. It is worth noting though, that the BPM-Forum members commented more frequently on how to improve this figure, while there were no comments whatsoever by the non-member group.

Based on these findings we conclude that the respondents generally show consensus about the two definitions and six statements on BPM and BPM-systems. This supports the notion that BPM and supporting technologies have evolved from a management concept to an integrated paradigm. Our respondents agree with the vision that BPM is about integration of processes and information with the reuse of existing information systems, modeling and execution of processes, and the offering of real-time management information. In addition, BPM is seen as the key to business innovation. It should also be noted that end-users of BPM agree more with this vision on how BPM(S) evolved, while BPM-Forum members tend to see BPM as means to make processes and IS/IT systems more flexible and adaptive to change.

7.5 Competencies needed in BPM-projects

For this research a competency is defined as the required knowledge, skills and attitude by members involved in a BPM-project. In the survey three open questions were formulated to determine which types of competencies are needed in BPM-projects according to the respondents. The first question was related to general knowledge, skills and attitude while the other two questions asked for specific competencies in the domains of business and IT. The answers provided by the respondents show a large diversity. Table 7.3 gives an overview of knowledge and skills mentioned most by the respondents (sorted by domain).

The general skills that were mentioned are typically those one would expect. Nonetheless, a skill as process mindedness is also mentioned specifically, especially by the respondents with an IT background. This is of specific importance for the educational curriculum on BPM.

As can be seen in table 7.3, the business related competencies that were mentioned by the respondents are:

1. Knowledge about administrative processes,
2. Knowledge on methodologies to model processes and
3. The ability (skill) to overview processes within the organization and throughout the supply chain.

	General	Business	IT
Knowledge		Administrative Organization Process modeling methodologies	SOA and web services Architectures Knowledge about existing IT applications Integration techniques and methodologies Modeling data and processes UML
Skills	Analytical abilities Process minded Communicative abilities	To be able to oversee processes within the organization and throughout the supply chain	

Table 7.3 Knowledge and skill needed in BPM-projects

The first is related to the judgment of the quality of current processes and suggestions on how to improve these. The second is about choosing the right modeling method for the situation at hand and being able to actually model (draw) the processes. The third is related to the tendency by many practitioners to dive into details when it comes to processes without having a broader overview on relations and dependencies ate the same time.

For the Information Technology domain, respondents gave answers that merely deal with knowledge aspects. This might be the case because the respondents actually use IT-related knowledge, while for the general and business domain knowledge is not explicitly defined while the skills side becomes more important to mention explicitly. For example, we see that the knowledge and skills for process modeling in the business domain are interpreted as being able to use techniques like flowcharts or Event-driven Process Chains (EPCs). Almost the same field of knowledge in the IT domain, is related to understanding the Business Process Modeling Notation (BPMN) or Unified Modeling Language (UML). The latter methodology was regarded very important as it was mentioned several times by the respondents.

Finally, the survey contained questions about software to support BPM-projects. It appeared that respondents mentioned quite different applications ranging from process modeling tools such as Microsoft Visio and ARIS (from IDS Scheer) to middleware solutions for information system integration and process support. These differences match the different roles of the respondents: end-users and consultants suggest process modeling tools, while developers mention the middleware solutions more often. Once again, this illustrates that there is a strong need for persons who are able to communicate and bind professionals from the domains of business and IT. It also supports the statement that multidisciplinary project teams are key to the success of any BPM-project.

7.6 Conclusions

In this chapter we presented the results of a survey among Dutch consultants, developers and end-users. We queried 39 professionals on how they view the concept of BPM and the competencies needed during BPM-projects. The three groups were recruited from two separate populations with a high and low level of knowledge about BPM. One of the interesting results is that the different groups share a common view on BPM and BPM-systems, regardless of their role in the BPM value chain. On the other hand, our survey shows a number of significant differences between the professional groups. Among other things, developers and consultants with a specific BPM-experience more strongly believe that applying BPM enables organizations to improve processes and IS/IT in a more flexible and adaptive way. This is driven by the fact that developers and consultants are actually involved with the design and deployment of BPM-systems. Interpreting these differences, it seems that one of the most important risks of large BPM-projects is that the project is considered to be IT-driven only. If so, the responsibility for success is solely placed at the IT department. It should be noted however that

even though IT is very important, technology exists primarily to support the implementation of BPM – not the other way around. Management support is imperative, together with involvement of process owners and technical people. As this research has shown, the skill to bring the business and IT domains together is crucial for organizations and BPM projects. Consequently, it is the challenge for (professional) universities to educate students in such a way that they will be able to meet these requirements of practice in the market.

7.7 Discussion and future research

Some important limitations should be recognized with regard to the results of this research. Most prominent, the results are limited to the Netherlands, i.e. to the opinions of Dutch BPM practitioners. An obvious extension of this research is to conduct the survey in other countries, and to subsequently explore the validity of our BPM definitions and list of competencies. A very interesting step for further research is to see if the definition of the BPM-domain and competencies differs between countries and/or cultural regions. This could be specifically investigated through surveying enterprises with international establishments. Another opportunity for further research is to compare the competencies collected by this research with those found by Bandara et al. (2007). It is important to note that in their research Bandara et al. did not find competencies that are related to skills in the architecture (e.g. SOA) and web services domain while in our research these were seen as very important.

Design and Implementation of Business Process Management Curriculum: A Case in Dutch Higher Education[8]

This chapter describes a joint effort by two educational and scientific institutes, the HU University of Applied Sciences and Utrecht University, in designing a BPM course that not only transfers theoretical knowledge but lets students also experience real life BPM-systems and implementation issues. We also describe the implementation of the developed module with an indication of its success: it is now running for the fifth time, and although there continue to be points for improvement, over the years several scientific papers in the BPM domain resulted from the course, as well as a reasonable amount of students started their final thesis project in the BPM-domain.

8.1 Introduction

The adoption of Information Technology (IT) by organizations has grown tremendously in the last fifty years. During this period the focus of how IT is used has gradually changed from computational support to using IT as a means to realize more effective and efficient processes. One of the trends that have caused this change is the rapidly growing globalization in which organizations collaborate within and across supply chains around the world. Traditional IT support for these types of collaboration is expensive and the implementation of customized solutions does not live up to expectations (Ravesteyn and Versendaal, 2009). Consequently one of the domains receiving increased attention is that of Business Process Management. BPM can be considered a 'holistic' management approach that enables process orientation and improvement within organizations and aims at more flexible processes and information systems, thereby making organizations more agile (Weske, 2007). Based on the service-oriented architecture (SOA) paradigm BPM-systems enable analyses, modeling, execution and improvement of an organizations public and private processes thereby extending the usability of legacy systems and increasing the flexibility of processes (Weske, 2007; Hiemstra et al., 2009).

The change towards process orientation in organizations requires a cross-functional perspective on processes and customers instead of a focus on hierarchy and functions (Seethamraju, 2007) and therefore emphasis has shifted from functional specialization towards processes (Malekzadeh, 1998). If we review the information systems curricula at Universities we notice that there is a growing attention for modules with a clear emphasis on business process analyses and

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automation. The importance of cross-functional integration and business process orientation has also been notified in the domain of business education; however, shortcomings in existing curricula are still there (Seethamraju, 2007).

This chapter addresses the topic of BPM competencies in University education and provides an example on how to set up a process oriented curriculum, based on four years of experiences by two Dutch Universities that established a joint BPM course for both fulltime and part-time undergraduate and graduate students.

In the following section we describe related work on process oriented education modules. The third section describes the course design and content. The fourth section will relate the outcomes and the experiences of the students together with the lessons learned. In the final and fifth section we present some conclusions and suggestions for further improvements to the course.

8.2 Related work

As a start to this research, a study was conducted to find best-practices of other universities about the development of a BPM course (Ravesteyn et al., 2008). However despite the amount of research available on BPM there were was little in-depth information available on curricula that specifically addressed training in skills and competencies in BPM.

Fingar (2006) stated that the curricula of MBA-courses at business schools are too focused on administrative skills and hardly pay any attention to (process) innovation. He suggests a curriculum in which a core of MBA topics (such as finance and accounting, quantitative analysis, economics, marketing and organizational behaviour) is integrated with modules that teach skills in business process management, business activity monitoring, process modeling, process improvement and simulation.

In (Bandare et al., 2007) a study is described that determines whether there is a large demand for business process modeling skills. For this 300 online job vacancies that explicitly mentioned process modeling skills were analyzed. Subsequently she organized a focus group representing potential BPM recruiters to validate and contextualize the findings. It should be noted however, that this study was focused on business process modeling skills and not the broader set of competencies needed in business process management projects.

Zur Meuhlen (2008) reveals a more detailed view on the skills that are needed in BPM efforts. He distinguishes four different groups that are involved in BPM-projects: (1) executives, (2) business analysts, (3) systems analysts, and (4) vendors or systems integrators. Each group has different responsibilities and therefore needs a differentiated set of skills. For example, executives need to ensure process

performance and compliance, and hence need skills in process analysis, governance and portfolio management. In contrast systems analysts are responsible for the implementation of the process and its corresponding information systems and therefore need skills in process modeling, workflow implementation, user interface design and systems integration. In his paper Zur Meuhlen does not only provide insight in BPM skills, he also presents a preliminary list of universities that offer BPM programs.

While the papers mentioned above are interesting none of them describe how to develop a curriculum in BPM or experiences in teaching. The only paper that does focus on the development process is by Recker and Rosemann (2009). They explain in detail the setup, structure, and experiences of a course in business process modeling at the Queensland University of Technology in Australia. However the topic is on business process modeling and does not include management: the paper merely provides insights in how to develop a process oriented curriculum and which teaching techniques can be used.

Because the amount of literature on education in BPM is sparse we decided to include literature on Enterprise Resource Planning (ERP) course design. Systems for ERP as well as systems for BPM are both enterprise information systems dealing with cross-functional processes. ERP systems generally contain several sorts of workflow processes, which are made explicit in BPM systems. We found that most of the ERP education development is based on one of the following four categories of approaches (Hawking et al., 2005; Jensen et al., 2005):

1. ERP training;
2. ERP and business processes;
3. Information Systems approach;
4. Selection and implementation concepts.

The first approach is basically instruction or training in a specific ERP system. This is very similar to the training courses that the ERP and also BPM-systems developers and suppliers provide to their customers and could be done by reusing commercial training material. The second approach focuses on business processes and related concepts (e.g. financial administration or production scheduling and planning) and uses ERP to assist in the presentation and clarification of these methods and concepts. For this approach, commercial training material is not sufficient; and new material will have to be developed. The third approach uses ERP to illustrate information systems concepts. It is very similar to the second approach; only the target group or goal differs. Instead of teaching business students and business concepts, the target group will most likely be computer science / information systems students and the concepts that are taught are different. The

last approach is to teach about ERP related skills, such as selection and implementation of ERP software. It is not really necessary to use a real live ERP system for this although it could give a clearer picture of the complexity of such systems. Of course, it is also possible to combine aspects of all approaches to create a more hybrid approach.

Typically in the course we aimed to develop we wanted to use a BPM-system in support and clarification to the theory. Furthermore in teaching BPM it is important to realize that not only process related knowledge and skills are essential, we also want students to have a high degree of self-awareness, be able to think critical and keep on learning continuously. In the field of BPM, particularly, it is becoming increasingly important to also understand aspects of the development, implementation and maintenance of e-business solutions due to the continuing evolution of BPM (McGaughey and Gunasekaran, 2008). Therefore any course on BPM should in our opinion consist of three parts 1) theory and methods from a business perspective 2) theory and methods from a technical perspective and 3) a practical part that integrates the former two via lifelike exercises and confronts the student with state-of-the-art software.

8.3 Course Design

To teach students all three aspects of BPM as defined in section 2, five years ago the HU University of Applied Sciences together with the Utrecht University developed a course that can be followed by both Master and Bachelor students simultaneously. The course was designed with two tracks that complement each other. The first track consists of theory on BPM from both the business and technical perspectives. Each week during a three hour period we first discuss scientific theory, methods and techniques, that is then followed by a guest lecture in which practical examples are discussed in relation to the theory of the first half of the period. The second track is entirely based on a case study that we developed in which the students have to analyze, improve, implement and execute the processes in a supply chain. For this again a three hour time period is reserved. The entire course now runs for 9 weeks and is followed by presentations in week 10. Students that follow and finish the course are awarded 7.5 ECTS (European Credits) which means that the total time spent on this course should amount to 210 hours. So besides the 54 hours of classes (both theory and practical) students should spend a total of 156 hours on self study. This time should be spent for about 50% on theoretical assignments and 50% on the practical assignment. Grading of the course consists of a 50% judgment of the digestion of the theoretical part, and a 50% judgment of the practical work.

An innovative feature of the course is that we purposely combine students from bachelor level (who follow a computer science course at the HU University of Applied Sciences) with students from a masters level (from the master business informatics of the Utrecht University). This combination means that students who follow practical orientated education and tend to be very pragmatic have to work together with students that do a scientific education and have a more analytical and critical perspective. Yet, while the students have different levels of education (which in practice will be very normal during a BPM project), it does not mean that one group is better than the other. Typically the master students will take the lead in the theoretical scientific track while the bachelor students are better equipped to manage the practical track. Because we purposely combine the students into groups for their assignments they must work together. This also helps us partly to simulate the business (master business informatics) versus IT (bachelor computer science) divide which students will encounter in practice. Furthermore we let the students experience one of the most important aspects of BPM, the fact that they will need to be able to work with persons from different disciplines and with different perspectives.

An overview of the course is given in figure 8.1 and in the following two subsections both the theoretical and the practical track will be explained in more detail.
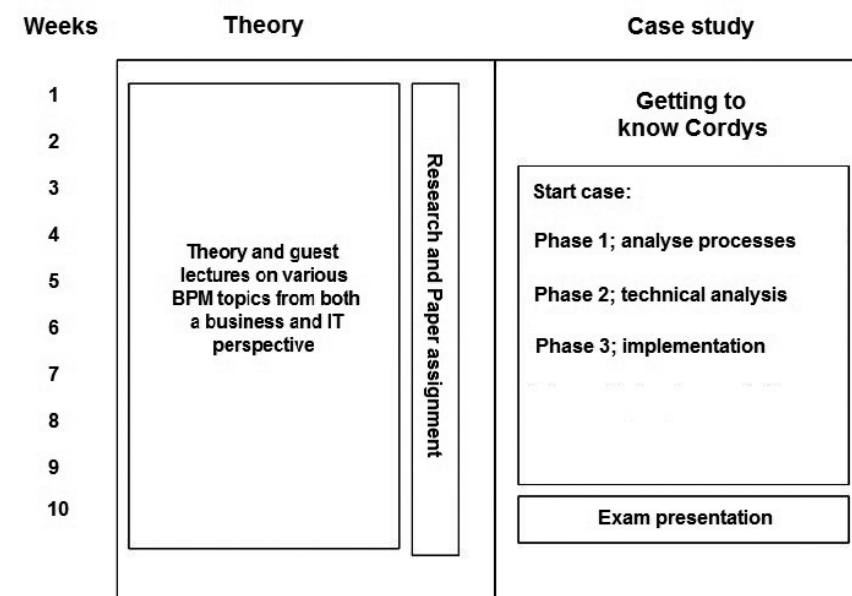

Figure 8.1 Course overview

8.3.1 Theoretical track

During the theoretical track students are presented with a wide range of topics related to BPM from both a business and IT perspective. Furthermore students (in teams of two) have to perform research and write a paper, for which the literature and state-of-the-art of BPM research and practice as presented in the lectures of the theoretical track can be used. Each year we present students with one or more topics from which they can choose to write their paper; some of the topics in the past were: BPM-systems implementation, human interaction management, BPM-mashups, ERP and BPM, and business rules management in relation to BPM.
In the lectures, more or less the following topics are covered:

- BPM basics from a business perspective; business process management can provide organizations with the ability to save money and time. The role processes play within an enterprise, to stay competitive and remain agile in the changing global market place is highlighted.
- BPM-systems implementation; the aim of this unit is to introduce the student to the general concepts of business process management systems (BPMS). In short we cover the history of BPM-systems, its characteristics and architecture, give an overview of the providers of BPMSs etc.
- BPM standards, methods and techniques are introduced. We focus on the role of standards (modeling, information, quality, and IT). Maturity models and business and IT alignment are discussed. Also the importance of quality management methods and techniques are covered.
- Business Process Modeling. An overview of different techniques to model, analyze and improve processes is given. Furthermore the Business Process Modeling Notation and its execution language (BPEL) are taught and practiced.
- Service Oriented Architecture (SOA) in relation to BPM. The synergy and differences between BPM and SOA are presented. The SOA paradigm is explained together with the business drivers for SOA. Important SOA concepts like loose-coupling, service granularity, service contracts, integration and enterprise service bus, governance and security. Also SOA standards and strategies for deploying SOA are discussed.
- BPM(S) Implementation. Here we take the students from process design through implementation to the management of processes and their supporting information systems. Students learn the distinction between business processes and business rules and how they can be implemented in information systems.
- Human Interaction Management / Dynamic BPM. While most current BPM efforts are focused on well structured processes there are also many ad-hoc

activities and non-structured processes that need managing and control. The consequences of the fast increasing amount of knowledge workers and a changing way of working (place and time independent) are discussed together with the methods and tools to support these types of activities and processes.
- BPM and performance measurement. Here we cover the essentials of Business Intelligence (origins and drivers, major characteristics, implementation aspects, lifecycle etc.). Other important aspects that are covered are: BI strategy, business process monitoring and control, business and technical requirements for a BI architecture and the difference between BI and business activity monitoring (BAM).

Besides covering each of these topics in theoretical lectures we also invite companies to come and present their perspective and experiences. Invitations are sent to three different categories of companies a) consultancy organizations b) software developers (BPM system vendors) and c) end user organizations. In this way students obtain an overview of the different perspectives on BPM related issues. Organizations that have participated in the course are amongst others: BEA/Oracle (software developer), ASR/Fortis (end user in the financial sector), Capgemini (consultancy), Cordys (software developer), O&I (management consultancy), SNS/Real (end user in the financial sector), and PriceWaterhouseCoopers (consultancy). Furthermore during the last three years the chairman of the Dutch BPM-Forum (Frits Bussemaker) gave a guest lecture at the start of the course.

The grading of the theoretical part is solely based on the quality of the research paper that students need to write in teams of two. In the paper it should be easily verifiable to what degree the students were able to include and process the theory and practical lessons from the (guest) lectures.

8.3.2 Practical track

The practical part of the course is developed in such a way that students are able to attain knowledge and skills in three categories of competencies related to BPM, labeled: 'business administration', 'information architecture and technology' and 'influence and alignment'.

The first group of competencies states students should be able to recognize and understand the relations between the various functions and departments in an organization and between organizations. Furthermore they should be able to identify relevant market developments for the organization and to propose process improvements and/or implementation of ICT applications as a response to these developments. Finally they should be able to identify and to model company

processes and interactions within and between organizations. The second group of competencies are more technical and students that master them are 1) able to design a system architecture for collaboration in extended enterprises in which new ICT capabilities are used 2) understand the basics of SOA and BPM-systems, and 3) are able to install and configure BPM-systems and use them to integrate different information systems within an organization and across its supply chain. The final group of competencies is very much aimed at communicative skills. Within BPM projects students should 1) be able to be conversant with both the domains of business and ICT within the organization 2) be able to communicate with all organizational layers on a clear and effective way about investments, business and ICT innovations in terms of business issues and benefits 3) be able to reflect on their own choices and activities and to indicate their own skills, and 4) be able to apply the set of conversational techniques and competences in order to achieve effective communication in interviews and presentations.

To let students acquire the complete set of competencies a case study is developed in which students are challenged to improve processes across a supply chain. This chain consists of three organizations that collaborate with each other: a Retailer, a Wholesaler and a Manufacturer (see figure 8.2). Students are divided into teams of two and then assigned to one organization in the supply chain. Each supply chain therefore consists of at least six students. Depending on the number of students in the course more instances of supply chains are formed.
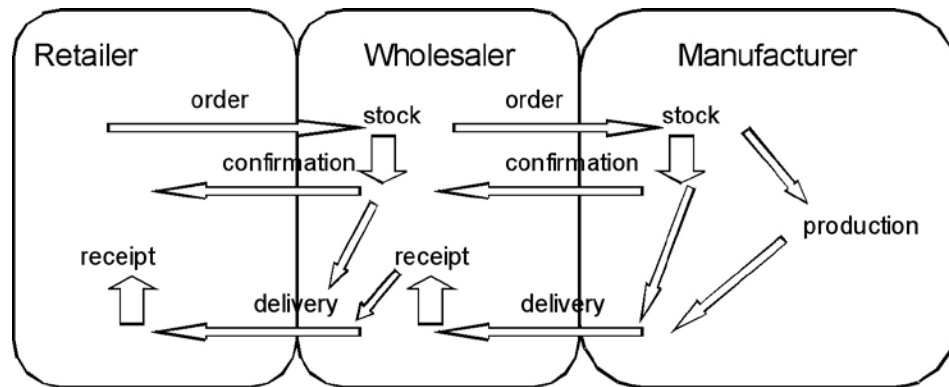

Figure 8.2 An overview of the supply chain processes in the case study

The supply chain case consists of a wholesaler offering bicycles to retailers. If the retailer wants to buy from this specific wholesaler, he currently has to make a phone call or sent an email. However the students should develop a purchase application that the retailer can use to connect to the wholesalers system. This application should make use of the existing information systems and needs to be completely based on web services. To fulfill the orders of the retailer, the wholesaler has to manage stock levels in his warehouse system. When an item in stock falls below a certain threshold, the wholesaler must restock the item by ordering this at the manufacturer. In order to comply with the wholesaler's request, the manufacturer may have to execute a production run to build the finished goods. Again these processes are only automated within the boundaries of the respective organizations. It is the task of the students to analyze and improve these processes and then implement and execute them by using a particular BPM-system (in our course we use Cordys BOP 4; www.cordys.com).

During this case study students will have to go through several phases (similar to those of a real life BPM-systems implementation project) to be able to develop a good supply chain solution. During the first phase students need to create a clear picture of both the processes within the organization that they are assigned and of the interaction between the business partners in the supply chain and their own internal processes. Thereby they learn the difference between processes which will be kept internal or private to the organization and those that will be shared with partners in the supply chain, also called public processes. Together the organizations within a supply chain must agree on a process architecture for the whole supply-chain. Furthermore a set of appropriate key performance indicators for monitoring the supply chain should be determined. Performance indicators can be formulated on the activity-, business- or supply chain levels. During this phase the models are descriptive only but they should be modeled using the features available through the Cordys system. At the end of this phase (typically two to three weeks) a functional design should be handed over to the lecturer for control purposes.

In the second phase students have to identify, per organization in the supply chain, which information will be required from the other business partners and accordingly which web services have to be developed. The information that is delivered and used by the web services is deducted from the process analysis done in the first phase of the project. Next to this the students should also take into account the existing information systems (for the course we only use 3 different SQL databases). Furthermore during this phase an information architecture should be developed and integration to the systems which are going to be reused needs to be accomplished. In the case both straight through processing and human interaction activities are used to integrate the order and delivery processes, students should be aware of this.

The students are expected to at least look at the various tables in each of the partner databases (such as product-, sales-, purchase- and production-tables and

various other linked tables), and develop web services or applications that are able to:

- browse through the products (productid, name, price) of the retailer, wholesaler and manufacturer
- browse through the sales and purchase orders of the wholesaler (including order details)
- browse through the sales orders of the manufacturer (including order details)
- browse through the production orders of the manufacturer
- browse through the product stock levels (aggregated)
- provide information on ordered goods
- exchange information (such as order confirmations, delivery dates, updated stock levels)
- update customer information
- update order information
- update product information (such as price, quantities)

In the final phase the proposed solution must be developed and implemented. The modeled processes should be executed by using the developed web services and applications. End-users should be able to start applications within their Internet browser and use them to start process activities. Also the identified key performance indicators should be implemented in order to monitor the operations in the supply chain. For this the students need to develop dashboards from which the performance indicators can easily be accessed by graphs, reports or performance meters.

At the end of the course each group of students that represents a supply chain are asked to present their solution. Processes are run by using the applications and several web services are checked (specifically does were the process does not seem to work correct or were students have made decisions regarding activities in a process that do not seem logical), finally the performance indicators are also checked. When the developed solution does not work properly it is often because one of the supply chain organizations has not delivered the correct web services or has a faulty integration to their backend systems. If this is the case the students that represent that specific organization are tested further on their level of knowledge and skills.

In the following section we discuss some of the outcomes and lessons learned during the five times that we have now run this course.

8.4 Outcomes and Lessons Learned

The course has run four complete cycles since 2006 (a fifth being taught as we write) and the amount of data for an evaluation is substantial. Over a 115 students have completed the course, of which around 34 were bachelor computer science students and 81 were graduate students business informatics. Yearly, the students evaluate the course through filling in a partly open and partly closed questionnaire. The overall conclusion is that the course is judged as being relevant (over the years scoring around 3.9 on a scale from 1 (lowest) – 5 (highest)). Each year the theoretical topics and the corresponding guest lectures are highly approved of, except for the odd guest lecture which is deemed too commercial, as e.g. a student complaints: "[…] a guest lecture in which the vendor's competitor is defined as incompetent should not be provided, and lacks an academic level […]". Furthermore, there are some topics that students find less satisfying and that return more or less every year.

First and foremost the students find that cooperation between students of the two different universities, with the different types of education and levels, is difficult and time consuming. Within a short time of typically two months they are forced to learn to know each other and work together: "[…] it is so difficult to meet with my team-mate: he has a different curriculum schedule. Moreover, the difference in level is also hard to cope with: I had to do a lot of work in writing the paper […]". However, we deliberately take students out of their comfort zone and that experience is according to the evaluations not appreciated: in 2007, the students valued their collaboration with students from 'the other' university as 2.1 on a scale of 1 (lowest) – 5 (highest). As this is part of the course design and it simulates real life projects we have decided not to change this aspect, but instead to work on a better facilitation for cooperation: in 2008 we 'forced' students to create teams immediately after the kick-off (during a drink provided by the university) instead of giving them a week time. A second finding from the evaluation is that students find the BPM-system, with which they have to work in the practical track, complex and far from easy. Because most of the students haven't worked with a BPM-system before they have to get to know the user interface and functionality of the application and be able to use it to build a supply chain solution all within 9 weeks. Especially if during the theoretical track we had a guest lecture from another BPMS vendor, students often asked us to use that other system. We feel however that they do not fully realize that the effort to know and master any system is complex and any system would cause learning difficulties; moreover, demos of vendors of systems always provide a colored reality, which is different from the real experience.

A final issue which we receive during every evaluation is the complexity that comes with collaborating between the partners within a supply chain during the practical track. Students find that they really have to communicate and come to an agreement with all organizations in the supply chain on how the processes are going to be analyzed, what methods for process improvement are used, which information needs to be exchanged, and how to develop and publish web services. This is in accordance with the final results that we observe. Each year the supply chain that provides the best solution is the one which had thought out and agreed upon a clear architecture on all levels from process to application. Furthermore such a team typically uses the architecture to communicate about the projects progress. Whereas those that do not succeed in realizing optimized and integrated supply chain processes usually paid to much attention on only optimizing and automating their own organization without communicating with the other supply chain partners (i.e. they realize stovepipe solutions).

In short we can state that the students who participate in this course value it highly even though especially in the practical track they encounter a lot of issues and problems that make it difficult to fully accomplish the assignment.

Although every year there are areas of improvement and we continue to work on those, we are confirmed in our general approach through the years as multiple published scientific papers resulted from the theoretical part, and also more and more students now perform their final thesis project on the topic of BPM, having become enthusiastic after following the course.

From a scientific viewpoint, notably, the theoretical part of the BPM-course in 2007 provided us with enough material to write an overall paper on success factors of BPMS implementations using the material in papers that students provided (Ravesteyn and Versendaal, 2007). Based on the material from the 2008 course too an overall paper has been published, this time on method fragments in BPMS implementation, again using the input from student papers (Ravesteyn and Jansen, 2009). In 2009, one of the papers from students was, with changes and additions by the teachers, submitted to the International Information Management Association (IIMA) conference, and elected as best paper (Kristjansson et al., 2009). In 2010 we have told our current batch of students that we intend to submit the best student contributions to the IIMA 2010 Student Consortium.

8.5 Conclusions and Future Outlook

In conclusion, we state that the way in which the BPM course curriculum has been developed really enables students to not only acquire knowledge on BPM topics but to also attain skills that are highly valued by industry. By putting together students from different institutes and experience levels we simulate many of the

'soft' problems that people typically encounter in a real life BPM-systems implementation project.

Even though the BPM course can be considered a success there is a price we pay. Organizing the course is a major organizational effort for both universities involved. Each year, the timetables of both universities need to be synchronized for both students and lecturers, besides this arranging between 5 to 8 guest lectures takes a considerable amount of time. Also the effort needed to configure and maintain the BPM-system is substantial and finally students need a lot of energy for this course because they are taken out of their comfort zone and need to deal with a new and complex environment.

Based on the experiences of the last few years and the evaluations of the students we are continuously exploring possibilities to improve the course. One change is to make the group of students more equal. We will no longer combine groups of bachelor and master students of the two universities but we will offer this course to students who are following the bachelor business informatics. This means that there will be two different types of students in the course (more business oriented versus more technology oriented) but that they are on the same level of education. We expect that this will make the practical track of the course less complicated. Also this provides space at the master level of the business informatics education to provide a BPM advanced course that will focus completely on research in the BPM domain. Another change we are considering is the amount of involvement of business; currently this is limited to providing a number of guest lectures but we are thinking of having industry to submit small research projects that the students do as part of the course. This will further improve the practicality of the course. Finally we are continuously improving the amount of knowledge, support and information available on the BPM-system (Cordys) we use. Up till now we have used the Cordys C2 version of the application but with the currently running course we use Cordys BOP 4 and also the process factory which is a lighter version of the application that is offered as software as a service (SaaS). So while the domain of BPM is changing rapidly we aim to offer a course that is challenging and up-to-date and complies with the demands of our students, as well as science and industry.

A Situational Implementation Method for Business Process Management Systems[9]

For the integrated implementation of Business Process Management and supporting information systems many methods are available. Most of these methods, however, apply a one-size fits all approach and do not take into account the specific situation of the organization in which an information system is to be implemented. These situational factors, however, strongly determine the success of any implementation project. In this chapter a method is provided that establishes situational factors of and their influence on implementation methods. The provided method enables a more successful implementation project, because the project team can create a more suitable implementation method for business process management system implementation projects.

9.1 implementing Information Systems

Lately Business Process Management (BPM) has gained much attention from management and IT departments of organizations as a means to increase agility and flexibility. To realize these organizational goals it is important to have flexible information systems that support the organizations processes. In dynamic environments where processes change often the most promising approach to achieve this is, is by applying the concept of service-oriented architecture (SOA) (Krafzig, Banke and Slama, 2005). Implementation of BPM-Systems (BPMS) that enable support of both the BPM and SOA paradigms, however, is highly complex. During each implementation the specific situation of the organization must be carefully considered.

There are many methods available for implementing information systems such as BPMS, Enterprise Resource Planning, Business Intelligence, Customer Relationship Management, and others. Both researchers and practitioners have developed overarching frameworks based on existing methods and this is no different for the BPM domain. Multiple efforts have been made in constructing overall methods for implementation. Kettinger, Teng and Guha (1997) have developed a business process reengineering (BPR) implementation framework based on different BPR implementation methods. Table 9.1 gives an overview of 21 different implementation methods for BPM. The list is constructed based on an assignment to 47 master students that followed the BPM course at the Utrecht University. Each individual student had to search for 3 BPM (-related) implementation methods. This resulted in 141 methods of which 21 could be uniquely identified. This

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[9] Originally published as: Ravesteyn, P., & Jansen, R.L. (2009). A Situational Implementation Method for Business Process Management Systems. *Conference Proceedings Americas Conference on Information Systems 2009.*

table is not exclusive, however, because there are many other methods available.

An analysis of the implementation methods in table 9.1 shows that many methods do not take into account the context in which they are used and those that do only state that the context should be analyzed but don't provide specific context dependent implementation activities. Furthermore there are only five methods that are based on scientific research (Brahe and Bordbar, 2007; Fitzgerald and Murphy, 1996; Jennings et al., 2000; Rajagopal, 2002; Rinderle, Kreher and Dadam, 2005; Stoica, Chawat and Shin, 2004; Van Der Aalst and Van Hee, 2002) but these are seldom applied in practical situations. Ten methods are based on professional best practices without scientific foundations. Finally, six methods are actively being used in practice while at the same time supported by an extensive body of scientific research.

Although each of the 21 methods mentioned are in their own rights unique, commonalities can easily be extracted. Generally, BPM implementation methods consist of two phases. The first can be labeled the 'design' phase, during which the organization is analyzed (often by the means of process models of the as-is and to-be situations). The second phase is the 'development phase' and this is when the organization actually has to change and work with the optimized processes.

No.	Name	Scientific	Professional	Characteristics	Source
1	Pronto		X	DEMO, speech-acts	www.sogeti.com
2	Cordys@Work		X	Agile software development method	www.cordys.com
3	ARIS House of Business Engineering (HOBE)	X	X	Based on ARIS architecture	Scheer and Nüttgens (2000)
4	ADEPT (An Agent-Based Approach to BPM)	X		Agent based approach	Jennings et al. (2000), Rinderle, Kreher and Dadam (2005)
5	Interactive, process-oriented system development (IPSD)	X		BPR	Van Der Aalst and Van Hee (2002)
6	Process Innovation Method	X	X	BPR and process improvement	Malone, Crowston and Herman (2003)
7	Six Sigma	X	X	Six Sigma, lean manufacturing	De Feo and Barnard (2005)
8	Goal-Oriented Organization Design (GOOD)	X	X	Human interaction management	Harrison-Broninski (2005)
9	Rajagopal ERP implementation	X		BPM	Rajagopal (2002)
10	Strategy Driven Approach	X	X	CMMI	Jeston and Nelis (2006)
11	Smart BPM		X	BPMS	www.pegasystems.com
12	Pattern based approach	X		BPR	Brahe and Bordbar (2007)
13	Business Process Maturity Model (BPMM)	X	X	CMMI, BPR and TQM	Curtis and Aalden (2006)
14	RACI method		X	Project management	http://www.gordian-transformationpartners.com
15	A Systems Approach to BPM		X	BPR and enterprise architecture	Ramesh .(2007)
16	Bizzdesign's BPM approach		X	Process modeling and BPR	www.bizzdesign.com
17	Nine-step approach (Capgemini)		X	Process maturity based	www.capgemini.com
18	Goal driven BPM		X	BPM	www.tibco.com
19	Fitzgerald and Murphy's implementation method	X		BPR	Stoica, Chawat and Shin (2004) Fitzgerald and Murphy (1996)
20	BPM Implementation method		X	Workflow management and BPR	Burlton (2001)
21	BPR method		X	BPR	Hammer and Champy (2001)

Table 9.1 Different BPM Related Implementation Methods

The methods in table 9.1 propose a one size fits all approach and do not take into account the context of an organization that implements both BPM and supporting IT. Although many providers of implementation methods and tools do acknowledge the need to customize their methods to the situation at hand, they do not provide any means for method customization. Due to strong consultant influences, who are the professionals that should decide in which way a method should be used, it is assumed that consultants generally have the skills to customize implementation methods on the fly. This introduces room for error because we cannot expect consultants to have the experience and knowledge to be able to tackle every situation. For that reason we propose that implementation methods are made more context-dependent. This means that an implementation method should provide variable and conditional activities and steps that cater to many

different situations. Also such a method should provide analyses tools that help tailor the implementation method. The research question of this paper is: *Can a situational implementation method be developed for BPM systems?*

An aspect in relation to BPM is the state-of-the-art BPMS that are used increasingly to support integrated BPM and SOA implementations. This trend causes some organizations to think of BPM as an IT project instead of the implementation of a management strategy. We state that that the use of a BPMS implies deep and enterprise-wide process analyses, and the inclusion of process performance measurement for continuous process (quality) monitoring and improvement and therefore the implementation should consider both IT and management aspects. Current contributions to academic and professional journals are more focused on what the BPM concept is, and why organizations start BPM-projects (Fremantle, Weerawarana and Khalaf, 2002; Karagiannis, 1995; Ravesteyn and Versendaal, 2007; Van der Aalst, Ter Hofstede and Weske, 2003; Weske, Van der Aalst and Verbeek, 2004). And while there is research on the maturity level of organizations that are using BPM (Hammer, 2007; Harmon, 2004; Lee, Lee and Kang, 2007; Rosemann and De Bruin, 2005), the question of how a BPM-system can be implemented, and what business value it can bring, continues to be a grey area. All the more if during the implementation project an organizations context is taken into account.

In figure 9.1 the different levels of the generic implementation method concept (cf. Weske, 2007) are shown to clarify the importance of context. At the meta-level the language/ontology that is used to describe an implementation method is defined. For instance, an implementation method can be described using the terminology used by the ISO–standard, a process modeling language such as Petri nets, or with plain text. In this research method engineering is used to describe our proposed implementation method on a meta-level. Method Engineering is a proven technique to develop meta models (Brinkkemper, 1996).

| META IMPLEMENTATION METHOD |
| IMPLEMENTATION METHOD |
| IMPLEMENTATION INSTANTIATION |

Figure 9.1 Three levels of an implementation method

At the second level the implementation method itself is described. All the phases, activities, roles, deliverables, etc. that are part of the method are explained in relation to each other. Frequently the method consists of tutorials, training material, decisions sheets and several templates that can be used to record infor-

mation that is needed during the project or that is a deliverable. In this chapter the process deliverable diagram (figure 9.3) is an example of a method on level 2. When a method is used to actually implement a BPMS in an organization that method is instantiated, which is level 3 in figure 9.1. In practice each implementation (instantiation of the method) will not necessarily be the same as earlier implementations because an analyses of the specific organizational circumstances will determine the best way to approach the implementation. It is on this level that situational factors will determine the use of the implementation method. As stated before this is currently the domain of the consultants because most methods do not provide different implementation activities, the method proposed in this chapter does.

The remainder of this chapter describes the development of a situational BPM implementation method. The following section describes the research approach, section 3 then gives an example of an implementation fragment; in section 4 the fragment is validated and finally sections 5 and 6 give preliminary conclusions regarding this research and an overview of the work that still has to be done.

9.2 Research approach

As a starting point in the development of a situational dependent BPMS implementation method we chose the Information System Research Framework of Hevner, March, Park and Ram (2004) as shown in figure 9.2. The most important reason for this is that Hevner et al. (2004) propagate that studies in the IT as well as the IS research domain are both about descriptive and prescriptive research.

The descriptive part of the research (knowledge-producing activity) aims to understand, explain and predict why certain phenomena in the IT are occurring, while the prescriptive approach (knowledge-using activity) aims at improving performance to meet the business need (Hevner et al., 2004; March and Smith, 1995).

Although the framework of Hevner et al. primarily focuses on technology-based design, the model can also be used for other practices than technology-design approaches. This holistic approach with its clear boundaries and guidelines enables the framework to serve as a basis for this research.

The research consists of four major activities based on the framework. First, critical success factors of BPM-systems implementation were collected from existing research (the knowledge base). In the BPMS domain critical success factors can be defined as those areas where 'things have to go right' for a BPMS implementation to succeed (Ward and Peppard, 2002). The list of factors is a first indication towards the context in which an organization is starting its BPM project and contains both management and IT related aspects. The list of critical success

factors is based on the research by Ravesteyn and Versendaal (2007), table 9.2 gives an overview.
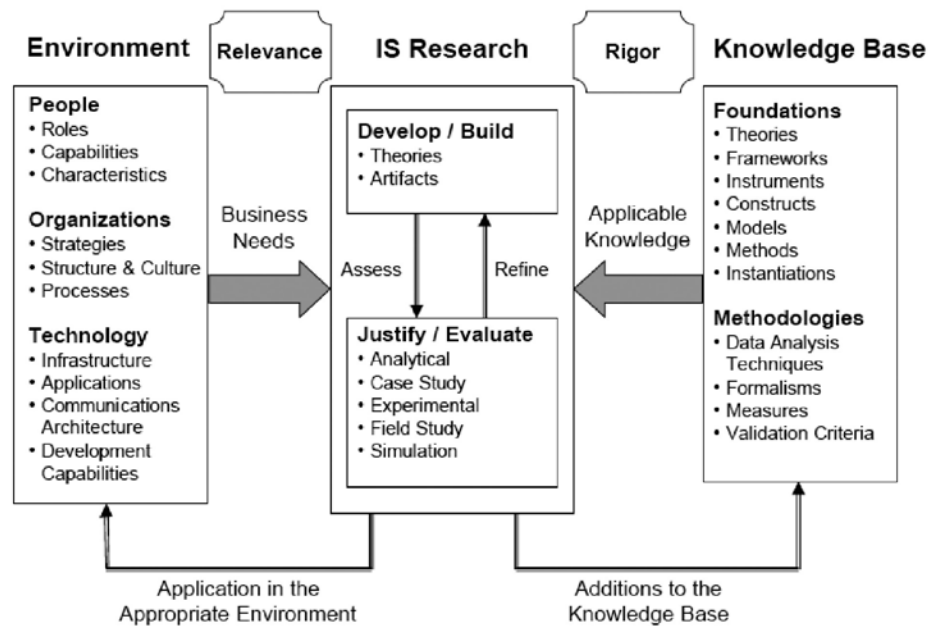

Figure 9.2 Information Systems Research Framework (Hevner et al. 2004)

Secondly a list of situational factors is constructed based on experience from business (the environment). A situational factor can be any factor, such as an environmental factor that contributes to the set of conditions to which an organization acts or reacts. Situational factors can be very basic for instance the size of the organization in employees or revenue. A factor such as the number of employees gives an idea about the amount of different roles and responsibilities that are related to the organizations processes. Also factors can be BPM specific instead of generic. For example the level of knowledge the organizations software developers (or the IT department) have in regards to service development. The development and use of web services in creating a service-oriented architecture in support of the organizations processes is important to the agility and flexibility of these processes. When the IT department has little or no knowledge of how to correctly develop web services, this should be taken into account before the implementation.

The third activity (develop/build) is building a repository of implementation activities based on combinations of critical success factors and situational factors. An implementation activity is a task or series of tasks that have to be executed by actors to realize the goal of a successfully implemented BPM-system. The different activities are based on an analysis of the identified implementation methods from both business and sciences (table 9.1). Finally the constructed implementation fragments are validated (justify/evaluate). Different validation techniques are available but in this research only case studies are used as means of validation.

Critical Success Factors	
1	Know-how and experience with Project Management
2	Experience with Change Management
3	Understanding the BPM concept
4	A well organized design phase (modeling)
5	Understanding the processes of the company
6	Using the 'best' modeling standards and techniques
7	Understanding interdependencies and integration of data sources
8	Well organized maintenance and (quality) control of the process models
9	Understanding how processes and data are linked together
10	Understanding how to develop and use web services
11	Involving the right people in the project
12	Having a set of key performance indicators and measuring the change (improvement)
13	Ensuring that the BPM project is part of a continuous optimization effort
14	Creating a culture of attention to quality within the organization

Table 9.2 Critical Success Factors When Implementing BPM

9.3 BPM-system Implementation Fragment – An example

In this section we will use the critical success factor 'Understanding how to develop and use web services' as an example to explain how implementation fragments are developed based on situational factors. This factor is both about understanding the concept of SOA as how to actually develop web services. As a first step we defined several situational factors that can occur at a specific organization and that influence the activities that are done during the implementation of BPMS.

There are several important contextual aspects that influence the success of using web services. First there is the degree of involvement of different stakeholder's (in- and external) in the project. Is there agreement on the function that web services will have? Are there already web services available inside or outside the organization that can be used? How about service level agreements on services? And what about pricing? The project team alone cannot tackle these questions.

Closely related to the involvement of stakeholders is the availability of reference models for the organizations processes and related specifications for data models or web services. In many large industries there are already standards available that can easily be adopted. In many cases, however, organizations that are implementing BPMS do not use these standards because the first processes to be implemented are internally orientated. By not adhering to standards from the start, seeds are planted that will cause problems for later projects. As soon as web services need to communicate with services outside the organizations boundaries, existing industry standards will have to be followed and 'old' services from earlier projects can no longer be (re)-used.

Another factor that influences implementation activities is the SOA maturity of the organization. Is there technical knowledge available in the organization? Should partners be involved? Does the organization have a SOA strategy or perhaps even (parts of) a SOA in place? Are there any methods and tools available for web services development? Do business people understand the SOA paradigm? Again these are questions that influence the SOA delivery strategy (Terlouw, Terlouw and Slinger, 2009) and which should be tackled if BPM-systems implementation is going to be successful.

In figure 9.3 part of a process deliverable diagram (consistent with method engineering) belonging to the implementation fragment that is constructed based on the critical success factor 'Understanding how to use web services' is shown. To keep the figure comprehensible not all of the situational factors that have been discussed are included. In this example only the SOA maturity of the organization is discussed.

There is a distinction between activities that should be done when the organization has a low maturity or when it has a high maturity. In the diagram the different paths are created through decision-boxes that create different routes that can be taken depending on the maturity. The method consists of four main phases that contain multiple sub-activities and concepts. Just the two phases with activities related to this critical success factor are shown in detail with there sub-activities.
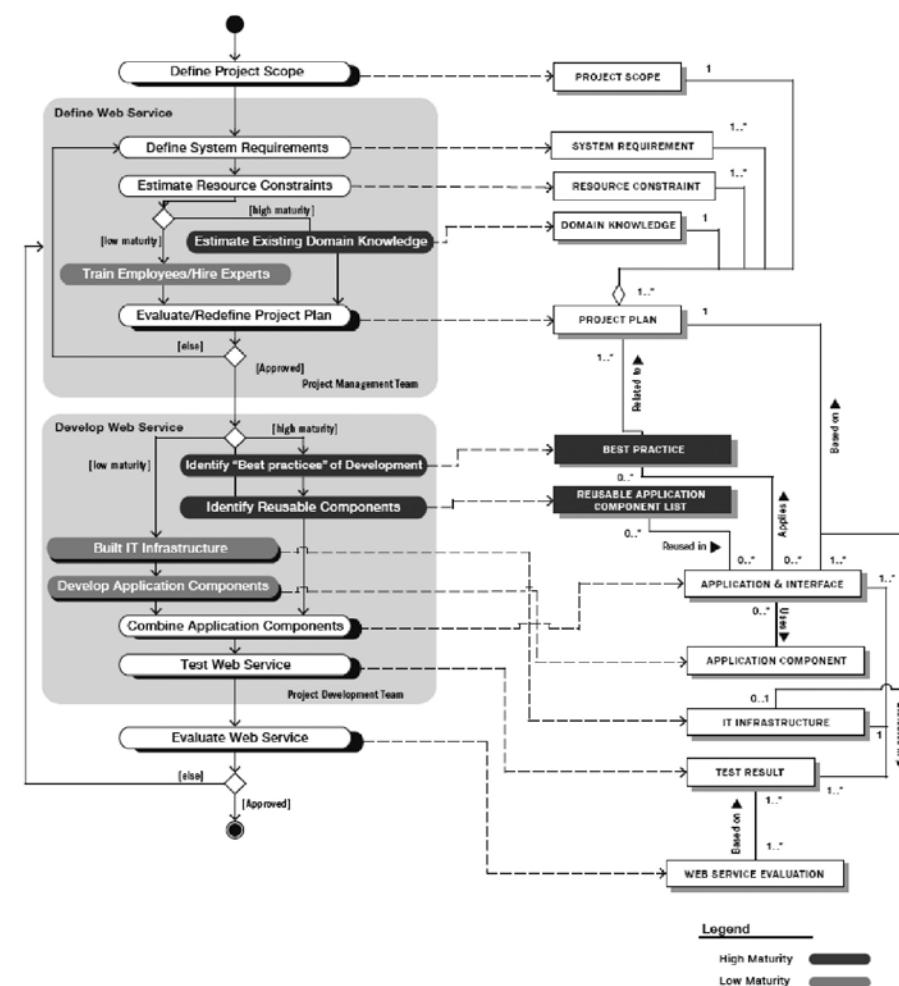
Figure 9.3 BPMS implementation fragment for the CSF 'Understanding how to use web services'

In the 'define project scope' phase the feasibility, nature and range of service solutions in the context of this project are defined (Papazoglou and Van de Heuvel, 2006). This is followed by the 'define web service' phase which contains 5 possible activities. The first two activities 'define system requirements' and 'estimate resource constraints' have to be executed for each project. In these activities resources' consumption, boundaries and limitations are defined for the development of a web service (Moor and Van de Heuvel, 2004) and also the availability of resources within a company in relation to the required consumption for the

development need to be determined (Jeston and Nelis, 2006). Then depending on the maturity of the organization either the 'estimate existing domain knowledge' or the 'train employees/hire experts' is undertaken. When there is a high organizational maturity the existing domain knowledge is analyzed in order to locate the internal experts who will be involved in the project (Croft, 1986) while in a low maturity situation employees should be trained and/or domain experts should be hired. The final activity in this phase is 'evaluate/redefine project plan' and should deliver a detailed report of the required activities and processes to be followed for the accomplishment of the services development project (Jeston and Nelis, 2006).

The 'develop web service' phase contains the actual development activities. Again these depend on the maturity of the organization. In a low maturity environment the technical infrastructure in terms of hardware and networking systems (Jeston and Nelis, 2006) should be built or made ready for services first (e.g. decisions on integration technology). Subsequently application components must be developed. "A component is a binary unit that exports and imports functionality using a standardized interface mechanism. The underlying component infrastructure supports composition of services by providing mechanisms for introspection, event handling, persistence, dynamic linking and layout management (Broy et al., 1998)." In general, application frameworks are required for building services as well as for composing them. If there is a high level of maturity several "Best Practices" of past projects can be identified and be reused also reusable services can be integrated into the new project. Finally the new web services can be developed and the corresponding documentation (a description of the self-contained, modular applications used in the web service along with a protocol interface description (Fensel and Bussler, 2002)) are delivered and then tested.

The final phase 'evaluate web service' consists of an overall assessment of the developed services and if this is not accepted several iterations may occur before a final approval. The assessment of the web services are based on its functionality in relation with the predefined requirements (Fensel and Bussler, 2002).

In a similar manner as shown here, we constructed implementation fragments for the remaining critical success factors. Together the fragments are the basis for a context dependent BPM-systems implementation method. In the following section the validation of the implementation fragments is described.

9.4 Validation

To validate the developed implementation fragments we did case studies at customers of Cordys. Cordys is a global software company based in the Nether-

lands that develops and sells a BPMS. Here we describe one case study conducted at an 'International Financial Services Company' (IFSC).

9.4.1 Case: International Financial Services Company

IFSC is an international financial services provider active in the fields of banking and insurance. The company offers its products and services through its own distribution channels, in cooperation with intermediaries and distribution partners. A subsidiary of IFSC is the Local Insurance Company (LIC). LIC is a provider of disability income insurance, health insurance and pension plans in the Netherlands. LIC employs over 600 people and has a comprehensive national network of financial advisors in the Netherlands. To improve and better manage the complexity of its integrated product offering and process chains LIC decided to implement a BPMS application. The implementation has to provide improvement of both BPM and Business Activity Monitoring capabilities that already exist and provide the flexibility and agility the organization needs to manage its response to new legislative change.

In a first project the implementation of Cordys has already seen the required processing time for a new participant in a pension scheme reduced from a thirteen minute process involving 70 – 80 data input screens, to a two minute process involving a single interface. In a second project LIC will be using the platform to manage the complex process of changing the status of thousands of pension policies to ensure compliance with the latest financial legislation. The company also plans to better manage third party organizations, by integrating business processes with web services. LIC has a number of other projects planned to create composite applications that combine existing and new functionality to improve various business processes.

For this case study three interviews were held. All interviewees had roles as either project manager or department manager and were involved in the BPMS projects. Each respondent was asked to relate the activities in the implementation fragment (of figure 9.3) to there current practice and provide any perceived disadvantages and advantages.

Based on the interviews it was clear that there is no overall maturity that can be taken into account. Projects should realize that the maturity of departments can differ greatly within the organization. Therefore every project should start with a maturity analysis. Based on the outcomes, the respondents agreed that training people (as suggested in a low maturity situation) can be an effective implementation activity. However this might also be needed in some high maturity situations when new project members or employees with little knowledge of service orientation are added. Therefore this activity can not completely be ruled out. Also the activity 'develop web service' consists of two paths that are recog-

nized but again a high maturity situation should not entirely rule out the low maturity activities (while a low maturity does normally mean that there are no services available to be reused).

Based on this validation we conclude that although the example fragment can be used in practice, more alternative paths based on different situations need to be constructed.

9.5 Conclusions

In this chapter we show that there are many different implementation methods available for BPM and supporting IT. Most of these methods do not, however, provide a situational implementation approach. Because organizations operate in different contexts, variable implementation methods are needed. A context dependent BPMS implementation method is proposed consisting of implementation fragments that are based on critical success factors of BPM implementation and situational factors that are organization specific. The developed implementation fragments and their activities in this research are based on earlier research and existing implementation methods.

In total 14 BPMS implementation fragments have been developed. Each fragment takes into account several contextual factors and proposes corresponding implementation activities thereby tailoring a BPMS implementation for a specific organization. This chapter describes the process of development of implementation fragments and illustrates the results by one example based on the critical success factor 'Understanding how to use web services'.

The validation suggests that the fragment is usable in practice and can add value to the implementation process by realizing that each organization operates in a different context. However more situational dependent paths are needed.

9.6 Discussion and Future Research

The objective of this research is to develop a context dependent implementation method for BPMS. The current method contains 14 implementation fragments but should be extended to include more success factors. While future research will extend the method it will never be finished, possibilities for extensions are: more activities (sector specific), cultural context, etc.

Besides adding more content to the method, more validation is also needed. Not only does each fragment needs testing but also the entire implementation method should be validated in several projects to determine if this approach really adds value by increasing the rate of successful BPMS implementations.

Conclusions

As described in the introduction of this dissertation the main question of this research is:

Which situational factors and competences determine the success of Business Process Management Systems implementation?

In this chapter an overview of the conclusions per research question is provided, which together form a reflection and conclusion on the overall research question of this dissertation. Subsequently, implications, and limitations and future research are discussed.

10.1 Answering the Research Questions

RQ1: What are the success factors of Business Process Management System implementations?

When implementing a BPMS it is important to take into account which factors influence the success of the implementation project. To determine these factors and also to identify whether the factors are perceived differently both qualitative and quantitative research was performed. This research question was subdivided into three related questions:

RQ1.1. What are Business Process Management Systems and can they be related to existing and earlier concepts?

In this dissertation the following definition for BPMS is proposed (chapter 4, pg. 48):

A Business Process Management System is a (suite of) software application(s) that enable the modeling, execution, technical and operational monitoring, and user representation of business processes and rules, based on integration of both existing and new information systems functionality that is orchestrated and integrated via services.

This definition was based on the characteristics of different management disciplines that influenced the functionality and architecture of BPMS as described in tables 2.2 & 2.3 in chapter 2. Finally this definition was found to be supported by 39 respondents of a survey among Dutch BPM professionals (mean score is 5.0 and standard deviation is 1.47), as shown in chapter 5.

The state-of-the-art BPMS applications that are currently available are based on many different innovations in the business and IT domain during the past two

decades. The most important concepts that have driven BPMS development are: Total Quality Management, Business Process Reengineering, Enterprise Resource Planning, Business Process Modeling, Workflow Management, Business Intelligence, and different techniques for Enterprise Application Integration.

However, as is explained in chapter 3, the functionality needed to support different types of processes is constantly changing. It is therefore expected that functionality will be added to the basic IS/IT architecture of a BPMS. This will especially be the case for the support of ad hoc activities and dynamic processes.

RQ1.2. Which factors determine the success of Business Process Management Systems implementation?

As is shown in chapter 4 there are 55 factors that influence the success of BPMS implementation projects. This list was narrowed down to include only critical success factors. As is described in chapter 4 this was done by counting the number of times success factors were found in the literature study and combining this with the outcomes of the interviews and surveys that were held. Based on this the following list of 14 factors remains (not shown in any particular order):

1. Project Management: does the organization have much know-how and experience with Project Management?
2. Change Management: does the organization have change management experience?
3. Understanding the BPM concept: is there a shared vision and understanding on BPM?
4. Organization of the modeling design phase; is there a well organized mechanism for modeling processes?
5. Understanding the process: do the stakeholders understand the concept of a 'process' and do they understand the processes involved in the project?
6. Using the 'best' modeling standards & techniques: is there consensus between the project stakeholders on what modeling method best fits the project goals?
7. Understanding interdependencies and integration of data sources: is it clear whether there are any interdependencies and integration issues between data sources that are related to the processes that are part of the project?
8. Maintenance and control - including quality - of the models is important: does the organization have a mechanism in place to maintain and control processes (including models) after the implementation project has finished?

9. Integration of processes and data: does the organization understand how the processes and data involved in the project are linked together?
10. (Use of) web services: is there a common understanding on the concept of (web) services and how to use them in a BPMS implementation project?
11. Involving the right people in the project: are the different stakeholders represented in the project and is there management support for the project?
12. Performance measurement: has a set of key performance indicators been developed to measuring the change in process improvement that is expected from the project?
13. Continuous optimization: has the organization made sure that the BPMS project and its results are part of a continuous optimization effort?
14. An organization and culture of quality: for a BPMS implementation to be successful there should be a culture of attention to quality within the organization, has this been realized?

It is worth noting that many of the critical success factors found are related to the way in which the process of implementing a BPMS is organized. Organizations need a clear approach for managing the project and assign an experienced project manager. It is important to realize that implementing a BPMS will often mean that employees need to change the way in which they are working and therefore change management is important. Furthermore, the organization should understand that BPM is a continuous effort and therefore it needs to be part of the organizational strategy to continuously add value to the business. The processes which will be executed using the BPMS should be modeled during the design phase of the project and the way in which this is done should be well organized (responsibilities should be clear, level of detail should be decided, etc.). Also all stakeholders involved in the project should have a common understanding of what a particular process is. For the BPMS implementation to succeed the right persons should be involved in the project such as process owners, process and content experts, managers with decision power and employees or consultants with knowledge of the BPM-system and any information systems that will be part of the project. Finally the organization should create a culture in which everybody in the organization is involved in continuously optimizing the quality (efficiency and effectiveness) of the organizations processes. To be able to do this performance measurement methods and techniques should be in place before the BPMS is implemented. This ensures that the effect of the BPMS can be measured.

The remaining critical success factors are mostly concerned with technical issues such as integration of data sources, their linkage with processes and the use of web services.

Finally the choice of modeling standards and techniques to be used in the BPMS implementation project (together with the maintenance of the models both during and after the project) were found to be critical success factors.

RQ1.3. How are BPMSs success factors perceived by stakeholders in the BPM industry?

In chapter 5 we showed the results of a survey that was sent out to 925 Dutch organizations. Based on the answers of 39 respondents (divided in BPM consultants, developers of BPMS and end-users) it is concluded that there is little difference in the way that success factors are perceived between the respondents' roles in an organization or by their level of expertise in the BPM domain. In other words, the different groups of respondents share a common view on BPM and BPMSs. The only difference that stands out is that developers and consultants with specific BPM-experience have a stronger belief that applying BPM enables organizations to improve processes and IS/IT in a more flexible and adaptive way. This outcome can be understood from the fact that these respondents are actually involved in the design and deployment of BPMSs. Also, developers appear to have a stronger opinion on some of the success factors, as this group strongly agreed on the statements that:

1) aligning software tools to the organizations strategy, and
2) reusing existing information systems and applications when implementing a BPMS is of high importance.

As described in chapter 4 the critical success factors of BPMS implementation were found through a study in the Netherlands. However in chapter 6, taking an international perspective, differences could be identified between groups of respondents with different levels of experience and coming from different cultures on how they perceive success factors for a BPMS implementation. The survey underlying chapter 6 was completed by 39 respondents from 11 different countries. Central goal of the survey was to explore how BPM-systems success factors are perceived by professionals from different countries (i.e. cultural backgrounds) and how this is related to other characteristics such as their level of experience within the BPM domain. A first interesting result from the survey is that people with a high level of experience specifically believe that the success factor strong project management is important. A second interesting result is that the importance rating of the success factors depends on the national/cultural background or the level of experience of the respondents. Also, significant differences between the professionals from the Anglo countries and Nordic countries are found with regard to factors like: "understanding the BPM concept", "having strong management support and involvement", "the need for the BPM(S) implementation to start within the organization before external processes and systems are included" and "understanding how processes and data are linked together". These success factors seem to be more important for BPM professionals that act in Northern European countries compared to those in the United States, United Kingdom and Canada. However it remains difficult to state whether this can be explained by the different scores that these regions have on the cultural dimension as determined by Hofstede (1982): this is worth exploring further. A third result found in chapter 6 is that respondents with more experience in BPMS implementations tend to find the 'soft' or intangible success factors more important than others, in particular the factors "alignment of the implementation to the organizations strategy", "strong project management" and "the influence of culture on the success of a BPMS project". Finally, the answers of the most experienced BPM professionals support the notion that organizational culture plays a vital role in the success of a BPMS implementation as BPM coincides with fundamental changes within an organization.

Next to the factors related to BPMS implementation success from a business perspective, this research also explored the competences that are needed in BPMS projects. The corresponding research question was:

RQ2: What are the competences needed in Business Process Management System implementation projects?

This research sub-question is subdivided in two questions which are related to two different stakeholder views regarding the competences. The first question is based on a business perspective while the second takes a teaching perspective.

RQ2.1. According to the stakeholders of the BPM industry what are the competences needed for BPMS implementation?

In the same survey as described in chapter 5 (and which is also used for RQ1.3) we asked the respondents to describe the competences they find important during BPMS implementation projects. The outcomes are described in chapter 7. In this chapter a competence is defined as the required knowledge, skills and attitude by members involved in a BPMS-project. The 39 respondents judged the following competences as important (based on table 7.3):

a. Knowledge about administrative processes
b. Knowledge on methodologies to model processes
c. The ability (skill) to have an overview of processes within the organization and throughout the supply chain
d. Knowledge on SOA and web services
e. Knowledge about IS/IT Architecture
f. Knowledge about existing IS/IT applications

g. Knowledge about integration techniques and methodologies
h. Knowledge about modeling data and processes
i. Knowledge on the Unified Modeling Language (UML)
j. High analytical capabilities and skills
k. A process minded attitude
l. Good communicative skills

The first three competences that are needed during a BPMS implementation are related to the fact that it is important to be able to analyze as-is processes, ascertain their quality and provide suggestions on how to improve them. It is important to take into account that not each modeling method maybe useable in the situation at hand. Furthermore it should be realized that many practitioners tend to dive into details when it comes to analyzing and modeling processes without having a more abstract overview on relations and dependencies with other processes both inside and outside the organization.

The competences listed d to i are related to more technical issues when implementing BPMS. According to the respondents of the survey knowledge on different IT methods and techniques are important for a successful BPMS implementation. Remarkable is that knowledge on Unified Modeling Language (UML) is explicitly mentioned as important (several respondents noted this as answer to an open question) while no respondent mentioned the Business Process Execution Language (BPEL). The underlying reason for this is probably that the IT departments of the organizations in which the respondents are working are 'translating' process models to UML and therefore it is perceived as an important competence. Also when the survey was performed in 2007 BPEL was not yet popular enough (or known) among the respondents.

Finally, listed competences j to l are general competences that are not only key to the success of BPMS implementation but to any IT/IS project.

In chapter 7 we concluded that the list of aspects is incomplete and that the aspects themselves can be defined more generically; e.g. 'Knowledge on the Unified Modeling Language (UML) may include any likewise architectural modeling technique. Also many aspects are very IS/IT related which is probably caused by the fact that the majority of the respondents in the survey have an IS/IT background or role in their company. In conclusion the aspects found should be considered important in a BPMS implementation project, and not having this knowledge and these skills onboard in a project team can compromise the success of the project.

RQ2.2. What competences are addressed in academic Business Process Management curricula?

This question was answered by actively engaging in the design and implementation of a BPM course for a joint student group from the HU University of Applied Sciences and Utrecht University. The module was taught for five years and subsequently evaluated and improved during that period. We described this action research in chapter 8. Over the years the competences that students acquire are grouped into three categories related to BPM, labeled: 'business administration', 'information architecture and technology' and 'influence and alignment'.

The first group of competences requires BPM students to recognize and understand the relations between the various functions and departments in an organization and between organizations in relation to relevant market developments. Based on this competence 1) process improvements should be recognized including the possibilities to use IS/IT. Also an important competence in this group is 2) the ability to identify and to model company processes and interactions within and between organizations.

The second group of competences are IS/IT related and state that students should 1) be able to design a system architecture for collaboration in extended enterprises in which new ICT capabilities are used 2) understand the basics of SOA and BPM-systems, and 3) are able to install and configure BPMSs and use them to integrate different IS/IT within an organization and across its supply chain.

The final group of competences is very much aimed at communicative skills and require BPM students to 1) be able to be conversant with both the domains of business and IS/IT within the organization 2) be able to communicate with all organizational layers on a clear and effective way about investments, business and IS/IT innovations in terms of business issues and benefits 3) be able to reflect on their own choices and activities and to indicate their own skills, and 4) be able to apply the set of conversational techniques and competences in order to achieve effective communication in interviews and presentations.

Based on the answers found to RQ2.1 and RQ2.2 we can now answer to RQ2. In table 10.1 both sets of competences (from a business and academic perspective) are shown categorized according to the groups mentioned above. The two arrays of competences appear to have many similarities. One exception is the competence: 'Knowledge on the Unified Modeling Language'. We believe that this is because this competence is a very specific one, while all the other competences are formulated on a more common level.

	Professional competences	Academic competences
Business administration	Knowledge about administrative processes	Recognizing process improvements including the possibilities to use IS/IT
	Knowledge on methodologies to model processes	Being able to identify and to model company processes and interactions within and between organizations
	The ability (skill) to have an overview of processes within the organization and throughout the supply chain	
	A process minded attitude	
Information architecture and technology	Knowledge on SOA and web services	Being able to design a system architecture for collaboration in extended enterprises in which new ICT capabilities are used
	Knowledge about IS/IT Architecture	Understand the basics of SOA and BPM-systems
	Knowledge about existing IS/IT applications	Being able to install and configure BPMSs and use them to integrate different IS/IT within an organization and across its supply chain
	Knowledge about integration techniques and methodologies	
	Knowledge about modeling data and processes	
Influence and Alignment	High analytical capabilities and skills	Being able to be conversant with both the domains of business and IS/IT within the organization
	Good communicative skills	Being able to communicate with all organizational layers on a clear and effective way about investments, business and IS/IT innovations in terms of business issues and benefits
		Being able to reflect on their own choices and activities and to indicate their own skills
		Being able to apply the set of conversational techniques and competences in order to achieve effective communication in interviews and presentations

Table 10.1 Comparison of competences

RQ3: How can an implementation method for Business Process Management System implementation be made situational?

An important concept in this research question is that of 'situational' in this dissertation also referred to as 'context sensitive'. With this we mean that depending on the situation at hand in a specific organization the factors or competences that are important in relation to the success of the implementation project may be different. Therefore the implementation of a BPMS has a better chance for success when the implementation method used provides variable and conditional activities and steps that cater to many different situations. Examples of situational factors are: size of the organization, complexity of its processes, number of suppliers and customers, process maturity, number of information systems etc. As we showed in chapter 9 there are many different implementation methods available for BPMSs. However most of these methods do not provide different sets of activities that can be executed depending on the specific context of the organization in which a BPMS is implemented. Based on the design research method of Hevner et al. (2004) a context sensitive BPM(S) implementation method is developed which is based on the (critical) success factors found in this dissertation research, supplemented with situational factors that are derived from literature and are commonly known differences between organizations (such as the examples mentioned above).

Currently the context sensitive BPMS implementation method consists of 14 implementation fragments. Each fragment relates to one critical success factor and takes into account several other situational factors. Together these fragments enable the assembly and use of a tailor made BPMS implementation method for a specific organization.

By answering the three research questions we have also answered the main question of this dissertation:

Which situational factors and competences determine the success of Business Process Management Systems implementation?

In this research an overview of both the factors and competences that influence the success of Business Process Management Systems implementation has been constructed and validated. While much knowledge already exists on the factors that are related to Enterprise Systems implementation (mostly ERP) and workflow management, there was little about BPMS. In this dissertation a key list of success factors for BPMS implementation has been investigated to determine if different stakeholders have a different perspective on these factors. Overall, only small differences between stakeholders were found. Finally, an effort was made to find out if differences in cultural background influenced the perspective of stakeholders

regarding the importance of the factors found in this research. Although significant differences were indeed found between cultural backgrounds (as well as between levels of experience) the number of respondents to the survey is to limited to draw ultimate or generic conclusions.

This research also attributes to the available set of competences needed to implement information systems such as enterprise systems by adding a set of competences specifically defined for BPMS implementation. Also these findings have been used to improve existing courses and develop new courses for two higher educational institutions in the Netherlands, thereby immediately implementing the findings of this dissertation research.

The findings in this research are input to an implementation method that takes into account the context of the organization in which a BPMS is being implemented. While this method is still in development and the fragments are currently being validated by using them in BPMS implementation projects, it is (as far as we know) the first situational implementation method available.

A more detailed description of the implications of this research is given in the next paragraph.

10.2 Implications of this research

10.2.1 Implementation of Business Process Management Systems

The research on success factors of BPMS implementation has shown that there are a lot of issues that have to be taken into account before a BPMS can successfully support the processes of an organization. It has also made clear that a BPMS implementation is not like any other enterprise system implementation, because during a BPMS implementation often many other (legacy) information systems within the organization need to be connected to the BPMS and integrated into a service oriented architecture. So, in essence, besides implementing an information system, BPMS projects are also about developing a sort of virtual application based on the service oriented architecture paradigm. Organizations that start implementing BPMS, in the longer run, will be confronted with the fact that implementing a BPMS is not mainly an IS/IT-project but a project that should be aligned to the strategic goals of the business. This implies that BPMS projects are of strategic importance and should preferably be initiated and constantly supported by the top management within the organization.

Another result of this research is the context-sensitive implementation method for BPMS. We developed this method with the aim of increasing the number of successful BPMS implementations by offering an implementation method that better fits the situation at hand in a specific organization. For example imagine an organization that has already modeled all its processes as part of an effort to

receive an ISO certification. Furthermore this organization has a system in place that ensures the process models are maintained and correct. In this situation when a BPMS is implemented certain implementation activities can be skipped or need less emphasis. While in an organization which is implementing a BPMS for the first time, and has no process descriptions and models, more implementation steps need to be executed.

While the method is still in its early development stages (more implementation fragments need to be added) several organizations in the Netherlands (both large consultancy firms and end user organizations in the financial and electricity sectors) have already expressed their interest in using this method. Currently possibilities to cooperate with one or two organizations that are willing to adopt and use the method in their BPMS implementation projects are examined. This should result in the method being tested and consequently expanded continuously.

In addition to these developments we were also invited to present the method at several professional conferences in the Netherlands, England and Portugal.

10.2.2 Research and education in BPM

Part of this dissertation research was focused on identifying the competences needed in BPM projects. Based on this research a BPM master course has been further developed incorporating all phases of the BPM lifecycle. A course which not only covers scientific theory but also provides hands-on experience with state-of-the-art BPMSs is very rare and therefore (considering the complications of maintaining and developing the course material) quite an accomplishment. Additionally this course has triggered many students to participate in the BPM research lines of the HU University of Applied Sciences and Utrecht University and publish their results.

In the BPMS implementation research line students have have developed or validated approaches to be used in implementation projects. In Aydinli, Brinkkemper and Ravesteyn (2008) a business process and organizational re-design and implementation project for an e-government service organization is described. For this project a new BPR implementation method was developed (Aydinli and Ravesteyn, 2010) which was also applied in a business process improvement project in a governmental Shared Service Centre (SSC). As the use of web services and Service Oriented Architectures (SOA) are important issues when implementing a BPMS several research projects focused on these areas. Dow and Ravesteyn (2008) developed a model which can aid Service Oriented Architecture designers by giving them a set of researched criteria that can be used to measure the quality of enterprise service definitions. This model can also be used when designing services as part of a BPMS implementation. In relation to this research a method for defining optimum service granularity was also developed (Wiersma and Rav-

esteyn, 2010). Finally students have started projects to validate (parts of) the implementation method that is developed during this dissertation research (Hagemans, Kelder and Ravesteyn, 2010).

As part of the research line that focuses on process maturity students have developed several frameworks and maturity models. Hiemstra, Ravesteyn and Versendaal (2009) describe in there paper a maturity model that focuses on providing organizations a holistic view of the alignment between BPM/SOA in their current situation and in relation to their desired state. As such, it supports the organization in evolving towards BPM/SOA alignment. Zoet, Schakel and Ravesteyn (2009) developed a process classification framework distinguishing between five types of processes: straight through processing, workflow processes, case based processes, human centric business processes and knowledge management processes.

In 2008 a new research line in Business Rules Management was started which focuses on integrating concepts in this domain, such as governance, risk and compliance, with business process management. In a publication by Zoet, Welke, Ravesteyn and Versendaal (2009) different kinds of risk affecting a business process are introduced, after which solutions to the problem of risk mitigation are discussed, resulting in a proposed framework to mollify these risks by incorporating a class of risk mitigation rules into business process development. In 2010 Martijn Zoet started his PhD research in this domain.

The last research line focuses on dynamic business process management (in chapter 3 we also refer to dynamic BPM as human interaction management). One of the major issues that are researched is how to let knowledge workers communicate efficiently about the processes of which they are a part. Currently e-mail is the main tool that is used but it is also one of the main sources of information overload, which threatens the efficiency, effectiveness and health of knowledge workers. Kristjansson, Mikalef, Versendaal and Ravesteyn (2009) address this problem by taking a human driven and collaborative perspective in constructing a conceptual model for the processing of e-mails (this publication won a best paper award). While Haanappel and Ravesteyn (2010) developed a framework to enhance communication between knowledge workers.

In summary this dissertation research has had a clear impact on the research conducted at the HU University of Applied Sciences and Utrecht University. However it also helps other universities to rise to the challenge of educating students in such a way that they are able to meet the requirements of organizations in the BPM industry. At present universities from Belgium and Portugal have shown interest in adopting (parts of) the course.

Currently the competences identified in this research are used as foundation to both bachelor and master BPM courses at the HU University of Applied Sci-

ences (HU) and the Utrecht University (UU). At the HU the bachelor study 'business informatics' has a 15 ECTS (European Credit Transfer System, 1 ECTS is 28 hours of study) module on BPM in which the both the business competences (predominately process modeling) and the technical competences (execution of process models) are part of the learning goals. Furthermore the 'master of informatics' at the HU has several 3 ECTS modules, 2 covering different process standards, 1 module on business IT alignment and 2 modules on Enterprise Architecture and Process Architecture. At the UU there are two BPM modules of both 7.5 ECTS, the first is a module in the bachelor 'business informatics' covering all basic aspects of BPM and the second is a 7.5 ECTS module that is part of the 'master business informatics' that focuses on doing research in the BPM domain.

Finally the competences found in this research are also being used as input to a study by the Dutch BPM-Forum to determine competences for BPM professionals. The BPM-Forum is a association for BPM professionals and its goals are to both share knowledge on BPM as to develop new knowledge in the Netherlands. As stated one of their current studies is to determine if there is a need (and the possibility) to develop a BPM certification program specifically designed for the Netherlands.

10.3 Opportunities for future research

Research is never finished; there will always be points of discussion about the findings from studies. Hence, there is possibility to do further research. In the final section of this chapter we discuss opportunities for future research.

10.3.1 BPMS implementation method

An important contribution of this research is the insight in success factors of BPMS implementation and consequently the context-sensitive implementation method that is developed. The first version of the method is based on the 14 factors (as described in chapter 4) that are critical to BPMS implementation. While this ensures a sound scientific foundation to the method, it also brings limitations. The first is that the 14 factors were only validated in the Netherlands and therefore the method might be of less value for use in other countries. This is confirmed by the study described in chapter 6 on how success factors are perceived by people from different cultures or with different levels of experience. Even this study has its limitations because it only considered Northern European and Anglo-American countries. Therefore the set of activities and situations currently covered by the situational implementation method needs to be expanded. The final method should include implementation fragments for all 55 success factors found. Secondly the

situational factors that are currently included in the implementation method are based on literature findings and common differences between organizations (for example size, type of product or service etc.). These factors should be studied and validated further. A first possibility is to include the difference in culture and experience level as situational factors in the implementation fragments. Finally the implementation method has only been validated using a limited amount of case studies. To further assess the usability and added value of the method real life implementations should be executed using the method from beginning to end. A possibility for future research would be to follow several BPMS implementations in which some project teams use the context-sensitive method and others use another method.

10.3.2 A changing world

In the introduction to this dissertation one of the research sub-questions inquired whether BPMSs could be derived from earlier concepts, as was shown in chapter 2 this was indeed true. However (as is described in chapter 3), both the business and IS/IT disciplines are constantly changing and consequently the functionality and underlying architecture of a BPMS also has to change. Chapter 3 already showed one of the directions in which BPMS research is expanding, but there are more.

A first phenomenon that should be examined more in-depth is the trend of providing applications and functionality from 'the Cloud'. Although this can be considered just another hosting offering from software providers, this trend goes much further. Specifically interesting in this regard is the possibility to use functionality (services) offered by different providers and combining them to create the information (system) a consumer wants. This is also called creating mashups and is rapidly becoming popular because of the possibility to quickly and cheaply create custom tailored information solutions. While mashups and cloud computing hold many promises there are still many questions that need to be answered, for example regarding security, service agreements, governance issues, etc.

A second domain raising attention in relation to BPMS is that of business rules. Although many BPMSs offer functionality to define, manage and execute rules as part of a process, they do not (yet) provide support to the complete business rules management (BRM) lifecycle. Increasingly organizations realize that legislation and policies often determine how activities and processes are designed. Transparent, well defined and controlled rules could greatly enhance process flexibility. For instance imagine an insurance organization which due to a change in legislation has to change certain processes. If these processes are supported by custom developed information systems with business rules and decisions hard coded in the software program, it will take a huge effort to find and change them.

Even if the processes are supported by a BPMS, process flexibility is not guaranteed if the business rules that are affected by a change in legislation are not separately registered and maintained. A business analyst might still need to go through all the models to determine where the business rules are modeled and how they are connected to information systems. If rules are separately modeled and maintained (for instance in a business rule engine) and then reused in the BPMS, there is only one place where you need to find and change the business rules that are influenced by new legislation. Therefore the relation between BRM and BPMS is an interesting research domain to be studied further.

A third research domain that we mention is the relation between BPM and ERP. As shown in the introduction the importance and number of implementations of BPMSs are growing rapidly. Many implementation projects will be in organizations which already have an ERP system running for several years. This not only means that the BPMS is going to be integrated with the ERP system, but more importantly that the processes supported by ERP need to be made transparent so that they can be leveraged in the BPMS. This is where problems arise, because many organizations do not have an up-to-date overview of how processes are implemented in the ERP system; at best the organization can provide the original implementation documentation but often this is lacking. Other issues that need to be solved are for example which system is going to be leading in support of processes, or in measuring processes. All in all the relation between BPMS and ERP systems in organizations will be an interesting research domain for years to come.

The research areas mentioned so far focused on technology issues related to BPMS but it is also possible to look at how current BPMS technology can be used in different industries and sectors to enable or support process innovation. For example the life sciences sector is changing rapidly from internally oriented organizations towards externally oriented organizations that are trying to collaborate in their research and development efforts. This change is driven by the fact that R&D in the life sciences sector (such as medicine development) has very long lead-times and high costs; therefore the risk organizations encounter is very high. If organizations collaborate in their R&D efforts (also called 'open innovation') they can share risks and shorten the time-to-market of new products. To be able to do this, it is necessary that organizations open up (part of) their processes to partners in the supply chain. This again has triggered many BPMS vendors to target the life sciences market. It is interesting to investigate if the requirements that life science organizations have towards BPMS are the same or differ from other sectors. Based on the outcomes, both the architecture of BPMS and the implementation method might need adjustments. This can also be explored for many other markets, e.g. financial, construction, healthcare and the like.

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Summary

The market for Business Process Management (BPM) software is growing rapidly, predictions for 2010 range from anywhere between 1 to 6 billion dollars, this means the market has more than doubled since 2005. Although there is a lot of publicity regarding BPM there is still much debate on what BPM is. This is also true for BPM software, commonly knows as Business Process Management Systems (BPMS). Therefore this dissertation provides an investigation on BPMS. More specifically the history and future of BPMS are described together with the issues concerning the implementation of BPMS. The main research question in this dissertation is:

What factors and competences determine the success of Business Process Management Systems implementation in a particular situation?

To answer this question the following research sub-questions were formulated:

1. *What are the success factors of Business Process Management System implementations?*
2. *What are the competencies needed by stakeholders involved in Business Process Management System implementations projects?*
3. *How can an implementation method for Business Process Management System implementation be made context sensitive?*

In chapter two concepts, features and characteristics of BPMS are identified, and traced back to business and IT concepts from the past, like Business Process Reengineering (BPR), Total Quality Management (TQM), Enterprise Resource Planning (ERP) systems and Workflow Management (WFM) systems. We conclude that much of what current BPMS entail comes from earlier business and IT innovations. However, the combination of functionality, concepts and characteristics in BPMS make new applications in IT possible.

However the combination of functionality, concepts and characteristics in current BPMSs is very much based on the agricultural- and industrial-based view of the economy. Currently western economies are rapidly moving towards an information and service economy in which the ratio of knowledge workers is rising dramatically. Compared to the 'old' type of worker the knowledge worker is typically highly educated, used to collaborating with other knowledge workers and less likely to be sensitive to a controlling style of management in the execu-

tion of his or her work. While many organizations are initiating business process improvement projects to improve their processes, this is done with BPM-systems that are mostly only capable of supporting straight through processes and workflow processes but not dynamic and collaborative processes. Chapter three in this dissertation therefore proposes a new architecture for BPM-systems that include functionality to support knowledge workers in their dynamic and collaborative activities and processes.

The first research question is answered in chapters four to six in which success factors for BPMS implementation are identified and both qualitatively and quantitatively validated. A list of 55 success factors is constructed of which, in chapter four, 14 are classified as critical success factors when implementing BPMS in a Dutch organization. Based on the identified factors a BPMS implementation approach is suggested in chapters four and five while chapter six describes an international comparative research in which significant differences are found between respondents from Northern European versus Anglo-American countries, and between respondents with different levels of experience with BPMS implementations.

The competencies (knowledge, skills and attitudes) that project members involved in BPMS implementation projects need are identified in chapters seven and eight. Furthermore chapter eight also describes how these competencies are used in designing a BPM course that not only transfers theoretical knowledge but lets students also experience real life BPM-systems and implementation issues.

Finally chapter nine describes how most methods that are currently used for BPMS implementation do not take into account the specific situation of the organization in which the system is to be implemented. However, these situational factors strongly determine the success of an implementation project. Therefore in this chapter a method is provided that establishes situational factors of and their influence on implementation methods. The provided method aims at enabling a more successful implementation project, because the project team can create a more suitable implementation method for business process management system implementation projects.

Samenvatting

De markt voor Business Process Management (BPM) software groeit razend snel. Voor 2010 wordt er een marktomvang voorspeld van tussen de 1 tot 6 miljard dollar, dit betekend dat deze markt sinds 2005 meer dan verdubbeld is. BPM krijgt ook in toenemende mate publiciteit in de markt echter dan gaat het veelal om wat BPM nu precies wel en niet is en niet over hoe het toegepast kan worden. Hetzelfde geldt voor BPM software, beter bekend als Business Process Management Systemen (BPMS). Het onderzoek beschreven in dit proefschrift focust op BPMS, het ontstaan, waar het naartoe gaat en wat er allemaal komt kijken bij de invoering en het gebruik ervan. De hoofdonderzoeksvraag in dit proefschrift is:

Welke factoren en competenties bepalen het succes van de implementatie van Business Process Management Systemen in een specifieke situatie?

Centraal in dit proefschrift staan de volgende onderzoeksvragen:

1. *Wat zijn de succes factoren bij de implementatie van Business Process Management Systemen?*
2. *Welke competenties hebben stakeholders in een Business Process Management Systeem implementatie project nodig?*
3. *Hoe ziet een Business Process Management Systeem implementatie methodiek eruit welke rekening houdt met de omgevingsfactoren van een organisatie?*

In hoofdstuk twee worden de achterliggende concepten en functionaliteit van BPMS behandeld. Er wordt in gegaan op de ontwikkelingen die in het IT en business domein hebben plaatsgevonden en die in de hedendaagse BPMS zijn terug te vinden. Aan de orde komen onder meer Business Process Reengineering (BPR), Total Quality Management (TQM), Enterprise Resource Planning (ERP) en Workflow Management (WFM) systemen, en hoewel deze allemaal hun invloed hebben op de huidige BPM-systemen maakt de combinatie hiervan nieuwe toepassingen mogelijk.

Echter de huidige BPM-systemen zijn nog steeds gebaseerd op een industriële kijk op de economie terwijl de westerse economieën razendsnel veranderen naar diensten economieën waarin het percentage kenniswerkers ten opzichte van de traditionele fabrieksarbeider snel toeneemt. Deze kenniswerkers zijn hoogopgeleid en werken veel samen met allerlei partijen in hun omgeving. Een traditionele sturende management stijl past hier niet bij en dat is typisch de vorm van procesturing die BPM-systemen momenteel ondersteunen. Hoofdstuk 3 gaat in op

deze veranderende omgeving en stelt een nieuwe architectuur voor BPM-systemen voor opdat deze ook voor de dynamische processen waarin kenniswerkers actief zijn, gebruikt kunnen worden.

Vervolgens wordt in de hoofdstukken vier tot en met zes een antwoord gegeven op de eerste onderzoeksvraag. In dit deel van het proefschrift worden succes factoren van BPMS implementatie geïdentificeerd en op zowel een kwalitatieve als kwantitatieve wijze gevalideerd. Hieruit komt uiteindelijk een lijst van 55 succes factoren waarvan zoals in hoofdstuk vier is omschreven 14 beschouwd kunnen worden als kritische succesfactoren van BPMS implementaties in Nederland. Tevens wordt in hoofdstuk vier en vijf op basis van deze onderzoeken een globale implementatie aanpak omschreven. Hoofdstuk zes laat vervolgens zien dat er duidelijke verschillen zijn tussen verschillende culturen in de perceptie van wat nu kritische succesfactoren zijn op basis van een vergelijkend onderzoek tussen Noord Europese en Anglo-Amerikaanse landen. Uit dit onderzoek blijkt ook dat de factor ervaring een rol speelt in deze ervaring.

De competenties (kennis, vaardigheden en houding) die mensen in een Business Process Management Systeem implementatie project nodig hebben worden geïdentificeerd in hoofdstukken zeven en acht. Tevens wordt in hoofdstuk acht beschreven hoe op basis van de gevonden competenties een BPM onderwijs module is ontwikkeld die studenten niet alleen theoretische kennis bijbrengt maar ook ervaring laat opdoen met echte BPM-systemen en implementatie aspecten.

Tot slot wordt in hoofdstuk negen in gegaan op hoe de meeste methoden voor BPMS implementatie die momenteel op de markt zijn niet in staat zijn rekening te houden met specifieke aspecten die spelen bij de organisatie waar een BPMS wordt geïmplementeerd. Echter aangezien juist dit soort situationele aspecten van grote invloed kunnen zijn op het succes van een implementatie dient hier wel rekening mee te worden gehouden. In dit hoofdstuk wordt onderzoek beschreven naar het ontwikkelen van een methode die hier wel rekening mee houdt en die daarmee tot doel heeft de kans op een succesvolle implementatie te verhogen.

Curriculum Vitae

Pascal Ravesteijn (1975) received his bachelor degree in Industrial Management at the HU University of Applied Sciences in 1999 and in 2003 Pascal finished the part-time Masters in General Management at Nyenrode Business University. In 1999 Pascal started working for the HU University of Applied Sciences where he currently holds the position of senior lecturer after having several roles such as project leader, lecturer, and manager. Furthermore he is also a lecturer/researcher at Utrecht University. At both institutions Pascal performs research in the Business Process Management domain and lectures BPM at the bachelor and master levels.

Pascal holds the position of conference chair at the International Information Management Association (IIMA) and was responsible for the organization of the 21st edition of the Annual Information Management Association conference (IIMA 2010) in Utrecht, the Netherlands. Pascal is also a board member of the Dutch BPM-Forum which is a society for BPM professionals and researchers in the Netherlands, and of NeWork Community which supports organizations in the transformation to the knowledge economy. Furthermore he is a member of the editorial board of the International Journal of Global Management Studies and the editorial board of the Journal of E-Government Studies and Best Practices. Also he has reviewed papers for numerous journals and conferences such as the Business Process Management Journal, MIS Quarterly, European Conference on Information Systems, Australasian Conference on Information Systems, Americas Conference on Information Systems and the Pacific Asia Conference on Information Systems.