

Evaluating the State-of-the-Art in Business Process Management Tools and Methodologies

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Evaluating the State-of-the-Art in Business Process Management Tools and Methodologies

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by

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Abstract

Although people have tried to control processes for centuries, with the more recent introduction of larger economies-of-scale and the toughening economic environment organisations are increasingly interested in improving their business processes. This has resulted in the emergence of Business Process Management (BPM), a field that has quickly grown into a multi billion euro industry. The development of the industry has led to an abundance of tools and methodologies that claim enormous benefits. In practice however, most organisations attain a low level of maturity in managing their business processes and largely continue to rely on standard office tooling. There is a large gap between theoretical BPM developments and its application in practice.

The main goal of this research is to evaluate the state-of-the-art in BPM tools and methodologies and its suitability for satisfying the expectations of a large financial service provider's financial accounting department starting with BPM. The expectations are elicited using a self-constructed catalogue of criteria and a case study has taken place at a financial accounting department of a large Dutch financial service provider. The empirical results gathered from the case study combined with an extensive literature review allow the main research goal to be answered.

Although it is not possible to give a definitive verdict, BPM tools and methodologies do not appear to form a bottleneck in the practice of BPM. This thesis provides recommendations to tool and methodology developers through which they can improve their products and to organisations practicing BPM so they can improve their current approaches. A practical advice is given to the management of the case study department that allows them to determine their BPM strategy. Finally a number of alternative causes for the gap between theoretical BPM developments and practice are introduced.

Keywords: business processes, BPM, workflow, process modelling, tool evaluation, ARIS, EPC's

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Preface

This document has been produced in the master thesis project as part of the Master program Information Architecture at Delft University of Technology (TU Delft) from March 2009 until February 2010. The work on the project took place at the Dutch financial service provider ING in Amsterdam.

With this master thesis report lying before me in its finished format, I realise that my time as a student has come to an end. The completion of the graduation project has been an enormous endeavour that required persistence, ingenuity, initiative and social skills. It gave me a unique insight into the world of managing business processes; a field that interested me greatly during the last years of my studies.

I firmly believe that BPM will play a large role in the organisation of the future and I am glad that I had the chance to discover the field while performing my master thesis. Besides the successes of BPM I was also able to see the difficulties: it is no easy task to support and practice BPM successfully within a large organisation such as ING. In the light of two recent major take-overs² it is interesting to see how the consolidating BPM market will develop in the coming years and overcome the problems highlighted by this thesis project.

This thesis could not have been completed without the guidance, assistance and support of a number of people that I would like to mention now. First of all, my immediate supervisor at the TU Delft, Jan Hidders, who always made time to discuss the thesis project and was very helpful in determining the theoretical course. My professor, Geert-Jan Houben who, from a distance, was critical of my work when it was necessary and provided detailed comments regarding the draft version of this document. The external committee member, Jan van den Berg, whose enthusiastic external view during our discussions was extremely helpful in allowing me to place my work in a broader perspective.

My supervisor at ING, Albert-Jan van Beek, who arranged all the resources I needed to be able to complete my work and stimulated me to go out and get the information I needed. The ‘business people’, Frits van den Born and Hans Kaandorp, who invested a lot of time in me during the start of the case study when the general lay-out of the process models was created. I am glad I was able to pay them back with the work performed in the case study and by supporting the project ‘Fast Close’. The BPM experts at ING, Arnout Westra and Theo-Willem de Boer, who trained me to be able to model in ARIS and answered countless of my questions. ING BPM consultant, Tomasz Tomkowicz, whose academic background allowed for discussions that contributed value to both the ING and TU Delft perspectives of my work.

The consultants of IDS Scheer, Frank Luyckx and Jan-Hein Tempelman, who shared valuable information with me concerning the BPM field in general and pointed me to a great number of interesting sources. And finally my direct colleagues at the project department, who made it easy to come into ‘work’ every day for over 10 months without it ever becoming boring. The environment at ING was stimulating to work in and I can recommend performing an internship at ING to anyone that is interested.

I hope you enjoy reading my work!

Rob Konterman
Amsterdam, the Netherlands
January 26, 2010

² IBM takeover of Lombardi [91] and Software AG takeover IDS Scheer [92]

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Part I: Preliminaries

1 Introduction

This chapter introduces the background and situation leading to the problem addressed by this thesis. The problem is demarcated and a main research goal and research questions are formulated. Finally the approach and report structure are given.

1.1 Background

Although people have been trying to control all kinds of different types of processes for centuries, especially for the last 40 years the issue of fit between an organisation and its strategy, structure, processes, technology and environment has been a basis for theory construction and research [50]. With the introduction of large economies-of-scale and the toughening economic environment the improvement and management of business processes in order to enhance performance is under increasing interest [70, 88]. This has resulted in the emergence of the field of Business Process Management (BPM).

The term BPM is in use by a number of different types of communities – including executives, business process consultants, business analysts, enterprise architects, CIO's, and software developers – and has different meanings to different people [31]. The broad and tangible [59] definition provided by van der Aalst serves the purpose of this study will be used throughout the remainder of this report:

“Supporting business processes using methods, techniques, and software to design, enact, control, and analyse operational processes involving humans, organisations, applications, documents and other sources of information [125].”

By using this definition, the research restricts itself to operational processes, thereby excluding processes at the strategic level or that cannot be made explicit [124]. Further details about the scope of BPM used in this thesis are given in section 2.1.

1.2 Situation

1.2.1 High Capabilities

BPM is supported by a growing market of tools and methodologies; it is one of the fastest growing software markets estimated to grow from US\$500 million in 2006 to US\$6 billion in 2011. At the same time the number of vendors is decreasing, from nearly 150 vendors in 2006 to only 25 in 2007 [80].

The growing yet consolidating market has spurred theoretical developments that can deal with sophisticated issues around business processes [127]. Technologically advanced tools and methodologies support organisations that practice BPM [54, 83, 84, 130].

1.2.2 Low Maturity

Despite the advanced technology available, organisations are not managing their processes as they should. There are multiple maturity models available for measuring the maturity level of an organisation regarding BPM [23, 71, 75, 78, 96], most of which are based on the Capability Maturity Model – Integrated (CMMI) [82].

Research based on these models shows that the maturity level of most organisations is very low [67, 75, 127]. The average maturity level decreases for organisations with more than 1,000 employees [67] and organisations still use simple and manual techniques in dealing with business processes [31, 127].

1.3 Problem

In order to obtain the three core benefits of successful BPM: efficiency, effectiveness and agility [100], organisations must start to take full advantage of the high capabilities offered to them by BPM tools and methodologies. This is currently not the case and is illustrated by the low level of maturity in most organisations despite the great interest that these organisations have in the field [31, 83]. The gap between the current situation of low maturity to the desired situation of high maturity is a problem.

1.4 Focus & Demarcation

The problem posed in the previous section can have a number of causes. Rosemann & de Bruin [95, 96] define six critical factors that lead to BPM success: strategic alignment, culture, people, governance, methods and IT. Although it is preferable to research all the factors, due to time constraints this master thesis limits itself to researching the factors ‘methods’ and ‘IT’, see Figure 1.1.

The factors are defined as [95]:

- IT: The use of IT resources in the implementation and conduct of BPM practices.
- Methods: The adoption of formal, well-defined and repeatable methodologies for conducting BPM.

These two factors will be referred to as ‘BPM tools and methodologies’ and form the research focus of this thesis.

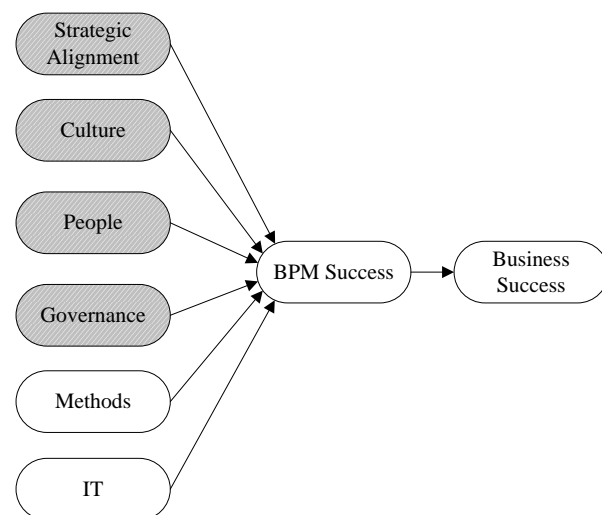


Figure 1.1: Critical BPM Success Factors [96]

1.5 Research Goal

1.5.1 Project Department

The thesis project takes place at the ‘project department’, a department of ING: a large Dutch financial service provider. For the exact definition and scope of the project department, see section 3.1. The management of this department has provided the following assignment:

“Describe the entire Financial Statement & Closure Process (yearly, quarterly, and monthly): involved parties, IT/Infra components, critical business office applications (excel/access) workflow, throughput time, dependencies and process deliverables. Identify bottlenecks, risks and give recommendations for improvements. [7]”

Comparing the activities described in the assignment to the previously presented definition of BPM by van der Aalst [125], it is clear that the department is interested in starting to practice BPM. This provides an excellent opportunity to discover the expectations that these (starting) practitioners have

of BPM and how suitable³ BPM tools and methodologies are for satisfying these expectations. The level to which these expectations can be satisfied provides an indication of whether BPM tools and methodologies form a bottleneck that can explain the existence of the identified problem. The case study that is performed as part of this master's thesis will fulfil the assignment provided by the project department.

1.5.2 Goal

The combination of the problem identified in this chapter, the work to be performed and the opportunity to research the expectations of the starting BPM practitioners at the project department lead to the formulation of the main research goal:

“Evaluate the suitability of the state-of-the-art in Business Process Management (BPM) tools & methodologies for satisfying the expectations of a large financial service provider’s financial accounting department starting with BPM.”

In order to achieve the main research goal, a number of research questions have been constructed:

1. *What is the state-of-the-art in BPM tools & methodologies?*
2. *What are expectations of a large financial service provider’s financial accounting department starting with BPM?*
3. *How can BPM tools & methodologies be evaluated against these expectations?*

These research questions will be answered throughout the thesis project and the results will be summarised in the conclusions.

1.6 Research Approach

The main research goal and the research questions will be addressed by eliciting the expectations of the decision-makers of the project department using a ‘Catalogue of Criteria’ and subsequently conducting a case study and literature review to evaluate the suitability of BPM tools and methodologies. The approach consists of a partly overlapping but generally sequential approach consisting of seven phases. Details of the activities performed are discussed in the chapter/sections indicated. Figure 1.2 shows the flow of the research approach, deliverables and indicates in which phases the research questions (RQ’s) are answered.

Phase 1: Case Study Definition - Section 4.3

Construct the definition of the case study to be performed at the project department. Specify the exact information to be collected and the deliverables to be produced.

Phase 2: Context Analysis - Section 4.4 and chapter 3

Determine the tools to be used in the case study, the scope of the research and investigate the characteristics of the project department.

Phase 3: Modelling - Chapter 4

Collect the information specified in Phase 1 and create the process models required in the case study.

Phase 4: Analysis - Chapter 4

Perform analysis on the process models created in Phase 3, produce the Analysis Report as required by the project department and support the improvement project Fast Close.

³ In line with a number of studies in the BPM field [51, 54, 95] the term ‘suitability’ is used to describe the quality of the tools and methodologies.

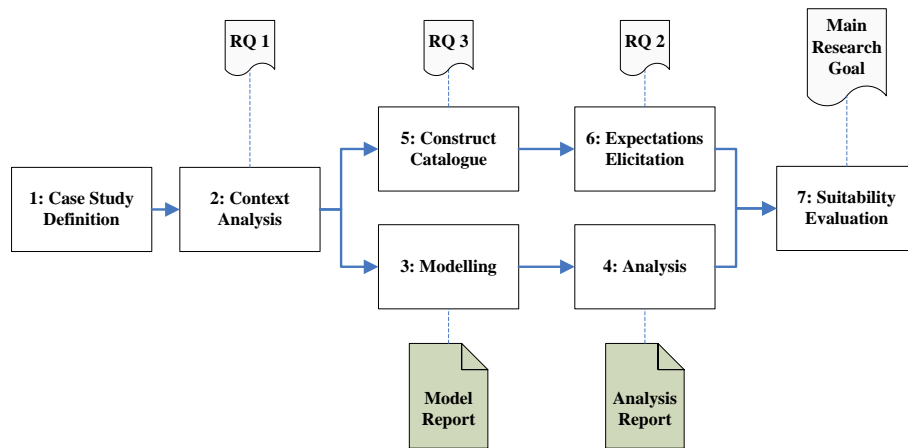


Figure 1.2: Research Approach

Phase 5: Construct Catalogue - Chapter 5

Construct a Catalogue of Criteria that can be used to elicit the expectations of BPM (Phase 5) and evaluate the suitability of BPM tools and methodologies (Phase 7).

Phase 6: Expectations Elicitation - Chapter 6

Elicit the expectations of the project department regarding BPM using the Catalogue of Criteria.

Phase 7: Suitability Evaluation - Chapter 7

Select a feasible number of criteria from the Catalogue of Criteria and evaluate them based on the results of the case study and literature review.

This approach addresses the presented research goal and delivers the results required by the project department, see section 4.3. The approach attempts to solve a general problem by examining a specific case study (conducted in phases 1 through 4) to see whether the results are more generally applicable.

1.6.1 Constraints

It is preferable to elicit the expectations from a large group of starting BPM practitioners from different companies. The limited time available for performing the thesis and the level of commitment required from the interviewees means that using the decision-makers at the project department is more practically feasible.

Furthermore a detailed analysis of the performance of the state-of-the-art in BPM tools & methodologies is preferred to determine the suitability. Since the number of BPM tools exceed 300 [54], this would take too long to complete and require a large sum to pay for license fees. A feasible option is to use the results of the practical case study combined with literature review.

1.7 Report Structure

Figure 1.3 presents the structure of the report, which consists of three parts: Preliminaries, Evaluation, Conclusions

Part I comprises the preliminaries that provide an overall picture of the topic of discussion. Chapter 1 introduces the problem addressed by the thesis, demarcates it and formulates a research goal and approach. Chapter 2 defines the scope and provides background on the topic Business Process Management and introduces a number of important concepts. Chapter 3 describes the characteristics of the environment in which the project takes place that are relevant for the results derived from the thesis.

Part II comprises the activities undertaken to perform the evaluation necessary to address the main research goal and answer the research questions. In chapter 4 the case study used for the practical evaluation is detailed and discussed. In chapter 5 the evaluation framework that is the basis of the research is introduced. In chapter 6 the process and results of the expectations elicitation are detailed and in chapter 7 the actual evaluation is performed.

Part III comprises the conclusions that can be drawn from the thesis project. Chapter 8 contains the advice given to the project department to support in determining their BPM strategy. Chapter 9 presents the contributions and answers to the research questions and main research goal. In chapter 10 the limitations, future work and applicability of the results are reflected upon.

The appendices complete the report and are given in the order in which they are introduced in the main text.

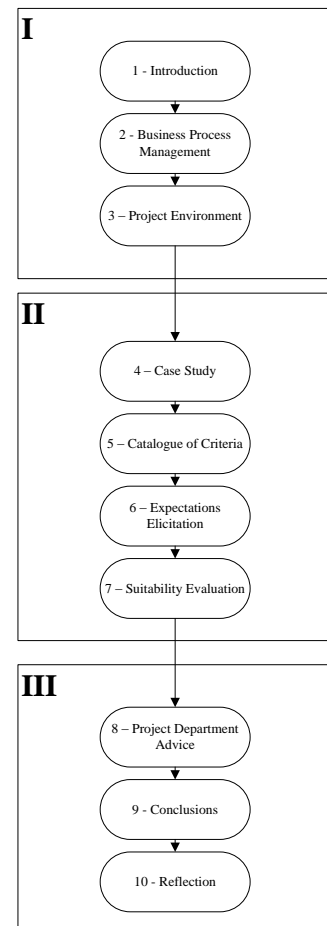


Figure 1.3: Report Structure

2 Business Process Management

This chapter introduces a number of important concepts used later in the project and provides the background for the main topic of this master thesis: Business Process Management. The scope of BPM, its tools and benefits & drawbacks are presented, followed by a short introduction of how BPM is initiated and governed in practice.

2.1 Scope

BPM knows two main ‘predecessors’ that are introduced in this section: Business Process Re-Engineering (BPR) and Workflow Management. These terms are introduced in a historical perspective followed by the introduction of the BPM lifecycle in order to determine the scope of BPM used in this thesis.

2.1.1 Workflow Management

BPM is often considered as the next step after the workflow wave of the 1990’s [124]. The Workflow Management Coalition (WfMC) was established in 1993 by a collection of workflow users and vendors and initiated the first efforts to standardise interactions of long running transactions. By 1995 the WfMC had produced a standard set of terms and definitions, and a standard reference architecture. One of the terms defined is the definition of workflow:

“The automation of a business process, in whole or part, during which documents, information or tasks are passed from one participant to another for action, according to a set of procedural rules. [135]”

Early work in the workflow domain during the 1970’s focused on the development of office information systems which aimed to streamline and automate the functioning of the modern office environment. The success of this work was very limited, in large part due to the immature technology of the time (limited computing accessibility, simplistic user interface capabilities, and minimal network availability). Advances during the last two decades (particularly with respect to the widespread availability of the PC, graphical user interfaces and networking technology), have resulted in advanced Workflow Management Systems (WfMS) coming to market, and an increased interest in the management of business processes in general [134]. These software systems support the execution of business processes in an organisation. They take care of the distribution of work and data to the right people at the right time [134].

2.1.2 Business Process Re-Engineering

BPR has been a popular term since the 1990’s especially after Hammer & Champy [30] and Davenport [16] published books to elaborate BPR related issues and cases [65]. BPR calls for a radical obliteration of existing business processes and subsequently replacing them by newly designed (automated) processes [56]. Hammer & Champy define re-engineering as:

“The fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures such as cost, quality, service, and speed. [30]”

Although several organisations report successful experiences by applying BPR, it soon became clear that over 70 percent of efforts failed [15], partly due to lack of support software [129].

2.1.3 Business Process Management

The previous sections have introduced two predecessors of BPM: BPR and Workflow Management. The difference between BPM and its predecessors will be made clear using a BPM lifecycle. Different such lifecycles have been proposed by Havey [32] and Hill, Sinur, Flint & Melenovsky [36]. Due to its succinctness and relevance, the generic lifecycle by van der Aalst [125] will be used in this thesis. It is displayed in Figure 2.1 and consists of four phases:

- Process Design: the processes are (re)designed
- System Configuration: designs are implemented by configuring a process aware information system
- Process Enactment: the operational business processes are executed using the system configured
- Diagnosis: the operational processes are analysed to identify problems and possible improvements.

BPM differs from Workflow Management through its support for the Diagnosis phase in the BPM lifecycle. Its scope is greater than just the workflow of processes and also includes the identification of problems and possible improvements in processes. BPM also offers more advanced support in the Process Design phase through simulation, verification and validation of process designs [124].

As illustrated by the lifecycle, BPM is concerned with the ongoing management of processes as opposed to the one-off changes induced by BPR [3]. BPM is more practical, iterative and incremental in fine-tuning business processes [56]. It is concerned both with the transition to better processes as well as the continuous management of these processes.

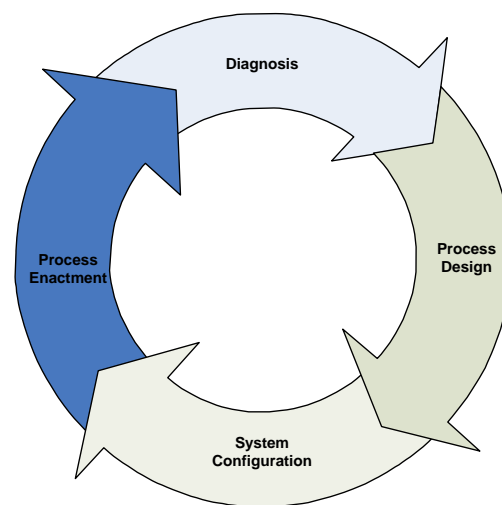


Figure 2.1: BPM Lifecycle [125]

2.2 Tools

Two different categories of BPM tooling can be distinguished: BPM Systems (BPMS) and Business Process Analysis (BPA) tools. The scope of BPA tools is concerned with how every day business complexity can be turned into structured models: from business to model. On the other hand, BPMS concern themselves with automating, executing and monitoring business processes: from model to execution [81].

2.2.1 BPMS

The definition of a BPMS provided by van der Aalst [125]:

“A generic software system that is driven by explicit process designs to enact and manage operational business processes.”

There are a large number of different types of BPMS with varying amounts of functionality developed by vendors such as Pegasystems, IBM, Lombardi, Software AG, Savvion, Metastorm and Tibco Software [35].

2.2.2 BPA Tools

The primary purpose of BPA tools is to visualise, analyse and improve business processes. They provide insight into an enterprise's structure – i.e. how strategy, products and services, processes, roles, information and systems are related and influence one another [81] and often provide simulation capabilities [124].

BPA tools vary in functionality and are developed by vendors such as IDS Scheer, Casewise, Metastorm, MEGA, and IBM [84].

2.3 Benefits & Drawbacks

The potential benefits of BPM are propagated throughout literature. Table 2.1 gives an overview of the most prominent benefits categorised into the categories recognised by Rudden [100]:

- Efficiency: Reduction of waste solved by the initial deployment of a BPM solution
- Effectiveness: Improvement of the effect that the process has: exception handling, decision making and regulatory compliance.
- Agility: Increased agility in an environment where processes change frequently.

Category	Benefit
Efficiency	Cost reduction
	Eliminate manual data entry
	Faster time to market
	Reduce manual analysis/routing
	Reduce process cycle time
	Streamlining processes
Effectiveness	Consistent execution
	Cost reduction
	Handle exceptions faster and better
	Make better decisions
Agility	Easier change management
	Faster regulatory compliance
	Higher flexibility
	Improve B2B agility
	Support new business models

Table 2.1: Benefits of BPM [22, 100, 130]

The drawbacks are far less prominent in literature but include:

- Although not specific to BPM: employee reluctance to work with the new software [38].
- The troublesome integration with back office systems [38].
- Slow implementation due to lack of operational pressure [112].

2.4 BPM in Practice

2.4.1 Initiatives

The current economic climate has resulted in cost-cutting projects being launched in organisations all over the world. Figure 2.2 shows recent survey data showing that 47% of participants is considering, expanding/upgrading or piloting a new BPM project during the coming year [83].

These initiatives are often concerned with improving efficiency: one of the key benefits of BPM [74, 100]. They are often a component of a larger project [86] and require a cultural change within the organisation [52].

2.4.2 Governance

Common BPM governance practices are to deploy a Centre of Excellence and appoint a Chief Process Officer.

Centre of Excellence

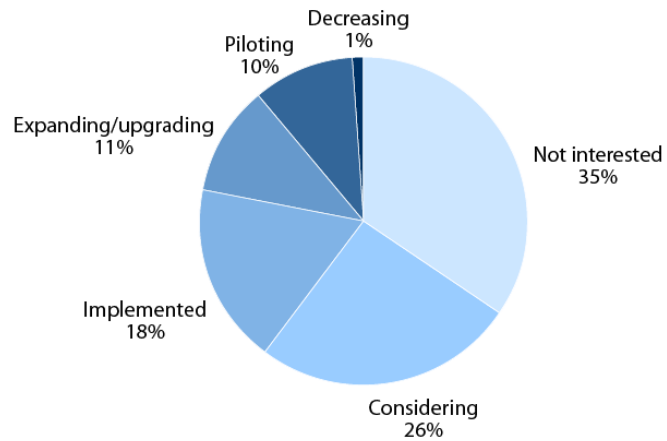
A BPM Centre of Excellence (CoE) is a governance mechanism that is widely adopted by organisations aiming for a consistent and centralised roll-out of BPM initiatives. According to Jesus, Macieira, Karrer & Rosemann [49] such a centre must possess three main capabilities:

- Diffusion of BPM concepts & benefits: the provision of BPM methodologies, techniques and tools.
- Creation of convergence among BPM initiatives: creating alignment, governance and convergence of all BPM-related activities within the organisation in order to create synergy and consistency.
- Strategic alignment and BPM culture: linking BPM services with corporate strategy and establishing a culture that is materialised in thinking about business processes as essential corporate assets.

Chief Process Officer

The Chief Process Officer (CPO) is the link between IT and business knowledge concerning the processes of an organisation. He is responsible for building up and maintaining business process models, process management consultancy, integrating the main processes into the business strategy, definition of process goals in accordance with the process owner and process controlling [75]. Although the recognition of the need for a CPO is growing, the position is not established in many organisations [75, 110] and the associated tasks are often the responsibility of the Chief Information Officer (CIO).

“What are your firm’s plans to implement BPM in the next 12 months?”



Base: 2,227 SMB and enterprise IT decision-makers (percentages do not total 100 because of rounding)

Figure 2.2: Survey Results BPM Plans [83]

3 Project Environment

This chapter describes the environment in which the master thesis took place. The project department and the process that is subject of the case study are introduced, followed by the characteristics of the work performed. Finally an introduction into BPM at the project department and at ING is given.

3.1 Project Department

The thesis project takes place at ING in Amsterdam at what will be further referred to as the 'project department'. This department: Service Management Group & Division Controller (SMT G&DC) is the Application Service Provider of IT operations for Finance Business Partners within ING [42]. One of the tasks of the department is to provide and maintain IT systems and applications that allow its ING internal clients to perform their business processes. The project supervisor at ING is team leader of one of the teams of the department SMT G&DC.

This thesis uses a broad description of the term project department, whereby not only the previously mentioned department SMT G&DC is included, but also one of its clients that is responsible for performing the Financial Statement & Closure Process (FSCP): the department Retail Financial Accounting. The term 'project department' is used in the broadest possible sense in this document.

3.2 The Financial Statement & Closure Process

During the Financial Statement & Closure Process (FSCP) the organisation must obtain, analyse, consolidate information from various resources, perform reconciliations, and make adjustments before a set of financial statements can be made. This process ranges from information inputted from local retail offices up to audits performed by Senior. This process is critical due to the fact that if it is not completed on time or does not deliver correct data this will have severe impact on the position of ING Group NV.

The FSCP is a very complicated process in which many departments, employee roles, systems and applications play a role. The complexity of the process is the result of numerous mergers, acquisitions and IT infrastructure alterations that have taken place. Due to time constraints, this case study concerns itself with a limited subset of the FSCP. The scope that this case study concerns itself with is limited to Retail Banking Nederland.

3.3 Characteristics

The day-to-day activities of the project department are dominated by the working day that the FSCP finds itself in. This process repeats itself every month and is of increased importance to the organisation during the quarterly and yearly closing processes. Depending on the working day different systems are running, checklists are used and datasets are analysed.

Accuracy is of utmost importance as the department is responsible for the numbers that it delivers. The work performed consists of a great number of automatic and manual checks and controls that together guarantee the accuracy of the data.

The information that is handled by the department has a confidential nature and is handled with extreme care. Certain employees are not allowed to trade stocks on the stock market or have to abide to strict rules when trading. Furthermore, like much of ING, the department is under scrutiny of

external regulators such as the Autoriteit Financiële Markten (AFM) and De Nederlandsche Bank (DNB).

Large volumes of information are being processed daily by large IT systems and there is frequent, close contact between business and IT when changes must be pushed through or problems must be solved.

The project department closely monitors the applications used in the business processes. There is a large screen that displays real-time monitoring information so that potential problems can be signalled in an early stage. A daily information e-mail concerning incidents and process progress is sent to all employees of the department. Outside office hours there are people on stand-by in case there are incidents.

3.3.1 Current Economic Climate

The current economic climate plays a large role in the projects being launched at the project department. There are fewer funds available for large improvement projects and the focus lies on the improvement of efficiency. The main driver behind the project introduced during the case study was the current economic situation.

3.4 BPM at the Project Department

This section gives a short introduction to BPM at the project department: describing the previous initiatives that have taken place and the company resources that are available.

3.4.1 Previous Initiatives

An attempt at modelling the FSCP had previously been undertaken by the project department at the end of 2007. This attempt used already available documentation to describe the process flow by way of simple office tooling [33]. Early in the case study an evaluation of these models was done to determine their suitability for structuring the model to be constructed. These models proved to be too outdated and lacking in detail to be able to fulfil this role.

A number of the applications that the department supports are monitored by software tools that generate alerts. The larger central ING applications are monitored by the ING Master Control Room (MCR). The business processes however are not monitored besides a daily information e-mail that is sent to all department employees.

No further BPM initiatives have been undertaken at the project department and the work associated with this thesis project is the first formal BPM initiative.

3.4.2 Company Resources

The history of BPM as a discipline at ING goes back to 1999, when an initiative was launched in Belgium using the tool ARIS. In 2004 the ARIS Suite was named the ING standard tool for BPM and made available for the entire organisation.

ING has established a CoE called BPM Support that supports departments that are interested in practicing BPM using ARIS. ING has not appointed a CPO. ING's own definition of BPM reads as follows:

“BPM represents the management of added values produced during each step of a treatment delivering a service/product to an external or internal client. Business Process Management is a methodology and not a technique. BPM supports ING in developing, maintaining and optimising her business processes. One of the aspects of BPM is modelling or designing

processes. Modelling the ING business processes is an important tool for obtaining quick insight into the quality and verifiability of activities within existing product chains and operational business units [42].”

It is clear from the definition above that ING considers BPM as a methodology for modelling and analysing business processes and does not consider other activities such as simulation, monitoring, automation, etc. BPM within ING was originally driven mainly by compliance requirements but the focus is now switching to other capabilities such as automation of business processes and the application of Lean Six Sigma, a process improvement method [118]. This has yet to be translated into an updated internal definition of BPM.

Inside the Business Line Retail Banking there is a separate BPM department that concerns itself with modelling the business processes of Retail Banking. This department provides support to initiatives concerning Retail Banking processes and manages the Release Cycle Management process for created process models. Using the IBM Information Framework (IFW), an industry-standard framework of best practices designed to streamline and improve operations across the enterprise, the department attempts to integrate business and IT for its Business Line [40, 42].

Part II: Evaluation

4 Case Study

This chapter describes the activities undertaken during the case study that took place at the project department. Due to the confidential nature of the deliverables produced during the case study no information can be provided with respect to the content in this document. The required deliverables have been presented to the management of the project department and the results are presented here at an abstract level. Appendix F displays a number of example models that have been made anonymous to illustrate the results.

4.1 Motivation & Purpose

A case study examines a phenomenon in its natural setting, employing multiple methods of data collection to gather information from one or a few entities (people, groups, or organisations) [8]. The case study method is a scientific and recommended way to research an emerging area in which few previous studies have been conducted [63, 136].

As previously presented by Trkman [120], the banking and financial service industry is a particular suitable sector for conducting a BPM case study for the following reasons:

- It is a competitive environment, where BPM is constantly needed to improve the performance of business activities and to enable enterprise wide monitoring and coordination [59].
- Banks often disaggregate their value chain into independently operable functional units, which amplifies the importance of BPM [37].
- Banks reap the benefits of effective BPM due to the impact of process performance on business performance [93].
- The acquisition and the treatment of information is a central activity in banking and the impact of process innovations in IT is likely to be larger than in other industries [11].
- Banks namely critically require IT to coordinate huge volumes of information [6].
- IT investments are perceived as a necessity to pursue the rationalisation and cost management due to intensified competition and crisis in the financial sector [18].

The case study has four purposes:

- Fulfil the assignment provided by the project department (see section 1.5.1) and create the deliverables required to support the project Fast Close.
- Create support for implementing BPM at the project department.
- Construct maintainable process models for the project department.
- Stimulate interviewees at the project department to think intensively about BPM in order to better be able to elicit expectations.

4.2 Fast Close

The project Fast Close is part of ING's 'Back to Basics' strategy which aims to simplify and drive operational excellence and build a stronger organisation. ING's Finance function needs to contribute to this strategy by supporting the businesses with accurate and timely financial (management) information [46].

Fast Close has been initiated to transform and improve ING's finance organisation so that it supports the internal business partners with a faster, better and cheaper closing process. Creating and implementing a more efficient closing process enables faster financial information to be provided to the business. This involves the improvement of the underlying systems and processes. The acceleration of the delivery of information is critical to be able to manage the business effectively. By

reducing the time-consuming finance workarounds and manual processes, finance expertise can be used more effectively [46].

The scope of the Fast Close project entails multiple Business Lines of ING. One of the goals of this case study is to support the project Fast Close for the Business Line Retail Banking.

4.3 Definitions

Together with the four members of the management team of the project department the definitions for the case study were drafted. Meetings were held with each member of the management team in which they indicated their expectations of the modelling work and potential analysis possibilities. In correspondence with the project supervisor the information to be collected for each process step was agreed, the result can be seen in appendix A.

Two deliverables were specified:

- The Model Report containing the process models of the FSCP.
- The Analysis Report containing the results of a number of questions posed by the project department.

The determined scope of the ‘entire FSCP’ (see section 1.5.1) was later adjusted to the Retail Banking Nederland domain of the FSCP (see section 4.5).

4.4 Tool Selection

There are two important aspects to take into account when selecting a suitable tool for the case study:

- The tool must fit into the project department’s organisation so that deliverables can be managed efficiently after the case study is completed.
- The tool must provide a good representation of the state-of-the-art in consensus with the main research goal of the thesis.

The standard tool to describe (business) processes within ING is IDS Scheer’s ARIS Business Designer [42], a web-based tool for BPM [41]. Business Designer is one of many tools of the ARIS Platform supported by ING’s CoE and claims to be the ideal tool for getting started with BPM [41]. The CoE maintains databases, licenses and provides support to allow other departments within ING to practice BPM using the ARIS Platform [42].

In the introduction the two types of BPM tools have been presented: BPA tools and BPMS. The state-of-the-art of both types is discussed in the following sections.

4.4.1 BPA Tools

The state-of-the-art in ‘Business Process Analysis, EA Tools, And IT Planning’ has recently been analysed by Forrester [84] in a 93-criteria evaluation. The results are displayed in appendix B. The clear leader based on the combination of strategy, current offering and market presence for the BPA category is the vendor IDS Scheer with its ARIS Toolset. The ARIS Toolset is based on Event-Driven Process Chains (EPC’s): a modelling notation that is simple and easy for non-technical users to pick up [56].

4.4.2 BPMS

Forrester discerns and has evaluated three different types of BPMS: Integration-Centric, Human-Centric and Document-Centric. Appendix B displays the full results of these evaluations; the results are presented as an overview here. The vendor IBM is appointed leader in all three categories with different products.

Integration-Centric

The state-of-the-art in ‘Integration-Centric Business Process Management Suites’ has recently been analysed by Forrester [131] in a 109-criteria evaluation. The vendors Software AG and IBM are leaders in this field and provide comprehensive functionality for a wide range of projects.

Human-Centric

The state-of-the-art in ‘Human-Centric BPMS For Banking And Investments’ has recently been analysed by Forrester [87] in a 174-criteria evaluation. This evaluation aimed at the financial service industry appointed Pegasystems, Appian and IBM as leaders due to their provision of financial services frameworks and prebuilt processes.

Document-Centric

The state-of-the-art in ‘Business Process Management for Document Processes’ has recently been analysed by Forrester [62] in a 150-criteria evaluation. The evaluation brings forward IBM, EMC and Global 360 as leaders in the field. These vendors have strong capture and repository support and incorporate an innovative, granular, iterative approach to building and optimising document-intensive processes.

4.4.3 Conclusion

Regarding the fact that no single tool can perform all the tasks of BPM [84], a tool must be selected that best fits the tasks performed during the case study. The nature of the work to be performed during the case study (see section 1.5.1) is focused on modelling and analysing and therefore it is a logical choice to select a BPA tool.

This case study will use the BPA tool ARIS Toolset by IDS Scheer and its corresponding EPC modelling notation. It is well supported by ING and represents the state-of-the-art in BPM tooling for the tasks performed during the case study. Furthermore it is easy for business users to pick up [56], essential for the starting BPM practitioners at the project department. An introduction of the EPC modelling notation is provided in appendix C.

4.5 Methodology

A literature review and internal and external [112] expert consultation led to the discovery of the number of relevant documents describing BPM methodologies shown in Table 4.1.

Document Name	Developer	Content	Source
Business Process Architecture & Modelling Guidelines	IDS Scheer Netherlands	A collection of guidelines used by consultants of IDS Scheer Netherlands in order to standardise process models.	[68]
Improving the business processes of a bank	Climent, Mula & Hernández	Business process capturing methodology for the banking industry.	[13]
The critical success factors of business process management	Trkman	Brief overview of steps performed during process modelling case study.	[120]
A reference model for conceptual modelling of production planning processes	Hernández, Mula & Ferriols	A conceptual modelling methodology for production planning processes.	[34]

Table 4.1: Business Process Modelling Methodologies

The only suitable methodology that was described in sufficient detail was the methodology by Climent, Mula & Hernández [13]. The document by IDS Scheer Netherlands is a collection of guidelines based on the principles of Design & Engineering Methodology for Organizations (DEMO) developed by Dietz [20] and not a methodology [68]. The methodology described by Hernández, Mula & Ferriols [34] focuses on production planning processes; a process that does not share many aspects with the domain of the case study. The methodology employed by Trkman [120] is applicable but unfortunately not described in much detail.

The lack of a standard methodology for BPM has also been signalled by Sadiq, Indulska, Bandara, & Chong [105] and is a 'pain point' for BPM vendors that each need to re-invent the wheel for their own product. The diversity of contexts that surround BPM projects make it very difficult to construct a one-size-fits all methodology that can emerge as an industry standard [105].

The case study is executed using the methodology by Climent, Mula & Hernández. This is a general, tool-independent modelling methodology for capturing the critical business processes of a bank and discovering improvements [13] that is presented in appendix D.

Below the name of the step is given followed by the actions performed during the modelling of the FSCP. This section describes the steps followed but does not evaluate the process; this is done in chapter 7.

Seek available information about the company to be modelled

The modelling work took place at the 'project department': one of the three departments that play a role in the process. The close proximity of the departments involved in the process made it easy to obtain relevant documents and speak to people involved in the process. Analysis of these documents and preliminary meetings gave a good general overview of the FSCP, its participants, their jobs and the departments involved.

Identify the people linked to the processes from the company organisational chart

With the departments involved in the FSCP made clear in the previous step it was possible to identify the managers of these departments through use of the application PeopleFinder on the ING Intranet [42].

Conduct interviews with the people identified on the organisational chart

Exploratory interviews were set up with managers of the involved departments in order to be able to draw up the contours of the FSCP. The focus of these interviews was to obtain the maximum amount of information about the process and discover additional documents that might help describe the process.

Identify relevant processes for both the company and the modelling team

The scope and relevancy of the processes to be modelled were determined based on the time available for completing the case study. The scope was limited to the domain of Retail Banking Nederland and the abstraction level was finalised.

Identify the appropriate individuals to obtain information about each process

For each of the sub processes of the FSCP more knowledgeable employees were identified by higher level management. They delivered detailed information about these sub processes and in some cases identified other employees that could provide this information.

Start with the description of the processes identified

The identified sub processes of the FSCP were described to the fullest extent possible using standard office tooling⁴ in order to quickly gather a lot of information. Specifically with the goals of the project

⁴ The office tooling used was Microsoft Excel and Microsoft Word

Fast Close in mind information about dependencies, starting times, throughput times, etc. was gathered. See appendix A for details.

Identify the appropriate technique and tool for modelling

The tool ARIS Business Designer and its corresponding modelling notation (or technique) EPC had been identified as appropriate before the start of the modelling process, see section 4.4.

Develop business process models

This step requires a translation from the process description in the office tooling to ARIS Business Designer. This translation required a formalisation of the often implicit information contained in the office tool descriptions. Further refinement of the models took place paired with additional information gathering handled by e-mail and telephone.

Validate and/or correct

The business process models developed in the previous step have gone through a Release Cycle Management (RCM) process. The purpose of the RCM process is to ensure that new and changed models are transferred from the development- to the production environment in a controlled manner [45]. More details on validation are available in the corresponding section below.

Discover relevant aspects

The drafted process models were analysed in an analysis session in order to discover relevant aspects along or near the critical path. Relevant aspects are aspects that can be improved upon (easily) and due to their position on the critical path, shorten this path. The results of this session were captured in a document that served as input for the kick-off meeting of the project Fast Close. The information provided in the document was used to identify the focus areas for the first phase of the project.

Set out proposals for improvement

The analysis phase of the Fast Close project resulted in proposals being made multiple levels. At the analytical level recommendations were made to ensure the applications of better practices. At the redesign level more radical changes were proposed. These proposals were discussed during the project team meetings and are to be subjected to further investigation and detailing in the months following this report.

4.6 Validation

The reliability of the results of the case study depends on the validation of the model of the FSCP. Model validation is defined as:

“Does the model represent and correctly reproduce the behaviours of the real world system [69]?”

Automatic validation is impossible due to the fact that EPC models contain constructs that require that require human judgment to assess correctness [126]. In this project validation occurs through the Release Cycle Management (RCM) process at ING and the results of model analysis. Both validation steps are described in more detail below.

4.6.1 Release Cycle Management

ING's RCM process for ARIS process models consists of the following steps:

1. The modeller constructs his models in the Development database
2. The modeller presents his models to the local ARIS domain expert
3. The domain expert checks and approves/rejects the models
4. The model is copied to the Review database and presented to the process owner
5. The process owner approves/rejects the models

6. The model is copied to the Production database and published on the ING intranet
7. The model is copied to the Archive database where all approved models are stored

In step 3 the 'ARIS Semantic Check' is performed. This step actually consists of the verification of a number of syntactical rules [44], see appendix E for details.

The RCM process ensures that published process models adhere to a number of standard ING rules; the owners of the modelled processes acknowledge their existence and validate their correctness. This step is explicitly necessary to allow for the models to be published on the ING intranet through ARIS Process Web.

4.6.2 Model Analysis

The constructed deliverables were able to support the analysis phase of the project Fast Close to the satisfaction of the project team members. The bottlenecks, risks, redundancies and improvements identified during the analysis of the process models proved to actually exist when consulting the relevant experts later in the project through detailed interviews. In a number of cases additional process information came forward in project meetings; process models were updated accordingly.

The models allowed the project team members to:

- Agree on the definition, scope and details of the process being examined, avoiding miscommunication.
- Determine the critical path and detect possible float⁵ in the process flow; especially important for this project.
- Perform an impact analysis: see which areas of the process flow are impacted by a possible change.
- Determine which internal organisational units and applications are involved in the process, so communication with responsible parties can be established.
- Quickly recognise abnormalities in the process flow such as loops and non value adding activities.

These results support the claim that the constructed models are valid according to the definition posed earlier in this section.

4.7 Conclusions

The collection of the information necessary for constructing the models required a lot of effort from both the modeller and the domain experts that needed to be interviewed. The reward came in the form of the successful delivery of the requested deliverables and valuable information to be used in the practical evaluation of BPM criteria.

At the end of the case study the management of the project department followed up the advice to continue the practice of BPM at the project department by continuing maintenance of the process models, see chapter 8 for details. The fact that monetary and human resources have been made available to continue practicing BPM at the project department is a major success for the case study.

⁵ Float, also known as 'slack', is the difference between of start and finish date/time for consecutive tasks [1].

5 Catalogue of Criteria

The evaluation of the suitability of BPM tools and methodologies requires a framework that encompasses the entire field, possesses sufficient detail and is still useful in practice. This framework is necessary to be able to pinpoint the expectations that starting practitioners have and consequently evaluate these.

A number of studies evaluate part of the BPM field [10, 22, 25, 48, 51, 108], but none provide a framework that encompasses the entire field. With no useful framework found, it was necessary to construct one: the Catalogue of Criteria (CoC). The CoC is a categorised list of functional, non-functional & technical criteria applicable to the tools and methodologies of BPM. The criteria are categorised according to the tasks that BPM fulfils and represent the union of the criteria found in previous evaluations while merging doubles.

The CoC gives a full overview of the field of BPM. It is partly based on the possibilities currently offered; something that cannot be avoided in a field still in development. By consulting scientific papers wherever possible an unbiased representation of the field has been given. Due to the fact that BPM has a strong technology component [26] the CoC is technology-oriented.

5.1 Categories

The CoC is categorised using a slightly altered version of the six tasks of BPM defined by Schmietendorf [108]. These tasks are joined by a category of generally applicable criteria and the result is visible in Table 5.1.

Category	Description
Modelling	The modelling of (business) processes using graphical notations.
Analysis & Optimisation	The analysis of previously constructed models in order to discover redundancies, bottlenecks, risks and possible improvements.
Simulation	The dynamic analysis of established process models through use of simulation software.
Automation & Integration	The translation of constructed process models into automated processes and the necessary integration that accompanies it.
Monitoring & Control	The monitoring and controlling of business processes, also known as Business Activity Monitoring (BAM).
General	Generally applicable criteria that span multiple tasks.

Table 5.1: Categories of the Catalogue of Criteria [108]

5.2 Criteria

The consultation of scientific papers, white papers, evaluation reports and experiences during the early phase of the case study led to the allocation of between five and ten criteria to each of the previously defined categories. The major contributing sources are listed in Table 5.2.

Title	Author(s)	Ref
Renaissance of Business Process Modelling	Kirikova & Makna	[54]
Business Process Simulation – A Tool Survey	Jansen-Vullers & Netjes	[48]
Characterisation and Tool Supported Selection of Business Process Modeling Methodologies	Kaschek et al	[51]
Procedure and guidelines for evaluation of BPM methodologies	Filipowska & Kaczmarek	[22]
Criteria for the Evaluation of Business Process Simulation Tools	Bosilj-Vuksic, Ceric & Hlupic	[10]
Assessment of Business Process Modeling Tools under Consideration of Business Process Management Activities	Schmietendorf	[108]
Selection Requirements for Business Activity Monitoring Tools	Gartner	[25]

Table 5.2: Major Contributing Sources Catalogue of Criteria

Table 5.3 presents the criteria in the CoC with the name, description, example/additional information (used in interviews, see chapter 6) and source given. The source represents the origin from which the criterion and its description are taken. The criteria without sources came forward from own experience during the early phase of the thesis project.

Catalogue of Criteria				
Task	Criterion	Description	Example / Additional information	Source
	Modelling	The modelling of (business) processes using graphical notations.		[108]
	Expressiveness: Control Flow Perspective	The modelling notation is able to express a large number of different basic and complex modelling constructs describing the control-flow.	The control-flow is the order in which statements and instructions are executed. Examples are logic gates (AND, OR, XOR) and events.	[48, 54, 102]
	Expressiveness: Data Perspective	The modelling notation is able to express a large number of different basic and complex modelling constructs describing the data perspective	The data perspective is concerned with data representation and handling. Examples are data communication channels and data-based decision making.	[48, 54, 101]
	Expressiveness: Resource Perspective	The modelling notation is able to express a large number of different basic and complex modelling constructs describing the resource perspective	The resource perspective is concerned with the various ways that resources are represented and utilized in the process. Examples of resources are enabling elements such as people and organizational units.	[48, 54, 104]
	Expressiveness: Exception Handling Perspective	The modelling notation is able to express a large number of different basic and complex modelling constructs describing the exception handling perspective	The exception handling perspective deals with the possibility and support for modelling deviations to the normal execution of the process.	[48, 54, 103]
	Communication	The modelling notation is suitable for communication to all levels within the organization.	End users require detailed work descriptions of day-to-day processes. Senior management is in need of a high-level overview of the model without ignoring important details.	[48]
	Ease of Model Building	Model builders find it easy to construct models.	There is a user-friendly graphical user interface through which the model is constructed.	[48]
	Flexibility	The modelling process can be undertaken from a number of different perspectives.	One can start by defining the organisational units involved with the model but also with the systems/applications.	[54]
	Granularity	The modelling notation is able to model in a great amount of detail.	The modelling of extremely detailed information such as e-mails being sent, telephone calls being made, etc.	[48, 51]
	Readability	People familiar with the domain modelled by a modelling notation find the notation simple and clear.	The notation uses intuitive symbols that are easily recognisable.	[51]
	Semantics and Correctness	The modelling notation has formal semantics and can be verified for correctness.	Modelling notations with formal semantics provide a precise and unambiguous description of the behaviour of the modelled process leading to more powerful analysis methods and tools.	[48]

Analysis & Optimisation	The analysis of previously constructed models in order to discover redundancies, bottlenecks, risks and possible improvements.		[108]
Behavioural Analysis	The ability to analyze the (complex) behaviour of a process	Example: sequential actions, synchronization, asynchronous execution, loops, exceptions, etc	[47, 51]
Functional Analysis	The ability to analyze a process functionally: the goal of the process, process tasks and general process description.	Example: discover whether all process tasks strive towards the same process goal.	[47, 51]
Organizational Analysis	The ability to analyze the participants of the business process: departments, people, systems and their roles.	Example: discover whether two departments are performing similar actions.	[47, 51]
Resource Analysis	The ability to analyze the resources of a process: inputs and outputs, internal data, etc.	Example: discover possibilities for streamlining internal data storage in the process.	[47, 51]
ABPD	The use of Automated Business Process Discovery (ABPD) tools in order to visualize existing business processes and to identify possible improvements	Example: use ABPD to discover where in the process bottlenecks lie and how they are caused. This can be done by having a program analyze a log file to determine process structures.	[24, 122, 125]
Methodology Support	The level of support for process transformation methodologies and business management strategies	Examples of such methodologies and strategies are Six Sigma and Lean.	[60, 106]
Cost Reduction	The ability to analyze a process in order to research improvements that will make it more cost efficient.	Example: Find departments that perform similar work and research possibilities for merging them to reduce costs.	[22]
Time Reduction	The ability to analyze a process in order to research improvements that will make it more time efficient.	Example: Find process steps that do not add value to the end result and remove them to save time.	[22]
Simulation	The dynamic analysis of established process models through use of simulation software.		[108]
Distributions	The facilities available for providing information about the distributions of performed simulations	The average performance of a process does not give information about occurrences in extreme cases. The same queues may be empty as well as overloaded in different intervals during the execution of the process. The spread of values and deviation is important information.	[48]
Ease of Simulation Building	The efficiency of the work accompanying the performance of simulations.	The possibilities to save time & money by reusing models, improved reliability and time needed to construct the simulation models.	[10]
Performance Dimensions	The facilities for specifying performance dimensions	The simulation model developer should be able to specify several different time, costs, quality and flexibility aspects.	[48]
Scenarios	The facilities available for writing scenarios to experiment with the model.	By performing the simulation with different scenario's the simulation results can be optimized. The availability of resources and other effects can be written into the scenarios.	[10, 48]
Statistical Facilities	The statistical facilities available	A lot of information is collected when performing a large number of simulations. This information can be represented in various ways, providing information about ranges, deviations, etc.	[10]
Tracking	The facilities available for tracking the model	Examples of such facilities are: error messages, displays of the values of logical elements such as functions and variables, the possibility of obtaining special files for verification such as trace and echo files, provision of step function etc.	[10]
Animation	The graphical animation of a simulation	An animation of a simulation may uncover additional insights into possible improvements to the process by providing information about the flow of control and data parameters.	[10, 48]
Automation & Integration	The translation of constructed process models into automated processes and the necessary integration that accompanies it.		[108]
B2B Collaboration	The support for Business to Business (B2B) collaboration: the linking of services between companies.	An example is inter-company Service Oriented Architecture (SOA) where companies make their services available externally.	[20, 39]

Process Model Reusability	The ability to re-use defined business process models in the IT application without reinterpretation	Processes described by business users can be handed over to the implementing IT department and transformed into IT process models without requiring reinterpretation by IT staff.	[117]
Execution	Support for dynamic, rule-based, automated execution across multiple systems.	Automation enables organizations to streamline or eliminate repetitive, manual tasks. Premium automation platforms provide these capabilities without requiring deep programming expertise.	[108]
Integration	The support for integration of systems allowing them to read, modify and exchange critical data.	Example: The integration of different databases using a database management system	[108]
Orchestration	The support for orchestration of business processes spanning functional departments, computer networks and IT environments.	Orchestration supports the oversight and execution of discrete, independent automation activities in a cohesive, coordinated, and intelligent manner.	[108]
Monitoring & Control	The monitoring and controlling of business processes, also known as Business Activity Monitoring (BAM).		[108]
Dashboard	The provision of information through use of a dashboard	A dashboard can provide information about what percentage of users experience troubles when executing a certain process.	[25]
Forecasting	Support of forecast analytic models and rules that trigger on forecast changes	An example is dynamically assigning more processing power to a process that requires it	[25]
Guided Decision Support	Guided decision making support with suggested actions and resolutions based on information collected by a monitoring application.	A certain process fails to fully execute, a decision to restart the process or not can be made using information from a monitoring tool.	[25]
Historical Data	The availability of historical monitoring data to provide context for rules and alerts.	Examples are: captured event replay to enable analysis and debugging; detect correlations; and model, simulate and optimize rules	[25]
Multiple Format Alert Delivery	The delivery of alerts in multiple formats for convenience and fast information provision	Examples are e-mail, instant message, icon-tray, Short Message Service (SMS) or pager.	[25]
Real-Time Information Delivery	The provision of real-time information	The provision of real-time information (through a dashboard or other utility)	[25, 60]
General	Generally applicable criteria		
Exchangeability	The level of exchangeability between different tools supporting BPM	Can a model exported from one tool be imported into another tool without significant loss of information?	[51]
Information Management	The storage of information in a central, easily accessible location	A common database that users can log into to view, delete and maintain models.	[54]
Reporting	The quality of the reports that can be generated.	Do the reports provide the information that is requested in a suitable manner?	-
Security	The security facilities available	Is it possible to define user read/write rights in the business process repository? Can the information be safely stored?	-
Compliance	The level of support for regulatory compliance	Is there support for compliance regulations such as the possibility to describe risks, key controls and potentially SOX rule validation	-
Business Rules	The support for business rules	Business rules are rules that must hold during the execution of a process. An example is that complaints must be handled within 5 days for example.	-

Table 5.3: Catalogue of Criteria

The CoC provides a comprehensive overview of the field of BPM and will be used throughout the rest of the thesis.

6 Expectations Elicitation

The expectations of a project department starting with BPM were elicited by performing interviews with a selection of interviewees from the project department using the CoC. This chapter discusses the selection of the interviewees, the methodology used to elicit the expectations and the results of the elicitation.

6.1 Selection of Interviewees

Three groups of employees can be distinguished in the project department:

- The IT Group: responsible for providing IT support for the business processes of the Business Group.
- The Business Group: responsible for performing the business process.
- The Architect Group: responsible for governing the information and enterprise architecture surrounding the business process.

All 14 managers, team leaders, consultants and architects involved in the business process were selected, providing a complete overview of the expectations of the ‘decision-makers’ of the project department. In the case of a full-blown BPM initiative being started, these people would be most important to have on-board.

Figure 6.1 below displays the place in the hierarchy of the different interviewees; each has been labelled using a letter and number combination for reference during the presentation of the results.

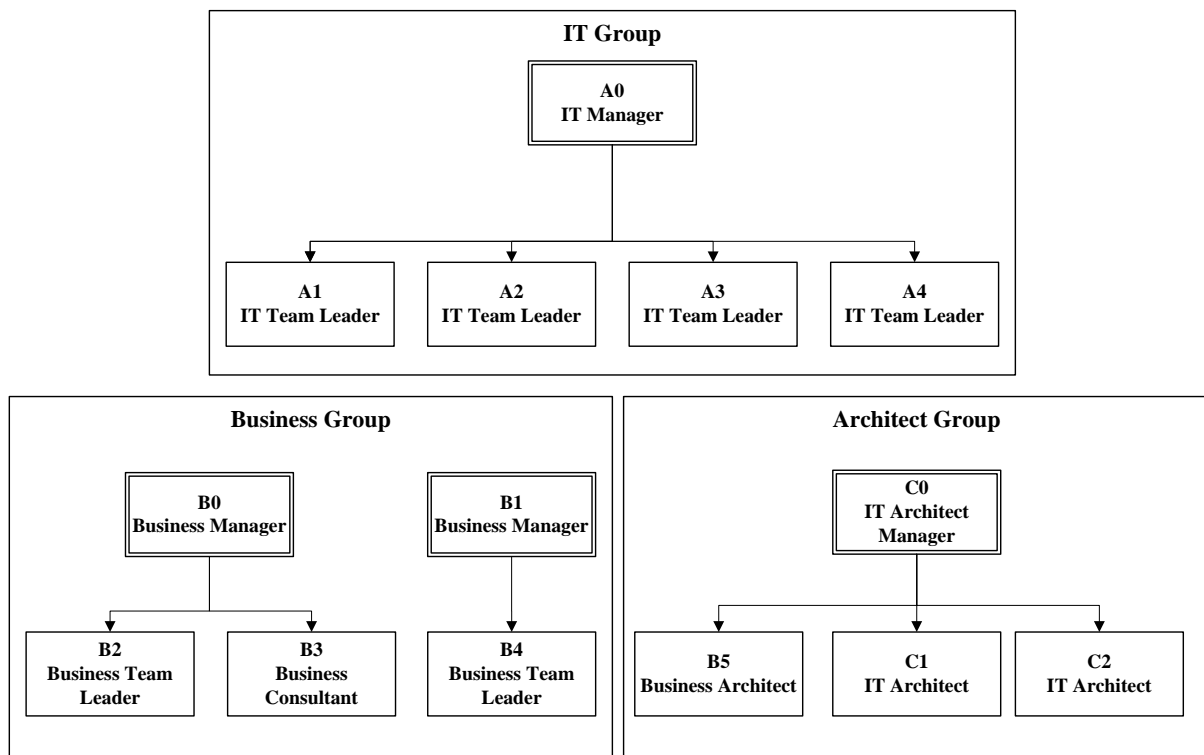


Figure 6.1: Interviewee Selection Hierarchy

6.2 Methodology

This section discusses the methodology used to elicit the expectations of the decision-makers of the project department. First the BPM questionnaire used is discussed after which the interview procedure is detailed.

Each interviewee was made familiar with the work completed during the case study before the start of the interview to ensure he/she was sufficiently stimulated to think intensively about BPM in order to elicit better answers.

6.2.1 Questionnaire

The questionnaire used during the interviews consists of the contents of the CoC (see chapter 5) with an additional column to be able to indicate the importance. The questionnaire was pilot tested with the ING project supervisor.

Example / Additional Information

The goal of the information is to stimulate the interviewee to think creatively about the criterion being discussed. The concepts presented in the CoC are often quite abstract and this information provides the interviewee with a better understanding of the criterion.

Criterion Importance

The interviewee is asked to answer the question below for each criterion.

“If you were to start practicing BPM in the near future, how important do you think it is that this criterion is met in a satisfactory manner?”

The interviewee selects his/her answer on the 7-point Likert scale [64] shown in Table 6.1 below. This scale was chosen for a number of reasons:

- A 7-point scale has been shown to be more reliable than a scale with fewer points; a 9-point scale does not increase reliability [2].
- The middle alternative in a 7-point scale can well serve as an anchor for opinion [2, 107].
- Fully labelled response scales are significantly more reliable than end-point labelling [2].

+++	Very important
++	Important
+	Somewhat important
0	Neutral
-	Somewhat unimportant
--	Unimportant
---	Very unimportant

Table 6.1: Possible Answers Criterion Importance

The interviewee does not have the option to indicate a ‘not applicable’ opinion; this would create holes in the dataset and has not shown to produce an improvement in reliability [2]. The interviewee has the option to comment on every criterion, these comments were recorded using a tape recorder. This allows for both quantitative as well as qualitative analysis

Task Importance

The interviewee is asked to answer the question below for each of the five tasks of BPM on the same scale.

“If you were to start practicing BPM in the near future, how important do you think it is that this BPM task is supported in a satisfactory manner?”

Follow-up Questions

A number of follow-up questions are included in order to determine the opinions concerning starting with BPM at the project department. The answers will be used to advise the project department on their BPM strategy and investigate the stance towards BPM in general.

The interviewee is asked the follow-up questions shown below.

1. Did you know what BPM was prior to the case study executed?
2. Have you previously engaged in BPM-related activities?
3. Do you see a role for BPM in your department's future?
4. If it were up to you, would you invest (money & resources) substantially in BPM within the next 2 years?
5. Do you think your department is currently ready to start implementing BPM on a large scale?
6. Do you think your department is ready to start implementing BPM within the next 2 years?

All questions are to be answered with yes or no and leave room for comments.

6.2.2 Interviews

The interviews took place between the 14th of October and the 1st of December 2009. Each interviewee received the introductory letter (see appendix G) and the questionnaire by e-mail at least three working days before the interview. An interviewee was not invited for the interview before he/she was briefed about the results of the case study.

Build-up

The planned time for every interview was 60 minutes. The first 10 minutes consisted of an introduction into BPM and its capabilities in order to make sure the interviewee had sufficient knowledge of the field. During the next 5 minutes a check was performed to see if the interviewee interpreted the contents of the introductory letter correctly and was aware of how the questions should be answered. The remaining 45 minutes were used to answer the questions in the questionnaire. The interview was taped in order to be able to retrieve comments afterwards.

Answers

Each criterion in the questionnaire was briefly introduced after which the interviewee was asked to indicate the level of importance. If necessary additional information and examples were provided; making sure not to steer the interviewee towards a certain answer.

6.3 Results

In this section the results of the interviews are presented, starting with the processing. After that the results of the task importance question are given, followed by the criterion importance results. Finally the results of the follow-up questions are presented and a number of remarks are made.

6.3.1 Processing

The results of the interviews are converted from the ordinal Likert scale to a numerical scale running from 3 (very important) to -3 (very unimportant); entailing a risk that subsequent analysis will give misleading results [55]. Due to time constraints and the nature of this study a detailed statistical analysis did not take place; the results presented in this section provide a sufficient indication of the expectations of BPM.

A number of statistics were calculated from the results (see appendix H); the most important results are discussed in this chapter.

6.3.2 Task Importance

The results regarding task importance are very clear: interviewees believe that when starting with BPM that modelling, analysis & optimisation and monitoring & control should be supported. The tasks simulation and automation & integration are seen as less important. Figure 6.2 displays the average and standard deviation of the BPM task importance.

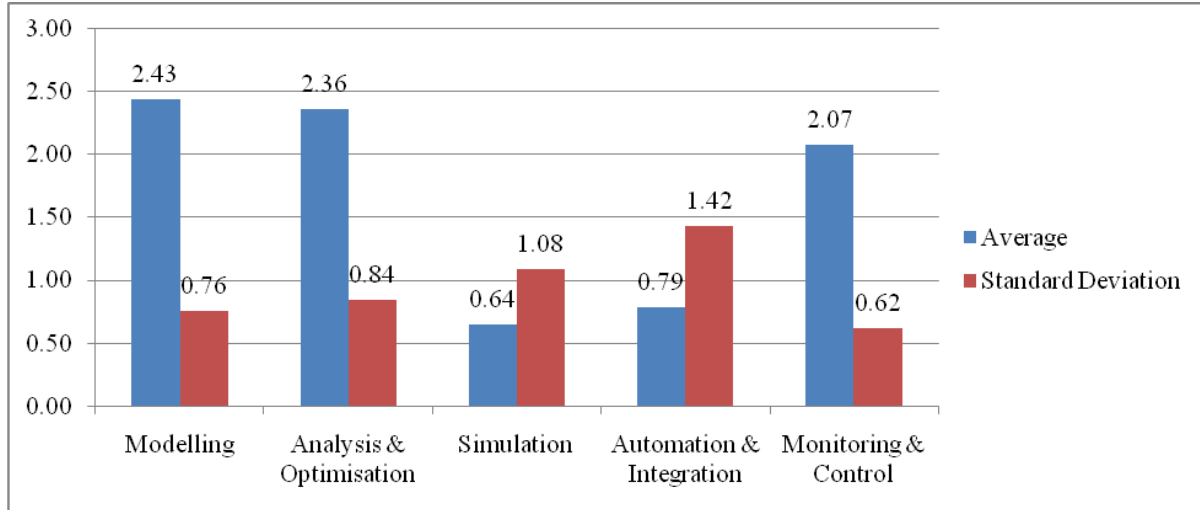


Figure 6.2: Results Task Importance

6.3.3 Criterion Importance

This section gives an overview of the criterion importance results; the full results are available in appendix H.

Highest Averages

The five criteria with the highest average are given in Table 6.2 and will all be elaborately discussed in the evaluation phase.

Task	Criterion	Average
Modelling	Communication	2.57
Analysis & Optimisation	Behavioural Analysis	2.21
Monitoring & Control	Real-Time Information Delivery	2.21
General	Information Management	2.14
Modelling	Readability	2.00

Table 6.2: Highest Ranking Criteria

Lowest Averages

The five criteria with the lowest average are given in Table 6.3 and are discussed briefly below.

Task	Criterion	Average
Automation & Integration	B2B Collaboration	-0.50
Analysis & Optimisation	ABPD	0.07
Simulation	Animation	0.07
Analysis & Optimisation	Methodology Support	0.29
Modelling	Ease of Model Building	0.57

Table 6.3: Lowest Ranking Criteria

Automation & Integration: B2B Collaboration trails the field with its very low average score. Interviewees indicate that since banks in general and financial accounting departments specifically

handle confidential data it is too risky to open up their processes and integrate with external parties. A number of interviewees do see possibilities for automatically connecting payment traffic information to their processes using open market standards.

Analysis & Optimisation: Automated Business Process Discovery (ABPD) scores very low due to the fact that interviewees do not believe it can be implemented successfully (for their processes) due to the fact that human interpretation is always necessary. A number of interviewees indicate that it can be useful for identifying processes they might otherwise miss.

Simulation: Animation scores poorly because interviewees trust that the executor of a process simulation can represent the results in such a manner that it is interpretable for all audiences within the organisation.

Analysis & Optimisation: Methodology support does not score high due to the fact that the project department is not familiar with these methodologies and strategies.

Modelling: Ease of Model Building completes the list of criteria with low averages because almost all interviewees believe that a specialist should perform the modelling work with whatever training is necessary.

6.3.4 Follow-up Questions

The follow-up questions are displayed and numbered below for convenience.

1. Did you know what BPM was prior to the case study executed?
2. Have you previously engaged in BPM-related activities?
3. Do you see a role for BPM in your department's future?
4. If it were up to you, would you invest (money & resources) substantially in BPM within the next 2 years?
5. Do you think your department is currently ready to start implementing BPM on a large scale?
6. Do you think your department is ready to start implementing BPM within the next 2 years?

The results are visible in Figure 6.3 and are briefly discussed; question numbers are indicated in parentheses.

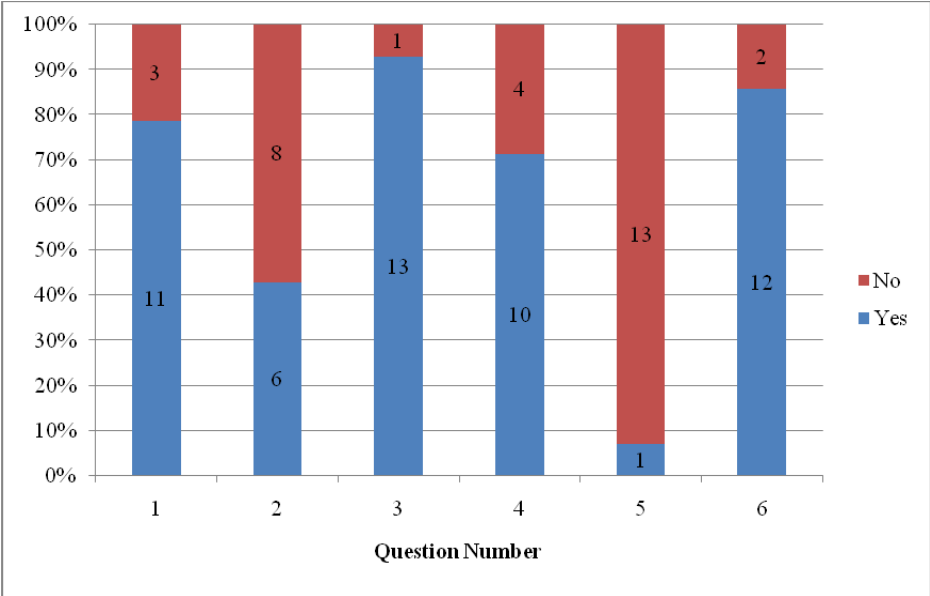


Figure 6.3: Results Follow-up Questions

Most interviewees knew what BPM was prior to the case study executed (Q1) but only six people had actually performed BPM-related activities (Q2). This usually consisted of general process improvement and did not involve sophisticated BPM tools. Most people did not recognise BPM as a methodology but more as a collection of tools.

All but one of the interviewees thinks that BPM can play a role in their department's future (Q3). The dissident wants the business side of the department to first take the lead in initiating BPM.

Ten interviewees would invest substantial money and resources in BPM during the next two years (Q4). The interviewees that answer negatively to this question indicate that other projects currently have priority.

Only one of the interviewees thinks that their department currently ready to implement BPM (Q5). The main reasons for this result are the perceived lack of knowledge about processes inside the department and the lack of resources, money and expertise available for initiating such an implementation. A surprisingly larger amount of interviewees think their department will be ready within two years (Q6). They stress that this will require radical changes; higher level manager B0 mentions that this will require external expertise.

The final follow-up question is an open question where interviewees can comment on the questionnaire, the research and BPM in general. A number of interviewees indicate that they see a great future for BPM at their departments and within ING in general. They think more attention should be paid to the possibility of rolling out BPM as a methodology as opposed to the smaller process improvements initiatives that are being undertaken. A suggestion for a potential reason why BPM has not been launched at the department is the fact that most business case calculations are made across a period of one or two years while the benefits of BPM materialise after a longer period of time.

6.3.5 Remarks

During the expectations elicitation a number of interesting findings came forward.

- The criteria in the questionnaire are formulated in a desirable manner, making interviewees want to generally award a positive importance indication. This is illustrated by the average score of 1.29 awarded across all criteria/interviewees.
- Interviewees took their time in answering the questions, there were ample comments made and none of the interviewees rushed through the process.
- The higher level business managers (B0 & B1) required more explanation than other interviewees in order to be able to answer all the questions. The subject started to become quite technologically detailed for them as this is not something they deal with on a regular basis.

7 Suitability Evaluation

In this chapter the evaluation of the suitability of the state-of-the-art in BPM tools and methodologies is performed. First the process of the selection of criteria to be evaluated is detailed, after which the evaluation methodology is described. Subsequently the criteria are evaluated per BPM task and a number of general conclusions are drawn.

The criteria are organised per BPM task complemented by the generally applicable criteria:

- Modelling criteria
- Analysis & Optimisation criteria
- Monitoring & Control criteria
- General criteria

The information in appendix I plays an important role in the understanding of this chapter. Although the information contained there is not required to be able to read this chapter, the justification for the reasoning done in this chapter is given there.

7.1 Criteria Selection

Due to time constraints not all the criteria in the CoC can be evaluated. A representative selection has to be made that does not negatively affect the research goal. This is done by selecting the most important criteria from the most important tasks of BPM as found during the expectations elicitation.

Analysing the previously presented Figure 6.2 it is immediately clear that three of the five tasks are deemed more important than the remaining two: Modelling, Analysis & Optimisation and Monitoring & Control outrank Simulation and Automation & Integration in this respect. The selection process continues without the criteria in these two tasks and with the category 'General'. The eight highest-scoring criteria from the remaining tasks were selected, see Table 7.1.

Category	Criterion	Average
Modelling	Communication	2.57
Analysis & Optimisation	Behavioural Analysis	2.21
Monitoring & Control	Real-Time Information Delivery	2.21
General	Information Management	2.14
Modelling	Readability	2.00
Modelling	Expressiveness: Data Perspective	1.93
Monitoring & Control	Historical Data	1.93
Analysis & Optimisation	Time Reduction	1.86

Table 7.1: Eight Highest Ranking Criteria of Selected BPM Tasks

It is possible that a certain group of employees in the project department finds a particular criterion very important, because it is relevant for their line of work for example. In order to discover these criteria we analyse the specific results per employee group. As presented, the interviewees are a member of either the IT, Business or Architect groups. The criteria in Table 7.2 were selected based on their rank in a particular group's importance list.

Category	Criterion	Average			Selection Reason	
		Total	IT	Business		Architect
Monitoring & Control	Dashboard	1.79	1.80	2.40	1.00	Highest ranking Business criterion
Monitoring & Control	Forecasting	1.79	2.00	1.60	1.75	Highest ranking IT criterion
General	Business Rules	1.79	1.60	1.60	2.25	Highest ranking Architect criterion

Table 7.2: Highest Ranking Criteria per Employee Group

Coincidentally these three criteria were also the three next-ranking criteria on the overall list with their 1.79 average. The criterion Modelling: Expressiveness: Control Flow, which has the same average, is also included: bringing the total of selected criteria to be evaluated to twelve.

7.2 Methodology

In this section the suitability of each criterion is evaluated using the empirical results from the case study and an extensive literature review. The information collected from the consulted sources is detailed in appendix I. This chapter summarises the information, evaluates it and gives recommendations, see the respective sections below.

A summary, evaluation or recommendation can apply to multiple criteria; in which case it is repeated. Criteria are displayed in *italics*.

7.2.1 Summary

For each criterion a short summary of the most important information collected in appendix I is presented, divided up into the four categories in Table 7.3. The information that has been collected provides an overview of the state-of-the-art in BPM tools and methodologies.

Category	Contents
Comments	A summary of the comments given during the expectations elicitation.
Case Study	Empirical results of the case study and opinions voiced by users, if applicable.
Best Practices / External Case Studies	Evidence of best practices and external case studies found, preferably at financial service providers.
Literature	General literature such as tool & standards evaluations, tool & standards descriptions, research papers, white papers and survey data.

Table 7.3: Categories of Information in Evaluation

The summary captures the essence of the information provided without becoming subjective.

7.2.2 Evaluation

During the evaluation of a criterion the four categories of information in Table 7.3 are examined. If available, priority is given to information related to organisations that possess similar characteristics as the project department such as banks and large organisations in general.

The evaluation is performed based on the retrieved information, making sure to separate the results of the case study from the literature review. Despite the fact that ‘suitability’ is a subjective term as definitive judgement as possible is given.

7.2.3 Recommendations

For each criterion recommendations are given to BPM-implementing organisations and BPM tool and methodology developers through which they can improve their performance. These recommendations are based on experiences in the case study and findings in literature. It is explicitly mentioned whether the recommendation pertains to either ‘organisations’ or ‘developers’.

7.3 Modelling Criteria

Modelling is defined as: the modelling of (business) processes using graphical notations [108]. Four criteria are evaluated from this category:

- Expressiveness: Control Flow Perspective
- Expressiveness: Data Perspective
- Communication
- Readability

7.3.1 Expressiveness: Control Flow Perspective

Expressiveness: Control Flow Perspective considers whether the modelling notation is able to express a large number of different basic and complex modelling constructs describing the control flow of the process [48, 54, 102].

Criterion	Expressiveness: Control Flow Perspective
Comments	The interviewees think that this criterion should be supported in a sufficient manner but do not think a great deal of detail is necessary. They are unaware of the expressiveness that the different modelling languages have.
Case Study	Users found the process models more difficult to understand than the flowchart models they were used to. The expressiveness of the modelling notation did not limit the modelling capabilities. There were a number of control flow limitations that were detrimental to the readability of the process models.
Best Practices / External Case Studies	None found.
Literature	The control flow patterns as defined by van der Aalst, Russell, ter Hofstede & Edmond [102] are not well supported by current BPM product offerings; with the case study modelling tool ARIS being the worst performer. Zur Muehlen, Recker & Indulska [137] argue that an increase in constructs does not always lead to better modelling results.

Table 7.4: Summary Criterion Expressiveness: Control Flow Perspective

Although BPM tools have been proven to lack expressiveness regarding the control flow aspect, it is unlikely that this represents a problem in practice. Although ARIS performs poorly regarding expressiveness [102], it is currently the leading BPA tool available in the market (see section 4.4.1). An excess of constructs will sooner create needlessly complex process models. The modelling notation used in the case study did not limit the modelling capabilities but the readability of the models was negatively influenced, partly due to internal ING limitations.

Recommendations

- Organisations should investigate the constructs they require and support only those, filtering out the rest. This ensures that process models can be communicated effectively and are easily readable.

7.3.2 Expressiveness: Data Perspective

Expressiveness: Data Perspective considers whether the modelling notation is able to express a large number of different basic and complex modelling constructs describing the data perspective [48, 54, 101].

Criterion	Expressiveness: Data Perspective
Comments	The interviewees' interest in data and communication can be explained by the work at the project department, which makes intensive use of large database systems and data warehouses. The comments do not express a certain particularly strong perspective.
Case Study	No detrimental effects caused by the expressiveness of the data perspective were found in the case study.
Best Practices / External Case Studies	None found.
Literature	The level of direct support for data patterns as defined by van der Aalst, Russell, ter Hofstede & Edmond [101] in standard workflow design tools is minimal. Data representation now often occurs graphically through ER diagrams, class diagrams and object-role models. There is clearly a need for better support in capturing the integration between the control flow and data perspectives at design time. Zur Muehlen, Recker & Indulska [137] argue that an increase in constructs does not always lead to better modelling results.

Table 7.5: Summary Criterion Expressiveness: Data Perspective

The case study results were largely positive with the negative issues being caused by internal ING restrictions. The literature suggests that there is a need for improvement in order to be able to support more advanced date modelling currently represented through other diagrammatic approaches.

Recommendations

- Certain data-intensive departments, such as the project department, can benefit from extensive data modelling. Data representation and modelling often occurs in all types of different documents and applications; this could well be combined and stored in a central repository, greatly improving standardisation. Such a technology would need to be integrated with the actual flow of data in order to stay up-to-date and leading.
- Organisations should investigate the constructs they require and support only those, filtering out the rest. This ensures that construct-excess will not negatively influence the readability and the ability to communicate process models.
- Developers need to create better support in capturing the integration between the control flow and data perspectives at design time.

7.3.3 Communication

Communication considers whether the modelling notation is suitable for communication to all levels within the organisation [48]. It is dependent on the readability of the process models (see section 7.3.4) but is a distinctly different aspect and is concerned with the means by which process models can be communicated for example.

Criterion	Communication
Comments	Interviewees stress that they think it is very important that process models can be communicated (to all levels in the organisation). They have been frustrated by the lack of communicability of process models in the past and want to make sure all contributors to a process know what their role is.
Case Study	<p>The models created during the case study did not always communicate well, even to domain experts. This can be caused by lack of training of the modeller, the lack of existence of a standard modelling methodology or the complexity of the modelled process.</p> <p>The publication features used during the case study were effective and easy to use. The models contributed to the communication between business and IT employees in the project, seconded by the respondents to the BPM evaluation questionnaire. These respondents also indicated that they see major possibilities for BPM in their change management efforts.</p>
Best Practices / External Case Studies	Volvo Aero Group reported positive communication results regarding their use of a BPM knowledge management system.
Literature	Many standards currently under development attack the communication gap between business and IT [4, 61]. A Forrester [84] evaluation shows positive results regarding support for web publishing leading to improved communication.

Table 7.6: Summary Criterion Communication

The well-known communication gap between business and IT has been around for a long time [53] and is one of the problems addressed by BPM. Current developments are under way to try and close this gap by providing a common terminology through these two groups can communicate. Both the case study and literature have shown that current BPM tooling is often outperformed by standard office tooling. The shortcomings of BPM tooling, lack of modeller-training and absence of a standard modelling methodology lead to process models that communicate difficultly.

Recommendations

- Organisations must train their process modellers extensively in order to allow them create models that are easy to communicate.
- Developers need to focus on developing tools that can replace the BPM capabilities of standard office tooling.
- Organisations and developers should develop a standard modelling methodology for modelling business processes.

7.3.4 Readability

Readability considers whether people familiar with the domain modelled by a modelling notation find the notation simple and clear [51]. This criterion is associated with and is beneficial for the criterion communication but addresses a distinctly different aspect.

Criterion	Readability
Comments	The interviewees realize that a certain amount of effort is required to be able to read a model and accept that this requires some explanation. Naturally they want the model to be easily understandable.
Case Study	<p>Respondents to the BPM evaluation questionnaire indicated that the EPC notation was understandable by business users after a short introduction (see appendix C).</p> <p>The models created during the case study were not always easily readable for users, possibly caused by lack of training of the modeller.</p>
Best Practices / External Case Studies	<p>Rabobank improved the readability of its process models by allowing graphical models to be textually represented [112].</p> <p>First Horizon National mentioned ‘rapid user acceptance’ as one of the successes of its BPM deployment [85].</p>
Literature	<p>Many standards are developed with terms such as understandability, readability or comprehensibility as their focus [4, 72, 110].</p> <p>The image of the domain of model design must not be seen as a domain for specialists [5].</p> <p>There exist possibilities for automatically improving the readability of process models using style rules, for example for OR-joins in EPC models [28].</p>

Table 7.7: Summary Criterion Readability

As with *Communication*, *Readability* of process models must be improved and there are many ongoing developments that strive towards this goal. Professional training and modelling practices will improve the readability of process models within organisations. Business users should be heavily involved in the creation of the process models to ensure they fully understand and are willing to work with them.

Recommendations

- Organisations must train their process modellers extensively in order to allow them create readable process models.
- Organisations should limit the amount of constructs available to modellers in order to standardise modelling efforts.
- Business users must be involved in the modelling of business processes to ensure that they understand the process models being created.
- Developers should advance the support for automatic validation and correction of process models based on style rules. Accordingly organisations should define their own style rules and apply them to their process models consistently.
- Developers should ensure their software includes a simple drawing mode that can be used without restricting modeller freedom too much.

7.4 Analysis & Optimisation Criteria

Analysis & Optimisation is defined as: the analysis of previously constructed models in order to discover redundancies, bottlenecks, risks and possible improvements [108]. Two criteria are evaluated from this category:

- Behavioural Analysis
- Time Reduction

7.4.1 Behavioural Analysis

Behavioural Analysis considers whether it is possible to analyse the (complex) behaviour of a process [47, 51]. This criterion is strongly associated to *Expressiveness: Control Flow Perspective* and is dependent on it due to the fact that there must be a modelled process in order to perform behavioural analysis. Automatic analysis of process models is not included in the evaluation: ABPD is a separate criterion.

Criterion	Behavioural Analysis
Comments	This criterion proved very important to the interviewees, finishing in second position in the list of criterion averages. Interviewees see this as the main benefit of performing BPM: conducting analysis to identify bottlenecks, dependencies and possible risks.
Case Study	The behavioural analysis performed during the case study delivered positive results towards the project Fast Close, seconded by respondents to the BPM evaluation questionnaire.
Best Practices / External Case Studies	Several case studies [59, 109] have shown that behavioural analysis leads to results.
Literature	None found.

Table 7.8: Summary Criterion Behavioural Analysis

This criterion is of a high abstraction level and is part of most analysis generally performed on process models. The numerous case studies describing the successes obtained by implementing BPM all involve behavioural analysis. There is no detailed information available about the role that behavioural analysis fulfilled in these case studies.

Recommendations

- None

7.4.2 Time Reduction

Time Reduction considers whether it is possible to analyse a process in order to research improvements that will make it more time efficient [22].

Criterion	Time Reduction
Comments	Interviewees indicate that time reduction scored highly due to a project (related to the case study) that had recently been launched with the aim to shorten the lead time of the FSCP.
Case Study	The tooling used in the case study did not explicitly support time reduction analysis; a manual workaround had to be found. The BPM approach taken in the case study showed added value regarding time reduction: the main goal of the project Fast Close. BPM evaluation questionnaire respondents indicated that they were able to easily identify the critical path and potential improvements.
Best Practices / External Case Studies	Positive case studies have been described at Crédit Suisse [59] and a healthcare provider [109].
Literature	Literature studies investigating the time reduction capabilities of BPM tooling show positive results [90, 113, 121].

Table 7.9: Summary Criterion Time Reduction

There are a great number of best practices and external case studies available that show how *Time Reduction* can be achieved by implementing BPM. Additional information and detailed analysis is necessary to be able to determine how exactly this time reduction was achieved.

Recommendations

- Organisations should inquire as to how other organisations achieved time reduction in their business processes before starting their own analysis. There exist a large number of useful best practices for this criterion that can serve as examples.

7.5 Monitoring & Control Criteria

Monitoring & Control is defined as: The monitoring and controlling of business processes, also known as Business Activity Monitoring [108]. Four criteria are evaluated from this category:

- Dashboard
- Forecasting
- Historical Data
- Real-Time Information Delivery

7.5.1 Dashboard

Dashboard is concerned with the provision of monitoring information through way of a dashboard [25], allowing for quick overview of the current status of the business processes while omitting unnecessary details.

Criterion	Dashboard
Comments	Dashboards are common in large organisations such as ING and interviewees had little comments on the criterion.
Case Study	Not applicable.
Best Practices / External Case Studies	A case study at Archstone, a provider of apartments in America, reporting a positive experience in implementing monitoring through dashboards by a BPM team [74].
Literature	BPM tooling contains support for dashboard functionality [80, 109] and the area will undergo modest growth in coming years [31].

Table 7.10: Summary Criterion Dashboard

There seems to be sufficient support for the provision of monitoring information through dashboards from current BPM tooling. A requirement is that the connection is made between the BPMS and the system/application responsible for handling the work-flow. The largest challenge lies in realising this connection (technically and functionally); until this is done most organisations will continue to use separate BI tools to provide them with monitoring information.

Recommendations

- Organisations should define and model their KPI’s carefully in accordance with the monitoring information they wish to obtain [60].
- Developers should focus on the development of BPM tooling that can integrate with organisations’ existing IT infrastructure in order to facilitate the monitoring of business processes through dashboards.

7.5.2 Forecasting

Forecasting considers whether there is support for forecast analytic models and rules that trigger on forecast changes [25].

Criterion	Forecasting
Comments	Interviewees want this criterion to be supported but a number think their existing tools and analysis methods can outperform BPM in this respect.
Case Study	Not applicable.
Best Practices / External Case Studies	None found.
Literature	BPM/BPI tooling exists that allows for work forecasting [109] and process execution prediction [27].

Table 7.11: Summary Criterion Forecasting

There is not much literature to be found on this subject; the focus often lies on forecasting during simulation of business processes. Forecasting tooling exists but no experience reports have been found indicating whether it is successful or not.

Recommendations

- None

7.5.3 Historical Data

Historical Data considers whether there is support for historical data to provide context for rules and alerts [25]. By measuring, storing and analysing historical data the process, its rules and alerts can be optimised to improve performance.

Criterion	Historical Data
Comments	Interviewees think historical data is important and will allow for input to be able to forecast (either through manual or automated analysis) future developments.
Case Study	Not applicable.
Best Practices / External Case Studies	The monitoring and measurement of business processes has been successfully implemented at Crédit Suisse [59].
Literature	There are numerous possibilities for collecting and storing historical data in BPM systems [12, 86, 90, 109].

Table 7.12: Summary Criterion Historical Data

The monitoring of business processes and the data collection that corresponds with it is one of the core tasks of BPM. It is well supported by almost all BPM tools associated with process execution. How this monitoring is performed differs greatly per organisation and depends on which types of applications are used.

The collection of historical data is not a problem for BPM tools once the technical and functional connection is made between the BPMS and the system/application currently responsible for handling the work-flow. In organisations with a low BPM maturity this is currently not the case. The largest challenge lies in realising this connection; until this is done most organisations will continue to use separate BI tools to provide them with monitoring information.

Recommendations

- Developers should focus on the development of BPM tooling that can integrate with organisations' existing IT infrastructure in order to facilitate the collection of historical data.

7.5.4 Real-Time Information Delivery

Real-Time Information Delivery is closely related to Business Activity Monitoring and is concerned with providing real-time information for monitoring purposes [25].

Criterion	Real-Time Information Delivery
Comments	The work characteristics at the project department require that monitoring occurs in near real-time. For the work performed it is important that the right employee is alerted immediately when a system is not functioning; this is handled through ITIL ⁶ Incident Management practices.
Case Study	Not applicable.
Best Practices / External Case Studies	Case studies describe successful implementations of real-time information delivery at Crédit Suisse [60], a provider of apartments in America [74] and a healthcare provider [109].
Literature	A Forrester evaluation [84] shows that all evaluated BPM tools support real-time monitoring. Forrester [83] also predicts that BAM will not see significant success in BPM environments due to the level of integration and technical skill required to truly implement it. The implementation of a process measurement solution must be iterative, as business users are usually very cautious about having their processes measured [60].

Table 7.13: Summary Criterion Real-Time Information Delivery

The provision of real-time information delivery is not a problem for BPM tools once the connection is made between the BPMS and the system/application responsible for handling the work-flow. The largest challenge lies in realising this connection; until this is done most organisations will continue to use separate BI tools to provide them with monitoring information.

Recommendations

- Developers should focus on the development of BPM tooling that can integrate with organisations' existing IT infrastructure in order to facilitate the monitoring of business processes with real-time information delivery.

7.6 General Criteria

The general criteria category is a collection of criteria that are applicable to multiple tasks of BPM. Two criteria are evaluated from this category:

- Information Management
- Business Rules

⁶ The Information Technology Infrastructure Library (ITIL) is a set of concepts and practices for managing Information Technology (IT) services.

7.6.1 Information Management

Information Management is concerned with the storage of information in a central, easily accessible location.

Criterion	Information Management
Comments	Many interviewees mentioned, not necessarily at this criterion, that it is important to have a common terminology inside an organisation. When everyone is speaking the same ‘language’ it is much easier to communicate. This is a need that is partly answered by information management: if everyone can use and discuss the same process models it is easier to communicate.
Case Study	The CoE and the domain-specific BPM support department at ING supported the information management sufficiently by providing a central repository and managing the RCM process. BPM evaluation questionnaire respondents indicate that it is important to define the maintenance of the process models and to not select a high too high level of detail in order to keep the contained information easy to manage.
Best Practices / External Case Studies	Volvo Aero Group [29] and a provider of apartments in America [74] successfully implemented information management practices.
Literature	In a Forrester [84] evaluation the evaluated BPM tools score well on the criterion repository support. One of the tools supports management of access rights for any object granularity [29]. A large percentage of respondents in a prominent BPM survey indirectly indicate they attach importance to linking knowledge management and BPM.

Table 7.14: Summary Criterion Information Management

BPM tooling provides advanced possibilities for information management. The provision of a common terminology through information management practices is one of the main advantages of applying BPM in large organisations. Such a common terminology makes sure that all parties involved in a business process are speaking the same language.

Recommendations

- None

7.6.2 Business Rules

Business Rules is a general criterion and thus spans multiple tasks of BPM: Business rules perform decision-making in automated processes, provide important information in the modelling stage and are subjected to tests during simulation.

Criterion	Business Rules
Comments	Business rules are a well understood item within a large organisation such as ING. Interviewees valued the support for business rules highly but gave no additional comments.
Case Study	Not applicable.
Best Practices / External Case Studies	A best practice presentation by Forrester [114] recommends that organisations do not give business users too much power in adjusting their business rules when this affects the flow of IT processes: change control must remain in the hands of IT.

Literature	<p>A Forrester [84] evaluation shows a number of tools attaining the maximum score on the criterion business rules.</p> <p>Standards such as Semantics of Business Vocabulary and Business Rules (SBVR) [56, 77] and BPEL [39] have been developed or expanded with support for business rules. Vendors currently offer tools that allow non-technical users to specify business rules that are integrated into business processes [25].</p> <p>Many BPMS contain or communicate with a Business Rules Engine (BRE) [59], a niche market in which modest growth is expected [31].</p>
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Table 7.15: Summary Criterion Business Rules

Business rules are currently well supported by BPM tools, either in the form of integration within a BPMS or in a separate BRE. The standards being developed can contribute greatly to the capabilities of the business rules domain in the future.

Recommendations

- Organisations must be careful giving business users too much power in adjusting their business rules when this affects the flow of IT processes: change control must remain in the hands of IT.
- Developers and standards organisations must continue the development of standards such as SBVR so that business users can easily specify their business rules.

7.7 Conclusions

Now that each criterion has been evaluated an overview has been created of the suitability of the state-of-the-art in BPM tools and methodologies for satisfying the elicited expectations. All of the evaluated criteria are supported at least partly by BPM tools and methodologies. The general conclusions that can be drawn are discussed in this section; criteria are displayed in *italics*.

Modelling

Three criteria in this category are not evaluated favourably: *Expressiveness: Data Perspective* and especially *Communication* and *Readability* require improved support. Fortunately a number of standards are currently in development for the latter two criteria that should improve the situation.

Analysis & Optimisation

The two criteria in this category: *Behavioural Analysis* and *Time Reduction* are evaluated favourably. There are a lot of examples of external case studies that illustrate the support for these criteria. Especially time reduction seems to be a specialty of BPM tools and methodologies.

Monitoring & Control

The four criteria in this category: *Dashboard*, *Forecasting*, *Historical Data* and *Real-Time Information Delivery* are very well supported but developments are necessary to allow for the integration of BPM tools with systems and applications. No indications have been found of work being performed in this area.

General

The two criteria in this category: *Information Management* and *Business Rules* are very well supported by BPM tools and methodologies.

Recommendations

Besides the evaluation, it was possible to provide a number of recommendations to BPM practicing organisations and BPM software developers that were based on the case study and literature evaluations and in most cases both.

Part III: Conclusions

8 Project Department Advice

The decision-makers of the project department's optimism about the role that BPM can play at their department and their willingness to invest in it predict a bright future for BPM (see section 6.3.4). Based on the experiences during the completion of this thesis project an advice is given to the project department to allow them to determine their BPM strategy for the coming years.

Due to the success of the case study the recommendations given are generally favourable towards the practice of BPM. Combined with the expectations elicited, the information gathered through the follow-up questions in the BPM questionnaire and the literature review performed it was possible to construct the advice described below.

General

The key goals of BPM are aligned with the recessionary needs currently influencing ING's strategy [74], so despite budget cuts the BPM initiative should be continued.

1. Continue maintenance of process models

Continue the maintenance of the constructed process models at the project department. This thesis project was initiated from the IT side of the department but the maintenance must be placed at the business side since the business owns the entire business process and IT only fulfils a supporting role. The implementation of the project Fast Close will incur a large number of changes to the process models; these changes must be maintained. Although not one of the evaluated criteria, maintenance of process models was mentioned by a number of respondents as being very important and in retrospect should have been included in the CoC.

2. Analyse process models in projects

Continue to use the constructed process models both in the project Fast Close and in other projects to analyse and discover bottlenecks, risks, redundancies and improvements that will help improve efficiency and effectiveness.

3. Expand modelling efforts

There are possibilities for modelling additional business processes at the project department. A limited scope of the FSCP has been modelled and more detail can be added. As a small side-project a SOx Authorisation Process has been modelled for one of the team leaders of the project department so that it's workings could be presented to internal clients. There are numerous such processes currently not described at all or in a limited fashion that can be included in the modelling efforts. A number of these processes could be modelled in the near future after a careful indexation of whether it provides sufficient value.

4. Postpone Simulation and Automation & Integration

The expectations of the project department regarding the categories Simulation and Automation & Integration are very low. Interviewees do not see the benefit of putting a lot of information into a simulation model to discover improvements that they could have found themselves by previously established analysis methods. Regarding the automation and integration of business processes they believe their systems, applications and processes are too complex to automate using one tool.

5. Investigate Monitoring & Control

Although not one of the tasks practiced during the case study the task Monitoring & Control of BPM has a lot of potential for the project department. Interviewees indicate that they find it very important that BPM supports this task and the work characteristics of the department allow this task to add much value. An investigation is necessary to determine how this can best be undertaken but the potential is evident.

6. Act immediately

The conduction of this thesis project in general and the case study specifically has brought BPM under the attention of the decision-makers of the project department. The successful case study has shown them the added value of BPM (see their response to the advice below) and it is important to maintain the created momentum.

Response

This advice has been presented to the management team of the project department and will be used to determine their BPM strategy. The first and second recommendations have been accepted and acted upon by appointing ARIS as the designated tool for future process modelling and analysis for the project Fast Close.

9 Conclusions

This chapter describes the main contributions of the thesis, the process and the results, the answers to the research questions and the main research goal.

9.1 Contributions

The main contribution of this thesis is an overview of the overall suitability of the state-of-the-art in BPM tools and methodologies. Furthermore recommendations are provided to BPM-practicing organisations for improving their current BPM approaches and to software and standards developers to help them determine their focus in the coming years.

The project department received its requested deliverables: the Model Report and Analysis Report. These deliverables were also used to support the improvement project Fast Close that was part of the case study. Furthermore an advice was given to the department to help them determine their BPM strategy.

9.2 Process & Results

The main research goal of this thesis was:

“Evaluate the suitability of the state-of-the-art in Business Process Management (BPM) tools & methodologies for satisfying the expectations of a large financial service provider’s financial accounting department starting with BPM.”

This thesis project addressed the research goal by first eliciting the expectations of the decision-makers of the project department using a newly constructed Catalogue of Criteria. Subsequently a case study and literature review were undertaken to evaluate the suitability of BPM tools and methodologies.

The case study contributed to a project within the Business Line Retail Banking at ING and brought forward insights into the practical side of BPM. The decision of the management of the project department to take the created process models into maintenance illustrates the success of the case study. The work performed during this thesis work was able to be transformed into a practical advice to the management of the project department to allow them to determine the BPM strategy.

The literature review consisted of an extensive examination of tool & standards evaluations, tool & standards descriptions, research papers, white papers and survey data concerning BPM that led to interesting findings.

The literature and case study results allowed the twelve most important criteria of BPM as presented by the decision-makers of the project department to be evaluated. Although not originally part of the research goal it proved possible during the evaluation to formulate a number of recommendations concerning the application and development of BPM in general.

9.3 Research Questions

The research questions proposed in section 1.5.2 have been answered during the course of this thesis.

1. *What is the state-of-the-art in BPM tools & methodologies?*

The state-of-the-art in BPM tools has been researched during the selection of a tool to use in the case study (section 4.4). The extensive evaluations of BPM tools that have been found [62, 84, 87, 131] provide an accurate description of the state-of-the-art in BPM tools. A number of (modelling) methodologies were found [13, 34, 68, 120] in the search for a suitable methodology to use in the case study (section 4.5). The literature review (see appendix I) brought forward a number of successful BPM case studies that employed BPM methodologies but no details about the methodologies were available.

2. *What are expectations of a large financial service provider's financial accounting department starting with BPM?*

The expectations of the decision-makers of the project department and how they were elicited are presented in chapter 6. Participants expect the tasks 'Modelling', 'Analysis & Optimisation' and 'Monitoring & Control' to be sufficiently supported and attach the most importance to the criteria 'Communication', 'Behavioural Analysis' and 'Real-Time Information Delivery'.

3. *How can BPM tools & methodologies be evaluated against these expectations?*

This has been successfully performed using the Catalogue of Criteria: a categorised list of criteria related to specific BPM tasks, presented in chapter 5. The evaluation is performed in chapter 7 and detailed information has been gathered in appendix I.

9.4 Main Research Goal

Despite the extensive evaluation with its valuable results, it is not possible to provide a definitive verdict on whether the state-of-the-art in BPM tools and methodologies is or is not suitable for satisfying the expectations of a large financial service provider's financial accounting department starting with BPM. Although BPM tools and methodologies have major shortcomings they address all of the expectations at least partly (see section 7.7). Looking at the success of external case studies, BPM tools and methodologies do not appear to be a bottleneck in the successful implementation of BPM and cannot be held responsible for the low BPM maturity level in most organisations.

This means that the cause for the problem defined in section 1.3 is likely to lie within one of the other BPM success factors defined by Rosemann & de Bruin [96]: strategic alignment, culture, people or governance. Possibilities for future research in these areas are detailed in section 10.3.

10 Reflection

This final chapter of the master thesis reports reflects upon the work performed, describing the limitations, applicability of the results, possibilities for future work and a number of final remarks.

10.1 Limitations

The conduction of 14 interviews with decision-makers of the project department was sufficient to support the goal of this thesis project. However to be able to chart the expectations of all BPM practitioners, regardless of the properties of their departments, a larger number is required. A large number of different organisations will need to be involved and an efficient data collection mechanism needs to be implemented. If higher level managers are to be involved in such a survey, the questions need to be formulated at a higher abstraction level to allow them to answer them.

The practical evaluation was performed from a personal viewpoint, influenced by my personal skills as a modeller and analyst and dependant on the characteristics of the business process being modelled. In order to obtain more reliable practical evaluation results a larger number of varying case studies by different persons should be analysed.

The literature review was performed using a large library of resources made available by the TU Delft and ING. It is possible that there exist other knowledgeable sources that were unavailable during the thesis project that may lead to new insights.

10.2 Applicability of Results

The results of this master thesis are partly dependent on the employees and business processes of the project department. In order to value the results correctly these properties must be taken into account. The defining properties of the project department that affect the results are that it is *starting to practice BPM*, *supports a financial accounting process*, and is *located within a large financial service provider*, see Figure 10.1.

The literature review performed for the 12 evaluated criteria is applicable to organisations of all types. Due to the lack of literature available describing the expectations that BPM practitioners in general it is not possible to prove whether all results are more broadly applicable, this requires additional research.

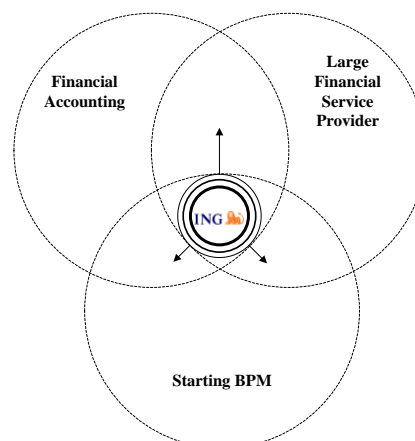


Figure 10.1: Applicability Results

10.3 Future Work

The verdict of this thesis is that the suitability of BPM tools and methodologies does not appear to be a serious bottleneck in the implementation of BPM in practice. The gap between theoretical BPM developments and its application in practice is likely caused by one of the other factors defined by Rosemann & de Bruin [96]: strategic alignment, culture, people or governance. Interesting findings concerned with these factors are described below.

10.3.1 Strategic Alignment

IDS Scheer [112] indicates that the major cause of failing BPM initiatives is not the tooling but the lack of determination of a clear BPM strategy by the initiating organisational unit. Often initiatives are started without clear goals in mind and the practice of BPM becomes a goal in itself. It is important to choose a tool that matches the strategic goal [84] in order to successfully practice BPM.

10.3.2 Culture & People

Forrester [128] indicates that human nature is the biggest barrier to successful BPM. This is seconded by ING experts; in the company's internal magazine for Retail Banking Nederland: 'Verder' [43] they state that managers are reluctant to cooperate in BPM projects and open up their process information because they are afraid to lose control over their processes.

10.3.3 Governance

Although officially not within the scope of this thesis project, a number of governance issues came forward during the evaluation. For example, a number of the CoE's modelling restrictions negatively affected the quality of the process models. Additional research is necessary whether this is a major bottleneck in the successful practicing of BPM. The surprisingly low number of BPM modelling methodologies found (see section 4.5) also makes an interesting research topic.

10.4 Final Remarks

It is the author's belief that this master thesis is a valuable addition to research in the field of BPM. With quite a large number of vendors competing for market share the market is changing rapidly and some of the information available has a commercial orientation. This report has tried to give a non-biased overview of the state-of-the-art in the field and appoint important improvement points. With 34% of the sources referenced in this report published in 2008 or 2009 an up-to-date picture has been painted of the state of BPM that presents other researchers with interesting material for further research.

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Acronyms

ABPD	Automated Business Process Discovery
AFM	Autoriteit Financiële Markten
ARIS	Architecture of Integrated Information Systems
B2B	Business to Business
BAM	Business Activity Monitoring
BI	Business Intelligence
BPA	Business Process Analysis
BPM	Business Process Management
BPMM	Business Process Management Maturity
BPMN	Business Process Modeling Notation
BPMS	Business Process Management System
BPXL	Business Process Extension Layers
BRE	Business Rule Engine
BRS	Business Rule System
CIO	Chief Information Officer
CMM	Capability Maturity Model
CMMI	Capability Maturity Model – Integrated
CoC	Catalogue of Criteria
CoE	Centre of Excellence
CPO	Chief Process Officer
DEMO	Design & Engineering Methodology for Organizations
DNB	De Nederlandsche Bank
EPC	Event-driven Process Chain
FNL	Finance Nederland
FSCP	Financial Statement & Closure Process
IFW	(IBM) Information FrameWork
IT	Information Technology
ITIL	Information Technology Infrastructure Library
KDM	Knowledge Discovery Metamodel
KM	Knowledge Management
KPI	Key Performance Indicator
MCR	Master Control Room
OMG	Object Management Group
PC	Personal Computer
PFO	Process (-Focused) Organisation
RCM	Release Cycle Management
RQ	Research Question
SBVR	Semantics of Business Vocabulary and Business Rules
SMS	Short Message Service
SMT G&DC	Service Management Group & Division Controller
SOA	Service-Oriented Architecture
SOx	Sarbanes-Oxley Regulations
SPOT	Single Point of Truth
TU Delft	Delft University of Technology
WfMC	Workflow Management Coalition
WfMS	Workflow Management Systems
XML	eXtensible Markup Language

Appendices

A. Modelling Requirements

This appendix displays the information collected for each process step of the FSCP during the case study, all fields marked with * are mandatory.

Process Step Name	Type	Description
General		
Name *	Text	Clear descriptive name
Part of *	Text	The hierarchical superior process step
ID *	##	Reference number
Work description *	Text	A short description of the work performed
Automatic *	Yes/No	No if human intervention is necessary to complete the process step
Triggers		
Trigger 1 *	Text	The process steps or events that trigger the start of the process step
Trigger 2	Text	
Trigger 3	Text	
Trigger Rule *	Logic	A logical formula representing the rule that triggers the process step
Systems		
Input System	Text	The systems that provide input
Output System	Text	The systems that take output
Parties Involved		
Performer *	Text	The performing organisational unit
Responsible *	Text	The responsible organisational unit
Times		
Earliest Start (ES) *	wd	Information concerning the range of starting and finishing times of the process step. Noted in working days (wd) and time in hours.
Time *	Time	
Latest Start (LS) *	Wd	
Time *	Time	
Earliest Finish (EF) *	wd	
Time *	Time	
Latest Finish (LF) *	wd	
Time *	Time	
Normal running day(s) *	#, #	The normal running working days
Frequency *	Text	Frequency
Processing Time *	Hour	Processing time
Communication & Obligations		
SLA information	Text	Important Service Level Agreement information
Incident communication	Text	Organisational unit to warn in case of incidents
Function communication	Text	Communication associated with the regular carrying out
Miscellaneous		
Contact person 1 *	Text	Contact persons for this process step
Contact person 2	Text	
Contact person 3	Text	
Remarks	Text	Any other remarks

B. Forrester Evaluations

This appendix contains the results of the evaluations by Forrester concerning BPA tools and BPMS used in the tool selection for the case study. The following information is presented:

- The Forrester Wave: Business Process Analysis, EA Tools, And IT Planning [84]
- The Forrester Wave: Integration-Centric Business Process Management Suites [131]
- The Forrester Wave: Human-Centric BPMS For Banking And Investments [87]
- The Forrester Wave: Business Process Management For Document Processes [62]

Business Process Analysis, EA Tools, And IT Planning

Figure B.1 below depicts the results of the Business Process Analysis category, appointing Casewise, IDS Scheer and Metastorm as leaders.

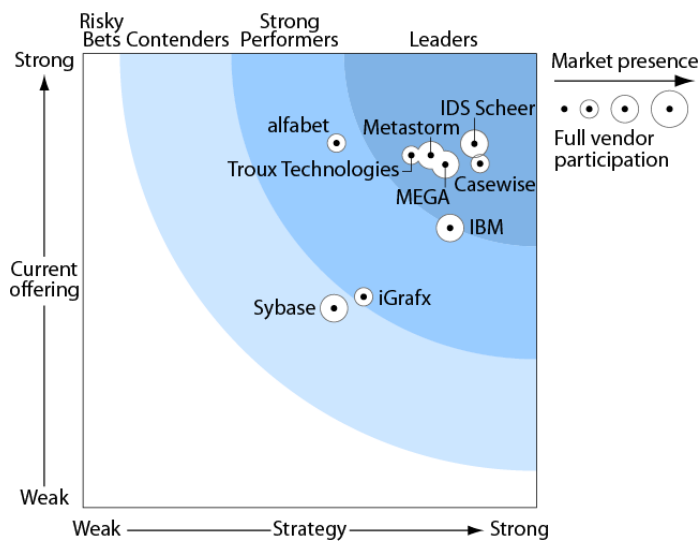


Figure B.1: BPA Tool Evaluations [84]

Integration-Centric Business Process Management Suites

Figure B.2 below depicts the results of the evaluation, appointing Software AG, IBM, TIBCO, Vitria, Oracle, SAP, and Cordys as leaders.

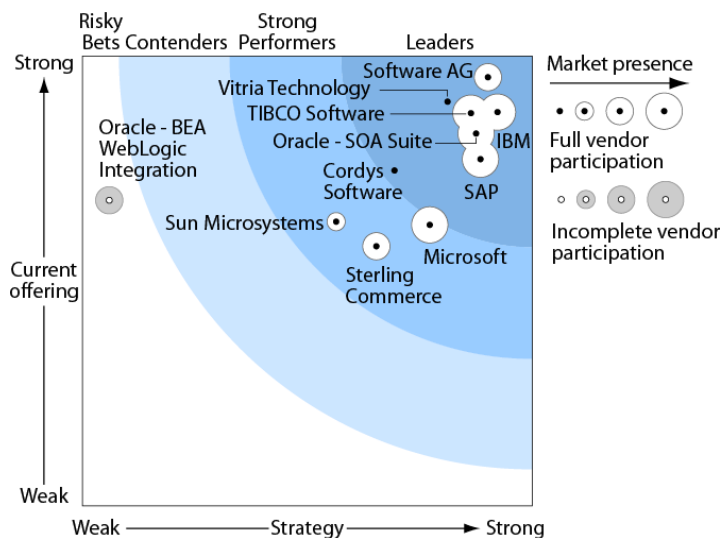


Figure B.2: Integration-Centric BPMS Evaluations [131]

Human-Centric BPMS For Banking And Investments

Figure B.3 below depicts the results of the evaluation, appointing Pegasystems, Appian and IBM as leaders.

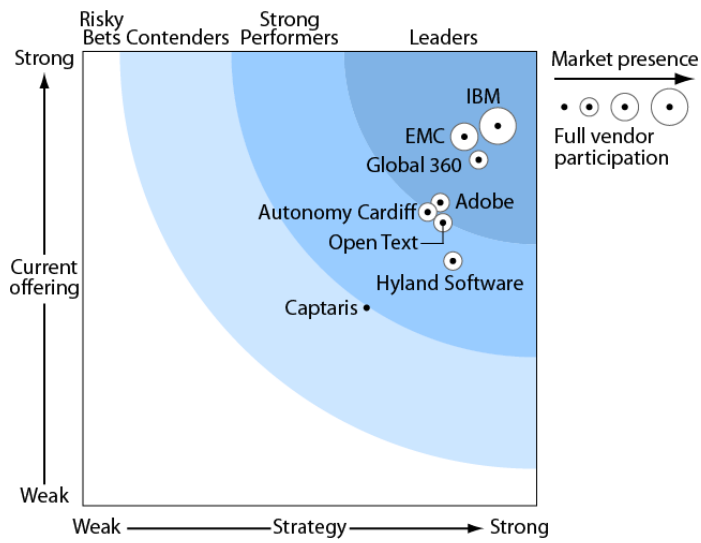


Figure B.3: Human-Centric BPMS Evaluations [87]

Business Process Management For Document Processes

Figure B.4 below depicts the results of the evaluation, appointing IBM, EMC and Global 360 as leaders.

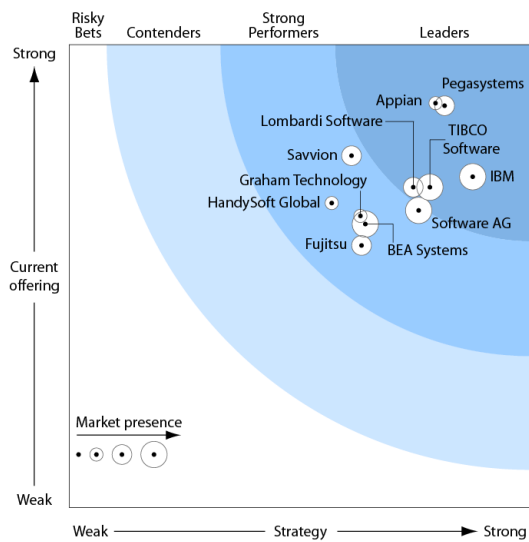


Figure B.4: Document-Centric BPMS Evaluations [62]

C. Introduction to EPC's

This appendix contains a short introduction to Event-Driven Process Chains (EPC's), the modelling notation used by IDS Scheer's ARIS Toolset and in the case study of this thesis project. This same introduction to EPC's was provided to users of the process models in the case study. The information in this section has been taken from Wikipedia [133] and adjusted for readability.

C.1 Elements

C.1.1 Event

Events are passive elements in EPC. They describe under what circumstances a function or a process works or which state a function or a process results in. Examples of events are "requirement captured", "material on stock", etc. In the EPC graph an event is represented as hexagon. In general, an EPC diagram must start with an event and end with an event.

C.1.2 Function

Functions are active elements in EPC. They model the tasks or activities within the company. Functions describe transformations from an initial state to a resulting state. In case different resulting states can occur, the selection of the respective resulting state can be modelled explicitly as a decision function using logical connectors. Functions can be refined into another EPC. In this case it is called hierarchical function. Examples of functions are "capture requirement", "check material on stock", etc. In the EPC graph a function is represented as rounded rectangle.

C.1.3 Organisational Unit

Organization units determine which person or organization within the structure of an enterprise is responsible for a specific function. Examples are "sales department", "sales manager", "procurement manager", etc. It is represented as an ellipse with a vertical line.

C.1.4 Information, Material, or Resource Object

In the EPC, the information, material, or resource objects portray objects in the real world, for example business objects, entities, etc., which can be input data serving as the basis for a function, or output data produced by a function. Examples are "material", "order", etc. In the EPC graph such an object is represented as rectangle.

C.1.5 Logical Connector

In the EPC the logical relationships between elements in the control flow, that is, events and functions are described by logical connectors. With the help of logical connectors it is possible to split the control flow from one flow to two or more flows and to synchronize the control flow from two or more flows to one flow.

C.1.6 Logical Relationships

There are three kinds of logical relationships defined in EPC:

- **Branch/Merge:** Branch and merge correspond to making decision of which path to choose among several control flows. A branch may have one incoming control flow and two or more outgoing control flows. When the condition is fulfilled, a branch activates exactly only one of the outgoing control flows and deactivates the others. The counterpart of a branch is a merge. A merge may have two or more incoming flows and one outgoing control flow. A merge synchronizes an activated and the deactivated alternatives. The control will then be passed to

the next element after the merge. A branch in the EPC is represented by an opening XOR, whereas a merge is represented as a closing XOR connectors.

- Fork/Join: Fork and join correspond to activating all paths in the control flow concurrently. A fork may have one incoming control flow and two or more outgoing control flows. When the condition is fulfilled, a fork activates all of the outgoing control flows in parallel. A join may have two or more incoming control flows and one outgoing control flow. A join synchronizes all activated incoming control flows. In the EPC diagram how the concurrency achieved is not a matter. In reality the concurrency can be achieved by true parallelism or by virtual concurrency achieved by interleaving. A fork in the EPC is represented by an opening 'AND', whereas a join is represented as a closing 'AND' connectors.
- OR: An 'OR' relationship corresponds to activating one or more paths among control flows. An opening 'OR' connector may have one incoming control flow and two or more outgoing control flows. When the condition is fulfilled, an opening 'OR' connector activates one or more control flows and deactivates the rest of them. The counterpart of this is the closing 'OR' connector. When at least one of the incoming control flows is activated, the closing 'OR' connector will pass the control to the next element after it.

C.1.7 Control Flow

A control flow connects events with functions, process paths, or logical connectors creating chronological sequence and logical interdependencies between them. A control flow is represented as a dashed arrow.

C.1.8 Information Flow

Information flows show the connection between functions and input or output data, upon which the function reads changes or writes.

C.1.9 Organization Unit Assignment

Organization unit assignments show the connection between an organization unit and the function it is responsible for.

C.1.10 Process Path

Process paths serve as navigation aid in the EPC. They show the connection from or to other processes. The process path is represented as a compound symbol composed of a function symbol superimposed upon an event symbol. To employ the process path symbol in an EPC diagram, a symbol is connected to the process path symbol, indicating that the process diagrammed incorporates the entirety of a second process which, for diagrammatic simplicity, is represented by a single symbol.

C.2 Example

An example process model incorporating many of the elements presented above is given in Figure C.1.

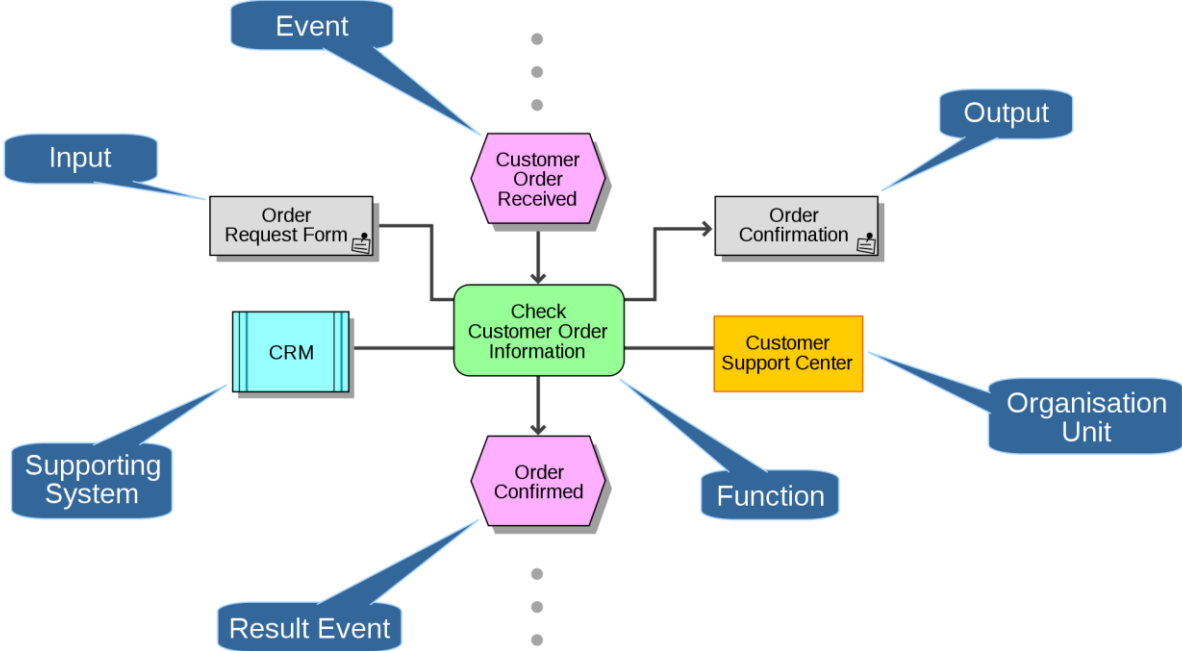


Figure C.1: Example Process Model [133]

D. Case Study Methodology

This appendix contains the modelling methodology of Climent, Mula & Hernández [13]. The authors constructed this methodology empirically by performing field work. The text below has been taken from [13] and slightly adjusted.

Seek available information about the company to be modelled.

This is achieved by visits and, secondly, by obtaining information from the internet or other media. The aim is to understand everything needed to develop the models, such as the people who work there, the jobs they do, the departments which appear, etc.

Identify the people linked to the processes from the company organisational chart.

All the individuals linked to the company processes are identified from the company organisational chart.

Conduct interviews with the people identified on the organisational chart.

Once the people linked to the processes have been determined, interviews must be set-up with them to obtain the maximum amount of information possible about the processes that each undertakes.

Identify relevant processes for both the company and the modelling team.

Once all or most of the necessary information has been obtained, the most important processes to be modelled for both the company and the modelling team must be identified.

Identify the appropriate individuals to obtain information about each process.

Having determined the key modelling processes, it is necessary to identify the appropriate individuals relating to these processes to obtain the maximum amount of information on each process.

Start with the description of the processes identified.

A description is provided for each process once all the information related with the process being considered has been obtained.

Identify the appropriate technique and tool for modelling.

We need to identify suitable modelling tools which allow us to properly interpret the situation being studied to support the BPM. As far as the modelling technique is concerned, we consider those which properly and assertively represent the aspects to be studied. In this sense, it is advisable to have more than one technique to be able to study the system from different point-of-view or perspectives.

Develop business process models.

When all the processes have been described and the modelling technique chosen, we must start to develop the business process models.

Validate and/or correct.

Certain feedback from the company being modelled is necessary during the BPM development. This is required to generate a more precise and enriched model using the knowledge of bank staff. Thus, the corresponding validations are appropriately undertaken and any related corrections are made to achieve a more precise model.

Discover relevant aspects.

Once all the processes are validated and corrected, all the critical aspects observed must be determined. The critical aspects can be highlighted in the business process models in relation to the business process diagram development activities and the interview process. From each interview, the people related to each business process will recommend which process must be highlighted. Finally,

the method to find the relevant aspects is directly related to the business process environment needs and to the modeller proposal.

Set out proposals for improvement.

Finally, improvement proposals may be established with the model developed. These proposals may be made at the analytical level (the application of better practices) or at the redesign level (which require more profound changes to the organisational structure).

E. Syntactical Checks

During the ARIS RCM process the following syntactical rules must hold [44]:

- Path begins with a start event. This rule checks whether all start objects are of the Event type.
- Path ends with an event or function. This rule checks whether all end objects are of the Event or Function type.
- Function or rule after a joining rule. This rule checks whether the successor of a joining rule is of the Event or Function type.
- Event after splitting rule. This rule checks whether the successors of a splitting rule are of the Event type.
- No OR or XOR after a single event. This rule checks whether there is no opening OR or XOR rule (distributor) after events.

The majority of these rules are mandatory but a number are suggested guidelines that may be ignored if sufficiently motivated.

F. Case Study Examples

This appendix provides details concerning a number of the conclusions drawn during the case study in order to provide insight into the reasoning. All information represented in the models has been made anonymous for confidentiality reasons. Sections of this appendix are referenced by the corresponding letter from appendix I.

Example A: Control Flow Operators & Periods

Often a large number of control flow operators (AND, OR, XOR) and Events were necessary to define the logic associated with the process control flow. This negatively affected the readability and communicability of EPC CD⁷ level diagrams. Figure F.1 shows five Events together forming the input of the Function ‘Analyse data’. The Events ‘Accountancy data transferred’ and ‘System definitions 1 maintained’ add important information to the model. The three Events describing the period (working days) in which the Function is active are necessary since they are used as inputs at the lower level EPC diagram detailing ‘Analyse data’. These Events clutter the model unnecessarily however and make it necessary to use an OR operator while otherwise a more informative AND operator could have been used.

The period in which a Function was active was indicated by the previously mentioned Events, but required additional detail at times. This was done by adding a textual attribute to each Function to indicate the active working days. This text is shown at the top-left corner of each Function, in the case of ‘Correct data’ in Figure F.1 this is represented by the text ‘[9 – 12]’ representing working days 9 through 12.

Example B: Alternating Functions and Events

The ING BPM CoE [45] and ARIS modelling literature referenced [17] prescribe that Functions and Events be alternated during process modelling in order to explicitly show the status of the process. In some cases this needlessly clutters the process models, see for example Figure F.1. In this example the Events ‘Data analysed’ and ‘Data corrected’, following the Functions ‘Analyse data’ and ‘Correct data’ provide no additional information.

Example C: Leaf EPC Models

Due to the model hierarchy prescribed by ING specifically and ARIS in general occasionally leaf models were simple repetitions of their parent model with a fraction additional detail. In Figure F.2 the detailing of the Function ‘Transfer accountancy data’ from Figure F.1 is given as an EPC model. Only three of the eight objects in this model (the Application System Types) provide additional information, the rest is repeated from the EPC CD diagram. The detailed model is necessary due to the fact that it is not possible to model Application System Types at the EPC CD level.

Example D: Process Interface Objects

Due to the fact that Process Interface objects are used to connect linked process models, the models quickly become cluttered. These objects must be repeated each time a link is made from one model to the other, making the models look unnecessarily complicated. In Figure F.1 there are four such Process Interface objects that complicate a simple five Function process flow. This would normally not present a problem if the process model was not already bloated with objects (see examples A and B).

⁷ In ARIS, three levels of diagrams are used in order from high to low: Value-Added Chain Diagrams (VACD), EPC Column Display (EPC CD) and EPC [17].

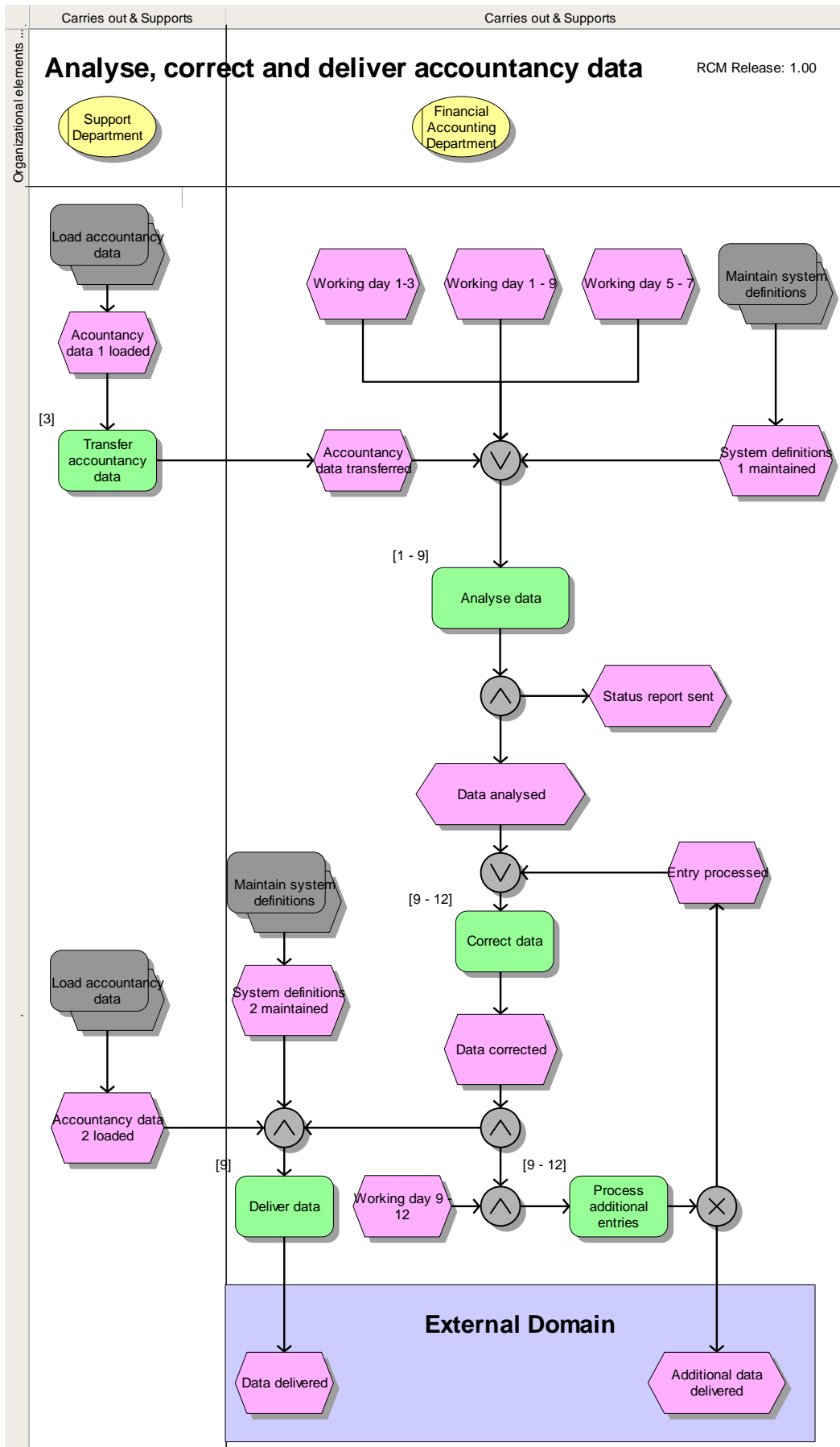


Figure F.1: EPC CD Example

Transfer accountancy data RCM Release: 1.00

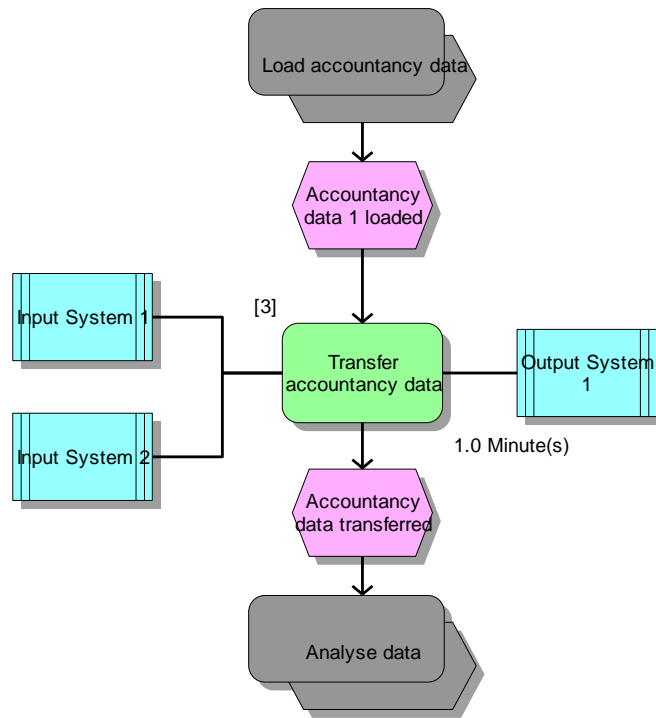


Figure F.2: EPC Repetition Example

G. Introductory Letter

P.O. Box 1800, 1000 BV Amsterdam

Interviewee

Subject
Survey Business Process Management

Date

Dear sir/madam,

You have been selected to participate in a survey about Business Process Management (BPM) at ING. This survey is conducted as part of my MSc Thesis Project at the Delft University of Technology where I am investigating the expectations of non-practitioners of BPM about the field in order to evaluate to what extent these expectations can be met by the state-of-the-art of BPM methodologies and tools. This project is supervised by Albert-Jan van Beek, team manager of Fin BI within FNL/SMT G&DC.

The insights gained from this survey will be used for my MSc Thesis but also by BPM practitioners within ING (by Tomasz Tomkowicz, Associate Architect) in order to be able to determine the company strategy with regards to BPM. Your engaged participation in this survey is of extreme importance for both goals.

Since this survey is intended for non-practitioners of BPM, let us start by defining BPM:

“Supporting business processes using methods, techniques, and software to design, enact, control, and analyse operational processes involving humans, organisations, applications, documents and other sources of information.”

The figure of the BPM Life Cycle on the right gives a representation of the different activities that can be employed with BPM. These activities can be performed in different orders and there are many supporting tools & methodologies available.

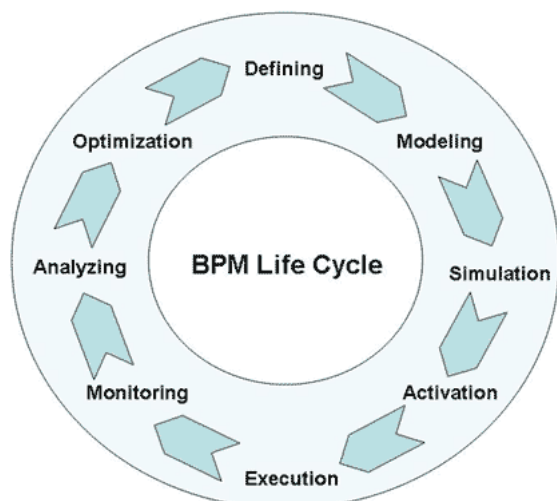


Figure G.1: BPM Life Cycle

The form accompanying this letter shows a ‘Catalogue of Criteria’ I have constructed in order to evaluate the field of BPM. These criteria are divided up into six categories and represent the tasks that BPM supports expanded with some generally applicable criteria.

- Modelling
- Analysis & Optimisation
- Simulation
- Automation & Integration
- Monitoring & Control
- General

The categories and their criteria are introduced in the questionnaire. For each criterion the same question is posed:

“If you were to start practicing BPM in the near future, how important do you think it is that this criterion is met in a satisfactory manner?”

Your answer must be indicated on a 7-point scale with the following denominations:

+++	Very important
++	Important
+	Somewhat important
0	Neutral
-	Somewhat unimportant
--	Unimportant
---	Very unimportant

Table G.1: Expectations Elicitation Answering Scale

In order to help you answer this question a description of each criterion/category is given as well as an example or other form of additional information as inspiration. Relative answers are natural to give, but make sure to treat each criterion in its own right. During the interview further verbal explanation can be given upon request. The interview will be taped allowing for additional comments about the reasoning behind each answer, don’t hesitate to elaborate on your answers. The criteria are functionally grouped with no further particular order. The form is concluded by some task-related and general BPM questions.

In order to obtain the most reliable results and to ensure you have a full understanding of each of the criteria this survey will be conducted by me in person. This information has been sent to you in advance for preparation purposes.

Kind regards,

Rob Konterman

H. Expectations Results

This appendix displays the results of the expectations elicitation for the task importance and criterion importance. The tables are sorted by average and provide the following details:

- Avg: Average over total set
- St Dev Standard deviation over total set
- Avg_IT: Average of the IT Group
- Avg_Bus: Average of the Business Group
- Avg_Arch: Average of the Architect Group

Task	Avg	St Dev	Avg_IT	Avg_Bus	Avg_Arch
Modelling	2.43	0.76	2.80	2.20	2.25
Analysis & Optimisation	2.36	0.84	2.40	2.20	2.50
Monitoring & Control	2.07	0.62	2.20	2.20	1.75
Automation & Integration	0.79	1.42	0.00	1.40	1.00
Simulation	0.64	1.08	1.00	0.40	0.50

Table H.1: Detailed Task Importance Results

Criterion	Avg	St Dev	Avg_IT	Avg_Bus	Avg_Arch
Modelling					
Communication	2.57	0.65	2.20	2.80	2.75
Readability	2.00	0.96	2.00	1.60	2.50
Expressiveness: Data Perspective	1.93	1.27	1.40	1.80	2.75
Expressiveness: Control Flow	1.79	1.42	1.80	1.80	1.75
Expressiveness: Resource Perspective	1.07	0.92	1.80	0.20	1.25
Granularity	0.93	1.49	1.00	1.60	0.00
Semantics and Correctness	0.93	1.07	0.80	1.80	0.00
Flexibility	0.86	1.46	0.80	0.40	1.50
Expressiveness: Exception Handling	0.71	1.33	0.60	0.60	1.00
Ease of Model Building	0.57	1.34	0.60	0.60	0.50
Analysis & Optimisation					
Behavioural Analysis	2.21	0.70	2.40	2.20	2.00
Time Reduction	1.86	1.23	1.60	2.60	1.25
Functional Analysis	1.50	0.94	1.20	1.20	2.25
Resource Analysis	1.29	1.33	1.40	1.00	1.50
Organisational Analysis	1.14	1.29	1.40	0.40	1.75
Cost Reduction	1.00	1.30	1.00	0.80	1.25
Methodology Support	0.29	1.44	0.60	1.00	-1.00
ABPD	0.07	1.49	0.00	0.00	0.25
Simulation					
Tracking	1.93	0.73	2.00	1.80	2.00
Ease of Simulation Building	1.64	1.28	0.80	2.40	1.75
Scenarios	1.57	1.02	2.20	1.00	1.50
Distributions	1.21	1.53	0.40	1.20	2.25
Performance Dimensions	0.57	1.55	0.40	0.40	1.00
Statistical Facilities	0.57	1.40	1.00	0.00	0.75
Animation	0.07	1.54	0.40	-0.20	0.00

Automation & Integration					
Integration	1.57	1.09	1.40	1.40	2.00
Orchestration	1.43	1.28	1.40	1.00	2.00
Execution	1.36	1.28	1.80	1.20	1.00
Process Model Reusability	0.93	1.69	0.60	0.80	1.50
B2B Collaboration	-0.50	2.07	-1.20	0.00	-0.25
Monitoring & Control					
Real-Time Information Delivery	2.21	0.70	1.80	2.60	2.25
Historical Data	1.93	0.73	1.80	2.20	1.75
Dashboard	1.79	0.97	1.80	2.40	1.00
Forecasting	1.79	0.89	2.00	1.60	1.75
Guided Decision Support	1.07	0.83	0.60	1.40	1.25
Multiple Format Alert Delivery	0.64	1.50	1.40	0.20	0.25
General					
Information Management	2.14	0.66	2.20	2.40	1.75
Business Rules	1.79	0.89	1.60	1.60	2.25
Exchangeability	1.64	1.22	1.00	1.80	2.25
Reporting	1.64	0.93	1.20	2.20	1.50
Compliance	1.43	0.94	1.80	1.00	1.50
Security	1.21	1.58	1.60	2.00	-0.25

Table H.2: Detailed Criterion Importance Results

The scores are calculated using Table H.3 below.

Score	Conversion	Label
+++	3	Very important
++	2	Important
+	1	Somewhat important
0	0	Neutral
-	-1	Somewhat unimportant
--	-2	Unimportant
---	-3	Very unimportant

Table H.3: Score Conversion Table

I.Evaluation Information

This appendix contains the detailed information related to the criteria evaluated in the main text. The information that has been collected provides an overview of the state-of-the-art in BPM tools and methodologies.

I.1 Introduction

The information gathered provides the background for the evaluation performed in the main text; it is taken from a great variety of different resources, including the following:

- ACS
- Blackwell Synergy
- BPMInstitute
- BPTrends
- Cambridge Univ.Press
- Elsevier ScienceDirect
- Emerald Library
- Forrester
- Foundation and Trends Reference Journals
- Gartner
- IDS Scheer
- IEEE Xplore
- ING Internal Documents
- Ingenta
- IOP - Inst.of Physics
- nature.com
- Oxford Journals
- SpringerLink
- SwetsWise
- Taylor & Francis Group
- Wiley Interscience
- Workflowpatterns.com

As well as many other BPM-related websites found by searching the web. The TU Delft possesses licenses for the scientific websites listed above. Due to the fast recent developments in the field recent sources were used whenever possible.

There is an enormous of literature available about BPM and it is growing at an exponential pace. By maintaining a large personal searchable digital library of over 400 literature resources this information proved controllable. By subscribing to numerous newsletters and groups such as Forrester Research, BPTrends, IDS Scheer's ARIS News, BPMInstitute and a number of LinkedIn BPM groups the library was kept up-to-date with the latest developments in the field.

A number of important notes on the information presented here:

- A number of criteria contain case study results that are specific to the modelling notation used: EPC's; see appendix C for details.
- The opinions from users about the case study results were gathered using the 'BPM Evaluation Questionnaire', see appendix J.
- A number of evaluations apply to multiple criteria and can therefore appear multiple times.

- Much of the information presented in this appendix is taken directly from the source but not presented as a quotation.
- The ‘users’ that are referred to in the case study evaluations are the members of the project team that interpreted the created process models.

The evaluation takes place per criterion. After a short introduction an overview of the criterion is given, see Table I.1.

Name	The name of the criterion
Description	The description of the criteria used in the Catalogue of Criteria and the interviews.
Source	The literature source of the criterion

Table I.1: Criterion Overview Template

Followed by the information concerning the criterion divided up into a number of sections, see Table I.2.

Section	Contents
Comments	The comments that the interviewees gave during the requirements elicitation and the associated score.
Case Study	Empirical results of the case study and opinions voiced by users, if applicable.
Best Practices / External Case Studies	Evidence of best practices and external case studies found, preferably at financial service providers.
Literature	General literature such as tool & standards evaluations, tool & standards descriptions, research papers, white papers and survey data.

Table I.2: Criterion Information Overview Template

The criteria are organised per BPM task appended with the generally applicable criteria:

- Modelling criteria
- Analysis & Optimisation criteria
- Monitoring & Control criteria
- General criteria

Criteria are displayed in *italics*.

I.2 Modelling Criteria

Modelling is defined as the modelling of (business) processes using graphical notations [108]. Four criteria are evaluated from this category:

- Expressiveness: Control Flow
- Expressiveness: Data Perspective
- Communication
- Readability

I.2.1 Expressiveness: Control Flow Perspective

Expressiveness: Control Flow considers whether the modelling notation is able to express a large number of different basic and complex modelling constructs describing the control flow of the process. The criterion has been extensively evaluated by The Workflow Patterns initiative that will be introduced in the literature section and which serves as the main source for this evaluation.

Name	Expressiveness: Control Flow
Description	The modelling notation is able to express a large number of different basic and complex modelling constructs describing the control flow.
Source	Kirikova & Makna [54], Jansen-Vullers & Netjes [48] and Russell, ter Hofstede, van der Aalst & Mulyar [102]

Comments

The interviewees think that this criterion should be supported in a sufficient manner but do not think a great deal of detail is necessary. They are unaware of the expressiveness that the different modelling languages have.

Score	Comment
+++	Extremely important
++	This should provide a good basis for modelling, therefore it is important.
++	From an architect's that focuses on automation point of view I think this criterion is very important.
+	This is not very complicated for my processes and therefore less interesting.
+	This can be nice at a high level, but details should not be contained in the process model.
0	I prefer some freedom in this respect, not necessary to detail every sequence, etc.

Case Study

During the case study there were problems with expressing the control flow of a process, often a large number of operators (AND, OR, XOR) and Events were necessary to define the flow. This confused the people that needed to read the model, for details see appendix F: Example A. Although business people experienced no problem reading flowchart models they needed additional explanation to be able to interpret the operators used in the process models. The expressiveness of the modelling notation did not limit the modelling capabilities.

The amount of constructs available for modelling in the case study had been constrained by an ING BPM filter. A number of control flow issues came forward that were detrimental to the readability of the process models, see appendix C for details about the EPC-notation:

- There was no satisfactory manner for detailing the period of time that a certain sub process was active. Many smaller processes run during a certain time period after which a new process starts, this had to be indicated using Events that clutter the model or by inserting comments in the models for clarity. For details see appendix F: Example A.
- In order to adhere to the optional syntactical EPC rules applied within ING decisions in process models had to be explicitly modelled using Events, leading to a large increase in Events in the process models. For every decision instance a choice had to be made between syntactic correctness and readability. For details see appendix F: Example B.
- Due to the model hierarchy prescribed by ING specifically and ARIS in general occasionally leaf models were simple repetitions of their parent model with a fraction additional detail. In a number of these cases it would have been better to move this detail to a higher level model, which was impossible due to the constraints imposed. For details see appendix F: Example C.
- Due to the fact that Process Interface objects are used to connect linked process models, the models quickly become cluttered. These objects must be repeated each time a link is made from one model to the other. For details see appendix F: Example D.

Best Practices / External Case Studies

None found.

Literature

A great amount of research has been performed on the expressiveness of BPM standards and products by The Workflow Patterns initiative, a joint effort between Eindhoven University of Technology (led by Professor Wil van der Aalst) and Queensland University of Technology (led by Professor Arthur

ter Hofstede). The initiative has defined detailed descriptions of workflow patterns from four perspectives: control flow, data, resource, and exception handling [115].

The initiative has performed evaluations of BPM standards and the BPM tools implementing them regarding control flow expressiveness based on 43 patterns [102]. The results of this evaluation have been processed and summed up in Table I.3. A pattern can be either:

- Directly supported: +
- Indirectly supported: + / -
- Not supported: -

The results are sorted descending by patterns directly supported. In general the BPM standards fare better in the evaluations than the BPM tools since they are not faced with the burden of actually having to implement everything that they are able to model [102].

Since this evaluation is concerned with BPM tools and methodologies and not so much with standards, the first three languages in the table are left out of scope. The fourth contender, COSA 5.1, performs much poorer, especially when regarding patterns not supported.

Product / Language	-	+ / -	+
UML 2.0 Activity Diagrams	13	5	25
BPMN version 1.0	10	9	24
XPDL version 2.0	10	9	24
COSA 5.1	22	2	19
Oracle BPEL v10.1.2	21	3	19
SAP Workflow version 4.6c	23	3	17
FileNet P8 BPM Suite version 3.5	25	1	17
BPEL version 1.1	22	4	17
WebSphere Integration Developer 6.0.2	22	4	17
FLOWer 3.5.1	19	8	16
Sun ONE iPlanet Integration Server 3.0	28	0	15
Staffware Process Suite 10	29	0	14
IBM WebSphere MQ Workflow 3.4	32	0	11
EPCs by ARIS Toolset version 6.2 ⁸	31	2	10

Table I.3: Control Flow Product / Standard Evaluation Results [102]

The conclusion can be drawn that the control flow patterns as defined by van der Aalst, Russell, ter Hofstede & Edmond [102] are not well supported by current BPM product offerings.

The fact that organisations impose their own sets of modelling constructs motivated Zur Muehlen, Recker & Indulska [137] to research whether process modelling languages were overly complex. They argue that an increase in constructs does not always lead to better modelling results. Furthermore they found that users of BPMN favoured a set of constructs that had low levels of excess constructs and less redundancy, even when this incurred smaller expressiveness. At the same time, the users were content to increase the level of construct overlap (i.e. potentially increasing ambiguity) in order to increase their ability to model more concepts.

I.2.2 Expressiveness: Data Perspective

Expressiveness: Data Perspective considers whether the modelling notation is able to express a large number of different basic and complex modelling constructs describing the data perspective. The criterion has been extensively evaluated by The Workflow Patterns initiative that will be introduced in the literature section and which serves as the main source for this evaluation.

⁸ The case study uses version 7.02 of the ARIS Toolset

Name	Expressiveness: Data perspective
Description	The modelling notation is able to express a large number of different basic and complex modelling constructs describing the data perspective.
Source	Kirikova & Makna [54], Jansen-Vullers & Netjes [48] and van der Aalst, Russell, ter Hofstede & Edmond [101]

Comments

The interviewees' interest in data and communication can be explained by the work at the project department, which makes intensive use of large database systems and data warehouses. The comments do not express a certain particularly strong perspective.

Score	Comment
+++	I believe it is important to move to a service-based (SOA) situation; therefore it is important to describe the data perspective.
++	Not always necessary, but nice to have in case you need it. In that case it is important.
++	From an architect's that focuses on automation point of view I think this criterion is very important.
+	Communication lines are most important, to a lesser extent the data-based decision making.

Case Study

The case study re-used applications from the central repository library that had been previously set up. This library contained most (90%) of the applications required for modelling the processes; a number of smaller, specific applications were added to the library during modelling.

The amount of data objects able to be used during the case study was limited by the ING BPM filter but was sufficient for modelling objects such as e-mails, phone calls, databases, applications and physical folders. The modelling effort was however constrained by the fact that it was not possible to model applications at higher model levels (EPC column display level).

Best Practices / External Case Studies

None found.

Literature

A great amount of research has been performed on the expressiveness of BPM standards and products by The Workflow Patterns initiative, a joint effort between Eindhoven University of Technology (led by Professor Wil van der Aalst) and Queensland University of Technology (led by Professor Arthur ter Hofstede). The initiative has defined detailed descriptions of workflow patterns from four perspectives: control flow, data, resource, and exception handling [115]. The initiative has performed evaluations of BPM standards and the BPM tools that implement them regarding data expressiveness based on 39 patterns [101]. The results of this evaluation have been processed and summed up in Table I.4. A pattern can be either:

- Directly supported: +
- Indirectly supported: + / -
- Not supported: -

Product / Language	-	+ / -	+
FLOWer 2.05	7	12	20
COSA 4.2	17	5	17
Staffware Process Suite version 9	14	12	13
MQSeries Workflow 3.3.2	15	11	13
BPEL4WS 1.1	20	7	12
XPDL 1.0	23	5	11

Table I.4: Data Product / Standard Evaluation Results [101]

The results are sorted descending by patterns directly supported. It is immediately apparent that the level of direct support for data patterns in standard workflow design tools is minimal. Data representation now often occurs graphically through ER diagrams, class diagrams and object-role models. One of the conclusions of the evaluation is that there is clearly a need for better support in capturing the integration between the control flow and data perspectives at design time [101].

Zur Muehlen, Recker & Indulska [137] were motivated to research whether process modelling languages were overly complex by the fact that organisations impose their own sets of modelling constructs. They argue that an increase in constructs does not always lead to better modelling results. Furthermore they found that users of BPMN favoured a set of constructs that had low levels of excess constructs and less redundancy, even when this incurred smaller expressiveness. At the same time, the users were content to increase the level of construct overlap (i.e. potentially increasing ambiguity) in order to increase their ability to model more concepts.

I.2.3 Communication

Communication considers whether the modelling notation is suitable for communication to all levels within the organisation [48]. Models can be used to communicate detailed work instructions to low-level employees and/or provide senior management with an overview of company processes. It is dependent on the criterion *Readability* but is a distinctly different aspect and is concerned with the means by which process models can be communicated for example.

Name	Communication
Description	The modelling notation is suitable for communication to all levels within the organisation.
Source	Jansen-Vullers & Netjes [48]

The well-known communication gap between business and IT has been around for a long time [53] and is one of the problems addressed by BPM. The easy communication of process models can help close this gap. The interviewees second this by valuing this criterion the highest of all criteria.

Comments

Interviewees stress that they think it is very important that process models can be communicated (to all levels in the organisation). They have been frustrated by the lack of communicability of process models in the past and want to make sure all contributors to a process know what their role is.

Score	Comment
+++	I want all levels within the organisation to know to which processes they contribute. This means that will not simply throw something onto someone else's plate, they will be more informed.
+++	This is very important; my previous experiences illustrate that this it is very difficult to achieve good communication through process modelling.
+++	People cannot do their work if the model cannot be communicated to all levels, very important.
+++	A lot of errors occur when the model is not able to be communicated. Very important to make sure everyone is thinking along the same lines.
++	It is important for people to see where in the process they are performing their work.

Case Study

The models created during the case study did not always communicate well, even to domain experts. Users of the process models mentioned that the models were complicated and cluttered. For details see the case study results of *Expressiveness: Control Flow* and *Expressiveness: Data Perspective*.

Model users mentioned that the models were difficult to communicate due to the fact that it took a large table to be able to present the printed version of the models. Even with all the models laid out

across the table it was difficult to recognise the connections between the models. With 23 models (one Value Added Chain Diagram, three EPC Column Display diagram and 19 EPC diagrams) containing hundreds of objects (of which 144 Functions, 58 Application System Types) the complexity of the created process models is illustrated.

A potential cause of the reduced communicability of the process models can also lie in mistakes made during modelling. Modellers must be well trained in order to be able to model successfully. The lack of a standard modelling methodology applied during the creation of the process models may also have contributed; see section 4.5.

Respondents to the BPM evaluation questionnaire indicated that the average manager would not be able to easily understand the created process models. Respondents indicate they see how most value for change management as opposed to dealing with daily work.

The complexity of the business process described in the process models played a large role in the ability to communicate the models. The modelling of a simple transactional process would likely achieve much better results.

The lack of communicability of the process models resulted in the information gathering in the modelling phases of the case study to be done using standard office tooling, displaying the shortcomings of BPM tooling in this respect.

The publication of the process models through ARIS Process Web allowed for easy communication of the models to a large number of employees within the project department. By placing a link to the process models on the project department's SharePoint websites it was ensured that the necessary people could access the models.

A major contribution of the created process models to the project Fast Close was that the models ensured that IT and business employees were discussing the same process. Because both parties were looking at the same process model, there was less room for miscommunication.

A number of ARIS features for communication were used during the case study:

- The process models were exported to Microsoft PowerPoint to be presented to the management team of the project department.
- The process models were exported to Microsoft Word to inform project team members of recent process model changes and detailed process information.

These actions were easy to perform and intuitive in their use.

Best Practices / External Case Studies

Volvo Aero Group, a subsidiary of The Volvo Group states a reduction in training lead time when introducing an employee to a new work area related to their use of the QualiWare Product Suite as a knowledge management system [29].

Literature

The strong point of ARIS is its suitability for communication with process owners [48].

Forrester [84] evaluates BPA vendor's tools based on a number of criteria, one of which is support for web publishing; a technique commonly used to communicate process models to a large audience. IDS Scheer achieves the maximum score in this category with its ARIS Business Publisher application; a number of other vendors follow with a score of 4 out of 5.

The currently ongoing development of BPMN 2.0 aims at improving the communication between (business and software) modellers [4].

According to Oracle [79] one of the benefits of BPM is the closing of the communication gap between business and IT.

Becker, Rosemann & von Uthmann [5] present a framework for quality assurance and state that a business process model should serve as a communication base for all persons involved placing restrictions on the level of quality of such models.

Communication between experts in different domains is only possible on the foundation of a joint ontology (which is often assumed implicitly), and therefore such an ontology is essential for successful communication between (traditional) business and IT experts [53].

The IDEF methodology was developed by the U.S. Air Force in order to allow for more in-depth analysis and better communication techniques for individuals concerned with improving manufacturing productivity [61].

Mendling, Reijers & Cardoso [73] have researched the understandability of process models and find that process model readers tend to exaggerate the differences in model understandability, that self-assessment of modelling competence appears to be invalid, and that the number of arcs in models has an important influence on understandability.

I.2.4 Readability

Readability considers whether people familiar with the domain modelled by a modelling notation find the notation simple and clear [51]. This criterion is associated with and is beneficial for the criterion communication but addresses a distinctly different aspect.

Name	Readability
Description	People familiar with the domain modelled by a modelling notation find the notation simple and clear.
Source	Kaschek, Pavlov, Shekhovtsov & Zlatkin [51]

A diagram is readable if its meaning is easily captured by the way it is drawn [111]. Whether the meaning is easily captured is a very subjective criterion and depends on how and to whom the model must be communicated.

Comments

The interviewees realise that a certain amount of effort is required to be able to read a model and accept that this requires some explanation. Naturally they want the model to be easy to understand.

Score	Comment
+++	People never read the manual, so it is important that they recognise a process right away.
+++	It is very important that the models are easily readable.
++	It is not a problem if a bit of explanation is necessary when showing someone a model. Although you must not be caught behind if someone totally does not understand the model.
+	Process models will generally be quite complex, you cannot expect too much of the readability in this case
+	It is not a problem if the reader of such a model needs to invest some effort to be able to read the model.
0	A certain amount of detailed knowledge is necessary anyway, so great readability is not necessary.

Case Study

During the performance of the case study a number of points came forward that concerned the readability aspect.

- Employees involved in the case study were accustomed to working with flowchart models and experienced some problems with reading the EPC notation. After a short introduction (see appendix C) of the most common constructs they were able to read the models.
- The centrally applied ING BPM filter in ARIS that limits the amount of constructs that can be used is a successful method for enhancing the readability of the models.
- The readability of a model depends for a large part on the expertise of the modeller. The modeller makes decisions about the level of detail in the models, where model steps are split and how they are built up hierarchically. Therefore it is important that modellers are trained well before they start their work. In the ING case this involved an introductory course 'BPM with ARIS' which did not prepare the modeller well enough for these complex decisions that had to be made: a more extensive training is required. A good practice would have been to involve the business in the creation of the actual models instead of merely extracting information from them.

Respondents to the BPM evaluation questionnaire indicated that it takes a while to learn the modelling notation and be able to easily read it. Once the notation is understood they think it is a good method to clearly model the different steps of a business process.

A number of the other modelling criteria subjected to this evaluation contain readability related evaluations, see the respective sections.

Best Practices / External Case Studies

Rabobank has created a special feature in its BPMS that allows people to generate a textual representation of a graphical model in order to enhance readability for people that prefer this [112].

A large American bank: First Horizon National successfully deployed BPM and specifically mentioned 'rapid user acceptance' as a great success. Using the tool Fuego BPMS from Fuego Software (now BEA Systems Aqualogic BPM) the processes were intuitive and easy to learn, required minimal training, and enabled very smooth transitions to new work methods [85].

Literature

Even though BPMN was developed with the lack of comprehensibility of BPML in mind [110], Recker, Indulska, Rosemann & Green [89] indicate a number of shortcomings that will lead to decreased model understandability in their evaluation of BPMN.

The primary goal of BPMN is to provide a notation that is readily understandable by all business users, from the business analysts that create the initial drafts of the processes, to the technical developers responsible for implementing the technology that will perform those processes, and finally, to the business people who will manage and monitor those processes [4].

Readability is one of the pillars on which the EPML is built [72].

In their analytical evaluation of BPMN using the Semiotic Quality Framework by Krogstie & Sølvsber [58], Wahl & Sindre [132] conclude that BPMN particularly excels in terms of comprehensibility appropriateness due to its construct specialisations and type aggregations, and is well-suited generally for the domain of business process modelling.

Luttighuis, Lankhorst, van de Wetering, Bal & van den Berg [66] express a number of requirements that visualisation features must fulfil in order to improve readability.

Becker, Rosemann & von Uthmann [5] present a framework for quality assurance and state that the understandability of process models is of growing importance; however the design of process models

often turns out to be very problematic. Furthermore a risk is signalled when the model design is seen as a domain of 'modelling specialists' who are the only ones that understand their models.

Rosemann [97] states that elaborated modelling techniques often come with the price of limited understandability.

Gruhn & Laue [28] show that the quality of models can be improved automatically using their knowledge of style rules, leading to an increase in the understandability of the models. One of the examples given is a style rule for EPC OR-joins that allows for transformation of the complying model into formally founded languages. Furthermore they recommend the formalisation of measures that provide information about the understandability and complexity of a business process model.

I.3 Analysis & Optimisation Criteria

Analysis & Optimisation is defined as: the analysis of previously constructed models in order to discover redundancies, bottlenecks, risks and possible improvements [108]. Two criteria are evaluated from this category:

- Behavioural Analysis
- Time Reduction

I.3.1 Behavioural Analysis

Behavioural Analysis considers whether it is possible to analyse the (complex) behaviour of a process [47, 51]. This criterion is strongly associated to the criterion *Expressiveness: Control-Flow* and is dependent on it. Automatic analysis of process models is not included in the evaluation; ABPD is a separate criterion.

Name	Behavioural Analysis
Description	The ability to analyse the (complex) behaviour of a process.
Source	Kaschek, Pavlov, Shekhovtsov & Zlatkin [51] and Jablonski & Bussler [47]

This criterion is of a high abstraction level and contains most analysis performed on process models. It was not possible to find literature or best practices / external case studies related to this criterion.

Comments

This criterion proved very important to the interviewees, finishing in second position in the list of criterion averages. Interviewees see this as the main benefit of performing BPM: conducting analysis to identify bottlenecks, dependencies and possible risks.

Score	Comment
+++	I want to stress the importance of this criterion
+++	This is why we are starting BPM
+++	Important to be able to understand the process.

Case Study

In the chapter 'Case Study' in the main report the results of the case study regarding recognised redundancies, bottlenecks, risks and possible improvements are discussed. The outcome was positive and relevant input was able to be provided towards the project Fast Close.

Respondents to the BPM evaluation questionnaire indicated that it is easy to analyse the behaviour of the business process once it is clearly modelled and to determine dependencies and possible improvements.

Best Practices / External Case Studies

Several case studies detailed elsewhere [59, 109] show that behavioural analysis delivers results.

Literature

None found.

I.3.2 Time Reduction

Time Reduction considers whether it is possible to analyse a process in order to research improvements that will make it more time efficient [22]. Time (and cost) reduction is one of the main objectives of BPM and there are ample examples available where this has been accomplished.

Name	Time Reduction
Description	The ability to analyse a process in order to research improvements that will make it more time efficient.
Source	Filipowska & Kaczmarek [22]

In the research performed in the service industry by Vergidis, Turner & Tiwara [127] lead time / cycle time is the most widely used KPI. Time reduction is usually the result of extensive behavioural analysis.

Comments

Interviewees indicate that time reduction scored highly due to a project (related to the case study) that had recently been launched with the aim to shorten the lead time of the FSCP.

Score	Comment
+++	This is currently important due to the project I am involved in.
++	This is primarily concerning the project I am currently working on, but this is always an issue.
-	I don't think analysis should specifically be pointed at either cost or time reduction, but that general analysis will deliver both.

Case Study

As recognised by Luttighuis, Lankhorst, van de Wetering, Bal & van den Berg [66] lead time analysis requires specific attributes; something that came forward during the case study. It was not possible to easily represent throughput-time information into the model, making it difficult to identify the critical path. It is possible that there exists (even within the ARIS Toolset) more suitable software to perform this analysis.

In the chapter 'Case Study' in the main report the results of the case study regarding recognised redundancies, bottlenecks, risks and possible improvements leading to time reduction are discussed. The positive results from the case study regarding time reduction illustrate the added value of BPM in this respect.

Respondents to the BPM evaluation questionnaire indicated that the created process models can be used to determine the critical path of the process flow and lead to the signalling of inefficiencies and potential improvements.

Best Practices / External Case Studies

Küng & Hagen [59] claim that BPM can reduce lead time to a degree that would never be in scope using traditional methods and tools. This statement is a lesson learned from their experience with BPM and in particular from the results of a case study performed at Crédit Suisse in Switzerland.

A leading banking company, with operations in over 60 countries and 11 million credit cards in circulation, uses TIBCO BPM software to model automate close to 30 business processes. This has

resulted in a reduction in time necessary to process credit card applications from several days down to 18 minutes [109].

A leading healthcare provider with over 2 million customers, three medical centres and a 650-member group practice uses TIBCO BPM software to automate and streamline patient information processing, customer support, and accounts payable. This has enabled them to resolve customer issues within 8 instead of 24 hours and reduce invoice processing time from 13 to 1.8 days, while maintaining HIPAA compliance [109].

Literature

Tupa, Basl & Skocil [121] demonstrate that their use of process management tools in their Cost-Quality-Time methodology leads to quality improvement, cost and process time reduction effectively and simply. The process modelling tool used in this methodology is IDS Scheer's ARIS.

Terziovski, Fitzpatrick & O'Neill [113] demonstrate through their research in the financial sector that it is reasonable to conclude that BPM practices have a significant and positive effect on profitability, cycle time reduction, and customer satisfaction.

Reijers & van der Aalst [90] show in their research that workflow management systems such as Staffware, COSA and FLOWer reduce process lead time and wait time by an average of 48%.

I.4 Monitoring & Control Criteria

Monitoring & Control is defined as: The monitoring and controlling of business processes, also known as Business Activity Monitoring (BAM) [108]. Four criteria are evaluated from this category:

- Dashboard
- Forecasting
- Historical Data
- Real-time Information Delivery

I.4.1 Dashboard

Dashboard is concerned with the provision of monitoring information through way of a dashboard [25], allowing for quick oversight of the current status of the business processes while omitting unnecessary details.

Name	Dashboard
Description	The provision of information through use of a dashboard
Source	Selection Requirements for Business Activity Monitoring Tools by Gartner [25].

In order to present information in a dashboard, it is necessary to define Key Performance Indicators (KPI's). Küng, Hagen, Rodel & Seifert [60] have found that the quality of process models and descriptions are key for an effective definition and measurement of KPI's in their research about process measurement in a large financial service provider.

Comments

Dashboards are common in large organisations such as ING and interviewees had little comments on the criterion.

Score	Comment
++	Important in providing an overview of monitoring information.

Case Study

Not applicable.

Best Practices / External Case Studies

Archstone, a leading provider of apartments in America, initiated a BPM team that was able to create process-specific dashboards to enable associates to quickly find the status of a given process instance, which helped to eliminate confusion about the resolution and completion of work tasks. Each time a form flowed from one person to another, the real-time dashboard would update with the most current information related to the request [74].

Literature

Oracle [80] states that there is a general agreement that a BPMS includes intelligence dashboards that provide historical and real-time process monitoring, reporting, and analytics.

TIBCO's iProcess Analytics tool provides business intelligence based on historical process data. The tool makes process definitions and case data available as XML that can be loaded into a client application that provides standard and user-defined KPI's that can be displayed in graphical management reports [109].

Data in 'The State of BPM 2008 Survey' by Harmon & Wolf [31] shows that the development of BAM, real-time monitoring and executive dashboards will be an area of modest growth in coming years.

I.4.2 Forecasting

Forecasting considers whether there is support for forecast analytic models and rules that trigger on forecast changes [25]. It can be used to determine whether the purchase of new hardware is necessary for example.

Name	Forecasting
Description	Support of forecast analytic models and rules that trigger on forecast changes.
Source	Selection Requirements for Business Activity Monitoring Tools by Gartner [25].

There is not much literature to be found on this subject; the focus often lies on forecasting during simulation of business processes.

Comments

Interviewees want this criterion to be supported but a number think their existing tools and analysis methods can outperform BPM in this respect.

Score	Comment
+	I don't see much value in this; I don't think you can do this successfully until you have everything put into place correctly.
+	There are other (better) ways to do this
0	My processes know too many dependencies in order to be able to perform this.

Case Study

Not applicable.

Best Practices / External Case Studies

None found.

Literature

TIBCO's BPM software possesses a feature called 'case prediction' that projects the outcome of a live case. It outputs a list of "predicted work items" including expected activity start times, which can be used to improve work forecasting and estimate the expected completion of cases [109].

The paper of Fabio Casati, Malu Castellanos, Umeshwar Dayal, Mehmet Sayal, and Ming-Chien Shan [27] presents a set of integrated tools that supports business and IT users in managing process execution quality by providing several features, such as analysis, prediction, monitoring, control, and optimisation.

I.4.3 Historical Data

Historical Data considers whether there is support for historical data to provide context for rules and alerts [25]. By measuring, storing and analysing historical data the process, its rules and alerts can be optimised to improve performance.

Name	Historical Data
Description	The availability of historical data to provide context for rules and alerts.
Source	Selection Requirements for Business Activity Monitoring Tools by Gartner [25].

Comments

Interviewees think historical data is important and will allow for input to be able to forecast (either through manual or automated analysis) future developments.

Score	Comment
+++	I have more confidence in my analysis capabilities of historical information than in the forecasting capabilities of a system.

Case Study

Not applicable.

Best Practices / External Case Studies

Küng & Hagen [59] state that BPM systems make it possible to monitor critical processes carefully, investigate whether service level agreements are violated and allow identification of poor parts of processes.

Literature

TIBCO's iProcess Analytics tool provides business intelligence based on historical process data. The tool makes process definitions and case data available as XML that can be loaded into a client application that provides standard and user-defined KPI's that can be displayed in graphical management reports [109].

According to Forrester [86], BPM software also provides real-time and historical reporting that can be used by business managers and process owners to measure and improve those processes.

Oracle [80] states that there is a general agreement that a BPMS includes intelligence dashboards that provide historical and real-time process monitoring, reporting, and analytics.

Combining data warehouse technology with a BPM solution provides a powerful combination, enabling the enterprise to perform an in depth historical analysis of the monitored metrics in order to detect any abnormal pattern or opportunities [12].

I.4.4 Real-Time Information Delivery

Real-Time Information Delivery is closely related to Business Activity Monitoring and is concerned with providing real-time information for monitoring purposes. In order to present information in a dashboard, it is necessary to define Key Performance Indicators (KPI's). Küng, Hagen, Rodel & Seifert [60] have found that the quality of process models and descriptions are key for an effective definition and measurement of KPI's in their research about process measurement in a large financial service provider.

Business Activity Monitoring (BAM) is “the real-time reporting, analysis and alerting of significant business events, accomplished by gathering data, key performance indicators and business events from multiple applications” [21].

Name	Real-Time Information Delivery
Description	The provision of real-time information
Source	Selection Requirements for Business Activity Monitoring Tools by Gartner [25] and Küng & Hagen [60].

Comments

The work characteristics at the project department require that monitoring occurs more or less in real-time. For the work performed it is important that the responsible employee is alerted immediately when a system is not functioning; this currently occurs through ITIL Incident Management practices.

Score	Comment
++	This is important; otherwise people will use other ways to monitor their important processes.

Case Study

Not applicable.

Best Practices / External Case Studies

Küng, Hagen, Rodel & Seifert [60] describe how process measurement has successfully been implemented at Crédit Suisse. See the literature section for details.

Archstone, a leading provider of apartments in America, initiated a BPM team that was able to create process-specific dashboards to enable associates to quickly find the status of a given process instance, which helped to eliminate confusion about the resolution and completion of work tasks. Each time a form flowed from one person to another, the real-time dashboard would update with the most current information related to the request [74].

A leading healthcare provider with over 2 million customers, three medical centres and a 650-member group practice uses TIBCO BPM software to automate and streamline patient information processing, customer support, and accounts payable. This enables them to keep all patient records up to date in near real-time [109].

Literature

Forrester [84] evaluates BPA vendor's tools on a number of criteria, one of which is support for flexibility and monitoring. The vendors' scores vary greatly but IDS Scheer, MEGA and Metastorm have obtained the maximum score on this criterion and all support real-time monitoring and alert notification.

Forrester [83] states that all BPM suites provide some level of business activity monitoring and predicts that the level of integration and technical skill required to truly implement BAM will keep it from seeing significant success in BPM environments. Most organisations will continue to leverage separate business intelligence (BI) tools to provide robust monitoring of process and business-related metrics.

Data in The State of BPM 2008 Survey by Harmon & Wolf [31] shows that the development of BAM, real-time monitoring and executive dashboards will be an area of modest growth in coming years.

Küng, Hagen, Rodel & Seifert [60] mention five valuable lessons learned from their case study of performing process measurement at Crédit Suisse.

- The quality of process models and descriptions are key for an effective definition and measurement of KPI's.

- Tool evaluation for process monitoring and measurement has to be done very carefully. Most likely monitoring and measurement-related requirements cannot be met by one single tool/architectural approach.
- Process measurement and monitoring produces large masses of data; in particular in the finance industry where payment or securities operations processes have to be monitored/measured. This aspect has to be considered when the infrastructure is to be established.
- To facilitate the measurement of key processes in an end-to-end manner, the usage of commercial off-the-shelf software seems to be appropriate. However, it must be considered that key processes usually span multiple applications based on different technologies. This in turn means that the effort needed to collect and integrate the required performance-relevant data stemming from diverse systems is considerable.
- The implementation of a process measurement solution must be iterative, as business users are usually very cautious about having their processes measured. Our experience shows that the objections mentioned at the beginning quite often fade away as soon as people recognise the potential the approach.

I.5 General Criteria

The general criteria category is a collection of criteria that are applicable to multiple tasks of BPM. Two criteria are evaluated from this category:

- Information Management
- Business Rules

I.5.1 Information Management

Information Management is concerned with the storage of information in a central, easily accessible repository.

Name	Information Management
Description	The storage of information in a central, easily accessible repository.
Source	Kirikova & Makna [54]

Comments

Many interviewees mentioned, not necessarily at this criterion, that it is important to have a common terminology inside an organisation. When everyone is speaking the same ‘language’ it is much easier to communicate. This is a need that is partly answered by information management: if everyone can use and discuss the same process models it is easier to communicate.

Score	Comment
+++	Very important to have a single point of truth (SPOT)

Case Study

The CoE at ING fulfilled its role well by providing a central BPM infrastructure that multiple ING departments use to practice their BPM activities. All of the ARIS products supported by ING access the same central repository that is maintained by the CoE.

The Retail BPM department carried out the RCM process for the models created in the contributing to the standardisation of process models throughout the Retail domain within ING.

Although it was not included in the case study, the Retail BPM department supports the use of ARIS software as a Knowledge Management (KM) system. Documents used in business processes can be

linked to the process models to ensure all department are working with (the latest versions of) company documents.

Respondents to the BPM evaluation questionnaire indicated that they were sceptical about how willing users and management would be to keep the created process models up-to-date. This ‘documentation work’ is not one of the favourite tasks of employees and cannot count on a lot of energy. For this reason they prefer not to model the process in too much detail.

Best Practices / External Case Studies

Archstone, a leading provider of apartments in America was able to reduce the amount of forms in its organisation greatly by employing BPM. Furthermore it created a secure, unified access point for all of its critical on-site information allowing employees and management to quickly find the status of a given process instance [74].

Volvo Aero Group, a subsidiary of The Volvo Group claims a reduction in training lead time when introducing an employee to a new work area related to their use of the QualiWare Product Suite as a knowledge management system [25].

Literature

Forrester [84] evaluates BPA vendor's tools on a number of criteria, one of which is support for a repository. The criterion takes into account whether the repository is centralised or distributed and whether it supports versioning, stages and variants management, check-in/check-out and import- & export formats. The evaluated tools score very highly on this criterion; especially MEGA and Metastorm perform well, indicating that the aspect of information management is well supported.

The previously mentioned vendor MEGA's software supports management of access rights for any object granularity in its repository [29].

The most recently proposed Business Process Modeling Notation (BPMN), for example, has only limited capabilities to cater for tacit knowledge for knowledge management or cost drivers in an activity-based costing project [98].

35% of respondents in The State of Business Process Management: 2008 [31] indicate that if they were to hire outside consultants to help with BPM projects they would focus their efforts on linking knowledge management and BPM: one of the top-four results and a 7% increase compared with the previous edition of the survey.

I.5.2 Business Rules

Business Rules is a general criterion and thus spans multiple tasks of BPM: Business rules perform decision-making in automated processes, provide important information in the modelling stage and are subjected to tests during simulation.

Business Rule Systems or Business Rule Engines are separate systems for the handling of business rules. They represent a niche market – largely confined to the Financial and Insurance industries [31].

Name	Business Rules
Description	The support for business rules
Source	None.

Comments

Business rules are a well understood item within a large organisation such as ING. Interviewees valued the support for business rules highly but gave no additional comments.

Case Study

Not applicable.

Best Practices / External Case Studies

None found.

Literature

Forrester [84] evaluates BPA vendor's tools on a number of criteria, one of which is support for business rules. The vendors Casewise and IDS Scheer score the maximum score on this criterion indicating that business rules are well supported by both.

The Semantics of Business Vocabulary and Business Rules (SBVR) specification by OMG allows the non-graphical natural language to be used as a notation for its predominantly graphical standards, such as UML [77]. This allows the specification of business rules (often in natural language) to be transformed to formats that can be interpreted by IT systems. OMG is considering integrating SBVR into standards such as BPDM and Knowledge Discovery Metamodel (KDM) [56].

Many vendors offer applications aimed at non-technical users that allow for specification of business rules and integration of these rules into business processes [25].

Many BPMS contain a business rules engine that aims for extraction of business rules from traditional software applications and store and manage them through a separate component [59].

BPEL has been extended with business rules, task management and human interactions. These extensions are defined in Business Process Extension Layers (BPXL) [39].

Data in The State of BPM 2008 Survey by Harmon & Wolf [31] shows that modest growth can be expected for the Business Rule Systems market. It is currently unclear whether companies will think of rules as a separate technology or simply conceptualise them as a capability within a BPMS product.

J. Evaluation Questionnaire

This appendix contains the BPM Evaluation Questionnaire used to gather comments to be used as input for the evaluation of the case study in chapter 7. It has been reformatted to fit in this thesis report.

BPM Evaluation Questionnaire				
<p>The goal of this short questionnaire is to evaluate the results of the case study (Fast Close) performed based on the criteria listed below. Two major tasks were performed during the case study: 'modelling' and 'analysis & optimisation'. The models created during the case study were delivered to you and have been available during the analysis phase of the project Fast Close.</p> <p>Not all people that have received this questionnaire have worked extensively with the models; I would still like to ask you to evaluate the four criteria as fully as possible: describe both positive and negative findings that have come forward during your work with the models.</p> <p>If you are unable to evaluate the criterion please note this as well. On the back of the form there is room for general comments.</p> <p>Examples Readability: "I thought the notation contained a lot of symbols that were difficult to interpret." Behavioural Analysis: "I was able to perform an extensive behavioural analysis on the models regarding process flow but found it difficult to identify loops and exception handling routines."</p>				
Task	Criterion	Description	Example / Additional information	Evaluation
Modelling		The modelling of (business) processes using graphical notations.		
	Communication	The modelling notation is suitable for communication to all levels within the organization.	End users require detailed work descriptions of day-to-day processes. Senior management is in need of a high-level overview of the model without ignoring important details.	Write your answer here
	Readability	People familiar with the domain modelled by a modelling notation find the notation simple and clear.	The notation uses intuitive symbols that are easily recognisable.	Write your answer here
Analysis & Optimisation		The analysis of previously constructed models in order to discover redundancies, bottlenecks, risks and possible improvements.		
	Behavioural analysis	The ability to analyze the (complex) behaviour of a process	Example: sequential actions, synchronization, asynchronous execution, loops, exceptions, etc	Write your answer here
	Time reduction	The ability to analyze a process in order to research improvements that will make it more time efficient.	Example: Find process steps that do not add value to the end result and remove them to save time.	Write your answer here

Table J.1: BPM Evaluation Questionnaire