Supporting Different Levels of BPM Maturity. Instruments for Early and Late BPM Adopters

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from
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and
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St. Gallen, October 26, 2011

The President:

Prof. Dr. Thomas Bieger
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Anne K. Cleven
Contributions


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<tr>
<td>ABPMP</td>
<td>Association of Business Process Management Professionals</td>
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<tr>
<td>ACM</td>
<td>Association for Computing Machinery</td>
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<tr>
<td>AVE</td>
<td>Average Variance Extracted</td>
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<td>BAM</td>
<td>Business Activity Monitoring</td>
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<td>BI</td>
<td>Business Intelligence</td>
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<td>BISE</td>
<td>Business &amp; Information Systems Engineering</td>
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<td>BPI</td>
<td>Business Process Intelligence</td>
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<td>BPM</td>
<td>Business Process Management</td>
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<td>BSC</td>
<td>Balanced Scorecard</td>
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<td>CIP</td>
<td>Continuous Improvement Process</td>
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<td>CMM</td>
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<td>CMMI</td>
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<td>DC</td>
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<td>DRG</td>
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<td>GDP</td>
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<td>EJIS</td>
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<td>Abbreviation</td>
<td>Full Form</td>
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<td>FP</td>
<td>Financial Performance</td>
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<td>IT Infrastructure Library</td>
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<td>KPI</td>
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<td>MM</td>
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<td>MSA</td>
<td>Measure of Sampling Adequacy</td>
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<td>P</td>
<td>People</td>
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<td>PDCA</td>
<td>Plan-do-check-act</td>
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<td>PLS</td>
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<td>PS</td>
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<td>Resource-based View</td>
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<td>TBL</td>
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<td>TQM</td>
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Abstract

Business process management (BPM) is of high relevance to organisations that seek to establish efficient organisational structures, reduce costs and increase quality, productivity and customer satisfaction. However, despite the growing popularity of the approach the degree of BPM adoption differs substantially across industries. Moreover, most organisations are far from being able to realise the benefits that are associated with BPM. That is because current approaches rarely cater for the different stages of embedding of BPM within an organisation, nor do they take into account the specific characteristics of the organisations they are meant to support.

This cumulative dissertation proposes instruments that support early and late adopters of BPM at their respective levels of BPM maturity. Hospitals are late adopters of BPM and have only recently begun to implement the approach due to a strong increase of competition in their industry. By contrast, manufacturing and service industries are early adopters of BPM and have commenced their venture towards process management years ago. In six individual articles this thesis develops a deep understanding of the problems experienced in each stakeholder group and builds instruments to systematically advance their respective BPM approaches. It does this by applying a design science research approach. The first part of this thesis is dedicated to hospitals as late BPM adopters. The impact of process orientation on hospital performance is analysed and a maturity model to support hospitals in understanding and establishing process management is proposed. The second part of this thesis is dedicated to manufacturing and service organisations as early BPM adopters. Manufacturing and service organisations experience acute problems with measuring and improving their processes’ performance. Based on a rigorous deduction of relevant design factors the thesis proposes design patterns and a maturity model for process performance management.

Keywords: Process Orientation, Business Process Management, Process Performance Management, Maturity Model, Design Pattern, Design Science Research
Kurzfassung


**Stichwörter:** Prozessorientierung, Geschäftsprozessmanagement, Prozess Performance Management, Reifegradmodell, Gestaltungsmuster, gestaltungsorientierte Wirtschaftsinformatik
Part A

1 Exposition

In the struggle for survival, the fittest win out at the expense of their rivals because they succeed in adapting themselves best to their environment.

(Charles Darwin)

1.1 Introduction and Motivation

Technological advances, increasing customer demands, globalisation, and a resulting fierce competition are just a few reasons that force organisations to be highly adaptive today. A prominent answer to this challenge is business process management (BPM). BPM is associated with a number of benefits including cost reductions, quality and productivity improvements and an increased customer satisfaction. While the origins of the concept can be traced back to the emergence of scientific management, it was only with the introduction of business process reengineering in the 1990s that BPM developed as a distinct concept [Melão, Pidd 2000]. Since then the popularity of BPM has increased largely in both information systems (IS) and management research, and also in practice [Gartner Inc. 2010; Hung 2006; Zairi 1997].

BPM is based on the notion that processes represent an organisation’s “strategic assets” [Smart et al. 2009, p. 494]. Consequently, BPM designs the overall management of organisations around the lifecycles of their business processes [Recker 2008]. As a management concept, BPM makes use of a compound selection of concepts and methods from earlier approaches such as total quality management, six sigma, lean management, and Kaizen [Bonham 2008; Smith, Fingar 2003]. From a technology perspective, BPM employs an array of tools and techniques such as automated business process discovery, process monitoring and workflow management systems [van der Aalst et al. 2003].

Despite the growing popularity of the approach that we have been witnessing over the last two decades, two facts are undeniable: Firstly, the degree of adoption of BPM across industries varies considerably [Neubauer 2009; Reijers et al. 2010]. Secondly, regardless of the degree of adoption, the majority of organisations still struggle at various stages of BPM implementation [Bandara et al. 2007; Sadiq et al. 2007].
In an attempt to resolve the first issue, some researchers have engaged in explaining the heterogeneity in BPM adoption [Pritchard, Armistead 1999; Reijers et al. 2010]. However, to date these efforts have not produced generally reliable answers. A theory that lends assistance in identifying criteria to explain different levels of BPM adoption is the innovation diffusion theory [Rogers 1962]. Innovation diffusion theory attempts to understand and explain which factors influence the adoption of innovations: If an innovation such as a new technology or management paradigm is at the same time compatible with the existing premises of an organisation, easy to understand and use, and associated with potential superiority over competitors, the organisation is likely to be an early adopter of this innovation [Bradford, Florin 2003; Midgley 1987]. Applied to the adoption of BPM this means that organisations with a general need for flow orientation, a familiarity with flow-oriented thinking, and a perceived need to develop and sustain a competitive advantage, are likely to be early adopters of the approach.

This thesis aims to develop instruments for both late and early adopters of BPM. Hospitals are chosen as representatives of late BPM adopters. Though strongly driven by the patient-flow, hospitals have only recently begun to consider the adoption of BPM [Gemmel et al. 2008]. This is on the hand explainable with a strong resistance of physicians to comply with something other than their profession [Fottler 1987], and on the other with a traditionally very low level of competition in the hospital sector. Only with recent reforms of health care systems all over the world that are actively encouraging competition, have hospitals begun to invest heavily in BPM. Thus, hospitals characterise as late adopters of BPM.

Manufacturing and service organisations are chosen as representatives of early adopters. Both are characterised by the need to efficiently handle order-flows, have gained knowledge in process orientation, e.g., through the implementation of enterprise resource planning systems, and typically operate in highly competitive environments. Thus, there is little argument on the claim that manufacturing and service organisations characterise as early adopters of BPM.

Insights into the characteristics of organisations that adopt BPM in practice may also be of help to address the second issue, i.e., the fact that a great number of organisations still struggles with the implementation of BPM. Only by knowing more about the types of users of BPM, their motivation, objectives and their organisational and environmental background, it becomes possible for researchers to appropriately position their research activities and engage in the development of more useful instruments. Consequently, research has to pick up this need and develop innovative BPM solutions.
that take into account the individual circumstances of their users and provide adequate support for an easy adoption. This is the goal of the thesis at hand.

1.2 Detailed Problem Description and Research Questions

Over the last two decades, BPM has been of enormous interest to management and IS research, which has led to a sheer flood of diverse research output. Nevertheless, an analysis of the current state of BPM research, as briefly outlined in section 1.1, reveals that several problems still remain unsolved. Taking up the overall goal of this thesis to develop instruments that support early and late BPM adopters, the following section describes in detail the problems that are to be addressed. In so doing, first the problems experienced by hospitals as the representatives of late BPM adopters are portrayed. On this basis, the first set of research questions is deduced. Subsequently, problems of manufacturing and service organisations as the representatives of early BPM adopters are illustrated and translated into the second set of research questions.

Late Adopters: BPM in Hospitals

– The hospital sector has traditionally been characterised by a particularly low level of competition, and—as a consequence—also by a low level of institutional pressure and little need for operational efficiency. Because health care costs were, until recently, fully reimbursed, there was basically no incentive for hospitals to even waste a thought on improving their productivity [Haraden, Resar 2004]. This situation has changed dramatically with the introduction of new payment schemes all over the world, which aim to create transparency and comparability of both costs and quality of care [Busato, von Below 2010; Mougeot, Maréchal 2006]. Therewith, the new compensation schemes initiate active competition among hospitals. Wasteful work is no longer compensated, which again threatens the institutional survival of inefficiently and non-profitably working hospitals. Being faced with a competitive environment all of a sudden, hospitals need to reconsider their institutional self-conception and start thinking and acting both economically and resource-aware [Malk, Beth 2010]. In consequence, hospitals are investing significantly in means to streamline their operations while still ensuring a high quality of patient care. Although it appears only reasonable to consider and adopt BPM as a suitable solution, little to no empirical research exists that investigates the impact of process orientation on hospital performance [Vera, Kuntz 2007]. However, insights regarding the effects of process management on both internal performance dimensions (e.g., people per-
Performance) and external performance dimensions (e.g., patient satisfaction or financial performance) could contribute to the development of more adequate instruments to introduce BPM into the hospital sector.

Initial efforts with respect to the introduction of process management into the hospital sector have been made with organisational models such as patient-focused care [Hurst 1996] and clinical pathways [Bragato, Jacobs 2003]. Yet, while hospitals appear to be well aware of the need for process management, difficulties with its adoption have so far not been surpassed. It turns out that hospitals are quite often characterised by features that are little beneficial if not to say detrimental to the introduction of process management: They employ a workforce that mainly consists of highly specialised experts, whose major loyalty belongs to their profession rather than to the organisation [Fottler 1987]. Moreover, the traditionally function-oriented organisational structure of hospitals has caused many institutions to evolve into loosely coupled sets of highly specialised silos with disparate local goals and limited communication capabilities [Vera, Kuntz 2007]. It appears that a possible solution to this challenge is the development of instruments that consider the specific requirements as they are found in hospitals, e.g., by focussing in particular on organisational issues.

From the just described problems the first set of research questions that is to be addressed in this dissertation can be formulated (Table 1).

<table>
<thead>
<tr>
<th>No.</th>
<th>Research Question</th>
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<tbody>
<tr>
<td>I.a</td>
<td>How does BPM affect organisational performance in late BPM adopters (represented by hospitals)?</td>
</tr>
<tr>
<td>I.b</td>
<td>How can BPM in late BPM adopters (represented by hospitals) be systematically advanced?</td>
</tr>
</tbody>
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Table 1: First Set of Research Questions

Early Adopters: BPM in Manufacturing and Service Organisations

In contrast to hospitals, organisations of the manufacturing and service industries have at all times operated under competitive conditions. Technological advances, changing customer demands and a high market pressure represent just a few challenges that they are regularly confronted with. As a consequence, these organisations have begun to adopt BPM essentially from its emergence on. As the concept was hardly defined by then and also falsely assumed to require radical change, the majority of the early efforts failed [Al-Mashari et al. 2001;
Smith, Fingar 2003]. Yet, after the initial difficulties had been surpassed, more and more organisations successfully mastered the early steps of discovering, analysing, documenting, and (re-)designing their work practices and have today matured to a level of well-defined process landscapes [Bandara et al. 2007]. In order to now fully take advantage of having transformed their work practices, they need to develop and enact approaches to monitor and improve their processes on an ongoing basis [Hammer 2010]. Yet, not all companies are found to manage this task without trouble [Genrich et al. 2008]. In fact, recent quantitative studies revealed that many organisations struggle with the implementation of a consistent approach to manage their processes’ performance [Vergidis et al. 2008; Wolf, Harmon 2010]. The underlying causes are manifold. While some organisations have difficulties choosing an adequate set of key performance indicators (KPIs), others fail to develop an appropriate information technology (IT) infrastructure, while still others do not succeed in aligning their process performance management (PPM) efforts with their corporate performance management (CPM). The variety of difficulties suggests that there is not just one solution to the problem. Thus, it appears necessary to systematically analyse the different problem situations in order to be able to design adequate problem solutions.

One of the most serious reasons for failure of PPM initiatives turns out to be the missing ability of organisations to align their business interests in PPM with their IT capabilities [Elbashir et al. 2008]. Because PPM covers such diverse topics as process monitoring technology, the implementation of measurements and controls, and the development of means for improving process execution quality [Grigori et al. 2004], the majority of organisations has not yet accomplished translating it into concerted action. Some, however, have succeeded and it appears valuable to make use of adequate research methods to draw on their experience and knowledge in order to derive more generally applicable rules and designs for PPM implementation [van Aken 2004]. Another promising solution to bridge the business-IT divide appears to be the development of instruments that on the one hand facilitate communication between business and IT, and on the other provide stepwise guidance for jointly improving PPM capabilities.

The above outlined problems motivate the second set of research questions, which is to be addressed by this dissertation (Table 2).


<table>
<thead>
<tr>
<th>No.</th>
<th>Research Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>II.a</td>
<td>What are relevant design factors for the development of PPM instruments in early BPM adopters (represented by manufacturing and service organisations)?</td>
</tr>
<tr>
<td>II.b</td>
<td>How can PPM in early BPM adopters (represented by manufacturing and service organisations) be systematically advanced?</td>
</tr>
</tbody>
</table>

Table 2: Second Set of Research Questions

The research questions of this dissertation are addressed by applying the design science research (DSR) approach. “Design science research is a research paradigm in which a designer answers questions relevant to human problems via the creation of innovative artifacts, thereby contributing new knowledge to the body of scientific evidence” [Hevner, Chatterjee 2010, p. 5]. In concrete terms, this thesis reports findings obtained from the design and evaluation of instruments to support BPM adoption for early and late adopters. The dichotomy of the research questions within both sets of questions thereby reflects the necessity to first analyse a problem before a solution can be properly built and evaluated.

1.3 Contribution and Audience

The main proposition of the thesis at hand is the development of ‘instruments’ that support BPM adopters at different levels of adoption. This raises the question of what is meant by the notion ‘instrument’. The explanation is founded in a brief retrospection on the development of the broader term ‘artefact’ as it took place in the IS and DSR community. The discussion on what typifies an (IT) artefacts has a long history in IS research and started with early works from researchers like Weber [1987]. In general, an artefact represents something that is built by humans, in contrast to something that occurs naturally [Simon 1969]. In the narrower context of DSR, March and Smith [1995] proposed the differentiation of four distinct artefact types: Constructs (vocabulary and language), models (abstraction and representation), methods (algorithms and practices), and instantiations (prototypes and complete IS). The work by March and Smith mainly refers to the differentiation of IT artefacts. However, since DSR aims to purposefully design artefacts that address human and organisational problems [Alter 2006; Hevner et al. 2004], more recent contributions encourage and in fact support the complementary development of artefacts that inform both organisational and IT design [Winter 2008]. However, in the domain of organisational design no commonly agreed upon classification or taxonomy of artefact types has been developed so far. Moreover, it appears that not all artefacts that are being built are palpably attributable to only one
distinct artefact type: Winter et al. [2009] investigate the differences and similarities between the two artefact types model and method and come to the conclusion that in many cases the strict dichotomy cannot be maintained reasonably. In the particular case of this dissertation two types of artefacts are proposed: Maturity models (MMs) and design patterns. Neither of them characterises as pure model or pure method. However, both share the goal to guide early and late adopters of BPM in their respective BPM adoption efforts. Thereby, they qualify as instruments in the way the term is defined by the Oxford English Dictionary (OED): Something that “serves or contributes to the accomplishment of a purpose or end” [OED 2011]. In order to strengthen the means-end character of the proposed solutions and to avoid the generality of the term ‘artefact’, the herein proposed solutions are thus subsumed under the hypernym ‘instruments’.

The instruments that are presented in this dissertation have been developed specifically for two practitioner audiences: Organisations that seek assistance in becoming process-oriented and organisations that seek support in measuring and improving their process performance (cf. section 1.2). While both audiences are represented by a specific group of representatives, that is, hospitals on the one hand and manufacturing and service organisations on the other, the presented instruments may also be useful and relevant to organisations sharing the same respective characteristics: Organisations that are characterised by a very fragmented organisational structure, little experience with flow orientation and a workforce that is strongly focused on maintaining individual power may find the instruments for late adopters useful. By contrast, organisations that are deeply familiar with flow orientation, have shifted their focus from unit to process management and aim to continuously improve their processes’ performance may find the instruments for early adopters useful. This dissertation is also intended for a broad audience in BPM research and DSR. It seeks to provide deeper insights into contingencies that determine the usefulness of BPM instruments and stimulate more research in this particular field.

1.4 Thesis Structure

This cumulative doctoral thesis is organised in two parts: Part A provides an overview of the whole thesis, while part B consists of six research papers that address the research questions in detail.

The first section of part A explains the motivation for this research and provides a detailed problem description. On this basis, both research questions and audience of this
thesis are deduced. Relevant conceptual foundations of this work are presented in section 2, while the chosen research paradigm and research methods are described in section 3. Section 4 gives an overview of the individual contributions and embeds them in the bigger picture of this thesis. Section 5 summarises the research results, presents implications for practice and research and concludes with an outline of opportunities for further research.

Part B constitutes the main part of this thesis consisting of six articles that present the research results in full detail. Four articles have been published resp. are currently in press (contributions C – F) in proceedings of peer-reviewed international conferences and a peer-reviewed edited book, while two articles have been submitted for publication to ranked scientific journals and are currently under review (contributions A and B). Because all publications have been published in or submitted to different academic outlets, articles slightly vary in scope and level of analysis. For a consistent presentation, the format of all contributions has been unified. British English has been chosen as the language style and consistently applied to all articles. Minor grammar and spelling mistakes in the original publications have been corrected and minor editorial revisions have been made. The references of all papers have been consolidated, revised and unified towards a consistent citation format. The layout of some figures and tables has been harmonised. It occurred that original tables employed a smaller font size or otherwise different format and the redesigned tables exceeded the herein given page dimensions. In this case, the table was soundly split and continued on the following page. This document includes a consolidated table of contents as well as lists of figures, tables and abbreviations that span both parts of the thesis and aim to improve readability and traceability. As a result of consolidation, numbering of sections, figures and tables differs from the original publications. A table precedes each contribution that summarises the article’s bibliographical information, that is, title, author(s) and affiliation(s), publication type, year and status, and the correct full citation.
2 Research Foundations

*If I have seen further, it is by standing on the shoulders of giants.*

Isaac Newton

Research is at its heart a cumulative endeavour and all progress that is potentially being made depends and builds on prior efforts by other researchers. This section introduces concepts that have been drawn upon in the course of writing this thesis. At this point only a selection of these foundations is presented: Concepts that are essential for the reader to develop a thorough understanding of this work’s findings and to relate these findings to the existing body of knowledge are introduced in this section. A more detailed description of foundations and related work is included in each of the articles that are presented in full length in part B of this document.

BPM represents the central research phenomenon of this dissertation and is introduced in section 2.1. PPM represents a subfield of BPM that is of particular relevance to early BPM adopters, who already have adopted BPM and are now trying to improve their processes. PPM is introduced in section 2.2. In order to address the problems currently experienced by early and late adopters of BPM, this thesis proposes two types of instruments: MMs and patterns. Relevant foundations of both are presented in sections 2.3 and 2.4 respectively.

2.1 Business Process Management

_Emergence and Definition_

The last two decades saw great interest in BPM as a management concept. Its early foundations had already been laid in the 1920s with the development of scientific management, but it only became entirely practicable with the introduction of IT in the 1980s and 1990s [Bonham 2008; Davenport 1993; Hammer 1990]. Despite the omnipresent interest in the phenomenon, researchers and practitioners have not yet agreed upon a common definition. Following Michael Hammer—one of the concept’s intellectual fathers—BPM is defined as “a comprehensive system for managing and transforming organisational operations” [Hammer 2010, p. 3]. The concept of BPM builds upon the notion of a business process as a series of cross-functional activities that need to be performed in order to collectively achieve a predefined goal [Davenport 1993; Hammer 1990].
Prior Research

From its early days, BPM has attracted a variety of research fields including management research, computer science, mathematics, linguistics, and philosophy, altogether truly characterising it as a “multi-disciplinary ‘theory in practice’ subject” [Ko et al. 2009]. However, not least due to this versatility and interdisciplinarity a successful implementation of BPM is highly challenging. In an attempt to provide guidance for the implementation of BPM, researchers and practitioners have developed various so-called BPM lifecycle models [ABPMP 2009; Mendling 2008; van der Aalst et al. 2003; Weske 2007]. Typically, these models encompass phases like process analysis, design, implementation, enactment, monitoring, and refinement [Mendling 2008; Reijers et al. 2010]. All BPM lifecycle models focus on the process as the central object to be improved [Reijers et al. 2010]. Complementing the work on BPM lifecycle models, another field of BPM research investigates critical success factors for its implementation [Alibabaei et al. 2009; Trkman 2010]. Critical success factors include an active involvement of employees, the development of a process-oriented culture, the definition of process ownerships, and the use of suitable, process-aware IT tools. Success factors name capabilities that are required for an effectual adoption of BPM, but they do not predicate when these capabilities are to be acquired. In an attempt to address this issue, a number of MMs for BPM has been developed recently that assist organisations in becoming more successful with their BPM adoption [Rosemann et al. 2006]. Already being high, the importance of BPM is likely to grow in the future leading to a broader adoption across various industries. However, a number of challenges are still to be addressed.

Challenges and Research Gaps

Current approaches to BPM—be they lifecycle models, analysis techniques or BPM technology—rarely, if ever, consider differences in the types of organisations they are built for. That is, existing approaches are not designed to be adaptable to varying characteristics like domains, profit motives or strategic orientation. In consequence, a number of frameworks, methods and models are too complex or too sophisticated to be used by many organisations. Moreover, “most approaches do not cater for the various stages of experience and embedding of BPM within an organization” [Jeston 2006, p. 59]: Necessary premises are not specified, competencies are falsely taken for granted and maturity paths are not clearly outlined. The mentioned deficiencies have partly provoked restraints in applying these approaches and also induced disbeliefs and misunderstandings about the potential of BPM [Vergidis et al. 2008]. As a consequence,
future BPM research needs to determine the effectiveness of existing approaches and engage in developing instruments that better match specific organisational traits so as to decrease inhibition thresholds and increase usability [Neubauer 2009; Reijers et al. 2010].

2.2 Process Performance Management

Emergence and Definition

Very much like the earlier excitement about BPM [Corea, Walters 2007; Smart et al. 2009], the current hype around PPM is fuelled by enormous practitioner interest. Essentially, PPM represents a subfield of BPM that covers the later phases of the BPM lifecycle, that is, monitoring and refinement. However, due to the fact that only today companies are actually entering these phases, PPM is being discussed intensely just now [Genrich et al. 2008]. The most elaborate definition of the concept that has been proposed so far is provided by practitioners: The Association of Business Process Management Professionals (ABPMP) defines the measurement of process performance as “the formal, planned monitoring of process execution and the tracing of results to determine the effectiveness and efficiency of the process” [ABPMP 2009, p. 22]. The data collected in the measurement process is then “used to make decisions for improving or retiring existing processes and/or introducing new processes in order to meet the strategic objectives of the organisation” [ABPMP 2009, p. 22]. This definition makes it clear that PPM consists of two main constituents: The measurement and the improvement of business process performance. Concepts that have been identified as contributing to either of the two constituents include defining performance metrics, monitoring, controlling and simulating processes, aligning process and enterprise performance, and a number of other concepts [Kueng 2000]. While a broadly accepted understanding of PPM is still pending, there have already been a number of efforts in research and in practice addressing both measurement and improvement of processes performance.

Prior Research

Some of the extant approaches to PPM stem from the business realm and have been developed in organisational and industrial research. Several represent broad strategic management concepts like, e.g., total quality management [Isaksson 2006], six sigma [Snee, Hoerl 2005], lean management [Houy 2005], or business process reengineering [Davenport 1993; Hammer 1990]. Others rather characterise as techniques either to be used in the context of a larger concept or on their own, like process mapping and root
cause analysis [Siha, Saad 2008] or statistical process control. IS research, too, is increasingly engaged with the provision of solutions for measuring and managing process performance and process execution quality [Genrich et al. 2008]. Specific techniques include business activity monitoring, process mining or simulation [Kueng 2000; Powell et al. 2001]. A rather recently introduced concept builds on applying business intelligence (BI) techniques like statistical analysis and data mining for analysing process data. The concept is termed (business) process intelligence (BPI) and is employed to both uncover weaknesses and discover opportunities for business process improvement [Grigori et al. 2004]. While traditionally BI has provided historical, retrospective analyses, in the context of BPI it is used to take the “pulse of the company” [Hall 2004, p. 3] by generating findings based on present-day transactional data. That is, organisations use BI capabilities for tactical and operational process improvements [Elbashir et al. 2008]. Despite the illustrated diversity of available instruments and concepts, various issues have so far not been resolved.

**Challenges and Research Gaps**

A study by Al-Mashari et al. reveals that regarding PPM “organisations are still not competent in integration aspects” [2001, p. 449]. This does not only relate to the integration of business and IT initiatives but also to the integration of process and enterprise performance management paradigms. Neubauer asserts these findings stating that when asked about methods for controlling and improving processes, organisations “feel a lack of appropriate methods for the economic alignment of business processes and systems” [2009, p. 173]. Complementary, van der Aalst et al. [2007] report that despite a growing pressure to improve the efficiency of business processes, organisations are not yet familiar and comfortable with the use of process analysis software and are lacking adequate IT competencies. An empirical study carried out by Kueng et al. [2001] reveals that further problems lie in an unsystematic measurement of business processes, a high time lag in data provision and a complicated access to process performance measurement data. Causes for these problems are unclear responsibilities, the wide dispersion of measurement data, a lot of manual data handling and a low level of IT integration. Future work hence needs to develop instruments that bridge the described gaps and support organisations in their integration efforts. Genrich et al. emphasise that “beyond the availability of powerful tools, it remains critical to understand the business” [2008, p. 10] and to adequately coordinate and align business and IT initiatives in PPM.
2.3 Maturity Models

Emergence and Definition

The development of organisational capabilities and the dynamics of organisational evolution have intrigued both researchers and practitioners since the advent of corporate ventures. Over time, a multitude of theories that aim at explaining and predicting patterns of organisational change has been developed, including life cycle theory, teleology, dialectics, and evolution [Gardner 1965; Van de Ven, Poole 1995]. Especially life cycle theory is closely related to the concept of MMs in that both describe a typical pathway of change based on distinct stages of development [Fraser et al. 2002]. Maturity is typically understood as a “measure to evaluate the capabilities of an organisation” [Rosemann, de Bruin 2005, p. 1], while MM are defined as instruments for systematically documenting and guiding the development of organisations based on anticipated, desired or archetypal evolution paths [Becker et al. 2009].

Prior Research

MMS have been developed for a broad range of subjects, e.g., technologies and/or systems [e.g., Popovic et al. 2009], processes [e.g., Rosemann, de Bruin 2005] or people [e.g., Curtis et al. 2010]. The basic components of a MM are a number of maturity levels (archetypal states of maturity), a number of dimensions (capability areas) and an evolution path that can be staged, continuous or dimension-based. Staged MMs require all elements of one distinct level to be achieved, whereas continuous models allow characteristics to be scored at several levels [Fraser et al. 2002, p. 224]. Dimension-based MMs define individual maturity levels for each dimension and determine the overall maturity by aggregating the maturity levels of the individual dimensions [van Steenbergen 2011, p. 109]. Current literature suggests two approaches for developing MMs: A top-down and the bottom-up approach [Lahrmann et al. 2011a, p. 177; Mettler, Rohner 2009]. While the top-down approach specifies that levels be defined first and thereafter completed with characteristics describing the different dimensions, the bottom-up approach prescribes that dimensions and characteristics be derived first and then assigned to different maturity levels. MMs may offer different types of recommendation, that is, descriptive, prescriptive or comparative information. Descriptive MMs are diagnostic in nature and portray evolution patterns empirically observed in a number of organisations at a certain point in time, whereas prescriptive models offer guidance for capability improvement and comprise detailed counselling. Comparative models, in turn, provide means for contemplating the own with other organisations’ maturity [van Steenbergen 2011, p. 113]. Likewise may the intention to make use of a
MM either be induced by the goal to determine the own organisation’s position or the search for guidance on how to improve certain capabilities. A third motive may be the aspiration to match the own capability level with that of peers [Fraser et al. 2002, p. 247]. While the popularity of MMs has increased largely in the fields of IS and DSR recently, some criticism remains, which provides opportunities for further research.

**Challenges and Research Gaps**

Repeated criticism pertains to a lack of rigour regarding the development of MMs. McCormack et al. remark that most extant models rely “upon anecdotal evidence and case studies describing success stories” [2009, p. 793] and lack an adequate theoretical basis. Kohlegger et al. support this finding stating that many MM developers “simply build on their predecessors without much thinking about the appropriateness of their design decisions” [2009, p. 51]. The development process is subject to much arbitrariness and subjectivity in defining both dimensions and maturity levels and to date reliable and comprehensible MM development techniques represent an exception [Lahrmann et al. 2011a, p. 177]. Another frequently raised objection concerns the inconsiderate use of extant models in new application domains and the associated negligence of organisation- and industry-specific characteristics [Mettler, Rohner 2009, p. 3]. Existing BPM MMs, which are especially relevant for the thesis at hand, are criticised for being almost identical and hardly differing with regard to their scope, domain focus, and audience [Plattfaut et al. 2011, p. 328]. Moreover, a number of existing MMs fail to provide an appropriate balance between the usually complex reality they aim to model and overly simple maturity concepts. Future research needs to pick up on these issues by being more rigorous in the process of MM design and by clearly defining principles of form and function for MMs as design products [Pöppelbuß, Röglinger 2011].

**2.4 Design Patterns**

**Emergence and Definition**

Within the IS domain design patterns (also short ‘patterns’) became prominent in the field of object-oriented programming [Gamma et al. 1995]. Therein a pattern describes a pair of a regularly recurring problem and a respective general solution. The general solution is not meant to solve one specific problem, but to serve as a template that can be reused for advancing the problem solving process for a certain problem class.
Prior Research

Over time the value of patterns has been recognised by other domains like organisational research, in which patterns are employed for reusing existing knowledge. So called ‘organisational patterns’ are “abstract organisational design proposals that can be easily adapted and reused [and] that represent solutions to specific problems within an organisation” [Persson, Stirna 2002, p. 182]. Organisational patterns also connect problem and solution classes, while reflecting the context and the way the pattern should be applied. Like conceptual models, patterns represent an abstraction of the real world and like reference models they possess a certain normative character [Casati et al. 2000]. In order to use a pattern in a specific context it needs to be adapted accordingly. A well-known example for patterns in the IS domain are the business-IT alignment patterns proposed by Henderson and Venkatraman [1993]. In the DSR domain Vaishnavi and Kuechler provided a prominent example with their seminal book on DSR methods and patterns [Vaishnavi, Kuechler 2007].

Challenges and Research Gaps

Design patterns in object-oriented programming follow a certain documentation standard; they are perceived as templates or blueprints that can be reused with rather little effort. Organisational patterns on the contrary do not follow a commonly accepted modelling or representation standard and lack a formal foundation. Thus, they are more difficult to reuse or instantiate in new settings. Despite Vaishnavi and Kuechler saying that patterns are “almost never presented as a set of strict rules because precision always limits applicability” [2007, p. 58], it adds rigour and enhances the comprehensibility if new patterns are either modelled using a known modelling technique or are based on extant and already well-accepted patterns. Moreover, though patterns are quite frequently used in IS and organisational research it is still challenging to determine the “cost/benefit ratio of patterns objectively” [Wendorff 2001, p. 79]. Consequently, future research on the one hand needs to work on a formal foundation and on the other provide scientific evidence that design patterns actually improve development processes.
3 Research Design

Consequently we as designers, or as the designers of design processes, have had to be explicit as never before about what is involved in creating a design and what takes place while the creation is going on.

Herbert A. Simon

Crucial for high quality research is not only the selection of an interesting and relevant problem, but also the choice of a suitable and rigorous research design for investigating this problem. As the overall objective of this research consists in developing useful instruments for supporting BPM implementation at different levels of adoption, the DSR approach is chosen (cf. section 1.1). Section 3.1 briefly introduces the approach in general terms, while section 3.2 describes how distinct research methods have been applied for addressing the individual research questions of this thesis.

3.1 Design Science Research

The IS discipline has long been debating on the relevance of its research outcomes to the practitioner community [Benbasat, Zmud 1999; Saunders 1998; Srivastava, Teo 2005]. Yet, while researchers concur in that quality IS research may not neglect relevance in favour of rigour [Winter 2007], only few existing approaches emphasise relevance as an essential research goal. One of these approaches is the much-discussed DSR approach.

DSR has its roots in constructing disciplines like engineering and architecture. It aims to answer “questions relevant to human problems via the creation of innovative artifacts” [Hevner, Chatterjee 2010, p. 5]. The approach is on the one hand concerned with reflecting on and methodising the design process (design science (DS)), and on the other with rigorously building and evaluating relevant artefacts (design research (DR)) [Baskerville 2008; Winter 2008]. Its primary objective to solve problems distinguishes DSR from behavioural research, which is on the contrary concerned with exploring and understanding unexplained phenomena: Through developing and testing theories, behavioural research seeks for truth as opposed to utility. However, while pursuing distinct goals, the two paradigms are complementary in nature [Hevner, Chatterjee 2010]. Behavioural theories “inform researchers and practitioners of the interactions among people, technology, and organizations” [Hevner et al. 2004, p. 76]
and thereby support the process of designing and evaluating design artefacts. The actual conceptualisation and development of relevant problem solutions, however, represent the exclusive goal of the DSR approach.

At the heart of any research endeavour—be it design-oriented or behavioural—stands the research process [Nunamaker Jr et al. 1991]. It encompasses a sequence of steps in which one or more research methods are applied. Pursuing “improvement research” [Vaishnavi, Kuechler 2007, p. 11] the DR process differs from the one traditionally applied in behavioural research. Many authors have contributed to developing a commonly accepted line of action for the DR process [Peffers et al. 2007; Rossi, Sein 2003; Vaishnavi, Kuechler 2007]. While small differences still exist, all approaches agree in that a rigorous DR process should generally encompass the following phases. DR research begins with the identification, definition and motivation of the research problem, commonly by means of explorative research methods like surveys. Based on an accurate understanding of the problem, the objectives of a possible solution are derived. The core of the DR process is concerned with the construction of the solution. This involves the transformation of the previously defined objectives into tangible solutions or solution fragments [Winter 2008]. When the development phase is completed, an evaluation of the utility of the proposed solution follows, for instance by use of metrics, case studies or logical reasoning. As design is inherently an iterative search process [Simon 1969], returning to earlier phases in the process is not only possible, but in fact encouraged.

The dissertation at hand is primarily attributable to the DSR paradigm, as it pursues the goal to develop instruments that support organisations in improving their BPM initiatives at different levels of BPM adoption. Notwithstanding, behavioural research has an important role in this work as will be outlined in the subsequent section.

3.2 Research Methods

Ranging from modelling grammars over management methods to full-scale IS the variety of possible outputs from DR is vast (cf. section 1.3). Just as huge is the spectrum of potential research methods that may be applied in the DR process. Some advice on the selection of adequate research methods for conducting rigorous DR has for example been provided by Vaishnavi and Kuechler [2007]. However, as on the one hand the design of new and innovative artefacts is highly individual and on the other the diversity of output types basically infinite, there are no strictly defined standards to adhere to. This section introduces the qualitative and quantitative research methods and analy-
Part A: Research Design

Research Question I.a

Research question I.a asks for the way BPM affects organisational performance in late BPM adopters (represented by hospitals). In order to answer this question, a causal model is developed proposing hypotheses on the effect of process orientation on different dimensions of internal and external hospital performance. The validity of the proposed hypotheses is tested using structural equation modelling (SEM). SEM originated from the social sciences and is used for analysing cause-effect relationships between latent constructs [Hair et al. 2011]. The partial least square (PLS) approach is one approach to SEM that is particularly suitable if the causal “relationships are loosely recognized, and the objective is the discovery of relationships” [Hair et al. 2006, p. 732]. In the broader context of this thesis, the PLS-based analysis of the proposed model does not only answer research question I.a, but also provides justification for the development of an instrument that supports hospitals in becoming more process-oriented. Given the to date broad lack of instruments for this purpose (cf. section B.2.2) and the attested positive effect of process orientation on a hospital’s competitiveness and organisational performance (cf. section A.5), the development of such instrument appears not only justified but both necessary and desirable.

Research Question II.a

Research question II.a asks for relevant design factors for PPM artefacts in early BPM adopters (represented by manufacturing and service organisations). Since, in this case, organisations struggle advancing their PPM approach despite the availability of several suitable instruments, it is necessary to plunge deeper into the nature of the underlying problem. For this purpose, contribution C proposes two patterns that are subsequently briefly sketched. In order to achieve a deeper understanding of a given problem situation, a quantitative questionnaire-based investigation is proposed. The approach commences with the development of a questionnaire that broadly covers the knowledge base of the area under investigation. Thereon, the questionnaire is to be distributed to a population sufficiently large and representative to establish a reliable impression of the problem situation. In the first analysis strategy, the survey participants are asked only to answer the questionnaire as to how they conceive the current situation within their organisations, while the second analysis strategy also includes the investigation of the

---

1 The full description of the proposed approach is presented in section C.3.
desired situation. Actual data analysis begins with an exploratory factor analysis (EFA). In both analysis strategies the EFA serves the identification of a number of relevant and mutually independent factors that describe the problem situation. However, while the first analysis strategy is restricted to the problem situation, the second also analyses factors describing the desired situation. Both analysis strategies pursue with a cluster analysis, which serves the purpose of identifying archetypal problem classes. Again, the second analysis strategy extends the analysis and also determines typical classes of desired solutions. Both strategies conclude with an interpretation of the identified clusters. In order to answer research question II.a, article C applies the first analysis strategy and article D the second. In such way, distinct problem classes and a number of relevant design factors for PPM instruments are identified (cf. section C.3.2.5 and section D.4.2).

Research Questions I.b and II.b

Research questions I.b and II.b ask for instruments that systematically advance BPM in late BPM adopters and PPM in early BPM adopters respectively. Both types of BPM adopters appear to face difficulties in developing road maps for their respective endeavours—late BPM adopters mostly due to their unfamiliarity with the BPM concept and little experience with carrying out organisational change, and early BPM adopters largely due to alignment problems between business and IT in their PPM initiatives (cf. section 1.2). MMs offer strong methodological support for guiding organisational improvement efforts, but have in recent literature frequently been criticised for not being theoretically well-founded and rigorously built (cf. section 2.3). An approach that has proven eligible for rigorously building MMs, is the Rasch algorithm [Dekleva, Drehmer 1997; Lahrmann et al. 2011a]. The Rasch algorithm is a questionnaire-based quantitative analysis technique that in the context of maturity modelling facilitates bottom-up model development (cf. section 2.3). The fundamental idea is that each questionnaire item represents a particular level of evolution regarding the object of maturity assessment. The algorithm presumes that responses to questionnaire items depend on a latent respondent characteristic that represents certain knowledge or a specific capability. It is based on the assumption that entities that are more developed are more likely to master all items, while only the easier items are presumed to be reached by all surveyed entities [Bond, Fox 2007]. By counting the answers that indicate the presence of capabilities, the algorithm calculates two scores: One for the difficulty of items and one for the ability of the surveyed entities. Both scores are measured on the same interval scale, which allows for estimating the likeliness, with which a certain entity masters a certain item. In this way, the Rasch algorithm allows for the
inductive allocation of items onto maturity levels based on the measurement of item
difficulty as well as the assessment of surveyed entities based on their capability level
[Dekleva, Drehmer 1997]. Tailoring the Rasch algorithm for MM development re-
quires some slight modifications to the original model: Five-tired Likert scales are em-
ployed instead of the originally proposed dichotomous scales, because rating scales
have a stronger expressive power. Moreover, subsequent to the Rasch analysis, cluster
analysis is used to avoid subjectivity in defining maturity levels. Both contributions B
and F employ the Rasch algorithm for MM development. Thereby, they not only pro-
pose answers to research questions I.b and II.b respectively, but also fulfil the re-
quirement of following a rigorous and reliable artefact construction process.

Research Question II.b

Also addressing research question II.b contribution E applies the multiple extracting
case study method originally proposed by van Aken [2004]. Case studies are a fre-
quently used research method in the study of IS phenomena [Palvia et al. 2004]. They
allow the researcher to study a research phenomenon directly as it is perceived by the
subjects involved, to learn about the state of practice, and to understand real-world
processes and decision making. The extracting multiple case study method is “a kind
of best-practice research [that] is aimed at uncovering technological rules as already
used in practice” [van Aken 2004, p. 232]. This exploration of and reflection on
knowledge and skills developed in practice is a forceful research activity and one that
has led to a number of powerful technological rules and influential design theories
[Gregor 2008]. In contribution E this variant of the case study method is chosen to
analyse the rich body of experience and tacit knowledge on how to align business re-
quirements and IT capabilities in the context of PPM. The multiple-case design allows
for cross-case analysis as well as generalising and positioning the findings [Benbasat
et al. 1987]. Ultimately, contribution E proposes four patterns of business-IT align-
ment in PPM together with a set of contingency factors that determine the usefulness
and applicability of each pattern.

Table 3 provides an overview over the research methods and analysis techniques em-
ployed to answer the research questions of the dissertation at hand.

<table>
<thead>
<tr>
<th>Research Question</th>
<th>Contribution</th>
<th>Research Methods and Analysis Techniques</th>
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<tbody>
<tr>
<td>I.a</td>
<td>A</td>
<td>Partial Least Squares (Structural Equation Modelling)</td>
</tr>
<tr>
<td>II.a</td>
<td>C, D</td>
<td>Exploratory Factor Analysis and Cluster Analysis</td>
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## Part A: Research Design

<table>
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<th>Research Question</th>
<th>Contribution</th>
<th>Research Methods and Analysis Techniques</th>
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<tr>
<td>I.b, II.b</td>
<td>B, F</td>
<td>Rasch Algorithm and Cluster Analysis</td>
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<tr>
<td>II.b</td>
<td>E</td>
<td>Multiple Extracting Case Study Method</td>
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_Table 3:_ Research Questions, Employed Research Methods and Analysis Techniques
4 Research Results

The original idea makes design distinctive, function makes it work and quality adds value.

Serge Zuev

At its heart, this thesis consists of six individual pieces of research that have been published in and submitted to academic outlets and are presented in full length in part B of this document. All findings presented in this dissertation result from research that has been conducted over the past two years. The order of the papers does not reflect the actual timeline of their publication. Instead, articles have been rearranged depending on their contribution to answering the guiding research questions of this dissertation. Section 4.1 embeds the individual research findings of each contribution in the bigger picture of this thesis. Section 4.2 introduces the findings addressing the first set of research questions, that is, how BPM may contribute to improving organisational performance of late BPM adopters (represented by hospitals) and how the advancement of BPM in late adopters can be systematically supported. Section 4.3 presents the findings addressing the second set of research questions concerning early BPM adopters (represented by manufacturing and service organisations). All findings are presented by means of a brief synoptic summary of each contribution.

4.1 Instruments for Late and Early BPM Adopters

The work presented in this dissertation is motivated essentially by two observations: On the one hand, despite a high and—in fact—still increasing popularity of BPM, the degree of its adoption varies significantly [Neubauer 2009; Reijers et al. 2010]. On the other, regardless of a number of reported success stories, most organisations still experience severe difficulties at various stages of its implementation [Bandara et al. 2007; Sadiq et al. 2007]. In view of these facts, the thesis at hand has as its goal the development of instruments that support both early and late adopters of BPM at their respective stages of BPM adoption. For pursuing this goal, the thesis follows a DSR approach (cf. section 1.2). Pursuing DR means following a defined process (cf. section 3.1). This process is initiated by the identification of a certain need, which is grounded in a deep understanding of the problem and a proper justification of the value of a solution. The solution’s concept and its objectives are inferred rationally from the problem description. Subsequently the solution is developed and evaluated. Figure 1 visu-
alises which part each contribution captures in the global research process of the thesis. In accordance with the dichotomy of this work’s audience, the figure is subdivided into two areas that cover the articles contributing to the development of instruments for late BPM adopters and early BPM adopters respectively.

![Supporting Different Levels of BPM Maturity. Instruments for Early and Late BPM Adopters](image)

**Figure 1: Framework of Contributions**

The need for and justification of a solution for hospitals as late BPM adopters as well as a first conceptualisation of the proposed instrument are addressed in contribution A. A deeper and theoretically well-founded conceptualisation as well as the actual development and evaluation of the instrument are presented in contribution B. Contribution

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2 For the purpose of greater clarity the assignment of each article to one or more phase(s) is made based on its primary contribution to the global research process.
C pursues an in-depth analysis of current problem situations as they are found in manufacturing and service organisations as early BPM adopters. Based on the insights gained in contribution C, contribution D elaborates relevant design factors for PPM instruments. Both contribution E and F propose and evaluate different instruments to systematically advance PPM in early BPM adopters.

Subsequently, each publication is briefly summarised including an overview of its respective motivation and findings as well as each articles’ contribution to this work’s research questions. In order to avoid redundancy with the complete articles presented in part B, each summary is restricted to one and a half pages.

4.2 Late Adopters

4.2.1 Contribution A – The Performance Impact of Process Orientation in Hospitals: Theoretical Model and Empirical Test

Motivation

As has been briefly motivated in section 1, hospitals qualify as late if not to say very late BPM adopters. In particular due to the—until lately—remarkably low level of competition and the full reimbursement of costs, hospitals felt basically no need for implementing means to increase their productivity. However, in the light of recent global health care reforms, which begin to seriously threaten their long-term survival, hospitals experience an enormous institutional pressure. This newly experienced pressure causes them to invest heavily in process management and improvement efforts.3 Contribution A takes the just described situation as an opportunity to empirically test on the one hand whether the often cited benefits of process orientation and management also apply for hospitals (as the representatives of late BPM adopters), and on the other how process orientation and process management affect internal and external hospital performance dimensions.

Findings

The study employs the balance scorecard and the logic inherent in the dynamic capability theory to test the direct and indirect effects of process orientation on internal per-

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3 The term ‘BPM’ is primarily used in the business context. However, the notion ‘business’ process management is not considered adequate in the health care context, so that in contributions A and B the notion of BPM has been substituted by the terms ‘process orientation’ and ‘process management’. Moreover, process orientation and process management are used interchangeably in the context of this dissertation. The difference in wording is a result of individual publishing.
formance (specified via ‘operational efficiency’, ‘people’ and ‘clinical quality’) and on external performance (specified via ‘patient satisfaction’ and ‘financial performance’).

The analysis of data from 145 clinical and administrative managers of all acute somatic hospitals in Switzerland that are affected by the new regulations resulted in the following findings. ‘Process orientation’, defined as “the degree to which a hospital thinks and works truly flow-oriented across all clinical and support functions and is committed to continuous improvement” (cf. section A.3), is found to positively affect operational efficiency, people and clinical quality. Explaining more than 50 percent of the variance each, process orientation turns out to be a valid predictor for the increase in operational efficiency and clinical quality respectively. Surprisingly, the direct effect of process orientation on people is found to be by far the strongest, indicating that documenting processes, describing expected progress and outcome, reducing functional borders, and supporting continuous improvement increases ambition, job satisfaction and the level of competence of the hospital workforce. Moreover, the analysis reveals that process-oriented work also positively affects the two major stakeholder groups of hospitals, that is, the state or private owner and the patients. Decreased lengths of stay and waiting times (operational efficiency) and a higher motivation and satisfaction in the workforce (people) are found to increase financial performance. Fewer complications and lower rehospitalisation rates (clinical quality) and a higher motivation and satisfaction in the workforce (people) in turn positively affect patient satisfaction. In summary, the hypothesis that process orientation strengthens a hospital’s competitive advantage and increases its overall level of performance is strongly supported.

Contribution

In the more general context of this dissertation, article A contributes to answering research question I.a and does this as follows. Whereas the benefits of BPM for manufacturing and service organisations in highly competitive industries have been reported in several quantitative and qualitative studies, such evidence is largely missing for the hospital sector [Vera, Kuntz 2007]. The findings of contribution A confirm the positive impact of process orientation on both competitiveness and organisational performance of hospitals. Given the current difficulties that hospitals experience with adopting a comprehensive process management approach these findings substantiate the need for instruments that support hospitals in this endeavour, while taking their specific organisational characteristics into account.
4.2.2 Contribution B – Competitiveness via Process Management – A Theoretically Grounded Maturity Model for Hospitals

Motivation

The traditional organisational structure of hospitals resembles “a collection of professional functions” [Gemmel et al. 2008, p. 1209] that are brought together to cure patients. Over time, this organisational structure together with dubious incentive systems and an intense shielding of medical groups has caused hospitals to evolve into loosely coupled sets of specialised silos [Vera, Kuntz 2007]. This silo structure in turn has provoked the development of disparate local goals, restricted cross-departmental communication and long delays in the treatment process. All of these factors are strongly counter-productive for the adoption of process management, but need to be considered when developing an instrument specifically designed for the introduction of process management into hospitals. The development of such an instrument is the goal of contribution B.

Findings

As has been shown in article A, process orientation and management contribute positively to the competitiveness and performance of hospitals. This fact together with a broad lack of instruments that have been designed purposefully to support the implementation of process management in hospitals (cf. section B.2.2) motivated the development of a MM with this exact purpose in contribution B. MMs have been introduced in section 2.3 as powerful instruments for guiding change in organisations. In order to comprehensively address the above mentioned specific characteristics of hospitals first a maturity concept is developed based on established theory. The concept draws on socio-technical theory and organisational culture theory. Socio-technical theory proposes that effectively and efficiently designing organisational systems requires taking into account the social and the technical subsystem, which also adequately reflects the bipartite nature of the BPM concept. Due to the fact that in particular organisational structures and values as well as effectual communication capabilities are largely obsolete in hospitals, the social system is further refined by the concepts provided in the organisational culture theory. In summary, the suggested maturity concept consists of the five dimensions culture, strategy, structure, practices, and IT. The questionnaire-based Rasch algorithm adapted for MM construction (cf. section 3.2) is applied to develop the model. The data set comprises 145 questionnaires collected from managers of all acute somatic hospitals in Switzerland. The resulting staged MM consists of five maturity levels: ‘Encouragement of Process Orientation’ (level 1), ‘Case-by-Case
Part A: Research Results

Handling’ (level 2), ‘Defined Processes’ (level 3), ‘Occasional Corrective Action’ (level 4), and ‘Closed Loop Improvement’ (level 5). The model clearly shows a shift from a phase that primarily addresses ‘soft’ culture- and strategy-related issues in the first two levels to a phase that addresses the more tangible and implementation-related issues in the higher maturity levels. A first interview-based evaluation of the model reveals that it is of particular relevance and utility for the intended audiences—clinical and administrative hospital managers—due to the following reasons. The interviewees attest the model a well-chosen language, an appropriate overview functionality on an adequate level of detail, an aptitude as a tool for self-assessment and—due to the fact that the model represents an ‘empirically validated journey towards process management’—also normative quality.

Contribution

The MM proposed in contribution B addresses research question I.b. Not least due to the—until recently—low level of competition in their sector, hospitals have for a long time basically endured their inefficiency and only responded to delays “by adding resources” [Haraden, Resar 2004, p. 3]. Moreover, hospitals characterise as rather inexperienced in organisational transformation and are only rarely familiar with process-oriented management concepts. Considering these special characteristics, contribution B proposes a model that is in particular useful for hospitals as late adopters of BPM. It provides guidance not for the whole BPM endeavour, but for the very first steps in becoming truly process-oriented. A comparatively low complexity combined with a high usability turn out to make it very attractive for its intended users.

4.3 Early Adopters

4.3.1 Contribution C – Process Performance Management – Identifying Stereotype Problem Situations as a Basis for Effective and Efficient Design Research

Motivation

Over recent years organisations from the manufacturing and service industries have made noticeable progress in their efforts to become a ‘process enterprise’. They have torn down functional walls, combined related activities and eliminated wasteful ones, aligned information and work flows, and defined process ownerships [Bandara et al. 2007]. Having processes and process ownerships in place, they now need to move further towards an active management of processes, including continuous measurement
and improvement of process performance [Hammer 2010]. However, being accustomed to unit-based performance management, not all companies accomplish this paradigm shift smoothly. Quite the opposite, many organisations struggle developing a process-oriented performance management approach, which has motivated the research presented in contribution C.

**Findings**

An accurate and detailed problem analysis is essential at the beginning of any effort to develop and design new solutions. In order to systematically analyse and deeply understand the type of problems that organisations experience with implementing continuous PPM, contribution C employs a combination of two exploratory questionnaire-based research methods (cf. section 3.2). Based on a comprehensive literature analysis a questionnaire is developed that includes items related to BPM, BI and performance management so as to fully reflect the multidisciplinarity of PPM. The analysis is performed on 45 questionnaires collected from BI specialists and executives working on both the IT and the business side. The first step in the analysis reveals that problems experienced by organisations that currently try to establish a consistent PPM approach, can be described by means of five factors. These factors are termed ‘Broad plan-do-check-act (PDCA)-based use of PPM measures’, ‘BPM Maturity’, ‘PPM Process Diffusion’, ‘BI-enabled, Integrated PPM’, and ‘High-quality Information Base’ (cf. Table 16). The second step aims to disclose whether typical problem classes can be identified among the surveyed companies. Four distinct problem classes are identified (cf. Figure 9). ‘PPM Beginners’ lack essentially any premise that could be leveraged as a basis for PPM—neither from a BI perspective nor from a BPM perspective are fundamental concepts in place. ‘Information Quality-driven BPM Traditionalists’ have both a high BPM maturity and also a high-quality information base, but have not yet aligned the two so as to measure and improve process performance. ‘KPI Enthusiasts’ are highly ambitious regarding the number of process performance metrics they employ, but lack a sufficient BPM maturity. ‘PPM Experts’ finally appear to master the integration of their BI and BPM capabilities into a consistent PPM approach. Nonetheless, they, too, are lacking continuous improvement capabilities.

**Contribution**

Taking the broader perspective of the whole dissertation, paper C contributes to answering research question II.a. By means of a systematic analysis of PPM problem situations, a first step towards relevant design factors for useful PPM instruments is made: The identified problem classes provide detailed insights into what difficulties
organisations that are currently engaged in PPM initiatives experience. Moreover, they supply first hints towards design factors for future solutions by disclosing deficits in the current approaches. However, in order to more accurately carve out these design factors, a more in-depth study should analyse not only current, but also intended approaches to PPM so as to encounter the assumption that all organisations are striving for one ideal target solution. This fact motivates contribution D.

4.3.2 Contribution D – Process Performance Management – Illuminating Design Issues through a Systematic Problem Analysis

Motivation

A number of recent quantitative studies attest that organisations currently struggle establishing an integrated end-to-end quantification and improvement of process performance and process outcomes [Neubauer 2009; Vergidis et al. 2008; Wolf, Harmon 2010]. However, these studies neither truly engage in identifying the underlying reasons for the experienced difficulties, nor do they propose possible solutions for their elimination. Contribution D addresses this lack by analysing current and desired approaches to PPM, carving out their characterising factors and identifying the most popular development trends.

Findings

Contribution D builds on and extends the findings presented in contribution C: Besides characterising the current approaches and their respective weaknesses, it also identifies factors describing the desired approaches to PPM and aims to distinguish common types among these. In so doing, contribution D employs the same questionnaire but an extended set of data covering not only as-is but also to-be values for each questionnaire item. The research methodology also remains the same but is applied twice, first to the as-is and subsequently to the to-be data (cf. section 3.2). As the current approaches have already been described in the preceding section, this section focuses on the additional findings. Four distinct factors are found to describe desired approaches to PPM. These factors are termed ‘Scope and Quality of KPI Measurement’, ‘PPM Coverage of Core Processes’, ‘BPM Maturity’, and ‘Integrated, Methodologically Sound PPM’. The second step of the analysis results in four different types of PPM approaches that organisations strive for in the future (cf. Figure 11). The ‘Measurement-focused Approach’ emphasises the use of a broad set of KPIs for high-quality decision making. Organisations that intend to make use of this approach use PPM in an ad-hoc manner, but do not stress a systematic alignment with their CPM approach.
By contrast, the ‘BPM-biased Approach’ postulates a high consistency of processes across functions and systems, but neglects basically all kind of measurement-based process improvement. The ‘Selective Approach’ in turn features well-documented processes and an integrated and systematic process measurement, but applies PPM only to a limited set of processes. Ultimately, the so called ‘Full-scale Approach’ encompasses the use a manageable number of process performance metrics, primarily for the measurement of core processes. A consistent process orientation and a sound alignment of PPM efforts with CPM objectives are considered essential. For identifying on the one hand the most popular development trends between current and desired approaches and on the other hand factors that require the most improvement, an item-based migration analysis is accomplished. The analysis reveals that in a number of organisations business and IT initiatives in PPM have largely drifted apart and have caused a considerable business-IT divide. However, the majority of organisations aim to address this problem and implement a holistic well-aligned and integrated PPM approach in future. Contribution D concludes with a brief validation of the findings from the quantitative analysis by means of three case studies.

Contribution

Research question II.a of this dissertation asks for design factors that are relevant for the development of effectual PPM instruments for early BPM adopters. In combination, contribution C and D provide a copious answer to this question. Broadening the research findings presented in contribution C, the results of contribution D reveal that a considerable number of organisations currently suffers from a severe misalignment of business and IT initiatives in the context of PPM, but strives for a full-blown and sophisticated approach. The detailed item-based migration analysis unveils that, in order to overcome the undesirable parallelism of a strong process orientation and a strong but isolated IT infrastructure, organisations need to conjointly develop PPM business and IT capabilities and enhance these through a continuous improvement process. The fact that business-IT alignment turns out to be a big challenge in the phase of establishing process measurement and optimisation is not entirely surprising. Following Van Looy [2010] the introduction of new tools that are required to holistically implement process measurements and controls, plays a major role in this context. Inevitably, these tools do not completely comply with the individual PPM approach chosen by an organisation and thus first need to undergo a process of adaptation and user acceptance building.
4.3.3 Contribution E – Exploring Patterns of Business-IT Alignment for the Purpose of Process Performance Measurement

Motivation

The analysis of current and desired PPM approaches in contributions C and D has revealed that especially the lack of business-IT alignment in PPM represents a constant source of trouble. However, some organisations have taken up the challenge and started developing their individual approaches towards a holistic PPM. Contribution E draws on the experiences made by six different companies from the manufacturing and service industries in order to derive more generally applicable rules and designs for PPM implementation. Since, in the PPM context, IT primarily comes into play for the measurement of performance, the focus of this contribution lies on measurement aspects.

Findings

The findings of contribution E are generated using the extracting multiple case study method (cf. section 3.2). Semi-structured interviews with process and performance analysts, quality managers, and BI professionals are the primary method for data collection and aim to investigate the business strategy and background that form the basis for PPM, the IT systems and capabilities used to support PPM, the way business needs and IT capabilities are matched, and enablers and inhibitors of the respective approach. Employing the business-IT alignment model proposed by Henderson and Venkatraman [1993] as a conceptual lens for case analysis, a framework is derived that systematises four different alignment patterns for PPM (cf. Figure 14). Two contingency factors are identified that determine the derived patterns: The primary driver behind the PPM initiative (business pull or IT push) and the organisational perception of PPM technology as either an enabler or inhibitor of the initiative. It turns out that four out of the six analysed companies consider PPM technology as a strategic enabler for an effectual PPM implementation. Three of these organisations started their PPM initiatives out of a business need. These three prove to be most successful in their PPM endeavours, largely because the goals pursued with the PPM approach match those of the overall corporate strategy. Particularly unsuccessful is one approach that characterises as an IT or technology push, rather than a business pull. The primary driver behind this initiative is the availability of a strong technology for process performance analysis. However, because the corporate strategy of the company emphasises product innovation rather than efficiency improvement, the approach never advanced from its status as a pilot study. Contribution E concludes with a discussion on both the conditions
under which the patterns are most suitable and the enablers and inhibitors that are to be considered with each.

**Contribution**

Research question II.b of this thesis asks for solutions that support the systematic improvement of PPM approaches in early BPM adopters. It is broadly acknowledged that the assumption ‘one-size-fits-all’ or—in other words—one solution solves all problems, is outdated [Winter 2011]. A solution is the more useful and attractive for its potential users the closer it is to the specific problem the users suffer from. Consequently, in order to increase the usefulness and attractiveness of a solution, the developer should identify contingency factors that describe different problem situations and build solutions that take these contingencies into account. Contribution E proposes two contingency factors and four PPM business-IT alignment patterns suitable under different constellations of these contingency factors. Complementing the identified patterns with enablers and inhibitors, contribution B provides a valuable instrument for organisations to decide on an approach that best suits their individual organisational settings. Thereby, article E contributes to answering research question II.b.

### 4.3.4 Contribution F – Managing Process Performance to Enable Corporate Sustainability – A Capability Maturity Model

**Motivation**

Contributions C and D as well as other quantitative and qualitative studies [Vergidis et al. 2008; Wolf, Harmon 2010] have affirmed that organisations find it difficult to translate the multiple components of PPM into concerted action. Ignorance prevails about when to acquire which capabilities and how to match and integrate the different parties involved in the development of a consistent approach. Thus, an instrument is required that on the one hand provides guidance for establishing an effective approach to PPM and on the other serves as a common communication platform for the involved stakeholders. The development of such an instrument is the goal of contribution F.

**Findings**

In prior use cases, MMs have proven to be serviceable instruments for systematically guiding the development of organisations based on archetypal improvement paths (cf. section 2.3). However, MMs are frequently criticised for not depicting cause-effect relationships, which may lessen the value for their later users. In order to address this criticism, IS success models and their underlying theory are employed for conceptual-
ising PPM maturity. With regard to content the model covers three dimensions: BPM as the business-related foundation of PPM, BI as the information-technological basis for PPM, and PPM itself to cover process-specific measurement and improvement capabilities. A comprehensive literature analysis serves the deduction of items for a questionnaire, which in turn is used as the basis for model development. For constructing the model, the questionnaire-based Rasch algorithm adapted for MM construction (cf. section 3.2) is used. The data set comprises 49 questionnaires collected from BI specialists as well as process and performance analysts from manufacturing and service companies. The resulting MM consists of five maturity levels: ‘PPM infant’ (level 1), ‘PPM child’ (level 2), ‘PPM Teenager’ (level 3), ‘PPM Adult’ (level 4), and ‘PPM Sage’ (level 5). Level 1 is characterised by a corporate-wide commitment to BPM and the intention to adopt process orientation as a central paradigm. Process owners are appointed and assigned adequate decision-making authority. Source systems for process monitoring and controlling are mainly transactional and not yet properly integrated. The scope of process performance measurement is limited to core processes. Organisations at level 2 have an organisational unit in place that is dedicated to the strategic management and central coordination of business processes. The selection of process instruments is guided by the overall business strategy and thus aligned with the organisation’s strategic objectives. On level 3, organisations have also centralised the PPM function. Enhanced system integration enables process consistency across functional and system borders and the integration of BI into operational processes makes process performance data available to all staff levels. Level 4 is characterised by a further manifestation of the process paradigm. At this stage, process ownership is not just a role but an established organisational entity with significant authority. A comprehensive set of indicators enables the organisation to monitor and control its performance actively. On level 5 PPM initiatives are aligned with the CPM approach so as to directly reflect the overall organisational goals and translate them into immediate action. At this stage, process performance measurement and improvement are established over the entire landscape of the organisation’s processes. The usefulness of the proposed MM is assessed by discussing its aptitude for measuring corporate sustainability goals on a process level. The model is found to provide constructive guidance on when to obtain both essential business and IT capabilities and how to effectively orchestrate them.

Contribution

Contribution F provides a complementary instrument to the patterns described in contribution E and in so doing also adds to answering research question II.b. The proposed
MM guides organisations in acquiring relevant capabilities for an effectual PPM approach and also serves as a communication vehicle for the involved business and IT stakeholders. Being grounded in the cause-effect logic of IS success models it offers insights into which actions evoke which business outcomes. Thus, it may also serve as a basis for defining service levels for both business and IT that have to be reached in order to produce the desired outcome.
5 Closure

Imagination is more important than knowledge. For knowledge is limited to all we now know and understand, while imagination embraces the entire world, and all there ever will be to know and understand.

Albert Einstein

Section 5 is dedicated to a summary of the results presented in this thesis. To this end section 5.1 revisits the research questions and integrates the respective findings. Additional findings that have been generated in the course of this research are presented in section 5.2. Section 5.3 is dedicated to a brief retrospection on the chosen research methods, while implications for the intended audiences are discussed in section 5.4. Part A concludes with an outline of opportunities for further research in section 5.5.

5.1 Revisiting the Research Questions

Research Question I.a: How does BPM affect organisational performance in late BPM adopters (represented by hospitals)?

Over the last few years, the positive performance-impact of process-oriented work as it is advocated in BPM has been confirmed in several studies in the manufacturing and service industries. With the quantitative analysis presented in contribution A, this thesis complements extant research by validating the positive impact of process orientation also on the competitiveness and performance of hospitals as late adopters of BPM. It appears that by adopting process management, hospitals can increase their competitiveness substantially and realise not only efficiency gains, but also a much higher level of personnel satisfaction and clinical quality. The improved competitiveness in turn is found to enhance patient satisfaction and financial performance significantly.

The results of the study on the one hand confirm earlier findings that process orientation has a positive effect on efficiency and organisational performance [McCormack 2001; Ou et al. 2010]. On the other, frequently assumed but to date rarely analysed effects like the positive impact of process orientation on employees are validated: It appears that a decreased task ownership ambiguity and an increased cooperation through process management have a significant positive influence on the level of people satisfaction and competence. Moreover, the level of patient satisfaction is signifi-
cantly higher with increased process orientation, which is reflected in patients feeling better informed and cared for and appreciating a smoother patient flow. In this thesis the hypothesised positive effects of process orientation on organisational performance have been validated for hospitals in particular. However, parts of the effects may be generalisable and occur in a similar way in organisations that also characterise as late BPM adopters. An increase in the level of employee satisfaction and competence may characterise as a general phenomenon, whereas an increase in quality and customer satisfaction through process orientation may especially occur in other service-oriented organisations, whose goods are intangible and customer-specific like, e.g., government agencies. The delivery of services requires a strong interaction between the service provider and the service customer [Edvardsson et al. 2005]. It is likely that the more process-oriented the service delivery is the higher are both service quality and customer satisfaction.

Research Question I.b: How can BPM in late BPM adopters (represented by hospitals) be systematically advanced?

Late BPM adopters like hospitals are usually characterised by a pronounced function-oriented organisational structure, incentive systems that stimulate local optima, an accumulation of excess resources, powerful institutional rules, and limited communication capabilities. Therewith, the prerequisites for a successful adoption of process management in hospitals are—to put it mildly—humble. This dissertation takes up the challenge and proposes a MM that provides guidance for the first steps of becoming process-oriented. The first phases of the model deal with the encouragement of process orientation by incorporating it into the hospital strategy and by establishing a culture of open communication and cooperation. The later phases in the model are concerned with a manifestation of process work in day-to-day practices by making the workforce familiar with the end-to-end processes and continuous improvement.

Research question I.b has—like research question I.a—been answered specifically for hospitals as one group of representatives for late BPM adopters. Other late adopters of BPM like, e.g., utility companies may pursue a slightly different maturation path when adopting process management: For adopting process management in hospitals, it is inevitable that physicians are supportive. They hold the key position in the care process and are in a very powerful position to prevent process management [Vera, Kuntz 2007]. Seeing their primary purpose in curing patients they are known for having a strong reluctance towards any organisational change, which is not directly discernible as supporting their concerns [Fottler 1987]. Hence, successfully establishing process
Part A: Closure

orientation in hospitals requires a good deal of reasoning and of persuading the medical personnel. Utility companies—while also exhibiting a highly function-oriented organisational structure—are characterised by a different distribution of power, which is usually significantly more hierarchical: If a utility company embarks on implementing BPM, the decision is most likely made by a strong central authority and propagated top-down into the organisation. Although, in this case, too, the introduction of process management will most certainly require a lot of training, it is less likely that there is severe resistance from the workforce. Thus, the MM proposed in contribution B is also considered serviceable to other late adopters of BPM. However, especially persuading and motivating employees to process-oriented work practices may be less challenging and absorb less time. Experiences from early adopters of BPM, who have operated under competitive circumstances for decades, suggest that manufacturing organisations were slightly faster in adopting BPM than their service-oriented companions. It is assumed that in late adopters, once the mindset and culture for process orientation has been developed, the pace of real adoption and manifestation will depend on the level of competition and economical pressure the respective organisation experiences. The MM proposed in this dissertation supports both manufacturing and service organisations in evaluating and taking the required steps.

Research Question II.a: What are relevant design factors for the development of PPM instruments in early BPM adopters (represented by manufacturing and service organisations)?

Prior research has consistently reported difficulties of organisations with establishing consistent and effectual approaches to PPM. However, neither reasons for the problems nor requirements for potential solutions have been thoroughly analysed. With contributions C and D this thesis addresses this gap and uncovers that a substantial business IT divide impedes the success of current PPM endeavours. A systematic deviation analysis between current and desired approaches to PPM reveals that the most important design factors encompass an integration of PPM and CPM efforts, a conjoint improvement of business and IT capabilities, a consistent application of the PDCA-cycle, and the development of an effective set of process performance metrics. These initiatives should be accompanied by means of sufficient BI governance structures that support a timely provision of data and a closer integration of operational and strategic initiatives. The ability to implement these design factors enables organisations to realise a Full-scale Approach to PPM, which is desired by most of the surveyed companies.
Being based on a diversified population of manufacturing and service organisations a sufficient generality is inherent in the findings presented in contributions C and D. Consequently, the derived design factors qualify as a well-grounded general basis to rely on in PPM implementation endeavours.

Research Question II.b: How can PPM in early BPM adopters (represented by manufacturing and service organisations) be systematically advanced?

A full-scale approach to PPM puts organisations in the position to permanently monitor its processes’ performance, stay alert to improvement opportunities and take corrective action if a process fails to contribute to the strategic goals. Building on the insights into problems and relevant design factors presented above, contributions E and F provide complementary solutions for the development of an effectual approach to PPM. Contribution E proposes four patterns supporting organisations with the alignment of business and IT in PPM. Contingency factors that determine the usefulness of each pattern are the perceived primary driver behind the PPM initiative (business or IT) and the perception of PPM technology as an enabler or inhibitor. The patterns are further enriched with enablers and inhibitors for their implementation. Contribution F proposes a MM that guides organisations in systematically acquiring and advancing business and IT capabilities for PPM. Incorporating the cause-effect logic of IS success models it provides information on how conjoint business and IT activities (causes) can produce desired outcomes (effects).

Instruments presented in contribution E and F are derived from the analysis of manufacturing and service organisations. Both instruments offer guidance for systematically advancing PPM in early adopters of BPM. However, being enriched with contingency factors the patterns proposed in contribution E further allow for the selection of an alternative that is close to the individual characteristics of an organisation.

5.2 Additional Findings

With the development of instruments to support practitioners in successfully advancing their BPM initiatives this dissertation first and foremost conducts DR. Further findings that have been generated in the course of the study provide additions to the DS knowledge base.

Constructing and evaluating artefacts in general involves a considerable resource commitment. If the solution to be developed fails to adequately solve the identified problem, these resources are wasted. Thus, every DR project should commence with a methodological and systematic analysis of the problem. Contribution C proposes two
related patterns that facilitate an in depth investigation of a given problem situation. Similar to the patterns proposed by Vaishnavi and Kuechler [2007] these patterns contribute to a more rigorous DR process and to the avoidance of wasted resources. The usefulness of the patterns has been confirmed in contributions C and D.

Recently, the Rasch algorithm has been suggested as a potent method for the inductive design of MMs [Lahrmann et al. 2011a]. Just like DR artefacts, research methods need to be evaluated before they are added to the DS knowledge base. This thesis employs the Rasch algorithm twice and in so doing generates two relevant and highly useful MMs. Thereby, it confirms the usefulness of the Rasch algorithm for rigorously building MMs.

SEM is a research method from the social sciences that is employed for exploring and validating causal relationships among latent constructs (cf. section 3.2). In the context of this thesis it is employed as a means that provides justification for the development of an instrument. The SEM analysis confirms the hypothesised benefits associated with the adoption of process orientation in hospitals and thereby substantiates the need for the development of an instrument that supports hospitals in acquiring the necessary capabilities. Moreover, the combination of the developed instrument and the validated cause-effect relationships provide the basic elements for the development of a kernel theory-based design theory as suggested by Goldkuhl [2004]. Figure 2 sketches the relationships based on the hospital example.

Figure 2: Basic Elements for a Kernel Theory-based Design Theory

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4 Both patterns are also briefly introduced in section 3.2.
5.3 Revisiting the Research Methodology

In order to answer the research questions of this dissertation a number of different quantitative and qualitative research methods have been employed (cf. section 3.2). This chapter is devoted to a brief retrospection and critical reflection on the respective method choices. Research question I.a aims at discovering whether process-oriented work has a positive effect on organisational performance in hospitals. While for example multiple case studies would have provided multifaceted insights into the matter, a generalisation of causal relations is with the application of case studies not reasonably possible. The quantitative statistical analysis technique PLS has become a quasi standard for the discovery of loosely recognised causal relationships [Hair et al. 2006] and has thus been considered most suitable for the objective pursued in this study. Both research questions I.b and II.b ask for instruments that advance BPM and PPM in late and early adopters respectively. Since MMs have proven to be highly useful tools for guiding the development of organisations in different areas of application (cf. section 2.3) they are also chosen in this dissertation. However, more often than not the development of MMs is based on anecdotal evidence or case studies describing success stories. In consequence, MMs have often been criticised for a certain arbitrariness in their development process. In order to prevent being exposed to this criticism a questionnaire-based quantitative approach is chosen instead, which is based on the Rasch algorithm and a subsequent cluster analysis (cf. section 3.2). Research question II.a aims at identifying relevant design factors for PPM instruments in early BPM adopters. Both quantitative (e.g., survey) and qualitative (e.g., expert interviews) approaches represent valid possibilities. In the specific case of this thesis, the choice of a factor and cluster analysis-based approach is motivated by the opportunity to access a large number of experts on the one hand and the strength of the survey approach to discover and provide generalisable statements about a representative sample of organisations on the other [Gable 1994]. In also contributing to research question II.b, that is, the development of instruments to advance PPM in early BPM adopters, contribution E applies the extracting multiple case study approach. The resulting design patterns are augmented with detailed information, which would not have been possible gathering using quantitative research methods. Due to the fact that the field of PPM is still young both in research and practice, the extracting multiple case study is considered the most appropriate approach for assessing the so far mostly tacit knowledge in the area.
5.4 Implications for Practice and Research

The objective of this dissertation lies in developing instruments that support both early and late adopters of BPM at their corresponding levels of BPM adoption. Following a rigorous DR process this dissertation has comprehensively accomplished this goal.

Considering practice, the proposed instruments provide concrete, normative and practical guidance for late adopters to get involved with BPM, and for early adopters to successfully align and integrate their PPM initiatives. Having established the differentiation between early and late adopters of BPM, the question naturally arises whether late adopters can learn from early adopters and benefit from the use of their instruments. The answer must probably be: Partly yes, partly no. While for organisations such as utility companies instruments that inform the successful development of a PPM approach are likely to become relevant when they further mature in their BPM initiative, this must not be the case in hospitals. In the light of increased competition the importance of improving efficiency and quality of care is expected to rise. However, even if hospitals may eventually experience the same problems that organisations with a higher BPM maturity face today, a similar rigorous assessment of process performance may due to ethical reasons never be established. Obviously, these differences are not least the consequence of dissimilarities in organisational goals and objectives: Especially those organisations that do not primarily focus on efficiency, but pursue, e.g., humanitarian goals instead may adopt BPM much later or even choose other approaches, which are more directly designed to achieve, e.g., effectiveness or awareness. Depending on the overall business goals an organisation pursues, it is more or less likely both to initiate a BPM endeavour in the first place and to take the initiative so far as to establish a metric-based IT-supported performance measurement.

Considering research, the instruments proposed in this thesis also represent an addition to the knowledge base that future BPM research and DSR activities may build upon. A comparison of the instruments moreover illustrates impressively, how versatile and extremely complex the field of BPM research is. There is no one approach that fits all types of current or prospective users of BPM. Quite the contrary, usefulness and acceptance of each approach depend highly on the overall organisational objectives, the environmental background and the readiness for change of each adopting organisation. MMs as instruments to help approaching BPM, however, have in this thesis proved to be of value for both late and early adopters. While focusing on very different BPM adoption levels, both models are valued by their respective stakeholder groups for their guidance quality, low complexity and high usability. Furthermore, applying the Rasch
algorithm for allocating items to different maturity levels appears to create a high credibility among the model users. Regarding the problems experienced with the adoption of BPM, a higher maturity seems to be accompanied by an increasing problem-diversity: While late adopters of BPM are first and foremost concerned with the question if process-oriented work practices will improve their organisational performance at all, early adopters are confronted with a multitude of possible directions for improving their already chosen approach. To them a proof of concept for BPM is no longer of concern. Late adopters, by contrast, have in the beginning of their journey towards BPM not yet encountered the full diversity of both opportunities and possible problems. For researchers to build on, the thesis at hand provides insights into contingencies that determine the usefulness of BPM instruments for two different types of BPM adopters. Lastly, methodising the design process by proposing innovative research methods this thesis also contributes to the DS knowledge base.

5.5 Need for Further Research

The findings generated in this study provide the basis for several future research activities in the fields of BPM research and DSR. Each article presented in part B includes an individual research agenda that pertains to the specific results presented in the respective article. This section presents an outlook on research opportunities from the overall perspective of the whole cumulative dissertation.

- **Generalisability of results for late adopters:** This dissertation proposes instruments that lend support for the adoption of BPM for two audiences: Late and early adopters. The development of instruments for early adopters is based on studying and analysing a diversified population of manufacturing and service organisations, which results in a broad generality of the findings. By contrast, the findings and instrument for late adopters are developed for hospitals as one important group of representatives of late adopters. Consequently, a general validity of the findings cannot be claimed for all types of late BPM adopters. Some thoughts on the transferability of the results to other representatives of late BPM adopters are presented in section 5.1. However, future research needs to investigate whether the hypothesised positive effect of process orientation on competitiveness and organisational performance is also valid for other types of late BPM adopters. Moreover, adopting process management in hospitals requires a lot of persuading and commitment building among the workforce. Whether cultural and didactic factors play an equally important role in other late BPM adopters also represents an interesting question for further research.
Further contingencies for BPM adoption: BPM is a highly versatile and complex approach. In order to support organisations in successfully implementing it, a huge number of instruments, tools and techniques has been developed. However, quite a number of these instruments fail to deliver the desired value. While they do encompass important guidance for the adoption and implementation of BPM, several instruments are simply not designed in a way that makes them consumable and easy-to-use for their intended user groups. This in turn lies in the fact that developers of BPM instruments have not yet sufficiently analysed what kind of organisations actually embrace BPM in practice and which activities they undertake [Reijers et al. 2010]. This dissertation makes an encouraging step in this direction. However, in order to further engage in the development of more useful instruments, future research needs to extend this work and understand deeper the types of users of BPM, their motivation, goals and their organisational and environmental background.

Development of a process management design theory for hospitals: With their 1992 article Walls et al. initiated an active and still ongoing discussion on what are and what constitutes design theories [Walls et al. 1992]. In general, a design theory provides theorised practical knowledge to support design activities. Walls et al. [1992], Goldkuhl [2004] and Gregor and Jones [2007] consider justificatory knowledge, that is, kernel theories, to be a core component of design theories. The contributions on process orientation in hospitals presented in this thesis provide the basic elements for developing a kernel theory-based design theory (cf. section 5.2). Both Kuechler et al. [2009] and Baskerville and Pries-Heje [2010] have recently proposed promising contributions on ways to formalise design theories. Drawing on these contributions for building a process management design theory for hospitals represents a propitious opportunity for future research.

Extending the DS method base: The primary goal of DSR lies in the development of artefacts that provide innovative solutions for practical problems. One of the most important measures for assessing the quality of DR outcomes is utility. However, the rigour of solution construction, that is, the rigour of DR process varies considerably [Winter 2008]. This is not least the case due to the broad variety of possible DR outcomes (cf. section 3.2). This dissertation presents several examples on how to enhance rigour and validity of solution development through the innovative use of well-established research methods (e.g., exploratory factor and cluster analysis patterns for analysing problem classes
and identifying relevant design factors). In order to further strengthen the rigor of DR, future research efforts should consider contributing to the DS method base by proposing innovative research methods, similar to the patterns presented herein.
Part B


<table>
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<th>Title</th>
<th>The Performance Impact of Process Orientation in Hospitals: Theoretical Model and Empirical Test</th>
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Table 4: Bibliographical Information for Contribution A

Abstract. Process orientation contributes significantly to an organisation’s overall performance. While this proposition has been confirmed for profit-oriented organisations of various industries, little research exists that validates the same statement in the hospital sector. This paper proposes and evaluates a theoretical model that investigates the effect of process orientation on hospital performance. The concept of the balanced scorecard is applied to comprehensively cover all facets that constitute hospital performance. A set of hypotheses is proposed conceptualising the direct and indirect effects of process orientation on external performance perspectives (identified as patient satisfaction and financial performance) through internal performance perspectives (identified as people, operational performance and clinical quality). The model is empirically tested by means of a questionnaire-based survey among clinical and administrative management of hospitals in Switzerland. 145 complete questionnaires from 129 hospitals are analysed. Statistical results affirm that process orientation significantly enhances hospital performance. Moreover, results attest the positive effect of people
and operational efficiency on financial performance, while rejecting the effect of clinical quality on financial performance. On the contrary, people and clinical quality prove to have a significant positive effect on patient satisfaction, whereas the hypothesised positive effect of operational efficiency on patient satisfaction is not supported.

**Keywords:** Process Orientation, Clinical Pathways, Hospital Performance, Balanced Scorecard, Partial Least Squares
A.1 Introduction

Life expectancy is an essential indicator for the effectiveness of a national health care system. Right after Japan (82.6), Switzerland is leading the member states of the Organisation for Economic Co-Operation and Development (OECD) with an estimated life expectancy of 81.9 years [birth in 2007; OECD 2010]. The high performance of the Swiss health care system is also reflected in the number of primary care doctors or the number of hospital beds per resident, both being among the highest of all industrialized countries. Predictably, however, Switzerland also takes a leading position with regard to health care expenditures: In 2007 the costs of health care accounted for 10.8 percent of the gross domestic product (GDP) and were only excelled by France (11.0%) and the United States (US) [16.0%; OECD 2010]. As a matter of fact, the rate of health care cost increase has been exceeding the rate of GDP growth for several years. As a consequence, the Swiss health care system is—like that of many other OECD countries—turning into a burden for the national economy [Herzlinger 2007]. While some of the causes for this development lie in exogenous factors such as an ageing population [Prada et al. 2004], one of the prime reasons lies in the currently applied scheme of hospital payment. This scheme is based on the two pillars of retrospective financing of stationary care through health insurers and the legal obligation for cantonal deficit coverage. Over time, this system has led to a loss of transparency regarding the height of reimbursement for inpatient care as well as a lack of incentives for hospitals to reduce costs or improve efficiency due to the guaranteed shortage compensation by the cantons [Busato, von Below 2010]. As a result, health care service delivery has become inefficient and costs have become disproportionately high. In an attempt to increase transparency and stabilise the costs of medical treatment in hospitals, the Swiss parliament decided to substitute the existing system by a fixed-fee prospective payment based on diagnosis related groups (DRG) from 2012 on [SwissDRG 2011]. The new regime resembles systems already in place in Australia, the US or Germany [Gesundheitsberichterstattung des Bundes 2011]. Instead of being reimbursed for treatments, medications and other resources, Swiss hospitals will soon earn a fixed fee per case based on the DRG catalogue [SwissDRG 2011]. The introduction of the DRG compensation scheme will lead to an active encouragement of competition between hospitals as it creates transparency and in particular comparability of both costs and quality of inpatient care [Dormont et al. 2006]. In view of these challenges hospitals are increasingly searching for means to streamline their operations in order to keep up with the pressure for institutional survival, while at the same time maintaining a high quality of care, realising efficiency gains and reducing costs [Bra-
In industries such as manufacturing, finance and logistics, the answer to increased competition has long been the adoption of process orientation [Zairi 1997]. A substantial body of research confirms the positive effects of this paradigm on efficiency and financial performance [e.g., Hung 2006; Kohlbacher 2010; Skrinjar et al. 2008]. In the health care sector process orientation has been introduced in the form of organisational models such as the patient-focused hospital or clinical pathways [Bragato, Jacobs 2003; Vera, Kuntz 2007]. Actuated by the success experienced in other industries, massive investments in process management have been made in the hospital sector over the past years [Dykes, Wheeler 1997; Haraden, Resar 2004]. So far, however, little empirical research is available that investigates factual performance-related benefits of process orientation in the hospital sector [Ho et al. 1999; Vera, Kuntz 2007]. Concepts for measuring hospital performance, in contrast, have been subject to intense research [Fottler 1987; Griffith et al. 2002; Marley et al. 2004]. With hospitals increasingly being pushed into competitive market structures all over the world, the use of the balanced scorecard (BSC) for measuring and guiding hospital performance has become common practice [Chang et al. 2008; Kershaw, Kershaw 2001; Walker, Dunn 2006].

Against this background, it is the purpose of this paper to develop and provide empirical validation for a research model investigating the direct and indirect effects of process orientation on the different facets of hospital performance. A previously developed measure for process orientation and newly developed measures for the five BSC perspectives people, operational performance, clinical quality, patient satisfaction, and financial performance are used to examine the proposed hypotheses. The model is empirically validated based on 145 questionnaires from clinical and administrative hospital managers of 129 hospitals in Switzerland.

The article is organised as follows. The subsequent section introduces prior research based on a review of the relevant literature in order to lay the conceptual foundation for developing the research model. In the succeeding section the model is described and hypotheses are established. Thereafter, instrument design and survey procedure are described. The fifth section presents the results of testing the proposed research hypotheses through statistical data analysis. The article concludes with a discussion of theoretical and practical implications and the limitations of the study.
A.2 Conceptual Background and Prior Research

Historically, hospitals have been considered as “a collection of professional functions, brought together to care for, and later cure, the patients” [Gemmel et al. 2008, p. 1209]. In consequence, hospitals have traditionally been structured along clinical departments and specialised functional units. Over time, this organisational structure has caused many hospitals to evolve into loosely coupled sets of highly specialised functional silos with disparate local goals, limited communication capabilities and long delays in the treatment process [Vera, Kuntz 2007]. Incentive systems that rewarded “conformity to powerful institutional rules, myths, and structures” [Fottler 1987, p. 372] and payment systems that nurtured both exaggerate spending and the accumulation of excess resources further provided for growing inefficiencies in the system. The resulting rise of medical costs has led to reforms of health care systems all over the world, entailing the development of process-oriented improvement approaches and frameworks for hospital performance measurement as well as a plethora of research thereof. In this section, relevant literature on process orientation and performance measurement in the hospital sector is discussed.

A.2.1 Process Orientation in Hospitals

Research on process orientation and process management originated from organisation theory and practice and has received considerable attention since the early 1990s. Available literature spans qualitative and quantitative research studies in for- and non-for-profit organisations as well as inter-organisational settings and covers a wide range of descriptive, diagnostic and normative work. Process orientation is commonly understood as a cross-functional, customer-oriented paradigm of organisational thinking and working [McCormack 2001; Skrinjar et al. 2008]. A number of researchers have investigated critical success factors for establishing a process-oriented organisation [Ahmad et al. 2007; Trkman 2010]. In particular active involvement of employees, the development of a process-oriented culture and the use of continuous improvement mechanisms have been found to be crucial prerequisites. Other researchers have investigated the effects of process orientation on organisational performance [Kohlbacher 2010; Skrinjar et al. 2008]. These studies have shown that process orientation supports cost reductions; an improvement of customer satisfaction, quality and productivity; a decrease in cycle times; and a better fit of products and services with customer demands.

In the hospital world, process orientation is today commonly seen as the weapon of choice to accomplish cost reductions, quality of care improvements, outcome stan-
standardisation, and optimised resource utilisation [Kaluzny 2000; Vera, Kuntz 2007]. The most prominent and influential approaches that have been developed to foster process orientation in hospitals are patient-focused care [Hurst 1996], clinical pathways [Bragato, Jacobs 2003], and the application of quality management approaches like lean management and six sigma [Fischman 2010]. However, while an increased interest in process orientation is clearly discernible, quantitative research studies on the phenomenon are fairly scarce in the health care context. A series of three papers that have been identified in the course of the literature analysis empirically tests the causal relationships of the Malcolm Baldrige National Quality Award (MBNQA), a US award promoting quality awareness [Goldstein, Schweikhart 2002; Marley et al. 2004; Meyer, Collier 2001]. Within the MBNQA framework, process management is one of the six constructs whose effect on patient and stakeholder satisfaction as well as organisational performance is measured. Process management is therein defined as “all key work processes—health care processes and those key processes that support the delivery of health care” [Goldstein, Schweikhart 2002, p. 64]. Meyer & Collier [2001] find a significant effect of process management on patient satisfaction. The hypothesised effect of process management on organisational performance, however, is not supported. Marley et al. [2004] modify and reduce the MBNQA model and study the effects of clinical and process quality on patient satisfaction. The hypothesised positive effect of process quality on patient satisfaction is supported. Vera & Kuntz [2007] make use of the data envelopment method to validate their proposition that a high degree of process-based hospital organisation (defined through the constructs process optimisation, clinical pathways, multi-disciplinary teamwork, activity-based costing, profit centres, and performance-based pay) has a positive effect on hospital efficiency. The authors find a significant linear relationship between process-oriented organisational design and hospital efficiency. The most recent study, introduced by Gemmel et al. [2008], develops a measurement tool for assessing the degree to which a hospital is process-oriented. For this purpose, the authors build on prior work by McCormack [2001] and define the dimensions process view, process job as well as process management and measurement. Testing their measurement tool in a university hospital, the authors find that the three components are still largely misaligned, leading to a poor overall process orientation at the assessed hospital. All in all—as has likewise been stated by Vera & Kuntz [2007]—empirical quantitative research on process orientation in hospitals is fairly scarce and does thus far not reflect the increased practitioner interest.
A.2.2 Hospital Performance Measurement

The measurement of organisational performance in hospitals has been said to be “extremely complex” [McCracken et al. 2001, p. 213]. This is not least the case due to some unique characteristics of health care institutions: While the great majority of organisations pursue an optimisation of different financial objectives, the primary goal of hospitals is the “preservation and enhancement of human life” [Fottler 1987, p. 369]. This circumstance calls for a surrogate of purely rational performance measurement approaches with concepts taking into account facets like patient safety or the quality of clinical care. Moreover, unlike most other organisations, hospitals have a workforce that mainly consists of highly specialised professionals whose major loyalty refers to the profession rather than to the organisation. This, in turn, results in a restricted control over those, who are most responsible for creating both value and expenses [Bohmer 2009; Fottler 1987; Glouberman, Mintzberg 2001]. Notwithstanding, the research stream examining hospital performance measurement has evolved into a rich and flourishing field of health care and management research. A wide number of academics have studied different dimensions of hospital performance including structural factors, process factors, stakeholders, outcome, quality, patient safety, and institutional survival using subjective as well as objective indicators across various organisational levels and professional groups [Donabedian 2005; Fottler 1987; McCracken et al. 2001]. Still, every dimension “has been repeatedly criticized” [Griffith et al. 2006, p. 393] and hospital performance measurement remains challenging, not least due to the fact that the availability of data is limited and the required information often needs to be collected by means of interviews or questionnaires [Fottler 1987].

The multiple goal system of today’s hospitals, which encompasses “meeting the needs of all consumers regardless of their ability to pay for services while simultaneously remaining financially solvent” [McCracken et al. 2001, p. 213], appears to become tameable through the use of the BSC. The BSC is a multidimensional framework for measuring and managing organisational performance on the basis of both financial and non-financial indicators [Kaplan, Norton 1992]. A plenitude of qualitative [e.g., Gumbus et al. 2003; Kershaw, Kershaw 2001] and some quantitative research on the use of the BSC in the health care sector has been carried out. Contributing to the quantitative studies, Yang and Tung [2006] examine the causal relationships among BSC performance indicators in Taiwan’s public hospital system. The authors find a significant positive relationship between the learning and growth perspective and both the customer and the financial perspective. Moreover, their hypothesised positive effects of quality
on efficiency and financial results are supported. While the positive effects of efficiency on the customer and financial perspectives are also verified, the impact of customer satisfaction on financial results remains ambiguous. Chan & Seaman [2009] take a broader perspective and study the role of the BSC in establishing the links between strategy, structure, performance management and outcome in Canadian health care institutions. Their main findings suggest that an innovation-oriented hospital strategy enhances decentralised decision making and delegation of authority and that patient satisfaction represents that prime indicator for hospital performance evaluation.

The latest quantitative contribution on the use of the BSC in health care is provided by Lovaglio [2011]. The author’s aim is to methodologically conceptualise the BSC in the health care sector in order to provide hospital management with an effective tool for making organisational design decisions. The results from applying a two-step model building strategy to the Lombardy hospital sector indicate a positive effect of medical human capital on clinical process. Moreover, the hypothesised positive impact of the two constructs patient satisfaction and clinical process on economic performance is found statistically significant.

In summary, the analysis of available literature suggests that current research on both process orientation as an antecedent of hospital performance and the causal relationships of the BSC in the hospital sector is quite ambiguous and partly fragmentary. Part of the problem may lie in the relative novelty of process orientation as a research phenomenon in the health care industry. Another part may lie in the lack of a broadly accepted theoretical grounding of the hypothesised cause-effect-relationships proposed in the BSC [Nørreklit 2003]. This has motivated the research presented in this article, which attempts to build such theory, while grounding it in existing theoretical knowledge.

### A.3 Theory and Hypotheses

In the light of recent regulatory developments hospitals may less than ever act as establishments whose funding and institutional survival is naturally secured by the society. Quite the contrary, due to severe cost containments and increased regulation of financial compensation, hospitals are forced to seriously (re-)analyse their position in the health care market. The introduction of the DRG-based payment scheme is tantamount to a shift from the former full reimbursement of health care services, i.e., a complete funding of hospitals (referred to as object funding), towards a funding of clinical cases (referred to as subject funding) [Berger et al. 2010]. As such the new payment scheme is no longer designed to compensate any wasteful work, which in
turn threatens the long term survival of inefficiently and non-profitably working hospitals. As a consequence, hospitals need to undergo a mind shift towards perceiving themselves as organisations actively operating in a competitive market [Malk, Beth 2010].

Being a player in a competitive market, hospitals need to continuously monitor and control both their competitive strengths and their overall organisational performance as a health care institution. Consequently, they need an instrument capable of providing an overview over performance drivers, outcomes and their relationships in a consistent control system. As has been outlined earlier the BSC represents a prominent instrument for measuring and managing drivers of organisational performance. Recently, the use of the BSC has spread throughout the health care domain and a number of studies have shown its applicability and usefulness in this sector [Chang et al. 2008; Walker, Dunn 2006]. Its underlying causal link structure, as originally suggested by Kaplan & Norton [1996], however, has repeatedly been criticised for lacking “a reliable theoretical base” [Nørreklit 2003, p. 592] and being highly subjective [Ittner et al. 2003]. An influential theoretical framework that has frequently been employed for examining how organisations achieve competitive advantages and realise superior performance is the dynamic capability (DC) theory [Eisenhardt, Martin 2000]. The DC theory originated from the resource-based view (RBV) of the firm, which suggests that organisations gain a competitive advantage by exploiting valuable resources that are rare and hard to acquire [Barney 1991; Wernerfelt 1984]. Extending and partly compensating the RBV the DC theory suggests building capability advantages instead of focusing on resources (resource-picking) [Makadok 2001]. Capabilities are in the context of the DC theory defined as “a learned and stable pattern of collective activity through which the organization systematically generates and modifies its operating routines in pursuit of improved effectiveness” [Zollo, Winter 2002, p. 340].

This study employs the DC theory to conceptualise the effect of process orientation on hospital performance and to overcome the deficiencies associated with the cause-effect-logic of the BSC. The latter is accomplished by structuring the BSC dimensions along the competitive forces by which a hospital may build its positional advantage (internal performance perspective) and the factors constituting hospital performance (external performance perspective). The resulting research model is shown in Figure 3.
As has been pointed out above, process orientation describes an organisation’s capability of thinking and working genuinely cross-functional and customer-oriented while being committed to continuous improvement. In the hospital context—Gemmel et al. note—“process orientation [...] starts with the awareness that the flow of the patient determines the sequence of activities to be performed” [2008, p. 1216]. The main processes for the treatment of patients are scheduling and preparation, admission, diagnosis, treatment, therapy, discharge, and after-care [Mentges 2006]. Due to the fact that processes run across the whole hospital structure, span different hierarchies and involve various professional groups, a hospital’s process landscape is typically highly complex. Prior research suggests that this high complexity and factors like the pronounced shielding of different specialised groups challenge the development of a holistic process orientation in hospitals [Vera, Kuntz 2007]. Notwithstanding, it is repeatedly proposed as the way a hospital’s competitive potential may be realised and hence as a crucial source of competitive advantage [Gemmel et al. 2008; Vera, Kuntz 2007]. Following Chen et al. [2009], Gemmel et al. [2008] and Vera & Kuntz [Vera, Kuntz 2007] process orientation is defined as the degree to which a hospital thinks and works truly flow-oriented across all clinical and support functions and is committed to continuous improvement.
Ma states that in order for an organisation to outperform its opponents and realise sustainable performance, it “needs multiple competitive advantages” [Ma 1998, p. 259]. Following Yang & Tung, an often analysed factor of competitive advantage—and an often analysed dimension in the health care BSC literature—is operational efficiency [Yang, Tung 2006]. The authors find that “higher-efficiency hospitals can attain a higher market share as a result of being able to attract and treat more patients” [Yang, Tung 2006, p. 286]. Efficiency is included in this study as a construct reflecting the degree to which a hospital works both fluently and steadily and is capable of realising short waiting times and lengths of stay. Besides operational efficiency, Veillard and his co-authors [2005] as well as Wicks et al. [2007] remark in their respective work that personnel largely determines a hospital’s competitiveness. For the purpose of this study, the people construct is defined as the degree to which a hospital’s entire workforce is competent and shows a high employee satisfaction. Considering the quality and effectiveness of clinical work as a third factor of hospital competition appears reasonable bearing in mind that a hospital’s primary objective represents the preservation and enhancement of human life [Zelman et al. 2003]. While some studies regard quality of care as the ultimate outcome of hospital performance or the end itself [e.g., West 2001], the study at hand views clinical quality as an integral dimension of competitiveness that allows hospitals to realise better overall performance. The clinical quality construct reflects the degree to which the hospital adheres to quality standards and keeps complication and rehospitalisation rates low.

The meaning of the term organisational performance or institutional success in the hospital sector has been discussed intensely [Fottler 1987; McCracken et al. 2001]. Like any other business, hospitals have to think and act economically and be able to both fund themselves and remain financially solvent—especially given the increasingly limited availability of public funding. However, an exclusive focus on financial outcomes—as is common in other industries—appears inappropriate and too one-dimensional for health care institutions and has been criticised by a number of researchers [e.g., Wicks et al. 2007; Yang, Tung 2006]. Chan & Seaman [2009] in their empirical study find that patient satisfaction may even have a higher meaning for hospital performance evaluation than economic outcomes. In this study both dimensions are employed for assessing hospital performance: The financial performance construct reflects the degree to which a hospital is able to generate growth in revenues, keep process costs low and the overall cost level competitive, whereas the patient satisfaction construct reflects the degree to which a hospital’s patients feel adequately treated and informed, value the smooth procedures and do not issue complaints.
Part B: The Performance Impact of Process Orientation in Hospitals

An overview over the constructs used in this study is provided in Table 5.

<table>
<thead>
<tr>
<th>Construct</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Process orientation (PO)</strong></td>
<td>The PO construct reflects the degree to which a hospital thinks and works truly flow-oriented across all clinical and support functions and is committed to continuous improvement.</td>
</tr>
<tr>
<td><strong>People (P)</strong></td>
<td>The people construct reflects the degree to which a hospital’s entire workforce is competent and shows a high employee satisfaction.</td>
</tr>
<tr>
<td><strong>Operational efficiency (OE)</strong></td>
<td>The operational efficiency construct reflects the degree to which a hospital works both fluently and steadily and is capable of realising short waiting times and lengths of stay.</td>
</tr>
<tr>
<td><strong>Clinical quality (CQ)</strong></td>
<td>The clinical quality construct reflects the degree to which the hospital adheres to quality standards and keeps complication and rehospitalisation rates low.</td>
</tr>
<tr>
<td><strong>Patient satisfaction (PS)</strong></td>
<td>The patient satisfaction construct reflects the degree to which a hospital’s patients feel adequately treated and informed, value the smooth procedures and do not issue complaints.</td>
</tr>
<tr>
<td><strong>Financial performance (FP)</strong></td>
<td>The financial performance construct reflects the degree to which a hospital is able to generate growth in revenues, keep process costs low and the overall cost level competitive</td>
</tr>
</tbody>
</table>

Table 5: Construct Definitions

Subsequent to the conceptualisation of the relevant constructs, the deduction of hypothesised relationships is presented. A proposition that has consistently been made by various researchers [Gemmel et al. 2008; Sussan, Johnson 2003] is that process orientation has a strong impact on the efficiency of operations. Haraden & Resar argue that improving the flow between and among departments contributes significantly to saving material and human resources, “reducing delays and unclogging bottlenecks” [2004, p. 4]. Vera & Kuntz in their empirical study find that “25% of the variation in hospital efficiency is accounted for by the degree of process-based organization” [2007, p. 62] and conclude that hospital efficiency largely depends on the degree to which the hospital works process-oriented. Following these findings, the first hypothesis of this study reads:

**Hypothesis 1a: Process orientation is expected to have a positive effect on operational efficiency.**
According to West [2001] a link between process orientation and people may also be present. As Poelmanns and his colleagues remark, clear process definitions (e.g., of clinical pathways) “facilitate communication between healthcare professionals” [2010, p. 506]. Moreover, by describing expected progress and outcomes they serve as a vehicle for educating and orienting clinical and administrative staff and increase people’s identification with their jobs. In addition, West [2001] notes that the structural features of an organisation may determine the working experience of its employees. Coffey et al. [1992] find that the implementation of clinical paths reduces task ownership ambiguity and encourages cooperation, manifesting in higher job satisfaction and employee morale. Hence, it can be expected that process orientations contributes to more ambitious and satisfied employees, leading to the following hypothesis:

**Hypothesis 1b:** Process orientation is expected to have a positive effect on people.

While quantitative research on the effect of process orientation on clinical quality is to date fairly rare, qualitative studies provide some valuable insights. In their study of two orthopaedic units in Scotland Bragato & Jacobs [2003] find that the introduction of clinical pathways significantly contributed to a reduction of variation in processes and in the overall outcome of care. Both Haraden & Resar [2004] and Marley et al. [2004] support this finding, observing in their respective studies that a continuous assessment and improvement of hospital processes enhances clinical outcomes and patient safety and reduces unplanned readmissions. Based on these findings the next hypothesis is:

**Hypothesis 1c:** Process orientation is expected to have a positive effect on clinical quality.

A hospital’s operational and organisational performance stands and falls with the engagement and qualification of its personnel. If these personnel are either incapable or unwilling to contribute to both efficient operations and a high quality of care, the hospital is in risk of losing its competitiveness in the short and institutional existence in the long term. As a consequence, the people construct takes the central position in the proposed research model. A number of researchers have investigated the influence of a hospital’s workforce on health care quality resulting, however, in ambiguous findings. In her comprehensive literature review West [2001] primarily found studies that reported a weak influence of personnel experience and competencies on the quality of care. Contrary to these findings are the results presented by Yang & Tung [2006], who found a significant reduction of the net mortality rate as a consequence of increased personnel training. Lovaglio [2011], too, reports a positive effect of human capital on
quality and outcome of care. The effect of personnel qualification and satisfaction on operational efficiency has not been researched in any of the identified studies. Drawing on the logic of self-efficacy theory [Gist, Mitchell 1992], however, which suggests that an individual’s perception of her capabilities positively affects work-related performance, it is expected that if a hospital’s staff feels qualified for and satisfied with their jobs this contributes positively to the efficiency of operations. As a result, the following two relationships are hypothesised:

**Hypothesis 2a:** People is expected to have a positive effect on operational efficiency.

**Hypothesis 2b:** People is expected to have a positive effect on clinical quality.

DC theory suggests that an organisation needs to excel on “multiple strategically important vectors” [Ma 1998, p. 259] in order to achieve superior performance. That is, the aggregate of multiple competitive advantages determines organisational performance. Building on this proposition the research model is designed as a two-layer feed-forward system connecting each competitive advantage construct with each performance construct. The validity of this assumption is further supported by prior research. Analysing hospitals in Taiwan, Yang & Tung [2006] found that shorter lengths of stay lead to a significantly better operating profit margin. Chang et al. [2008] observed an increase in patient satisfaction when interdepartmental admission times and overall delays were reduced. These research findings support the expectation that operational efficiency may improve both patient satisfaction and financial performance. Thus, the following hypothesis is suggested:

**Hypothesis 3a:** Operational efficiency is expected to have a positive effect on patient satisfaction.

**Hypothesis 3b:** Operational efficiency is expected to have a positive effect on financial performance.

Mostly following the original cause-effect-relationships proposed by Kaplan & Norton [1996], prior research in the hospital sector has not comprehensively examined the relationships that directly link people to patient satisfaction and financial performance. Notwithstanding, it is expected that the quality and satisfaction of hospital personnel have a positive effect in particular on the satisfaction level of patients and to an unknown extend also on financial performance. In a broad meta-analysis Harter and his co-authors [2002] investigate the relationship between employee satisfaction and engagement and business outcomes across 36 companies of different industries, includ-
ing health care. Their findings show a significant correlation of employee satisfaction with customer satisfaction, profitability and productivity. Building on these results, the study at hand assumes not only correlation but causality between people and both patient satisfaction and financial performance, and proposes:

**Hypothesis 4a:** People is expected to have a positive effect on patient satisfaction.

**Hypothesis 4b:** People is expected to have a positive effect on financial performance.

The effects of clinical quality on patient satisfaction and financial performance are two of the most intensively discussed relationships in hospital performance research. A high clinical quality with little complications and a low rehospitalisation rate is often associated with content patients. While Marley et al. [2004] assert this proposition in their research, Lovaglio [2011] found the same relationship to be insignificant. The hypothesised positive effect of clinical quality on financial performance, by contrary, was supported in his study [Lovaglio 2011]. Performing their analysis on specific key performance indicators Yang & Tung [2006] found that a higher return on assets was significantly determined by a lower net mortality. Consistent with a rich body of prior research it is thus hypothesised that clinical quality contributes positively to patient satisfaction and financial performance:

**Hypothesis 5a:** Clinical quality is expected to have a positive effect on patient satisfaction.

**Hypothesis 5b:** Clinical quality is expected to have a positive effect on financial performance.

### A.4 Research Design and Methodology

#### A.4.1 Instrument Design

The six constructs of interest to this study are process orientation, operational efficiency, people, clinical quality, patient satisfaction, and financial performance. The development of the survey instrument was guided by Churchill’s [1979] well-known and often employed procedure. The process was initiated with a comprehensive literature review encompassing the areas of BPM, performance management and health care management in order to establish and specify the domain of each construct. This step yielded in a concise definition for each construct delineating its scope and embedding it in the overall theoretical coherence. In order to both increase the reliability of research results and nurture a cumulative research tradition, it is recommended to use
validated scales from preceding studies wherever possible [Boudreau et al. 2001; Kim 2009]. If the subject under investigation does not have a rich history of prior research, the development of new scales is appropriate [Hair et al. 2006]. The generation of items to represent each of the six constructs started with a broad search for available scales. The analysis of existing literature revealed that in the health care context neither process orientation nor the BSC and its different perspectives have so far been subject of intense quantitative research. Nonetheless, wherever available, existing measures were adapted. For measuring process orientation, the survey instrument developed by Chen et al. [2009] was useful. Its items examine the degree to which an organisation conducts its activities through end-to-end processes rather than in separate functional areas [Chen et al. 2009]. As the original construct was developed for the electronics industry its wording was modified to fit the health care context of this study. Moreover, its scope was extended through additional items so as to account for a hospital’s capabilities in diagnosing the necessity for and implementing process change as suggested by Gemmel et al. [2008] and Vera & Kuntz [2007]. The BSC—having been recognised as a potent instrument for guiding hospital performance management [Gumbus et al. 2003; Walker, Dunn 2006; Zelman et al. 2003]—has hitherto mainly been studied through qualitative research. The generation of items measuring the BSC perspectives has thus largely been informed by results from available case study research. Competency, satisfaction and loyalty are commonly cited indicators for measuring the people perspective in the hospital context [Kershaw, Kershaw 2001; Olden, Smith 2008; Walker, Dunn 2006]. Thus, items representing this study’s people construct examine the level of employee competency and satisfaction as well as the stability of the employment rate. Operational efficiency is represented through items measuring the extent to which a hospital is capable of realising short waiting times and minimising the average length of stay [Chow et al. 1998; Griffith et al. 2002]. The importance of assessing clinical quality for measuring hospital performance has been emphasised by researchers such as Zelman et al. [2003] and Olden & Smith [2008]. Clinical quality is in this study measured through items assessing the complication rate [Griffith et al. 2006], the rehospitalisation rate, negative redundancies (e.g., redundant examinations) as well as compliance with defined quality standards. For measuring the financial performance of hospitals a huge variety of indicators has been suggested [McCacken et al. 2001; Pink et al. 2001]. Following Walker & Dunn [2006], Gumbus et al. [2003] and Griffith et al. [2002] items assessing the growth in revenue, process/case costs and the competitiveness of prices properly reflect the financial perspective and were thus chosen for this study. Items or indicators for the measurement of
patient satisfaction vary only slightly in extant literature. Following Lovaglio [2011] and Meyer & Collier [2001] patient satisfaction was operationalised with items measuring the number of patient complaints on the one hand, and patient satisfaction with the provided level of care and information and the smoothness of operations on the other. In order to test the relationships hypothesised in the research model, each construct was measured on a five-tired Likert scales anchored between 1 (strongly disagree) and 5 (strongly agree).

A.4.2 Survey Procedure & Data Collection

Before implementing the survey, the instrument was tested and refined in face-to-face interview sessions with practitioners and academics in order to eliminate poor wording, ambiguity and layout deficiencies. The resulting survey was then pilot-tested among a group of 50 master students with sound knowledge in health care management. The resulting values for Cronbach’s alpha for each factor were satisfactory, exceeding the threshold value of 0.70 as suggested by Nunnally [1978]. Based on the results of the pilot study minor modifications were made to the survey design. The final survey consisted of 27 items representing the six constructs as well as a number of demographic items.

Information for the actual study was collected using a standardised written questionnaire, which was distributed to 319 clinical and administrative hospital managers, covering all acute somatic hospitals in Switzerland, which are directly affected by the introduction of DRG. Because of the objective of this study to evaluate the impact of process orientation on overall hospital performance, the target population consisted of clinical and administrative hospital managers, who have a deep knowledge of performance measurement and management as well as a profound cognisance of their institutions’ process landscapes. All of them are responsible for daily business as well as for organisational change initiatives in their respective hospitals. Accordingly, respondents were capable of providing valid information on the level of process orientation in their hospitals as well as its internal and external performance. The questionnaire was sent at the beginning of October 2010. By the end of January 2011, a total of 149 questionnaires had been returned, yielding a response rate of 46.7 percent. 145 questionnaires were complete and regarded in the subsequent analyses.

Organisational demographics revealed that the distribution of public (73%), non-profit (6%) and private (21%) hospitals being part of the analysis adequately represent the given parent population of Swiss hospitals [cf. Bundesamt für Statistik 2006]. With regard to size, 8 percent of the surveyed hospitals fall into the category 1-50 beds, 28
percent into the category 51-200 beds, 20 percent into the category 201-400 beds, 16 percent into the category 401-600 beds, and 29 percent have more than 600 beds. Concerning the characteristics of care, 33 percent of the surveyed hospitals deliver primary health care (i.e., a broad range of ambulant and inpatient treatments), 10 percent secondary care (i.e., partially specialised, interdisciplinary and mainly inpatient treatments), 34 percent tertiary care (i.e., special clinics, incl. non-somatic care), and 23 percent non-acute care (i.e., rehabilitation, chronic care). Personal demographics revealed that 50 percent of the respondents classify their job as administrative/managerial, 23 percent as clinical/therapeutic, 12 percent as consulting hospital management, and 15 percent as other.

A.5 Data Analysis and Hypotheses Testing

“In some instances, relationships are strictly specified, and the objective is a confirmation of the relationship. At other times, the relationships are loosely recognized, and the objective is the discovery of relationships” [Hair et al. 2006, p. 732]. Especially for the latter purpose, i.e., theory development or the extension of existing structural theory, the partial least square (PLS) approach has become a quasi standard [Hair et al. 2011]. PLS is therefore considered particularly suitable for the objective pursued in this study. PLS aims at maximising the explained variance of dependent latent constructs and is based on regression path and factor analysis. SmartPLS 2.0 (M3) was used for measurement validation and testing of the structural model [Ringle et al. 2005].

A.5.1 Measurement Model

PLS assessments follow a two-step procedure of first evaluating the measurement and then the structural model. Evaluating the measurement model involves assessing the reliability as well as the convergent and discriminant validity of the scales employed to represent each construct [Chin 2010]. In order to assess indicator reliability—a measure specifying the part of an indicator’s variance that is explained by the underlying latent construct—confirmatory factor analysis was used. A factor loading of 0.7 and more indicates that at least 50% of the indicator’s variance is explained through the latent variable [Götz et al. 2010]. As can be seen from Table 6, all loadings of the scale items on their corresponding latent constructs met the loading criterion of 0.7 (two values being 0.699, 0.696) and were significant at P<0.001.
### Constructs and Indicators

<table>
<thead>
<tr>
<th>Constructs and Indicators</th>
<th>Item</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Loadings</th>
<th>t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Process orientation</strong> (5-tired Likert scale; 1 = “strongly disagree”, 5 = “strongly agree”) (adapted from Chen et al. [2009], Vera &amp; Kuntz [2007] and Gemmel et al.[2008])</td>
<td><strong>PO1</strong> The work in our hospital is process-oriented.</td>
<td>3.39</td>
<td>1.09</td>
<td>0.779</td>
<td>29.599</td>
</tr>
<tr>
<td></td>
<td><strong>PO2</strong> Processes are documented and/or modelled.</td>
<td>3.27</td>
<td>1.12</td>
<td>0.807</td>
<td>25.905</td>
</tr>
<tr>
<td></td>
<td><strong>PO3</strong> Processes have defined owners (e.g., case managers).</td>
<td>3.17</td>
<td>1.10</td>
<td>0.782</td>
<td>21.243</td>
</tr>
<tr>
<td></td>
<td><strong>PO4</strong> Process owners (e.g., case managers) are authorized to issue directives.</td>
<td>2.88</td>
<td>1.12</td>
<td>0.741</td>
<td>16.252</td>
</tr>
<tr>
<td></td>
<td><strong>PO5</strong> The performance of all processes is reviewed on a regular basis.</td>
<td>2.81</td>
<td>1.18</td>
<td>0.842</td>
<td>31.926</td>
</tr>
<tr>
<td></td>
<td><strong>PO6</strong> The results of performance measurement are used to change processes.</td>
<td>3.15</td>
<td>1.12</td>
<td>0.792</td>
<td>22.154</td>
</tr>
<tr>
<td></td>
<td><strong>PO7</strong> Unsatisfactory processes are adapted.</td>
<td>3.48</td>
<td>0.93</td>
<td>0.822</td>
<td>30.643</td>
</tr>
<tr>
<td></td>
<td><strong>PO8</strong> We have a defined procedure in place for changing processes.</td>
<td>2.79</td>
<td>1.28</td>
<td>0.699</td>
<td>13.564</td>
</tr>
<tr>
<td></td>
<td><strong>PO9</strong> Thinking in department-spanning processes is encouraged through regular training.</td>
<td>2.87</td>
<td>1.17</td>
<td>0.696</td>
<td>13.636</td>
</tr>
<tr>
<td><strong>People</strong> (5-tired Likert scale; 1 = “strongly disagree”, 5 = “strongly agree”) (based on Kershaw &amp; Kershaw [2001], Olden &amp; Smith [2008] and Walker &amp; Dunn [2006])</td>
<td><strong>P1</strong> Our hospital has a constant employee rate.</td>
<td>3.83</td>
<td>0.96</td>
<td>0.728</td>
<td>14.615</td>
</tr>
<tr>
<td></td>
<td><strong>P2</strong> Our employee satisfaction is high.</td>
<td>3.43</td>
<td>1.03</td>
<td>0.884</td>
<td>47.160</td>
</tr>
<tr>
<td></td>
<td><strong>P3</strong> We are known as a good hospital with competent staff (good reputation).</td>
<td>4.08</td>
<td>0.93</td>
<td>0.839</td>
<td>33.198</td>
</tr>
<tr>
<td><strong>Operational Efficiency</strong> (5-tired Likert scale; 1 = “strongly disagree”, 5 = “strongly agree”) (based on Chow et al. [1998] and Griffith et al. [2002])</td>
<td><strong>OP1</strong> The processes in our hospital are efficient.</td>
<td>3.10</td>
<td>1.00</td>
<td>0.802</td>
<td>22.960</td>
</tr>
<tr>
<td></td>
<td><strong>OP2</strong> Our hospital has short waiting times.</td>
<td>3.22</td>
<td>1.17</td>
<td>0.740</td>
<td>17.927</td>
</tr>
<tr>
<td></td>
<td><strong>OP3</strong> Our hospital has a short length of stay.</td>
<td>3.69</td>
<td>1.05</td>
<td>0.847</td>
<td>30.762</td>
</tr>
<tr>
<td></td>
<td><strong>OP4</strong> We discharge our patients within the average length of stay.</td>
<td>3.84</td>
<td>0.95</td>
<td>0.747</td>
<td>17.084</td>
</tr>
</tbody>
</table>
### Table 6: Construct Characteristics

Construct reliability evaluates the internal consistency or unidimensionality of a latent variable, i.e., the degree to which indicators assigned to the same construct “reveal a strong mutual association” [Götz et al. 2010, p. 695]. Statistics for measuring internal consistency are Cronbach’s alpha and composite reliability $\rho$ [Chin 2010]. A construct is considered internally consistent if its Cronbach’s alpha and its $\rho$ both exceed a value...
of 0.7 [Tenenhaus et al. 2005]. Cronbach’s alpha and composite reliability values of all constructs surpassed the required thresholds, with the lowest values being 0.756 and 0.859 respectively. Convergent validity examines the ability of a latent variable to explain its indicators’ variance [Henseler et al. 2009]. The average variance extracted (AVE) captures the amount of explained variance relative to the total amount of variance and is considered sufficient if it exceeds a value of 0.5 “meaning that 50% or more variance of the indicators should be accounted for” [Chin 2010, p. 671]. The lowest AVE value measured in this study was 0.6. Discriminant validity measures if the latent constructs used are in fact conceptually distinct. Fornell & Larcker suggested that discriminant validity is provided for when the square root of AVE of each construct exceeds the correlation of this construct with any other of the model’s constructs [Götz et al. 2010]. The highest bipartite correlation (0.744) in this study was found between clinical quality and operational efficiency. Considering the lowest square root of AVE being 0.775 for process orientation the Fornell-Larcker criterion is thus also met. A summary of the quality criteria employed is provided in Table 7. Overall, the results of measurement model assessment exhibited sufficient quality to proceed with testing the proposed structural model.

<table>
<thead>
<tr>
<th>Construct</th>
<th>Cronbach’s α</th>
<th>ρ</th>
<th>AVE</th>
<th>Inter-construct Correlations</th>
</tr>
</thead>
<tbody>
<tr>
<td>PO</td>
<td>0.917</td>
<td>0.931</td>
<td>0.600</td>
<td>0.775</td>
</tr>
<tr>
<td>P</td>
<td>0.756</td>
<td>0.859</td>
<td>0.672</td>
<td>0.512 0.820</td>
</tr>
<tr>
<td>OE</td>
<td>0.793</td>
<td>0.865</td>
<td>0.617</td>
<td>0.559 0.663 0.785</td>
</tr>
<tr>
<td>CQ</td>
<td>0.817</td>
<td>0.879</td>
<td>0.647</td>
<td>0.595 0.698 0.744 0.804</td>
</tr>
<tr>
<td>PS</td>
<td>0.847</td>
<td>0.897</td>
<td>0.687</td>
<td>0.483 0.725 0.645 0.719 0.829</td>
</tr>
<tr>
<td>FP</td>
<td>0.799</td>
<td>0.882</td>
<td>0.714</td>
<td>0.636 0.710 0.678 0.649 0.551 0.845</td>
</tr>
</tbody>
</table>

Table 7: Scale Properties

Notes: PO = Process Orientation; P = People; OE = Operational Efficiency; CQ = Clinical Quality; PS = Patient Satisfaction; FP = Financial Performance; Items on Diagonal (bold) Represent the Square Root of the AVE Values

A.5.2 Structural Model

Testing the structural model means examining the explanatory power of the hypothesized relationships between the latent constructs. Primary evaluation criteria for this purpose are the $R^2$ measures as well as level and significance of the path coefficients $β$
[Hair et al. 2011]. $R^2$ measures indicate the amount of variance of a given construct that is explained by the model [Chin 2010]. The goodness of path coefficients, i.e., the precision of the PLS estimates, can be analysed using resampling methods [Götz et al. 2010]. According to Chin [2010] the bootstrapping approach represents an adequate nonparametric approach for this purpose. Bootstrapping with 500 samples was performed to assess each path coefficient’s significance. Path coefficients, significance levels and $R^2$ values for the proposed structural model are shown in Figure 4.

![Figure 4: PLS Analysis of the Research Model](image)

The research model explained 62 percent of the variance in the dependent variable patient satisfaction and 59 percent in the dependent variable financial performance, while variance explained in operational efficiency, people and clinical quality were 51 percent, 26 percent and 56 percent respectively. Examining the 11 hypothesised relationships in the model, two paths were found insignificant and thus did not support the prior hypothesis (the link between operational efficiency and patient satisfaction as well as the link between clinical quality and financial performance). One path was found being significant at $P<0.01$ (link between operational efficiency and financial performance), while all other paths were found being significant at $P<0.001$. The directionality of all paths was confirmed as hypothesised in the proposed model.
All three constructs constituting a hospital’s positional advantage, operational efficiency, people and clinical quality were predicted positively by process orientation ($\beta = 0.298$, $\beta = 0.512$ and $\beta = 0.322$ respectively), providing support for hypothesis H1a, H1b and H1c. These findings confirmed the initial expectation that a hospital's positional advantage is strongly determined by its capability to work process-oriented. Contrary to our expectations, the effect of process orientation on people turned out to be the strongest. People had a strong positive impact on both operational efficiency ($\beta = 0.511$) and clinical quality ($\beta = 0.533$), supporting hypothesis H2a and H2b. Patient satisfaction was predicted positively by two of the three proposed determinants of hospital performance, namely people ($\beta = 0.417$) and clinical quality ($\beta = 0.351$), lending support for hypotheses H4a and H5a, but not be the third, operational efficiency, thereby refuting hypothesis H3a. Financial performance as the second construct measuring hospital performance was also positively predicted by two out of three determinants, in this case operational efficiency ($\beta = 0.303$) and people ($\beta = 0.402$), which supported H3b and H4b. The suggested positive effect of clinical quality on financial performance, by contrast, was insignificant leading to a rejection of hypothesis H5b. Table 8 provides a summary of the hypothesis testing results.

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Path Description</th>
<th>Path Coefficient and Significance</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1a</td>
<td>Process orientation $\rightarrow$ Operational efficiency</td>
<td>$0.298^{***}$</td>
<td>Supported</td>
</tr>
<tr>
<td>H1b</td>
<td>Process orientation $\rightarrow$ People</td>
<td>$0.512^{***}$</td>
<td>Supported</td>
</tr>
<tr>
<td>H1c</td>
<td>Process orientation $\rightarrow$ Clinical quality</td>
<td>$0.322^{***}$</td>
<td>Supported</td>
</tr>
<tr>
<td>H2a</td>
<td>People $\rightarrow$ Operational efficiency</td>
<td>$0.511^{***}$</td>
<td>Supported</td>
</tr>
<tr>
<td>H2b</td>
<td>People $\rightarrow$ Clinical quality</td>
<td>$0.533^{***}$</td>
<td>Supported</td>
</tr>
<tr>
<td>H3a</td>
<td>Operational efficiency $\rightarrow$ Patient satisfaction</td>
<td>$0.117^\text{n.s.}$</td>
<td>Not supported</td>
</tr>
<tr>
<td>H3b</td>
<td>Operational efficiency $\rightarrow$ Financial performance</td>
<td>$0.303^{**}$</td>
<td>Supported</td>
</tr>
<tr>
<td>H4a</td>
<td>People $\rightarrow$ Patient satisfaction</td>
<td>$0.402^{***}$</td>
<td>Supported</td>
</tr>
<tr>
<td>H4b</td>
<td>People $\rightarrow$ Financial performance</td>
<td>$0.417^{***}$</td>
<td>Supported</td>
</tr>
<tr>
<td>H5a</td>
<td>Clinical quality $\rightarrow$ Patient satisfaction</td>
<td>$0.351^{***}$</td>
<td>Supported</td>
</tr>
<tr>
<td>H5b</td>
<td>Clinical quality $\rightarrow$ Financial performance</td>
<td>$0.133^\text{n.s.}$</td>
<td>Not supported</td>
</tr>
</tbody>
</table>

Table 8: Results of PLS Path Analysis
A.6 Discussion

The objective of this study was to develop and empirically validate a theoretical model conceptualising the impact of process orientation on hospital performance. Using data collected from 145 clinical and administrative hospital managers the proposed model was tested. The model exhibited an adequate fit with the surveyed data supporting the contention that process orientation contributes to a hospital’s competitiveness and overall performance. Nine out of 11 hypothesised relationships were found statistically significant, two were rejected. These results contain a number of interesting research findings to be discussed.

A.6.1 Implications for Research

First, while process orientation and process factors were said to be highly effective in explaining hospital performance aspects such as clinical quality as early as in 1987 [Fottler 1987], to date hardly any empirical research is available validating this proposition. Prior research was mainly restricted to analysing the impact of process orientation on a single performance indicator, namely hospital efficiency [Gemmel et al. 2008; Vera, Kuntz 2007]. While the results introduced herein are consistent with the findings presented in prior studies, they supplement these revealing the importance of process orientation not only for efficiency gains, but also for a higher level of personnel satisfaction and clinical quality. To the best knowledge of the authors, quantitative empirical studies researching the impact of process orientation on competitiveness and organisational performance are still quite rare in other industries, too. This may not last be the case due to the lack of an adequate measurement instrument as was also stated by Chen et al. [2009]. It is hoped that the instrument introduced herein will be of help in future studies on the impact of process orientation.

Second, this study addresses the continued criticism against the BSC as a practitioner instrument, lacking a reliable theoretical base [Nørreklit 2003]. Using the DC theory as a theoretical framework, the dimensions of the BSC were structured so as to form an internal performance perspective containing the areas of competitive advantage and an external performance perspective covering the factors that constitute hospital performance. Through the use of path analysis a potentially more complete and theoretically legitimate cause-effect-structure could be established and empirically validated. This may encourage further quantitative research on the usefulness of the BSC as a valuable instrument for performance measurement and control.
A.6.2 Implications for Practice

Besides an empirical validation of the suggestion: “... administrators should feel more confident to follow the BSC framework to improve the performance of their hospitals.” [Yang, Tung 2006], a number of recommendations for practice can be derived from the analysis (cf. Figure 4 and Table 8). First, H1c indicates process orientation to have a direct and positive influence on clinical quality. Process documentation or process models are widely used (shown by indicator PO2 with an item mean of 3.27). Process models are adapted on the basis of performance measurement (indicator PO6 with an item mean of 3.15) and/or failure analyses (indicator PO7 with an item mean of 3.48). Some of the constructs and indicators associated with the continuous improvement process (CIP) have a relatively low item mean (PO4: 2.88, PO5: 2.81, PO8: 2.79). By systematising and strengthening the CIP, processes could be adapted more effectively and, in particular, sooner. The recommendation for hospitals therefore is: Establish a CIP organisation with the authority to issue directives. Install the CIP at a sufficiently high level, e.g., directly supported through top management, in order to create impact.

Second, H1b indicates process orientation to have a direct and positive influence on people. The construct people is determined by indicators, which reflect the satisfaction of personnel and show a high level of acceptance (shown by item mean values of P1: 3.83, P2: 3.43, P3: 4.08). Employee satisfaction can be ensured and enhanced by the systematic increase in process orientation. The recommendation for hospitals therefore is: Clarify the significance of defined roles, clear allocation of tasks, prompt and complete information flow, CIP, etc. for employee satisfaction and derive appropriate measures.

Third, H3a shows no direct influence of operational efficiency on patient satisfaction. A struggle to get enough patients, which exists, e.g., in Germany under the DRG system may be happening also in Switzerland. The very introduction of DRG will kindle competition between providers. Operational efficiency indicators such as e.g., OP2 (short waiting times) should therefore not play a significant role in the perception of hospital personnel. The importance of this indicator could nonetheless change markedly and rapidly under the new system. The recommendation for hospitals therefore is: Observe the development of the correlation between operational efficiency and patient satisfaction. Introduce patient complaints management and extend the existing system of patient complaints management, which tracks this and other associated indicators in order to be able to initiate measures in the area of operational efficiency, if necessary.
Fourth, no direct influence on financial performance was shown for clinical quality as represented by H5b. With the introduction of the DRG system, cases where the patient is readmitted within a certain number of days after discharge are regarded as one billing unit and remunerated at a flat rate [SwissDRG 2011]. As a consequence, it is possible that treatments and therapies, which begin after discharge because—at least from the patient’s point of view—the previous treatments/therapies were not successful, cannot be billed at full cost. Swiss hospitals are not yet familiar with this practice as the DRG system and therefore this arrangement will not come into effect until 2012. Only pilot regions have some experience at least with the technical processing of coding, invoicing and handling. Clinical quality might start to impact on financial performance from 2012 onwards and increase. The recommendation for hospitals therefore is: Closely monitor the correlation between readmissions within the ‘guarantee period’ and costs.

Fifth, the influence of operational efficiency on financial performance represented by H3b is rated as fairly low. It remains to be clarified whether the costing systems in Swiss hospitals can provide managers of clinics and other units with adequate insight into the correlations between their respective operational efficiency and their share of financial performance. The recommendation for hospitals therefore is: Define combined indicators for financial reporting, medical controlling and process management, make them available and have them monitored by a controlling system. Integrate financial reporting, medical controlling and process management to one integrated controlling approach.

Sixth, the impacts of process orientation e.g., on people (represented by H1b) or on clinical quality (H1c) shown in the research model, as well as the consequences outlined above, lead to the conclusion that process initiatives cannot be instituted by hospital management primarily on the basis of financial arguments. The recommendation for hospitals therefore is: Don’t carry out process initiatives merely from the perspective of efficiency.

### A.6.3 Study Limitations and Future Research

Like every empirical study, this study, too, comes with limitations. When interpreting the findings presented in this study the reader should take these limitations into account.

First, the measurement of performance as operationalised in this study completely relies on the personal appraisal of the hospital managers who completed the survey.
While subjective measurement of performance is both valid and common in management research, there is still the threat of subjectivity biasing the results. Future research may thus also incorporate objective performance measures to further reduce potential bias.

Second, this study purposefully focused on process orientation as the only antecedent of competitive advantage (directly) and ultimately superior organisational performance (indirectly). The authors are well aware of the fact that process orientation is not the only capability hospitals can and should acquire to remain their competitiveness and institutional survival. Future research on other capabilities is strongly encouraged.

Third, as Simon remarks: “To a Platonic mind, everything in the world is connected with everything else—and perhaps it is. Everything is connected, but some things are more connected than others. The world is a large matrix of interactions in which most of the entries are very close to zero” [Simon 1973, p. 23]. In this study an intervening-variable type of path model was employed to measure the effects of process orientation on performance [Luft, Shields 2003]. Though based on a broadly accepted theory, largely supported by existing literature and empirically validated on a data set of 145, the suggested relationships are still no general truth and to be interpreted with care.
Contribution B – Competitiveness via Process Management – A Theoretically Grounded Maturity Model for Hospitals

Abstract. In order to improve transparency and stabilise health care costs, several countries have decided to reform their healthcare system on the basis of diagnosis related groups (DRG). DRG systems induce active competition among hospitals, forcing them to become more efficient and effective. In consequence, hospitals are investing considerably in process orientation and management. However, to date there is neither a consensus on what capabilities hospitals need to acquire for becoming process-oriented, nor a general agreement on the sequence of development stages they have to traverse. To this end, this study proposes a theoretically grounded conceptualisation of process management capabilities and presents a staged maturity model algorithmically derived on the basis of empirical data from 129 acute somatic hospitals in Switzerland. The five maturity levels start with ‘encouragement of process orientation’ (level 1), ‘case-by-case handling’ (level 2), and ‘defined processes’ (level 3). Ultimately, hospitals can reach the levels ‘occasional corrective action’ (level 4) and ‘closed loop improvement’ (level 5). The empirically derived model reveals why available maturity models for process management are not applicable in the hospitals context: Their comparatively high complexity on the one hand and their strong focus on topics like an
adequate IT integration and process automation on the other make them inadequate for solving the problems felt in the hospital sector, which are primarily cultural and structural.

**Keywords:** Health care management, Process management, Maturity model, Design science research
B.1 Introduction

The Swiss health care system takes a leading position among the member states of the Organisation for Economic Co-Operation and Development (OECD). Its high performance is reflected in an above average life expectancy [81.9 years, birth in 2007; OECD 2010] as well as the numbers of primary care doctors and hospital beds per resident, both being among the highest of all industrialised countries [OECD 2010]. However, Switzerland also faces significant health care expenditures: in 2007 the costs of health care accounted for 10.8% of the gross domestic product [OECD 2010]. As a consequence, the Swiss health care system has—like that of many other OECD countries—turned into a burden for the national economy [Herzlinger 2007]. In an attempt to improve transparency and stabilise health care costs, the Swiss parliament decided to substitute the existing system by a fixed-fee prospective payment based on diagnosis related groups (DRG) from 2012 on [SwissDRG 2011]. Instead of being reimbursed for treatments, medications and other resources, Swiss hospitals will earn a fixed fee per case based on the DRG catalogue [SwissDRG 2011]. The introduction of the DRG compensation scheme is tantamount to an active encouragement of competition between hospitals as it creates both transparency and comparability of costs and quality of inpatient care [Dormont et al. 2006, p. 31].

In view of these developments hospitals can no longer act as organisations whose funding and institutional survival is "a given" and thus secure. As the DRG-based payment scheme is not designed to compensate wasteful work, the survival of inefficiently and non-profitably working hospitals is seriously threatened. Thus, hospitals are forced to re-examine their institutional self-conception and need to begin acting as organisations that operate in a competitive environment [Malk, Beth 2010, p. 24]. In consequence, Swiss hospitals—like other hospitals in Europe that are affected by the introduction of DRG—are investing significantly in means to streamline operations while ensuring a high quality of patient care [Helfert 2009, p. 937]. In industries such as manufacturing, finance, and logistics, the adoption of business process management (BPM) has long been the answer to increased competition and institutional pressure [Zairi 1997, p. 66]. A substantial body of research confirms the aptitude of BPM for gaining and sustaining efficiency and competitive advantage [e.g., Kohlbacher 2010; Skrinjar et al. 2008]. Stimulated by the success experienced in other industries, organisational models such as the patient-focused hospital or clinical pathways have been developed to introduce process management into hospitals [Bragato, Jacobs 2003; Hurst 1996]. However, the implementation of process-oriented paradigms in the hospi-
tal context can be a considerable challenge and involves overcoming a number of obstacles [Every et al. 2000, p. 463]. These include a distinct functional division of labour and incentive mechanisms rewarding conformity with professional rather than institutional values [Vera, Kuntz 2007, p. 58].

To date there is neither a consensus on what capabilities hospitals need to acquire for becoming process-oriented nor a general agreement on the series of development stages they have to traverse. In fact, research has yet to develop an understanding of both the required capabilities for and maturity levels of process management in hospitals. To this end, this study proposes a theoretically grounded conceptualisation of process management capabilities and presents a staged maturity model algorithmically derived on the basis of empirical data from 129 acute somatic hospitals in Switzerland.

The remainder of this article is structured as follows. The second section presents a brief overview of related literature on maturity research in general and process management maturity in particular. In outlining general design decisions and conceptualising process management maturity, sections B.3.1 and B.3.2 provide the basis for model development, while sections B.3.3 and B.3.4 introduce the employed development approach and describe the collection and analysis of data. Section B.4 is dedicated to the presentation of the model, which is again followed by a brief evaluation in section B.5. A short reflective discussion on implications, limitations and future research concludes the article.

### B.2 Foundations

#### B.2.1 Stages of Development and Maturity Research

The development of organisational capabilities and the dynamics of organisational evolution have intrigued both researchers and practitioners since the advent of corporate ventures. Over time a multitude of theories that aim at explaining and predicting patterns of organisational change has been developed, including life cycle theory, teleology, dialectics, and evolution [Gardner 1965; Van de Ven, Poole 1995, p. 520]. Especially life cycle theory is closely related to the concept of maturity models (MMs) in that both describe a typical pathway of change based on distinct stages of development [Fraser et al. 2002, p. 244]. MMs have recently gained increased attention as capable tools for enabling fast and uncomplicated capability (self-) assessments and for guiding improvement efforts [Becker et al. 2009, p. 213]. Maturity is in the context of maturity modelling understood as a “measure to evaluate the capabilities of an organisation” [Rosemann, de Bruin 2005, p. 1]. MMs allow for the assessment of maturity of a
variety of different objects, e.g. technologies and/or systems [e.g., Popovic et al. 2009], processes [e.g., Rosemann, de Bruin 2005] or people [e.g., Curtis et al. 2010]. Dimensions are capability areas that describe specific aspects of the object of maturity assessment. Each dimension in a MM is further specified by several characteristics [practices, measures, or activities; Fraser et al. 2002, p. 246]. While some models base the maturity assessment on only one dimension, a common practice today is the use of a cumulative set of different dimensions [van Steenbergen 2011, p. 114]. Levels are archetypal states of maturity of the object that is assessed. Each maturity level “represents a distinctive evolutionary plateau” [Dekleva, Drehmer 1997, p. 95]. With regard to the development of MMs the top-down and the bottom-up approach can be distinguished [Lahrmann et al. 2011a, p. 177]. While the top-down approach specifies that levels be defined first and thereafter completed with characteristics describing the different dimensions, the bottom-up approach prescribes that dimensions and characteristics be derived first and then assigned to different maturity levels. Moreover, three maturity principles can be discriminated: staged, continuous and dimension-based. While staged models require all elements of one distinct level to be achieved, continuous models allow characteristics to be scored at several levels [Fraser et al. 2002, p. 224]. The dimension-based maturity principle, in contrast, defines individual maturity levels for each dimension. The overall maturity of an object is then represented by aggregating the maturity levels of the individual dimensions [van Steenbergen 2011, p. 109]. The primary purpose of a MM denotes the major type of recommendation it offers, that is, descriptive, prescriptive or comparative information. Descriptive MMs are diagnostic in nature and portray evolution patterns empirically observed in a number of organisations at a certain point in time, whereas prescriptive models offer guidance for capability improvement and comprise detailed counselling. Comparative models, in turn, provide means for juxtaposing an organisation’s own with other organisations’ maturity levels [van Steenbergen 2011, p. 113]. The intention to make use of a MM may either be induced by the objective to evaluate the own organisation’s position or the search for guidance on how to improve certain capabilities. A third alternative represents the wish to match the own capability level with that of other projects, business units or organisations [Fraser et al. 2002, p. 247].

Figure 5 provides an overview of the described characteristics. Shaded cells mark the characteristics of the model proposed in this study that are described in detail in section B.4.
B.2.2 Process Management Maturity Models

A number of models to assess the maturity of BPM has been developed over recent years [Rosemann, de Bruin 2005, p. 3; Rosemann, vom Brocke 2010, p. 109]. Among these a great plenty is based on the well-known Capability Maturity Model (CMM) developed by the Software Engineering Institute at Carnegie Mellon University for assessing the maturity of software development processes [e.g., Fisher 2004; Rohloff 2009]. Maturity in these models is defined and measured in different ways: Maturity definitions include for instance effectiveness and efficiency, while maturity measurement differentiates subjective or objective measures [Rosemann, vom Brocke 2010, p. 111]. Existing MMS can further be distinguished into those that regard instances of specific process types as the object of maturity assessment and those that aim at the maturity evaluation of BPM as a holistic management approach [Pöppelbuß, Röglinger 2011, p. 343].

Following the search practices suggested by vom Brocke et al. [2009] and Fettke [2006], we conducted an extensive literature search so as to identify potentially available BPM MM for the hospital sector. In order to cover the most relevant IS and health care outlets, like journals, books, conference proceedings, and practitioner magazines, the scholarly databases ScienceDirect, Proquest, EBSCOhost were included in the search. The search strings used were ‘maturity model’, ‘life cycle’, ‘business process management’, ‘health care’, ‘hospital’, and ‘clinical path’. However, despite the comprehensiveness of the search, MMs that are specifically dedicated to the assessment of process management in hospitals were not found and are not available to date to the best knowledge of the authors. This result, however, is not entirely unexpected as it coincides with frequent criticism pertaining to existing BPM MM: These are found to be almost identical and hardly differing with regard to their scope, domain focus, and audience [Plattfaut et al. 2011, p. 328]. Another frequently raised objection concerns the inconsiderate use of extant models in new application domains and the associated negligence of organisation- and industry-specific characteristics [Mettler, Rohner 2009, p. 3]. McCormack et al. further remark that most available models mainly rely
“upon anecdotal evidence and case studies describing success stories” [2009, p. 793] and lack an adequate theoretical basis. The same applies to reliable and comprehensible MM development techniques, which to date represent an exception [Lahrmann et al. 2011a, p. 177].

**B.3 Model Development**

**B.3.1 General Design Decisions**

Like other artefact types such as constructs and methods, MMs represent design objects that need to be rigorously constructed in order to guarantee their quality and efficacy, and in particular their utility [Becker et al. 2009, p. 214]. A very recent proposal by Pöppelbuß and Röglinger offers a set of design principles to assist researchers in “maturity model design and substantiation” [2011, p. 345]. Besides its function as a checklist or documentation template when designing MMs, it serves as an instrument to evaluate and compare alternative models. Their framework is herein employed to define the scope and set the boundaries of the model to be proposed (Table 10), whereas especially the employed maturity concept as well as the algorithm for model development are subsequently described in greater detail.

<table>
<thead>
<tr>
<th>Design Principles</th>
<th>Realisation in this Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Application domain</td>
<td>Acute somatic hospitals</td>
</tr>
<tr>
<td>b) Purpose of use</td>
<td>Self-evaluation and benchmarking</td>
</tr>
<tr>
<td>c) Target group</td>
<td>Clinical and administrative hospital managers</td>
</tr>
<tr>
<td>d) Class of entities under investigation</td>
<td>Process management capabilities</td>
</tr>
<tr>
<td>e) Differentiation from related maturity models</td>
<td>Shows hospital domain focus</td>
</tr>
<tr>
<td></td>
<td>Design is based on empirical data</td>
</tr>
<tr>
<td></td>
<td>Presents evolution patterns empirically observed in a number of organisations at a point in time</td>
</tr>
<tr>
<td>f) Design process and extent of empirical validation</td>
<td>Bottom-up, Rasch analysis based design</td>
</tr>
<tr>
<td></td>
<td>Initial empirical validation</td>
</tr>
<tr>
<td>g) Maturity and dimensions of maturity</td>
<td>Process management maturity</td>
</tr>
<tr>
<td></td>
<td>5 theoretically deduced dimensions of maturity</td>
</tr>
<tr>
<td>h) Maturity levels and maturation paths</td>
<td>maturity levels</td>
</tr>
<tr>
<td></td>
<td>Staged maturation</td>
</tr>
</tbody>
</table>
Table 10: Definition of Scope

**B.3.2 Conceptualisation of Process Management Capability Dimensions**

The lack of well-founded conceptualisations of maturity and maturity dimensions has been criticised by a number of authors. Rosemann and de Bruin, for instance, fault the frequent “focus on only one dimension for measuring BPM” [2005, p. 3]. Both Lahrmann et al. [2011a, p. 177] and Mettler [2011, p. 78] further name a poor if not missing theoretical basis as one of the major shortcomings of currently available MMs. By drawing upon broadly accepted organisational and information systems (IS) theories for the conceptualisation of process management maturity, we aim at providing a rigorous foundation for the development of the model proposed in this study.

Having emerged only about two decades ago, BPM has just recently found entrance to serious research. Rigorous theory for describing and explaining the phenomenon has thus not yet been developed [Melão, Pidd 2000, p. 125]. While some existing theories have been proposed to theoretically ground BPM [e.g. the task-technology-fit theory; Trkman 2010, p. 126] no broad consensus has been achieved so far. Ko et al. characterise process management as a cross-disciplinary approach that adopts a “variety of paradigms and methodologies” [2009, p. 745]. Adequately depicting process management maturity thus calls for a conceptualisation that is capable of capturing this variety.

Soanes and Stevenson define maturity as a “state of being complete, perfect, or ready” or the “fullness of development” [2008, p. 906]. In order to cover dimensions that establish a fullness of development in process management, we draw upon the constructs proposed in the socio-technical theory on the one hand and the organisational culture theory on the other. Socio-technical theory proposes that effectively and efficiently designing organisational systems requires taking into account both the social and the technical subsystem [Bostrom, Heinen 1977, p. 14]. The same holds true for BPM: While the approach intends to increase the performance of an organisation through
breaking functional walls and stream-lining work, it only became truly practicable with the introduction of information technology (IT) in the 1980s and 1990s [Bonham 2008, p. 125]. According to socio-technical theory the technical system comprises the two components technology and tasks. For the development of our MM we have translated these concepts into the process management capability dimensions IT and practices.

When holistically implementing BPM especially the social system is of great importance, which is why we employ organisational culture theory for a closer analysis of required capabilities. Organisational culture theory differentiates the three constructs assumptions, espoused values and artefacts [Hatch 1993, p. 956]. Assumptions represent the most intangible construct that comprises believes and ways of interpersonal communication and behaviour. For the MM presented in this study we termed this construct culture. Espoused values are goals, strategies and standards, which are condensed under the term strategy as the fourth capability dimension of our MM. Structure represents the fifth and last dimension of process management maturity derived from the original construct artefacts, which covers tangible and visible organisational structures like, e.g., departments. Both theories postulate that their respective constructs are interdependent and should be mutually aligned in order to maximise organisational benefits. The conceptual basis for our MM is thus formed by five capability dimensions: Culture, strategy, structure, practices, and IT (Figure 6).

![Figure 6: Process Management Capability Dimensions](image)

Having outlined the conceptual focus of our MM, we proceed with the domain focus and scope of content. Goldstein and Schweikhart define process management in hospitals as “all key work processes—health care processes and those key processes that
support the delivery of health care” [2002, p. 64]. By means of a comprehensive literature analysis items were derived describing relevant work practices, principles and activities for each of the five capability dimensions. Table 11 provides a detailed description for each maturity dimension, while single items are introduced in the course of data analysis.

<table>
<thead>
<tr>
<th><strong>Dimension</strong></th>
<th><strong>No. of Items</strong></th>
<th><strong>Definition</strong></th>
<th><strong>References</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Culture</td>
<td>5</td>
<td>The culture capability dimension covers communication and leadership-related practices that are essential for a hospital to establish effectual process management. These practices include for instance an open communication across functional borders and hierarchical levels as well as the empowerment of clinical and administrative staff.</td>
<td>[Alibabaei et al. 2009; Lok et al. 2005; Scott 2007; West 2001]</td>
</tr>
<tr>
<td>Strategy</td>
<td>4</td>
<td>In defining strategic objectives the strategy capability dimension covers principles that are prerequisite for a full development of process management. These include among others cross-departmental and cross-clinic cooperation and information exchange.</td>
<td>[Alibabaei et al. 2009; Goldstein, Schweikhart 2002; Hung 2006; Lok et al. 2005]</td>
</tr>
<tr>
<td>Structure</td>
<td>3</td>
<td>The structure capability dimension comprises organisational factors that are essential for process management like for instance little barriers between clinics and other departments and the regular deployment of cross-professional teams.</td>
<td>[Hung 2006; Lok et al. 2005]</td>
</tr>
<tr>
<td>Practices</td>
<td>6</td>
<td>The practices capability dimension summarises work practices that are crucial for process management in hospitals like regular (care) process performance re-viewing, (care) process documentation and patient flow orientation.</td>
<td>[Every et al. 2000; Gemmel et al. 2008; Marley et al. 2004; Vera, Kuntz 2007]</td>
</tr>
<tr>
<td>IT</td>
<td>3</td>
<td>The IT capability dimension contains items that capture in how far the employed hospital IT systems are able to support a smooth flow of complete patient care, are easy to use and facilitate an adequate availability of (patient) data.</td>
<td>[Bhattacherjee, Hikmet 2007; Fitterer, Rohner 2010; Goldstein, Schweikhart 2002]</td>
</tr>
</tbody>
</table>

*Table 11: Detailed Description of Maturity Dimensions*
**B.3.3 The Rasch Analysis for MM Development**

The Rasch analysis (RA) has proven a viable questionnaire-based approach to building empirically grounded MMs [Dekleva, Drehmer 1997, p. 96]. The fundamental idea is that each item included in the questionnaire represents a particular level of evolution with regard to the object of maturity assessment. The algorithm presumes that responses to questionnaire items depend on a latent respondent characteristic that represents certain knowledge or specific capabilities of the surveyed entity. The algorithm is based on the proposition that entities that are more developed are more likely to master all items, while only the less challenging items are presumed to be mastered by all surveyed entities [Bond, Fox 2007, p. 37]. By counting the answers that indicate the presence of capabilities, the algorithm calculates two scores: one for the difficulty of items and one for the ability of the surveyed entities. Both scores are measured on the same interval scale, which allows for estimating the likeliness, with which a certain entity masters a certain item. For evaluating the quality of the model, two statistics termed ‘Infit’ and ‘Outfit’ are used. Both assess whether data that has been analysed (items and survey participants) fit the expectations specified in the model. Applied in the context of MM development the RA allows for the inductive allocation of items onto maturity levels based on the measurement of item difficulty as well as the assessment of surveyed entities based on their capability level [Dekleva, Drehmer 1997, p. 97].

Tailoring the RA for MM development requires some slight modifications of the basic model [Lahrmann et al. 2011a, p. 182]. Because rating scales have a stronger expressive power, five-tired Likert scales are employed instead of the originally proposed dichotomous scales. Conducting the RA yields a single ordinal scale that represents the logit measure of each item and entity, but no distinct maturity levels. In order to avoid subjectivity in defining maturity levels, the modified RA thus employs cluster analysis based on the item logits. Since most MMs use five maturity levels [van Steenbergen 2011, p. 90], the anticipated number of clusters is set to five.

**B.3.4 Data Collection and Analysis**

Prior to questionnaire distribution, the instrument was tested and refined in face-to-face interview sessions with five hospital managers and five academics with health care background in order to eliminate poor wording and ambiguity. As the model is intended to be used by both administrative and clinical managers, special attention was paid to clear and understandable language for either audience. Based on the feedback
provided by the pre-test participants minor wording modifications were made. The final questionnaire consisted of twenty-one items describing different capabilities for process management in hospitals.

Information for the actual study was collected using a standardised written questionnaire, which was distributed to 319 clinical and administrative hospital managers, covering all acute somatic hospitals in Switzerland that are directly affected by the introduction of DRG. Because of the objective of this study to develop a MM for process management in hospitals, the target population consisted of clinical and administrative hospital managers, who have a profound cognizance of their institutions’ process landscapes. All of them are responsible for daily business as well as for organisational change initiatives in their respective institutions. Accordingly, respondents were capable of providing valid information regarding the object of study. The questionnaire was sent at the beginning of October 2010. By the end of January 2011 a total of 149 questionnaires had been returned, yielding a response rate of 46.7 percent. 145 questionnaires were complete and have been regarded in the subsequent analyses.

Organisational demographics revealed that the distribution of public (73%), non-profit (6%) and private (21%) hospitals being part of the analysis adequately represent the given parent population of Swiss hospitals. With regard to size, 8% of the surveyed hospitals fall into the category 1-50 beds, 28% into the category 51-200 beds, 20% into the category 201-400 beds, 16% into the category 401-600 beds, and 29% have more than 600 beds. Concerning the characteristics of care, 33% of the surveyed hospitals deliver primary health care (i.e., broad range of ambulant and inpatient treatments), 10% secondary care (i.e., partially specialised, interdisciplinary and mainly inpatient treatments), 34% tertiary care (i.e., special clinics, incl. non-somatic care), and 23% non-acute care (i.e., rehabilitation, chronic care). Personal demographics revealed that 50% of the respondents classify their job as administrative/managerial, 23% as clinical/therapeutic, 12% as consulting hospital management, and 15% as other.

The BIGSTEPS software, Version 2.82 (Linacre and Wright 1998) was used to obtain the Rasch item calibration. Infit and Outfit statistics, used to assess if the data conforms to the model’s assumptions, were tested. Values greater than 2 for either of the two statistics should not occur in more than 5 percent of the items. Our data set meets this quality criterion. Table 12 shows the results of applying the RA ordered by the levels achieved by means of the subsequent cluster analysis. The table includes levels, dimensions, item descriptions, and references as well as logit, Infit and Outfit values.
<table>
<thead>
<tr>
<th>Level</th>
<th>Dimension</th>
<th>Item</th>
<th>Reference</th>
<th>Logit</th>
<th>Infit</th>
<th>Outfit</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Practices</td>
<td>The performance of all (care) processes is reviewed on a regular basis.</td>
<td>[Gemmel et al. 2008, p. 1213; Marley et al. 2004, p. 359]</td>
<td>0.73</td>
<td>-0.29</td>
<td>-0.28</td>
</tr>
<tr>
<td></td>
<td>Practices</td>
<td>Process owners (e.g., case managers) have sufficient authority to issue directives.</td>
<td>[Every et al. 2000, p. 364]</td>
<td>0.65</td>
<td>-0.23</td>
<td>-0.28</td>
</tr>
<tr>
<td></td>
<td>Strategy</td>
<td>The strategy of our hospital is consistently supported on all hierarchical levels.</td>
<td>[Goldstein, Schweikhart 2002, p. 66]</td>
<td>0.58</td>
<td>-0.71</td>
<td>-0.87</td>
</tr>
<tr>
<td></td>
<td>IT</td>
<td>Our hospital information systems are easy to use and support clear and understandable interaction.</td>
<td>[Bhattacherjee, Hikmet 2007, p. 736]</td>
<td>0.50</td>
<td>0.30</td>
<td>0.42</td>
</tr>
<tr>
<td>4</td>
<td>Structure</td>
<td>Decisions (on both patient care and hospital organisation) are made collectively.</td>
<td>[Hung 2006, p. 29]</td>
<td>0.32</td>
<td>0.27</td>
<td>0.20</td>
</tr>
<tr>
<td></td>
<td>Practices</td>
<td>Performance measurement results are used to change and adapt (care) processes.</td>
<td>[Gemmel et al. 2008, p. 1213; Marley et al. 2004, p. 359]</td>
<td>0.30</td>
<td>-0.69</td>
<td>-0.79</td>
</tr>
<tr>
<td></td>
<td>IT</td>
<td>Our hospital information systems are well integrated and support a smooth flow of complete patient care.</td>
<td>[Bhattacherjee, Hikmet 2007, p. 736; Fitterer, Rohner 2010, p. 323]</td>
<td>0.25</td>
<td>1.93</td>
<td>2.29</td>
</tr>
<tr>
<td>3</td>
<td>Practices</td>
<td>Our staff is able to name and describe the different (care) processes of upstream and downstream departments (clinics).</td>
<td>[Gemmel et al. 2008, p. 1213]</td>
<td>0.16</td>
<td>-0.79</td>
<td>-0.81</td>
</tr>
<tr>
<td></td>
<td>Practices</td>
<td>(Care) processes are broadly documented and/or modelled.</td>
<td>[Gemmel et al. 2008, p. 1213; Vera, Kuntz 2007, p. 60]</td>
<td>0.15</td>
<td>-0.69</td>
<td>-0.90</td>
</tr>
<tr>
<td></td>
<td>Structure</td>
<td>There are no or little barriers between the departments (clinics) of our hospital.</td>
<td>[Lok et al. 2005, p. 1367]</td>
<td>0.06</td>
<td>0.27</td>
<td>0.20</td>
</tr>
<tr>
<td></td>
<td>IT</td>
<td>Our IT team facilitates a timely and high-quality availability of required (patient) data.</td>
<td>[Fitterer, Rohner 2010, p. 323; Goldstein, Schweikhart 2002, p. 66]</td>
<td>0.06</td>
<td>1.73</td>
<td>2.14</td>
</tr>
</tbody>
</table>
Table 12: Results of Rasch and Cluster Analysis

B.4 A staged Maturity Model for Process Management in Hospitals

The MM is constructed using the results of both the RA and the succeeding cluster analysis. Along the dimensions that form the theoretical basis of our maturity concept, the items are assigned to the levels as they were determined by applying the algo-
The resulting model is a staged MM that describes the evolution of process management as it takes place in 129 Swiss hospitals that have taken part in the investigation (Figure 7). Some cells of the MM are empty owing to the fact that on “each maturity level certain components of [the object of maturity] become evident and others barely registered” [McCormack et al. 2009, p. 795]. In the case of the herein proposed model it becomes evident that a full implementation of process management in Swiss hospitals begins with ‘setting the scene’ by laying a focus on the rather soft factors culture and strategy in stages 1 and 2. From there on, the focus shifts to the more tangible implementation-related factors like structure, work practices and IT. The stages of the MM are cumulative, that is they are traversed subsequently while additively increasing the level of maturity of each dimension.

<table>
<thead>
<tr>
<th>Stage 1</th>
<th>Stage 2</th>
<th>Stage 3</th>
<th>Stage 4</th>
<th>Stage 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Encouragement of Process Orientation</td>
<td>Case-by-Case Handling</td>
<td>Defined Processes</td>
<td>Occasional Corrective Action</td>
<td>Closed Loop Improvement</td>
</tr>
<tr>
<td><strong>Culture</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Employees are encouraged to contribute their own ideas for (care) process improvement.</td>
<td>- We practice a culture of open communication.</td>
<td>- Our senior management does not apply an authoritarian leadership style.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Communication in our hospital spans hierarchical levels (vertical).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Strategy</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Cross-departmental and cross-clinical cooperation is a fundamental element of our strategy.</td>
<td>- Adherence to strategic objectives is continuously reviewed.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Cross-departmental and cross-clinical exchange of information is a fundamental element of our strategy.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Structure</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- We regularly employ interdisciplinary teams consisting of members from different medical professions.</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Practices</strong></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
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<td></td>
<td></td>
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<tr>
<td><strong>IT</strong></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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</tbody>
</table>

*Figure 7: A Maturity Model for Hospital Process Management*
The full maturation path is outlined in the following:

- **Stage 1 – Encouragement of Process Orientation**
  The first level is characterised by an initial strategic commitment to process management, which is reflected in the fact that cross-clinic cooperation and information exchange represent fundamental elements of the strategy and are thus actively promoted by hospital management. While staff is encouraged to contribute ideas for improving work practices, it is not yet clear whether these ideas are actually put into practice. A regular employment of cross-professional teams also points to the appreciation of a process oriented mode of operations.

- **Stage 2 – Case-by-Case Handling**
  Level two features a further movement towards process management. Open communication is actively practiced, not only between regular doctors and chief physicians of the same clinic but also between different clinics. However, with respect to process management this stage still has an ad-hoc character: While adherence to the strategic goal of implementing process management is continuously reviewed, cross-departmental issues are in this stage only addressed in a case-by-case manner.

- **Stage 3 – Defined Processes**
  On level three, process orientation spreads throughout the hospital: Procedures are now modelled and documented, work steps are adjusted to follow the patient flow, and doctors and other employees are aware of the processes of upstream and downstream departments and clinics. Visible and invisible barriers between departments diminish noticeable and senior management as well as chief physicians abandon their authoritarian leadership style. Clinical and administrative processes are on this stage supported by IT systems that facilitate a timely and high-quality provision of required (patient) data.

- **Stage 4 – Occasional Corrective Action**
  Level four represents a further manifestation of process management. Hospital IS are in place that are well integrated and facilitate a smooth flow of complete patient care. The performance of processes is measured on an occasional basis and – if necessary – procedures are adapted or changed. Decisions on alterations, both regarding patient care or hospital organisation, are made collectively.

- **Stage 5 – Closed Loop Improvement**
  Stage five of process orientation in hospitals is characterised by IS that are easy to use for all staff and enable a clear and highly understandable interaction.
Staff on all hierarchical levels is actively supporting the strategic decision to transform the hospital into a process-oriented organisation. At this stage, process ownership is not just a role but an established organisational entity with significant authority and process reviews are conducted on a regular basis in order to realise continuous improvement.

### B.5 Evaluation

The evaluation of artefacts represents an indispensable task in every design research endeavour [Hevner 2007, p. 89]. The need for the development of the herein proposed MM was driven by the latest developments in the Swiss hospital sector, characterised by a rising pressure for institutional survival. The proposed model outlines the typical evolution of process management as it actually takes place in hospitals based on a questionnaire-based quantitative methodology. As the results of our first round of empirical evaluation revealed, it turns out to be of particular relevance and utility for the intended audiences. In order to assess the usefulness of our model we conducted interviews with two clinical and two administrative hospital managers who did not participate in had not been part of the initial survey. The interviews commenced with a brief introduction on the background and purpose of the model. Thereafter, interviewees were asked to evaluate the model with respect to the following four aspects:

- **Completeness**: Is the model complete as relates to content?
- **Utility**: Does it allow for determining the own position, that is for conducting a valid self-assessment?
- **Utility**: Does the model also allow deriving means of improvement?
- **Advancement**: What would enhance the value of this model?

Answers are in the following presented in a summarised form. All four respondents valued the overview functionality of the model positively. Having just recently been confronted with process management as a possible answer to the increased cost containments, they appreciated the possibility to quickly obtain a grasp of what dimensions are crucial and how hospitals evolve in implementing process management. While the model was considered complete as relates to content on the given level of granularity all interviewees remarked that a second, more detailed level would provide additional benefits. Regarding the self assessment, all interviewees were quickly able to locate their respective hospital based on the model. Interestingly, assessments of the respective clinical and administrative managers did not differentiate much. It turned out, however, that the transition from one level to the next may not necessarily always
be staged, but could differ for some dimensions. Due to the fact that the model represents an empirically validated ‘journey’ towards process management, interviewees remarked that they felt able to identify necessary improvement steps based on the difference between their current position and the final stage of maturity. Thus, they attributed the model a normative character. With respect to utility, especially the two clinical managers remarked that – apart from the ‘gap analysis’ based on the maturity levels – they would appreciate additional guidance. Moreover, extending the model towards a tool for hospital-spanning assessments would be highly valuable, as one of the interviewees remarked, since the introduction of DRG also leads to a higher degree of specialisation, which again requires cooperation between hospitals. One evaluation criterion for selecting a cooperation partner may then be his level of competence with regard to process management.

B.6 Discussion and Conclusion

In the light of serious cost containments and an increased competition with the introduction of the DRG-based payment system, Swiss hospitals are more than ever in need of ways to operate effectively. Process management has repeatedly been named as an effectual approach for improving quality while reducing costs and resources. In this study we presented a theoretically grounded staged MM for process management in hospitals based on empirical data. While the model portrays evolution patterns empirically observed in a number of hospitals at a certain point in time and is thus basically descriptive in nature, a first empirical evaluation revealed that it nonetheless offers normative advice. The four evaluation partners positively valued its comprehensiveness as relates to content and the possibility to determine the own institution’s position. Additional benefits may be attainable by including ‘best practice’ guidance and conducting organisation-spanning assessments so as to enable a well-founded benchmarking.

From a theoretical perspective, the following implications are worth mentioning. The application of behavioural research methods in the context of design research as it is accomplished in this article is unconventional and innovative. Usually, the RA is employed to measure variables such as abilities, attitudes, and personal characteristics for psychological and educational assessments. Adapted for MM development the RA allows for the inductive allocation of capabilities onto maturity levels and thereby supports the rigorous design of MM. Moreover, through the use of cluster analysis the arbitrariness in assigning capabilities to different maturity levels that is inherent in
other development methods and has been criticised by several researchers is avoided [Lahrmann et al. 2011a, p. 177].

From a practical perspective, the following implications are worth mentioning. The model proposed in this article was specifically developed for the hospital sector. The legitimate question comes up, whether the guidance for introducing process management into hospitals differs from that required in the manufacturing and service industries, for which several models are available today. To answer this question, it is useful to briefly recapitulate the evolution of BPM in the manufacturing and service industries. In contrast to hospitals, organisations of the manufacturing and service industries have at all times operated under competitive conditions. As a consequence, these organisations have begun to adopt BPM essentially from its first appearance on. However, as the concept was hardly defined by then and also falsely assumed to require radical change, the majority of the very early BPM initiatives failed [Al-Mashari et al. 2001; Smith, Fingar 2003]. In consequence, BPM was (re-)defined as being more of an evolutionary approach geared to continuous improvement. Numerous BPM MM have been developed in succession, all with the objective to guide organisations in successfully accomplishing their BPM ventures. Probably due to the vast experiences they have been built upon, these models turn out to be highly complex. Moreover, many extant models have a strong focus on IT support and integration, but often neglect culture and structure, as a recent comprehensive analysis of BPM MM reveals [Van Looy 2010, p. 693]. While the mentioned characteristics make these models useful and valuable for manufacturing and service organisations, this is not the case for hospitals. Their development towards process orientation and management commences from a differing starting position in which organisational factors play the most important role. Today, hospitals are mostly characterised as loosely coupled sets of highly specialised silos with partly dubious incentive systems and an intense shielding of medical groups [Vera, Kuntz 2007, p. 64]. Consequently, their way towards a successful process management requires a much stronger focus on both cultural and structural factors than it does in manufacturing and service organisations, where the focus is rather on IT-support and process automation. The model introduced in this article offers an adequate level of complexity while addressing the specific problems that hospitals are actually facing.

Another question that calls for an answer is: How have hospitals that have been confronted with the DRG scheme for well over ten years now, like e.g., those in Germany managed the process challenge? Two recently conducted studies shed some light on this issue. Both Gemmel et al. [2008] and Vera and Kuntz [2007] investigated the ma-
turity of process orientation and management in German hospitals. Both studies emphasise the various benefits of process orientation and management for hospitals and at the same time consistently report on a very low level of implementation. However, Vera and Kuntz [2007, p. 64] strengthen the necessity of a hospital-wide commitment to process orientation and the establishment of a ‘process culture’ as a prerequisite for a successful realisation. It is thus assumed that the model proposed in this article may also be of value for hospital management in other countries that are affected by the introduction of DRG.

Like every empirical study, this one comes with limitations, too. One pertains to the evaluation of the model. While an initial evaluation has been accomplished, a broader assessment with a larger number of hospitals is indispensable. The development of the proposed model is based on a theory-led conceptualisation of maturity and a quantitative approach for determining the different stages of maturity. We consider this approach as a very promising and valuable one, but want to acknowledge that enriching it with qualitative methods may lead to an even stronger expressiveness and depth of the model.

Further research may apprehend and address the just named limitations. Moreover, longitudinal studies on the development of process management capabilities are of interest. Not least, investigating the actual impact of process orientation and process management on different aspects of hospital performance and an institution’s competitiveness represents an interesting avenue for further research.
Contribution C – Process Performance Management – Identifying Stereotype Problem Situations as a Basis for Effective and Efficient Design Research

<table>
<thead>
<tr>
<th>Title</th>
<th>Process Performance Management – Identifying Stereotype Problem Situations as a Basis for Effective and Efficient Design Research</th>
</tr>
</thead>
</table>
| Authors & Affiliations | Cleven, Anne; Wortmann, Felix; Winter, Robert  
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| Publication Type | Conference Paper |
| Year | 2010 |
| Status | Published |

Table 13: Bibliographical Information for Contribution C

Abstract. Just recently many organisations get involved with process performance management (PPM). It appears, however, that PPM initiatives confront organisations with multi-faceted and complex challenges that call for a detailed problem analysis before any solution is developed. In this paper we introduce two patterns for identifying stereotype problem situations in design research (DR) and apply one to the field of PPM. The application provides detailed insight into typical PPM problem situations and illustrates the usefulness of our approach.

Keywords: Design Research, Design Science, Process Performance Management, Problem Definition
C.1 Introduction

In today’s hypercompetitive and globalised world measuring and in particular managing organisational performance is obligatory [2006]. Hence, myriad of frameworks have been developed during the last few decades each focussing on a somewhat different set of performance-related aspects [Folan, Browne 2005]. However, only a few of these frameworks emphasise processes as the primary object of performance management [Folan, Browne 2005]. Similarly, performance issues have been widely neglected in extant business process management (BPM) approaches and systems so far. In fact, BPM systems are “still very much workflow management systems (WfMS) and have not yet matured in the support of the BPM diagnosis” [Ko et al. 2009]. Although some software suites provide features like business activity monitoring (BAM) and audit trails, the generation of meaningful reports or the prediction of process trends are still only rarely feasible [Ko et al. 2009]. Therefore, Elbashir et al. [2008] propose that effectively managing performance on a process level requires bringing together BPM on the one hand, and business intelligence (BI) capabilities and techniques on the other. Whatever the actual sophistication of PPM may be, it is undisputed that a prerequisite for the development of a suitable PPM solution is a detailed analysis of the respective problem situation. Within the information systems (IS) research community the DR approach has been recognised as a valuable means for rigorously developing useful problem solutions. However, with respect to how problem situations should be identified, there still is a lack of guidance as will be shown below. Therefore, the aim of this paper is twofold: Firstly, we suggest two approaches to identifying stereotype problem situations in DR in general. Secondly, applying one of the proposed approaches, we strive for understanding the nature of stereotype PPM problem situations in particular. We address these objectives by first providing a conceptual background, including a brief overview of the current DR literature and the concepts of BPM, BI and PPM (section C.2). Subsequently, we propose two approaches for identifying stereotype problem situations and apply the first approach in the field of PPM (section C.3). The concluding section (section C.4) summarizes and discusses our approach and gives an outlook on future work.

C.2 Background

C.2.1 Design Research

The DR paradigm has been discussed thoroughly in recent years and is just now gaining ground as a valued contributor to both “building knowledge and improving prac-
Raw text.

As mentioned above, DR artefacts are developed with the overall objective of transforming unsatisfactory real-world situations into more desirable ones. The appropriateness or usefulness of a planned solution for a certain problem is thereby greatly contingent upon the unique factors that characterise the problem situation. Some researchers like Fiedler [1964] in his work on the so-called ‘contingency model’ or Mitroff [2004] in his work on wicked problems, have emphasised the importance of thoroughly analysing and defining investigated problems in order to reveal their distinct characteristics. Up to now, however, extant DR literature has not incorporated these insights. Quite the contrary, while the analysis and specification of the problem situation within a DR project is of central importance for the success of the whole project, it has so far not received much academic attention (as opposed to, e.g., evaluation, which has been considered in great detail, cf. [Baskerville et al. 2007; Cleven et al. 2009; Pries-Heje et al. 2008a; Pries-Heje et al. 2008b]).
March and Smith, two of the very early authors of DR in IS, do not address the necessity of analysing the problem situation at all [March, Smith 1995]. In their much-cited MISQ paper, Hevner et al. admittedly express the importance of examining the ‘environment’, stating that “business needs are assessed and evaluated within the context of organisational strategies, structure, culture, and existing business processes” [Hevner et al. 2004, p. 79]. Nonetheless, they do not provide any normative or prescriptive guidelines on how to assess the business needs in their specific context. Peffers et al. emphasise the importance of the “knowledge of the state of the problem” [Peffers et al. 2007, p. 55] for providing an effective solution. However, further advice only gets as specific as the recommendation that “it may be useful to atomize the problem conceptually so that the solution can capture its complexity” [Peffers et al. 2007, p. 52].

C.2.2 Business Process Management

Although Nordsieck had already suggested adjusting a business’s activities along its value chain—as opposed to its functions or departments—as early as in 1934 [Nordsieck 1934], the actual change from a vertical, functional to a horizontal, process-oriented organisational structure only took place in the late 1980s. Especially Porter [1980], Hammer and Champy [1993], and Davenport [1993] have contributed to this paradigm shift by promoting a holistic and customer-focused process-orientation [De-Toro, McCabe 1997]. Today, BPM is a well-established concept, and a number of authors have developed a great variety of different approaches to it.

Across these approaches, BPM is commonly understood as a set of methods, techniques and tools to continuously (re-) design, enact, analyse, control and improve an organisation’s fundamental operational activities [Lee, Dale 1998; van der Aalst et al. 2003; Zairi 1997]. While putting different emphases in their works, the majority of researchers agree that BPM consists of four main processes that are affiliated with and build on each other, namely: (I) ‘process definition, design and modelling’, (II) ‘process implementation and enactment’, (III) ‘process monitoring and controlling’, and (IV) ‘process optimisation and refinement’. Kueng and Krahn found that in a large number of today’s organisations, performance measurement and assessment on a process level is realised only in a mediocre way [Kueng, Krahn 1999].

C.2.3 Business Intelligence

One of the very first persons to use the term ‘business intelligence’ was Hans Peter Luhn in his 1958 article "A Business Intelligence System" [Luhn 1958]. While in this early stage, the perception of BI had a slightly different tinge and was mainly re-
Part B: Process Performance Management – Identifying Stereotype Problem Situations

restricted to system- and technology-related issues, later definitions reflect the business-proximity and the methodological character of the concept. Today, BI (often likewise called business analytics) may be defined as “concepts and methods to improve business decision making by using fact-based support systems” [Power 2009, par. IV.2], and it constitutes a crucial component within a company’s management reporting infrastructure. BI systems provide decision makers with timely, relevant, and easy-to-use information and can be defined as “specialized tools for data analysis, query, and reporting, (such as OLAP and dashboards)” [Elbashir et al. 2008, p. 138]. BI systems are complemented by special IT infrastructure, such as data warehouses, data marts and “Extract, Transform and Load” tools, which are required for their deployment and effective use [Elbashir et al. 2008].

BI serves a multitude of different purposes. Such being the case, Sircar calls it the “latest battlefield” [Sircar 2009, p. 293] for organisations that are striving for either survival or—even more ambitious—a competitive advantage in today’s global and fiercely rival business environment. The concept holds a bundle of analytical capabilities that allow organisations to use their data effectively and to track exactly how their business performs. These capabilities range from retrospective, descriptive analyses, answering questions like ‘What happened?’ and ‘Where exactly was the problem?’ to future-oriented, predictive analyses, answering questions like ‘What happens if these trends continue?’ and ‘What will happen next?’ [Davenport, Harris 2007]. Thus descriptive or core analytics facilitate quick reactions or corrections, whereas predictive analytics help organisations anticipate future concerns like, for example, customer needs. Current research issues in the field of BI cover the quantification, measurement and evaluation of BI systems’ benefits and improved tactics for managing the BI processes within organisations efficiently [Jourdan et al. 2008; Lönnqvist, Pirttiäki 2006].

C.2.4 Process Performance Management

Organisational performance has an imperative influence on both the actions of companies and their competitiveness. Thus, the development of means for accurately measuring this performance has highly occupied researchers and practitioners in recent years [Keegan et al. 1989; Lynch, Cross 1991; Neely et al. 2002]. The following list represents a digest of dimensions that are included in existing performance measurement frameworks: cost, quality, productivity, flexibility, efficiency, growth, processes, customer satisfaction, delivery, and environment [Carton, Hofer 2006; Folan, Browne 2005]. A recent shift has taken the focus from the pure measurement of performance to a broader view of an actual management of performance [Amaratunga, Baldry 2002;
Folan, Browne 2005]. Performance management can then be defined as “the use of performance measurement information to effect positive change in organisational culture, systems and processes” [Folan, Browne 2005, p. 674].

Performance measurement and management systems address a variety of different aspects of performance, such as those in production planning [Karacapilidis, Pappis 1996] and cost accounting [Durden et al. 1999]. However, only few enable an organisation to manage its performance effectively on the level of business processes. Elbashir et al. state that the use of BI systems is obligatory for a company seeking to enhance its business process performance via measures like cost reduction and productivity improvement [Elbashir et al. 2008, p. 139]. Some currently available WfMS provide rudimentary process monitoring and control functions but “have not yet matured in the support of the BPM diagnosis.” [Ko et al. 2009, p. 748]. Ko et al. further point out that some software suites include BAM dashboards and facilitate the creation of useful audit trails, but the generation of “meaningful reports displaying process trends still requires external specialized reporting tools” [Ko et al. 2009, p. 749].

C.3 Identifying Fundamental PPM Problem Situations

C.3.1 Two Approaches to the Identification of Problem Situations

As has been pointed out in section C.2.1 extant DR literature has only on the surface touched the question of how to exactly analyse the problem situation under consideration and how to identify and specify its unique characteristics. However—as with any other research endeavour—specifying the exact problem situation is necessary in order to prevent wasted time and money [Creswell 2003]. In this section, we propose two related approaches to the task of rigorously analysing a DR problem. The approaches may be interpreted as patterns as they are known and frequently used in the field of object-oriented programming [Gamma et al. 1995]. A pattern describes a pair of a regularly recurring problem and a respective general solution. The general solution serves as a template that can be reused to fasten the problem solving process for a certain problem class. The subsequently proposed patterns provide two general variants for examining the specific characteristics of DR problems systematically.

A major subfield of the IS discipline deals with software design and software engineering [Benbasat, Zmud 2003]. It is this subfield that we consulted when developing our approaches. A software development project always starts off with a detailed analysis of the exact functional conditions, non-functional conditions and needs the planned software or system has to meet—that is, the requirements engineering (RE)
Part B: Process Performance Management – Identifying Stereotype Problem Situations

[Berenbach et al. 2009]. In their seminal 1998 book, Kotonya and Sommerville, two pre-eminent authors in the field of RE, identified four essential activities for the RE process, namely: (I) ‘requirements elicitation’, (II) ‘requirements analysis and negotiation’, (III) ‘requirements documentation’, and (IV) ‘requirements validation’ [Kotonya, Sommerville 1998]. The two approaches proposed herein relate to the first two activities of this process. The first approach, named *Lean Situation Identification Process*, is depicted on the left-hand side of Figure 8, whereas the second, named *Rich Situation Identification Process*, is shown on the right-hand side. As there is never a one-size-fits-all solution to problems [Bucher et al. 2007], both approaches identify a number of different starting positions from which organisations may commence. This allows for the development of solutions as close to the actual requirements as possible. Subsequently, the approaches are described in detail.

**Figure 8:** DR Problem Situation Identification Patterns

When starting a DR project, the very first step concerns the identification of the problem to be solved. The problem may either be identified deductively by means of a literature analysis or apprehended directly from real-world incidents [Swamidass 1991]. In order to achieve a deeper understanding of the problem situation as relates to its very specific characteristics, and to facilitate both a higher relevance and utility of the final solution(s), we propose to conduct an empirical investigation based on a survey.
In order to identify fundamental, i.e., stereotype problem situations a questionnaire needs to be developed based on knowledge to be acquired in the area under investigation (cf. Figure 8, phase (1) in both processes). Thereon, the questionnaire must be distributed to a population sufficiently large and representative to establish a reliable impression of the different situation stereotypes (cf. Figure 8, phase (2) in both processes). While the two patterns proposed herein work alike during the phase of requirements elucidation, they differ with regard to the phase of requirements analysis and negotiation.

The **Lean Situation Identification Process** is applied if the respondents selected for the survey are under time pressure and thus only have a limited amount of time, whereas the **Rich Situation Identification Process** may be employed if the respondents have a considerable amount of time. In the first case, the survey participants are asked only to answer the questionnaire as to how they conceive the current situation within their organisations (‘today’). In contrast, the second pattern includes the investigation of the desired (‘target’) situation as well. The actual analysis then begins with an exploratory factor analysis (EFA), which serves the purpose of developing a deeper understanding of the characteristics of the current problem situation (cf. Figure 8, phase (3) in the first approach and phase (3a) in the second) and those of the targeted situation (cf. Figure 8, phase (3b) in the second approach). In general, EFA serves the identification of a number of important and mutually independent factors from a multiplicity of contingent variables [Conway, Huffcutt 2003]. Subsequently, the question concerning whether there are common situations that feature the same characteristics can be tackled using cluster analysis. A cluster analysis serves the purpose of partitioning a set of observations into subsets that are homogeneous within and heterogeneous amongst each other [Hair Jr et al. 2006]. Again, the first pattern exclusively addresses the current situation, whereas the second also reveals situations the organisations polled are targeting. Both approaches conclude with an interpretation of the identified clusters (cf. Figure 8, phase (5) in both processes).

Both of the two approaches are associated with some specific assumptions as well as advantages and disadvantages. The **Lean Situation Identification Process** shows the clear advantage of having half as many questionnaire items as the second approach. Consequently, its analyses are only half as elaborate. However, this simplicity comes with the assumption that—irrespective of the individual starting situation—all companies are striving for one ideal target situation in which each of the identified factors or characteristics that describe the starting position will be maximised. The characteristics of the first approach are briefly summarised in the following table.
Usage Scenarios

- Respondents have a limited amount of time for questionnaire completion
- Exploratory analysis with a considerable number of items

Advantages

- Lightweight questionnaire covering “today” questions only
- Lightweight analysis (only one factor and one cluster analysis)
- Low number of situations (cluster “today”) results in less complex artefact construction and validation process

Disadvantages

- Situations are derived on the assumption that companies strive for a general improvement in regards to all factors, that is, one ideal target situation exists

Table 14: Characteristics of the Lean Situation Identification Process

The second approach, too, features some distinctive characteristics. Also addressing the targeted situation, it produces a much bigger deal of work. In return, it allows for a much more precise analysis of the requirements for each situation by facilitating a detailed migration analysis from initial to target situations. The following table briefly summarises the features of the second approach.

Usage Scenarios

- Respondents have a considerable amount of time for questionnaire completion
- Confirmatory analysis with a limited number of items

Advantages

- Situations precisely depict the requirements

Disadvantages

- Time-consuming questionnaire covering “today” and “target” questions
- Complex analysis (two factor and two cluster analyses)
- High number of situations (cluster “today” × cluster “target”) results in complex artefact construction and validation process

Table 15: Characteristics of the Rich Situation Identification Process

Subsequently, we apply the first pattern—the Lean Problem Situation Identification Process—for the examination of typical problem situations in the field of PPM.
C.3.2 Lean PPM Problem Situation Identification

C.3.2.1 Problem Identification and Questionnaire Development

As has been pointed out in the previous section, gaining knowledge through reviewing existing literature in the field under investigation is essential for the development of the questionnaire (cf. section C.3.1, [Czaja, Blair 1996]). As PPM represents a multidisciplinary field of study that builds on a variety of concepts, methods and techniques from other research areas, primarily BPM, BI and performance management [Melchert et al. 2004], the following sections represent the building blocks of the questionnaire:

- **BPM**: BPM is a fundamental pillar of PPM. Thus, the questionnaire contains items that address the degree to which an organisation is process-oriented. Consequently, factors like clear process responsibilities (process officers) [Samson, Challis 2002] and well-defined process documentation are covered. Moreover, the degree of consistent and transparent processes across systems and the organisation is taken into account [Bucher, Winter 2010].

- **BI**: BI serves as the information backbone of PPM (cf. section C.2.4). As well-defined BI responsibilities and processes are a prerequisite for effective and efficient information delivery, the questionnaire includes both. Furthermore, since data integration and data quality are key for holistic and reliable PPM, they are also covered by the questionnaire.

- **PPM**: The questionnaire also contains items that address what organisations actually measure (i.e., process cycle time, process costs, process quality). Furthermore, the data set covers information on where measures are deployed (i.e., production processes, sales processes). Finally, the questionnaire asks for the PPM approach in use, specifically, whether PPM is integrated into an overarching management approach (i.e., balanced scorecard, corporate performance management) and whether the plan-do-check-act (PDCA) cycle is applied to PPM.

C.3.2.2 Survey Conduction

The questionnaire was distributed at a BI and data warehousing (DWH) practitioner event held in October 2009. The participants were specialists and executives, working in the field of BI and DWH on both the IT and the business side thus having the required knowledge and information to answer the questions [Czaja, Blair 1996]. The questionnaire was designed to assess the current state of PPM in the participating organisations. Respective statements were formulated, and the respondents were re-
quested to indicate current values for the degree of realisation of each variable using a
five-tiered Likert scale. The questionnaire was pretested before use on both an indi-
vidual item level in early phases and as a whole before finally being distributed [Czaja,
Blair 1996].

Fourty-nine questionnaires were returned. If a data set was incomplete—that is, if one
or more than one of the 21 items was missing—the questionnaire was excluded. On
the basis of this criterion, 45 questionnaires were selected for further analysis. Al-
though the data set is rather small, the sample can be considered adequate for the pur-
pose of an EFA [de Winter et al. 2009]. The interviewed organisations are primarily
large and medium-sized companies from the German-speaking countries. 60 percent
have more than 1000 employees and another 22 percent have more than 100 employ-
ees. The sectors mainly represented were professional services (40%), banking, fi-
ance and insurance (29%), high-tech (11%), manufacturing and consumer goods
(7%), media and telecommunications (5%), and others (8%).

C.3.2.3 Exploratory Factor Analysis

The EFA was performed on the data set covering 21 items. The measure of sampling
adequacy (MSA, “Kaiser-Meyer-Olkin criterion”) for the data set is 0.777. MSA
represents an indicator for the extent to which the input variables belong together and
provides information on whether a factor analysis can reasonably be performed or not.
Kaiser and Rice suggest a value of 0.7 or more as ‘reasonable’, that is, the data set is
considered to be appropriate for applying EFA [Kaiser, Rice 1974; Stewart 1981]. Five
factors that jointly explain about 75.6 percent of the total variance were extracted by
means of principal component analysis. Both the Kaiser criterion and the scree plot
point to this solution. The resulting component matrix was rotated using the Varimax
method with Kaiser normalization in order to improve the interpretablity of the items’
assignment to the factors [Kaiser, Rice 1974]. The rotated component matrix is de-
picted in Table 16.

<table>
<thead>
<tr>
<th>Item description</th>
<th>F1</th>
<th>F2</th>
<th>F3</th>
<th>F4</th>
<th>F5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor (1) Broad, PDCA-based Use of PPM Measures</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Eigenvalue = 9.510; Variance explained = 45.287%</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adherence to schedules is measured for processes.</td>
<td>.834</td>
<td>.304</td>
<td>.059</td>
<td>.165</td>
<td>.102</td>
</tr>
<tr>
<td>Capacity utilization is measured for processes.</td>
<td>.787</td>
<td>.345</td>
<td>.332</td>
<td>.202</td>
<td>.083</td>
</tr>
<tr>
<td>Quality is measured for processes.</td>
<td>.758</td>
<td>.209</td>
<td>.228</td>
<td>.202</td>
<td>.190</td>
</tr>
<tr>
<td>Item description</td>
<td>F1</td>
<td>F2</td>
<td>F3</td>
<td>F4</td>
<td>F5</td>
</tr>
<tr>
<td>---------------------------------------------------------------------------------</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>Process resource utilisation is measured.</td>
<td>.735</td>
<td>.395</td>
<td>.069</td>
<td>.060</td>
<td>.059</td>
</tr>
<tr>
<td>Process costs are measured.</td>
<td>.728</td>
<td>.362</td>
<td>.305</td>
<td>.067</td>
<td>-.030</td>
</tr>
<tr>
<td>Process cycle times are measured.</td>
<td>.723</td>
<td>.221</td>
<td>.324</td>
<td>.331</td>
<td>.190</td>
</tr>
<tr>
<td>The plan-do-check-act (PDCA) cycle is applied for PPM.</td>
<td>.543</td>
<td>.168</td>
<td>.214</td>
<td>.415</td>
<td>.308</td>
</tr>
</tbody>
</table>

**Factor (2) BPM Maturity**  
*Eigenvalue = 2.530; Variance explained = 12.049%*

| Process flows are consistent and transparent beyond functional borders (organisational unit, division and department). | .239| .796| .284| .045| .063|
| Processes have defined process officers.                                         | .203| .765| .057| .105| .044|
| Processes are consistently documented and/or modelled.                           | .321| .758| -.062| .180| .216|
| Process flows are consistent and transparent beyond system borders.              | .404| .718| .358| -.047| .167|
| Process orientation is a central paradigm.                                       | .289| .660| -.110| .220| .046|

**Factor (3) PPM Process Diffusion**  
*Eigenvalue = 1.527; Variance explained = 7.269%*

| PPM also covers non-financial measures.                                           | .034| -.047| .843| .280| -.121|
| PPM is deployed for purchasing processes.                                        | .282| .156| .797| .158| .003|
| PPM is deployed for production processes.                                         | .260| -.064| .714| .272| .249|
| PPM is deployed for sales processes.                                             | .268| .394| .702| .008| .137|

**Factor (4) BI-enabled, Integrated PPM**  
*Eigenvalue = 1.209; Variance explained = 5.759%*

| Defined BI governance responsibilities and processes are in place.               | .033| .270| .134| .775| .094|
| PPM is part of the enterprise-wide balanced scorecard (BSC).                    | .392| -.031| .387| .750| -.020|
| PPM is part of the corporate performance management (CPM).                      | .297| .153| .469| .613| .102|

**Factor (5) High-quality Information Base**  
*Eigenvalue = 1.109; Variance explained = 5.283%*

| A central integrated data base is in place (e.g., an enterprise data warehouse (DWH)). | .009| .125| .018| .107| .907|
| Data quality is consistently high.                                              | .279| .128| .075| .023| .814|

Table 16: Factor Loadings
The five factors were constituted as follows:

- Seven items load high on the first factor, in the following referred to as Broad, PDCA-based Use of PPM Measures. All of the items are metric-related and address two questions: a) What is measured in the context of PPM? (Which key performance indicators (KPIs) are used?), and b) How is the measurement accomplished. The process KPIs explicitly addressed by this factor are adherence to schedule, capacity utilisation, process quality, process resource utilisation, process costs, and process cycle times. The PDCA-cycle is applied for KPI management.

- All five BPM-related items were found to have significant impact on the second factor, accounting for the degree of BPM Maturity. Organisations with high levels of BPM maturity, advocate process orientation as a central paradigm, foster process documentation/modelling and clear process responsibilities, thereby assuring consistent process flows across organisations and systems.

- Another four items load high on the third factor, representing PPM Process Diffusion. This factor expresses the degree of KPI usage in core business processes (covering procurement, production and sales activities). Furthermore, this factor strengthens the importance of non-financial measures.

- Three variables were found to have significant impact on the fourth factor, subsequently referred to as BI-enabled, Integrated PPM. Organisations with a high performance in this factor rely on well-defined, well-coordinated processes and management approaches in performance management, as well as in BI. In these companies, PPM is part of an integrated and comprehensive management approach, that is, BSC or CPM. To enable concepts like BSC or CPM, defined BI governance responsibilities and processes are in place.

- Finally, two variables load high on the fifth factor, in the following referred to as High-quality Information Base. According to our analysis, companies with a high-quality information base build upon a central integrated data store (e.g., an enterprise DWH) thereby assuring consistently high data quality across the organisation.

**C.3.2.4 Cluster Analysis**

In order to identify organisations with similar problem situations, cluster analysis is used. The cluster analysis is based on factor scores that are calculated using the regression method [Thompson 2004]. The Ward fusion algorithm and the squared Euclidean distance are applied for clustering, as this combination finds very good partitions re-
sulting in an appropriate number of clusters and similar number of observations in each cluster [Hair Jr et al. 2006; Ward Jr 1963]. On the basis of the dendrogram, i.e., the graphical representation of the fusion process, and the cluster sizes, the final number of clusters was defined [Hair Jr et al. 2006]. Table 17 contains the arithmetic means of the factor scores for each of the four clusters.

<table>
<thead>
<tr>
<th>Cluster</th>
<th>n</th>
<th>F1</th>
<th>F2</th>
<th>F3</th>
<th>F4</th>
<th>F5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cluster 1</td>
<td>11</td>
<td>-0.264</td>
<td>-0.214</td>
<td>0.206</td>
<td>-0.559</td>
<td>-1.159</td>
</tr>
<tr>
<td>Cluster 2</td>
<td>16</td>
<td>-0.234</td>
<td>0.301</td>
<td>-0.069</td>
<td>-0.605</td>
<td>0.702</td>
</tr>
<tr>
<td>Cluster 3</td>
<td>11</td>
<td>0.743</td>
<td>-0.626</td>
<td>-0.599</td>
<td>0.580</td>
<td>0.056</td>
</tr>
<tr>
<td>Cluster 4</td>
<td>7</td>
<td>-0.220</td>
<td>0.632</td>
<td>0.775</td>
<td>1.351</td>
<td>0.127</td>
</tr>
</tbody>
</table>

Table 17: Arithmetic Means of Factors per Cluster

**C.3.2.5 Identification of Situations**

For an easier interpretation and better comparison, the cluster means in Figure 9 are standardized to depict by how many standard deviations (SDs) a cluster value (cluster means from Table 17) is above or below the overall factor mean (across all cluster values).

The four clusters can be interpreted as follows:

- **Cluster 1 – PPM Beginner**: The first cluster is characterised by poor performance regarding four of the five factors. Only PPM Process Diffusion, that is, the degree of KPI use in core business processes, is at an above average level. The organisations in this cluster demonstrate a significant lack of performance with regard to a High-quality Information Base. Neither from a BI perspective nor from a BPM perspective are fundamental concepts in place that could be leveraged as a basis for PPM.

- **Cluster 2 – Information Quality-driven BPM Traditionalist**: The second cluster demonstrate positive performance with respect to BPM and information quality. BPM and information quality form a solid basis for PPM. Nevertheless, all three PPM related factors are low-performing. Companies in this cluster specifically lack well-defined, well-coordinated processes and management approaches in performance management and in BI.

- **Cluster 3 – KPI Enthusiasts**: The third cluster is characterised by high BI and low BPM performance. The extent to which KPIs are employed, appears am-
biguous: While the number of different measures in place is very high, only a very small number of business processes are actually being measured.

- **Cluster 4 – PPM Expert**: Companies in the fourth cluster show a high level of performance across four of the five factors. The only low-performing factor is factor one. In contrast to the KPI enthusiasts, PPM experts apply PPM to a significant number of their business processes, building upon a consistent set of limited metrics.

![Graph showing standardised arithmetic means of factors per cluster](image)

**Figure 9**: *Standardised Arithmetic Means of Factors per Cluster*

The above described clusters represent typical problem situations, or ‘points of departure’ from which organisations may commence when getting involved with PPM. These stereotype situations may now serve as a basis for defining the objectives of any type of artefact required to support the respective PPM initiative.

### C.4 Conclusion and Future Research

The aim of this paper was twofold: For one thing, we sought to suggest two patterns offering advice on how to identify stereotype problem situations in DR in general. For
another thing, by applying the first of the proposed patterns we aimed at understanding the nature of stereotype PPM problem situations in particular. With the former we hope to contribute to the extant DR literature by providing a rigorous and yet easy-to-use way to systematically analyse the specific characteristics of a problem under investigation. Applying the approach to the context of PPM a) in fact revealed four distinct problem situations that mark the ‘point of departure’ for possible PPM projects and b) showed that the approach provides valuable assistance for analysing a DR problem. However, there remains a need for further research: In their current versions, the patterns are not yet deeply elaborated and approved, and therefore need further evaluation and refinement. Moreover, the patterns assist a design researcher in gaining a first good understanding of a problem situation. Most certainly, however, additional deeper analyses will be required for the actual building of artefacts. Not least, the applicability of the second pattern has to be assessed and both patterns should be used in further contexts to carve out potential deficiencies.


**Contribution D – Process Performance Management – Illuminating Design Issues through a Systematic Problem Analysis**

<table>
<thead>
<tr>
<th>Title</th>
<th>Process Performance Management – Illuminating Design Issues through a Systematic Problem Analysis</th>
</tr>
</thead>
</table>
| Authors & Affiliations | Cleven, Anne; Winter, Robert; Wortmann, Felix  
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| Publication Type | Conference Paper |
| Year | 2011 |
| Status | Published |

Table 18: Bibliographical Information for Contribution D

**Abstract.** Business processes are the means by which organisations create value. Consequently, organisations need to continuously monitor and control their processes’ performance so as to provide a consistent and predictable execution quality. A number of today’s organisations, however, appear to encounter difficulties with measuring and improving their processes’ performance. In this paper, we set out to identify the gap between how organisations currently approach process performance management (PPM) and what they are striving to realise in the future. The systematic gap analysis results in a set of design factors that are valuable in guiding future design efforts for useful and relevant PPM solutions.

**Keywords:** Business Process Management, Process Performance Management, Problem Analysis, Empirical Research, Design Research
D.1 Introduction

Organisational efficiency, innovativeness and high productivity represent key requisites for organisations to secure their viability. In the light of the current economic crisis, sustaining these capabilities takes on even greater significance. Providing an organisation with the metrics and measures to survive in a fiercely competitive environment constitutes the core of the field of corporate performance management [Folan, Browne 2005; Saltmarshe et al. 2003]. Numerous research efforts from practitioners and researchers alike have brought about a multitude of different approaches, the most famous being the balanced scorecard [Kaplan, Norton 2005]. Only lately, however, have performance measurement and management concepts entered the field of business process management (BPM) so as to provide a detailed understanding of process performance issues and to foster an organisation’s flexibility, adaptability and competitiveness [Martin 2008]. It is thus hardly surprising that a number of surveys and research articles report on acute difficulties companies experience with a successful implementation [Robson 2004; Vergidis et al. 2008]. Both the measurement and the improvement of organisational performance on a process level appear to be highly challenging. In a 2009 international survey Wolf et al. reported that only 29 percent of the companies polled have always or at least in the majority of cases defined performance measures in place for evaluating the success of their major processes [Wolf, Harmon 2010]. With 16 percent the share of organisations always or at least in the majority of cases using performance data to effectively manage their processes is even smaller [Wolf, Harmon 2010].

While a number of surveys attest to the existence of organisations’ difficulties with implementing PPM there is a paucity of empirical research that explores how the problem is actually characterized. A precise understanding of the problem, however, is a critical prerequisite for the development of innovative artefacts to solve it. The problem analysis presented in this paper is part of a larger research project that follows the design science research paradigm [Hevner 2007]. The project aims at developing artefacts supporting the alignment between the PPM needs articulated by the business and adequate information technology (IT). Accordingly, the aim of this paper is to systematically analyse problems encountered with the development and accomplishment of PPM initiatives. In management science, problems are commonly understood as a gap “between some existing situation and some desired situation” [Pounds 1969, p. 5]. Based on this comprehension problem definitions can be interpreted as the precise specification of such gaps. In order to define a problem, one thus compares “what is
with what ought to be" [Smith 1989, p. 968]. Hence, the research questions (RQ) that are driving the herein reported study are formulated as follows:

**RQ1** – What factors characterise current PPM approaches?

**RQ2** – What factors characterise desired PPM approaches?

**RQ3** – What are the most popular development trends, and what changes do they require?

We address these questions through a combined approach of survey and case study research. The survey we conducted is exploratory in nature and allows for deriving insights into characteristics of both current and desired PPM approaches. It furthermore facilitates a detailed analysis of both the most popular movements between the two stages and the type of changes that have to be made for the transition. The subsequent case analyses serve two purposes: On the one hand they are employed as a means to validate the survey results. On the other hand they provide a deeper understanding of the nature and complexity of PPM initiatives in organisations. The case interviews thus enable a more profound appreciation of the problem we address and the generation of additional suggestions for improvements and future work.

The remainder of this paper is structured as follows. In the subsequent section, we provide the conceptual background for our research by introducing the concepts of BPM and PPM. The third section introduces the research methodology. Section D.4 presents the detailed problem analysis and the results that were derived. Based on the analysis we then propose how our results can serve as a basis for future research efforts aiming at the design of innovative PPM solutions (section D.5). The paper concludes with a summary and a brief outlook on future research activities.

### D.2 Background

BPM as a holistic management concept prescribing that all organisational and management activity be based on the business’s core processes has been around for more than one and a half decades now [Armistead et al. 1999; Lee, Dale 1998]. The concept of BPM builds upon the notion of a business process as a series of cross-functional activities that need to be performed in order to collectively achieve a predefined goal [Davenport 1993; Hammer 1990]. Core processes are frequently termed an organisation’s “strategic assets” [Smart et al. 2009, p. 494] and describe end-to-end work that covers the whole value chain. The shift to a horizontal, process-oriented structure occurred as a result of the increasing inefficiencies organisations encountered with a
strictly vertical and function-oriented work structure. Starting with Frederick Taylor, who revolutionised work organisation with task decomposition and job measurement, a number of concepts like statistic process control (1950s), total quality management (TQM, 1980s), six sigma (1980s), and business process reengineering (1990s) have further reinforced the trend toward process orientation [Bonham 2008]. Obtaining a comprehensive process orientation throughout the whole organisation, however, is a non-trivial goal and only became practicable with the introduction of IT in the 1980s and 1990s [Bonham 2008].

Up to today, a great plenty of organisations are still in the early steps of becoming consistently process-oriented, as they are just about to analyse, truly understand and intentionally (re-)design their work practices. Since it requires allocating organisational as well as IT resources, defining policies and regulations, and thoroughly considering contextual environments and risk factors, implementing BPM is a highly complex task [Smith, Fingar 2003]. In recent years, both practitioners and academia have contributed immensely to the body of BPM knowledge, providing a number of best-practice frameworks as well as well-grounded insights into BPM as a research phenomenon. Much work has been carried out in the areas of business process modelling and design [Damij 2007], managing information about processes [Davenport, Beers 1995], and process-aware information systems [Reijers 2006], to name a few. One of the latest hot topics in the field of BPM is termed PPM. PPM is fuelled by an enormous practitioner interest. The concept accounts for the fact that once business processes are defined and in place, that is, an organisation has moved further in the BPM lifecycle it “will need to begin measuring processes and their outputs, and to continually refine their designs” [Davenport, Beers 1995, p. 60]. The most elaborate definition of the notion of PPM has so far been provided by practitioners. The Association of Business Process Management Professionals (ABPMP), one of the premier non-for-profit practitioner organisations in the field of BPM, defines the measurement of process performance as “the formal, planned monitoring of process execution and the tracing of results to determine the effectiveness and efficiency of the process” [ABPMP 2009, p. 22]. The information gained in the measurement process is then “used to make decisions for improving or retiring existing processes and/or introducing new processes in order to meet the strategic objectives of the organization” [ABPMP 2009, p. 22]. It becomes obvious from this definition that PPM consists of two major building blocks: measurement and improvement of business process performance. Although the term PPM has as of yet not reached a broad popularity and the concept is still about to develop, there have been a number of prior efforts in both re-
search and practice addressing either the measurement or improvement of business processes performance, or sometimes even both. Some of these approaches represent broad management concepts, like e.g., TQM or six sigma, while others offer specific techniques for solving clearly delineated sub-problems of the whole challenge of PPM, like e.g., business activity monitoring, process mining, or simulation [Kueng 2000; Powell et al. 2001]. A rather recently introduced concept, termed (business) process intelligence, builds on applying business intelligence (BI) techniques like data mining and statistical analysis for analysing process data in order to uncover weaknesses and discover opportunities for improvement [Grigori et al. 2004]. While BI has traditionally provided historical, retrospective analyses, in the context of process intelligence it is used to take the “pulse of the company” [Hall 2004, p. 3], generating findings based on present-day transactional data that are analysed in near real-time. Drawing on the brief analysis of extant literature in the field of PPM, it appears that the perception of what constitutes PPM and what approaches represent valuable components for its implementation are fairly undisputed. Nonetheless—as has been pointed out earlier in this paper—a great plenty of today’s companies have not yet succeeded in establishing reasonable and integrated end-to-end PPM solutions [Vergidis et al. 2008; Wolf, Harmon 2010]. This perceived grievance motivated the subsequently described study.

D.3 Research Methodology

In order to address the above formulated RQs, we employ a mixed-method approach integrating quantitative (survey) and qualitative (case study) research. It has frequently been argued that the use of different research methods will produce more copious and more reliable results [Mingers 2001]. Surveys and case studies are thus not viewed as competing sources of evidence, but as complementary methods that are incomplete without the other. For investigating the problem of developing and maintaining a successful PPM approach, we first conducted an exploratory questionnaire-based survey that allowed us to achieve preliminary insights into current and desired approaches. Moreover, we analysed the movements between the as-is and the to-be situations and thereby illuminated the biggest change issues. In order to both validate the survey results and facilitate a deeper understanding of the problem as well as a better appreciation of its nature and complexity, we subsequently accomplished three case studies with organisations representing three of the beforehand identified ‘problem classes’. The subsequent sections describe in detail how data was collected and analysed.
D.3.1 Survey

Survey research has a strong tradition in the information systems (IS) discipline [King, Jun 2005]. It is frequently applied in order to gather knowledge on typical characteristics of larger populations in new and not yet well-known situations [Palvia et al. 2004]. “By studying a representative sample of organizations, the survey approach seeks to discover relationships that are common across organizations and hence to provide generalisable statements about the object of study“ [Gable 1994, p. 114]. Exploratory survey research is used during the early phases of research into a phenomenon, when the intent is to acquisition preliminary insight [Forza 2002]. Commonly an exploratory survey is not based on an existing model, as the concepts of interest are yet to be identified and better understood. Instead it helps to establish the concepts and discover new facets of the subject under research.

For developing the survey instrument, an initial list of measurement items was prepared through a broad review of both the academic and professional literature on PPM. As has been shown above, PPM represents a multidisciplinary field of study that builds on a variety of concepts, methods and techniques from other research areas. The three main areas have been identified to be BPM, BI and performance management [Bonham 2008]. The questionnaire thus included items from each of these areas. The first version of the questionnaire was pretested with regard to wording, coherency, and ease of interpretation by three academics with adequate expertise. The instrument was revised according to their feedback. Before finally being distributed the questionnaire was again pre-tested by three practitioners with regard to consistency, understandability, and adequacy of item sequence. The described proceeding resulted in a final questionnaire covering 21 items that relate to the research phenomenon PPM. The questionnaire was distributed at a practitioner event on BI and business analytics held in October 2009. The participants were specialists and executives working on both the IT and the business side, thus having the required knowledge and information to answer the questions [Forza 2002]. In order to minimise the potential of semantic misunderstandings, the questionnaire was introduced to the participants including explanations on the purpose and the basic concepts that are addressed. The questionnaire was designed to assess both the current and the desired state of PPM in the participating organisations. Respondents were asked to indicate the degrees of realisation for each item using a five-tiered Likert scale. Forty-nine questionnaires were returned. If a data set was incomplete, that is, if one or more than one of the 21 items was missing, the questionnaire was disregarded. On the basis of this criterion, 42 questionnaires were
selected for further analysis. The surveyed organisations are primarily large and medium-sized companies from the German-speaking countries. 60 percent have more than 1000 employees and another 22 percent have more than 100 employees. The sectors mainly represented were professional services (40%), banking, finance and insurance (29%), high tech (11%), manufacturing and consumer goods (7%), media and telecommunications (5%), and others (8%). For analysing the data we applied exploratory factor analysis (EFA) and cluster analysis. EFA serves the purpose of developing a deeper understanding of a specific problem situation and the identification of a number of important and mutually independent factors from a multiplicity of contingent variables [de Winter et al. 2009]. The question of whether there are common situations that feature the same characteristics can be tackled using cluster analysis. A cluster analysis serves the purpose of partitioning a set of observations into subsets that are homogeneous within and heterogeneous amongst them [Kaiser 1958].

Two EFA were performed independently for as-is and to-be situations each based on the resp. data set of 21 items. The measure of sampling adequacy (MSA, “Kaiser-Meyer-Olkin criterion”) for the as is (to-be) data set is 0.777 (0.767). MSA represents an indicator of the extent to which the input variables belong together and provides information on whether a factor analysis can reasonably be performed or not. Kaiser and Rice appraise a value of 0.7 and above as ‘reasonable’, that is, the data set is considered appropriate for applying EFA [Stewart 1981]. For the as-is (to-be) situation five (four) factors that jointly explain about 75.6 percent (71.9%) of the total variance were extracted by means of principal component analysis. The resulting component matrices were rotated using the Varimax method with Kaiser normalisation in order to improve the interpretability of the items’ assignment to the factors [Kaiser 1958]. In order to identify organisations with similar as-is resp. to-be approaches to PPM, cluster analysis is used. The cluster analysis is based on factor scores that are calculated using the regression method. The Ward fusion algorithm and the squared Euclidean distance are applied for clustering, as this combination finds very good partitions resulting in an appropriate number of clusters and similar number of observations in each cluster [Hair Jr et al. 2006]. On the basis of the dendrogram, the graphical representation of the fusion process, and the cluster sizes the final numbers of clusters for both situations were defined [Hair Jr et al. 2006]. The following section briefly outlines the conduct of the case studies.
D.3.2 Case Studies

Case studies and especially semi-structured interviews are considered highly useful for exploring areas in which research is in an early stage [Benbasat et al. 1987]. They allow the researcher to study a phenomenon directly as it is perceived by the subjects involved, to learn about the state of practice, and to understand real-world processes and decision making. Other than survey research, case studies allow for answering ‘how’ and ‘why’ questions [Benbasat et al. 1987]. In order to better understand the how and why of PPM approaches, case studies with three organisations were accomplished. The companies were selected so as to gain a deeper understanding of three distinct ‘problem classes’ that were identified through the survey. The attribution to a problem class was based on a self-assessment of the organisations. Data was collected via semi-structured face-to-face interviews with process and performance analysts, quality managers and BI specialists. Findings presented below aggregate results from interview analyses per organisation. Due to company request the cases are presented anonymously.

D.4 Research Findings

D.4.1 Current Approaches to PPM

By means of the EFA we were able to identify five distinct factors that effectively characterise current PPM approaches in the surveyed organisations. The first factor, which we subsequently refer to as Broad, plan-do-check-act (PDCA)-based Use of PPM Measures, combines seven items. All of the items are metric-related and shed light on a) which key performance indicators (KPIs) are used for PPM and b) which method is applied to conduct PPM, namely the PDCA-cycle. The second factor, termed BPM Maturity, consolidates five items that indicate a strong process orientation as a central organisational paradigm. Another four items were found to load high on the third factor, which we named PPM Process Diffusion. It reveals a high degree of KPI usage for the core business processes (covering procurement, production and sales) on the one hand and the importance of non-financial measures on the other. Factor four, in the following referred to as BI-enabled, Integrated PPM, groups three items that together strengthen the need for well-defined and well-coordinated processes in both enterprise performance management and BI. The fifth and last factor, High-quality Information Base, combines two items that point to the need for an integrated, high-quality data base for a consistent PPM approach. Building on these fac-
tors, we conducted a cluster analysis so as to classify similar current approaches to PPM. We derived the following four clusters.

The first cluster is characterised by poor efficacy with respect to four out of the five identified factors. Only PPM process diffusion, that is, the degree of KPI usage in core business processes, is at an above-average level. The approach is in particular lacking in a high-quality information base. Neither from a BI perspective nor from a BPM perspective are fundamental concepts in place that could be leveraged as a basis for PPM. Due to low degree of consistency and intentionality we termed this approach *Isolated Initiatives*.

The second cluster shows a strong performance with respect to BPM maturity and the quality of the information base. Both a profound process orientation and consistently high information quality form a solid basis for PPM. Nevertheless, all three directly PPM related factors—Broad, PDCA-based use of PPM measures, PPM process diffusion, and BI-enabled, integrated PPM—show a low degree of implementation. The approach specifically lacks well-defined, well-coordinated processes and concepts in performance management as well as in BI. Although this approach offers a promising basis to establish PPM, the fundamental components are not aligned, which let us call it *Fragmented Approach*.

The approach characterised in the third cluster puts a very strong focus on measurement. Organisations implementing this approach show an oddly high use of KPIs, which—considering the performance of the other factors—appears very ambitious: Although their BI landscape is integrated and rather sophisticated, essential BPM concepts that form the basis for PPM are not in place, and thus hamper a comprehensive and successful implementation. Because of its very strong concentration on KPI measurement we call this cluster the *Measurement-biased Approach*.

The fourth cluster shows a high performance across four out of the five factors. The only weak factor is factor one. It is thus plausible to call this approach the *Advanced Approach*. It is characterised through a high BPM maturity and a well-established BI organisation providing an adequate information base for PPM. Organisations using this approach apply performance measurement to a significant number of their business processes building upon a consistent set of limited metrics.

For an easier interpretation and better comparison of the different approaches we standardised the cluster means. Figure 10 depicts how many standard deviations (SDs) a cluster value is above or below the overall factor mean (across all cluster values).
D.4.2 Desired Approaches to PPM

The EFA we conducted on the data set describing the desired or to-be approaches resulted in four factors that can be interpreted as design factors for developing these approaches. The first factor combines ten items that collectively describe the extent and sophistication of process performance measurement. We thus called it *Scope and Quality of KPI Measurement*. The second factor, which we subsequently refer to as *PPM Coverage of Core Processes*, groups together the four items that describe the processes PPM is applied for and the need for non-financial measures. Four items load high on the factor subsequently called *BPM Maturity*. The last factor, called *Integrated, Methodologically Sound PPM*, consolidates three factors that point to a strong methodology as regards performance management issues. The subsequently accomplished cluster analysis again led to four distinct approaches, which we describe in the following.

The first cluster represents approaches that put an emphasis on a broad set of KPIs and high-quality decision making. Organisations striving to establish the approach subse-
quently called *Measurement-focused Approach* do not focus on achieving a high BPM maturity. They rather want to apply a considerable number of metrics for measuring the performance of their core processes and—in so doing—rely on a high-quality integrated data base. Not emphasising a methodologically sound and strategically anchored PPM initiative, these organisations aim at using PPM in an ad-hoc manner and not necessarily systematically aligned with corporate performance management issues.

The *BPM-biased Approach* represents a strong antagonism to the measurement-focused approach. Companies striving to launch this approach will put a strong emphasis on consistently documented processes that are transparent across functional and system borders. They neither want to attempt instituting PPM as an integral part of their organisations’ overall performance management approaches nor favor an ad hoc or on demand measurement. Quite the contrary: measurement is basically advent in this concept, characterising it as an approach rather meant to support the early phase of BPM adoption.

The third cluster advocates an elementary PPM approach that is aligned with the organisation’s strategic performance initiatives. Clear responsibilities for processes as well as defined measurement practices play important roles. However, organisations striving to implement this approach plan to apply PPM only to a constrained number of processes, giving this concept the name *Selective Approach*. The focus lies on a rigorous enterprise performance management with a strong measurement basis. Both non-financial KPIs and the measurement of organisational performance on a process level appear to have a supplementary character.

The *Full-scale Approach* is characterised by sound process performance measurement and management. Organisations striving to launch this approach intend to use a manageable number of performance metrics primarily for their core processes. A broad and consistent process orientation is perceived essential, and the strong conjunction of corporate and process performance management approaches points to the fact that these companies treat their processes as strategic assets.

Again, we standardised the cluster means: Figure 11 depicts how many standard SDs a cluster value is above or below the overall factor mean (across all cluster values).
While analysing both the existing and the desired PPM approaches is an attractive research goal, their mere description offers only limited use for gaining knowledge and achieving evidence on where improvement is required after all. The more intriguing questions thus are a) What are the most popular development trends between the clusters?, and b) What are the most important changes for the transition from a certain current to a more desired state? In order to answer these questions, we analysed the movement for each organisation that participated in the survey and aggregated the findings. The next chapter describes the results.

**D.4.3 Development Trends**

The movements between the current approaches to PPM on the left-hand side and the desired approaches on the right-hand side are visualised in Figure 12.

The number in the lower right corner of each of the squares indicates the population of each cluster. The thickness of the lines is proportionate to the number of movements. It is obvious—albeit not surprising—that most of the organisations are striving to prospectively realise the Full-scale Approach. On the contrary, a noticeably small number
of organisations aim at implementing the BPM-biased Approach. It is moreover inter-
esting that the dispersion of organisations across the different as-is approaches is com-
paratively homogenous, while there is a clear preference structure discernible across
the to-be approaches. Thus, although commencing from quite dissimilar starting posi-
tions, organisations appear to largely agree on what is the most desirable approach.
Due to the differing conditions, however, the ways to reach this position, that is, to
implement the more desired approach vary significantly.

![Diagram showing development trends]

**Figure 12: Development Trends**

In order to shed light on what are the most important changes to be made in order to
obtain the intended PPM approaches, we deeper analysed the most interesting move-
ments, which are the ones consisting of at least three movers. To this end, we calcu-
lated the weighted adjacency matrix for the migration graph (cf. Figure 12) based on
the items that are grouped by the to-be factors (cf. Table 19 and Table 20).\(^5\)

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\(^5\) In order to enhance readability the table of the original publication is split vertically in two parts, resulting in
Table 19 and Table 20.
### Scope and Quality of KPI Measurement

<table>
<thead>
<tr>
<th>Items</th>
<th>as-is Cluster</th>
<th>Isolated Initiatives</th>
<th>Fragmented Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Adherence to schedules is measured for processes.</strong></td>
<td>2.2</td>
<td>1.7</td>
<td>2.6</td>
</tr>
<tr>
<td><strong>Quality is measured for processes.</strong></td>
<td>1.6</td>
<td>2.2</td>
<td>2.2</td>
</tr>
<tr>
<td><strong>Process cycle times are measured.</strong></td>
<td>1.8</td>
<td>1.7</td>
<td>2.4</td>
</tr>
<tr>
<td><strong>Process costs are measured.</strong></td>
<td>2.1</td>
<td>1.8</td>
<td>2.3</td>
</tr>
<tr>
<td><strong>Capacity utilisation is measured for processes.</strong></td>
<td>2.2</td>
<td>1.3</td>
<td>2.8</td>
</tr>
<tr>
<td><strong>Process resource utilisation is measured.</strong></td>
<td>2.2</td>
<td>1.7</td>
<td>2.5</td>
</tr>
<tr>
<td><strong>Data quality is consistently high.</strong></td>
<td>1.7</td>
<td>2.7</td>
<td>3.4</td>
</tr>
<tr>
<td><strong>A central integrated data base is in place (e.g., an enterprise data warehouse (DWH)).</strong></td>
<td>1.6</td>
<td>2.3</td>
<td>3.8</td>
</tr>
<tr>
<td><strong>Processes have defined process officers.</strong></td>
<td>2.9</td>
<td>1.2</td>
<td>3.4</td>
</tr>
<tr>
<td><strong>Defined BI governance responsibilities and processes are in place.</strong></td>
<td>1.6</td>
<td>2.0</td>
<td>2.3</td>
</tr>
</tbody>
</table>

### PPM Coverage of Core Processes

<table>
<thead>
<tr>
<th>Items</th>
<th>as-is Cluster</th>
<th>Isolated Initiatives</th>
<th>Fragmented Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PPM is deployed for production processes.</strong></td>
<td>2.1</td>
<td>1.0</td>
<td>2.2</td>
</tr>
<tr>
<td><strong>PPM is deployed for sales processes.</strong></td>
<td>2.4</td>
<td>1.0</td>
<td>2.8</td>
</tr>
<tr>
<td><strong>PPM is deployed for purchasing processes.</strong></td>
<td>2.2</td>
<td>1.2</td>
<td>1.9</td>
</tr>
<tr>
<td><strong>PPM also covers non-financial measures.</strong></td>
<td>2.3</td>
<td>1.0</td>
<td>1.8</td>
</tr>
</tbody>
</table>

### BPM Maturity

<table>
<thead>
<tr>
<th>Items</th>
<th>as-is Cluster</th>
<th>Isolated Initiatives</th>
<th>Fragmented Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Process orientation is a central paradigm.</strong></td>
<td>2.9</td>
<td>1.5</td>
<td>3.1</td>
</tr>
<tr>
<td><strong>Process flows are consistent and transparent beyond functional borders.</strong></td>
<td>2.4</td>
<td>1.3</td>
<td>2.9</td>
</tr>
<tr>
<td><strong>Processes are consistently documented and/or modelled.</strong></td>
<td>2.2</td>
<td>2.2</td>
<td>2.9</td>
</tr>
<tr>
<td><strong>Process flows are consistent and transparent beyond system borders.</strong></td>
<td>2.3</td>
<td>1.5</td>
<td>2.8</td>
</tr>
</tbody>
</table>
**Table 19: Adjacency Matrix (a)**

<table>
<thead>
<tr>
<th>to-be Factors</th>
<th>as-is Cluster</th>
<th>Isolated Initiatives</th>
<th>Fragmented Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>as-is cluster</td>
<td>Full-scale Approach</td>
<td>as-is cluster</td>
</tr>
<tr>
<td></td>
<td>delta</td>
<td></td>
<td>delta</td>
</tr>
</tbody>
</table>

### Integrated, Methodologically Sound PPM

- **PPM is part of the enterprise-wide balanced scorecard (BSC).**
  - 1.7 2.0 1.4 0.3 1.5
- **PPM is part of the corporate performance management (CPM).**
  - 1.7 2.0 1.8 0.0 2.0
- **The plan-do-check-act (PDCA) cycle is applied for PPM.**
  - 1.4 1.7 2.0 0.0 2.1

### Scope and Quality of KPI Measurement

<table>
<thead>
<tr>
<th>to-be Factors</th>
<th>as-is Cluster</th>
<th>Measurement-biased Approach</th>
<th>Advanced Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>as-is cluster</td>
<td>Full-scale Approach</td>
<td>Delta</td>
</tr>
<tr>
<td></td>
<td>delta</td>
<td></td>
<td>delta</td>
</tr>
</tbody>
</table>

- **Adherence to schedules is measured for processes.**
  - 3.5 1.0 1.0 0.8 3.0 1.3
- **Quality is measured for processes.**
  - 3.0 0.7 1.3 1.4 2.7 1.5
- **Process cycle times are measured.**
  - 2.8 1.3 1.3 1.2 3.4 0.8
- **Process costs are measured.**
  - 2.8 0.7 1.3 1.8 2.9 1.3
- **Capacity utilisation is measured for processes.**
  - 2.8 1.3 1.3 1.2 3.3 1.0
- **Process resource utilisation is measured.**
  - 3.0 0.7 1.0 1.4 3.1 1.3
- **Data quality is consistently high.**
  - 3.1 1.7 1.0 1.4 2.7 1.5
- **A central integrated data base is in place (e.g., an enterprise data warehouse (DWH)).**
  - 3.1 1.3 1.3 0.8 3.7 0.8
- **Processes have defined process officers.**
  - 3.8 1.3 1.3 1.4 4.0 0.8
### Part B: Process Performance Management – Illuminating Design Issues

<table>
<thead>
<tr>
<th>to-be Factors</th>
<th>as-is Cluster</th>
<th>Measurement-biased Approach</th>
<th>Advanced Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Delta</td>
<td>delta</td>
</tr>
<tr>
<td></td>
<td>to-be Cluster</td>
<td>as-is cluster means</td>
<td>Measurement-focused App.</td>
</tr>
<tr>
<td>Defined BI governance responsibilities and processes are in place.</td>
<td>2.8</td>
<td>1.0</td>
<td>1.3</td>
</tr>
<tr>
<td><strong>PPM Coverage of Core Processes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PPM is deployed for production processes.</td>
<td><strong>2.5</strong></td>
<td>0.3</td>
<td>0.0</td>
</tr>
<tr>
<td>PPM is deployed for sales processes.</td>
<td><strong>2.0</strong></td>
<td>0.7</td>
<td>0.0</td>
</tr>
<tr>
<td>PPM is deployed for purchasing processes.</td>
<td><strong>1.6</strong></td>
<td>0.7</td>
<td>0.0</td>
</tr>
<tr>
<td>PPM also covers non-financial measures.</td>
<td><strong>2.1</strong></td>
<td>1.0</td>
<td>0.3</td>
</tr>
<tr>
<td><strong>BPM Maturity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Process orientation is a central paradigm.</td>
<td><strong>3.1</strong></td>
<td>1.0</td>
<td>0.7</td>
</tr>
<tr>
<td>Process flows are consistent and transparent beyond functional borders.</td>
<td><strong>2.3</strong></td>
<td>1.7</td>
<td>1.7</td>
</tr>
<tr>
<td>Processes are consistently documented and/or modelled.</td>
<td><strong>2.6</strong></td>
<td>1.7</td>
<td>2.0</td>
</tr>
<tr>
<td>Process flows are consistent and transparent beyond system borders.</td>
<td><strong>2.1</strong></td>
<td>1.0</td>
<td>1.3</td>
</tr>
<tr>
<td><strong>Integrated, Methodologically Sound PPM</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PPM is part of the enterprise-wide balanced scorecard (BSC).</td>
<td><strong>2.5</strong></td>
<td>0.0</td>
<td>0.3</td>
</tr>
<tr>
<td>PPM is part of the corporate performance management (CPM).</td>
<td><strong>2.4</strong></td>
<td>0.0</td>
<td>0.3</td>
</tr>
<tr>
<td>The plan-do-check-act (PDCA) cycle is applied for PPM.</td>
<td><strong>2.7</strong></td>
<td>0.0</td>
<td>0.3</td>
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*Table 20: Adjacency Matrix (b)*

The values represent the arithmetic means of the differences between the item values to-be and as-is across all movers per path. This allows us to identify the areas that require the most change when an enterprise intends to reach a certain to-be PPM ap-
proach. We chose to make the adjacency analysis on the item-level as opposed to on the factor level, because the aggregation of items into bunched concepts only allows for limited interpretability.

One of the major paths and the first movement described in the adjacency matrix is the shift from the Isolated Initiatives approach towards a Full-scale PPM implementation. Organisations running isolated PPM initiatives are especially characterised by the lack of a high-quality information base. Moreover, neither from a BI nor from a BPM perspective have these organisations established concepts in place. The more detailed analysis reveals that, in order to realise an effectual PPM concept, these companies explicitly focus on a) providing an adequate IT infrastructure and b) gaining a deeper knowledge about their work by consistently documenting their processes. Besides, in order to bundle thus far isolated initiatives, organisations consider integrating their PPM ambitions with an enterprise BSC and/or their enterprise performance management programme. Organisations starting off from the Fragmented Approach strive for either the Measurement-focused or the Full-scale Approach. As described above the Measurement-focused Approach emphasizes the use of a broad set of KPIs for high quality decision making regarding the improvement of core processes, assumedly often in an on-demand setting based on real-time data. While organisations using the Fragmented approach show a profound process orientation and possess a high-quality information base, the transition to the Measurement-focused Approach requires the development of a set of crucial process performance metrics like process quality, cycle times, as well as resource and capacity utilisation. Moreover, the change demands a stronger concentration on the measurement of core processes, in particular on the basis of non-financial metrics. A shift from the Fragmented Approach to the Full-scale Approach, on the other hand, first and foremost necessitates a more organised and well-planned method. In order to overcome the parallelism of a strong process orientation and an underutilised IT infrastructure, organisations rigorously implement the PDCA-cycle and align their process performance initiatives with the enterprise performance management. Bridging the business-IT-divide is further enhanced by making process flows transparent across functional borders for the whole workforce. The Measurement-biased Approach—as the name betrays—is characterised by a strong overestimation of KPI use and measurement. Consequently, each convergence towards another approach—be it Measurement-focused, Selective, or Full-scale—requires establishing a more sophisticated process orientation. In any case, the measurement-biased organisation must consistently design and model its processes and make them transparent
beyond both functional and system borders so as to enable a comprehensive and successful PPM implementation. The last movement we analysed in more detail leads from the Advanced to the Full-scale Approach. Due to the fact that the Advanced Approach already shows a comparatively high maturity, only minor adoptions are required. The analysis reveals that improvement of the overall data quality becomes necessary. As the measurement level of production processes is already very high, the focus will be shifted to sales and purchasing processes. An increased use of the BSC and the PDCA-cycle further fosters the holism of the approach.

As has been mentioned in section D.3, the survey we conducted was exploratory in nature and as such not based on well-known and empirically proven relationships. In order to validate our findings we thus complemented our analysis with three case studies. The selection of the cases was based on a self-assessment of the organisations when confronted with the survey results. Subsequently, the case study results are presented in detail. All three organisations are implementing a Full-scale PPM Approach, however, each starting off from a different as-is position.

### D.4.4 Validation of Results through Case Study Findings

#### D.4.4.1 Case 1 – Isolated Initiatives towards Full-scale

Company A is a globally operating insurance company. Due to a number of acquisitions, their current IT landscape is highly heterogeneous and fragmented. Their movement toward a Full-scale PPM Approach was initiated by the parent company, which prescribed that all subsidiaries have an approach in place by 2012. While those in charge of the PPM initiative at the subsidiary we worked with have a strong ambition themselves to realise a holistic PPM concept, there were a number of obstacles to resolve on the way towards a successful implementation. The interviews revealed that on the one hand a perceived low market pressure and entrenched functional work habits among the workforce hampered the establishment of a consistent process orientation and process culture. On the other hand, after an increased acquisition activity, the responsibility for the IT landscape was broken up between two detached teams that showed little willingness to work together. Hence, process-oriented thought and work patterns and enthusiasm for communicating and pursuing a shared goal represented additional levers on the way to an efficient PPM initiative.
D.4.4.2 Case 2 – Fragmented towards Full-scale

Company B is a global player in the construction industry. As a manufacturing company employing a lean six sigma approach for their production processes, they have a sound process understanding and culture. Their IT landscape is extraordinarily well integrated. The company is managed through a sophisticated CPM approach. However, major difficulties in establishing the intended comprehensive PPM approach on the one hand laid in identifying the appropriate metrics and KPIs to purposefully measure process performance and on the other hand in building the link between the black-box financial performance management and a white-box approach measuring performance on a process level. Moreover, the strong process orientation found in the production facilities was not equally lived in the sales and research & development departments, requiring additional process missionary work. The way to a Full-scale PPM Approach thus included the definition of value drives trees and a fostering of process thinking throughout the whole company.

D.4.4.3 Case 3 – Measurement-biased towards Full-scale

Organisation C is one of the largest telecommunication companies in Switzerland. Its strong competitive position makes market pressure a minor concern. The main focus of management lies on new product development and sales figures. The current PPM approach was a pilot project implemented within the boundaries of one department. The availability of an integrated IT infrastructure and a sophisticated PPM tool make nearly any kind of process performance measurement feasible. Dashboards were developed allowing for not only a retrospective, but a real-time performance assessment. However, nearly no improvement initiatives were launched on the basis of the copious measurement results. The workforce showed a strong resistance to the measurement initiatives for fear of complete transparency of the individual people performance. Moreover, the humble management valuation of the benefits attainable through an integrated Full-scale PPM Approach made the pilot department a lone fighter. Consequently, in this case a lot of educational and convictional work regarding the benefits of PPM needed to be carried out. The subsequent chapter summarises the findings and gives a brief outlook on future research.

D.5 Conclusion and Outlook

This paper provides a systematic analysis of the major issues and challenges related to PPM in organisations, as identified through an exploratory survey and perceived by
experts in the field. In order to illuminate design issues in the field, we applied a rigorous approach, using both quantitative and qualitative research methods. By means of an exploratory survey, we derived a set of four design factors that represent relevant prerequisites for developing suitable and well-fitting PPM solutions. The subsequent use of case studies followed two purposes: On the one hand, it allowed us to validate the identified approaches and the development trends. On the other hand, it revealed additional requirements for the development of artefacts to support PPM initiatives. Future research efforts will use the herein gained knowledge to inform the design of situational PPM artefacts.
Contribution E – Exploring Patterns of Business-IT Alignment for the Purpose of Process Performance Measurement

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<th>Title</th>
<th>Exploring Patterns of Business-IT Alignment for the Purpose of Process Performance Measurement</th>
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Table 21: Bibliographical Information for Contribution E

Abstract. Having successfully implemented the first phases of their business process management (BPM) initiatives, a number of organisations are just now facing the next big challenge: Maintaining the just gained flexibility through continuously measuring and improving their processes’ performance. Although numerous approaches are available, there is evidence that companies face severe difficulties in aligning their process-related measurement needs with the appropriate information technology (IT). This study presents and analyses the results of an extracting multiple case study. A framework of four patterns derived in the course of the analysis gives new insights in ways to design business-IT alignment into the context of process performance measurement.

Keywords: Business Process Management, Performance Management, Business-IT-Alignment
E.1 Introduction

In the sight of today’s turbulent and fiercely competitive world organisations are forced to be highly adaptive [Smith, Fingar 2003]. A popular approach for coping with ever-changing requirements while still improving operational efficiency is called BPM. Over recent decades, organisations have increasingly adopted BPM as a holistic management concept and, in so doing, aligned their organisational and management activities with their core processes [Armistead et al. 1999; Lee, Dale 1998]. However, thoroughly understanding and aligning an organisation’s processes does not suffice for the creation of enduring organisational performance. Quite the contrary: Once business processes are defined and in place, organisations “will need to begin measuring processes and their outputs and to continually refine their designs” [Davenport, Beers 1995, p. 60] so as to preserve their performance for the long term.

Practitioners and academia alike have developed a plenitude of approaches for addressing the challenges of measuring process performance. There is evidence, however, that despite the availability of quite sophisticated methods and tools on both the business and the IT side, today’s organisations are not truly capable of aligning these concepts so as to establish successful and integrated process performance measurement (PPM) approaches [Genrich et al. 2008; van der Aalst et al. 2007].

However, there is not a ‘one-size-fits-all’ approach to establishing PPM initiatives. We argue that different objectives require different PPM approaches and use the extracting multiple case study method for exploring and reflecting on existing practices. We do so by first providing a brief foundational background for our contribution introducing basic concepts of PPM and business-IT alignment (section E.2). Subsequently, we sketch the methodology of our research project (section E.3). Findings of the case analyses are presented in section E.4. The patterns we deduced from our research project are proposed in section E.5 and rounded off with a brief discussion on when they seem most applicable. The concluding section (section E.5.2) summarises our work, names implications and limitations, and gives an outlook on future work.

E.2 Foundations and Related Work

E.2.1 Process Performance Measurement

Very much like the earlier excitement about the BPM approach [Corea, Walters 2007; Smart et al. 2009], the current hype around the management of business process performance is fuelled by enormous practitioner interest. It is thus not a surprise that the
most elaborate conceptions of the notion have so far been provided by practitioners. The Association of Business Process Management Professionals (ABPMP), one of the premier non-for-profit practitioner organisations in the field of BPM, defines the measurement of process performance as “the formal, planned monitoring of process execution and the tracing of results to determine the effectiveness and efficiency of the process” [ABPMP 2009, p. 22]. The information gained in the measurement process is then “used to make decisions for improving or retiring existing processes and/or introducing new processes in order to meet the strategic objectives of the organisation” [ABPMP 2009, p. 22]. It becomes obvious from this definition that process performance management consists of two major building blocks: The measurement and the improvement of business process performance. Concepts that have been identified as contributing to either of the two building blocks include defining performance metrics, monitoring, controlling and simulating processes, aligning process and enterprise performance, and a number of other concepts [Kueng 2000]. Although the term process performance management has up to now not reached a broad popularity, and the concept is still about to develop, there have been a number of prior efforts in both research and practice addressing either the measurement or improvement of business processes performance, or sometimes even both.

Some of these approaches stem from the business realm and have been developed in organisational and industrial research. Several represent broad strategic management concepts like e.g., total quality management [Isaksson 2006], six sigma [Snee, Hoerl 2005], lean management [Houy 2005], or business process reengineering [Davenport 1993; Hammer 1990]. Others are rather techniques either to be used in the context of a larger concept or on their own, like process mapping and root cause analysis [Siha, Saad 2008] or statistical process control. At the same time, information systems (IS) researchers are increasingly engaged with providing solutions for measuring and managing process performance and process execution quality [Genrich et al. 2008] and provide specific techniques for solving clearly delineated sub-problems like e.g., business activity monitoring, process mining, or simulation [Kueng 2000; Powell et al. 2001]. A rather recently introduced concept, termed (business) process intelligence (BPI), builds on applying business intelligence (BI) techniques like data mining and statistical analysis to analysing process data in order to uncover weaknesses and discover opportunities for improvement [Grigori et al. 2004]. While BI has traditionally provided historical, retrospective analyses, in the context of BPI it is used to take the “pulse of the company” [Hall 2004, p. 3], generating findings based on present-day transactional data that are analysed in near real-time.
Despite the evidently rich repertoire of partly very mature solutions from both business and IT, today’s organisations find it difficult to align and integrate them into a consistent and successful approach to process performance measurement.

**E.2.2 Business-IT Alignment**

The alignment of business and IT has been discussed extensively in the IS research community [Luftman 2000; Luftman, Brier 1999]. It refers to a desired state in which an organisation is able to use its IT in an “appropriate and timely way, in harmony with business strategies, goals and needs” [Luftman, Brier 1999, p. 3] to better achieve its overall business objectives, e.g., increased performance, customer satisfaction or market share. In practice, however, this alignment is often hard to accomplish. Differences in goals, culture, and incentives cause an invisible gap between business and IT that is most often hard to bridge. As a consequence, IT systems are considered overly expensive, as they are neither fully accepted nor used by the business side and thus do not provide the intended return on investment.

In order to overcome the described gap it is essential to understand both the principal components and the relations that come into play in business-IT alignment. During the two decades since its first emergence in the academic literature, alignment has been conceptualised in various ways. The most widely accepted definition is the one provided by Henderson and Venkatraman [1993], who understand alignment as the overall degree of fit or integration between the four elements business strategy and IT strategy and organisational infrastructure and IT infrastructure. The direction of alignment is not predetermined and aims rather at answering “how IT is in harmony with the business, and how the business should, or could be in harmony with IT” [Luftman 2000, p. 2]. The ultimate goal is to ensure that the organisation’s partial strategies are defined consistently and lead the organisation as a whole into one uniform direction. Therefore, IT and business functions need to adapt their strategies in parallel. The achievement of alignment is an evolutionary and dynamic process [Chan, Reich 2007], which is contingent upon a number of factors such as support from senior management, good team work, leadership, trust, effective communication, and adequate knowledge of business and technical environments [Chan, Reich 2007; Luftman 2000]. Achieving and especially sustaining alignment requires strengthening its enablers and lessening its inhibitors [Luftman et al. 1999].

Figure 13 visualises the interplay of the elements of business-IT alignment. In the herein reported research study we employ the business-IT alignment model as a conceptual lens for analysing and understanding patterns of alignment in PPM initiatives.
E.3 Research Method

Case studies are a frequently used research method in the study of IS phenomena [Palvia et al. 2004] and have explicitly been advocated for the study of performance measurement systems (PMS) and their application in practice [Kaplan 1984]. Case studies allow the researcher to study a research phenomenon directly as it is perceived by the subjects involved, to learn about the state of practice, and to understand real-world processes and decision making. The extracting multiple case study method is an approach suggested by van Aken who describes it as “a kind of best-practice research [that] is aimed at uncovering technological rules as already used in practice” [van Aken 2004, p. 232]. This exploration of and reflection on knowledge and skills developed in practice is a forceful research activity and one that has led to a number of powerful technological rules and influential design theories [Gregor 2008]. We intentionally chose this variant of the case study method, as we strongly believe that there is a substantial body of both experience and tacit knowledge on how to align business requirements and IT capabilities in the context of PPM.

In order to better understand the experience and knowledge, as well as the ‘how’ and ‘why’ of PPM initiatives, we accomplished case studies with six different organisations that together provide an in-depth understanding of both current practices and challenges in contemporary real-life settings. Our unit of analysis is the procedure of aligning business requirements with IT capabilities in projects that aim at the development of a PPM approach. The chosen multiple-case design allows for cross-case

![Figure 13: Strategic Alignment Model [Henderson, Venkatraman 1993, p. 8]
analysis and a better generalisation and positioning of the findings [Benbasat et al. 1987]. As case partners, we only selected companies who explicitly stated that they had a PPM initiative under way. Companies were deliberately chosen from different industry sectors and with a wide variety of competitive and organisational characteristics in order to introduce diversity into the sample. Two of our case companies are from the service industry; the other four are from the manufacturing industry. Semi-structured face-to-face interviews with process and performance analysts, quality managers, and BI professionals constituted the main basis of inquiry. The interview guideline was designed using open-ended questions and was pretested prior to the actual interviews in order to elicit correct interpretation of questions and free flowing information. Questions were formulated to address four key aspects:

1) the business strategy and background that form the basis for PPM,
2) the IT systems and capabilities used to support PPM,
3) the way business needs and IT capabilities are matched, and
4) enablers and inhibitors of the respective approach.

Interviews typically lasted around one and a half hours. As each interview was completed and transcribed, it was analysed in detail. Thereafter, the main findings were summarised. Due to company request all cases are presented anonymously. The subsequent section presents aggregate results from the interview analyses per case organisation. When applicable, direct quotes from interviewees are included in the summary of the findings.

**E.4 Research Findings**

**Company A** is one of the largest telecommunications companies in Switzerland. Its strong competitive position makes market pressure a minor concern. The top management’s dominant strategic focus lies on new product development and maximising their market position. The overall business strategy of the organisation is very strongly focused on product innovation, growth and market share.

The implementation of a PMS represented a pilot project realised within the boundaries of one organisational department. Although PPM and improvement were of some importance to the top management, there was only limited support available. The existing IT capabilities, however, were advanced and fully designed for a comprehensive process analysis: The availability of an integrated IT infrastructure and a highly sophisticated process intelligence tool made nearly any kind of measurement feasible. Dashboards were in place, allowing for not only a retrospective, but a real-time proc-
Part B: Exploring Patterns of Business-IT Alignment

The whole project was pushed by one enthusiastic employee with a strong analytical background. Despite his strong commitment to the project, however, it was nearly impossible to win any additional support for it. This was not least the case because the workforce showed a strong resistance towards the measurement initiatives for fear of complete transparency of individual people performance. The BI specialist in charge of the project mentioned,

“In order for a process-oriented performance measurement approach to become truly successful, you have to reduce barriers of incomprehension and refusal among the employees. Otherwise, the resistance will just make the whole effort useless.”

Another inhibitor to the success of the PMS implementation was the humble management valuation of the benefits attainable through process-oriented performance measurement. Due to the above-mentioned strategic focus on product innovation, rather than efficiency enhancement, managers did not feel the pressure to launch any internal improvement initiatives. The management was simply reluctant to put any effort into learning new measures and altering a running system.

Company B is a globally operating insurance company. Its business strategy is based on a set of core values including the provision of added value for their customers in the form of innovative products, quality of service and productivity. In order to enhance overall customer satisfaction and achieve operational excellence, the parent company decided that all subsidiaries have six sigma-based improvement practices and adequate systems for process performance measurement in place by 2012.

In the course of the second case study, we accompanied one subsidiary of the whole insurance group that was just about implementing their PPM approach. Teams that had been trained in the six sigma methodology were in charge of selecting, prioritising and realising PPM and improvement projects. While the employees in charge of the projects had a strong ambition to implement sustainable practices for measurement and change, there were a number of obstacles to resolve on the way. The interviews revealed that on the one hand a perceived low market pressure and an entrenched functional work habit among the workforce hampered the establishment of a consistent process orientation and process culture. A member of the Six Sigma team mentioned,

“We have been working in this function-oriented way for a very long time, and it worked really well for us, but now it’s difficult for the people to understand the purpose behind a process-oriented measurement. That makes it very difficult to identify and define effective process performance indicators.”
Once the measures and metrics for a project are defined, an IT project is launched in order to aggregate and allocate the required data. Where possible, dashboards are designed that show the most important metrics graphically so they can be monitored at a glance. This makes it easier for the respective process owner to continually check whether the process operates in the defined manner. Where dashboards were installed the acceptance of PPM was significantly higher. However, past acquisition activity of the subsidiary had resulted in a highly fragmented IT landscape. As a result, it was not always possible to extract the required data along a complete process. Moreover, many of the systems in use were legacy systems that did not provide accurate data needed for measuring process performance at all (e.g., time stamps). If the IT was not able to provide the required metrics, the business reacted with a lack of understanding and disappointment.

**Company C** is a leading company in the pharmaceutical sector. The actuator for launching a corporate-wide lean six sigma programme as a strategic business initiative had been a significant rise in costs and the simultaneous quality drop of pharmaceutical products below an acceptable level.

In the course of our case study, the head of organisational redesign and excellence provided a deep insight into what had been achieved and how the programme had been carried out: Since the adoption of the combined approach, the organisation possessed an excellent knowledge about all its processes and has achieved enormous cost reductions. Production processes across world-wide subsidiaries have been standardised, and the intended next step lies in expanding the lean six sigma approach to processes in other functions, like human resource management, marketing and research & development. In order to measure process performance, the organisation primarily relies on statistical analyses. A major advantage of applying the six sigma methodology manifested in its strict and sequential measurement approach. Through a strong emphasis on product data that is captured and aggregated along the production process, the case company was easily able to locate any process inefficiencies. The IT infrastructure used along the production processes for data acquisition and analysis, had been reduced to a minimum. As the company’s quality manager said,

“We have constantly reduced the amount of IT we rely on in our production facilities. It is also part of our lean philosophy: We have as much IT in place as needed for the statistical analyses we conduct, but no more. Too much IT is rather disabling than enabling.”
Despite the definite strength of six sigma for measuring process quality and efficiency, the interviewees complained that the insufficiently analysed and elaborated relationship between cost of poor quality and the sigma quality level of processes impairs the full success of the approach.

**Company D** is a global player in the construction industry. Its business strategy is built on values such as excellent innovation, high quality and productivity and direct customer relations. As a manufacturing company employing a lean six sigma approach for its production processes they have a sound process understanding and culture. Their IT landscape is extraordinarily well integrated.

Company D’s way to a process-oriented performance measurement started with not only a very strong six sigma approach but also an elaborate and well-functioning finance-oriented corporate performance management (CPM) approach in place. Due to some inefficiencies and complaints in the service division, it was decided to expand the current measurement approach to an end-to-end scope in order to facilitate root cause analyses. The responsibility for implementing the approach was given to the IT department as it a) had direct access to all operational and analytical IS and b) was felt to have a reasonable understanding of the companies’ business processes. This decision, however, resulted in major difficulties in identifying the appropriate metrics and indicators to purposefully measure process performance. Although the technical BI capabilities of the team were exceptionally strong, a team member of the process improvement initiative said,

“*We are technically capable of extracting any measure from our systems. When consulting the process owners, however, it often proves that our knowledge of the processes is not deep enough, and we are not measuring what is actually important. Currently, our approach more or less represents a trial-and-error approach.*”

In order to be able to measure the financial impact of process inefficiencies, it was also planned to build a link between the so-called black-box financial performance management and a white-box approach for measuring performance on a process level. The process improvement team quickly realised that the definition of respective value driver trees was not possible without the availability of people with appropriate knowledge and skills to interpret, analyse and define such links.

**Company E** is a globally operating engineering company. With its business strategy it aims at achieving a technology leadership position showing global presence with high local expertise. In order to enhance customer satisfaction the top management decided
to restructure and reorganise the service division on the basis of the IT infrastructure library (ITIL) framework.

While previously described cases are all characterised by an evolutionary and continuous approach to establishing PPM, company E started its PPM and improvement initiative in conjunction with a reorganisation project: in order to optimise the customer contact management and realise higher process transparency as well as a better traceability of cost drivers, top management decided to redesign and standardise the service division according to the reference processes of the ITIL framework. In line with the restructuration project, the line management wanted a better basis for decision making for future process improvements on the basis of a few relevant and meaningful measures to be mainly automatically derived through the use of a dedicated IT infrastructure. One of the performance analysts formulated it in the following way,

“*We want as few process performance metrics as possible and as many as necessary. Both, performance monitoring and reporting need to be efficient to reduce the resources required to manage measurement and allocate more resources to interpret the results and think about process improvement.*”

The adequate set of measures was derived in an iterative procedure with the respective process owners, starting from a rather big set that was step by step reduced when a measure was considered irrelevant. In this case, the project team that was responsible for the development of the measurement approach experienced virtually no resistance from other employees—partly because the whole team consisted of people who were actively working in the processes themselves and partly because all other employees were informed and involved from the beginning. It was only the insufficient integration of existing IT systems, which were not optimised for process performance analyses, that marred this otherwise very successful approach: Due to missing links in the existing IT infrastructure, media disruptions were unavoidable, which were sometimes hazardous for the measurement quality. In order to tackle this challenge, it was decided to adapt the IT strategy with regard to technology scope and system competencies during the second rollout phase of the initiative and subsequently create a fit with the required skills and processes.

**Company F** is an international leading supplier of technology and services in the areas of building and industrial technology, automotive and consumer goods. Its business strategy is led by the three super-ordinate goals of innovation, diversification and internationalisation. The company’s PPM initiative rather emerged evolutionary and decentralised than as a strategic initiative.
Due to the widespread dispersion of its subsidiaries, the logistic function plays a major role in the company and is responsible for the worldwide specification, coordination and controlling of the global production and distribution processes and for the definition of process standards and performance levels. Case company F has a strong corporate performance measurement approach in place that allows for a detailed analysis of financial results. Over time, however, it became more and more obvious in the logistics department that the current approach was neither capable of adequately allocating budgets to departments, nor was it suitable for conducting root cause analyses in case of cost increases or faulty results. The business unit manager thus sought for a technology that was able to visualise processes on the one hand and automatically measure process metrics like cycle time, dropout quotes, or resource utilisation on the other. The BPI technology that was purchased quickly facilitated a comprehensive analysis of inefficiencies in the overall process landscape and thus immediately provided business value. The business unit manager noted,

“In this case, IT really is not only a supporter but an enabler. With these analyses we are capable of proving that some changes in the business strategy will become inevitable.”

It was pointed out, however, that despite the obvious benefits of the technology, it will become difficult to convince the business side of the value and necessity of a process-oriented approach to performance measurement.

E.5 Four Patterns of Business-IT Alignment

E.5.1 Case Study Synthesis and Framework Development

The aim of this research study lies in uncovering technological rules, design theories or patterns as they are already used in practice, that is, in exploring and reflecting on knowledge and skills that have either been built deliberately or emerged evolutionary [van Aken 2004]. These patterns can be interpreted as design patterns as they are known and frequently used in the world of object-oriented programming [Gamma et al. 1995]. Therein a pattern describes a pair of a regularly recurring problem and a respective general solution. The general solution is not meant to solve one specific problem, but to serve as a template that can be reused for advancing the problem solving process for a certain problem class. It is the goal of this research to illuminate four different design patterns for business-IT alignment in the context of PPM. The conceptual lens for exploring and extracting the patterns is the business-IT alignment framework proposed by Henderson and Venkatraman [1993]. The unit of analysis is the procedure
of aligning business requirements with IT capabilities in projects that aim at the development of an integrated PPM approach. In their seminal paper, Henderson and Venkatraman [1993] differentiate between two categories of alignment patterns, namely: ‘Business strategy as the driver’ and ‘IT strategy as the enabler’. In the context of this research, it proved valuable to slightly adapt these categories into a) the primary driver behind PPM and b) if PPM Technology represents a strategic enabler. These two dimensions allow us to classify the different patterns we identified in the course of our study. The first dimension indicates that PPM initiatives may either be implemented as part of executing the overall business strategy or as a consequence of the technological potential and IT capabilities the organisation owns. We name the first case ‘business pull’ and the second ‘IT push’. The second dimension indicates whether the available PPM technology is perceived as an enabler for realising the pursued business strategy or not.

Figure 14: A Framework of Four Patterns for Business-IT Alignment in the Context of PPM

Companies B, D and E all started their PPM initiatives as a consequence of a strategic decision and their chosen PPM approaches were selected so as to support their overall business strategy, namely six sigma in the first two and ITIL in the last case. PPM technology is in these cases used as an enabler for implementing the business strategy. While company C likewise started its PPM initiative using six sigma, IT was not perceived as a strategic enabler and was thus reduced. Company A had the necessary IT infrastructure in place, but its overall business strategy focused on innovation rather than on efficiency and thus PPM was not perceived as an enabler for implementing the business strategy. Company F started its PPM initiative in a dedicated business func-
tion, tentatively trying to support process improvement through the use of IT. Providing the evidence that PPM technology is able to better implement the overall business strategy, it is the aim to adapt the IT strategy accordingly. Figure 14 visualises the classification of approaches.

Following the perspectives introduced in the 1993 Henderson and Venkatraman paper, we subsequently describe the individual patterns we derived in detail. The descriptions provide an overview of the patterns and hints on when they appear most applicable, as well as enablers and inhibitors that have been identified in the course of the case analyses.

### E.5.2 Four Patterns for Aligning Business and IT in PPM

The first quadrant can be divided into two sub-patterns 1a (derived from cases B and D) and 1b (derived from case E) with the latter representing a more mature version of the first. Both patterns are anchored on the notion that the business strategy aims at increasing the organisation’s overall efficiency and process performance. Since the business strategy represents the actuator for the PPM initiative, both patterns are characterised as business pull. In the first case the business strategy acts as the direct driver for organisational (re)design choices. The IS infrastructure is only adapted in a second step. IT is in this pattern regarded as an enabler for a comprehensive PPM approach leading to intensified efforts for improving applications, skills and IT operations.

![Alignment Pattern 1a](image)

**Observed Enablers**
- Well understood overall business strategy
- PPM endeavour in line with overall business strategy
- Dedicated team for carrying the PPM initiative into the organisation
- Benefits of PPM are well understood, appreciated and wanted from the business side
- Business perceives IT as an effective means to support the PPM initiative
- Use of dashboards enhances PPM acceptance
- IT staff has appropriate analysis skills
- Homogeneous, highly integrated IT infrastructure
- Strong technical BI capabilities

**Observed Inhibitors**
- Entrenched functional work habit
- Full responsibility for PPM initiative with the IT team
- IT has insufficient knowledge of business processes
- Troubled communication between IT and process owners
- Missing integration between metrics and measures from CPM and PPM
- Lack of sufficient data for end-to-end PPM
- Inhomogeneous, highly disintegrated IT infrastructure

*Figure 15: Alignment Pattern 1a*
In order to implement this pattern, it is important that the business side provides a strategy translator who is capable of articulating the logic and choices underlying the chosen business strategy and respective PPM initiative. Moreover, it is important that the IT infrastructure is properly integrated so as to picture processes from beginning to end and that the IT staff has appropriate analysis skills. As could be seen in case B a lack of sufficient data, an entrenched functional work habit and a much disintegrated IT infrastructure are hazardous to the implementation of this pattern. Case company D had given the full responsibility for realising their six sigma approach to the IT team, which led to a trial-and-error variant of process performance measurement and thus complicated a successful implementation. An overview of the pattern and some of its critical enablers and inhibitors as observed in the case studies is given in Figure 15.

As mentioned above, pattern 1b can be seen as a more mature variant of pattern 1a. While it also prescribes following the path from business strategy to adapting organisational processes and skills and subsequently adjusting IS infrastructure and IT capabilities accordingly, it thereafter suggests adopting the IT strategy so as to identify the best possible IT competencies for implementing the business strategy. Changes to the IS infrastructure that are made in the second step are reconsidered and, if necessary, redesigned in order to provide a sustainable IT support for implementing the business strategy in step (4).

Pattern 1b has been derived from the case of company E. In this case, embedding the implementation of a PPM initiative in a reorganisation initiative proved very valuable. Moreover, a very early involvement of business and IT stakeholders into the project prevented misunderstandings and potentially defensive attitudes. A disintegrated IT
infrastructure again proved to be hazardous to measurement quality and the capability of depicting whole processes. Figure 16 summarises the main characteristics of pattern 1b as well as the enablers and inhibitors that were observed in the case.

Pattern 2, like the previous two, belongs to the category business pull. The PPM programme starts as a business initiative, e.g., as a result of the strategic decision to implement a lean six sigma programme as has been the case with company C. In contrast to previous patterns, however, IT is in this case seen as an inhibitor (illustrated by the ‘-’ symbol in Figure 17). As the analysis of the case material revealed, IT was felt to be a confounder in the process of identifying and removing process inefficiencies. In line with the people empowerment principle that is strongly grounded in the concept of lean management process improvement ideas are rather generated decentralised by people than centralised through the use of IT systems. Pattern 2 thus seems especially applicable if the chosen business strategy and culture implies a strong focus on enabling and empowering the workforce and a comparatively little reliance on IT. Moreover, the success of this pattern appeared to strongly depend on the mindset of the people involved: While employees in the manufacturing department appreciated being part of improvement initiatives, employees in the non-production area felt restricted and overly controlled. An overview of this pattern and the most crucial enablers and inhibitors that were observed in the case is given in Figure 17.

Figure 17: Alignment Pattern 2

The remaining two patterns that we identified in the course of analysing our case data are both categorised as IT push. They are akin in so far as they both depict an alignment procedure that starts with the acquisition of a new PPM IT system. In pattern 3, the availability of advanced technology for business process performance measurement does—on a limited scale—induce organisational change, but does not unfold the
power necessary to also provoke change on the strategic level. In the case of company A, which sparked pattern 3, the reason laid in the chosen business strategy that strongly focused on product innovation and market share expansion, but not at all on improving the organisation’s efficiency. As a consequence, IT was not regarded as a strategic enabler, and the enthusiastic employee who started the PPM endeavour was not capable of convincing the top management to roll out the initiative to a broader level. Figure 18 summarises the main characteristics of pattern 3, including enablers and inhibitors that have been observed in the analysis of case A.

Figure 18: Alignment Pattern 3

The last pattern, too, starts with the acquisition of sophisticated PPM technology. In contrast to the previous pattern, however, this pattern suggests following the path from adjusting and improving the organisational processes and structure toward integrating PPM into the business strategy.

Figure 19: Alignment Pattern 4
This approach is especially viable if the chosen strategy already focuses on efficiency improvement and cost reduction. As could be witnessed in the case of company F, pursuing this pattern demands for a corporate culture and leadership style that allow or even support bottom-up improvement initiatives and employee engagement. A strong function-oriented incentive system and a missing alignment between metrics and measures from CPM and PPM in contrast were identified as contra-conducive for a successful PPM initiative. Pattern 4, as well as the enablers and inhibitors identified in case F, are summarised in Figure 19.

**E.6 Implications, Limitations and Future Work**

In this contribution we used the extracting multiple case study method for analysing and reflecting on contemporary approaches for aligning business and IT in the context of PPM initiatives. We identified four different patterns that describe the current practices in six case study companies. The pattern descriptions are enriched with enablers and inhibitors as they were identified in the course of the case analyses.

The study’s findings are expected to be of benefit to both the PPM research and practicing communities in terms of guidance for positioning their current research and practices. Practitioners may find our results interesting in that they offer the opportunity to compare their own approaches to PPM with current common practice and provide an overview of possible pitfalls. Moreover, we hope to have stimulated and encouraged other researchers to investigate analysing and improving business-IT alignment in the context of PPM. Limitations of our work show up in the limited set of six case companies that were analysed. A validation of the patterns with other companies needs to be carried out. Also, this research represents a snapshot of current approaches. Extensions of the presented work may thus include longitudinal studies of PPM initiatives. Future research will additionally need to explore further contingency factors that influence the way business-IT alignment is achieved in PPM endeavours.
Contribution F – Managing Process Performance to Enable Corporate Sustainability – A Capability Maturity Model

Table 22: Bibliographical Information for Contribution F

Abstract. Sustainability is among the key issues that organisations face today. Sustainability is frequently defined as economic activity that meets the needs of the present generation without compromising the ability of future generations to meet theirs. Despite being intensely discussed, however, the concept of sustainability is not as clear cut as is commonly believed. Likewise, neither kind nor scope of the capabilities organisations need to develop in order to become truly sustainable are currently well understood. This chapter proposes that process performance management (PPM) is a vital approach that organisations can use to address their sustainability concerns. Using a quantitative, questionnaire-based approach, the Rasch algorithm, we develop a capability maturity model that allows organisations to determine their current PPM maturity level and to identify required improvements regarding their process performance. The chapter concludes with a detailed discussion of the use of PPM to incorporate corporate sustainability in day-to-day operations.
F.1 Introduction

Many companies—in particular multinationals with a significant impact on both employment and the economy in general—periodically report their internal and external sustainability results in order to testify their sustainability performance [Baumgartner, Ebner 2010; Pojasek 2009; Wikström 2010]. This reporting habit is achieving growing approval and is adopted by an increasing number of organisations. A considerable number of companies, however, is only vaguely convinced about both their overall objectives and their capabilities in sustainability concerns [Baumgartner, Ebner 2010]. Even after more than thirty years of discussion on the concept, the business community does not seem to have agreed upon reasonable and practical approaches for an efficient implementation of sustainability issues [Labuschagne et al. 2005]. As a consequence many companies feel left in suspense and are fishing in murky waters.

The term sustainability gained great popularity with the definition provided by the Brundtland report, ‘Our Common Future’, in 1987. The report defines sustainable development as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” [The United Nations World Commission on Environment Development 1991, p. 43]. Based on this definition, the term triple bottom line (TBL) was coined, which refers to the three fundamental pillars of corporate sustainability [Savitz, Weber 2006]:

- the economic bottom line,
- the social bottom line, and
- the environmental bottom line.

Up to today, the required capabilities for achieving sustainability—particularly the necessary competencies in day-to-day operations—have not yet been consolidated and agreed upon. Part of the problem may be that some organisations show their commitment to being sustainable merely by changing their rhetoric and pursuing greenwashing [Laufer 2003; Stiller, Daub 2007]. Another part of the problem, however, is that organisations simply do not know what actions and measures to take or how to make sustainability part of their business routines and strategies [Baumgartner, Ebner 2010]. Most of the guidelines developed by governments, research institutions and organisations like the Global Reporting Initiative provide instructions on how to measure and report organisational sustainability performance [Commonwealth of Australia 2000; Global Reporting Initiative 2006; The United Nations World Commission on Environment Development 1991], but these guidelines lack advice on how to achieve sustainability in the first place [Isaksson 2006].
We propose that one of the most intuitive approaches to making manageable the giant challenge of sustainability and incorporating it into daily operations entails taking a process perspective and that the concept of process performance management (PPM) provides a valuable basis for establishing and maintaining sustainable business processes. This chapter illuminates the capabilities required to measure and manage performance on a process level. Using a quantitative approach, we develop a capability maturity model (CMM) that allows organisations to evaluate their current positions and to identify required improvements with respect to their PPM capabilities.

The remainder of this chapter is structured as follows. Section F.2 provides the conceptual background for our research by introducing the concepts of business process management (BPM) and PPM. This section establishes the fundamentals of maturity models (MMs) and maturity model (MM) development, as well as our conceptualisation of maturity for PPM. The subsequent section sketches out the methodology applied in developing MMs, including data collection and data analysis. The CMM itself is presented in detail in section F.4. Section F.5 then discusses how organisations can benefit from using the proposed model when striving for a comprehensive approach to measuring and managing corporate sustainability. The concluding section summarises our work and names limitations, along with implications for theory and practice.

**F.2 Foundations and Conceptual Background**

**F.2.1 Measuring and Managing Process Performance**

Analysing and improving organisational processes has been recognised as key to achieving organisational performance and has been discussed under the acronym BPM for roughly three decades in the business community [Armistead et al. 1999; Lee, Dale 1998; Smith, Fingar 2003]. However, since BPM still represents a young field of research and a number of organisations are only beginning to analyse, genuinely understand, and intentionally (re-)design their work practices [Bandara et al. 2007], available approaches to BPM often focus on the early phases of the BPM lifecycle. However, once organisations have increased their level of BPM maturity, they need “to begin measuring processes and their outputs, and to continually refine their designs” [Davenport, Beers 1995, p. 60]. Up to now, though, there is only little guidance on how to address performance management issues in the context of BPM [Kueng 2000; Vergidis et al. 2008].

One quite recent, but very promising approach addressing this gap is called PPM. As was the case for BPM at one time [Smart et al. 2009], PPM has generated enormous
practitioner interest, so the most elaborate conceptions of PPM have been provided by practitioners. The Association of Business Process Management Professionals (ABPMP), one of the premier non-for-profit practitioner organisations in the field of BPM, defines the measurement of process performance as “the formal, planned monitoring of process execution and the tracing of results to determine the effectiveness and efficiency of the process” [ABPMP 2009, p. 22]. The information gained in the measurement process is thereafter “used to make decisions for improving or retiring existing processes and/or introducing new processes in order to meet the strategic objectives of the organisation” [ABPMP 2009, p. 22]. Concepts that have been identified as contributing to either of the two components include defining performance metrics; monitoring, controlling and simulating processes; and aligning process and enterprise performance [Davamanirajan et al. 2006; Kueng 2000].

F.2.2 Maturity Assessments and MM Development

The popularity of MMs has increased largely in the fields of information systems (IS) and management science [Mettler, Rohner 2009]. Since the initial introduction of the concept in the 1970s [Gibson, Nolan 1974], myriad MMs have been developed in both theory and practice [e.g., Crawford 2006; Khaiata, Zualkernan 2009; Scott 2007]. MMs are a valuable instrument for systematically documenting and guiding the development of organisations based on anticipated, desired or archetypal evolution paths. A MM consists of a sequence of maturity levels for a class of objects [Becker et al. 2009; Klimko 2001]. Maturity in this context is understood as a “measure to evaluate the capabilities of an organisation” [de Bruin et al. 2005, p. 1], while the term capability is understood as the ability to achieve a predefined goal [van Steenbergen et al. 2010]. MM are applied as both an evaluative and comparative basis for self or third party assessment [Chrissis et al. 2003; de Bruin et al. 2005; Hakes 1996] and an informed approach to achieving continuous improvement [Ahern et al. 2003]. Table 23 provides a brief overview of the most important characteristics of MMs.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Object of Maturity Assessment</strong></td>
<td>MMs allow for the assessment of the maturity of a variety of objects. Most frequently assessed objects are technologies/systems [Popovic et al. 2009; Zumpe, Ihme 2006], processes [Chrissis et al. 2003; Paulk et al. 1993], people/workforce [Curtis et al. 2010] and management capabilities, such as project or knowledge management [Crawford 2006; Paulzen et al. 2002].</td>
</tr>
<tr>
<td><strong>Dimension</strong></td>
<td>Dimensions are specific capability areas that describe aspects of the object of maturity assessment. Dimensions should be both exhaustive and distinct [Met-</td>
</tr>
</tbody>
</table>
**Table 23: Characteristics of MMs**

While MMs are seeing increasing prominence, they are also the subject of some criticism: In particular, the rapid development of large numbers of MMs—de Bruin et al. identify over a hundred different MMs in their extensive review [de Bruin et al. 2005]—has led to a certain arbitrariness and negligence with respect to the development or design process of MMs [Becker et al. 2009; Mettler, Rohner 2009]. In addressing this grievance, de Bruin et al. suggest a MM lifecycle model that consists of six phases: scope, design, populate, test, deploy, and maintain [de Bruin et al. 2005]. Regarding the design phase in particular, Mettler and Rohner [2009] further suggest a top-down and a bottom-up approach. While the top-down approach specifies that levels be defined first and thereafter completed with characteristics that describe the different dimensions, the bottom-up approach prescribes that dimensions and characteristics be derived first and then assigned to different maturity levels. Several methods have been proposed for the derivation of characteristics, dimensions and levels. The most frequently mentioned qualitative methods are literature analysis, Delphi studies, case studies, expert interviews, and focus groups [Becker et al. 2009; de Bruin et al. 2005]. Quantitative methods are used less often, as they require a theoretical foundation, and many existing MMs lack a theoretical foundation [Lahrmann et al. 2011b]. However, an explicated theoretical foundation—that is, a rigorous derivation of the underlying maturity concept—serves to deepen the understanding of the relationships
and mutual impacts between parts of the model and should be carefully considered. The next section presents the conceptualisation of maturity that builds the theoretical foundation of our PPM CMM.

F.2.3 Conceptualising PPM Maturity

Soanes and Stevenson define maturity as a “state of being complete, perfect, or ready” or the “fullness of development” [Soanes, Stevenson 2008, p. 906]. We argue that depicting this appreciation of maturity in MMs requires not only the consideration of causes (such as, in this context, “processes have defined process owners”) but also that of effects (such as, in this context, “process flows are consistent and transparent beyond functional borders”). MMs that contain only effects do not provide guidance on how to improve the object whose maturity is to be measured, whereas MMs that incorporate only causes do not offer insights into the impact that is to be achieved. Building on this argumentation, we deploy IS success models and their underlying theory to conceptualise our MM [DeLone, McLean 2003; Gable et al. 2008; Petter et al. 2008]. In so doing, we intend to complement the relevance of MMs with the rigour of theory.

The purpose of IS success models is to explain which variables or components (causes) positively affect IS success (effect). IS success is conceptualised as being based on ‘IS use’—that is, the intention to use, as well as the actual use, which drives ‘IS impact’ or the ultimate IS net benefits. ‘IS use’ itself is influenced by ‘IS deployment’ or the quality of the IS system deployed. According to socio-technical theory [Bostrom, Heinen 1977] (STT) ‘IS deployment’ may be understood as a compound of different pieces of information technology (IT) and as an interplay of IT, people, methodological capabilities, and organisational practices. STT postulates that the social and the technical subsystems of an IS are interdependent and that they should work with each other in order to maximise the system’s benefits.

In line with common research practice [e.g., Gable et al. 2008], our analysis focuses on the causes of IS success, rather than on the success itself, so we collapse ‘IS use’ and ‘IS impact’ into one concept. Thus, the conceptual basis for our MM is formed by the three concepts: ‘social system’, ‘technical system’, and ‘use/impact’ (cf. Figure 20). Having outlined the conceptual focus of our MM, we proceed with the domain focus and scope of the content we chose. PPM, whose maturity we aim to measure, has been defined as the bipartite approach of process performance measurement—in other words, the planned monitoring of process execution and logging of results to determine the effectiveness and efficiency of a process—and improvement—that is, the use
of this information to make improvement decisions in line with the strategic objectives of the organisation (cf. section F.2.1). Elbashir et al. [2008] propose that effectively and sustainably managing performance on a process level requires bringing together BPM and business intelligence (BI) capabilities and techniques. Therefore, we propose that, in order to capture and depict PPM maturity comprehensively, we must use a compound of three dimensions: BPM as the business-related foundation for PPM, BI as the information-technological basis or enabler of PPM, and PPM itself to cover process-specific measurement and improvement capabilities.

Figure 20: Concepts that Represent Maturity

In developing the questionnaire, we built upon the two outlined perspectives. On the one hand, our work was guided by the conceptual results we derived from the IS success model and SST (‘social system’, ‘technical system’, ‘use/impact’). On the other hand, we brought together key insights from the BPM, BI and PPM domain. Table 24 shows the references that were used for the questionnaire development.

<table>
<thead>
<tr>
<th>Source</th>
<th>Conceptual Focus</th>
<th>Domain Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Socio</td>
<td>Technical</td>
</tr>
<tr>
<td>[Bandara et al. 2007; Paim et al. 2008]</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>[Alibabaei et al. 2009]</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>[Elbashir et al. 2008]</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>[Ko et al. 2009; Mutschler et al. 2008]</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>[Elbashir et al. 2008; Kueng 2000]</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>[Davenport 2010; Wixom, Watson 2010]</td>
<td>x</td>
<td></td>
</tr>
</tbody>
</table>
The next section introduces the research methodology employed and describes the data collection and analysis.

### F.3 Research Methodology

#### F.3.1 Using the Rasch Algorithm for MM Development

The Rasch algorithm has proven a viable approach to building empirically grounded MMs [Dekleva, Drehmer 1997]. By counting the answers that indicate the presence of capabilities, the algorithm calculates two scores: one for the difficulty of items and one for the ability of the surveyed entities. Both scores are measured on the same interval scale. In the context of MM construction, the measurement of item difficulty supports the inductive allocation of items onto maturity levels, and the capability of participants supports the assessment of organisations. In order to tailor the Rasch algorithm for MM development, the basic model has been modified slightly in three areas: (1) Because rating scales have a stronger expressive power, five-tired Likert scales are employed instead of the originally proposed dichotomous scales. (2) A MM helps its users determine where to improve their capabilities, so both current and desired degrees of realisation per item and per organisation are surveyed and analysed. The difficulty of an item for an organisation is then determined by the delta value, where a high positive gap expresses a difficult and desired item, and negative gaps and values on the threshold represent easy items. (3) The Rasch algorithm yields only a single ordinal scale that represents the logit measure of each item and organisation, but not distinct maturity levels. In order to overcome subjectivity in defining maturity levels, a cluster analysis based on the item logits is performed. The purpose of clustering is the “unsupervised classification of patterns (observations, data items or feature vectors) into groups (clusters)” [Jain et al. 1999, p. 264]. Since most MMs use five maturity levels [Becker et al. 2010], the anticipated number of clusters is set to five.
F.3.2 Data Collection

The data was collected using a written questionnaire that was distributed at a practitioner event on BI and business analytics held in October 2009. The participants were specialists and executives working as performance analysts, business developers, controllers, and BI specialists on both the business and the IT side, so they had the knowledge and information required to answer the questions [Czaja, Blair 1996]. The questionnaire was designed to assess both the current and the future desired state of PPM in the participating organisations. The selection of items was guided by the relevant literature in BPM, performance management and BI, as described in the preceding chapter. The first version of the questionnaire was pretested with regard to wording, coherency and ease of interpretation with three academics with adequate expertise, and the instrument was revised according to their feedback. Before being distributed, the questionnaire was pretested again with three practitioners with regard to consistency, understandability and adequacy of item sequence. The final questionnaire presented forty items that relate to the research phenomenon PPM.

Respondents were asked to indicate the current and the desired degree of realisation in their organisations for each of the forty items using a five-tiered Likert scale. Forty-nine questionnaires representing forty-nine different organisations were returned. The surveyed organisations are primarily large and medium-sized companies from the German-speaking countries. Sixty percent have more than one thousand employees, and another 22 percent have more than one hundred employees. The main sectors represented were professional services (40%), banking, finance and insurance (29%), high tech (11%), manufacturing and consumer goods (7%), media and telecommunication (5%), and others (8%).

F.3.3 Data Analysis

The BIGSTEPS software, Version 2.82 [Linacre, Wright 1998] was used to obtain the Rasch item calibration. Important output statistics are the measure of difficulty, the standard error and a set of standardised fit statistics (infit and outfit) for each item. Infit is sensitive to unexpected behaviour affecting responses to items that indicate capabilities near the organisation's ability level. Infit is approximately normally distributed with an expectation of zero and a standard deviation of one. Outfit is sensitive to unexpected behaviour by organisations on items that indicate capabilities far from the organisation's ability level. It is also approximately normally distributed. If the data conforms to the model, infits and outfits greater than 2 should not occur in more than 5
percent of the items [Dekleva, Drehmer 1997]. Our data set meets this quality criterion. Table 25 shows the results of applying the Rasch algorithm ordered by the levels achieved by means of the subsequent cluster analysis.

<table>
<thead>
<tr>
<th>Meas. Error</th>
<th>Infit</th>
<th>Outfit</th>
<th>Level</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.06</td>
<td>-1.91</td>
<td>0.56</td>
<td>5</td>
<td>PPM is part of the corporate performance management (CPM).</td>
</tr>
<tr>
<td>1.35</td>
<td>0.50</td>
<td>0.9</td>
<td>5</td>
<td>PPM is deployed for all processes of the organisation.</td>
</tr>
<tr>
<td>0.57</td>
<td>0.70</td>
<td>1.06</td>
<td>4</td>
<td>Defined BI governance responsibilities and processes are in place.</td>
</tr>
<tr>
<td>0.70</td>
<td>1.89</td>
<td>1.68</td>
<td>4</td>
<td>A central integrated database is in place (e.g., an enterprise data warehouse (DWH)).</td>
</tr>
<tr>
<td>0.70</td>
<td>-1.07</td>
<td>0.73</td>
<td>4</td>
<td>Processes have defined process owners.</td>
</tr>
<tr>
<td>0.57</td>
<td>-0.8</td>
<td>0.76</td>
<td>4</td>
<td>BI systems, such as dashboards, are used for the presentation of process performance indicators.</td>
</tr>
<tr>
<td>0.57</td>
<td>-2.44</td>
<td>1.06</td>
<td>4</td>
<td>Cycle time is measured for processes.</td>
</tr>
<tr>
<td>0.70</td>
<td>-0.67</td>
<td>0.83</td>
<td>4</td>
<td>Process costs are measured for processes.</td>
</tr>
<tr>
<td>0.82</td>
<td>-0.41</td>
<td>0.86</td>
<td>4</td>
<td>Quality is measured for processes.</td>
</tr>
<tr>
<td>0.57</td>
<td>-0.92</td>
<td>0.81</td>
<td>4</td>
<td>Resource utilisation is measured for processes.</td>
</tr>
<tr>
<td>0.57</td>
<td>0.96</td>
<td>1.11</td>
<td>4</td>
<td>PPM is deployed for production processes.</td>
</tr>
<tr>
<td>0.57</td>
<td>1.42</td>
<td>1.12</td>
<td>4</td>
<td>PPM is deployed for other administration processes (e.g., human relations).</td>
</tr>
<tr>
<td>0.20</td>
<td>0.26</td>
<td>0.91</td>
<td>3</td>
<td>Defined BI deployment and use processes are in place.</td>
</tr>
<tr>
<td>0.20</td>
<td>0.53</td>
<td>0.99</td>
<td>3</td>
<td>A defined BI architecture with distinct guidelines (standards and principles) is in place.</td>
</tr>
<tr>
<td>0.08</td>
<td>0.91</td>
<td>1.06</td>
<td>3</td>
<td>The embedding of BI into operational processes is appropriate.</td>
</tr>
<tr>
<td>0.08</td>
<td>-1.09</td>
<td>0.78</td>
<td>3</td>
<td>The use of information takes place across all organisational units.</td>
</tr>
<tr>
<td>0.45</td>
<td>-2.22</td>
<td>0.61</td>
<td>3</td>
<td>Process flows are consistent and transparent beyond system borders.</td>
</tr>
<tr>
<td>0.35</td>
<td>0.84</td>
<td>1.15</td>
<td>3</td>
<td>PPM is centrally coordinated and implemented.</td>
</tr>
<tr>
<td>0.33</td>
<td>1.26</td>
<td>1.08</td>
<td>3</td>
<td>A central data warehouse is used for analytically editing process performance indicators.</td>
</tr>
<tr>
<td>Meas.</td>
<td>Error</td>
<td>Infit</td>
<td>Outfit</td>
<td>Level</td>
</tr>
<tr>
<td>-------</td>
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</tr>
<tr>
<td>0.20</td>
<td>0.35</td>
<td>-1.75</td>
<td>0.68</td>
<td>3</td>
</tr>
<tr>
<td>0.33</td>
<td>0.35</td>
<td>-0.67</td>
<td>0.97</td>
<td>3</td>
</tr>
<tr>
<td>0.80</td>
<td>0.35</td>
<td>0.55</td>
<td>0.96</td>
<td>3</td>
</tr>
<tr>
<td>-0.17</td>
<td>0.36</td>
<td>0.30</td>
<td>1.09</td>
<td>3</td>
</tr>
<tr>
<td>-0.70</td>
<td>0.38</td>
<td>-0.92</td>
<td>0.70</td>
<td>2</td>
</tr>
<tr>
<td>-0.43</td>
<td>0.36</td>
<td>0.17</td>
<td>0.91</td>
<td>2</td>
</tr>
<tr>
<td>-0.17</td>
<td>0.36</td>
<td>-0.87</td>
<td>0.73</td>
<td>2</td>
</tr>
<tr>
<td>-0.17</td>
<td>0.36</td>
<td>0.35</td>
<td>1.04</td>
<td>2</td>
</tr>
<tr>
<td>-0.04</td>
<td>0.35</td>
<td>-0.31</td>
<td>0.84</td>
<td>2</td>
</tr>
<tr>
<td>-0.04</td>
<td>0.35</td>
<td>-1.23</td>
<td>0.79</td>
<td>2</td>
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<tr>
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</table>
PPM is utilised for planning, such as planning for capacities (ex ante).

Table 25: Results of Applying the Rasch Algorithm Ordered by Level (Cluster)

### F.4 Deriving a CMM for PPM

The CMM is built based on the results of the Rasch algorithm and the succeeding cluster analysis. Along the dimensions that form the theoretical and domain-related basis of our maturity concept, the items are assigned to the levels as they were determined by applying the algorithms. Table 26 shows the resulting impact-oriented PPM CMM.

<table>
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<th>Level 1</th>
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<tr>
<td>PPM Infant</td>
<td>PPM Child</td>
<td>PPM Teenager</td>
<td>PPM Adult</td>
<td>PPM Sage</td>
</tr>
<tr>
<td>Socio BPM</td>
<td>Empowered process owners</td>
<td>Central coordination</td>
<td>Clear ownership</td>
<td></td>
</tr>
<tr>
<td>PPM Empowered process owners</td>
<td>Central coordination</td>
<td>PPM is part of CPM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BI Standardised systems and processes</td>
<td>Defined governance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tech. PPM Transactional sources</td>
<td>DWH-based integration</td>
<td>BI-based presentation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BI Low latency in infrastructure</td>
<td>High-quality infrastructure</td>
<td>Central DWH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use / Impact BPM Cross-functional integration</td>
<td>Cross-system integration</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PPM Core processes</td>
<td>Sales processes</td>
<td>Accounting processes</td>
<td>Production and administrative processes</td>
<td>All processes</td>
</tr>
<tr>
<td>Ex post and ex ante analyses</td>
<td>Cross-functional integration</td>
<td></td>
<td></td>
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<tr>
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</table>
Table 26: PPM CMM

Various terms have been used in prior MM development efforts to describe the distinct levels of maturity that can be achieved. The well-known capability maturity model integration (CMMI) developed at Carnegie Mellon contains five maturity levels termed ‘Initial’, ‘Managed’, ‘Defined’, ‘Quantitatively Managed’, and ‘Optimizing’ [Chrissis et al. 2003]. The BI MM proposed by The Data Warehouse Institute offers six maturity levels labelled ‘Prenatal’, ‘Infant’, ‘Child’, ‘Teenager’, ‘Adult’, and ‘Sage’ [Eckerson 2009]. In denominating the levels of the model proposed here, we adopt the levels of the BI MM, leaving out the ‘Prenatal’ level.

Level 1 of the PPM CMM, titled ‘PPM Infant’, is characterised by a corporate-wide commitment to BPM and the intention to adopt process orientation as a central paradigm. The existing organisational structure is enriched when the process owners are assigned adequate decision-making authority to accomplish process (re-)designs. From a technical point of view, the BI infrastructure is sufficiently mature as to ensure a timely provision of analytical data. However, source systems for process monitoring and controlling are mainly transactional at this stage and have not yet been properly integrated. In the infant stage of PPM maturity, the scope of process performance measurement is limited to the organisation’s core processes, which are primarily measured for improvement (ex post) and planning (ex ante) purposes.

Organisations at level 2, called ‘PPM Child’, have an organisational unit in place that is dedicated to the strategic management and central coordination of business processes. This unit determines the standards, tools, mechanisms, and techniques to be used to integrate and anchor process orientation in the organisation. The selection of adequate instruments and frameworks is guided by the overall business strategy, so it is fully aligned with the organisation’s strategic objectives. At level 2 the functional scope for process owners is extended, as they are entrusted with the full responsibility for PPM tasks. Consequently, at level 2 they become fully accountable not only for the initial design but also for the continuous measurement and improvement of the processes they own. The BI infrastructure at this level is of consistently high quality as it relates to both data and system performance. The centralisation of BPM coordination
and the availability of a high-quality BI infrastructure support the reliable integration of processes across organisational functions. Moreover, the broadened use of process performance data facilitates cross-functional cooperation and avoids local performance optima. The scope of process performance analyses is extended to cover not only core processes but also sales processes, and results of the analyses are used for decision making by middle and upper management.

When they reach level 3, termed ‘PPM Teenager’, organisations have centralised the PPM function and have put into effect both standardised BI deployment routines and a defined BI architecture. A DWH is in place for the diagnostic analysis and enrichment of process performance indicators. Enhanced system integration enables process consistency across functional and system borders, allowing for the continuous measurement of processes from one end to the other. A fundamental set of process-related key performance indicators (KPIs), including operation rates and adherence to schedule, has been defined and is continuously measured. Finally, the integration of BI into operational processes makes process performance data available to all staff levels.

Level 4 of the PPM CMM, named ‘PPM Adult’, is characterised by a further manifestation of the process paradigm in which process ownerships have become prevalent. At this stage, process ownership is not just a role but an established organisational entity with significant authority. The existing BI landscape has further matured and is now supplemented by a set of defined governance guidelines. The technical capabilities have improved so as to enable a BI-based presentation of process performance data on dashboards. All transactional data, including process data that is meant to be analysed by means of the acquired BI capabilities is integrated in one enterprise DWH, and decision makers employ an advanced set of KPIs for process performance measurement. This set of indicators, which includes KPIs like cycle time, process quality, process costs, and resource utilisation, enables the organisation to monitor and control its performance actively as it relates to process results but particularly to process execution.

Attaining the highest level of PPM maturity, the level termed ‘PPM Sage’ aligns and integrates PPM initiatives with the CPM approach so as to directly reflect the overall organisational goals and translate them into immediate action. At this stage, process performance measurement and improvement are established over the entire landscape of the organisation’s processes, facilitating a comprehensive assessment of overall operational performance.

The next section discusses the application of PPM and the proposed CMM to support the measurement and management of corporate sustainability.
F.5 PPM as an Enabler of Corporate Sustainability

In striving for sustainability, organisations search for the “sweet spot” of sustainability in which injurious social and environmental impacts are minimised while an adequate rate of return is preserved [Nguyen, Slater 2010]. Establishing and maintaining this balance is a key challenge for organisations [Hessami et al. 2009]. The sustainable development or macro-level of sustainability defines the context in which organisations follow the “process of creating, testing, and maintaining opportunity” [Holling 2001, p. 390]. Uncontrollable factors like uncertainty, rapid environmental changes and a high degree of complexity [Hessami et al. 2009] affect an organisation’s ability to foster its adaptive capabilities and create opportunities, just as external influences like legal and societal requirements do [Baumgartner, Ebner 2010].

![Figure 21: The Concept of Sustainability [based on Baumgartner, Ebner 2010; Hessami et al. 2009; Nguyen, Slater 2010]](image)

To conceptualise and realise corporate sustainability, a company must derive a “consensus on what to sustain” [Wikström 2010, p. 100], analyse external and internal influences, and decide what steps to take and for how long. Figure 21, which provides an overview of the components of and influences on corporate sustainability, shows that, in order to assess TBL performance comprehensively, each of its dimensions should be measured.
How does PPM now contribute to achieving sustainability? The answer, according to Nguyen and her colleague, is that for sustainability holds true what is valid for any other business initiative, “If you can’t measure it, you can’t manage it” [Nguyen, Slater 2010, p. 10]. Traditional performance management approaches tend to overemphasize the measurement of outcomes (e.g., profitability, liquidity and solvency ratios) at the expense of execution quality. The same applies for sustainability management approaches: Pojasek states that many organisations still believe that measuring sustainability results provides “a strong indication of […] sustainability performance” [Pojasek 2009, p. 78]. However, in order to measure both sustainability and performance in an immediate and direct way, measurement must not be limited to process results but should also—and in particular—focus on the effectiveness, efficiency and quality of process execution itself.

The PPM CMM introduced in this chapter is a valuable instrument with which to take the first step in this direction. It identifies the necessary organisational and technical competencies for establishing a sound process-based sustainability management approach. Besides the organisational (e.g., central coordination of PPM issues, level 3) and technical (e.g., DWH-based integration, level 3) prerequisites, the model illuminates the resulting capabilities that manifest in a positive business impact (e.g., use of fundamental set of KPIs available to all staff, level 3). In order to build sustainability into the proposed model, the model must be enriched with a set of KPIs that reflect all three aspects of the TBL. Of these three aspects, the economic dimension—often termed the baseline of corporate sustainability [Wikström 2010]—is the most widely discussed. Aiming at sustainable profits, high productivity and long-term business growth, the economic dimension is seen as a prerequisite of “focus on environmental and social issues” [Isaksson 2006, p. 632]. Several renowned IS researchers also advocate integrating sustainability measures into daily operations and innovating IT in order to support the sustainable conduct of business. Melville [2010] suggests a set of environmental data sources and metrics that support the assessment of an organisation’s impact on the natural environment, while Elliot [2011] complements existing research by illuminating the main environmental challenges and suggesting the adoption of a multi-perspective approach to measuring sustainability.

In practice, too, increased efforts are put into measuring and improving sustainability performance. One prominent organisation that has committed to a rigorous measurement of sustainability performance is SAP. Their sustainability report [SAP 2011] discloses their economic performance—measured through revenue, operating margin and customer satisfaction—and their social performance—measured through employee
turnover, employee health, employee engagement, and the percentage of women in top management. Environmental sustainability is assessed using the KPIs greenhouse gas footprint, total energy consumed, percentage of renewable energy, and data centre energy. These metrics may serve as first examples to be integrated into the model proposed here.

F.6 Conclusion and Future Work

MMs have become an established means in the IS community to document capabilities systematically and guide organisations in their efforts to improve them. This chapter proposes a theoretically founded MM for assessing and evaluating competencies in the field of PPM. Our theoretical understanding of maturity embraces technical and social competencies that are required for the deployment of PPM, as well as the effects of a good deployment in terms of resulting business impacts. Because the model incorporates both causes and effects, it is expected to find broad practitioner approval.

Compared to MM development processes described elsewhere [e.g., Becker et al. 2009; de Bruin et al. 2005], the combined approach of behavioural and design research methods applied in developing the MM proposed here is unconventional and innovative. In particular, this approach avoids the arbitrariness in assigning capabilities to different maturity levels that is inherent in other development methods. The study will be of interest to other researchers engaged in the field of MM development, and we look forward to further lively discussion and progression in all directions of study.

We consider PPM a powerful concept for use in breaking the sustainability challenge into a set of manageable tasks that can be straightforwardly implemented, controlled, and continuously improved. It is our hope that our MM will support organisations in evaluating their current capabilities and identifying the competencies they must develop in order to improve. However, in its present form, our model provides only suggestions on necessary organisational and technical capabilities for incorporating sustainability into an organisation’s day-to-day business. In order to cover all three aspects of the TBL comprehensively, the model will have to be enriched with KPIs that directly measure economic, ecological and social performance on a process level. Therefore, while the proposed model does provide answers to the question of how to measure and manage sustainability, it does not emphasize what exactly needs to be controlled. Measurement frameworks suggesting effective metrics are thus discussed in detail the following chapter.
Bibliography

[ABPMP 2009]

[Ahern et al. 2003]

[Ahmad et al. 2007]

[Al-Mashari et al. 2001]

[Alibabaei et al. 2009]

[Alter 2006]

[Amaratunga, Baldry 2002]

[Armistead et al. 1999]

[Bandara et al. 2007]

[Barney 1991]

[Baskerville 2008]
[Baskerville, Pries-Heje 2010]

[Baskerville et al. 2007]

[Baumgartner, Ebner 2010]

[Becker et al. 2009]

[Becker et al. 2010]

[Benbasat et al. 1987]

[Benbasat, Zmud 1999]

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[Berenbach et al. 2009]

[Berger et al. 2010]

[Bhattacherjee, Hikmet 2007]
[Bohmer 2009]

[Bond, Fox 2007]

[Bonham 2008]

[Bostrom, Heinen 1977]

[Boudreau et al. 2001]

[Bradford, Florin 2003]

[Bragato, Jacobs 2003]

[Bucher et al. 2007]

[Bucher, Winter 2010]

[Bundesamt für Statistik 2006]
[Busato, von Below 2010]

[Carton, Hofer 2006]

[Casati et al. 2000]

[Chan, Seaman 2009]

[Chan, Reich 2007]

[Chang et al. 2008]

[Chen et al. 2009]

[Chin 2010]

[Chow et al. 1998]

[Chrissis et al. 2003]

[Churchill 1979]
[Cleven et al. 2009]

[Coffey et al. 1992]

[Commonwealth of Australia 2000]

[Corea, Walters 2007]

[Crawford 2006]

[Creswell 2003]

[Curtis et al. 2010]

[Czaja, Blair 1996]

[Damij 2007]

[Davamanirajan et al. 2006]

[Davenport 1993]
[Davenport 2010]

[Davenport, Beers 1995]

[Davenport, Harris 2007]

[de Bruin et al. 2005]
de Bruin, Tonia; Rosemann, Michael; Freeze, Ronald; Kulkarni, Uday: Understanding the Main Phases of Developing a Maturity Assessment Model. In: Campbell, B. et al. (eds.): Proceedings of the 16th Australasian Conference on Information Systems (ACIS 2005), Sydney, Australia, 2005, pp. 1-10.

[de Winter et al. 2009]

[Dekleva, Drehmer 1997]

[DeLone, McLean 2003]

[DeToro, McCabe 1997]

[Donabedian 2005]

[Dormont et al. 2006]

[Durden et al. 1999]

[Dykes, Wheeler 1997]
Bibliography

[Eckerson 2009]

[Edvardsson et al. 2005]

[Eisenhardt, Martin 2000]

[Elbashir et al. 2008]

[Elliot 2011]

[Every et al. 2000]

[Fettke 2006]

[Fiedler 1964]

[Fischman 2010]

[Fisher 2004]

[Fitterer, Rohner 2010]

[Folan, Browne 2005]
[Forza 2002]

[Fottler 1987]

[Fraser et al. 2002]

[Gable 1994]

[Gable et al. 2008]

[Gamma et al. 1995]
Gamma, Erich; Helm, Richard; Johnson, Ralph; Vlissides, John: Design Patterns: Elements of Reusable Object-Oriented Software. Addison-Wesley Professional Computing Series, Upper Saddle River, NJ 1995.

[Gardner 1965]

[Gartner Inc. 2010]

[Gemmel et al. 2008]

[Genrich et al. 2008]

[Gesundheitsberichterstattung des Bundes 2011]
[Gibson, Nolan 1974]

[Gibson et al. 2004]

[Gist, Mitchell 1992]

[Global Reporting Initiative 2006]

[Glouberman, Mintzberg 2001]

[Goldkuhl 2004]

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[Gregor 2008]

[Gregor, Jones 2007]
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[Griffith et al. 2002]

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[Hammer, Champy 1993]
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[Helfert 2009]

[Henderson, Venkatraman 1993]

[Henseler et al. 2009]

[Herzlinger 2007]

[Hessami et al. 2009]

[Hevner 2007]

[Hevner, Chatterjee 2010]

[Hevner et al. 2004]
[Ho et al. 1999]

[Holling 2001]

[Houy 2005]

[Hung 2006]

[Hurst 1996]

[Isaksson 2006]

[Ittner et al. 2003]

[Jain et al. 1999]

[Jeston 2006]

[Jourdan et al. 2008]

[Kaiser 1958]

[Kaiser, Rice 1974]

[Kaluzny 2000]
[Kaplan 1984]

[Kaplan, Norton 1996]

[Kaplan, Norton 1992]

[Kaplan, Norton 2005]

[Karacapilidis, Pappis 1996]

[Keegan et al. 1989]

[Kershaw, Kershaw 2001]

[Khiaita, Zualkernan 2009]

[Kim 2009]

[King, Jun 2005]

[Klimko 2001]

[Ko et al. 2009]

[Kohlbacher 2010]
[Kohlegger et al. 2009]
Kohlegger, Michael; Maier, Ronald; Thalmann, Stefan. Understanding Maturity Models Results of a Structured Content Analysis In: Paschke, Adrian et al. (eds.): Proceedings of the 5th Internationale Konferenz für Wissensmanagement und Wissenstechnologien (I-KNOW 2009) and 9th International Conference on Semantic Systems (I-SEMANTICS 2009), Graz, Austria, Verlag der Technischen Universität Graz, 2009, pp. 51-61.

[Kotonya, Sommerville 1998]

[Kuechler et al. 2009]

[Kueng 2000]

[Kueng, Krahn 1999]

[Kueng et al. 2001]

[Labuschagne et al. 2005]

[Lahrmann et al. 2011a]

[Lahrmann et al. 2011b]
[Laufer 2003]

[Lee, Dale 1998]

[Linacre, Wright 1998]

[Lok et al. 2005]

[Lönnqvist, Pirttiäki 2006]

[Lovaglio 2011]

[Luft, Shields 2003]

[Luftman 2000]

[Luftman, Brier 1999]

[Luftman et al. 1999]

[Luhn 1958]

[Lynch, Cross 1991]

[Ma 1998]
[Makadok 2001]

[Malk, Beth 2010]

[March, Smith 1995]

[Marley et al. 2004]

[Martin 2008]

[Mccormack 2001]

[Mccormack et al. 2009]
McCormack, Kevin; Willems, Jurgen; van den Bergh, Joachim; Deschoolmeester, Dirk; Willaert, Peter; Štemberger, Mojca Indihar; Škrinjar, Rok; Trkman, Peter; Bronzo Ladeira, Marcelo; Valadares de Oliveira, Marcos Paulo; Bosilj Vuksic, Vesna; Vlahovic, Nikola: A Global Investigation of Key Turning Points in Business Process Maturity. In: Business Process Management Journal 15 (2009) 5, pp. 792-815.

[McCracken et al. 2001]

[McKay, Marshall 2005]

[Melão, Pidd 2000]
[Melchert et al. 2004]

[Melville 2010]

[Mendling 2008]

[Mentges 2006]

[Mettler 2011]

[Mettler, Rohner 2009]
Mettler, Tobias; Rohner, Peter: Situational Maturity Models as Instrumental Artifacts for Organizational Design. In: Li, Jiexun Jason; Mohan, Kannan (eds.): Proceedings of the 4th International Conference on Design Science Research in Information Systems and Technology (DESRIST 2009), Malvern, PA, 2009.

[Meyer, Collier 2001]

[Midgley 1987]

[Mitroff 2004]

[Mougeot, Maréchal 2006]

[Mutschler et al. 2008]
[Neely et al. 2002]

[Neubauer 2009]

[Nguyen, Slater 2010]

[Nolan 1973]

[Nordsieck 1934]

[Nørrekliit 2003]

[Nunamaker Jr et al. 1991]

[Nunnally 1978]

[OECD 2010]

[OED 2011]

[Olden, Smith 2008]

[Ou et al. 2010]
[Paim et al. 2008]

[Palvia et al. 2004]

[Paulk et al. 1993]

[Paulzen et al. 2002]

[Peffers et al. 2007]

[Persson, Stirna 2002]

[Petter et al. 2008]

[Pink et al. 2001]

[Plattfaut et al. 2011]
[Poelmans et al. 2010]

[Pojasek 2009]

[Popovic et al. 2009]

[Pöppelbuß, Röglinger 2011]

[Porter 1980]

[Pounds 1969]

[Powell et al. 2001]

[Power 2009]

[Prada et al. 2004]
[Pries-Heje et al. 2008a]

[Pries-Heje et al. 2008b]

[Pritchard, Armistead 1999]

[Recker 2008]

[Reijers 2006]

[Reijers et al. 2010]

[Ringle et al. 2005]

[Robson 2004]

[Rogers 1962]

[Rohloff 2009]

[Rosemann, de Bruin 2005]
[Rosemann et al. 2006]

[Rosemann, vom Brocke 2010]

[Rossi, Sein 2003]

[Sadiq et al. 2007]

[Saltmarshe et al. 2003]

[Samson, Challis 2002]

[SAP 2011]

[Saunders 1998]

[Savitz, Weber 2006]

[Scott 2007]
[Siha, Saad 2008]

[Simon 1969]

[Simon 1973]

[Sircar 2009]

[Skrinjar et al. 2008]

[Smart et al. 2009]

[Smith, Fingar 2003]

[Snee, Hoerl 2005]

[Soanes, Stevenson 2008]

[Srivastava, Teo 2005]

[Stewart 1981]

[Stiller, Daub 2007]
[Sussan, Johnson 2003]

[Swamidass 1991]

[SwissDRG 2011]

[Tenenhaus et al. 2005]
Tenenhaus, Michel; Vinzi, Vincenzo Esposito; Chatelin, Yves-Marie; Lauro, Carlo: PLS Path Modeling. In: Computational Statistics & Data Analysis 48 (2005), pp. 159-205.

[The United Nations World Commission on Environment Development 1991]

[Thompson 2004]

[Trkman 2010]

[Vaishnavi, Kuechler 2007]

[van Aken 2004]

[Van de Ven, Poole 1995]

[van der Aalst et al. 2007]
[van der Aalst et al. 2003]

[Van Looy 2010]

[van Steenbergen 2011]

[van Steenbergen et al. 2010]
van Steenbergen, Marlies; Bos, Rik; Brinkkemper, Sjaak; van de Weerd, Inge; and Bekkers, Willem. The Design of Focus Area Maturity Models In: Winter, Robert; Zhao, J. Leon; Aier, Stephan (ed.): Proceedings of the 5th International Conference on Design Science Research in Information Systems and Technology (DESRIST 2010): Global Perspectives on Design Science Research, St. Gallen, Switzerland, LNCS 6105, Springer, Berlin, Heidelberg, Germany, 2010, pp. 317-332.

[Veillard et al. 2005]

[Venable 2006]

[Vera, Kuntz 2007]

[Vergidis et al. 2008]

[vom Brocke et al. 2009]
[Walker, Dunn 2006]

[Walls et al. 1992]

[Walls et al. 2004]

[Ward Jr 1963]

[Watson 2009]

[Weber 1987]

[Wendorff 2001]

[Wernerfelt 1984]

[Weske 2007]

[West 2001]

[Wicks et al. 2007]

[Wikström 2010]
[Williams, Williams 2007]

[Winter 2007]

[Winter 2008]

[Winter 2011]

[Winter et al. 2009]

[Wixom, Watson 2010]

[Wolf, Harmon 2010]

[Yang, Tung 2006]

[Zairi 1997]

[Zelman et al. 2003]

[Zollo, Winter 2002]
List of Publications

Peer-reviewed Journal Articles


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# Curriculum Vitae

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## Work Experience

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<td>Institute of Information Management, University of St.Gallen, Switzerland</td>
</tr>
<tr>
<td>2007</td>
<td>Working Student and Graduand</td>
<td>Miebach Logistik GmbH, Germany</td>
</tr>
<tr>
<td>2004 – 2005</td>
<td>Research Assistant</td>
<td>Institute of Information Management, University of Münster, Germany</td>
</tr>
<tr>
<td>2002 – 2004</td>
<td>Board Member for Public Relations and Student Consultant</td>
<td>Student Consultancy Study &amp; Consult e.V., Germany</td>
</tr>
<tr>
<td>2001</td>
<td>Working Student</td>
<td>Navona Group, Canada</td>
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