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A maturity model for BPM capability assessment in Dutch hospitals

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Master Thesis

“A maturity model for BPM capability assessment in Dutch hospitals”

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Abstract

Background Dutch hospitals are dealing with a variety of challenges impacting the quality of healthcare. Hospitals are under pressure to provide high-quality healthcare at an acceptable cost. The population is aging and requires care from a variety of medical specialists. Meanwhile, the government and health insurers are demanding more transparency into the quality of healthcare and are stimulating free market competition. Hospitals are dealing with complex, multidisciplinary processes and a departmentalised organisational structure which make it difficult to adapt to these changing conditions. Business Process Management (BPM) is a discipline that can be utilised by organisations desiring to improve quality. Several BPM maturity models exist that assist in the assessment and improvement of business process management capabilities. The goal of applying such a model is reaching a higher level of business process management maturity, and thereby improve the quality of the product or service that is being delivered. However, no such model exists specifically for the healthcare domain which takes into account healthcare-specific conditions. In this study, a domain-specific BPM maturity model for the Dutch hospital industry is developed.

Methodology The study was structured according to the Maturity Assessment Model Development Method. First, a literature study was conducted to identify the characteristics of general-purpose BPM maturity models and domain-specific process frameworks used in hospitals. A Delphi study was conducted among a panel of experts from Dutch hospitals and academia. A Delphi study constitutes a multi-round surveying technique for collecting rich data and reaching a consensus among a panel of experts. The selection of the capabilities identified by this panel was presented to a different, external panel of experts for validation. The model was further validated by developing a measurement instrument and applying it in one of the hospitals that was included in the Delphi study.

Results Eleven existing BPM maturity models were analysed for their structure and contents. In addition, two domain-specific process frameworks were analysed. This lead to the establishment of five healthcare-specific maturity levels in the proposed healthcare-specific BPM maturity model. After three consecutive rounds, the Delphi study yielded a total of thirty-three capabilities relevant to Dutch hospitals, spread across five different factors: People, culture, governance, strategic alignment and IT. Validation of the capabilities by an external panel supported the consensus that was reached in the Delphi study. Application of the measurement instrument showed that the model accurately reflects the practical situation and helps to identify relevant points for improvement.

Conclusions This study shows that the hospitals included in the panel are currently at a low-to-medium level of BPM maturity. They are aiming to improve their BPM maturity in the coming years and are implementing various projects to do so. The BPM maturity model developed in this study gives insight into the strong and weak points in regards to BPM capabilities, and helps to focus the efforts for future improvement. The model shows that capabilities related to people and culture are currently most influential in improving BPM maturity in hospitals. Further application of the model is needed to ensure generalisability.

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Introduction

This thesis was written as part of a study into the development of a Business Process Management (BPM) Maturity Model for Dutch hospitals.

Business Process Management (BPM) is a discipline that aims to "support business processes using methods, techniques, and software to design, enact, control, and analyse operational processes involving humans, organisations, applications, documents and other sources of information" (Weske, 2012). 'BPM maturity' is a concept used to indicate the stage of development of BPM capabilities. The concept of *maturity* is defined as "having reached the most advanced stage in a process" or "being fully grown or developed". Within BPM, it is understood that processes have lifecycles and can be improved through time (McCormack et al., 2009). Improvement of processes and process management capabilities therefore leads to higher BPM maturity. BPM maturity can be assessed and improved by using a BPM maturity model (BPMM). Such models include a number of distinctive maturity levels and define specific practices or capabilities for each level. Applied in inter-organisational settings, such models can be used for benchmarking and comparison (De Bruin, Freeze, Kulkarni, & Rosemann, 2005).

Examples of BPM maturity capabilities are the of use of process-supporting IT systems or the introduction of process owners (Rosemann & De Bruin, 2004, 2005a). Different BPM maturity models exist in literature, with each model providing a specific set of maturity levels and capabilities. These models may be general in nature or aimed at specific industry or domain. In this study, we found that healthcare providers face specific requirements and challenges that influence their (management of) business processes. Therefore, a BPM maturity model specific to the domain of Dutch hospitals may help to improve the quality of their BPM capabilities and thereby the quality of healthcare.

In the healthcare industry, the variety of specializations and therapies is increasing, while patients demand higher quality services and shorter waiting times (Øvretveit, 2000). In response to requirements imposed by the government and accreditation bodies, hospitals must integrate their information systems to better coordinate complex healthcare processes. Information systems in the hospital industry are however underdeveloped when compared to other industries (Helfert, 2009), particularly in terms of low technological sophistication and integration sophistication (Paré & Sicotte, 2001). Lack of funds, failure to recognize IT as a key stakeholder in hospital decisions and the implementation of Electronic Heath Records (EHRs) are shown to be some of the top IT management issues in hospitals (Jaana, Tamim, Paré, & Teitelbaum, 2011). Besides technical issues, the complexity of processes also introduces a variety of organisational challenges. These issues provide an obstacle for process improvement and, therefore, the quality of healthcare.

This study focuses on synthesizing existing knowledge on BPM maturity with industry-specific data collected from healthcare experts and quality frameworks. The end goal is to introduce a new model specific to the Dutch hospitals incorporating healthcare-specific terminologies and capabilities. In the following chapter, a problem statement is defined regarding the current issues in Dutch healthcare. It is shown that healthcare providers are facing increased pressure for providing higher quality care in a decentralized and competitive market (Øvretveit, 2000). A rising demand for healthcare and more stringent quality requirements are pushing healthcare providers to put their financial and IT resources to more efficient use. Following the problem statement, the practical and scientific relevance, the research questions and methods for this study are defined. The remainder of the thesis is devoted to answering each research question and presenting the proposed BPM Maturity Model.

1 Problem Statement

In The Netherlands, healthcare providers such as hospitals face increasing pressures in finances and quality management. Starting in 2006, the Dutch government has imposed several reforms in the healthcare industry to stimulate free market competition. This includes decentralisation efforts that transfer certain responsibilities formerly handled by government institutions towards healthcare providers, insurance companies and patients (Peeters, Delnoij, & Friele, 2014). Meanwhile, the government requires healthcare providers to publicly provide information on the quality of their care (Government of The Netherlands, 2012).

Healthcare expenditure in The Netherlands is relatively high, with 15.6% of the GDP spent on healthcare (Centraal Bureau Statistiek [CBS], 2014b). € 24.8 billion was spent on hospitals and medical specialists out of a total healthcare budget of € 94.2 billion in 2013, accounting to a proportion of 26% (CBS, 2014a). A yearly increase of 11.21% per capita healthcare expenditure was seen between 2001 and 2011 (Bloomberg, 2013). Hospital admissions in The Netherlands increased by a total of 58.8% over a ten-year period between 2002 and 2012, with 2573 admissions per 10.000 inhabitants in 2012 (CBS, 2014c). Compared to other national healthcare systems, only the United States shows a more rapid increase in healthcare costs. the National Institute for Health and the Environment (2014) states that volume growth is the main instigator of cost increase, especially in the mental healthcare sector. Expenditures for curative care are on par with international averages while expenditures for long-term care are relatively high. Bloomberg (2014) compares efficiency of national healthcare systems based on life expectancy and per capita cost of healthcare (relative and absolute). Between 2013 and 2014, the Dutch healthcare system fell from 25th to 40th place. This indicates a decline in efficiency. However, other reports such as the Euro Health Consumer Index 2015 rate The Netherlands as the number one healthcare system among thirty-five European countries (Björnberg, 2016). The Netherlands has scored in the top three in this index, which is measured based on forty-eight indicators. However, this report also mentions the over-use of in-patient care in The Netherlands (care requiring hospital admission).

All organisations, including hospitals, perform business processes with the purpose of providing value-adding services or products. In hospitals, the primary business process concerns curing and caring for patients. Supporting processes are in place to orchestrate procurement, logistics, administration et cetera. Hospitals use accreditation frameworks in order to assess and safeguard their level of performance, quality and safety. The efficient management of processes is required by accreditation frameworks such as NIAZ (Netherlands Institute for Accreditation in Healthcare, 2013). International accreditation bodies such as the Joint Commission International (JCI) also prescribe continuous process improvement for ensuring patient safety and efficient, standardised healthcare. These accreditation frameworks indicate that BPM maturity is essential for hospitals in order to gain accreditation status. Previous research has shown that there is a dependence between the process performance of an organisation and its maturity (Ravesteyn, Zoet, Spekschoor, & Loggen, 2012).

Rising costs and increased demand for healthcare, as well as efficiency obstacles, suggest the need for the improvement of process performance through the increase of BPM Maturity. This may be possible through the application of a BPM maturity model. While several generally applicable BPM maturity models already exist, these do not take into account the specific needs of the domain in which hospitals operate. Business process management is a holistic discipline that includes all variables that influence processes. Therefore, BPM Maturity Models must take into account all domain-relevant factors, such as organisational strategy & governance, methods, information technology, people and culture (Harmon, 2004). We propose the need for a domain-specific BPM Maturity Model for holistic maturity improvement in hospitals. This leads to the following problem statement:

“Currently, there exists no model tailored to Dutch hospitals that facilitates the assessment, comparison and continuous improvement of their BPM capabilities.”

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2 Relevance

The relevance of the research project is described in this chapter. According to the principles of design science research, which are presented in the next chapter, research should provide both an addition to scientific literature and a practical application. We first describe how the current state of BPM maturity in Dutch hospitals provides a trigger for performing this research. We then describe the gap in scientific literature in regards to a healthcare-specific BPM maturity model. As a result, we establish both the practical relevance and the scientific relevance of this research.

2.1 Practical Relevance

The problem statement presented in the previous chapter suggests the need for improved BPM maturity in Dutch hospitals. This is based on the fact that hospitals have complex processes and organisational structures and operate within a demanding environment. The ageing population requires more care, financial resources are strained, and the government, insurers and accreditation bodies demand stricter quality control and more transparency. As described below, the relatively weak BPM capabilities of hospitals (when compared to other sectors) suggest that these challenges can be better addressed when BPM maturity improves. In this chapter, the relevance of this study is further substantiated.

The complexity of process management in hospitals lies in its large variety of medical specialisations (Mans, Schonenberg, Song, van der Aalst, & Bakker, 2009). Patients may require the care of different medical specialists throughout their care process. This is also called the care pathway. A patient's care pathway can be highly variable and runs through different hospital departments. This proves to be a challenge, since data relating to the patient may be recorded inconsistently between specialists or stored in separate information systems (Mans, van der Aalst, Vanwersch, & Moleman, 2013). The complexities of healthcare processes introduce a risk of errors and unnecessary waiting times. Patients with the same diagnosis may encounter different waiting times in their process and the reasons for this are not always known (Mans et al., 2009). Earlier research shows a correlation between BPM maturity and process performance (Ravesteyn et al., 2012). Thus it follows that the improvement of BPM maturity and related capabilities may improve the process performance and quality of care in hospitals.

To identify the possibilities for improvement, we must first assess the current state of BPM maturity in hospitals. Previously collected data from over 1000 organisations shows that the Dutch healthcare and public sectors score lowest when compared to other sectors (Luyckx, 2012). Luyckx (2010) also identifies that hospitals are complex organisations that need to align their processes externally with other organisations (general practitioners, insurance companies) as well internally, between departments. Performance indicators and a proper reporting structure must be implemented to safeguard quality. Luyckx (2010) concludes that one of the main obstacles of BPM maturity in hospitals is the unique organisational structure: Doctors are the main decision makers within their individual departments. It is further suggested that doctors and business/IT departments within the hospital must work together on BPM decision making in order to improve BPM maturity.

Quality management departments in hospitals now face the challenge of aligning and standardising the processes within their organisation. In recent years, hospitals have started standardising processes for improving alignment, performance and gaining transparency (Mens, Ahlers, van Hattem, & Ravesteyn, 2015). The introduction of a standardised, enterprise-wide process architecture is a clear example of business process management. Thus, BPM maturity is improved through these initiatives. Standardised processes reduce overhead and errors and leads to better quality of healthcare (Mens, Luiten, Driel, Smit, & Ravesteyn, 2015).

Other research into the dependence between process maturity and performance shows that organisations score low on capabilities regarding information technology and measurement of processes (Ravesteyn et al., 2012). Hospitals are shown to have trouble integrating their information systems, which is necessary for managing and measuring entire processes (Helfert, 2009; Paré & Sicotte, 2001). A recent trend is the introduction of process

mining to gain understanding of the real-world processes (van der Aalst, 2011). This technique is used in hospitals to discover care pathways and identify performance issues or bottlenecks (Mans et al., 2009). The patient's care pathway is often variable and may include multiple specialisations that record data in different information systems. Process mining studies show that a group of patients with the same diagnosis may experience different care pathways with different waiting times (Mans et al., 2009). Thus, some patients are cured sooner than others. Process mining has helped to identify issues in processes that were not previously found. This shows that the process measurement capabilities of hospitals are indeed low. Improving these capabilities will allow hospitals to identify process issues and enable standardisation efforts.

Process mining initiatives also confirm issues in regards to low information technology maturity in hospitals (Mans et al., 2013). Process data is recorded in different information systems that are not integrated. The granularity and semantics of recorded data differs between systems. The lack of a uniform data structure proves to be an obstacle to mine processes and thus to properly measure and improve processes. These issues confirm that there is still much room for improvement in hospitals' BPM capabilities. While we are seeing some early initiatives to analyse and improve processes, more capabilities are needed to fully manage the process lifecycle for continuous improvement. The proposed BPM maturity model for hospitals will enable us to assess and further improve these capabilities.

2.2 Scientific Relevance

To determine scientific relevance of this study, we consider the current state of BPM maturity model in literature and related challenges. Van Looy, De Backer, & Poels (2011) identify three main issues when comparing current BPM maturity models in literature. First, a large variety of models is available with different scopes. This provides a challenge to organisations when selecting a model that will fit their organisational characteristics. While some models specifically measure the maturity of processes, others measure the maturity of BPM capabilities. This is a crucial difference that must be understood when selecting an appropriate maturity model. The characteristics of BPM maturity are explored further in the next chapter.

Second, terminology is inconsistent between models. Terms such as 'maturity levels' or 'capability levels' may be used interchangeably. Van Looy et al (2011) posit that the difference between a maturity level and a capability level should be sought in its scope. A capability is related to process-specific outcomes, where the level of knowledge and skills influence the quality of the outcome, i.e. the expected results of the process versus the actual results of the process. Maturity on the other hand is considered on the organisational level. It is concerned with the linking of individual processes to over-arching organisational goals and with establishing the ability of the organisation to manage these processes. The two concepts are intertwined, meaning that growth must be achieved both in organisational maturity as well as process capabilities.

Existing maturity models use different level structure with different naming conventions. Pöppelbuß, Plattfaut, & Niehaves (2015) compare different models that have three, four, or five distinct maturity levels. Because of these differences, the capabilities necessary for a specific level may not match between models. Additionally, the naming of levels is different. For example, the first maturity level is describes in different models as 'Initial' (Weber, Curtis, & Gardiner, 2008), 'Siloed' (Fisher, 2004) or 'Ad hoc' (McCormack et al., 2009). Also, the capability areas contained within the model may differ or overlap. Rohloff (2011) maps the capability areas of different models to illustrate the differences. The differences between two randomly chosen models from this mapping are illustrated in Table 1 below. It shows that naming of the capability areas may differ (such as in 'technology' and 'infrastructure') and that models use different abstraction levels for capability areas. For example, Rosemann & de Bruin (2005a, 2005b) define 'People' whereas Hammer (2007) distinguishes between 'Performers', 'Owners and 'Leadership'. In chapter 5.4, different BPM maturity models are compared to discover their characteristics and terminology.

BPM Maturity Model (Rosemann & De Bruin, 2005a, 2005b)	Process and Enterprise Maturity Model (Hammer, 2007)
Technology	Infrastructure
Methods	Design
	Metrics
	Expertise
People	Performers
	Owners
	Leadership

Table 1 Mapping of capability areas between two BPMM models according to Rohloff (2011)

The third issue with current maturity models as identified by Van Looy, De Backer, & Poels (2011) are the different levels of guidance. Some models provide tools or instruments to assess and improve processes in a practical manner, while other merely provide a theoretical explanation of maturity stages an organisation may encounter when improving its processes. This issue is countered by the application of a structured development method, such as the Maturity Assessment Model Development Method by De Bruin et al. (2005). The first two steps of this method encompass scoping the model and determining its design principles. These were defined in section 4.2. By providing transparency into the design of the proposed model on the basis of a known development method, we aim to provide a new addition to the current body of knowledge.

In this study, we address the three issues as defined by Van Looy, De Backer, & Poels (2011) as follows:

1. Relevance to the organisational characteristics of the hospital industry is ensured by cooperating with experts from this industry during the design and validation of the model.
2. Appropriate terminology is ensured by collecting data on existing maturity models and industry-specific models and frameworks, as well as data from experts
3. The level of guidance of the model is determined by establishing the scope and design principles of the model, as shown in section 4.2.

Based on the known information that improved BPM maturity leads to improved process performance (Ravesteyn et al., 2012) and that BPM maturity in healthcare is relatively low (Luyckx, 2010) we can conclude that the proposed maturity model possesses practical relevance as well as the ability to fill a gap in (scientific) literature.

3 Research Approach

This chapter describes the research framework, research questions and methods used for this study. We first consider the research framework. This study is of the 'designing' type, meaning that an artefact (The industry-specific BPM maturity model) is developed as a result of answering the main research question. Designing research in the information systems domain is commonly structured according to the Design Science Research framework by Hevner et al. (2004) as shown in Figure 1 below. The green arrows in this framework illustrate that both the business needs from the environment as well as applicable knowledge from existing literature provide input for research. In our case, the environment is the Dutch healthcare industry. As shown in the problem statement, there is a business need for improved BPM maturity. Applicable knowledge is collected in the form of existing BPM maturity models as well as quality and accreditation frameworks for healthcare.

By pulling together the business needs and applicable knowledge, a new artefact in the form of an industry-specific BPM maturity model is developed and evaluated. The artefact must provide both a practical solution (application in the appropriate environment) as well as an addition to the knowledge base. Validation methods are used to assess the efficacy of the newly developed model, so that it may prove useful to hospitals and serve as an addition to the body of knowledge on business process management. Hereby, the framework ensures that the end result of the study possesses both practical relevance as well as scientific rigor. This improves the usefulness of the developed artefact for the practical and scientific domains.

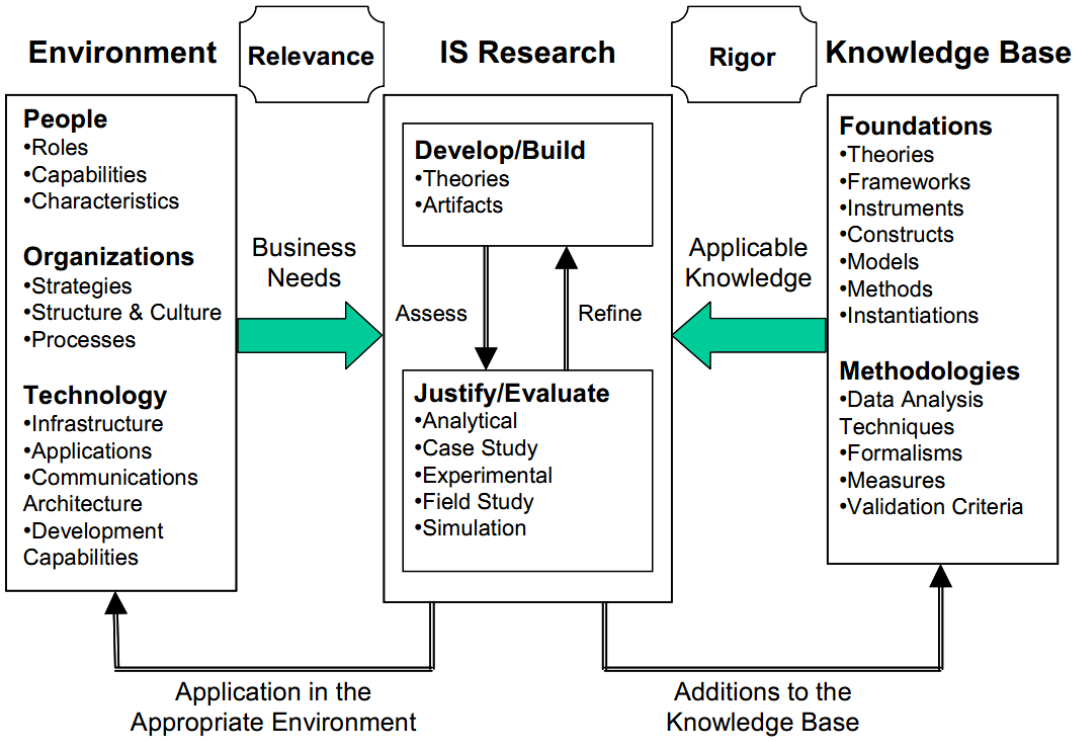

Figure 1 The Design Science Research Framework for Information Systems (Hevner et al., 2004)

Following the research framework, we consider the research questions for this study. The typology for research questions by Oost & Markenhof (2002) is used to structure the main research question. Oost & Markenhof (2002) define six types of research questions, namely (1) describing, (2) comparing, (3) defining, (4) evaluating, (5) explaining and (6) designing research questions. Seeing as this study is structured according to the design science research framework, it follows that the research question must be of the 'designing' type. Oost & Markenhof (2002) prescribe that research question for the designing type of research should provide a solution to an existing problem by using a developed artefact. Differences between the current and desired situation must be established,

as well as the reason for those differences existing. Based on these criteria and the context of this research as described above, the research questions for this study are defined as follows:

RQ: "Which healthcare-specific capabilities are required in developing a model for the assessment, comparison and continuous improvement of BPM capabilities in Dutch hospitals?"

In conjunction with the main research question, this study encompasses the following sub questions:

SQ 1.1 What defines BPM maturity?
SQ 1.2 What are the characteristics of BPM capability models in general?
SQ 1.3 What are the characteristics of process frameworks for hospitals?
SQ 1.4 To what extent are BPM practices performed in Dutch hospitals?
SQ 1.5 What are the specific needs for a healthcare-specific BPM capability model in Dutch hospitals?
SQ 1.6 Is the hospital-specific BPM capability model valid?

In the following chapter, research methods are linked to the main research question and the sub questions.

4 Research Methods

In this chapter, the research questions defined in the previous chapter are linked to research methods. The first phase of the project encompasses a literature review regarding SQ 1.1 and 1.2. The goal is to evaluate and interpret available research related to BPM maturity models. This results in an overview and comparison of current BPM maturity models.

Both the development and validation of the new model are structured according to the 'Maturity Assessment Model Development Framework' as composed by De Bruin et al. (2005). This development framework can be considered an 'umbrella method' which ties together a number of existing methods for the purpose of developing, validating, launching and maintaining a new framework or model. These methods include a literature review and multi-round Delphi study for the development of the framework. The reason for selecting this method of maturity model development is that it specifically relates to and is tested within the BPM domain with positive results. Other model development methods for maturity models exist, but are not specifically related to the BPM domain (Becker, Knackstedt, & Pöppelbuß, 2009; Van Steenbergen, Bos, Brinkkemper, Van De Weerd, & Bekkers, 2010). The literature review and multi-round Delphi study are used to answer SQ 1.3, 1.4 and 1.5. Within the Delphi study, a panel of experts is used to gather data on which factors are deemed most influential for BPM maturity in hospitals. This phase also establishes the current state of BPM capabilities and assessment methods in Dutch hospitals. The deliverable for this phase is a draft model or framework for the assessment of BPM capabilities in Dutch hospitals.

In the third and final phase of the project regarding SQ 1.6, the draft model is validated. This is done by presenting the preliminary results to a panel of experts from different entities within the same domain (healthcare). In this case, experts from Portuguese hospitals were used to validate the results. This leads to a final model and provides the input necessary for answering the main research question. Further generalization and maintenance of the model are considered out of the scope of this project. Table 1 below shows an overview of the methods, sources and required data for each of the sub questions.

RQ	Which healthcare-specific capabilities are required in a model for the assessment, comparison and continuous improvement of BPM capabilities in Dutch hospitals?		
Sub question	**Methods**	**Required data**	**Sources**
SQ 1.1, 1.2	Literature Review	Scientific literature	(Jalali & Wohlin, 2012)
SQ 1.3, 1.4, 1.5	Literature Review, Delphi Method (Maturity Assessment Model Development Framework)	Domain Expert Knowledge, Scientific literature, Domain literature	(De Bruin et al., 2005; De Bruin & Rosemann, 2007; Jalali & Wohlin, 2012)
SQ 1.6	Validation (Maturity Assessment Model Development Framework)	Domain Expert Knowledge	(De Bruin et al., 2005)

Table 2 Overview of research questions and methods

Figure 2 visually represents the positioning of the sub questions and main research question within the context of the chosen research methods, as well as the deliverables of the draft and final model for the assessment of BPM capabilities in Dutch hospitals.

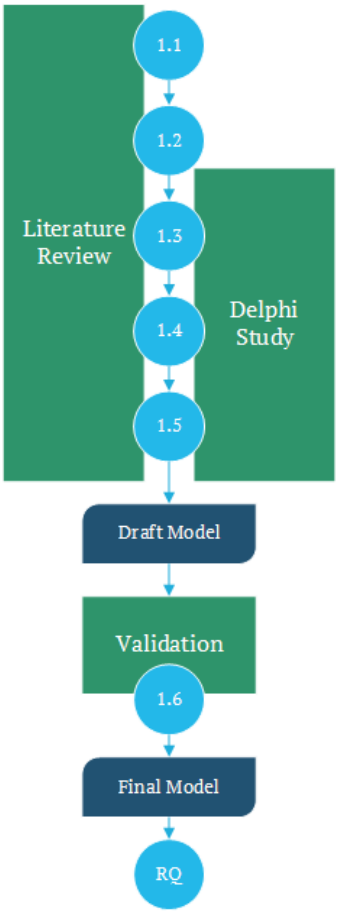

Figure 2 A visual representation of the research approach

The following sections describe the research methods in further detail. These include the literature review, the maturity assessment model development and the Delphi study.

4.1 Literature Review Method

The snowballing method by Jalali & Wohlin (2012) is used for literature review. Literature review contributes to answering sub questions one through five. Sub question one and two are concerned with the positioning of the research, by establishing a definition for BPM and BPM maturity and comparing existing BPM Maturity models. Sub question three through five are concerned with identifying the current state of business process management in hospitals and identifying factors that influence BPM capabilities. Literature used for answering these sub questions includes scientific literature, publications from the healthcare domain and accreditation standards.

As stated above, information is extracted from literature using the snowballing method. In this method, a small number of initial articles is used as a starting point. Relevant studies cited in these initial articles are explored further. This process is repeated with new literature found. The snowballing method is deemed appropriate for this study because the domain of business process management is well-established and includes a number of fundamental research papers that are easily identified. In the case of BPM maturity models, several overview papers were identified that provide model comparisons. These provide a useful starting point for further exploring relevant literature. By creating a meta-overview of these overviews, we establish a complete image of the most relevant BPMM literature for this study. In this case, the snowballing method is considered more time-effective than a structured literature review using database searches with predefined search terms. Jalali & Wohlin (2012) posit that these database searches generate too much noise and, despite the extra effort of scanning all available

literature, do not ultimately lead to a better selection of literature compared to the snowballing method. Literature gathered using this method is presented in chapters 5 and 6.

4.2 Maturity Assessment Model Development Method

The domain-specific maturity model is developed according to the method presented by De Bruin et al. (2005) in their paper "Understanding the main phases of developing a maturity assessment model". In this paper, the authors present a generalized development method for domain-specific maturity models, intending to enable creation of new models widely applicable within the chosen domain. The model should strike a balance between complexity and simplicity, in order to be both understandable and applicable in practice. The development framework incorporates the use of a Delphi study to gain consensus on the dimensions that should be included in the model among a (small) group of experts. The development method was used in the creation of the BPM Maturity Model by Rosemann & de Bruin (2005a, 2005b). This maturity model is well-established in literature and has proven its usefulness in practice. The development method used for this model will be adopted in this study because of its track record and its focus on developing domain-specific BPM maturity models.

De Bruin et al. (2005) posit that most maturity models originate from the Capability Maturity Model Integration (CMMI). The CMMI includes five levels of maturity, (1) Initial, (2) Managed, (3) Defined, (4) Quantitatively Managed and (5) Optimizing. We will describe these levels in further detail in later chapters. Most maturity models in literature also include five levels of maturity, either with the same or slightly different naming of the levels. For this reason, the five levels of maturity are accepted as a standard. The goal of the development method is to establish which domain-specific capabilities should be included in the model and how these should be linked to each maturity level.

Furthermore, De Bruin et al. (2005) identify three main types of maturity models:

1. Descriptive
2. Prescriptive
3. Comparative

These three types are inclusive, meaning that a model usually starts out as a descriptive and then evolves into a prescriptive and comparative model as it is further developed (De Bruin et al., 2005). A model is initially descriptive, meaning that it is used only for assessing the capabilities of an organisation. Then, the prescriptive type of model also provides guidelines for improving maturity. Finally, the comparative type of model allows for benchmarking across organisations within a domain. It also allows for situational (context-sensitive) assessment. This means that the model takes into account contextual factors in determining the optimum maturity level for the organisation. Contextual factors are for example the size of the organisation or the overall maturity of the market in which it operates. In order for a maturity model to evolve, rigorous application of the model will be needed in practice. This is currently out of the scope of the project and therefore the focus will be on creating an accurate descriptive model.

Following the fundamental concepts of maturity levels and types of maturity models, we now consider the phases contained within the development method. The six phases for the development of a maturity model as described by De Bruin et al. (2005) are defined as follows:

Figure 3 Phases of developing a maturity model (De Bruin et al., 2005)

The six phases encompass the following activities, as defined by De Bruin et al. (2005):

1. **Scope**
   Within the scope phase, boundaries are set for development of the maturity model. The focus of the model and the development stakeholders must be established. This focus can be domain specific or general in nature. The development stakeholders can consist of academics, practitioners, government or a combination of these. The need for the model must also be identified through wishes expressed by stakeholders or gaps in literature.

2. **Design**
   The design phase encompasses establishing criteria that influence the design of the model. These are (1) the audience of the model, (2) the method of application, (3) the driver of application, (4) respondents, (5) area of application. First, the audience of the model is determined. The model may be applied by internal staff of an organisation or external auditors or consultants. Depending on the audience of the model, the method of its application may be either self-assessment, assessment assisted by a third party of assessment by a certified practitioner. The driver of applying the model can be internal requirements, external requirements or both. It is then determined which stakeholders need to involved as respondents upon application of the model, such as management, staff or business partners. The model may be designed for application in a single entity or region or across multiple entities or regions. Following the establishment of these criteria, the overall stages of the maturity model are determined. This is usually done in the form of five cumulative stages, as inspired by the CMMI. Each stage is provided with a label for identification as well as the requirements necessary for reaching that level.

3. **Populate**
   The populating phase is concerned with establishing measurement units and instruments. In other words, what should be measured and how do we measure? The components of the model are populated in detail. Population data can be gathered through literature review (in domains with a sufficient body of knowledge), as well as interviews or surveys with domain experts. In the paper, De Bruin et al. (2005) suggest the use of a Delphi study for this purpose. A Delphi study is used to gain consensus among a group of experts using several rounds of surveys. The Delphi study method is further described in the following section (4.3). The completion of this phase leads to a populated model.

4. **Test**
   The conceptual maturity model is tested for relevance and rigor by applying it in a number of case studies. Interviews and brainstorm sessions serve to further refine the model in terms validity, reliability and generalizability. In our case, the model is validated by a group of experts using a survey. This group of experts is different from the group used in the initial development of the model. This phase will be the final phase used in this study. The next two phases, deploy and maintain, fall outside of the scope of this study but are included in this method description for completeness.

5. **Deploy**
   The model is usually first deployed within the organisations whose staff were involved in the model's development. Because generalizability of the model can't be established yet, other organisations that would benefit from the application of the model must be identified. The model can then be further deployed within the domain.

6. **Maintain**
   In the maintaining phase, the authors of the model need provide the necessary resources for applying the model. This could mean the availability of documentation or an online survey used as a measuring instrument. Furthermore, a repository must be created to keep track of the model's evolution. In case the model is prescriptive in nature, there must be means available to longitudinally track the effect of interventions that are applied to improve maturity.

Based on the development model for maturity models as described above, preliminary criteria are established in relation to the scope and the design of the model. The focus of the model is clearly specific to the domain of hospitals in The Netherlands. Development stakeholders are both practitioners working within these hospitals as well as persons in academia with experience relating to research in healthcare processes and management.

The audience of the model is the internal management of the organisation. The idea is that quality management departments within hospitals will be able to apply the model to improve their business process maturity. The model may be self-assessed or applied with the assistance of a third party, such as the author of the model. Application of the model is driven both by external requirements (accreditation standards and government regulations) as well as internal requirements (the need to improve quality). Respondents for the model are the management and staff of hospitals involved. Seeing as the model is developed for hospitals in The Netherlands, it is considered to be applicable to multiple entities within a single region. The criteria and their characteristics relating to phase one and two of the development framework are summarised in Table 3, in accordance with the first two phases of the Maturity Assessment Model Development Method.

Phase	Criterion	Characteristic
1 - Scope	Focus of Model	Domain Specific
	Development Stakeholders	Combination of academia and practitioners
2 - Design	Audience	Internal (Management / Quality Department)
	Method of Application	Self-assessed or assisted by model author
	Driver of application	Both internal and external requirements
	Respondents	Employees in different roles
	Application area	Multiple entities in a single region

Table 3 Scoping and design characteristics of the maturity model for Dutch hospitals

Following the definition of scope and design choices for the model, it must be populated. In the populate phase, several methods can be used to gather data from domain experts. De Bruin et al. (2005) suggest the use of a Delphi study for BPM maturity model development. In the next section, the general setup of the Delphi study within this research is elaborated upon.

4.3 Delphi Method

The Delphi method is a type of study used to gather a consensual opinion from a panel of experts on a complex subject. This is done using multiple rounds of anonymised surveys, usually three or more, until consensus is reached. Multiple-round techniques lead to richer and more refined data than single-round techniques (Yousuf, 2007). Delphi surveys are usually distributed electronically to ensure anonymity of respondents. The Delphi method uses anonymity to its advantage to eliminate the effects of group pressure (Hsu & Sandford, 2007). The Delphi method is used for the collection of both qualitative and quantitative data. The first round of a Delphi study is relatively less structured than subsequent rounds. In this round, open-ended survey items are used to allow respondents to provide a rich spectrum of opinions. In subsequent rounds, the surveys become more structured so that the panel may converge towards a consensus. The survey items become more quantitative in nature, using predefined scales or lists so that answers may be provided numerically. This allows for the level of consensus to be expressed in a statistic manner at the end of the study. Three or more rounds are usually performed within one Delphi study, depending on the complexity of the subject and the rate of progress towards consensus. The general process of conducting a Delphi study is outlined as follows:

1. **Problem definition:**
   The researcher uses existing literature to frame the problem statement and provide structure to the first survey round. The problem definition for this project is described in chapter 1. The problem statement is further substantiated by describing the practical and scientific relevance of this research in chapter 2.

2. **Candidate Selection:**
   A list of candidates for the expert panel is established on the basis of predetermined criteria. The experts are invited for participation in the Delphi study. This process is described in the introduction of chapter 7.
3. **First Delphi Round:**
   The first survey is distributed for the purpose of collecting opinions using open-ended survey items. The results of this round are presented in section 7.1.
4. **Second Delphi Round:**
   The opinions from the first survey are summarised into a list of statements by the researcher. The summarised statements are presented in the second survey for the purpose or ranking or rating by the experts. The results of this round are presented in section 7.2.
5. **Third Delphi Round:**
   The results of the second survey are summarised by the researcher. This shows which statements have the highest support from the expert panel. In the third survey, the experts indicate the extent to which they agree with the majority opinion. Reasons may be provided for disagreeing with the majority opinion. The results of the third survey are summarised by the researcher. The results of this round are presented in section 7.3.
6. **Conclusion:**
   If sufficient consensus is achieved, the final results are presented to the expert panel. Otherwise, a fourth survey may be initiated where reasons for disagreeing with the majority opinion are evaluated by the panel so that a new majority opinion may be established.

Delphi studies have been used in earlier research to successfully gather data for the creation on a BPM maturity model (Rosemann & De Bruin, 2005b). The Delphi study is considered suitable for BPM research as it is a mature field, in which a sufficient collection of existing literature is available to frame the initial problem and identify gaps. Also, a sufficient number of experts is available in the field able to serve on the expert panel. Literature identifies certain benefits and challenges relating to the use of Delphi studies. The benefits are described as follows (Hsu & Sandford, 2007; Rosemann & De Bruin, 2005b; Yousuf, 2007):

- The Multi-round setup enables the formation of consensus on a complex subject, using controlled feedback to reduce discord.
- Respondent anonymity may lead to the elicitation of more creative responses and reduces social pressures.
- Surveys are administered electronically and are easily distributed to geographically dispersed respondents.
- Consensus is tracked and measured in a statistical manner.

Challenges relating to Delphi studies are defined as follows (Hsu & Sandford, 2007; Rosemann & De Bruin, 2005b; Yousuf, 2007):

- A sufficient number of experts willing to commit to participation in multiple rounds is needed.
- The experts must allocate a significant amount of time to complete all rounds and may drop out due to survey fatigue.
- Waiting times are introduced since all respondents must complete the survey within a specific round.
- Collected responses must be carefully coded to avoid the introduction of bias by the researcher.
- Response coding is time consuming, especially with larger numbers of respondents.

Existing literature on the Delphi method does not impose specific minimum or maximum limits to the number of respondents that must be included in a Delphi study. To ensure sufficient variety of opinions and accuracy of the results, we have chosen to include between five to ten experts in the panel. Compared to traditional quantitative research, a smaller number of respondents is deemed acceptable since rich data is gathered from a targeted group of experts. In this regard, the necessary number of respondents should be compared to that of a focus group

session. Within the context of this research project, we consider a minimum of five respondents is necessary for gathering sufficient variety in opinions. A maximum of ten respondents is set to comply with time constraints for this study. The surveys are distributed electronically, to facilitate the anonymous collection of data from respondents working in different organisations nationwide.

The respondents are invited to partake in the study using a telephone call, with additional details and instructions sent via e-mail. Experts are included both from industry (hospitals) as well as academia (researchers with experience pertaining to healthcare). This thesis project is conducted from within the research group of Process Innovation & Information Systems at HU University of Applied Sciences Utrecht. The research group's network is used to gather experts from academia and a variety of Dutch hospitals. The research group has pre-existing contacts with relevant practitioners in hospitals and academic researchers. The aim is to allot a period of three weeks to each round of the Delphi study to both ensure continuity of the study while allowing sufficient time for the experts to provide their response. The results of the Delphi study are described in chapter 7. In the next chapter, we further delve into the relevance of this research

5 Business Process Management & Maturity

In this chapter, the concept of Business Process Management Maturity is explored, also called BPM Maturity or BPMM. Seeing as BPM Maturity is used to quantify the maturity of Business Process Management (BPM), we must first discuss the concepts of 'business processes' and 'business process management'. By defining the concept of BPM maturity, the first sub question will be answered at the end of this chapter.

5.1 The Business Process

Business processes are considered to be a collection of activities, usually in a specific order, facilitating the creation of value for the customer. A business process may span across departments, information systems or organisations and can be linked to other business processes. Business processes have a certain input and output, represented by a so-called precondition and post condition (Weske, 2012).

Visual representation of business processes is achieved through business process modelling, for which notation styles exist in various shapes and sizes. An example is the Business Process Modelling Notation (BPMN). This notation contains a number of elements that represent activities, decisions, events and process flows within a business process. Activities within business processes may be executed by automated systems and humans. A condition for the successful execution of business processes is that the humans and systems involved in a process work together well to facilitate the succession of one activity to another. This is why business processes are often supported by information systems such as Business Process Management Systems (BPMS).

Process modelling allows for the development of processes on a higher abstraction level, taking away the technical aspects of specific platforms or systems. It thereby encourages that information systems should facilitate the process instead of the process being restricted by information systems present.

An example of a business process modelled using BPMN is shown in Figure 4 below. This simple process is concerned with checking the status of a patient in a hospital. When the patient arrives for consultation, it is checked whether the patient is already registered in the hospital's health records or not.

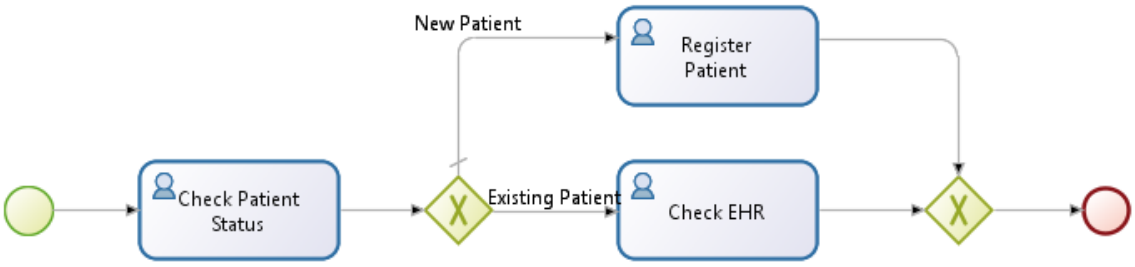

Figure 4 Example of a process modelled using BPMN

The process model illustrated in Figure 4 contains the most common objects found in BPMN, namely (1) events (2) activities (3) gateways and (4) sequence flows. The events encompass the start and end event, represented by the green and red circle. The activities are represented by the rounded rectangles, with each activity having a unique name consisting of at least a verb and a noun. The icon displayed in the top left of each rectangle identifies the type of task belonging to the activity. In this case it is a human task, indicating that a human interacts with an information system to complete it. Other examples of task types are service tasks, script tasks, business rule tasks and manual tasks.

The third object shown in this diagram is the gateway, in this case an exclusive (XOR) gateway. This indicates that one of the available paths must be chosen based on a predefined condition. Another exclusive gateway is used to join both paths, indicating that one of the available paths must be completed in order to pass the gateway. Other common types of gateways are the parallel gateway and the inclusive gateway. The parallel gateway to fork and join parallel process paths, which must all be completed for the process to continue. The inclusive gateway is used to select a number of available paths, ranging from one path to all available paths, based on predefined conditions. In this regard it fills the gap between the exclusive and parallel gateways, which only allow the selection of one or all paths, respectively. The last object is the sequence flow, which connects all aforementioned elements. Conditions related to gateways may be displayed on the sequence flows.

BPMN contains four object categories, the first of which are the flow objects containing the events, activities and gateways described earlier. These objects control the flow of the process. The category of connecting objects encompasses sequence flows, as well as message flows and associations. These serve to connect flow objects in various ways. Besides the objects shown in the example diagram, there also exist 'artefacts' and a 'swim lanes' categories. Artefacts encompass objects such as annotations and groups, which help to visually structure the diagram but have no effect on the process execution. Swim lanes are used to indicate which employees or departments are involved in the execution of specific activities. Swim lanes relating to a single process are contained in a so-called 'pool'. Within BPM systems, the division of activities into swim lanes usually dictates which employees or departments have the technical rights to execute these processes within the system.

Besides the core elements described in this section, the full BPMN standard contains over 100 types of objects. A large number of scenario's can be covered using only the core elements, therefore facilitating the design and readability of such diagrams for both technical and business users without extensive training. The actual implementation and configuration of the process models into a BPM system may of course require more detailed knowledge of the standard, as for example activity types or information flows need to be modelled in more detail. Furthermore, technical knowledge is needed to connect the BPM systems to other information systems it orchestrates, thereby facilitating data interoperability.

In the next section, we go beyond the design and implementation of process models and look at the entire lifecycle of Business Process Management (BPM).

5.2 Business Process Management (BPM)

Hammer & Champy (1993) and Davenport (1992) are often cited as leading sources regarding the shift towards process-minded reengineering in corporations. This started in the early '90s. The concept of BPM stems from the earlier discipline of Workflow Management (WfM), which was defined as follows (Lawrence, 1997): *"The automation of a business process, in whole or part, during which documents, information or tasks are passed from one participant to another for action, according to a set of procedural rules."* Building on from the concept of Workflow Management, Business Process Management takes a broader scope. Not only does it focus on the automation of a business process, it also considers surrounding activities: Managing the lifecycle of a process. In the Business Process Lifecycle (BPL) model, Weske et al. (2004) consider the management of a business process to occur in a cyclical manner. Each iteration of the lifecycle leads to a process fitting the organisational requirements. The BPL is shown in Figure 5 and contains four stages. These are (1) process design, (2) system configuration, (3) process enactment and (4) diagnosis. This process design entails the visual illustration of a business processes. This is usually done through a modelling tool. In the system configuration phase, this process model is loaded into a business process management system. During process enactment, the business process is executed within an information system such as a BPM system. The fourth stage, diagnosis, allows us to monitor the execution of the business process and draw conclusions about its efficiency or bottlenecks. This allows the adjustment/redesign of the business process upon the new iteration of the lifecycle, to better adhere to applicable requirements. Much like the PDCA cycle, the business process lifecycle can be seen as a method for continuous improvement.

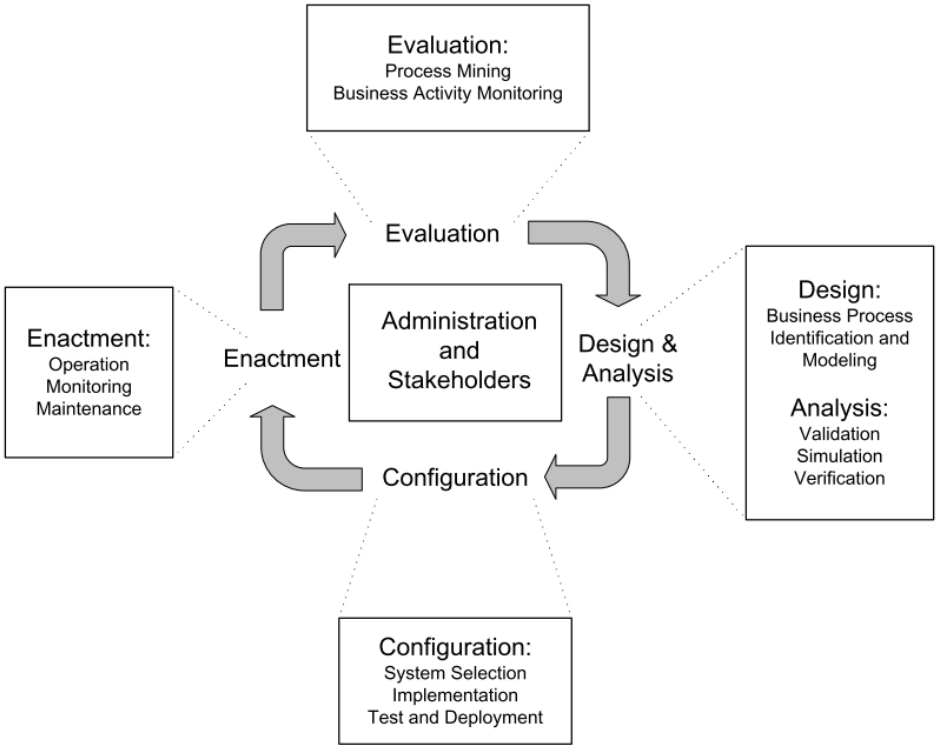

Figure 5 The Business Process Lifecycle (Weske, 2012)

Within Workflow Management, this full cycle does not occur. The analysis of the process is not mentioned in the accompanying definition. Workflow Management is concerned with the automation of the business process, which relates to the process design, system configuration and process enactment stages of the Business Process Lifecycle. BPM expands upon WfM by introducing analysis techniques, thereby closing the cycle and enabling incremental and structured quality improvement. BPM also enriches the phases by considering the alignment of the process to business requirements. Thereby, BPM takes the focus away from software-based automation of processes and towards the general support of business processes, executed either by systems or humans, using a variety of tools and techniques which may or may not be software-based. For example, BPM also addresses methods for the elicitation of business processes and structuring implementation projects. This underscores that while information technology is an important facilitator in BPM, it does not solely determine the success of BPM projects.

Business Process Management (BPM) is defined in literature as a discipline that aims to *"support business processes using concepts, methods, techniques, and software to design, enact, control, and analyse operational processes involving humans, organisations, applications, documents and other sources of information"* (Weske, 2012).

From this definition a number of elements can be distilled. The first four elements are concepts, methods, techniques and software. These may be considered the facilitators of business process management. These may include concepts, methods or techniques for business process modelling (such as BPMN) or analysis and simulation.

These facilitators are used to design, enact and control and analyse operational processes. These four elements describe the phases of the business process lifecycle. The lifecycle is iterative. The four phases are repeated to gain an improved alignment of the process with external or internal requirements. This assures process quality.

Finally, business process management involves humans, organisations, applications, documents and other sources of information. This part of the definition shows the broadness of the business process management discipline. It involves actors and information sources at all levels of the enterprise. Processes often transverse a

multitude of organisational departments and information systems. Therefore, a holistic view is required when performing process improvement initiatives. Improving just one type of application or a single department within an organisation in terms of processes is a good starting point, but all relevant stakeholders must be involved to improve quality of the end-to-end process. This underscores the challenge of improving BPM maturity, which we will discuss in the next section.

5.3 BPM Maturity

'BPM maturity' is a concept used to indicate the stage of development of BPM practices. The word *mature* is defined as "having reached the most advanced stage in a process" or "being fully grown or developed". Within BPM, it is understood that processes have lifecycles and can be improved throughout time (McCormack et al., 2009) BPM maturity can be expressed in BPM maturity model (BPMM), which usually describes a number of maturity levels and specific capabilities related to each level. Along with the model itself, some type of measurement instrument, such as a survey, is usually included in the model's method in order to assess the organisational capabilities. In addition, a BPM Maturity Model may be used to compare the progress of maturity over time or between different departments or organisations. In this regard, it may also be used as a benchmarking tool (De Bruin et al., 2005). Maturity models may be designed to be generally applicable to any type of organisation, can be tailored to a specific type of industry (such as logistics).

In the previous section we described the broadness of the BPM discipline. This is reflected in BPM Maturity Models, which include many different factors within which capabilities are measured. Examples of such factors are the methods and information technologies used to support process management, strategic alignment and governance/management of processes as well as the people and culture of the organisation (Rosemann & De Bruin, 2004, 2005a).

While theory is clear about how business process management should ideally be performed, in practice this may not always be the case. The characteristics of high BPM maturity as defined by Rosemann & de Bruin (2005a) correspond to activities in the BPM lifecycle. Characteristics such as *innovation*, *proactivity* and *co-ordinated BPM activities* imply that an iterative lifecycle is performed where improvement and adjustment is continuous. On the other hand, low maturity characteristics such as *static*, *reactive* and *un-coordinated, isolated projects* indicate that only the *design* and possible the *configuration/implementation* phase of the lifecycle have been executed. In a low BPM maturity situation, little is done to improve BPM practices using *monitoring*, *adjustment* or *diagnosis*. Between the lowest and highest maturity stages, intermediate stages exist in which the lifecycle may not be fully iterated.

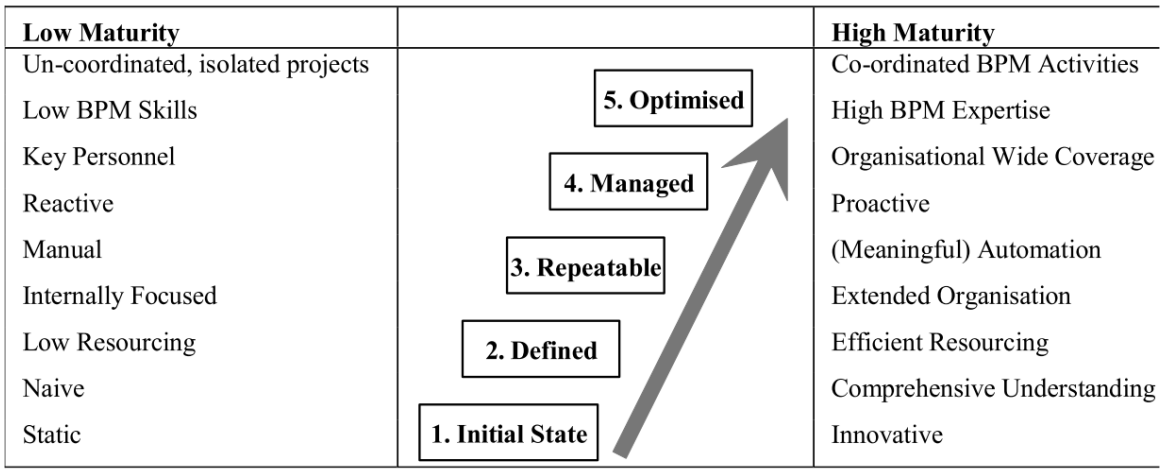

Figure 6 Characteristics of low and high BPM maturity (Rosemann & De Bruin, 2005a)

Van Looy et al (2011) compare various definitions of maturity as proposed by different standards consortia such as ISO (International Organization for Standardization) and OMG (Object Management Group) and FAA (Federal

Aviation Administration). We seek a definition that includes both the maturity of processes as well as the management of these processes. Such a definition is found in the CMMI (Capability Maturity Model Integration), which states that organisational process maturity is "the extent to which an organisation has explicitly and consistently deployed processes that are documented, managed, measured, controlled and continually improved. Organizational maturity may be measured via appraisals." (Software Engineering Insititute, 2006, p. 545). The definition of the OMG-BPMM (Weber et al., 2008, p. 72) is very similar, mentioning "the extent to which processes are explicitly defined, managed, measured, controlled and effective". The definition by ISO mentions efficacy of processes more specifically, by stating that maturity is related to "the extent to which an organizational unit consistently implements processes within a defined scope that contributes to the achievement of its business needs (current or projected)." (ISO/IEC, 2015, para. 3.4.2). However, it could be argued that the 'continuous improvement' of processes in the aforementioned definition also contributes to the efficacy of that process.

To answer sub question 1.1, which states "What defines BPM maturity?", we will adopt the definition of organizational (business) process maturity as stated in the CMMI: "The extent to which an organisation has explicitly and consistently deployed processes that are documented, managed, measured, controlled and continually improved." (Software Engineering Insititute, 2006) This definition is closely linked to the definition of business process management by Weske (2012), which includes the design, enactment, control and analysis of processes. The definition of BPM maturity expands upon the definition of BPM by including the extent to which processes are deployed and process-related practices are performed.

5.4 BPM Maturity Models

This chapter provides a synopsis of a selection of BPM Maturity models gathered from literature. The goal is to identify the characteristics of BPM maturity models in extant literature. Both in terms of the dimensions, measurable entities within the model as well as the measurement instrument used.

A preliminary search for "BPM maturity" in Google Scholar, sorted by relevance, has led to the discovery of a number of papers providing an overview of a number of known BPM maturity models. These papers are used as a starting point for continuing the literature review using the backward snowballing method. Prominent papers by Rosemann & Vom Brocke (2010) and Röglinger, Pöppelbuß, & Becker (2012), cited 145 and 78 times respectively, provide overviews of current (BPM) maturity models. Additional overviews were gained from Van Looy (2010) and Shafiei & Hajiheydari (2014). These overviews are summarised in a matrix in Table 4, resulting in a meta-overview of available BPM maturity models in literature. An additional search for BPM maturity models is performed for literature published after the publication date of the most recent overview, to catch any results that are not yet captured in existing overviews. However, no newer models were found.

	(Rosemann & Vom Brocke, 2010)	(Röglinger et al., 2012)	(Van Looy, 2010)	(Shafiei & Hajiheydari, 2014)	Times cited (per Google Scholar)
Process Condition Model (DeToro & McCabe, 1997)	x		x		152
Strategic Alignment Maturity Model (Luftman, 2003)	x				10
BPM Maturity Model (BPMMM) (Rosemann & De Bruin, 2005a, 2005b)		x	x	x	215 + 221
Process Performance Index (PPI) (Rummler-Brache Group, 2004)	x	x	x	x	49

BPR Maturity Model (BPRMM) (Maull, Tranfield, & Maull, 2003)	x	x	x	x	83
Business Process Maturity Model (BPMM-Fisher) (Fisher, 2004)		x	x	x	124
Process Management Maturity Assessment (PMMA) (Rohloff, 2009a, 2009b)		x	x	x	10 + 39
BPO Maturity Model (BPOMM) (Lockamy & McCormack, 2004; McCormack et al., 2009)		x	x	x	84
Capability Maturity Model Integration (CMMI) (SEI, 2010)	x		x		561
Process and Enterprise Maturity Model (PEMM) (Hammer, 2007)	x	x	x	x	411
Process Maturity Ladder (PML) (Harmon, 2004)	x	x	x	x	77
Business Process Maturity Model (BPMM-OMG) (Weber et al., 2008)	x	x	x	x	11
Business Process Maturity Model (BPMM-Lee) (Lee, Lee, & Kang, 2007)		x	x	x	55
Notes			+ 25 other models		

Table 4 Meta-overview of maturity model overviews found in existing literature

The nomenclature differs between models, but all models are either concerned with the maturity of processes or the maturity of business process management (BPM). A more recent study by Pöppelbuß, Plattfaut, & Niehaves (2015) reiterates the summary of models from Röglinger, Pöppelbuß, & Becker (2012) but does not provide more recent models. The BPM maturity models found in another recent study by Shafiei & Hajiheydari (2014) are identical to those found in Röglinger, Pöppelbuß, & Becker (2012). It is therefore assumed that the meta-overview presented in Table 4 provides a comprehensive overview of available maturity models and serves as a good starting point for exploring existing models. The models included in this table are analysed to discover the answers to the sub questions presented at the beginning of this chapter. This leads to an overview of dimensions and factors used in existing BPM maturity models, which are used as input for the creation of a new maturity model. Only models for which the full documentation is available will be included. This led to the exclusion of the Process Condition Model by DeToro & McCabe (1997), for which documentation was not retrievable via any sources available to the researcher. For practical purposes, only models that are mentioned in at least two of the overviews will be included in the comparison. This excludes the Strategic Alignment Maturity Model by Luftman (2003) and 25 additional models mentioned in the comparison by Van Looy (2010). This ensures that the most prominent models are compared for which documentation is readily available. The following models are compared:

1. BPM Maturity Model (BPMMM) (Rosemann & De Bruin, 2005a, 2005b)
2. Business Process Maturity Model (BPMM-Fisher) (Fisher, 2004)
3. BPR Maturity Model (BPRMM) (Maull, Tranfield, & Maull, 2003)
4. Process and Enterprise Maturity Model (PEMM) (Hammer, 2007)

5 . BPO Maturity Model (BPOMM) (McCormack et al., 2009)
6 . Capability Maturity Model Integration (CMMI) (SEI, 2006)
7 . Process Maturity Ladder (PML) (Harmon, 2004)
8 . Business Process Maturity Model (BPMM-OMG) (Weber et al., 2008)
9 . Business Process Maturity Model (BPMM-Lee) (Lee, Lee, & Kang, 2007)
1 0 . Process Performance Index (PPI) (Rummler-Brache Group, 2004)
1 1 . Process Management Maturity Assessment (PMMA) (Rohloff, 2009a, 2009b)

The full descriptions for these models are provided in 0. The results of the BPM Maturity Model are presented in the following section.

5.5 Conclusion

Following the descriptions of several BPM Maturity Models in 0, a meta-overview of BPM Maturity Model characteristics is provided in Table 5 below. Following the meta-overview, a general conclusion is given in regards to the characteristics that will be used as a foundation for developing a BPM Maturity Model for hospitals. The table is structured according to the typology of design characteristics used in the Maturity Assessment Model Development Method (De Bruin et al., 2005). We first consider the focus of the model, which is either general or tailored to a specific industry. In the evaluation of several models, we may see that a model is tailored to supply chain management processes (such as BPOMM) but is also applicable in other sectors. In regards to development stakeholders, a clear distinction is seen between models developed in academia or by practitioners. If the model was jointly developed by academia and practitioners (practitioners were actively involved in determining factors of the model), then both are considered development stakeholders.

Following the model focus and development stakeholders, the method of application and measurement instrument are defined. The type of measurement instrument used varies per model, but most include a survey with Likert scales. More extensive measurement instruments also include interviews and other types of analyses. We see that models with a long development history such as CMMI and BPMM-OMG have well-developed and well-documented measurement instruments. The authors of some models provide very little transparency on the measurement instrument. In this regard differences are seen between models that are academic or commercial in nature. Commercial parties may be less inclined to diverge detailed information about assessment instruments as this may put their profits at risk. Next, the method of application tells us if the measurement instrument can be used for self-assessment by the organisation itself, or if it is assisted by a third party (such as the creators of the model or trained consultants). Here we see that the more extensive measurement instruments usually include third party assistance, since trained personnel is required for interviews and analysis. Simpler measurement instruments such as surveys can usually be self-assessed.

Finally, we consider the dimensions of each model. The models are either two-dimensional or three-dimensional. One dimension usually represents a number of capability areas while the other axis represents maturity levels. Under ‘Dimension 1’, we define the dimension of the model related to specific BPM capabilities. These are given different names in different models, such as ‘Factors’, ‘Process areas’, ‘Components’ etc. Under ‘Dimension 2’, we define the dimension related to the competence of the organisation, or how well capabilities are executed. This dimension usually defines a number of maturity levels, which are also called stages or positions. One model, the BPMMM, explicitly defines a third dimension. Within this third dimension, the authors define the scope of the measurement. The scope defines how the model can be applied at different points in time to track maturity longitudinally or how it can be applied in different organisations or departments for maturity comparison.

	Model Focus	Development Stakeholders	Method of Application	Measurement instrument	Dimension 1	Dimension 2	Dimension 3
BPMMM (Rosemann & De Bruin, 2005a, 2005b)	General	Academia, Practitioners	Self-assessed or Third party assisted	Quantitative survey (five-point scale)	6 Factors	5 Maturity Levels	Scope (Organisational Unit / Point in time)
BPMMM (Fisher, 2004)	General	Practitioners	Third party assisted	Unknown	5 Levers of Change	5 States of Maturity	Not applicable
BPRMM (Maull et al., 2003)	General	Academia	Third party assisted	Quantitative survey (five-point scale)	10 Dimensions, within 5 Themes	5 Positions	Not applicable
PEMM (Hammer, 2007)	General	Academia, Practitioners	Self-assessed	Quantitative survey (three-point scale)	4 Enterprise Capabilities (13 sub-factors) + 5 Process Enablers (13 sub-factors)	4 Levels of Strength	Not applicable
BPOMM (Lockamy & McCormack, 2004)	General / Supply Chain Management	Academia	Self-assessed or Third party assisted	Quantitative survey (five-point scale)	5 BPO components	5 Stages of Business Process Orientation	Not applicable
CMMI for services, staged (SEI, 2010)	General	Academia, Practitioners	Third party assisted	SCAMPI Appraisal Method	24 Process areas in 4 categories	5 Maturity Levels	Not applicable

Process Maturity Ladder (PML) (Harmon, 2004)	General / Supply Chain Management	Practitioners	Self-assessed or Third party assisted	Survey and interviews	Not applicable	5 Maturity Levels	Not applicable
BPMM (Lee et al., 2007)	General	Academia, Practitioners	Unknown	Unknown	24 Process areas in 4 categories	5 Maturity Levels	Not applicable
BPMM-OMG (Weber et al., 2008)	General	Practitioners	Third party assisted	Interviews, analysis of process artefacts and quantitative data	29 Process areas	5 Maturity Levels	Not applicable
PPI (Rummler-Brache Group, 2004)	General	Practitioners	Self-assessed	Quantitative survey (five-point scale)	10 Key Success Factors	3 Maturity Stages	Not applicable
PMMA (Rohloff, 2009a, 2009b)	General	Academia, Practitioners	Third party assisted	'MS-Office based tool' and interviews	9 Categories	5 Maturity Levels	Not applicable

Table 5 Meta-overview of BPM maturity model characteristics

Table 5 provides an answer to our second sub question (1.2), which states: “What are the characteristics of BPM capability models in general?”. We have now identified different generally applicable BPM maturity models based on a literature study. The comparison of BPM maturity models provides us with an understanding of the common elements that make up a maturity model, including the maturity levels and capability areas.

Most maturity models in literature utilize five subsequent maturity levels that are applicable to any sector. It is therefore likely that a similar scale is suitable for the hospital sector. While some models measure the maturity of the process management, models such as the PEMM (Hammer, 2007) measure the maturity of a number of processes within the organisation independently. Furthermore, The BPM maturity models provide capability areas that are generally applicable in any sector. Such capabilities may include leadership, use of information technology and education of personnel. These capabilities can be adapted and expanded for the hospital sector. For example, specific information technology, such as electronic health records, may be needed to support healthcare processes. Having the patient as the main customer, we may assume that the use of patient-related indicators (such as patient satisfaction) also play a role in assessing the maturity of hospitals.

In the next chapter, we will explore quality and accreditation frameworks used in hospitals. Along with data gathered from an expert panel later on in this study, these frameworks will provide the necessary healthcare-specific capabilities that can be used to develop a BPM maturity model for hospitals.

6 BPM in Dutch Hospitals

In this chapter we study the hospital-specific types of models and frameworks used to support BPM capabilities as found in literature. These findings are then further enriched by using a survey to establish the use of these models or frameworks in practice and the self-assessed maturity of the organisations included in the expert panel.

6.1 NIAZ Accreditation

The Netherlands Institute for Accreditation in Healthcare, also known as *Nederlands Instituut voor Accreditatie in de Zorg* or NIAZ, is responsible for developing quality norms and accreditation standards for healthcare institutions. The institute was founded in 1998 as the successor of a pilot program for Dutch hospital accreditation originally founded in 1989. Four general hospitals and four university medical centres were involved in the founding committee. NIAZ belongs to the worldwide body for quality standards in healthcare, known as the International Society for Quality in Healthcare (ISQua). NIAZ is a non-profit organisation that operates independently and is funded by the healthcare institutions participating in accreditation programmes. Accreditation is performed by means of peer reviews, in which healthcare professionals assess the qualities of healthcare institutions to which they are not affiliated. Accredited healthcare institutions include mostly hospitals but can also be applied to other types of healthcare institutions, such as those for mental healthcare or long-term care. Seventy-one hospitals in The Netherlands are fully accredited by NIAZ at the time of writing. NIAZ accreditation is also applied in Flemish hospitals, where one hospital is currently accredited and a number of other hospitals are awaiting assessment.

The process of assessing a hospital for accreditation can be summarized as follows:

1. The hospital performs a self-assessment according to NIAZ standards.
2. Quick fixes found as a result of the self-assessment are implemented by the hospital.
3. NIAZ establishes a surveying team which decides if the hospital is ready for a survey visit.
4. The survey team assesses the hospital on-site.
5. A survey report is composed.
6. Based on the survey report, the authority for quality certificates decides if accreditation status is granted.
7. The hospital composes an improvement plan to address quality issues.
8. The survey team checks the progress of these improvements about a year after accreditation.

Based on the findings by the survey team, accreditation status may also be denied or postponed pending further investigation. Hospitals may appeal a decision made by the authority of quality certificates. Accreditation by NIAZ is valid for a period of four years before re-assessment is required.

Hospitals are assessed using a scoring system composed of nine fields, as well as a final quality judgment. The scoring system is derived from the INK Management Model. The INK Management Model is essentially a Dutch version of the EFQM Excellence Model (EFQM, 2015), developed by several European business leaders to improve operational excellence as a response to increasing international competition. The model was first launched in 1992. Figure 7 below shows an overview of the EFQM Excellence Model.

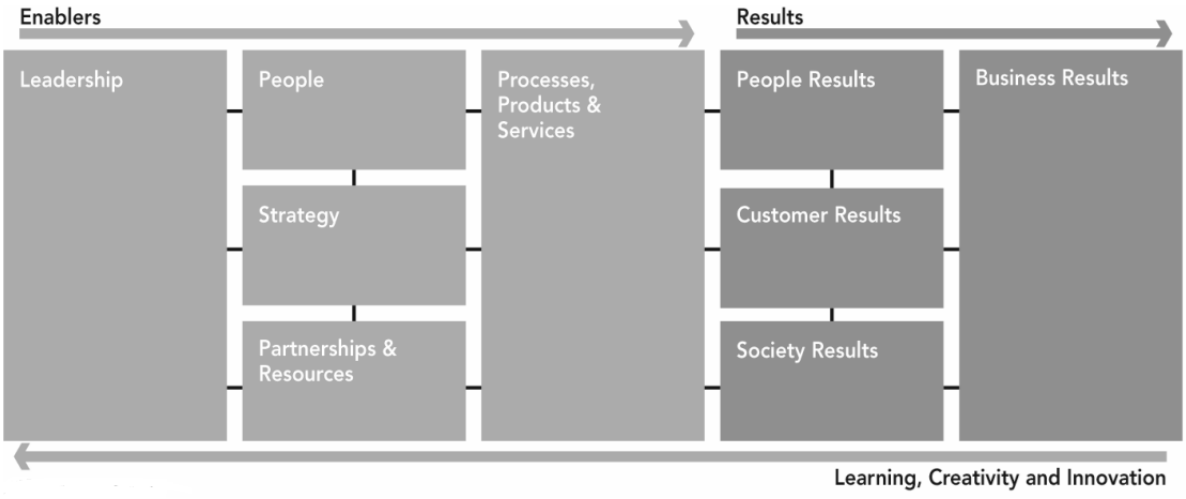

Figure 7 Overview of the EFQM Excellence Model (EFQM, 2015)

As is the case with the INK and EFQM models, NIAZ judges healthcare institutions on the basis of five organisational fields and four result fields. Within NIAZ, some of these fields use more healthcare-specific terminology compared to the EFQM model. For example, by considering the results for the patients instead of the general business results. The following nine fields are assessed (EFQM, 2015):

1. Leadership.
   The field of leadership is concerned with the responsibilities of all managerial staff and medical specialists within the hospital and the culture of continuous improvement. It defines the organisation's understanding of what accounts to good patient care. This is reflected in mission and vision statements.

2. Strategy and Policy.
   The ability of the organisation to translate its strategies and policies into clearly defined goals, which are clear to all involved personnel.

3. Management of members of staff.
   The hiring and retention of staff with adequate skills and competencies for carrying out necessary tasks within the organisation. Also concerned with regular performance evaluations and schooling of staff members, to ensure that skills stay up-to-date and match the tasks at hand.

4. Management of means.
   The purchasing, provision and protection of physical means. For example, provision of medication, blood and foodstuffs is performed according to relevant standards. Staff are properly trained for the proper use and maintenance of medical equipment. Patients and staff are protected from radiating agents or equipment. Information technology is properly secured against confidentiality breaches, data loss and downtime.

5. Management of care and other processes.
   The identification, design, measurement and management of processes. Processes are linked to the organisational strategy and goals and are adapted when necessary. Specifically, there are (among others) processes and regulations in place for risk management, complaint mediation and patient reanimation. Results for network partners.

6. Results for network partners
   The satisfaction of associate organisations or care providers in regards to the organisation's image and reputation, and possible improvements made by the organisation.

7. Results for members of staff.
   The outcomes of performance indicators relating to staff, such as the number of performance evaluation interviews, complaints, sick leave and incidents

8. Results for management and society
   The satisfaction of stakeholders in regards to the organisation's image and reputation, and possible improvements made by the organisation.

9. Results for the patient
   Outcomes of performance indicators relating to patients, such as patient and visitor satisfaction, complaints, waiting times, medication errors and incidents.

The scoring fields belonging to the NIAZ scoring system are illustrated in Figure 8 below. This figure indicates that fields one through five belong to the organisational category and fields six through nine belong to the result category. It is implied that information gathered from results is used for the improvement and innovation of the organisation. In this regard, the NIAZ scoring system and models it is based on have links to the PDCA cycle. This is reflected in the fact that individual capabilities of the scoring fields are subdivided into the assessment of specific plan, do, check and act practices.

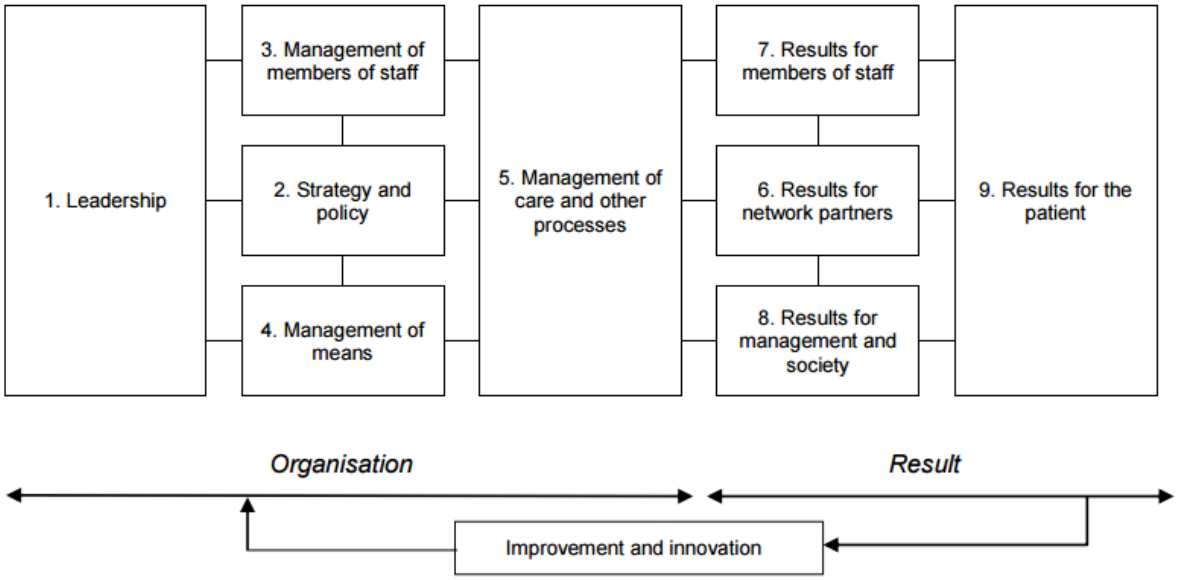

Figure 8 Fields belonging to the NIAZ scoring system (NIAZ, 2013)

Fields one through five are scored on the basis of a four-level classification system. Each element in the field is assessed in terms of the extent of its implementation in the organisation. It is also possible that an element is not applicable to the organisation and its evaluation is therefore omitted. Levels on through four of the classification system are broadly defined as follows:

1. The element is given no attention, or only plans exist for its implementation.
2. The element has been implemented on a limited scale or the quality cycle has not yet been performed.
3. The element has been implemented in all most critical places and the quality cycle has been performed at least once.
4. The element has been broadly implemented and the quality cycle is performed in a structural manner.

Each of the four classifications defines how practices relating to the PDCA cycle should be performed. In the lowest classification level, for example, only intentions exist to make adjustments based on the results while at the higher

level adjustments are structurally carried out to all components involved. These practices pertain to the 'Act' phase of the PDCA cycle.

For the result fields, elements are not scored on a normative scale. Instead, it is assessed to which extent the results have reached a level desired by the hospital itself. This means there are no predefined These elements include, for example, the results of research into the satisfaction of staff members or stakeholders, as well as data pertaining to the number of medication errors, incidents, complaints and the Hospital Standardized Mortality Ratio (HSMR). NIAZ prefers these indicators to be presented in the form of trend reports so that longitudinal changes may be analysed.

The EFQM excellence model provides insights into the assessment instrument used for measuring operational excellence. By allowing the self-assessment of several statements belonging to each field, using a five-point scale, the maturity of quality management within the organisation is identified. The following five levels are distinguished (van der Tuuk Adriani & Sibinga, 2008):

1. Activity- or product-oriented
   The organisation is focused on standard operating procedures (SOPs), emergency operating procedures (EOPs) and quality control.
2. Process-oriented
   The individual procedures are more cohesive and the focus is on quality assurance instead of just quality control.
3. System-oriented
   The focus is on so called Good Manufacturing Practices or GMPs, processes are cohesive. For the healthcare sector, specific Good Clinical Practices exist which ensure, for example, clinical protocols, record keeping, training, facilities and ethical standards.
4. Chain-oriented
   The quality system of the organisation is ISO based and suppliers and customers are actively involved in the value chain.
5. Recognized for excellence or Total Quality Management
   The focus is on continuous improvement and holistic quality management. Employees and outcomes are included in the quality cycle.

This five-point scale shows that a concept of maturity is also applied to this accreditation standard.

Research shows that Dutch healthcare organisations have a rich history in the application of quality methods in healthcare (Nabitz, Klazinga, & Walburg, 2000). Dutch company Philips was one of the key partners in the development of the EFQM model and was also one of the first organisations to establish a body for the promotion of this model through the INK, or *Instituut Nederlandse Kwaliteit* (Nabitz et al., 2000). In summary, we can conclude that EFQM model, which forms the basis for NIAZ accreditation, includes capabilities on every organisational level. This includes strategy, as well as management of processes. There is a clear focus on the results (outcomes) of activities. In organisations with low maturity, processes are simply performed without regard to quality. In organisations with higher levels of maturity, the quality cycle is completed. This means that the outcomes of processes are used to adjust and improve processes. Total quality management includes the satisfaction of employees, patients and partners. In this regard, we see a clear link between this model and the Business Process Lifecycle. As such, we conclude that the capabilities used in this model provide useful input for a BPM Maturity model for hospitals.

In the next section, the JCI accreditation standard is explored.

6.2 JCI Accreditation

JCI Accreditation is an international accreditation standard set up by the Joint Commission International. In The Netherlands, only two hospitals are currently JCI accredited. These are the University Medical Centres (UMCs) of Amsterdam and Utrecht. JCI accreditation sees widespread use in the United States, where the standard originates. It is also used in parts of Europe and Asia. In total, over 700 healthcare organisations are currently accredited. JCI Accreditation include standards for different types of healthcare institutions, including clinical laboratories and ambulatory care centres. The accreditation standards for hospitals are different for academic hospitals and regular hospitals.

JCI defines a number of participation requirements for organisations interested in receiving accreditation. The accreditation standards themselves are separated into two sections: a section for patient-centred standards and a section for healthcare-organisation management standards. An additional section is provided for standards relating to academic hospitals.

The patient-centred standards are subdivided into the following topics:

- International patient safety goals
- Access to care and continuity of care
- Patient and Family Rights
- Assessment of patients
- Care of patients
- Aesthesia and surgical care
- Medication management and use
- Patient and family education

The healthcare organisation management standards are subdivided into the following topics:

- Quality improvement and patient safety
- Prevention and control of infections
- Governance, leadership and direction
- Facility management and safety
- Staff qualifications and education
- Management of information

The additional section for academic hospitals contains the following topics:

- Medical professional education
- Human subjects research programs

The participation requirements for the accreditation program state that information provided by the hospital should be accurate and complete and that the survey panel should be permitted access for on-site evaluations. Survey dates are unannounced. Prior to the actual evaluation, steps are taken to ensure readiness of the organisation. An analysis of the current situation is made, resulting in a plan of actions. Improvements are made where possible. The readiness of the organisation is assessed halfway through the preparation phase, after which additional process improvements are made. A mock survey may be performed to help identify any final improvements. Ultimately, the actual survey is performed. The complete preparation process may last up to two years. Accreditation is granted for three years, after which re-accreditation is required.

While JCI accreditation is not currently popular in The Netherlands, some respondents in our expert panel have stated they will take these standards into account in the future. This is because JCI has a strong focus on patient safety and patient satisfaction. As we have seen in NIAZ accreditation, patient outcomes and continuous improvement become more important as quality increases. JCI is also very healthcare-specific, in that it is not

based on a 'general' quality improvement model as was the case with NIAZ. In this regard, JCI will provide further useful information towards the development of a new BPM maturity model for healthcare.

6.3 Quick Scan

A quick scan was performed as part of the first round of the Delphi study. This was done in the form of a survey. Our experts were asked several questions to determine the current state of their organisation. These questions relate to their use of accreditation standards and frameworks currently used. Also, the experts were asked to provide a general assessment of their current BPM maturity level. The panel of experts was selected by contacting professionals from practice and academia that were known within the network of the research group where this research was performed. This led to an expert panel consisting initially of seven members, with six from practice (hospitals) and one from academia. The selection process is further elaborated upon in chapter 7 on the Delphi Study. Because this survey is concerned with the use of process frameworks and accreditation standards within hospitals, the respondent from academia was excluded from this initial survey, but included in the remaining Delphi study rounds.

The characteristics of the expert panel were established using the following survey items:

- The number of years employed in the current role.
- The number of years employed in healthcare.

The practical use of models and frameworks that influence BPM was established using the following survey items:

- Accreditation standards the hospital complies with, or intends to comply with in the future.
- Management models and methods in used in the hospital.
- Other initiatives influencing process management in the organisation.

The above three survey items were structured by using a list of checkboxes with a few examples, while also allowing the respondents to fill in other options in a text field. For the accreditation standards, examples given were NIAZ, JCI and HKZ (ISO 9001) accreditation norms. For management models, we included the INK-model, the NICTIZ reference model or domain reference model for hospitals (DRH), Six sigma, Lean Enterprise and EMRAM. Examples given for other initiatives influencing process management were the modelling and improvement of process models, implementation of a BPM system, implementation of electronic health records and process mining. Following these three items, respondents were then asked to identify:

- Success factors influencing the improvement of process management.
- Obstacles preventing improvement of process management.
- The current level of maturity in the hospital.
- The expected level of maturity in the hospital in five years.
- The perceived value of a healthcare-specific BPM capability model.

A list of possible success factors and obstacles was provided, derived from earlier research by (Ravesteyn & Batenburg, 2010; Ravesteyn & Versendaal, 2007; Ravesteyn et al., 2012). The current and expected overall level of BPM maturity in the organisation was established on a scale of one to five, based on Harmon (2004). This was done to get a broad overview of maturity in the sector. Finally, respondents were asked to rate their perceived value of a healthcare-specific BPM Maturity Model for Dutch hospitals on a scale of one to ten.

The six respondents currently employed in hospitals report an average employment of 11.67 years in healthcare ($s = 10.69$) and an average of 3.34 years in their current role ($s = 2.25$). A minimum of four years' experience in healthcare was reported and maximum of thirty-two years.

For the accreditations standards, NIAZ was the most popular with five votes, followed by JCI with two votes. This can be attributed to the fact that NIAZ implementation has a long history in the Dutch hospital sector. One

respondent reported using various other accreditation standards, such as HACCP, which is related to hygiene and food safety. Table 6 shows an overview of responses given in regards to accreditation standards used

Management Method / Model	Votes	Percentage
NIAZ Accreditation	5	83.3%
JCI Accreditation	2	33.3 %
Other	1	16.7 %
HKZ (ISO 9001)	0	0 %

Table 6 Overview of responses for accreditation standards used in practice

Following the accreditation standards, respondents were asked to indicate the use of management models and methods within the organisation. We provided a list of five predefined models and methods and the option to include other answers. Out of the provided list including the INK model, NICTIZ reference model, Six Sigma, Lean Enterprise and EMRAM, the INK-model and Lean Enterprise were most popular, each garnering four votes. This was followed by the NICTIZ Reference Model with two votes and EMRAM with one vote. As other options, respondents indicated the use of ITIL (Information Technology Infrastructure Library) and TOC (Theory of Constraints). ITIL is concerned with various IT-related services and processes, such as managing the availability, security and capacity of IT resources. Theory of Constraints is a management philosophy that views organisations as a chain of links that work to achieve organisational goals. This chain is affected by constraints, or weak links, that must be identified and improved to achieve better results. Table 7 shows an overview of responses given in regards to management methods and models used.

Management Method / Model	Votes	Percentage
INK-model	4	66.7 %
Lean Enterprise	4	66.7 %
NICTIZ Reference Model	2	33.3 %
Other	2	33.3 %
EMRAM	2	16.7 %
Six Sigma	0	0 %

Table 7 Overview of responses for management methods and models used in practice

Furthermore, we asked respondents to describe current initiatives relating to process management that are being performed in the organisation. A list of four possible initiatives was provided, including modelling/improving process models, implementing a BPM system, implementing Electronic Health Records, and process mining. Respondents could also indicate other responses. All respondents indicated that the implementation of EHRs was currently ongoing. Modelling and improving process models was performed in all but one hospital. Implementation of a BPM system and process mining both received three votes by respondents. Other responses indicated that budget cuts required the re-evaluation of which healthcare services were provided and that tactical alignment and planning was being performed. Table 8 shows an overview of responses regarding other process management initiatives.

Initiative	Votes	Percentage
EHR Implementation	6	100 %
Modelling / improving process models	5	83.3 %
BPM System Implementation	3	50 %
Process Mining	3	50 %
Other	2	33.3 %

Table 8 Overview of responses for other initiatives related to process management

Following the collection of results regarding accreditation standards, management models/methods and other process management initiatives, respondents were asked to indicate the current perceived maturity level of their organisation and their expected maturity level in five years. This applies to the entire organisation. Table 9 shows an overview of current and expected levels of BPM maturity. In this table, we see that the respondent organisations currently experience maturity on either level two or three of the maturity scales as based on Harmon (2004). All respondents indicated a rise of one maturity level between now and five years, leading to a distribution of two votes for the 'Defined' maturity level and four votes for the 'Managed' maturity level. One respondent noted that it was difficult to indicate maturity for the entire organisation. Some departments or locations exhibit higher BPM maturity than others.

Levels	Current	Expected (5 yrs)
1 – Initial	-	-
2 – Repeatable	2	-
3 – Defined	4	2
4 – Managed	-	4
5 - Optimised	-	-

Table 9 Current and expected BPM Maturity levels of respondent organisations

The success factors and obstacles that influence process management were collected by presenting respondents with a list of such factors and obstacles based on (Ravesteyn & Batenburg, 2010; Ravesteyn & Versendaal, 2007; Ravesteyn et al., 2012). Respondents were allowed to provide as many answers as they deemed necessary. Table 10 shows an overview of the success factors and votes for each factor. Here, it is seen that the most prominent success factors are related to people and leadership. The use of IT and investment in BPM technologies is seen as a relatively less important factor in achieving process management success.

Success Factor	Votes	Percentage
People: The extent to which employees are participating in processes	**6**	100%
Leadership: Management Commitment	**6**	100%
Culture: Organisational culture changes towards a process oriented organisation	**5**	83.3%

People: Utilizing adequately trained people with the necessary knowledge for process improvement	**5**	83.3%
Methods: using methods for structured process standardisation and improvement	**5**	83.3%
Performance measurement: Using performance measures to benchmark and improve processes	**5**	83.3%
Process management: Utilizing process owners for maintaining and controlling processes	**5**	83.3%
Communication: The use of clear communication channels when performing BPM initiatives	**4**	66.7%
IT: Investing in BPM technologies	**3**	50%
Other	**1**	16.7%

Table 10 Process management success factors as experienced by the expert panel

Following the success factors, the obstacles for process management are shown in Table 11 below. The top obstacles appear to be mostly related to IT issues and cultural/organisational issues.

Obstacle	**Votes**	**Percentage**
The organisational culture is too department-oriented	**5**	83.3%
The IT landscape is providing too little process performance information	**5**	83.3%
The IT landscape is not flexible enough to support process changes and improvements	**4**	66.7%
The responsibilities of line managers versus process managers are not clearly defined	**3**	50%
The advantages of BPM are not seen by operational personnel.	**2**	33.3%
The IT landscape does not sufficiently support processes	**2**	33.3%
Process are defined but not kept up-to-date	**2**	33.3%
There are insufficient people with the necessary BPM competences	**2**	33.3%
BPM is considered to be mainly an IT issue	**1**	16.7%
Available BPM software does not meet our requirements for automating processes	**1**	16.7%
Available tools for process modelling do not meet our requirements	**1**	16.7%
Processes are usually adhered to, but are ignored during crises	**1**	16.7%
Other	**1**	16.7%
The advantages of BPM are not seen by management	**0**	0%
We do not have BPM software	**0**	0%
No obstacles experienced	**0**	0%

Table 11 Process management obstacles as experienced by the expert panel

These lists show that cultural and people-related factors seem to be the most influential drivers towards success. Hospital employees experience shortcomings in information technologies and BPM software. The IT landscape is said not to provide sufficient information for end-to-end performance measurement, and it is not flexible enough to adapt to changing processes. Additionally, the organisational culture is very much departmentalised, meaning that it is difficult to improve processes since these usually span a multitude of departments. This is reflected by the top success factors indicated by the respondents. They experience that a change towards a process-oriented culture is needed, with people who are actively participating in processes and leadership commitment towards process improvement initiatives.

Finally, respondents were asked to indicate their perceived value of a healthcare-specific BPM Maturity Model for Dutch hospitals on a scale from one to ten. The average rating was 5.17 (s = 2.93). There was high variance between ratings. Two respondents rated the perceived value of the proposed model lowly, with ratings of one and two respectively. They indicated that they did not see the added value of such a model as they believed existing management methods (such as Lean) provide sufficient tools for improving processes and process management. The four remaining respondents were reasonably enthusiastic with ratings between six and eight.

6.4 Conclusion

Information gathered from existing accreditation standards shows that these include a holistic method of process management, ranging from the strategic level to operational processes. When all aspects of the accreditation methods are covered in an organisation, there is sufficient focus on process outcomes for patients, employees and partners. This means that the Business Process Lifecycle is completed: The results of processes are frequently measured and used as input for continuous improvement. NIAZ and JCI are the main accreditation frameworks used in The Netherlands and internationally. This is reflected in our sample of respondents. Sub question 1.3 is hereby answered, which states “What are the characteristics of process frameworks for hospitals?”.

Based on data collected from our sample of respondents, we have established the current state of BPM in hospitals. It turns out that maturity levels are currently self-assessed as being low to average. All respondents indicated a desired improvement in BPM maturity in the coming years. This confirms that there is room for improvement and that a BPM maturity model may be useful tool. Respondents indicate that people and culturally-related capabilities are the most significant success factors in improving BPM maturity. Investing in Information Technology is not necessarily seen as a high priority. On the other hand, information technology is currently seen as a major obstacle since it is not adequately process-oriented. Respondents state that they cannot retrieve process performance information, or that systems are not flexible enough to support process changes. The traditional, department-oriented culture also proves to be a major obstacle when attempting to transform to a process-oriented organisation. We also see that the hospitals in our sample are working on various initiatives that influence business processes, such as the implementation of Electronic Health Records and Business Process Management Systems. The organisations are also looking to gain insight into their processes through modelling and documentation. In response to sub question 1.4, which states “To what extent are BPM practices performed in Dutch hospitals?”, we can conclude that BPM practices are currently performed at a low to average level of proficiency. This is supported by the self-indicated maturity level of our respondents, the obstacles they are currently facing and the initiatives taken to improve in the future.

7 Delphi Study

As described earlier, a Delphi study was used to gather information from a panel of experts relating to the topic of business process management in hospitals. Some of the characteristics indicate that a Delphi study includes multiple-round surveys that are administered anonymously. This is done in such a way that respondents cannot identify one another and do not interact directly. Anonymous identifiers are used to track each respondent in the survey, so that other respondents can see which responses belong to the same person. The anonymous identifiers allow the researcher to keep track of the progress of each respondent, and their real identities are known to the researcher for the purpose of contacting them for each survey round.

The panel of experts was composed from a list of potentially interesting contacts that were known to the research group of Process Innovation & Information Systems prior to the start of the project. Some of these respondents had previously indicated their interest for involvement in this project during earlier face-to-face meetings. All potential respondents were invited via telephone call. Persons who indicated interest in participating in the study were sent an e-mail containing an overview of the study objectives. Respondents were then sent a personalised link to the first survey round, containing their unique anonymous identifier. The initial survey for assessing the current state of BPM Maturity in hospitals using a quick scan, as described in section 6.3, was answered by seven respondents. Two respondents indicated no further interest in participating in the study after the first Delphi round, leading to a remainder of five respondents in the second round. This panel consists of four respondents employed at hospitals and one respondent from academia. In the third round, another respondent from a hospital dropped out, leaving four respondents. Table 12 presents an overview of the respondents per round. Respondents are either employed in a hospital (practice) or in academia.

	Practice	Academia
Round One	6	1
Round Two	4	1
Round Three	3	1

Table 12 Number of respondents per Delphi study round.

The surveys are set up using the forms functionality in Google Drive. This facilitates electronic distribution of each survey round to the panel of geographically dispersed respondents. Google Drive was chosen over other survey platforms as it allows unlimited survey items and respondents at no additional cost. Furthermore, functionalities such as field validation (ensuring the correct input of survey fields) and pre-filled fields (used for setting the anonymous respondent codes) were very necessary for this Delphi study and not always available in other survey platforms.

The Delphi study was performed in three rounds. The first round was used to collect opinions using open-ended question. Subsequent rounds serve to refine and reflect upon previously given answers and work towards consensus. Rounds one and two were filled in by the respondents at their own discretion. For the third and final round, an appointment was made for an accompanying telephone interview. This was done to further enrich or clarify answers given in the final round while filling in the survey form. The following sections describe the results of each round of the Delphi study.

7.1 First Round Results

The Delphi method prescribes that the first round of the study should be open-ended, in order to collect a variety of opinions and respondent creativity. The goal of the first round is to collect a list of capabilities which the respondents deem influential to maturity of business process management in hospitals. A minimal level of structure was added to the survey to get the respondents started in the right direction. This was done by asking them to provide capabilities which are necessary for process management using six high-level factors: Strategic Alignment, Governance, IT, Methods, People, and Culture. These factors were provided since they are commonly found in existing BPM Maturity Models, and are present in all organisations. Descriptions for each of the factors were provided, based on Rosemann & vom Brocke (2010). Respondents were also asked to rate the overall importance of each factor on a scale from 1 to 10. An additional open-ended survey item was provided to collect any remaining capabilities that respondents did not include in the six factors. The ratings of the overall factors are presented in Table 13. What is particularly interesting about these ratings is that the people and culture factors are scored highly by all respondents. IT and Methods on the other hand are relatively lowly-rated. Governance and Strategic alignment fall somewhere in the middle. In the next Delphi rounds, we will delve further into why respondents have provided these specific ratings and what these numbers mean.

Factor	Avg. score out of 10	Std. dev.
People	9.14	1.60
Culture	8.86	1.27
Governance	8.57	0.90
Strategic Alignment	8.29	1.90
IT	7.57	0.69
Methods	6.86	0.90

Table 13 Factor ratings provided in the first Delphi round

The data collected within each factor showed a wide variety of opinions. For the purpose of allowing respondents to rank or rate the given answers in the next round, the collected data must be structured and summarised into a list of capabilities. Below, the collected capabilities for each factor are presented in no particular order. The raw data for this round (in Dutch) is provided in Appendix III. In the appendix, the respondent code is used to identify answers belonging to the same respondent. The capabilities were identified as follows:

Strategic Alignment
Strategic Alignment is defined as "the tight linkage of organisational priorities and enterprise processes, enabling continual and effective action to improve business performance." (Rosemann & Vom Brocke, 2010). In this factor, respondents provided a number of industry-standard frameworks (such as NIAZ or JCI), and practices such as the Patient Reported Outcome Measures (PROM). The following capabilities were provided:

- Provide insight into the value chain
- Patient Reported Outcome Measures (PROM)
- ZiZo Standardised Quality Indicators (*Normen Zichtbare Zorg)*
- Accreditation Standards (NIAZ, JCI)
- Accountability towards health insurers
- Using business cases for process improvement
- Setting goals for process management in organisational mission, vision and strategy

Governance
Governance is defined as "appropriate and transparent accountability in terms of roles and responsibilities for different levels of BPM." (Rosemann & Vom Brocke, 2010). Governance is further concerned with collecting the results of key performance indicators and comparing these to performance criteria predefined on the strategic level. Respondents indicated a number of practices related to governance:

- Specification of responsibilities and tasks at the process level
- Frequent evaluation of progress in process management initiatives
- Governance based on process outcome indicators
- Governance based on soft skills (collaboration, behaviour, accountability)
- Setting process goals instead of department goals
- Agreeing on following process descriptions
- Prioritizing process management for high-risk business goals

Methods
Methods are defined as "tools and techniques that support and enable consistent activities on all levels of BPM)". Different methods may be applied to different stages in the process lifecycle (Rosemann & Vom Brocke, 2010). Examples of methods are the use of the Business Process Modelling Notation (BPMN) for documenting process models, or methods such as Six Sigma for process improvement. Respondents listed a number of specific techniques, as well as more general methods relating to process management.

- DMAIC
- Ist & Soll
- BPMN
- LEAN
- Method for describing, improving, controlling and managing processes
- Reference model for support process management
- Process mining
- Customising the names of existing process management methods to avoid negative connotations
- Defining the relations between different methods
- Standardising supporting processes

IT
IT is defined as "the software, hardware and information systems that enable and support process activities" (Rosemann & Vom Brocke, 2010). Within this factor, respondents listed some specific types of tools or engines, as well as certain connections between systems.

- Process modelling tool
- Workflow Engine
- Securing process models in a digital quality management system
- Rules Engine
- Connecting process descriptions with working procedures
- Connecting information systems for end-to-end process information
- BI Tools / KPI Dashboard
- EHRs for supporting the primary process
- SAP (or similar) for supporting processes

People
The people factor is related to human resources and their behaviour in terms of process management. It is defined as "the individuals and groups who continually enhance and apply their process and process management skills and knowledge to improve business performance." (Rosemann & Vom Brocke, 2010). The following capabilities were provided:

- Availability of primary healthcare staff
- Flat organisational structure
- Assigning process owners
- Stimulating knowledge sharing
- Training in describing and optimising healthcare processes
- Training in KPI-based steering
- Training in combining line management and process management
- Clarify the importance of the individual in the process chain
- Freedom and responsibility to internalize processes
- Using pilot projects to foster participation

Culture

Culture is defined as the "collective values and beliefs that shape process-related attitudes and behaviour to improve business performance" (Rosemann & Vom Brocke, 2010). It is closely related to the 'People' factor. The following capabilities were provided:

- Culture elements from LEAN
- Culture elements from McKinsey's 7s model
- Intrinsically motivated improvement culture and management style
- Open culture
- Management commitment
- Assigning a process management ambassador within management or the board
- Involvement of healthcare professionals
- Creating awareness of current issues

Other areas of interest

A final survey item was provided to allow respondents to input other areas of interest related to process management. Some capabilities were provided, which were found to fit into the factors provided earlier and were therefore moved. The original input for this survey item is provided in

At the end of this first survey round, sufficient opinions are collected to proceed to the next round. The capabilities as described above are presented to the expert panel in the second round, so that they may rate each of the capabilities. The second round is discussed in the next section.

7.2 Second Round Results

In the second round, the capabilities provided in each of the factors are presented to the respondents. Respondents are asked to rate the importance of each the capabilities on a five-point scale. A score of one means the capability is very unimportant, a score of five means the capability is very important. This allows us to rank the importance of the capabilities within each factor. The raw data collected in the first round was presented alongside the summarized list of capabilities to allow insight into other respondent's opinions. This data is presented in Appendix IV. For each of the capabilities respondents were allowed to provide additional feedback for their chosen ranking. Five respondents participated in this round.

In Table 14 below, the capabilities for strategic alignment and their average rankings on a scale of 1 to 5 are displayed. Here we notice that internally-focused capabilities are rated more highly. Externally focused capabilities such as accreditations or the ZiZo standardised quality indicators are rated lowly. In the additional comments, one respondent noted that these externally focused capabilities should not be the main driver for quality in a hospital. The respondent further notes that the primary client focused business operations should be

the main focus for improvement. Improving these will automatically lead to better results towards external bodies such as health insurers and auditors.

Strategic Alignment	Avg.	Std. Dev.
Provide insight into the value chain	4.4	0.49
Using business cases for process improvement	4.0	0.75
Setting goals for process management in organisational mission, vision and strategy	4.0	0.49
Patient Reported Outcome Measures (PROM)	3.8	0.75
Accreditation Standards (NIAZ, JCI)	3.8	0.75
Accountability towards health insurers	3.2	0.63
ZiZo Standardised Quality Indicators (*Normen Zichtbare Zorg)*	2.4	1.10

Table 14 Capability rankings for the strategic alignment factor

In the governance factor, most capabilities are rated highly, and there is less deviation in the scores. The most important capability is the specification of responsibilities and tasks at the process level. This should be done instead of the traditional department-based specification of responsibilities and tasks. In the additional comments, one respondent notes that process management requires a different management style compared to traditionally structured organisations. Process management should be implemented consistently, with a focus on continuous development and improvement of practices. Table 15 shows the rankings of capabilities in the governance factor.

Governance	Avg.	Std. Dev.
Specification of responsibilities and tasks at the process level	4.8	0.40
Governance based on process outcome indicators	4.4	0.49
Setting process goals instead of department goals	4.4	0.49
Governance based on soft skills (collaboration, behaviour, accountability)	4.0	0.89
Prioritizing process management for high-risk business goals	4.0	0.80
Agreeing on following process descriptions	3.8	0.75
Frequent evaluation of progress in process management initiatives	3.6	0.89

Table 15 Capability rankings for the governance factor

In the methods factor, most capabilities receive average scores with little deviation. Several different methods, specific and vague, are listed in this factor. One respondent indicates that a method is simply a means towards a goal. Therefore, it is difficult to say which method is more important, since methods may differ depending on the situation. Different methods may also be suitable for the same purpose. Another has a similar opinion and states that methods should be seen as tools that are selected depending on the situation. This respondent notes that the

connection between different methods is more important, so that a cohesive methodology is formed. The ranking of capabilities in the methods factor is shown in Table 16.

Methods	Avg.	Std. Dev.
IST & SOLL	4.0	0.75
Method for describing, improving, controlling and managing processes	4.0	0.63
Standardising supporting processes	4.0	0.49
DMAIC	3.8	0.49
LEAN	3.6	0.89
BPMN	3.4	1.02
Reference model for supporting process management	3.4	0.75
Using proprietary naming conventions for existing process management methods	3.4	1.02
Process mining	3.2	0.75
Defining the relations between different methods	3.2	1.10

Table 16 Capability rankings for the methods factor

In the IT factor, we see that business intelligence and a dashboard for key performance indicators are rated highly. Other IT capabilities receive average scores. In the additional comments, we see similar opinions as in the methods factor: IT should be considered a tool for supporting process management. The respondent notes that all of the capabilities mentioned could be beneficial to process management, but it is more important to establish proper connections between systems to establish a 'service bus' spanning entire processes. Many process management supporting IT functionalities are already present in hospitals, but more integration is needed to achieve a higher level of quality. Table 17 shows the capabilities and ratings for the IT factor.

IT	Avg.	Std. Dev.
BI Tools / KPI dashboard	4.4	1.02
Securing process models in a digital quality management system	4.4	0.63
Connecting process descriptions with working procedures	4.0	0.63
EHRs for supporting the primary process	4.0	0.89
Process modelling tool	3.6	1.20
Connecting information systems for end-to-end process information	3.4	0.49
SAP (or similar) for supporting secondary processes	3.4	0.89
Workflow engine	3.0	0.49
Rules engine	3.0	0.49

Table 17 Capability rankings for the IT factor

The people factor shows that respondents see appointment of process owners as the most important people-related capability. This is closely followed by a number of other capabilities that are rated highly. In general, we see that there is a focus on training and education of personnel towards a process-based way of working. In the first Delphi round, the people factor received the highest overall rating among all factors. This underlines the fact that processes within hospitals are very much human-driven, and that interventions for improving process management may have the highest impact when focused on the people aspect. Table 18 shows the ranking of the people-related capabilities as indicated by respondents.

People	Avg.	Std. Dev.
Assigning process owners	4.8	0.75
Availability of primary healthcare staff	4.2	1.02
Stimulating knowledge sharing	4.2	0.40
Training in describing and optimising healthcare processes	4.2	0.75
Training in KPI-based steering	4.2	0.75
Using pilot projects to foster participation	4.2	0.75
Clarify the importance of the individual in the process chain	4.0	1.02
Training in combining line management and process management	3.6	1.10
Flat organisational structure	3.4	1.02
Freedom and responsibility to internalize processes	3.4	0.40

Table 18 Capability rankings for the people factor

The final factor, culture, also received a high overall rating. The culture and people factor are closely related, which explains why the need for people-related interventions also requires cultural transformation. The commitment of management towards improving process management is seen as the most important capabilities overall, and is the only factor that received a 5 out of 5 rating. Other capabilities within this factor also score highly, indicating a high consensus among the experts. Again, we see capabilities that are related to the previous factor, such as the involvement of healthcare professionals. The cultural elements from LEAN and McKinsey scored relatively lowly, because some respondents indicated they were not familiar with these elements. These capabilities refer to specific methods. As we have seen in the methods factor, it is difficult to pinpoint a 'best' method seeing as they can all be useful in different situations. It appears that the respondents prefer a more 'method-agnostic' approach, and instead refer to very specific practices in this factor. Table 19 shows the ranking of capabilities in the culture factor.

Culture	Avg.	Std. Dev.
Management commitment	5.0	0.49
Involvement of healthcare professionals	4.6	0.40

Intrinsically motivated improvement culture and management style	4.4	0.49
Assigning a process management ambassador within management or the board	4.2	0.80
Creating awareness of current issues	4.2	0.00
Culture elements from LEAN	3.6	0.75
Open culture	3.4	0.49
Culture elements from McKinsey's 7s model	3.2	0.75

Table 19 Capability rankings for the culture factor

In conclusion, the second round provided valuable input for ranking the capabilities within each factor based on importance perceived by the experts. It is interesting to see that within some factors, capabilities are ranked closely to each other, while in others there is more deviation. We also see that some factors contain more highly rated capabilities overall (such as people and culture) while others don't (methods and IT). This already provides some guidance for shaping the maturity model. The respondents seem to clearly agree on the fact that people- and culture-related interventions have the highest importance.

In the first round of the Delphi study, we already asked the respondents to give an overall importance rating of each of the six factors on a scale of one to ten. By multiplying the capabilities ratings with the factor ratings, we can create an overall ranking of all factors using a weighted score. All capabilities ranked by their weighted score are presented in Table 20 below. This overall ranking will be used as input for the third Delphi round. This round is discussed in the next section.

Factor	**Capability**	**Weighted Score**
Culture	Management commitment	44.30
People	Assigning process owners	43.87
Governance	Specification of responsibilities and tasks at the process level	41.14
Culture	Involvement of healthcare professionals	40.76
Culture	Intrinsically motivated improvement culture and management style	38.98
People	Availability of primary healthcare staff	38.39
People	Stimulating knowledge sharing	38.39
People	Training in describing and optimising healthcare processes	38.39
People	Training in KPI-based steering	38.39
People	Using pilot projects to foster participation	38.39
Governance	Governance based on process outcome indicators	37.71

Governance	Setting process goals instead of department goals	37.71
Culture	Assigning a process management ambassador within management or the board	37.21
Culture	Creating awareness of current issues	37.21
People	Clarify the importance of the individual in the process chain	36.56
Strategic Alignment	Provide insight into the value chain	36.48
Governance	Governance based on soft skills (collaboration, behaviour, accountability)	34.28
Governance	Prioritizing process management for high-risk business goals	34.28
IT	BI Tools / KPI dashboard	33.31
IT	Securing process models in a digital quality management system	33.31
Strategic Alignment	Using business cases for process improvement	33.16
Strategic Alignment	Setting goals for process management in organisational mission, vision and strategy	33.16
People	Training in combining line management and process management	32.90
Governance	Agreeing on following process descriptions	32.57
Culture	Culture elements from LEAN	31.90
Strategic Alignment	Patient Reported Outcome Measures (PROM)	31.50
Strategic Alignment	Accreditation Standards (NIAZ, JCI)	31.50
People	Flat organisational structure	31.08
People	Freedom and responsibility to internalize processes	31.08
Governance	Frequent evaluation of progress in process management initiatives	30.85
IT	Connecting process descriptions with working procedures	30.28
IT	EHRs for supporting the primary process	30.28
Culture	Open culture	30.12
Culture	Culture elements from McKinsey's 7s model	28.35
Methods	IST & SOLL	27.44
Methods	Method for describing, improving, controlling and managing processes	27.44
Methods	Standardising supporting processes	27.44
IT	Process modelling tool	27.25

Strategic Alignment	Accountability towards health insurers	26.53
Methods	DMAIC	26.07
IT	Connecting information systems for end-to-end process information	25.74
IT	SAP (or similar) for supporting secondary processes	25.74
Methods	LEAN	24.70
Methods	BPMN	23.32
Methods	Reference model for supporting process management	23.32
Methods	Using proprietary naming conventions for existing process management methods	23.32
IT	Workflow engine	22.71
IT	Rules engine	22.71
Methods	Process Mining	21.95
Methods	Defining the relations between different methods	21.95
Strategic Alignment	ZiZo Standardised Quality Indicators (Normen Zichtbare Zorg)	19.90

Table 20 All capabilities and their weighted scores (factor score multiplied by capability score)

7.3 Third Round Results

We have now collected a variety of opinions from the expert and ranked these using quantitative methods. We want to arrive at a final conclusion regarding capabilities that must be included in the maturity model. In the third round, all capabilities are presented to the respondents in an overall ranking, as shown in the preceding section. This overall ranking is created by assigning a weighted score to each capabilities. This weighted score is the product of the capabilities score multiplied by the factor score. For example, the capability 'Patient Reported Outcome Measures (PROM)' received a capability score of 3.8, multiplied by the score of the strategic alignment factor in which it resides (8.29). This leads to a rounded weighted score of 31.5. The weighted scores are on a scale of 10 to 50. A score of 10 indicates a capability of lowest importance while a score of 50 indicates a capability of highest importance. Creating this overall ranking provides the necessary input for the maturity model, as it gives insight into which capabilities provide the highest impact to improving process management.

The third Delphi round was conducted using an electronic survey accompanied by a telephone interview. The researcher called each respondent individually and recorded the respondent's answer to the survey questions. To collect quantitative data on the level of consensus, respondents were asked to express their level of agreement on a scale of one to ten. A rating of one means the respondent fully disagrees with the presented ranking. A rating of ten means the respondent fully agrees with the presented ranking. A ranking was given for each of the six factors (strategic alignment, culture, methods, etc.). We also want to decide which capabilities should and should not be included in the model. This is done to strike a balance between model complexity and representativeness of the practical situation. The respondents also asked to give input on how to achieve this balance in the model. All comments provided by the respondents in the phone interviews are presented in Appendix V. The numerical level of agreement for the rankings is presented in this section.

Factor Rankings

Respondents were first asked to comment on the overall ranking of factors, as scored in round one. The panel unanimously agreed that culture and people are the most important elements in business process management for hospitals. Respondents stated that changes do not happen in hospitals unless primary employees are willing and motivated. Employees are directly responsible for changing their environment, while culture defines how people behave in this environment. Furthermore, culture is seen as important because it contributes a shared vision, which is seen as a requirement before other capabilities can be fulfilled.

After people and culture, the panel agrees that Governance is an important factor. Governance determines the responsibilities and tasks of hospital staff. It is also plays an important role in measuring the outcomes of processes. This factor is followed by Strategic Alignment, which is deemed useful for setting organisational goals. The panel agrees on the relatively low rating for IT and Methods. They say that these should be seen as supporting tools that follow other initiatives in the organisation.

Respondents rated their agreement with the current factor ranking with a 7, 7, 9, and 10 respectively. This means that the level of agreeance with the presented capability ranking was relatively high. Two respondents largely agreed by given a rating of 7, and two respondents (nearly) fully agreed by giving a rating of 9 and 10.

People

In the people factor, respondents agreed that the availability of primary healthcare staff for process improvement is essential. Their expertise is a requirement for business process management in hospitals. Three respondents noted that they would have expected the capability relating to ‘pilot projects’ to be rated higher. However, this capability has the second-highest score within the People factor. Four other capabilities have an identical score which is why the ‘pilot projects’ capability only appears lower in the list visually. Furthermore, respondents noted that training employees to combine line management and process management is situational, since it does not apply to all employees. By employing pilot projects, awareness for process improvement initiatives can be created. This appears to be one of the main challenges for the respondents in our panel. This is also reflected in the next factor, Culture.

Respondents rated their agreement with the ranking of people capabilities with a 7, 7, 7, and 8 respectively. There is little deviation in scoring between respondents.

Culture

Like in the People factor, respondents agree that creating awareness and a shared vision is an important part of organisational culture. One respondent notes that while management commitment is rated highly, commitment of primary staff is just as important. This is because the staff will be needed to make the actual changes. There were little other comments on this factor, as respondents stated they mostly agreed with the order of capabilities as presented.

Respondents rated their agreement with the ranking of people capabilities with a 7, 7, 7, and 8 respectively. There is little deviation in scoring between respondents.

Governance

Respondents again state their overall agreement with the ranking of capabilities in this factor. One respondent notes that PROM (Patient Reported Outcome Measures) are becoming more important. Hospitals are seeing that patient satisfaction is becoming a major factor in competing against other hospitals. There are some basics which hospitals must always adhere to, such as clean rooms and beds. They can compete by providing extras that further improve patient satisfaction. Another point that has proven important in satisfaction is how staff communicates with the patient. Another influential factor noted by respondents is the ability of the organisation to govern based on soft skills. This includes making the right agreements among staff and creating an environment of

improvement, where employees actively comment on each other's performance. This transformation to proactive governance is necessary for the entire process, so that individual parts of the value chain spend less time 'repairing' the work of previous parts.

Respondents rated their agreement with the ranking of governance capabilities with a 6, 7, 8, and 9 respectively. This means there is some deviation in the scores. The respondent giving the lowest score noted that governance based on soft skills is of higher importance than is currently reflected in the ranking.

Strategic Alignment

Respondents state that PROMs are also an important factor in achieving strategic alignment. This is because PROMs clearly define the outcome of the process, which can be linked to the intended strategy. PROMs also show where there are areas for improvement. Beyond this, hospitals must have a clear mission and vision that makes then stand apart from competitors.

There was some discussion about other capabilities. Respondents agree that accountability towards health insurers should be more important than accreditation standards. This is because health insurers and hospitals (ideally) strive for the same goal of providing high-quality healthcare and patient satisfaction. Both patients and insurers should be seen as the hospital's 'customers'. Accreditation standards certainly are important, but do not provide intrinsic motivation for improvement. Accreditation standards serve more as a support tool to meet certain quality standards. Furthermore, the use of business cases for process improvement is not yet widespread but is becoming more important in the hospitals respondents are working in. One respondent rated their agreement with a five. This respondent stated that PROMs (Patient Reported Outcome Measures) are the ultimate goal of process improvement, since the outcome of the process reflects its optimisation. However, this capability is still rated highly at 3.8 and was included in the final model.

Respondents rated their agreement with the ranking of strategic alignment capabilities with a 5, 7, 8, and 8 respectively. The score of five is considered an outlier. This is because the respondent felt that PROMs should be included as the most important capability within this factor.

IT

Respondents noted that the IT capabilities seem like an unstructured collection of IT tools. They note that IT mainly plays a supporting role and that its capabilities are strongly linked together. The basic requirement for improving IT in regards to Business Process Management currently appears to be the use of a process modelling tool. This would allow the creation of process models according to a uniform modelling language. Consequently, these process models can be linked to actual working procedures. It appears that the respondents are mostly discovering and modelling processes at the moment. Because the IT infrastructure is currently not process-driven, more advanced tools such as KPI dashboards will only become useful once end-to-end process information is available. Respondents note that for the future a process-driven system for primary processes will be essential. Ultimately, all IT systems (both for primary processes and supporting processes) must be process-driven for true end-to-end process information and steering. In regards to IT capabilities, we identify a certain layering in capabilities. Basic capabilities such as the process modelling must be fulfilled before more advanced capabilities can be achieved.

Respondents rated their agreement with the ranking of IT capabilities with a 5, 6, 7, and 8 respectively. The deviation in scores seems to be caused by the fact that some respondents use tools, such as process mining, which others do not deem relevant at this point.

Methods

In regards to Methods capabilities, respondents again noted that the methods mentioned seem like a big 'toolbox' from which one can choose. Respondents have contributed different methods which have proven to be suitable to

their specific situation. They note that there is no 'best' or 'one size fits all' method for improving BPM Maturity and that selecting a method is entirely situational. The majority of respondents note that LEAN is becoming increasingly popular in hospitals for improving processes.

Respondents rated their agreement with the ranking of Methods capabilities with a 4, 6, 6, and 8 respectively. Here, the deviation in scores also seems to be caused by the fact that respondents have different experiences in regards to the Methods that are relevant to their specific situation.

Overall Weighted Scores

After enquiring on the agreement with the ranking of capabilities within each factor, respondents were presented the overall ranking of capabilities with weighted scores, as shown in Table 20 at the end of the previous section. Respondents agreed that capabilities relating to people and culture are currently most influential in improving business process management. Agreement with the overall weighted scores was rated with a 6, 7, 8, and 8 respectively.

The agreement scores are summarised in the conclusion section found below.

7.4 Conclusion

Table 21 presents a summary of agreement scores that were collected in the third round of the Delphi study. Each column with a three-character code represents one member of the expert panel and their ratings. The agreement scores were collected for the factor rankings, the capability rankings within each factor, and the overall ranking of capabilities with weighted scores. For each of these, the average agreement score and standard deviation is calculated to show the level of consensus.

	#C00	#6F0	#F93	#009	Avg.	Std. Dev.
Factor Rankings	9	10	7	7	8.25	1.30
People capabilities	7	7	7	8	7.25	0.43
Culture capabilities	7	9	7	7	7.5	0.87
Governance capabilities	7	8	6	9	7.5	1.12
Strategic Alignment capabilities	7	8	5	8	7	1.22
IT capabilities	6	8	5	7	6.5	1.12
Methods capabilities	4	6	6	8	6	1.41
Overall Weighted Scores	7	8	6	8	7.25	0.83

Table 21 Summary of agreement scores for the Delphi Study

Table 23 shows that there is a medium to high level of consensus among the panel of experts. There is some variation between factors. Between the six factors, culture and governance receive the highest average agreement score. These are followed by People, Strategic Alignment, IT, and Methods. The People and Culture factors show the lowest level of deviation between the experts. We have established that in general 'People' and 'Culture' should be seen as the leading factors that are currently in need of improvement. Due to the unique organisational culture, creating willingness from all staff members working in different departments of the hospital is key. The

general sentiment is that hospitals traditionally have a departmentalised structure. Improving business process management will require 'breaking down walls' between departments.

Deviation in agreement scores is somewhat higher for the Governance, Strategic Alignment and IT factors and highest for the Methods factor. Based on these numbers we once again see the relative importance of People and Culture capabilities, based on the higher agreement scores and lower level of deviation. IT and Methods show relatively lower consensus. Based on the experts' comments, this is mainly caused by the fact that IT and Methods should be seen as a 'toolbox', from which one must select options that best fit the hospital's situation. This makes it less relevant to establish a certain Method or piece of information technology as the 'best' or 'most important' capability in regards to improving BPM maturity.

While some of the experts dropped out throughout the rounds, the final round of the Delphi study shows us that sufficient consensus has been reached in regards to healthcare-specific factors and capabilities that influence BPM maturity. The current ranking of factors and capabilities provides the starting point for composing the BPM maturity model. This answers sub question 1.5, which states: "What are the specific needs for a healthcare-specific BPM capability model in Dutch hospitals?"

Based on the experts' opinion, a threshold score or cut-off point will be established for which capabilities will and will not be included in the model. This is further explained in chapter 9. In the next chapter, a selection of capabilities is externally validated with a different panel of experts. This is done to validate their relevance in a practical context.

8 Validation

Before designing a BPM maturity model specific to hospitals, the factors and capabilities found in the Delphi Study should be validated externally. Therefore, validation of this study was performed by presenting the identified factors and capabilities to a sample of academic staff, hospitals staff and consultants with experience in healthcare. For this purpose, presentations were held during two workshops at the University of Minho in Portugal. The first workshop was held at the engineering faculty and the second workshop was held at the management faculty. The audience of workshops included students, university staff and external individuals from the healthcare sector. The sessions were on the subject of process management in healthcare and also included other research presentations.

The sample of Portuguese experts was selected because EU healthcare systems show a trend towards convergence and face common problems in terms of increasing demand for healthcare services and decreasing resources (Jakubowski & Busse, 1998; Papanicolas & Smith, 2013). Also, we see an increasing use of European and international quality standards in healthcare (Joint Commission International, 2015; Nabitz et al., 2000). When comparing the efficiency scores of the two national healthcare systems according to Bloomberg (2014), the following is seen: In 2013, The Netherlands and Portugal ranked closely, in 25th and 27th place respectively of the most efficient healthcare systems in the world. In 2014, The Netherlands dropped to 40th place while Portugal was ranked 28th. The Euro Health Consumer Index 2015 rates The Netherlands as the number one healthcare system in Europe, while Portugal is at the 20th place (Björnberg, 2016).

There are differences and similarities between the two countries in terms of healthcare expenditure and access regulation. The Dutch healthcare system is costlier but shows superior performance compared to Portugal (Björnberg, 2016). In both countries, the healthcare system is mostly publicly funded, with the Netherlands using relatively more public funding than Portugal. Portugal also shows relatively higher private funding of healthcare, with more out-of-pocket payments. In The Netherlands, entitlement to healthcare is granted through mandatory health insurance. In Portugal, universal healthcare is provided on the basis of citizenship, with fees (out-of-pocket payments) charged for certain services. In both countries, general practitioners serve as gatekeepers through which patients must be referred to access higher echelons of specialised healthcare.

Characteristic	The Netherlands	Portugal
Total Health Expenditure, Percentage of GDP (WHO, 2014c)	10.9%	9.5%
Public Health Expenditure, Percentage of GDP (WHO, 2014b)	9.5%	6.2%
Private Health Expenditure, Percentage of GDP (WHO, 2014a)	1.4%	3.3%
Out-of-pocket health expenditure, Percentage of total health expenditure (WHO, 2014d)	5.2%	26.8%
Entitlement to healthcare (Wendt, 2009)	Mandatory insurance	Citizenship
Access to specialists (Wendt, 2009)	Via Referral	Via Referral

Table 22 Comparison of characteristics between the Dutch and Portuguese healthcare systems

For developing our model, we used the maturity assessment model development method by De Bruin et al. (2005). We stated that the intended application area of the model consists of multiple entities (different hospitals) in a single region (The Netherlands). According to the typology presented by De Bruin et al. (2005), we can consider other national healthcare systems as different regions. The effect of the differences between the Dutch and Portuguese healthcare systems on BPM practices is currently unknown. However, for the purpose of this study it

assumed that the two systems are sufficiently similar to allow for validation of the capabilities. The participants in the validation sessions did not make any statements or provide comments that would suggest otherwise.

The outline of the workshop was as follows: The context of the Dutch healthcare system and the theoretical framework were explained to the audience. The research methods were explained, with detail given in regards to the Delphi study. A questionnaire was handed out to the attendees. Finally, some of the preliminary findings of the Delphi study were presented. The purpose of these presentations was to specifically validate the results of the Delphi study, to help determine the generalisability of the capabilities to be included in the final model for BPM Maturity in Dutch Hospitals.

To ensure the relevance of the data collected, only questionnaires filled out by hospital staff, academic staff and researchers/consultants with relevant (BPM and healthcare) expertise were included. Questionnaires from students were excluded. By using a different group of experts that share characteristics of our expert panel for the Delphi study, we aim to establish internal validity of the model. The sample was composed of thirteen persons in total. Eight of these were hospital staff, including one CIO and one IT employee. Furthermore, the sample included two consultants, two academic staff and one researcher. Similar to the method used in the Delphi study, the participants in the validation sessions were asked to rank the factors on a scale of one to ten, and the capabilities on a scale of one to five. Participants were also asked to provide comments or additions if desired. However, no additional capabilities were contributed.

For the purpose of validation, we first compare the factor scores of the Delphi expert panel with those of the validation workshop participants. Table 23 below is sorted in descending order according to the scores given by the Delphi panel. The mean score and standard deviation for each factor is listed for both the Delphi sample and the validation sample. In the validation session, the 'People' factor also receives the highest score. Both Strategic Alignment and Culture receive a score of 8.38, giving them a tied second place. Governance is third in the ranking with a score of 8.00. IT and Methods rank lowest, with a slightly higher score given for 'Methods' by the validation respondents compared to the Delphi respondents. From these results, we gather that the 'People' factor is certainly deemed most important by experts.

	Delphi (n = 7)		**Validation (n = 13)**	
Factor	**Score**	**std. dev.**	**Score**	**std. dev.**
People	9.14	1.60	8.85	1.17
Culture	8.86	1.27	8.38	1.73
Governance	8.57	0.90	8.00	1.11
Strategic Alignment	8.29	1.90	8.38	1.08
IT	7.57	0.69	7.31	1.77
Methods	6.86	0.90	7.92	1.54

Table 23 Factor rankings compared between the Delphi study and validation session

In the tables that follow we consider the scores of the top three capabilities within each factor. It was not possible to validate all capabilities due to time constraints. The top three capabilities were selected for validation s these were most likely to be included in the final model. We therefore needed to ascertain if there were any significant scoring differences between the Delphi panel and the validation panel, for these specific capabilities. We compare the average scores of the respondents from the Delphi study with the average score from the respondents of the validation sessions. Table 24 through Table 29 present the comparison of scores for the top three capabilities in each factor. First, Table 24 presents the capabilities for strategic alignment.

Strategic Alignment	Score (D)	Std. Dev.	Score (V)	Std. Dev.
Provide insight into the value chain	4.4	0.49	4.1	0.49
Using business cases for process improvement	4.0	0.75	3.5	0.66
Setting goals for process management in organisational mission, vision and strategy	4.0	0.49	4.1	0.64

Table 24 Comparison of scores for strategic alignment capabilities

Governance	Score (D)	Std. Dev.	Score (V)	Std. Dev.
Specification of responsibilities and tasks at the process level	4.8	0.40	4.7	0.63
Governance based on process outcome indicators	4.4	0.49	3.9	0.64
Setting process goals instead of department goals	4.4	0.49	4.0	0.71

Table 25 Comparison of scores for governance capabilities

Methods	Score (D)	Std. Dev.	Score (V)	Std. Dev.
IST & SOLL	4.0	0.75	4.0	0.82
Method for describing, improving, controlling and managing processes	4.0	0.63	4.2	0.60
Standardising supporting processes	4.0	0.49	4.2	0.60

Table 26 Comparison of scores for methods capabilities

IT	Score (D)	Std. Dev.	Score (V)	Std. Dev.
BI Tools / KPI dashboard	4.4	1.02	4.2	0.55
Securing process models in a digital quality management system	4.4	0.63	4.0	0.71
Connecting process descriptions with working procedures	4.0	0.63	4.2	0.55

Table 27 Comparison of scores for IT capabilities

People	Score (D)	Std. Dev.	Score (V)	Std. Dev.
Assigning process owners	4.8	0.75	4.2	0.80
Availability of primary healthcare staff	4.2	1.02	3.8	0.69
Stimulating knowledge sharing	4.2	0.40	4.4	0.65

Table 28 Comparison of scores for people capabilities

Culture	Score (D)	Std. Dev.	Score (V)	Std. Dev.
Management commitment	5.0	0.49	4.5	0.52
Involvement of healthcare professionals	4.6	0.40	4.7	0.48
Intrinsically motivated improvement culture and management style	4.4	0.49	4.4	0.77

Table 29 Comparison of scores for culture capabilities

As can be gathered from these tables, there is an overall consensus between our panel of experts from the Delphi study and the experts in the validation sessions. Out of the eighteen capabilities, the validation panel rated ten capabilities somewhat lower, six capabilities somewhat higher and two capabilities with the same score. The highest deviation between the two panels was found in the four capabilities listed in Table 30. One capability shows a difference of 0.6 points and three capabilities show a difference of 0.5 points. All other capabilities show a difference lower than 0.5 points.

Factor	Capability	Score (D)	Score (V)
Strategic Alignment	Using business cases for process improvement	4.0	3.5
Governance	Governance based on process outcome indicators	4.4	3.9
People	Assigning process owners	4.8	4.2
Culture	Management commitment	5.0	4.5

Table 30 Capabilities with notable scoring differences between Delphi panel experts and validation experts

These capabilities with high differences were all rated lower by the experts from the validation sessions than by our Delphi panel. The reason for this is not exactly clear, as no additional comments were provided. However, it must be noted that in the validation session, the experts have had a much shorter time to familiarise themselves with the capabilities than the experts from the Delphi study did. Additionally, the validation workshops were presented in English. This may have presented a language barrier to our Portuguese experts. In contrast, the Delphi study with the panel of experts from Dutch hospitals was conducted entirely in Dutch.

Despite these differences in scores, we can conclude that the validation sessions support the relevance of the capabilities as determined in the Delphi study. This contributes towards answering sub question 1.6, which states “Is the hospital-specific BPM capability model valid?”. Now that we know which factors and capabilities are deemed valid, we must further build and validate the model in the following chapter. The model will be tested and evaluated by performing a measurement in one of the hospitals that was included in the study. This will help to further answer sub question 1.6 relating to the validity of the model.

9 Towards a BPM Maturity Model for Dutch Hospitals

The BPMM Maturity Model for Dutch hospitals is developed based on the results of the Delphi study, combined with results from literature on existing BPM Maturity Models and healthcare-specific quality frameworks. In this chapter, we synthesize the resulting data to construct a BPM Maturity Model for Dutch hospitals. Following the identification and validation of healthcare-specific capabilities for BPM maturity, we must select the final set of capabilities to be included in the model. We must also select the necessary maturity levels to be included in the model. Finally, the complete model is applied in a practical setting. This is done by assessing BPM maturity in one of the hospitals of which an expert was included in the Delphi study. This allows us to see if the assessment's results match the practical situation as perceived by employees in the quality management department.

The following sections describe the composition of the model in terms of capabilities and maturity levels, followed by the practical application of the model.

9.1 Capabilities

The results from the Delphi study are used as input. A bar chart is included in Figure 9 to visualise the distribution of weighted scores, as presented previously in Table 20 in the section relating to the Delphi study results. This chart shows a couple of outliers at the high end of the distribution. The experts unanimously agreed on the high importance of these capabilities, 'Management commitment', and 'Assigning process owners'. Furthermore, the chart shows certain plateaus of capabilities with similar scores. These include for example the capabilities scoring between 35 and 40 points, and capabilities scoring between 30 and 35 points. A 'drop' in scoring is seen between these plateaus. The bars in the chart are colour-coded according to the factor they belong to. This shows the higher-scoring capabilities are mostly in the Culture and People categories, followed by Governance. Capabilities within the Strategic Alignment and IT factor are dispersed throughout the middle- and low end of the chart. Methods capabilities are mostly concentrated on the low end of the chart.

Certain criteria must be taken into account when selecting capabilities relevant to the model. First, the selected capabilities must have a score that is sufficiently high to reflect a level of consensus among the panel of experts. Second, we must strike a balance between complexity and representativeness of the model. This means the total number of capabilities must not be too high, as this may provide an obstacle for organisations willing to self-assess using the model. Nor must the number of capabilities be too low, which may cause necessary capabilities for measuring maturity to be omitted. Third, the set of selected capabilities must provide a holistic view of organisational BPM maturity. That is to say, it should include capabilities from different factors. This allows the organisation to measure different areas that influence maturity, thereby allowing them to focus improvement efforts on these areas.

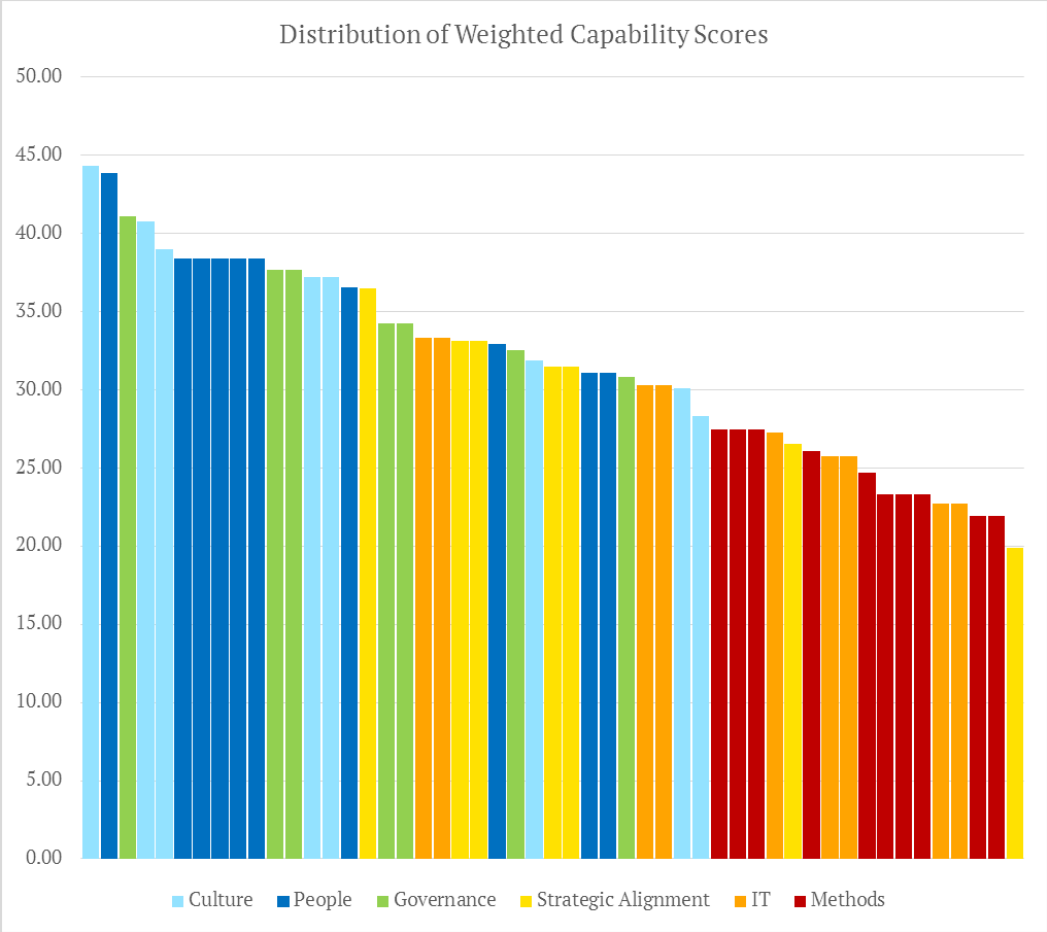

Figure 9 Distribution of weighted capability scores

Based on these criteria and opinions gathered from the expert panel, the threshold score for capabilities to include in the model was set at 30. Setting the threshold at 35 was also considered. However, this would create an imbalance in the capabilities included in the model. This would yield sixteen capabilities, of which seven are in the people category, five are in the culture category, three are in the governance category, and one is in the strategic alignment category. This would lead to the model being heavy on people and culture-related capabilities, therefore lacking the holistic nature we seek for in a BPM maturity model. Setting the threshold score at 30 yields a total of 33 capabilities to be included in the model. At this threshold, between four and ten capabilities are included in each factor apart from the Methods factor. Capabilities within the Methods factor score too low to be included at this threshold. There was insufficient consensus among the experts in regards to methods that influence BPM maturity. The experts noted that improving BPM maturity can be achieved with a variety of existing methods. This means there is no 'best' method primarily used for improving BPM maturity. Hospitals must choose a suitable method according to organisational characteristics. As a result, the proposed BPM maturity model will be method-agnostic. Due to the fact that a sufficient number and variety of capabilities is included in the model, it is assumed that omitting the Methods factor does not detract from the completeness of the model.

The experts included in the Delphi study stated that their organisations are currently at level two or three of BPM maturity (see Quick Scan in section 6.3). This resulted in some of the provided capabilities being very specific to these levels. Take for example the capability 'Setting process goals instead of department goals' or 'Specification of responsibilities and tasks at the process level'. We must generalise these capabilities in order to make them applicable to all maturity levels. The capability 'Setting process goals instead of department goals' would then be changed into 'Setting goals'. When the organisation sets goals at the department level, this capability is at level two. When it sets goals at the process level, the capability is at level three, and so on.

The capabilities are included in the proposed BPM maturity model in Table 31. The factors are sorted according to their relative importance, with factors that include higher-scoring capabilities placed higher in the model. We will establish the criteria for the maturity levels in the section hereafter.

Factor	Capability	1	2	3	4	5
People	Assigning Process Owners					
	Availability of primary healthcare staff					
	Knowledge sharing					
	Training in describing and optimising healthcare processes					
	Training in KPI-based steering					
	Using pilot projects to foster participation					
	Clarifying the importance of the individual in the process chain					
	Training in combining line management and process management					
	Flat organisational structure					
	Freedom and responsibility to internalize processes					
Culture	Management Commitment					
	Involvement of Healthcare Professionals in Process Improvement					
	Intrinsically motivated improvement culture and management style					
	Assigning a process management ambassador within management or the board					
	Creating awareness of current issues					
	Culture elements from LEAN					
	Open culture					
Governance	Specification of tasks & responsibilities					
	Use of outcome indicators					
	Setting goals					
	Governance based on soft skills (collaboration, behaviour, accountability)					
	Prioritizing process management for high-risk business goals					
	Agreeing on following process descriptions					
	Frequent evaluation of progress in process management initiatives					
	Providing insight into the value chain					

Strategic Alignment	Process Improvement Business Cases					
	Process Management Goals in organisational mission, vision and strategy					
	Patient Reported Outcome Measures (PROM)					
	Accreditation Standards (NIAZ, JCI)					
IT	Use of BI Tools / KPI dashboard					
	Securing process models in a digital quality management system					
	Connecting process descriptions with working procedures					
	EHRs for supporting the primary process					

Table 31 A BPM Maturity Model for hospitals

In the next section, the criteria belonging to the five maturity levels will be defined.

9.2 Maturity Levels

Following the establishment of the model's capabilities, we must now establish criteria for the maturity levels. The comparison of BPM Maturity Models in chapter 5.4 has shown that most models are composed out of two dimensions (or axes), with one dimension indicating the capabilities and the other dimension the levels or stages relating to these capabilities. For this reason, we propose the same general structure in this model. With some exceptions, most existing models present five distinct maturity levels. The general characteristics of the commonly found five maturity levels are described in Table 32. We must translate these levels into levels specific to our maturity model for hospitals.

In the maturity quick scan, as described in section 6.3, l it was seen that the hospitals currently found themselves at either level two or three of overall BPM maturity. Hospitals traditionally have a very strong departmentalised structure. A common challenge the experts in our panel are facing is transforming into process-driven organisations. Processes must 'break through' departmental boundaries and must be implemented at the enterprise-wide level. In literature, it is seen that each level of maturity adds additional integration of capabilities. This means going from 'siloed', departmentalised processes at the lower levels to fully integrated processes at the higher levels. The higher the level of maturity, the more insight is gained into process performance. Process-based steering also becomes possible at the higher levels. The hospitals included in this study generally find themselves in a situation where capabilities are being implemented in a limited number of departments, and the first steps are being taken to break down the walls in the departmentalised structure. This corresponds with the transition between level two and three as seen in literature.

Table 32 shows the proposed maturity levels for the hospital-specific BPM maturity model. A few changes are made in regards to the general characteristics of maturity levels found in models in literature. At level one, the capability is not implemented or only performed ad hoc. At level two, the capability is implemented in a minority of organisational units (or departments), or in less than half the departments within the entire organisation. At level three, the capability is implemented in the majority or organisational units (or departments), but not in the entire organisation. At level four, capabilities are implemented enterprise-wide. In addition, process outcomes are measured and controlled using quantitative data. At level five, the focus is on continuous improvement of processes and capabilities.

Maturity Level	General characteristics	Healthcare-specific characteristics
1	Capabilities performed ad hoc, in isolated instances, or not implemented	Capability not implemented or performed ad hoc
2	Process thinking starts to emerge. Processes are formally defined. Traditional functions are still in place.	Capability implemented in minority of organisational units
3	The organisation becomes process driven and integrated. Processes are intra-departmental and intra-organisational.	Capability implemented in majority of organisational units
4	Processes are measured, controlled and understood using (quantitative) data	Enterprise-wide (quantitative) measurement and control of capability
5	There is a focus on continuous improvement, optimisation, innovation of processes and capabilities	Continuous improvement of capability

Table 32 General characteristics of maturity levels and healthcare-specific maturity levels

Now that the capabilities and maturity levels of the model are established, the model must be applied in practice using a measurement instrument. In the next session, the model is applied in practice.

9.3 Model Application

A measurement instrument was developed in order to apply the model. The measurement instrument constitutes a straightforward representation of the capabilities found in the model. A single survey item is included for each capability, which is rated on a scale from one to five to indicate its maturity. The model may be used for self-assessment by relevant hospital staff or assisted by the model author. In this instance, one of the hospitals of which an expert was included in the Delphi study was used as the subject for the maturity assessment. The application of the model was guided by the author and assessed in an hour-long session with three employees of the quality management department. One of these employees was included in the Delphi study and was therefore familiar with the capabilities that were discussed in the three Delphi rounds.

Prior to assessing the hospital's BPM maturity using the model, the theoretical foundations, the research approach and the results of the study were presented in a 20-minute session. This was done primarily to familiarise the employees who had not partaken in the Delphi study with the contents of the model. Upon starting the assessment, the characteristics of each of the maturity levels was explained. Each capability was assessed in a group discussion among the employees. The resulting judgment of the maturity level was recorded into the measurement instrument by the researcher.

For each of the five factors, a maturity score was calculated based on the individual capability scores. Then, these factor scores were used to plot the organisation's maturity into a radar chart. This radar chart visualises the extent to which capabilities are implemented in each factor. Table 33 shows the resulting maturity scores per factor and the overall average maturity score. The entire measurement instrument with recorded results is included in Appendix VI.

Factor	Score
People	**1.67**
Culture	**1.86**
Governance	**1.50**
Strategic Alignment	**1.40**
IT	**2.63**
Overall Average	**1.81**

Table 33 Maturity scores resulting from practical application of the model in a hospital

The maturity scores presented in the table above are visualised in a radar chart in Figure 10 below.

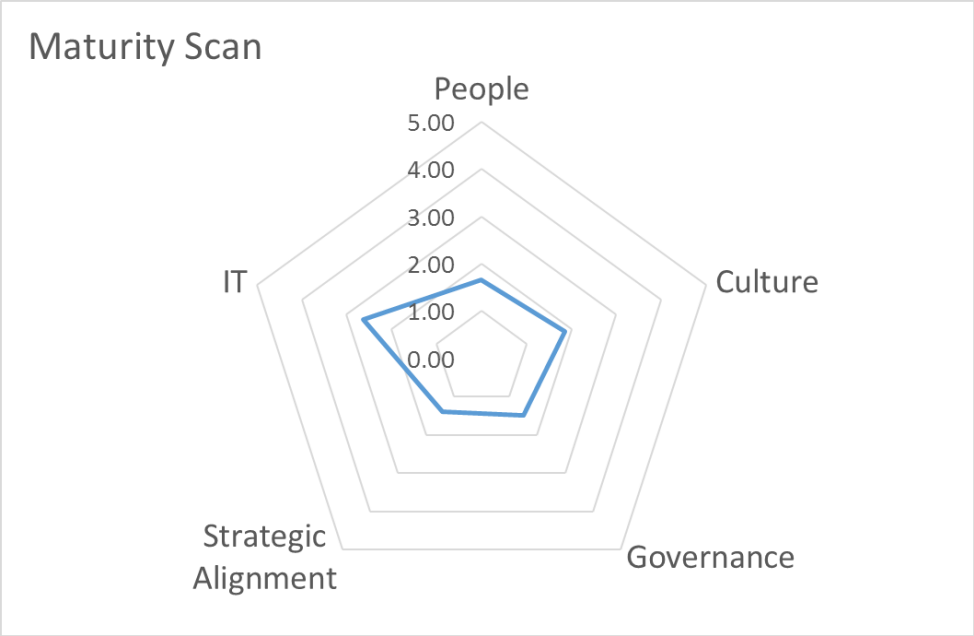

Figure 10 Radar Chart visualising the hospital's maturity across five factors

It is interesting to note that in the quick scan, which was performed prior to the first round of the Delphi study, the expert from this hospital judged the overall BPM maturity at level two. The results of the measurement come close to this result, with an overall average score of 1.81. In regards to the five factors, we see most factors scoring below 2. One factor, IT, scores markedly higher at 2.63. The employees included in this session noted that the overall result corresponds with their perception of organisational maturity.

The employees noted that the capabilities included in the model were highly relevant to their situation and provide plenty of discussion points in regards to areas for improvement. The factors that scored lowest currently provide the most obstacles for the quality management department. They also noted that it was at times difficult to judge the maturity level for a specific capability. This was due to the fact that some capabilities were implemented in a select number of departments but not in other departments, meaning that maturity differed per department. The overall organisational maturity of that capability should be judged based on how many departments have implemented it. In future applications of the model, this aspect could be further clarified by providing some examples of how a specific capability exhibits itself at different maturity levels.

In conclusion, the first application of the model shows that it is effective in assessing BPM maturity in hospitals. In the assessment session, the employees agreed with the capabilities and maturity levels provided in the model and provided suggestions for improvement. In future iterations of the model, the characteristics of the individual capabilities at each maturity level can be developed further. Prior to the assessment, clear instructions and examples must be provided so that capabilities are consistently judged from the same perspective. Opportunities for further research and improvement of the model will be discussed in the next chapter.

In Chapter 8, the capabilities of the model were validated in a session with experts from healthcare In this chapter, the model was further developed by selecting a set of relevant capabilities and adding maturity levels. The model was applied in practice and thereby further validated. This answers sub question 1.6, which states “Is the hospital-specific BPM capability model valid?”. The next chapter provides the conclusions for this study.

10 Conclusions

This study was performed in order to develop a model to facilitate the assessment and improvement of BPM maturity in Dutch hospitals. Literature shows that Hospitals in The Netherlands are part of one of the most expensive healthcare systems in the world. The population is ageing and requires more complex care. Changes in regulations have stimulated free-market competition in the industry, and the government and insurers are demanding more transparency into the quality of care. The pressure on the Dutch hospital industry is increasing due to these dynamics. Adapting to these challenges and transforming into a process-driven organisation has proven challenging for hospitals, which are traditionally department-oriented.

Business process management is a discipline that aims to support business processes. This is done through a holistic approach, which includes aspects such as people, culture, methods, information technology, governance, and strategic alignment. Improving capabilities relating to these aspects will help provide better quality products and services. . In literature, many models exist which facilitate the assessment or improvement of an organisation's business process management maturity. Such models are shown to be most effective when industry-specific capabilities are included. While many general-purpose BPM maturity models are available in literature, a healthcare-specific model was not found. Additionally, the healthcare sector is characterised by a relatively low level of maturity when compared to other sectors. In order to support the improvement of BPM maturity in Dutch hospitals and thereby contributing to the quality of healthcare, the development of a hospital-specific BPM maturity model was proposed. This was done on the basis of the following problem statement:

Problem statement: "Currently, there exists no model tailored to Dutch hospitals that facilitates the assessment, comparison and continuous improvement of their BPM capabilities."

One main research question and six sub questions were formulated to find a solution to this problem statement. The answers to these sub questions and the main research question are provided hereafter.

SQ 1.1 What defines BPM maturity?

Based on a literature review, the definition of BPM maturity was adapted from the Capability Maturity Model Integration (CMMI), which states: "The extent to which an organisation has explicitly and consistently deployed processes that are documented, managed, measured, controlled and continually improved." (Software Engineering Insititute, 2006).

SQ 1.2 What are the characteristics of BPM capability models in general?

Based on established overview papers, a selection was made of eleven well-known BPM maturity models. A meta-analysis of these models was made based on the typology of De Bruin et al. (2005). This typology encompasses the following aspects of maturity models: The model focus, development stakeholders, method of application, measurement instrument, and the dimensions of the model. Based on the meta-analysis, it was concluded that many models share a common structure. In most cases this structure includes five consecutive stages of maturity. Models present different sets of capabilities against which maturity is measured. Naming of these capabilities varies between models but the capabilities are similar in substance. The measurement instrument is usually an interview or survey.

SQ 1.3 What are the characteristics of process frameworks for hospitals?

NIAZ and JCI are commonly used process frameworks in hospital, with NIAZ being common in The Netherlands and JCI having a US and increasingly global focus. These models include aspects that focus on the results for the

patient. JCI is increasingly being used in Dutch hospitals and has a stronger focus on process improvement. Fully adhering to these frameworks implies that the BPM lifecycle is complete and the organisation should thus be at a high level of maturity.

SQ 1.4 To what extent are BPM practices performed in Dutch hospitals?

The perceived level of BPM maturity was assessed in a quick scan with six experts from practice prior to the start of the Delphi study. This scan showed that the hospitals included in this study are currently at low to medium level of maturity. The hospitals are currently working to model and improve their processes and implement business process management systems. Some of the main obstacles stated by the experts are the department-oriented organisational culture and the lack of process performance information from the IT landscape.

SQ 1.5 What are the needs for a healthcare-specific BPM capability model in Dutch hospitals?

Based on a three-round Delphi study with a panel of experts from hospitals and academia, a consensus was reached on capabilities that are most influential to BPM maturity in Dutch hospitals. The study initially yielded fifty-one capabilities across six factors. These six factors were adapted from existing BPM maturity models and provide a holistic scope. All capabilities were contributed by the panel of experts and ranked for importance. After setting a threshold on which capabilities to exclude, the final model yielded thirty-three capabilities across five factors. The model has a strong focus on people-related factors.

SQ 1.6 Is the hospital-specific BPM capability model valid?

The validity of the model was tested by presenting the six factors and a limited set of capabilities to a different panel of experts for rating. The ratings were then compared between the panel of experts from the Delphi study and the panel of experts from the validation sessions. The validation showed small differences in the ratings for factors and capabilities but presents a sufficient level of agreement between the groups. After further developing the model and adding five maturity levels, the model was applied in a practical setting in one of the hospitals that was included in the Delphi study. The result of the assessment matched the perception of the hospital's quality management staff. This shows that the model provides a representative measurement of BPM maturity in a hospital setting with capabilities deemed relevant by experts.

Main RQ: "Which healthcare-specific capabilities are required in developing a model for the assessment, comparison and continuous improvement of BPM capabilities in Dutch hospitals?"

Through literature and a panel of experts, data was collected on the possible structure and contents of a BPM maturity model for Dutch hospitals. An effective model strikes a balance between complexity and representativeness. Healthcare-specific capabilities are included in the model to ensure its relevant to the hospital industry. The final model contains thirty-three capabilities relevant to the Dutch hospital industry. These capabilities are segmented into five factors. A measurement instrument is used to assess the maturity of each capability along five maturity levels. Doing so results in an overview of the organisational maturity that highlights areas for improvement. This assessment helps to create awareness of current issues in regards to business process management and provides the starting point for future improvement. Thus, the model may contribute towards providing better quality healthcare.

This study has resulted in a scientific paper which was accepted for presentation at the 29th Bled eConference in Slovenia. The paper will be published in the conference proceedings after conclusion of the conference on June 22nd, 2016. The paper adds to the scientific body of knowledge by demonstrating how the Delphi study was used to gather healthcare-specific capabilities for a BPM maturity model. The paper is included in Appendix VII.

10.1 Limitations

This study was conducted with care and consideration, in order to ensure its validity and relevance. However, this study is not without its limitations. These are discussed in this section.

A large part of this study consisted of collecting data via a multi-round Delphi study. This method has yielded practically relevant data. However, there are several risks involved in the use of this method, as was described in the Research Methods chapter. The initial panel of experts included six experts from healthcare and one expert from academia. This was deemed to be a sufficiently sized group of experts to enable the collection of relevant data. Throughout the Delphi rounds, some experts dropped out which lead to smaller group of four experts (three from practice and one from academia) at the end of the study. This may have influenced the end result. However, it should be noted that most of the data collection was done in the first round of the Delphi study. The second and third round were more concerned with the refinement of the data that was initially collected.

The hospitals included in the Delphi study self-reported an organisational maturity level of either two or three on a scale of five. This means that the capabilities identified by the panel of experts may be biased towards capabilities that prove the most challenging at these specific levels. The current model shows a strong focus towards people- and culture oriented capabilities. Once higher levels of maturity are reached, this focus may shift to other areas/factors. Testing of the model is needed in a larger variety of hospitals with different levels of organisational maturity, in order to ascertain the relevance of the currently identified capabilities at each level.

Another possible issue is that no distinction was made between the type of hospital and the characteristics of the organisation. The effect of the hospital type (for example public, commercial, academic) or size on BPM practices is currently unknown. However, the quick maturity scan prior to the Delphi study shows that the hospitals included in the study exhibit similar levels of maturity. In the final Delphi round, the interviews with the experts further supported the notion that hospitals face similar issues in regards to process improvement, regardless of their organisational characteristics. In regards to organisational characteristics, it must be noted that the highest level of maturity may not be desirable for every organisation. Improvement of BPM capabilities requires interventions that translate into costs and efforts. For smaller organisations for example, the benefits of achieving the highest level of maturity may not outweigh the costs and efforts involved.

The validation of a selection of the model's capabilities was performed using a Portuguese panel of experts. The opportunity for validating these capabilities in Portuguese setting presented itself during a visit to the country for the purpose of presenting earlier research at a conference. Differences between the Dutch and Portuguese healthcare systems exist, but it unknown to which extent these affect BPM practices. However, the validation sessions supported the findings from the Delphi study, which indicates that experts in both healthcare systems are experiencing similar challenges.

Finally, the scope of the model is limited both in terms of its stage of development and application area. As described by de Bruin et al. (2005), a maturity model is developed through three stages: Descriptive, prescriptive, and comparative. A model's development starts in the descriptive stage. In this stage, a model is suitable for assessing (describing) the current state of maturity. However, it does not yet prescribe interventions for improving this maturity. Transforming the model into the higher phases requires widespread application in a practical setting. This was not possible within the time frame of this study. The development of the model was also limited to an application area in The Netherlands. A group of Dutch experts was used in the creation of the model. The results of the validation session with Portuguese experts support the generalizability of its capabilities to some extent. However, the limited use of the model in practice does not yet provide sufficient evidence for the generalizability of this model in either a national or international application area. The next session discusses opportunities for future research.

10.2 Future Research

This study provides various avenues for future research. The previous section mentions that the model has currently seen limited application in a practical setting. The model can be developed further through testing and research. The first opportunity for future research concerns the operationalisation of the model's constructs. Currently, the measurement instrument for the maturity model directly measures each capability using one survey item. Criteria or definitions must be developed for each of the capability's maturity levels. This would allow more precise and consistent assessment of maturity and ensure construct validity.

After the model's assessing aspects are fully operationalised, it may be possible to transform the model from a descriptive into a prescriptive model. This is the second opportunity for future research. Arriving at a prescriptive model would require the formulation of specific interventions or best practices for the factors and/or capabilities. These interventions would assist hospitals in improving their maturity. Extensive testing and research in practice is required to be able to create such a model.

Another opportunity for future research concerns the generalizability of the model. The model was developed using a small group of experts from Dutch hospitals. Further testing is needed to ensure generalizability of the model. In this regard, different possibilities exist. The model should be further tested in Dutch hospitals to further ensure its validity in this market. Collecting measurement data from a larger number and variety of Dutch hospitals may give insight into the effect of organisational characteristics (such as size, type of hospital and funding) on BPM maturity. Collecting data from hospitals at different levels of organisational maturity will also give more insight into which capabilities are most relevant at specific levels of maturity. Beyond development of the model in the Dutch market, it may be interesting to research the applicability of the model in European and international markets.

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Appendix I. Project Details

This appendix describes the details of the master thesis project in regards to the time frame and organisational structure as well as the proposed supervisors for the project. The master thesis project represents a study load of 45 ECTS. Out of the 45 ECTS, 40 are earned directly through the master thesis project. 4 ECTS are earned through the attending the mandatory twelve MBI colloquia during the graduation project. The remaining 1 ECTS was earned through completing the 'Introduction to MBI' course.

The project is performed within a fulltime position as a researcher at the research group for process innovation and information systems (PI&IS) at the HU University of Applied Sciences Utrecht (HU UAS). One of the disciplines in the group's research portfolio is Business Process Management. Professor Pascal Ravesteyn serves as the external supervisor for the project. Contacts within a number of Dutch hospitals are gathered from the research group's network.

Supervisors

The following professors have supervised this graduation project:

First Supervisor: R.S. Batenburg, PhD (Utrecht University)

Dr. Ronald Batenburg obtained his PhD in 1991 at Groningen University. After his PhD, he worked at Universities of Utrecht, Tilburg and Nijmegen as an assistant professor in organisational science, strategic policy making and HRM. Since 2000 he is an associate professor at Utrecht University within the department of Information and Computing Sciences. As of 2009, he server as the programme coordinator at the Netherlands institute for health services research (NIVEL). His research interests and publications are in the field of organisations and labour markets, specifically in relation to IT and in the healthcare sector.

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Dr. Marco Spruit is a researcher, manager and lecturer in the Business Informatics research group at the Institute of Information and Computing Sciences of Utrecht University where he lectures in Business Intelligence and Life Sciences & Health Informatics. In his Decision Analytics for Transparency (DAT) research, Marco develops Data Analytics based innovations for decision making processes using an action research approach, with the strategic goal of contributing to a better world by improving transparency in decision making processes. Marco has a PhD in linguistics relating to determinants of dialectal variation.

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Dr. Pascal Ravesteyn is professor of Process Innovation and Information Systems at HU University of Applied Sciences Utrecht, heading a research group, which explores the disciplines of Business Process Management, IT-driven business innovation and information planning. He obtained his PhD in 2011 at Utrecht University with research into the implementation of BPM systems. Pascal has a passion for the opportunities brought by IT as a driver of innovation in the control and optimization of business processes.

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Appendix II. BPM Maturity Model Descriptions

The following sections contain the descriptions of maturity models as compared in this research:

1. BPM Maturity Model (BPMMM) (Rosemann & De Bruin, 2005a, 2005b)
2. Business Process Maturity Model (BPMM-Fisher) (Fisher, 2004)
3. BPR Maturity Model (BPRMM) (Maull, Tranfield, & Maull, 2003)
4. Process and Enterprise Maturity Model (PEMM) (Hammer, 2007)
5. BPO Maturity Model (BPOMM) (McCormack et al., 2009)
6. Capability Maturity Model Integration (CMMI) (SEI, 2006)
7. Process Maturity Ladder (PML) (Harmon, 2004)
8. Business Process Maturity Model (BPMM-OMG) (Weber et al., 2008)
9. Business Process Maturity Model (BPMM-Lee) (Lee, Lee, & Kang, 2007)
10. Process Performance Index (PPI) (Rummler-Brache Group, 2004)
11. Process Management Maturity Assessment (PMMA) (Rohloff, 2009a, 2009b)

BPM Maturity Model (Rosemann & De Bruin, 2005a, 2005b)

The BPM Maturity Model by Rosemann de Bruin (2005a, 2005b) operates from the problem statement that previous models focus only on the measurement of BPM maturity in an organisation, while not accomplishing the application of the model for the betterment of BPM maturity. The BPM Maturity models by Rosemann & de Bruin is one of the few models seen in this comparison for which empirical validation was performed using two case studies. In their two papers, Rosemann & de Bruin first present BPMM Mark 1, which is largely based on existing literature. The model is the applied in different case studies and evolved into BPMM Mark 2, taking into account feedback from the organisations where it was applied. BPMM Mark 1 is shown in Figure 11 below.

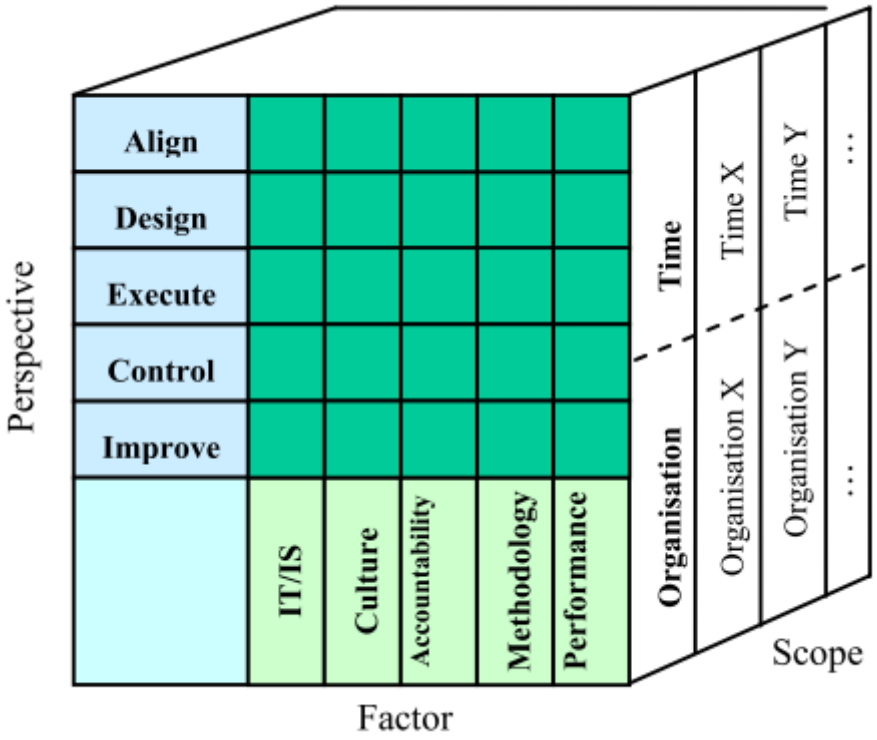


Figure 11 Mark 1 of the BPM Maturity Model by Rosemann & De Bruin (2005a)

The BPMM contains three dimensions. In the Mark 1 version, these are (1) Factors, (2) Perspectives and (3) Scope. Five factors and five perspectives make for a total of 25 measurable entities. The scope dimension is used on the one hand to create boundaries for the application of the model in terms of organisations or departments, and on the other hand to allow for longitudinal application of the model at different points in time. Each factor is measured using a set of questions that determine the maturity level in terms of coverage and proficiency. Coverage indicates the level of advancement in implementing BPM capabilities and proficiency indicates how well these are actually practiced.

The five factors are gathered from literature, while the perspectives are based on business process lifecycle models such as PDCA and DMAIC. The maturity levels that ensue as a result of applying this model have the same names as those used in the Capability Maturity Model (CMM) but differ in contents. The maturity is measured using a quantitative survey which can be both self-assessed or executed by third parties. With over 300 questions to evaluate each factor and perspective, it was challenging to prevent respondent fatigue. Rosemann & de Bruin indicate that part of the survey could be divided among people of different roles in the organisation to counter this problem.

The BPMM Mark 1 was validated by applying it in case studies in two Australian organisations in the public sector. These case studies led to feedback on the model itself that was processed for the development of BPMM Mark 2. While support for the five factors in BPMM Mark 1 was high, respondents indicated that the factors of leadership, education/training and skill sets should be included in the factor Culture. For this reason, a distinction was made between Culture and People. The People factor is more concerned with capabilities such as education and training, while the Culture factor includes the receptiveness of the organisation to process-driven thinking and process change.

The ability to apply the BPMM model longitudinally was seen as an advantage by the participants. However, a problem was found to be the non-completion of surveys due to the high number of questions. This was especially true for organisations which were at low maturity, because orientation into BPM maturity was seen as a burden. In Mark 2 of the model, the dimension of Perspectives was changed into Maturity Levels since it was found that perspectives made the survey questions repetitive and proved to be less relevant to respondents. The factors 'Accountability and 'Performance' were removed and replaced with the factors 'governance' and 'Strategic Alignment'. The coverage and proficiency level for each factor is also displayed in Mark 2 of the BPMM. The dimension scope remained the same, with the ability to apply the model at different points in time and within different divisions/organisations. Mark 2 of the BPMM is shown in Figure 12.

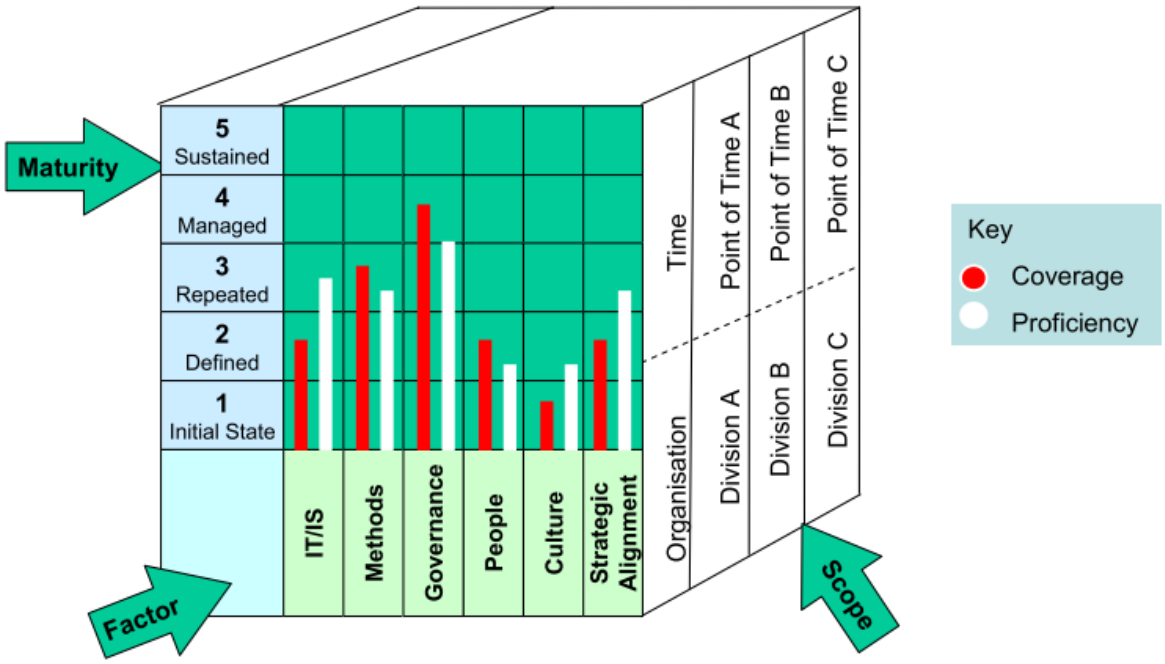


Figure 12 Mark 2 of the BPM Maturity Model by Rosemann & de Bruin (2005a)

In the Mark 2 version of Rosemann & de Bruin, the five factors are defined as follows:

1. IT/IS
2. Methods
3. Governance
4. People
5. Culture
6. Strategic Alignment

The maturity levels are defined as follows:

1. Initial state

2. Defined
3. Repeated
4. Managed
5. Sustained

The scope dimension contains the following elements:

1. Organisation
2. Time

The BPMM by Rosemann & de Bruin appears very relevant to this study, as it was developed with a thorough empirical validation through the use of case studies. This shows that the model was adapted to be more relevant to practitioners. A high level of transparency is given into the development of the model. The development process was standardised into the Maturity Assessment Model Development Framework, which includes the Delphi study for gathering consensus on BPMM contents from a panel of experts. Since this framework provided the most detailed and comprehensive account of the development of a BPMM, it was adopted for use in this study.

BPM Maturity Model (Fisher, 2004)

Fisher states that organisations usually only consider three levels of change: People, process and technology. Fisher posits that organisations should take a broader scope towards BPM maturity by also including the strategy and the controls/governance of the organisation. The five levers must be aligned (achieve a similar state of maturity) in order to gain effectiveness. The model should be used to assess the state of maturity for each level of change, after which a top-down action plan must be developed to eliminate gaps between the current state and the desired state. The goal is to come to a model that is both multi-dimensional and non-linear.

The model was developed by a consultancy firm. Little transparency is provided into the data sources or research that was performed to develop the model, as well the measurements instruments used for assessing maturity. Since the development was performed by a consultancy firm however, it is assumed that they would also take responsibility for applying the model in subject organisations. Also, the paper presents no information on the empirical validation of the model.

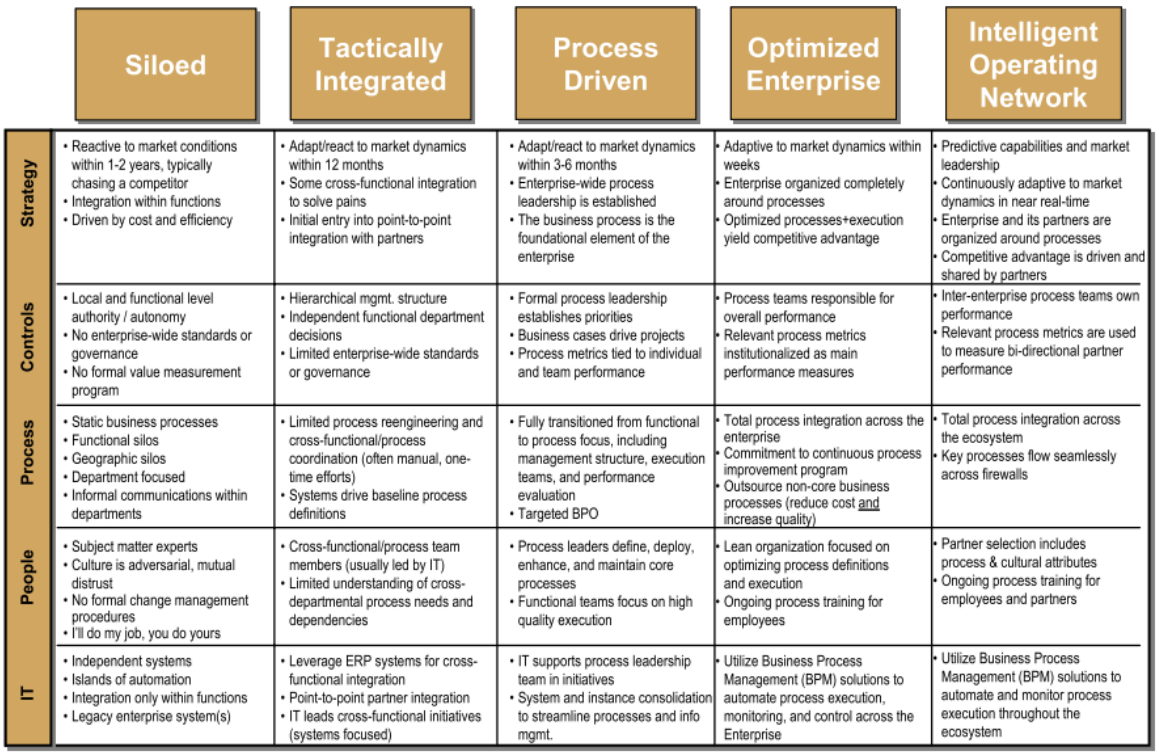
The five levers of change are defined as follows:

1. Strategy
2. Process
3. Technology
4. People
5. Controls

The five states of process maturity are defined as follows:

1. Siloed
2. Tactically Integrated
3. Process Driven
4. Optimized enterprise
5. Intelligent operating network

Each measurable entity within the model contains a number of statements reflecting the capabilities/practices of the organisation within the specific entity. The entire BPM Maturity model by Fisher (2004) is depicted in Figure 13.



	Siloed	Tactically Integrated	Process Driven	Optimized Enterprise	Intelligent Operating Network
Strategy	• Reactive to market conditions within 1-2 years, typically chasing a competitor • Integration within functions • Driven by cost and efficiency	• Adapt/react to market dynamics within 12 months • Some cross-functional integration to solve pains • Initial entry into point-to-point integration with partners	• Adapt/react to market dynamics within 3-6 months • Enterprise-wide process leadership is established • The business process is the foundational element of the enterprise	• Adaptive to market dynamics within weeks • Enterprise organized completely around processes • Optimized processes+execution yield competitive advantage	• Predictive capabilities and market leadership • Continuously adaptive to market dynamics in near real-time • Enterprise and its partners are organized around processes • Competitive advantage is driven and shared by partners
Controls	• Local and functional level authority / autonomy • No enterprise-wide standards or governance • No formal value measurement program	• Hierarchical mgmt. structure • Independent functional department decisions • Limited enterprise-wide standards or governance	• Formal process leadership establishes priorities • Business cases drive projects • Process metrics tied to individual and team performance	• Process teams responsible for overall performance • Relevant process metrics institutionalized as main performance measures	• Inter-enterprise process teams own performance • Relevant process metrics are used to measure bi-directional partner performance
Process	• Static business processes • Functional silos • Geographic silos • Department focused • Informal communications within departments	• Limited process reengineering and cross-functional/process coordination (often manual, one-time efforts) • Systems drive baseline process definitions	• Fully transitioned from functional to process focus, including management structure, execution teams, and performance evaluation • Targeted BPO	• Total process integration across the enterprise • Commitment to continuous process improvement program • Outsource non-core business processes (reduce cost and increase quality)	• Total process integration across the ecosystem • Key processes flow seamlessly across firewalls
People	• Subject matter experts • Culture is adversarial, mutual distrust • No formal change management procedures • I'll do my job, you do yours	• Cross-functional/process team members (usually led by IT) • Limited understanding of cross-departmental process needs and dependencies	• Process leaders define, deploy, enhance, and maintain core processes • Functional teams focus on high quality execution	• Lean organization focused on optimizing process definitions and execution • Ongoing process training for employees	• Partner selection includes process & cultural attributes • Ongoing process training for employees and partners
IT	• Independent systems • Islands of automation • Integration only within functions • Legacy enterprise system(s)	• Leverage ERP systems for cross-functional integration • Point-to-point partner integration • IT leads cross-functional initiatives (systems focused)	• IT supports process leadership team in initiatives • System and instance consolidation to streamline processes and info mgmt.	• Utilize Business Process Management (BPM) solutions to automate process execution, monitoring, and control across the Enterprise	• Utilize Business Process Management (BPM) solutions to automate and monitor process execution throughout the ecosystem

Figure 13 The BPM Maturity Model by Fisher (2004)

BPR Maturity Model (Maull et al., 2003)

The BPR Maturity Model (BPRMM) distils five themes from literature which are considered to be central in business process reengineering efforts:

1. Strategic Approach
2. Performance Measurement
3. Business Process Architecture
4. Human and Organisational Factors
5. Information Technology

These five themes are then elaborated into ten 'dimensions', which represent factors necessary in successful Business Process Reengineering projects. Instead of giving a unique label to each dimension, the dimensions all have specific maturity levels. For example, there are two dimensions named 'Strategy'. However, the first strategy dimension is measured in terms of organisational involvement, ranging from localised involvement within a single organisational department or broad involvement spanning across the entire organisation. The second strategy dimension is concerned with whether the strategy is 'single point' or 'dual point', meaning that a single point strategy only incorporates external requirements while a dual point strategy also considers internal competencies and capabilities.

The ten dimensions are defined as follows:

1. Strategy: The extent of organisational involvement.
2. Strategy: Focus on solely external requirements or both external requirements & internal capabilities
3. Performance measures: The extent of integration of BPR measures into organisational critical success factors.

4. Cost focus: The extent of focus on cost reduction.
5. Service improvement: The extent of focus on improving customer service.
6. Process Architecture: The extent of process architecture definition and deployment.
7. Process architecture: The extent of coverage of the organisation by the process architecture.
8. Structural reconfiguration: The extent of reconfiguring the company's structure.
9. Cultural change: The extent of changing the company's culture.

The ten dimensions contained within their respective themes, and the measurement levels for each dimension are depicted in Table 34.

Theme	**Dimension**	**Position 1**	**Position 5**
Strategic Approach	Strategy	Localised Involvement	Broad Involvement
	Strategy	Single point	Dual point
Performance Measurement	Performance measures	Localised	Strategic
	Cost focus	Little focus on cost reduction	Strong focus on cost reduction
	Service improvement	Little service focus	Strong service focus
Business Process Architecture	Process Architecture	None	Widely deployed
	Process Architecture	Isolated unit	Systemic
Human & Organisational Factors	Structural Reconfiguration	Sustain existing	Change existing
	Cultural Change	Sustain existing	Change existing
IT	Effect of IT	Did not enable	Enabler

Table 34 Dimensions and measurement levels for the ten BPR dimensions (Maull et al., 2003)

Besides the individual measurement levels for each dimension, the organisation's overall Business Process Reengineering Maturity level is defined according to five positions:

1. "Still thinking", the organisation has not yet carried out BPR activities.
2. The organisation has carried out some BPR activities.
3. The organisation has recently finished a BPR programme.
4. The organisation has finished a BPR programme and is capturing the knowledge gained.
5. The organisation is using the knowledge gained from a BPR programme to reengineer the business.

The factors (dimensions) used in this model are gained from literature and are validated using 33 small case studies. These case studies also served to perform a factor analysis on the companies studied in terms of dimensions that get the most focus during BPR projects. The researchers were able to group the companies into three categories based on this factor analysis, thereby providing a typology of BPR focus: (1) Service delivery improvement BPR, (2) Process-centric BPR and (3) Cost reduction BPR. It is interesting to note that the purpose of BPR projects is not necessarily the improvement of all factors, but may indeed be focussed on a specific set of factors that best serve the organisation's strategy or market position.

The maturity of the organisations studies was measured by locating their position for each statement on a five-point scale. This was done by conducting an interview with the individual or team having the responsibility for the BPR project. Based on the relatively large number of case studies, the researchers were able to accurately compare maturity positions between organisations and check them for consistency. In one case, a company's position was reclassified by two points, while in five cases a minor reclassification was made of one scale point. This amounted to less than two percent of the total data collected, signifying that the instrument is accurate in measuring BPR maturity across organisations.

Process and Enterprise Maturity Model (Hammer, 2007)

The Process and Enterprise Maturity model bases its design on two groups of factors, the process enablers and the enterprise capabilities. The process enablers determine how well a process functions, while the enterprise capabilities offer a supportive environment. This design decision stems from the author's proposition that organisations usually fail to transform because new processes are overlaid on the existing functional organisation. In order to achieve transformation, responsibilities must be re-assigned based on the process. In addition, organisational culture must adapt to increased teamwork and accountability.

The author states that the process enablers are interdependent and cannot function without one another. The process enabler of lowest strength is the weakest link and determines the overall maturity of the process enabler. Additionally, it is said that process enablers cannot be institutionalised unless the enterprise capabilities that support the processes are in place. PEMM is said to be different than other frameworks because it applies to all industries and all processes. Its development involved several large companies which used it to assess their process transformations.

The five process enablers are defined as follows, with sub-factors for each process enabler:

1. Design: The specification of the desired process execution.
    a. Purpose
    b. Context
    c. Documentation
2. Performers: Adequately skilled and knowledgeable people performing the process.
    a. Knowledge
    b. Skills
    c. Behaviour
3. Owner: A process owner responsible for its results.
    a. Identity
    b. Activities
    c. Authority
4. Infrastructure: Process-supporting information and management systems.
    a. Information Systems
    b. Human Resource Systems
5. Metrics: Measures used to track performance
    a. Definition
    b. Uses

Besides the process enablers, four enterprise capabilities are defined with a number of sub-factors:

1. Leadership: Support for the creation of processes
    a. Awareness
    b. Alignment
    c. Behaviour
    d. Style

2. Culture: Values of customer focus, teamwork, personal accountability and willingness to change.
    a. Teamwork
    b. Customer Focus
    c. Responsibility
    d. Attitude Toward Change
3. Expertise: Skills and methodology for process redesign
    a. People
    b. Methodology
4. Governance: Management of change initiatives
    a. Process Model
    b. Accountability
    c. Integration

The PEMM is self-assessed using a survey. For each sub-factor within the enterprise capabilities and process enablers, propositions are given pertaining to each of its respective levels of strength. These levels range from one to four. The respondent then indicates if this statement is largely true, somewhat true or largely untrue. The authors state that this increases the simplicity of the measurement instruments, thereby avoiding the need for consultants. The entire measurement instrument is provided by the author, providing insights into all the propositions belonging to specific levels of strength for each factor. In contrast to other models, this model does not attempt to calculate an overall level of organisational BPM maturity. Instead, it provides an assessment of individual processes, by applying the model to each distinct process. This allows the organisation to see which processes are in most need of transformation while providing focus on the specific areas of improvement.

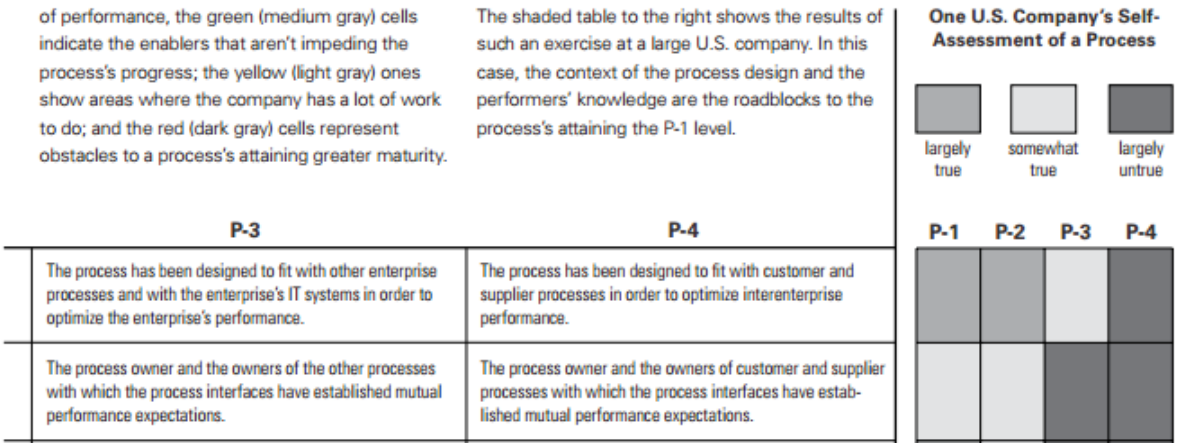


Figure 14 Fragment of the PEMM measurement instrument (Hammer, 2007)

BPO Maturity Model (Lockamy & McCormack, 2004; McCormack et al., 2009)

The Business Process Orientation Maturity Model (BPOMM) by McCormack et al. is a statistics-based model that uses data from BPM capability assessments to determine stabilizing factors in BPM maturity. The goal of this model is to provide a step-by-step description, or road map, of key turning points in the journey towards BPM maturity. In terms of stabilization, it is posited that certain BPM factors must be present within an organisation before other factors can be developed. This is represented in the form of a mountain where the lowest level of maturity is represented by the valley and the highest level of maturity is represented by the summit of the mountain. The journey upwards is anchored by 'base camps' which must be reached in order to progress further. This represents the maturity plateaus commonly seen in maturity models.

The factors identified in this model are the so called 'BPO components', the first three of which are considered the basic or key components, and the last two are supporting components.

1. Process view: Documentation and understanding of the process and related steps, activities and tasks.
2. Process jobs: Ownership of the process with horizontal instead of vertical responsibilities.
3. Process measurement and management systems: Systems for measurement (customer-driven and (team-driven) and rewards for process improvement.
4. Process structure: A structure of enterprise-wide horizontal thinking, which breaks down traditional functional silos.
5. Process values and beliefs: Commitment to continuous process improvement expressed in organisational values and beliefs.

The maturity is expressed in five stages:

1. Ad Hoc
2. Defined
3. Linked
4. Integrated
5. Extended.

The BPO Maturity Model depicted in Figure 15 shows a description of each stage in terms of achieved capabilities. This model is strongly linked to the discipline of Supply Chain Management, and therefore focuses more on the development of an inter-company, extended network than other maturity models observed in this study. This is reflected in the descriptions, which mention 'multi-firm networks' and cooperation of vendors and suppliers. This model shows a high level of empirical validation, as it was based on actual assessment data. As is commonly seen in other models, it uses a survey with five-point scales to assess the maturity of an organisation.

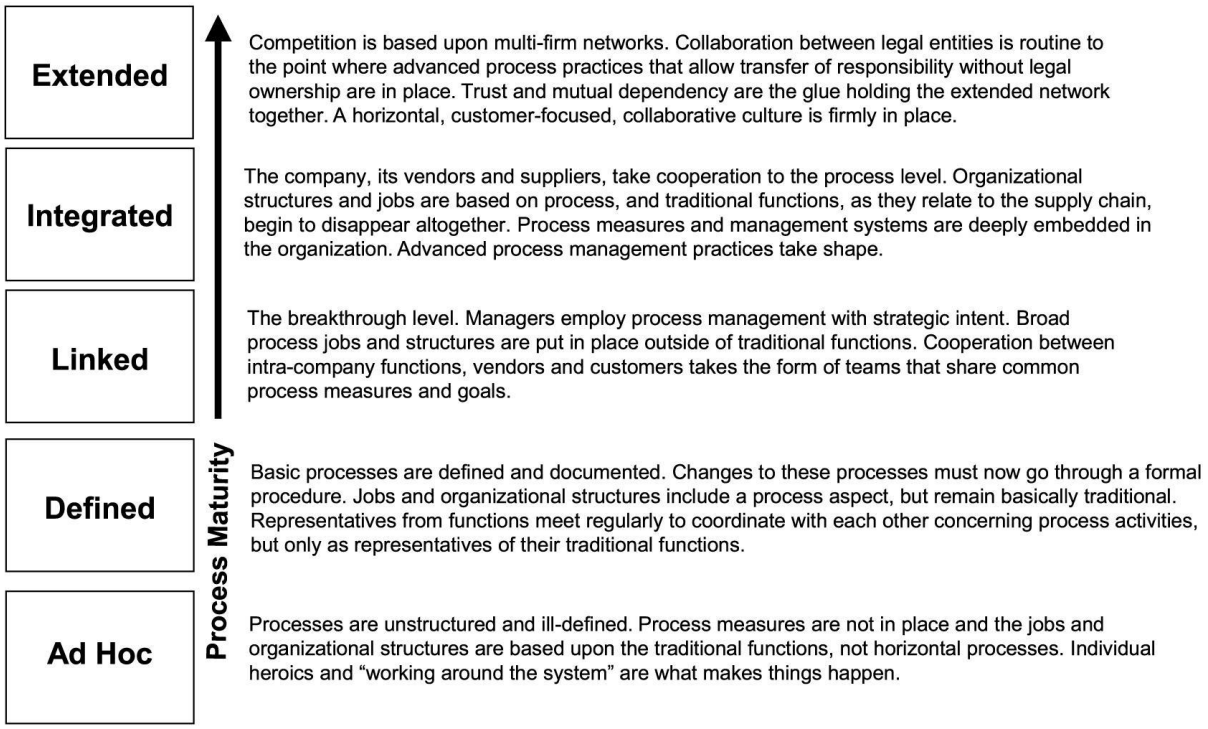


Figure 15 The BPO Maturity Model (Lockamy & McCormack, 2004)

Capability Maturity Model Integration for Services (SEI, 2010)

The Capability Maturity Model Integration (CMMI) was developed to integrate existing Capability Maturity Models (CMMs) in different sectors. While CMM originated in the software engineering discipline, the three currently existing integrated CMMs are for product and service development (CMMI for development), Service establishment and management (CMMI for services) and product and service acquisition (CMMI for acquisition). These models can be used for all sorts of organisations. In this section, we will specifically consider the CMMI for Services, because this version of CMMI is more closely related to the service-oriented nature of a hospital compared to CMMIs for development or acquisition.

CMMI is one of few models that features two distinct representations. The staged representation is used as a traditional approach to maturity, featuring five maturity levels used to assess the organisation using twenty-four process areas. Each process area is featured in only one of the maturity levels. As higher maturity levels are reached, more process areas must be implemented. The initial maturity level (Level one, or the initial level) contains no process areas as processes are considered to be poorly structured and uncontrolled at this level. Maturity level two (managed) introduces eight process areas, level three (defined) introduces twelve process areas and level four and five each introduce two process areas (quantitatively managed and optimizing, respectively).

The process areas are categorised into process management, project & work management, service establishment & delivery and support categories. In the staged representation of CMMI for services, maturity is measured across the entire organisation. Therefore, all process areas belonging to a certain maturity level must be developed in order to advance through the levels. However, in the continuous view of CMMI for services, an organisation selects one or more categories of process areas which it wants to (continuously) improve. In the continuous representation, the process areas are measured according to four capability levels (incomplete, performed, managed and defined), while in the stages representation, the organisational maturity is measured on a scale of five levels. The maturity levels are defined according to five cumulative phases: Initial, Managed, Defined, Quantitatively Managed and Optimizing. The maturity levels are defined as follows (Software Engineering Insititute, 2010):

1. Initial: Process are ad hoc and chaotic, there is no stable environment to support processes. Some isolated cases of process improvement may take place (heroics), but the organisation is unable to repeat successes.
2. Managed: Projects are managed more effectively, using adequately skilled employees, documentation and stakeholder involvement. Policies are in place according to which the projects are planned and executed, even in times of stress.
3. Defined: There exists a set of standard organisational processes which are improved over time. These standard processes form a starting point from which project-specific processes are tailored to their specific requirements. The organisation makes use of standards, process descriptions and procedures to support these processes.
4. Quantitatively Managed: Quantitative objectives for performance are specified at the organisational level and used to manage processes. Process performance data is statistically analysed to gain insight and support decision making. The main achievement in this maturity level is that process become quantitatively predictable.
5. Optimizing: Process performance is continuously improved, by revising processes according to changing business objectives. The effectivity of performance improvements is measured against performance goals.

Because we aim to develop a maturity level for hospitals at the enterprise level, we will consider the staged representation of CMMI for services specifically. This representation includes all process areas, spread across five maturity levels. The process areas and the maturity levels and categories they belong to are defined in Table 35.

Maturity Level	**Process Area**	**Category**
2	Configuration Management	Support
	Measurement & Analysis	
	Process & Product Quality Assurance	
	Requirements Management	Project & Work Management
	Supplier Agreement Management	
	Work Monitoring and Control	
	Work Planning	
	Service Delivery	Service Establishment & Delivery
3	Decision and Analysis Resolution	Support
	Incident Resolution and Prevention	Service Establishment & Delivery
	Service System Development	
	Service System Transition	
	Strategic Service Management	
	Integrated Work Management	Project & Work Management
	Capacity and Availability Management	

	Risk Management	
	Service Continuity	
	Organisational Process Definition	Process Management
	Organisational Process Focus	
	Organisational Training	
4	Organisational Process Performance	Process Management
	Quantitative Work Management	Project & Work Management
5	Causal Analysis and Resolution	Support
	Organisational Performance Management	Process Management

Table 35 Process areas and their categories for each maturity level in the CMMI for Services (SEI, 2010)

As can be seen in the table, the maturity level 2 (managed) contains more process areas in the support category than any of the other levels. Also, the process management category is not introduced until maturity level 3 (defined). This shows that certain 'basic' process areas must first be in place before the organisation can start managing processes. First through process definition, and then through organisation-wide process performance management in the higher maturity levels.

CMMI uses a specific assessment method, also named an appraisal method, for measuring organisational maturity. The Standard CMMI Appraisal Method for Process Improvement (SCAMPI) features three classes, A, B and C, with class A being the most rigorous appraisal class which is required for achieving an official rating. Appraisals are performed by qualified external teams using on-site visitations. Companies can also self-assess using CMMI for an informal quick scan rating. Compared to other models in this chapter, the CMMI is an expansive model with a long history of development. Beyond measuring maturity levels, a wide variety of training materials and methods are offered in order to guide organisations onto higher maturity levels. In this regard it goes much further than many other models that are mostly focused on assessment but do not provide comprehensive materials for improving organisations.

Process Maturity Ladder (PML) (Harmon, 2004)

The Process Maturity Ladder (PML) by Harmon (2004) is based on and uses the terminology of the Capability Maturity Model Integration (CMMI). While CMMI is a very formal method requiring extensive appraisal sessions, the PML offers an informal approach for the purpose of quickly evaluating BPM maturity and creating opportunities for discussion. The author states that more formal evaluations and process improvement initiatives should be guided by CMMI. The process of evaluating an organisation takes one to two weeks. Evaluation is performed by asking managers to fill out a survey beforehand, and then gathering further information through an on-site visit. The measurement instrument (the survey) is not publicly available and little information on its content can be found.

PML uses the same terminology for maturity levels as does the staged representation of CMMI. Within the staged approach, it is assumed that all capabilities of an organisation fall within one predefined maturity level. The author stresses that while this approach leads to a more 'dramatic' representation of BPM maturity, it does not capture the complexities of varying maturity levels between processes. Especially in large organisations, the author posits, more variance is seen between different organisational groups or units. PML allows the measurement of maturity on the process level, with individual maturity levels established for each process. Figure

16 shows a fragment of the PML measurement instrument, in which different maturity levels for processes are recorded.

Organization Audit Worksheet

Organization: *XYZ Company's Widget Sales Group*

Process	Maturity/Notes
Lead Gathering Process	*Level 1 - Undefined*
Initial Contact Process	*Level 2.5 - Not completely defined; Some measures and a management.*
Sales Call Process	*Level 3.5 - Defined in detail Well measured. Management vertically integrated.*

Figure 16 A fragment of the PML measurement instrument

PML attempts to expand upon the maturity level definitions as defined by CMM by introducing some practical tools or methods for each level beyond the first (initial) level. In the initial level, no processes are defined. An organisation climbs to the second level (repeatable) by defining at least some of their processes. Since the maturity level definitions are the same as used in CMMI, we refer to section to that section for the full definitions. The additions to these maturity levels as defined by PML are as follows:

1. Level 1 – Initial: Processes are performed ad-hoc.
2. Level 2 – Repeatable: The organisation uses modelling tools and notation systems to define at least some of its business processes
3. Level 3 – Defined: The organisation has a complete and integrated definition of is processes and has established some measures for managing and controlling these processes. The organisation stores and maintains its processes in a repository
4. Level 4 – Managed: The measures for managing and controlling processes are complete and integrated. There exists alignment between the management and measures of a process and its sub processes. As a practical tool, the author recommends using the Supply Chain Reference Model (SCOR) (Stewart, 1997) to examine supply chain processes. SCOR gives insight into the three highest-level layers of the supply chain, including the overall scope of the supply chain, the different configurations within the supply chain (such as build to stock and build to order) and the key business activities (such as production, packaging and testing).
5. Level 5 – Optimizing: PML posits that a Six Sigma program should be present in the organisation in combination with a green belt or black belt team. The six sigma efforts help to improve processes further.

The Process Maturity Ladder is an informal method for evaluating BPM Maturity that adds some practical methods to the maturity levels of the CMMI stages approach. It is used to assess individual processes on the five-level maturity scale, but does not define detailed organisational capabilities. Beyond stating the use of a survey and

management interviews, not much transparency is given into the measurement instrument and evaluation method.

Business Process Maturity Model (BPMM-OMG) (Weber et al., 2008)

The Business Process Maturity Model specified by the Object Management Group (OMG) has a long development history and is probably one of the most extensively documented models along with CMMI. BPMM-OMG is based on the Service Operations CMM, which was co-developed by NedBank and TeraQuest Metrics in 2002 in order to apply the advantages of the existing CMM for software in other organisational units not related to software development. The Service Operations CMM was intended to be released to the public and was the basis for the development of the BPMM. The authors argue that a standardised BPMM is needed because enterprise system implementations often fail and large sums of money are wasted. This is not only due to technology, but also the mismatch between the implementation and the state of the organisation. Weaknesses in business processes must first be solved for an organisation to be able to sustain mature process management capabilities.

BPMM has a general focus, meaning that it can be used both for organisations that develop products and deliver services. Also, the model is explicitly meant not only for assessing BPM maturity, but also for guiding process improvement. This is done by linking a set of best practices to each process area, which describe *what* should be done, but not *how* this should be done. This allows organisations to select their own methods and approaches for performing these practices. In addition, the authors posit that BPMM can be used for benchmarking and assessing suitability of suppliers.

As is the case with CMM, the BPMM provides five maturity levels, each with a specific set of process areas. The process areas are unique to each maturity level and serve as the foundation upon which a next maturity level is built. Several attributes pertaining to each process area are measured to determine the extent to which it contributes to organisational objectives. The authors state that the BPMM can be mapped to CMMI, but BPMM introduces more extensive guidance for process improvement. The maturity levels of BPMM are defined as follows (Weber et al., 2008):

1. Initial: Processes are performed inconsistently and in an ad hoc manner. Results are difficult to predict (inconsistent management)
2. Managed: Processes are stabilised within work units so that they may be performed in a repeatable manner. Similar processes in different work units may not be standardised across the organisation. (work unit management)
3. Standardised: Standardised processes are synthesized from best practices found in the work units. Processes are used for learning and gaining experience organisation-wide. (process management)
4. Predictable: Process performance is measured statistically, allowing for the identification of process variance and enabling the prediction of process outcomes. Standard processes are in place. (capability management)
5. Innovating: The organisation seeks innovation proactively and opportunistically in order to develop capabilities required for achieving its business objectives. (change management)

Next to the definition of each maturity level, the management focus for that level is defined. Here, we can see that the organisation moves from managing processes within work units, to managing processes at the organisational level. In addition, at the higher level the organisation focuses more on managing capabilities that result from the use of standard processes and changes that result from improvement. In Table 36 below, the process areas belonging to each maturity level are specified. The initial maturity level does not contain process area and is therefore not included in the table.

Maturity Level	Process Area
2	Organisational Process Leadership
	Organisational Business Governance
	Work Unit Requirements Management
	Work Unit Planning and Commitment
	Work Unit Monitoring and Control
	Work Unit Performance
	Sourcing Management
	Process and Product Assurance
3	Organisational Process Management
	Organisational Competency Development
	Organisational Resource Management
	Organisational Configuration Management
	Product and Service Business Management
	Product and Service Work Management
	Product and Service Preparation
	Product and Service Deployment
	Product and Service Operations
	Product and Service Support
4	Organisational Common Asset Management
	Organisational Capability and Performance Management
	Product and Service Process Integration
	Quantitative Product and Service Management
	Quantitative Process Management
5	Organisational Improvement Planning
	Organisational Performance Alignment
	Defect and Problem Prevention
	Continuous Capability Improvement

	Organisational Innovative Improvement
	Organisational Improvement Deployment

Table 36 Process areas and their related maturity levels according to BPMM-OMG (Weber et al., 2008)

As can be deducted from the table, BPMM represents 29 distinct process areas. The process areas again reflect the focus on work units in the lower levels and the focus on organisational capabilities in the higher levels. Similarities between CMMI and BPMM are again seen in these process areas.

BPMM does not provide a survey or other type of self-assessed measurement instrument. Like CMMI, it presents different classes of appraisals with varying degrees of formality. The appraisals are executed by trained teams. BPMM specifically states which forms of evidence are used to assess conformance of the organisation to the defined process areas. This includes the review of artefacts that support processes as well as artefacts that are the result of processes. Furthermore, interviews are held with people performing a process, overseeing the performance of a process and supporting the performance of a process. Lastly, quantitative data is collected that reflects the state of the organisation in terms of attitudes and behaviours, as well as quantitative data relating to the performance and outcomes of processes. The following four appraisal classes are defined by BPMM (Weber et al., 2008) :

1. Starter Appraisal: An appraisal with a duration of a few days that provides a quick overview of BPMM conformance. Evidence is collected but not reviewed in-depth.
2. Progress Appraisal: A more substantial appraisal that includes all process areas, in order to establish the maturity level of the organisation. This appraisal class may also be used as a preparation for the most extensive appraisal class, the confirmatory appraisal.
3. Supplier Appraisal: This appraisal class is specifically geared towards evaluating external organisations such as suppliers. The internal organisation is not involved in this appraisal class. Instead, the appraisal team collects quantitative data relating to the external party in order to verify their process maturity. This data may be used to substantiate contractual commitments.
4. Confirmatory Appraisal: All types of evidence are collected and thoroughly reviewed. This is done in different parts in the organisation. All process areas within a specific maturity level and its underlying maturity levels are evaluated and must be fully satisfied in order to officially establish maturity.

As is the case with CMMI, the BPMM-OMG provides very extensive documentation on the capabilities (process areas) required for BPM maturity improvement. However, the formality of its measurement method makes it difficult for organisations to self-assess and apply to model in practice.

Business Process Maturity Model (BPMM-Lee) (Lee et al., 2007)

The aim of the Business Process Maturity Model by Lee et al. (2007) is to provide a practical approach to assessing business process maturity. This is achieved by taking the CMM/CMMI framework as a basis and mapping process areas onto IMCO framework (Input, Measurement, Control and Output). Surveys conducted among practitioners are used as additional input in shaping the BPMM. Lee et al. posit that existing BPM maturity models found at the time of conducting their research were insufficiently matched to business processes found in practice. For example, they deem the CMMI/CMMI model too oriented towards software-producing organisations (even though different sector-oriented CMMs exist). They also consider the maturity models by Fisher (2004) and Harmon (2004) too abstract to apply in practice and not sufficiently focused on business practicalities. The model by Rosemann & de Bruin (2005a, 2005b) is considered 'unorganized and complex' due to its three dimensional structure, despite it also being grounded in practice through the use of case studies and surveys.

As described earlier, the structure of the BPM maturity model by Lee et al. is based on the CMMI. It therefore contains the following five maturity levels. Lee et al. define a focus for each maturity level, with the lower levels

focussing on the process management of individual work units, which integrate as the levels progress, leading to organisation standardisation and proactive improvement at the higher levels. Table 37 specifies each maturity level and focus area.

Maturity Level	Focus
1. Initial	Ad-hoc
2. Managed	Work unit process management
3. Defined	Organisational Process Standardisation
4. Quantitatively Managed	Quantitative Management
5. Optimizing	Proactive Process Improvement

Table 37 The maturity level and related focus areas for the BPMM by Lee et al. (2007)

Lee et al. define the different maturity levels by looking at their characteristics in terms of the focus of key process areas (KPAs), Measurement & analysis, Control and Influence on Process Improvement. For each level, these characteristics are defined as specified in Table 38 below. The 'Initial' maturity level is not included because processes are considered to be performed mostly ad-hoc at this level, meaning that the characteristics do not apply.

	Managed	Defined	Quantitatively Managed	Optimizing
Focus of KPAs	Work unit (product focus)	Organisation-wide (product focus)	Organisation-wide (product & process focus)	Organisation-wide (competitive advantage focus)
Measurement & Analysis	Black-box with control points	Grey-box (all process areas)	White-box (statistically analysed)	White-box (statistical predictability
Control	Reactive	Reactive/Adaptive	Adaptive/Proactive	Proactive
Influence on Process Improvement	Partially Controlled	Controlled	Partially Systematic	Systematic

Table 38 Characteristics of BPM maturity levels as defined by Lee et al. (2007)

The characteristics mentioned in this table show that as maturity increases, both monitoring and controlling processes moves from an ad-hoc manner to a structured, systematic manner. In the uppermost level, the loop is closed, meaning that monitoring information is used directly in controlling the processes. As the maturity levels progress, insight into processes improves, which is reflected by moving from a black box structure to a white box structure.

As is the case with CMMI, Lee et al. define a set of cumulative key process areas that emerge at specific maturity levels. Whereas CMMI uses four process area categories into which each process area is divided, the process areas of the model by Lee et al. are categorised according to the areas of the IMCO framework. The process areas are said to be elicited using surveys that were answered by twelve professionals from four different sectors. However, the exact method for eliciting these process areas is unknown. Lee et al. state that the survey contributed to the

addition of process areas relating to leadership, customer relationship management, common asset management and adaptability management. Besides this, some overlap with process areas from CMMI is evident. Whereas CMMI defines specific types of models either for development, services or acquisition, it appears that Lee et al. attempt to incorporate these types by specifying process areas that pertain to both products and services.

Maturity Level	**Process Area**	**IMCO Area**
2	Organisational Process Improvement Leadership	Input
	Product/Service Requirements Management	
	Planning	
	Configuration Management	
	Resource Management	
	Product/Service Investment Management	
	Supplier Agreement Management	
	Quality Assurance	Control
	Measurement & Analysis	
	Monitoring & Control	
3	Organisational Process Definition	Mechanism
	Organisational Collaboration Management	
	Organisational Common Asset Management	
	Product & Service Development	
	Organisational Process Management	Control
	Product & Service Management	
	Product & Service Provision	Output
	Customer Relationship Management	
4	Integrated Organisational Process Management	Control
	Quantitative Process Management	
	Quantitative Product & Service Management	
5	Causal analysis & resolution	Control
	Organisational Adaptability Improvement	
	Organisational Process Innovation & Deployment	Mechanism

Table 39 Process areas and their related maturity levels and IMCO areas in the BPMM by Lee et al. (2007)

It is shown that the process areas are mapped to the four areas of the IMCO framework (Input, Mechanism, Control, Output). The input area is concerned with managing and providing incoming materials, money, acquisitions, etc. This area encompasses processes performed early in the organisational value chain. The mechanism quadrant is used to produce or develop inputs into the product or service, using certain tools or man hours. Within the control quadrant, processes are monitored and analysed statistically. Finally, the output quadrant is concerned with delivery and maintenance of the product or service.

As can be seen in the table above, maturity level 2 (the managed level) does not yet include process areas belonging to the mechanism category. Lee et al. posit that this is because the necessary organisational process areas cannot yet be present. They first appear in level 3, the defined level. As is the case with CMMI for services, the managed level ensures that certain basic process areas are in place before more management and controlling is performed at the organisational level.

While Lee et al. provide a detailed argumentation of the development of their model, not much is known about how to administer the model in an organisation. The authors provide no information on the type of instrument used for measurement. At the time of writing, they indicate that the model was validated using a number of surveys and that they are planning to apply the model in organisations. No further literature was found that documents these efforts. As it stands, the model provides information regarding process areas that should be present at specific maturity levels, but the methods for assessing and improving process areas and organisational capabilities remain unclear.

Process Performance Index (PPI) (Rummler-Brache Group, 2004)

In their paper 'Business Process Management in U.S. firms today, the Rummler-Brache Group presents a measurement instrument for assessing the capability levels of organisations in terms of process management maturity. The goal of this instrument is to assess issues and opportunities relating to process management in the United States. For this purpose, thirty-two organisations, large and small, were surveyed across a variety of sectors. Besides identifying these issues and opportunities, the authors attempt to identify differences between industries.

The presented instrument is relatively simple, as it contains ten 'key success factors', each of which are measured using a single five-point Likert scale. They ten key success factors are defined as follows (Rummler-Brache Group, 2004):

1. Alignment with strategy: The linking of processes to organisational strategy and critical success factors.
2. Holistic approach: Enterprise-wide processes are considered when improving processes.
3. Process awareness by management & employees: The role of process management in process improvement is understood by relevant stakeholders in the organisation.
4. Portfolio of process management initiatives: Current issues relating to specific processes are understood and process improvement initiatives are linked to these issues.
5. Process improvement methodology: A standard approach is used to analyse and design processes.
6. Process metrics: There exist process measures at the individual, process and enterprise levels.
7. Customer focus: Customer value delivery is the main focus when analysing and designing processes.
8. Process management: Processes are monitored and continually improved by process owners.
9. Information systems: The process is leading in the information systems architecture.
10. Change management: Cultural and people-related issues that arise as a result of process changes are effectively addressed.

Organisations using the instrument self-assess the extent to which they agree each factor is present, on a level of one (strongly disagree) to five (strongly agree). The sum of all individual factor scores leads to an overall maturity score which falls between ten and fifty. The authors specify three distinct maturity stages based on the overall maturity score. These maturity stages are defined in Table 40 below.

Maturity Stage	Overall score	Definition
1. Process Management Initiation	10 to 25	Organisations in this stage are new to process management and have no or very few processes defined.
2. Process Management Evolution	26 to 40	The organisation is process-aware and performs structured process improvement programmes. Process owners have usually been established. In upper ranges of this stage, organisations have defined and make use of performance metrics.
3. Process Management Mastery	41 to 50	Process performance metrics are widely used throughout the organisation and process owners are rewarded based on their process performance. All stakeholders (management and employees) understand how their processes deliver value to the customer. Process management is fully integrated into performance evaluation and organisational planning.

Table 40 Maturity stages defined in the Process Performance Index by the Rummler-Brache Group (2004)

Based on their research among thirty-two organisations, the authors find that all respondents fall within the middle maturity stage of process management evolution. The average overall score was 30.8, which implies that the organisations as a whole exhibit a level of process management maturity that is almost exactly in the centre of the scale. Some differences are observed between industries. For example, the insurance industry and professional services industry ranked above average with overall scores of 38 and 36.5 respectively. The financial services industry and energy industry underperformed when compared to the average, with scores of 27.0 and 26.7 respectively. The authors do not elaborate further on the reasons for these differences existing. Furthermore, it must be taken into account that the sample size used in this study for a specific industry is rather small. Respondents from the energy sector made up only 9% of the total panel of respondents, for example.

An additional open-ended survey was used to identify current opportunities and issues relating to process management. As a result of this survey, the authors identify an expansive list of factors ranging from increasing competition, to a declining customer base and government regulations. Based on this survey, the authors state that the firms studied have a good grasp of customer centricity and that process improvement efforts are correctly aligned with the business strategy. The main opportunities for improvement are seen in process awareness among employees, the prioritisation of improvement initiatives and the ability to manage organisational change. The authors also observe a lack of a consistent approach or method for managing process improvement and an absence of adequate performance metrics.

Based on the fact that all of the studied firms fall within the 'process management evolution' phase, the authors provide a few quick recommendations for improvement. These include committing members of the management team to process management and verifying that process owners have access to tools and training. Beyond these recommendations, the model does not provide extensive guidance to improving BPM capabilities. In this regard, it must be seen mostly as an informal and quick way for assessing organisational maturity. The authors provide little transparency into the development method of the model and the reasoning for choosing the specific key

success factors. Combined with the simplicity of the measurement instrument, this model may be less suitable than other more extensive model in capturing organisational complexities and facilitating improvement.

Process Management Maturity Assessment (PMMA) (Rohloff, 2009a, 2009b)

Rohloff presents a BPM Maturity Model based on an initiative for the implementation of BPM practices at Siemens AG. This initiative includes the development of a process framework. The process framework describes all activities performed within the company on a high level. These include the management processes, Customer Relationship Management processes, Supply Chain Management processes, and supporting processes, among others. In this regard, the framework appears similar to the Domain Reference Model for Hospitals (NICTIZ, 2016), in that it describes the high-level domains in which processes take place.

Practices were put into place to guide the proper implementation of the process framework. Different implementation topics were identified, which lead to the development of a maturity model (The PMMA) alongside the process framework. We will be looking specifically at this maturity model as input for this research. Nine topics were identified in total, which form the basis for the factors included in the PMMA. The topics included in the model are described as follows (Rohloff, 2009b):

1. Process Portfolio & Target Setting
   Compiling a portfolio of processes within the organisations and setting targets and prioritisation for their improvement
2. Process Documentation
   Processes included in the improvement initiative are documented, including relevant Key Performance Indicators.
3. Process Performance Controlling
   Procedures for identifying the Key Performance Indicators.
4. Process Optimization
   Defining benchmarks and levers for improvement.
5. Methods & Tools
   Using methods and tools for process management based on the business strategy and other guidelines.
6. Process Management Organization
   Responsibilities and tasks for process management
7. Program Management, Qualification, Communication
   Systematic coordination of the program through project management.
8. Data Management
   Consistency and standardisation of data.
9. IT Architecture
   Defining the target architecture and migration requirements to support processes.

Each of the nine categories include further sub-categories, which are not defined in the paper. Rohloff describes how the PMMA can be mapped onto two other models, the BPMM by Rosemann & de Bruin (Rosemann & De Bruin, 2005a, 2005b) and the PEEM by Hammer (2007). For example, the areas of ‘Process Documentation’, ‘Process Optimization’, ‘Process Performance Controlling’, and ‘Methods & Tools’ can be mapped onto the ‘Methods’ factor in the BPMM. The topics of ‘Data Management’ and ‘IT Architecture’ correspond with the ‘Technology’ factor in the BPMM and the ‘Infrastructure’ factor in the PEEM. With this mapping, Rohloff describes how the topics relate to the factors found in other models and, in some cases, provide more detail.

The PMMA provides five maturity levels for each implementation topic. These maturity levels are adopted directly from CMMI and are defined as follows:

1. Initial
2. Managed
3. Defined
4. Quantitatively Managed
5. Optimizing

Rohloff states that each of the five levels defines a set of criteria for reaching that level. In accordance with scientific literature, it is stated that organisations should not necessarily aim for the highest maturity level. Instead, a maturity level that best fits the organisational characteristics should be found. Rohloff states that the assessment of the maturity level takes about two to three days. This is done by interviewing key staff members and is supported by an 'MS-Office based' tool.

The PMMA by Rohloff provides a practically-oriented BPM maturity model. This is shown by the fact that the model is based on a BPM initiative at Siemens AG. The model includes practical capabilities related to the project management of BPM initiatives. In this regard the model is prescriptive in nature, as it presents steps that should be taken to reach the next maturity level. The model shows links with existing models such as CMMI, PEEM, and BPMM and has similarities in terms of the maturity levels and factors used. One shortcoming of the model may be that it is not further tested in other organisations.

Appendix III. Delphi Study Results Round One

Strategische Afstemming (Strategic Alignment)	
Code	Response
#009	Operationele processen in ziekenhuizen worden nog steeds veelal gedicteerd door de medische professie en effectiviteit, niet door operational excellence. In toenemende mate is dit wel het geval aangejaagd door externe verantwoording (Zizo, accreditatie), door zorgverzekeraars (marktwerking / financiele prikkels) en door PROM. De strategische koers van het ziekenhuis wordt mede hierdoor bepaald en vertaald naar outcomes en procesverbeteringen. Eigen strategie, welek ook doorvertaald wordt naar procesmanagement op de werkvloer staat m.i.nog in de kinderschoenen.
#F93	bewustwording mbt huidige problematiek bewustwording mbt procesmanagement prioritering procesmanagement prioritering veranderingsdynamiek/ambitieniveau implementatie strategie/ambitieniveau invulling van randvoorwaarden Geleidelijke invoering (verkennen/identtificeren van processen> beheersen van processen> monitoren en verbeteren
#C00	Duidelijke missie, visie en strategie met duidelijke kaders en doelen. Vastgestelde KPIs op strategisch niveau die vertaald kunnen worden naar lagere niveaus. Communicatie en vooral leiderschap
#5FC	Beleggen procesmanagement als aandachtsgebied bij een MT-lid Vaststellen bedrijfsdoelstellingen en strategische koers ziekenhuis Vaststellen van ziekenhuisbreed beleid voor procesmanagement Risico's inventariseren ten aanzien van bedrijfsdoelstellingen (welke komen in gevaar en waar is actie nodig?)

	Volgorde van aanpak van processen prioriteren op basis van deze risicobeoordeling (dat doen wat het meest nodig is).
#FF6	- Commitment van alle lagen - Duidelijk inzicht in de 'value chain', wie draagt wat bij - Investeren in kennis om de lijn van strategisch niveau naar opertaioneel niveau te kunnen maken
#1CF	(geen opmerkingen, alleen cijfermatige waardering gegeven)
#6F0	(geen opmerkingen, alleen cijfermatige waardering gegeven)

Bestuur (Governance)	
Code	Reponse
#009	Sturing op proces en outcome indicatoren is wezenlijk bij de volwassenheid van procesmanageemnt. In de zorgsector zijn cultuuraspecten (samenwerken, aanspreken, gedrag) echter net zo wezenlijk als meten = weten. Goed bestuur zorgt voor sturing zowel op cijfers als op de zachtere indicatoren Wat nodig zou zijn is bijv het opstellen van een goede business case voordat er gestart wordt met procesverbetering
#F93	Het bestuur zou een grote invloed moeten hebben om zich door te ontwikkelen naar een procesgestuurde organisatie. Factoren: Visie en beleid, Stimuleren, controleren en bewaken. Sturen op indicatioren. Doorontwikkelen naar een matrix organisatie mbt verantwoordelijkheden (proces verantwoordelijken en lijn verantwoordelijken) Evaluatie voortgang
#C00	Zie vorige opmerking
#5FC	Betrokkenheid van alle stakeholders uit een proces in de vaststelling de uitwerking van een proces vaststellen en vaststelling van de TBV's over de verschillende rollen. Aanwezigheid van een goede dashboardtool om KPI's te presenteren. Vaststelling van proceseigenaren Beleggen van verantwoordelijk voor sturing en procesbewaking middels KPI's door proceseigenaren. Competenties van proceseigenaren Toerusting van proceseigenaren met werkbaar dashboard met de voor hun relevante stuurinformatie. Afspraken gemaakt over verantwoordelijkheid van proceseigenaar ten opzichte van lijnverantwoordelijke (bijv. afdelingshoofd).
#FF6	- Duidelijke demarcatie en beschrijving taken, verantwoordelijkheden en bevoegdheden - Erkenning van het belang en aandacht voor de uitvoering
#1CF	(geen opmerkingen, alleen cijfermatige waardering gegeven)
#6F0	(geen opmerkingen, alleen cijfermatige waardering gegeven)

Methodes (Methods)	
Code	Reponse

#009	DMAIC als projectmgt methode, IST en SOLL, modelering via zelf tekennotatie bijv BPMN. In de zorg is denk ik grote betrokkenheid van de werkvloer essentieel maar ook bottle neck om mensen uit het primaire proces vrij te maken.
#F93	BPM voor procesbeschrijving. LEAN methodiek om beschreven/beheerde processen te verbeteren Methode om tot proces beschrijving> verbetering> besturing en beheer te komen. Op dit moment is mij geen goed methode bekend . Een referentie model is geen methode maar helpt wel bij goed procesmanagement Er zijn vele methodes om tot procesverbetering te komen. Dit is per organisatie verschillen. Wij denken dat BPM en LEAN goed op elkaar aansluiten
#C00	Het is mi het beste om een term te kiezen voor je eigen methodiek en deze niet Lean of sixSigma of Toc te noemen. Deze termen zijn nl in de ziekenhuiswereld verkeerd bekend of men kent er slechte voorbeelden campn. Belangrijk om een eigen naam te kiezen die wel (onder de motorkap) gestoeld is op een of meerdere beproefde methodes, technieken kf managementfilisofieen. BV <naam ziekenhuis>methode voor zorgpaden <naam ziekenhuis>methode voor procesverbetering Etc. Verder: Process mining
#5FC	Kaders voor het opstellen van een procesbeschrijving en een procesmodel.
#FF6	Hoe minder hoe beter, belangrijk is hierbij met name om de onderlingen relatie tussen de verschilllende methodes helder te hebben.
#1CF	(geen opmerkingen, alleen cijfermatige waardering gegeven)
#6F0	(geen opmerkingen, alleen cijfermatige waardering gegeven)

IT	
Code	Reponse
#009	A fool with a tool is still a fool: dus ja het kan maar is niet wezenlijk. In de zorg kan het net zo professineel met Visio als met een professioneel pakket. Borging in kwaliteitssystemen is wel wezenlijk (bijv digitale kwaliteitssystemen waarin procesmodellen kunne worden opgenomen)
#F93	Modeleer tool Tool die procesbeschrijving en werkinstructies met elkaar koppelen Workflow engine Rules engine
#C00	We hebben een bpm systeem (BariumLive) om processen conform BPMN te modelleren en te publiceren op verschillende abstractieniveaus. Verder vele applicaties die het primaire proces ondersteunen (o.a. Ons EPD Epic) en SAP als ondersteuning van secundaire processen. Beide genoemde systemen zijn functioneel ingericht en er kan geen end-to-end procesinformatie gegenereerd worden. Dit is heel erg bepalend (beperkend). Verder: BI tools en Process mining tools
#5FC	IT ondersteuning in realiseren en beheren van processchema's IT ondersteuning in de monitoring / dashboard op KPI's

#FF6	Idem aan vorig punt, hoe minder hoe beter, onderlinge relatie management is de sleutel hierbij.
#1CF	(geen opmerkingen, alleen cijfermatige waardering gegeven)
#6F0	(geen opmerkingen, alleen cijfermatige waardering gegeven)

Mensgerelateerd	
Code	Reponse
#009	Zie eerder: betrokkenheid en draagvlak van mensen uit het primaire proces is wezenlijk maar beschikbaarheid / vrij rooseren is een strategsche keuze / investering
#F93	deskundigheid 'verbeter'cultuur leiderschap kennisdeling
#C00	Leiderschap Communicatie Betrokkenheid Platte hiërarchische structuur/open cultuur. Geen afdelingsdoelen waarop gestuurd wordt maar procesdoelen. Zaken die integrale samenwerking stimuleren ipv suboptimalisatie (BV resultaatverantwoordelijke eenheden - RVE: werkt dus tegen)
#5FC	Voldoende mensen met competenties om zorgprocessen in kaart te kunnen brengen en te kunnen optimaliseren Management opgeleid om op KPI's te sturen Management opgeleid om binnen organisatie combinatie te hebben tussen procesmanagement en lijnmanagement.
#FF6	- Motivatie - Ondersteuning in opleiding en tooling - Commitment leidinggevende - Inzicht in het belang van het individu in de procesketen - De mate van vrijheid en verantwoordelijkheid om het proces eigen te maken
#1CF	(geen opmerkingen, alleen cijfermatige waardering gegeven)
#6F0	(geen opmerkingen, alleen cijfermatige waardering gegeven)

Other areas of interest	
Code	Response
#009	Projectmanagement: de volwassenhed van opdrachtgeverschap en projectmanagement is ook nog niet zeer oog in de ziekenhuissector. Deze heeft m.i. veel invloed op maturiteit van procesmanagent. Standaardisatie van medisch handelen is al wel lang ingeburgerd maar standaardisatie van bedrijfsprocessen nog veel minder, alhoewel wel groeiende door rchtlijnen, zorgpaden etc.
#F93	Het kost veel tijd om een andere manier van denken te introduceren. betrokken houden zich vast aan tradities. Echter met een goede begeleiding en dosering ben ik ervan overtuigd dat ook de werkvloer in beweging kan komen als zij voordelen gaan inzien. Starten met pilotproject kan bijdragen tot succes. Eerst zien dan geloven. je moet zorgen voor discipelen binnen de organisatie die ook het woord gaan verspreiden.

#C00	Competentieontwikkeling Procesdoelen koppelen aan functies (ipv taken)
#FF6	In navolging van te vorige punt, de managementstijl. Er moet een stijl gekozen worden die een proces van continue verbetering stimuleert. Wanneer het zich beperkt tot een bureaucratisch proces waarbij op KPI's wordt gescored ontstaat er geen klimaat voor het continu verbeteren vanuit een intrinsieke motivatie maar blijft het een spel om de getalletjes. Volwassen organisaties worden mede gevormd door volwassen management.
#1CF	(geen opmerkingen)
#6F0	(geen opmerkingen)

Appendix IV. Delphi Study Results Round Two

Strategische afstemming						
	#6F0	#F93	#009	#FF6	#C00	Gem.
Value chain inzichtelijk maken (wie draagt wat bij)	4	5	5	4	4	4.4
Patient Reported Outcome Measures	3	5	4	3	4	3.8
Normen zichtbare zorg (ZiZo)	2	3	3	2	2	2.4
Accreditatienormen (bijv. NIAZ, JCI)	3	4	3	5	4	3.8
Verantwoording richting zorgverzekeraars	3	3	4	2	4	3.2
Opstellen van een business cases voor procesverbetering	4	3	5	4	4	4
Kaders en doelen voor procesmanagement in missie, visie en strategie opnemen	4	5	2	4	5	4

Opmerkingen bij strategische afstemming:

- #F93: “Externe verantwoording mag niet het hoofddoel zijn. Kwaliteit van zorg voor je client blijft het belangrijkste doel. Als je dit goed organiseerd zal je externe verantwoording ook goed zijn/beter worden. Primaire focus is je interne bedrijfsvoering. Externe prikkels helpen wel je interne bedrijfsvoering te verbeteren”

Bestuur						
	#6F0	#F93	#009	#FF6	#C00	Gem.
Op procesniveau specificeren van verantwoordelijkheden en taakverdeling	4	5	5	5	5	4.8
Regelmatige voortgangsevaluatie van procesmanagement-initiatieven	4	3	4	4	3	3.6
Sturing op proces- en outcome-indicatoren	4	5	4	4	5	4.4
Sturing op soft skills (samenwerken, gedrag, aanspreken)	5	5	3	4	3	4
Instellen van procesdoelen i.p.v. afdelingsdoelen	4	5	5	3	5	4.4
Afspraken maken over het opvolgen van procesbeschrijvingen	3	5	3	4	4	3.8
Procesmanagement prioriteren voor bedrijfsdoelstellingen met meeste risico’s	3	5	4	3	5	4

Opmerkingen bij bestuur:

- #F93: “Leidersschap is erg belangrijk in de transitie naar een procesgestuurd organisatie. Visie op bestuurlijk niveau is een voorwaarde om procesmatig werken consequent door te voeren. Procesmanagement vereist een ander soort management als het traditionele management. Er moet een verschuiving plaatsvinden van beheer naar continue ontwikkleing en verbetering.”

Methodes						
	#6F0	#F93	#009	#FF6	#C00	Gem.
DMAIC	4	3	5	4	3	3.8
IST en SOLL	4	4	5	4	3	4
BPMN	3	4	3	3	4	3.4
LEAN	4	4	4	3	3	3.6
Methode voor beschrijving, verbetering, besturing en beheer van processen	3	5	3	4	5	4
Referentiemodel ter ondersteuning procesmanagement	3	5	2	4	3	3.4
Process Mining	3	3	2	4	4	3.2
Toepassen van eigen naamgeving op procesmanagementmethodes om negatieve connotaties met bestaande methodes te voorkomen	3	3	2	4	5	3.4
Helder maken van relaties tussen gebruikte methodes	3	4	2	4	3	3.2
Standaardisatie van ondersteunende processen (zoals bij zorgprocessen gebruikelijk is)	4	5	4	2	5	4

Opmerkingen bij methodes:

- #F93: “"Methodes zijn hulpmiddelen. De keuze van de methode kan afhangen van wat er binnen een organisatie wordt gebruikt/speelt. Belangrijk is wel dat er goede samenhang tussen de methodes is. De keuze van een methode kan afhangkelijk zijn van de hulpvraag/knelpunt. Belangrijk is altijd wel dat wil je wat veranderen eerst het proces dudielijk moet zijn.”
- #C00: “Het is moeilijk aan te geven welke methode het beste is, dat is afhankelijk van de situatie. Ik gebruik bv BPMN maar VSM is ook prima. Kortom het gaat niet om de methode maar om het resultaat en in mijn geval is het vaak een mix van methodieken. Het gaat dus niet om het middel maar het doel”

IT						
	#6F0	#F93	#009	#FF6	#C00	Gem.
Modelleertool	3	4	4	2	5	3.6
Workflow engine	3	4	3	2	3	3

Rules engine	3	4	3	2	3	3
Koppeling procesbeschrijvingen met werkinstructies	3	5	4	3	5	4
Koppeling tussen systemen voor end-to-end procesinformatie	4	4	2	2	5	3.4
BI Tools / KPI dashboard	4	4	5	4	5	4.4
EPD ter ondersteuning primaire proces	5	5	3	3	4	4
SAP (of soortgelijk) ter ondersteuning secundaire processen	3	4	3	3	4	3.4
Borging van procesmodellen in digitaal kwaliteitssysteem	4	5	5	4	4	4.4

Opmerkingen bij IT:

- #F93: "SAP> system against people? IT kan procesmanagement ondersteunen. Alle bovenstaande functionaliteiten kunnen bijdrage om procesmanagement te verbeteren. De mogelijkheden van systemen (koppeling tussen systemen) en de IT rijpheid van de organisatie bepalen wat welke hulpmidelen inzetbaar zijn. Een goede IT architectuur die het proces ondersteunt is wel erg belangrijk. Er zijn al veel deel functionaliteiten beschikbaar maar geen integrale systemen die met elkaar werken. Het begrip Service bus is in veel ziekenhuizen nog niet toegepast. EPD systemen leveren mi tnt alleen deeloplossingen en die worden vaak onvoldoende gebruikt door veelal een gebrek aan visie/kennis/geld"

Mensgerelateerd						
	#6F0	#F93	#009	#FF6	#C00	Gem.
Vrijmaken van mensen uit primaire proces	4	3	4	5	5	4.2
Platte bedrijfsstructuur / Matrixorganisatie	3	5	2	4	3	3.4
Proceseigenaren aanstellen	4	5	5	5	5	4.8
Kennisdeling stimuleren	4	5	3	4	5	4.2
Opleiden in beschrijven en optimaliseren van zorgprocessen	4	3	5	4	5	4.2
Opleiden in sturen op KPIs	3	5	4	4	5	4.2
Opleiden in combineren van lijnmanagement met procesmanagement	4	5	2	3	4	3.6
Belang van het individu in de procesketen helder maken	5	2	4	5	4	4
Vrijheid en verantwoordelijkheid om het proces eigen te maken	4	3	2	5	3	3.4
Gebruik van pilot-projecten om betrokkenheid te creëren	4	5	4	4	4	4.2

Opmerkingen bij mensgerelateerd:

- #F93: “Vrijheid en verantwoordelijkheid om het proces eigen te maken> ondudielijke vraag waarvan ik niet weet welke richting jij opwil. Het hebben van een individuele verantwoordelijkheid om een(deel)proces eigen te maken is erg hoog/voorwaarde. Vrijheid zie ik dan als vrijblijvendheid> dit moet laag zijn, geen vrijblijvendheid dus”

Cultuur						
	#6F0	#F93	#009	#FF6	#C00	Gem.
Cultuurelementen uit LEAN	4	3	3	4	4	3.6
Cultuurelementen uit McKinsey 7s-model	3	3	3	4	3	3.2
Cultuur en managemenstijl van intrinsieke motivatie i.p.v. sturing op (KPI) getallen	5	5	4	4	4	4.4
Open cultuur	4	4	2	4	3	3.4
Commitment van leidinggevenden	5	5	5	5	5	5
Aanstellen van een procesmanagement-ambassadeur binnen directie/management	4	5	5	3	4	4.2
Betrokkenheid van zorgprofessionals	5	5	4	4	5	4.6
Bewustwording creëren van huidige problematiek	4	5	3	4	5	4.2

Appendix V. Delphi Study Results Round Three

Categorieën overall	
Code	Response
#009	• "In de zorg staat de zachte kant vaak bovenaan. • Lean management neemt een enorme vlucht, is operationeel maar wel heel duidelijk. • Dit resultaat komt waarschijnlijk door het soort respondenten (veel zorgmensen). Als je cultuur niet mee hebt, krijg je dingen niet voor elkaar. "
#F93	• IT middelen en methodes zijn meer hulpmiddelen. Cultuur vind ik het meest belangrijk, je moet beginnen bij een missie en visie. Dit zijn voorwaarden waaraan voldaan moet worden voordat je begint met de andere factoren • Ik zou cultuur op 1 zetten, gevolgd door bestuur op 2, mensgerelateerd op 3 • Bij <ziekenhuis> proberen we vooral van de zijkant te duwen wat betreft procesverbetering. Hier en daar verspreid de gedachte zich ook bottom-up, maar er is nog te weinig top-down commitment.
#C00	• mensen maken verandering. cultuur is het gedrag in een omgeving. Bestuur is een middel om verantwoordelijkheden te bepalen. Strategic alignment bepaalt het doel. IT middelen zijn volgend en niet bepalend. Wij merken dat een proces over meerdere afdelingen gaat. De muurtjes zijn hoog, hoger dan in het bedrijfsleven. • Mee eens dat cultuur en mens hoger staan. Mensen maken de verandering in de organisatie, cultuur is het gedrag van mensen in de omgeving • Bestuur is een middel om verantwoordelijkheden te bepalen, strategische afstemming bepaalt het doel. • IT Middelen zijn volgend en niet bepalend
#6F0	• Belangrijkst is dat mensen moeten willen, dit doen we door sturing d.m.v leiderschap, aansprekende personen gebruiken met een duidelijke boodschap, Tour de l'amour, Individuele gesprekken voeren en interactie. • IT middelen en methodes zijn meer ondersteunend maar vormen niet de kern.

Mensgerelateerd	
Code	Response
#009	• "Taakbevoegde verantwoordelijkheden (proceseigenaren aanstellen) • faciliteren van mensen (opleiden) anders kunnen ze het niet. • Pilotprojecten zijn m.i. belangrijker -> bij invoering EPDs enz. gaan dingen pas vliegen naar aanleiding van een goed voorbeeld. Eerst zien dan geloven. • Onderste factoren zijn wel belangrijk maar niet specifiek voor de zorg. "

#F93	• Opleiden in combineren van lijnmanagement en procesmanagement mag hoger. We zien dat afdelingsmanagers een dubbelrol krijgen. Het is inderdaad alleen van toepassing op deze managers (dus niet op alle medewerkers) maar het is wel cruciaal voor goed procesmanagement) • Pilot projecten zijn ook heel belangrijk. Zijn een goede manier om verandering teweeg te brengen, zowel bottom up als top down.
#C00	• Proceseigenaren aanstellen is een belangrijke factor (staat bovenaan) maar ook de uitvoering van de processen moet daarop volgen. • Vrijmaken van mensen uit primaire proces is heel belangrijk voor de inhoudelijke expertise, gebeurt dit niet dan blijkt de voortgang lastig. • Opleiding in combineren van lijnmanagement met procesmanagement kan op dezelfde plek blijven staan, maar dit is situationeel. Sluit niet aan bij iedere medewerker, alleen bij sommigen. • In een ziekenhuis zijn KPIs niet altijd procesgerelateerd, kan bijvoorbeeld de ligtijd zijn van een patient in een bed. Er is een verschil tussen procesprestatie-indicatoren en KPIs • Belang van het individu in de procesketen maken is een factor die hoger mag worden genoteerd
#6F0	• Gat tussen eerste factor - proceseigenaren aanstellen, en de rest is groot. • Pilot projecten zou ik hoger verwachten, is belangrijk om mensen mee te krijgen • Ook mensen vrijmaken uit het primaire proces hoger verwachten, hier begint het mee. • We gebruiken vooral Lean & Waardestroomanalyses (value chain analysis)

Cultuur	
Code	Response
#009	• "Commitment van leidinggevenden is dubbel in de ziekenhuiswereld: leidinggevenden maar ook medische staf (specialisten). Als het qua staf niet wil, dan houdt het ook echt op. • Integrale bekostiging -> veel medische staf komt in dienst van het ziekenhuizen. • KPIs zijn nog relatief nieuw, maar wel wezenlijk in procesmanagement. Door veranderende rol van zorgverz. steeds belangrijker. Sturing op getallen. "
#F93	• Bewustwording creëren mag hoger: Naar de derde plek. Consequenties van hokjes denken moeten namelijk helder worden gemaakt. Nu beseffen mensen zich nog niet voldoende dat ze onderdeel zijn van een keten.
#C00	• Leiderschap is het belangrijkt, evenals de inhoudelijke kennis van zorgprofessionals • Bewustwording creeren van huidige problematiek mag worden verhoogd naar plaats 1 of 2. Dit moet gedaan worden om inzicht te krijgen in waarom bepaalde initiatieven worden ondernomen. • LEAN cultuur wordt bij ons ingezet omdat het waardering geeft aan mensen

	• Niet bekend met McKinsey 7s, je kunt uiteraard allerlei verschillende methodieken inzetten.
#6F0	• Mee eens, herkenbare lijst

Bestuur	
Code	Response
#009	• "Taakverdeling bovenaan, mooi. • Afspraken maken over opvolgen > aanspreekcultuur. • Volgorde klopt wel. • Eerst TBVs, dan hoe stuur je erop. • Laatste twee gaan over planning & control. • Aandachtspunt: Als het niet volgens het proces gaat, wat doe je dan? Aanspreekcultuur. Veiligheid in een organisatie. "
#F93	• Sturing op soft skills mag hoger. • Afspraken maken over opvolgen van proces mag hoger. Hierbij wordt bekeken of er wel volgens afspraak wordt gewerkt. • In de praktijk is de organisatie vaak een reparatiefabriek. Probeert de fouten op te lossen die door een vorige schakel in de keten zijn gemaakt. Belangrijk is om afspraken te maken zodat door iedere schakel het juiste resultaat wordt geleverd, dan ga je naar een verbeterfabriek.
#C00	• Outcome-indicatoren worden steeds belangrijker. Waaronder PROMs, maar ook indicatoren over patienttevredenheid. Bij ons blijkt dat patienttevredenheid vooral beïnvloed wordt door de manier waarop patienten worden bejegend. Dit is te vergelijken met restaurants waarbij de kwaliteit van het eten gelijk is maar waar bij het ene restaurant de bediening vriendelijker is dan bij de andere. Daarnaast wordt gekeken naar satisfiers en dissatisfiers. Neem als voorbeeld een hotel: er zijn een aantal basics waaraan voldaan moet worden zoals een goed bed en een schone kamer. Zijn de basics in orde, dan kan er gekeken worden naar mogelijke extra's (waar je als het goed is niet extra voor betaalt). • Kano-model https://en.wikipedia.org/wiki/Kano_model • Bij BPM maturity moet je niet alleen kijken naar het 'blauwe' proces, in een ziekenhuis is vooral de ervaring van een patient belangrijk. Waar zorg over het algemeen op een hoog niveau staat maakt de patientervaring het verschil waarop geconcurreerd kan worden. <ziekenhuis> doet dit ook met het opstarten van een eigen privekliniek (commerciele kliniek). Link naar de ervaring van de klant moet duidelijker terugkomen in een dergelijk model.
#6F0	• Soft skills zou ik hoger verwachten, op een 4.4. Verder herkenbare lijst

Strategische Afstemming (Strategic Alignment)	
Code	Response
#009	• "Gelderse Vallei heeft bijvoorbeeld duidelijke mise en visie als voedingsziekenhuis. Dit wordt ook gerelateerd aan proces. • Business cases worden ook nog niet zoveel gebruikt. • PROM is in opkomst. • Waarom staat zorgverzekeraars zo laag? • Zou ik persooonlijk hoger zetten. Wordt strategie van een ziekenhuis momenteeel voor een groot deel door bepaald. "
#F93	• PROMs zijn het ultieme doel, de uitkomst van het proces. Deze mogen bovenaan. De uitkomst hiervan geeft aan wat de mate van optimalisatie is in je processen. • Accreditatienormen, Zizo en verantwoording richting zorgverzekeraars zijn een stok achter de deur maar het zijn slechts hulpmiddelen. • Zorgverzekeraars en ziekenhuizen willen als het goed is hetzelfde doel bereiken: Gemeenschappelijk belang richting de patient. • Zizo staat laag omdat het meer iets zegt over structuur maar onvoldoende over de uitkomsten.
#C00	• Het inzichtelijk maken van de value chain is heel belangrijk. Dit zegt wat de klantwaarde is. • Zizo mag inderdaad laag staan, dit zegt niets over het proces • PROMs mogen ook hoger komen te staan, zoals eerder besproken gaat het om de ervaring van de klant. • Verantwoording richting zorgverzekeraars moet hoger komen te staan dan accreditatienormen. Zorgverzekeraars zijn immers ook klanten. Accreditatienormen vormen voornamelijk afvinklijstjes die vervolgens in de kast verdwijnen. PROMs zijn vervolgens wel weer belangrijker dan verantwoording richting verzekeraars • Kaders en doelen voor procesmanagement opnemen in missie, visie en strategie: Dit zijn voornamelijk woorden maar nog geen daden. Er moet ook daadwerkelijke uitvoering plaatsvinden.
#6F0	• Er lopen wel initiatieven voor PROM, maar er is nog weinig draagvlak • Accreditatie is wel belangrijk, het is extrinisieke motivatie maar geeft wel genoeg drijfveer om verandering te weeg te brengen, omdat het moet

IT	
Code	Response
#009	• "Bij mensen die dingen implementeren zouden deze categorieen hoger scoren. • Voelt als een lijst van verschillende tools. • Modelleertool blijkt in de praktijk wel belangrijker, het helpt om mensen te leren modelleren. • SAP is wel erg logisch, is een sterk procesgeorienteerde tool. • Lijst is nogal een bijeenraapsel. • Modelleertool zou ik hoger zetten -> eenheid van taal. Dezelfde taal spreken wat betreft procesmanagement. • SAP, koppeling , heeft dat wel te maken met maturity? • Betekent eigenlijk: Ben je in staat om procesinformatie uit je proces te halen? Heb je de tools om KPIs te genereren? Daarmee heb je de koppeling tussen systemen en BI tools. Ben je in staat om managementinformatie te genereren? Kun je meten?"
#F93	• IT zijn met name hulpmiddelen. Goede procesinformatie is erg belangrijk. Je hebt bijvoorbeeld een systeem nodig waarin processes worden ondersteund en gekoppeld aan protocollen. • Workflow engine en rules engine worden nu als minder belangrijk gewaardeerd, maar zijn eigenlijk wel belangrijk. Mensen kennen het echter nog niet. Dit wordt bij hogere volwassenheid wel belangrijk. Wanneer je de basis hebt gelegd van IT-systemen die processen ondersteunen dan heb je workflow engine en rule engine nodig voor decision support. Huidige klimaat is hier nog niet rijp voor maar factoren zijn wel belangrijk
#C00	• Het allerbelangrijkste IT-middel wat nog niet bestaat is een procesgestuurd systeem voor primaire processen. Momenteel zijn er systemen (zoals Epic EPD) die slechts een deel van het proces ondersteunen. Dit biedt niet de mogelijkheid om over het gehele proces prestatie-indicatoren in te stellen en hierop te meten. Daarom zijn wij veel met process mining bezig. Veel van de genoemde factoren zijn hieraan gekoppeld. • Bijvoorbeeld een KPI dashboard is alleen nuttig als je een systeem hebt wat daadwerkelijk inzicht heeft in het gehele proces (end-to-end) • EPD moet procesgestuurd worden en niet alleen procesondersteunend (Je zet er een systeem boven wat aanstuurt door middel van een proces) • Bij <ziekenhuis> vormt de modelleertool zowel de borging (documentatie) als de koppeling van werkinstructies met procesbeschrijvingen. Eigenlijk drie factoren in één. • Factoren binnen IT-middelen zijn sterk in elkaar verweven
#6F0	• IT loopt achter, er zijn simpele standaard KPIs mogelijk maar nog geen mooie dashboards waar iedereen groot voordeel uit haalt of waar we heel bevlogen van worden. • EPD wordt per maart ingevoerd, dat biedt wellicht meer mogelijkheden. Hierover zijn mensen wel enthousiast • EPD zou ik daarom hoger verwachten op de lijst

	• Voor modelleren gebruiken we visio en een online tool waarmee protocollen gekoppeld kunnen worden aan het procesmodel. Het gebruik hiervan op de werkvloer is nog in wording, wordt af en toe gebruikt.

Methodes	
Code	Response
#009	• "Beschrijving: Op welke manier leg je het vast? • Standaardisatie is voor mij geen methode, is iets anders • DMAIC, LEAN en BPMN wel. • Wat geholpen heeft in maturity in ziekenhuizen: Lean en six sigma te introduceren als vaste methoden. Zijn gangbaar geworden. • Zitten er een paar tussen waarvan de vraag is of ze er thuis horen • Standaardisatie en helder maken relaties. Is meer iets strategisch dan IST en Soll, DMAIC, LEAN en BPMN zijn voor mij wezenlijk: is eenheid van taal. "
#F93	• Er zijn geen goede of slechte methodes • LEAN & BPM ondersteunen elkaar. BPM verduidelijkt de processen die je nodig hebt om met LEAN te werken • Referentiemodel wordt laag gewaardeerd, maar wij hebben er persoonlijk goede ervaringen mee omdat het een aanknopingspunt biedt voor discussies. • Process mining geeft tot nu toe alleen maar inzicht, leidt niet direct tot procesverbetering. Proces moet niet gezien worden als iets lineairs en daar proberen we met het referentiemodel op in te spelen. Process mining helpt wel om te ondervinden welke variaties er in het proces aanwezig zijn.
#C00	• Methodes zijn zeer situationeel, je selecteert ze aan de hand van het probleem wat zich op dat moment voordoet. • DMAIC en LEAN zijn goed te combineren en mogen hoger genoteerd worden. • Relaties tussen methodes aangeven is inderdaad minder belangrijk, het gaat erom of je de juiste methodes selecteert. • Bij de methode voor beschrijving, verbetering, besturing en beheer moet nog worden vermeld dat er ook implementatie en borging nodig is. Voordat je kunt besturen moet je implementeren en borgen. • Process mining staat hier vrij laag, maar mag hoger. Het is een belangrijk middel omdat er nog geen beter alternatieven zijn die het gehele proces inzichtelijk maken. Het kan zijn dat andere ziekenhuizen hier nog niet zo sterk mee bezig zijn of niet weten wat het is, en daarom een lagere waardering geven.
#6F0	• Is eigenlijk een grote gereedschapskist waar je uit kunt putten, verschillende methodes mogelijk waarvan het moeilijk te zeggen welke belangrijker is. De genoemde methode voor beschrijven, verbeteren, besturen en beheer omvat eigenlijk alles, dit wordt in verschillende andere methodes afgedekt.

Overige commentaren	
Code	Response
#009	• Komt wel overeen met het voorgaande. Sommigen hebben gewoon overlap: horen bij elkaar. De kunst is om de essentie eruit te halen. Cultuur, commitment, meten, bijsturen, strategieverhaal. Onder elke categorie maximaal 4 factoren: Dat heeft meer draagkracht dan wanneer het er heel veel zijn. Zeker de laatste twee categorieen kunnen met minder factoren af. Waarde model? klanten zullen niet zo snel ziekenhuis kiezen op basis van maturity level (itt bijv. software waar CMM wordt gebruikt).
#F93	• Het is afhankelijk van de organisatie/instelling waar je het best op kunt insteken en welke factoren van invloed zijn • IT middelen en methodes worden nu als minder belangrijk ervaren, omdat cultuur, bestuur en mensgerelateerde factoren op dit moment de grootste uitdaging vormen. Echter de IT middelen (en methodes) zijn juist in de toekomst belangrijker, wanneer de juiste basis in cultuur en bestuur aanwezig is. • Belang van de factoren hangt af van het stadium waarin de organisatie zich bevindt
#C00	• Verantwoording richting zorgverzekeraars hoger • Platte bedrijfsstructuur lager (is een mogelijke manier, maar niet perse de beste manier) • Process mining hoger.
#6F0	• (geen opmerkingen)

Appendix VI. Application of the BPM Maturity Measurement Instrument

The maturity model was applied in one of the hospitals of which an expert was included in the Delphi study. Maturity was assessed by the researcher together with three employees of the quality management department.

Capability scores for the people factor

People	**1**	**2**	**3**	**4**	**5**	**Score**
Assigning Process Owners		x				2
Availability of primary healthcare staff		x				2
Knowledge sharing	x					1
Training in describing and optimising healthcare processes	x					1
Training in KPI-based steering		x				2
Using pilot projects to foster participation			x			3
Clarifying the importance of the individual in the process chain		x				2
Training in combining line management and process management	x					1
Flat organisational structure						-
Freedom and responsibility to internalize processes	x					1
Average						**1.67**

Capability scores for the culture factor

Culture	**1**	**2**	**3**	**4**	**5**	**Score**
Management Commitment		x				2
Involvement of Healthcare Professionals in Process Improvement	x	x				1.5
Intrinsically motivated improvement culture and management style		x				2
Assigning a process management ambassador within management or the board		x				2
Creating awareness of current issues			x			3
Culture elements from LEAN	x					1
Open culture	x	x				1.5
Average						**1.86**

Capability scores for the governance factor

Governance	**1**	**2**	**3**	**4**	**5**	**Score**
Specification of tasks & responsibilities	x	x				1.5
Use of outcome indicators		x				2
Setting goals	x					1
Governance based on soft skills (collaboration, behaviour, accountability)	x					1
Prioritizing process management for high-risk business goals			x			3
Agreeing on following process descriptions	x					1
Frequent evaluation of progress in process management initiatives	x					1
Average						**1.50**

Capability scores for the strategic alignment factor

Strategic Alignment	**1**	**2**	**3**	**4**	**5**	**Score**
Providing insight into the value chain	x					1
Process Improvement Business Cases	x					1
Process Management Goals in organisational mission, vision and strategy	x	x				1.5
Patient Reported Outcome Measures (PROM)	x	x				1.5
Accreditation Standards (NIAZ, JCI)		x				2
Average						**1.40**

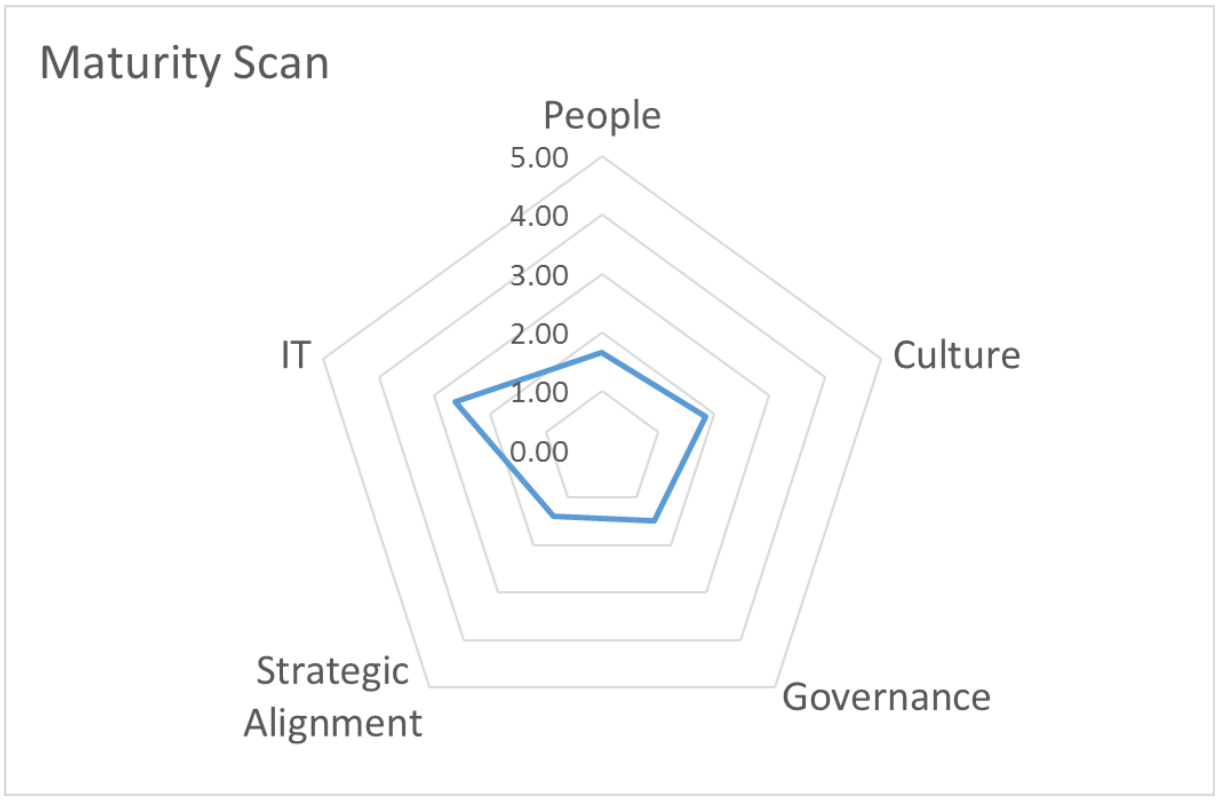
Capability scores for the IT factor

IT	**1**	**2**	**3**	**4**	**5**	**Score**
Use of BI Tools / KPI dashboard		x				2.5
Securing process models in a digital quality management system			x			3
Connecting process descriptions with working procedures		x	x			2.5
EHRs for supporting the primary process		x	x			2.5
Average						**2.63**

Summary of factor average scores

Factor	Score
People	**1.67**
Culture	**1.86**
Governance	**1.50**
Strategic Alignment	**1.40**
IT	**2.63**
Average	**1.81**

Radar chart visualising the maturity across five factors



Appendix VII. Conference Paper

29th Bled eConference

Digital Economy

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Using the Delphi Method to Identify Hospital-Specific Business Process Management Capabilities in The Netherlands

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Abstract

Business Process Management (BPM) is an important discipline for organisations that are desiring quality improvement. Many models for assessing, comparing and improving the maturity of organisational BPM are found in literature. An effective BPM Maturity Model should contain a validated set of capability areas specific to the application domain. We attempt to fill a gap by providing a model specific to the hospital industry. This paper presents the first phase in the development of such a model. For this we use the Delphi Method, a multi-round technique for collecting rich data and gaining consensus among a panel of experts. Based on the opinions provided by experts in hospitals and academia in The Netherlands, we identify relevant and domain-specific capabilities for improving BPM maturity in the Dutch hospital industry. Hospitals are characterised by complex, multidisciplinary processes. Our findings reflect that capabilities related to people and organisational culture are most important for achieving BPM maturity.

Keywords: bpm, maturity, hospitals, healthcare, process management, Delphi method

Introduction

Business Process Management (BPM) is a discipline that aims to "support business processes using methods, techniques, and software to design, enact, control, and analyse operational processes involving humans, organisations, applications, documents and other sources of information" (Weske, 2012). 'BPM maturity' is a concept used to indicate the stage of development of BPM practices. The word mature is defined as "having reached the most advanced stage in a process" or "being fully grown or developed". Within BPM, it is understood that processes have lifecycles and can be improved throughout time (McCormack et al., 2009). Improving processes and process management practices therefore leads to higher maturity, or so-called BPM maturity. BPM maturity can be assessed, improved and benchmarked using Business Process Maturity Models (BPMMs) (De Bruin, Freeze, Kulkarni, & Rosemann, 2005). A BPMM usually defines a number of maturity levels, with specific capabilities for each level. These capabilities tell us how well the organisation performs a certain competence in relation to business process management.

BPM is seen as a holistic principle to which many organisational aspects contribute. Examples of high-level capabilities influencing maturity are the alignment of organisational strategy to its operational processes, a culture of continuous improvement and the use of IT systems for supporting processes (Rosemann & De Bruin, 2004, 2005a). A wide array of BPMMs are found in literature. Some are designed for general use while others are aimed at specific domains. In this paper, we establish that existing BPMMs do not meet the specific needs of the hospital industry. The hospitals assessed in this paper face industry-specific challenges and are characterized by low to average BPM maturity. Some key challenges facing these hospitals are the aging population, rising costs and increasingly complex care pathways. The variety of specialisations and therapies is rising, while patients demand services of higher quality and shorter waiting times (Øvretveit, 2000). In response to requirements imposed by the government and accreditation bodies, hospitals must integrate their information systems to better coordinate healthcare processes. Information systems in the hospital sector are underdeveloped when compared to other sectors (Helfert, 2009), particularly in terms of low technological sophistication and integration sophistication (Paré & Sicotte, 2001). Lack of funds, failure to recognize IT as a key stakeholder in hospital decisions and the implementation of Electronic Heath Records (EHRs) are shown to be some of the top IT management issues in hospitals (Jaana, Tamim, Paré, & Teitelbaum, 2011). Thus, a BPM Maturity Model for hospitals may assist in improving BPM maturity and help to tackle these challenges, thereby improving the overall quality of healthcare.

In this paper we attempt to identify the relevant capabilities for a hospital-specific BPMM. The Delphi method is used to gather consensus on these capabilities among a panel of experts. In the following sections, we describe the Delphi method and its use in developing domain-specific BPMMs. We then describe the set-up of our case study using the Delphi method and present the results for healthcare-specific capabilities relevant for BPM maturity.

Literature Review

The complexity of process management in hospitals lies in its large variety of medical specialisations (Mans, Schonenberg, Song, van der Aalst, & Bakker, 2009). Patients may require the care of different medical specialists throughout their care process. This is also called the care pathway. A patient's care pathway can be highly variable and runs through different hospital departments. This proves to be a challenge, since data relating to the patient may be recorded inconsistently between specialists or stored in separate information systems (Mans, van der Aalst, Vanwersch, & Moleman, 2013). The complexities of healthcare processes introduce a risk of errors and unnecessary waiting times. Patients with the same diagnosis may encounter different waiting times in their process and the reasons for this are not always known (Mans et al., 2009). Earlier research shows a correlation between BPM maturity and process performance (Ravesteyn, Zoet, Spekschoor, & Loggen, 2012). Thus it follows that the improvement of BPM maturity and related capabilities may improve the process performance and quality of care in hospitals.

To identify the possibilities for improvement, we must first assess the current state of BPM maturity in hospitals. Previously collected data from over 1000 organisations shows that the Dutch healthcare and public sector score lowest when compared to other sectors (Luyckx, 2012). The difference in maturity is significant when compared to the highest-scoring financial and automotive sectors. Luyckx (2010) also identifies that hospitals are complex organisations that need to align their processes externally with other organisations (general practitioners, insurance companies) as well internally, between departments. Performance indicators and a proper reporting structure must be implemented to safeguard quality. Luyckx (2010) concludes that one of the main obstacles of BPM maturity in hospitals is the unique organisational structure: Doctors are the main decision makers within their individual departments. It is further suggested that doctors and business/IT departments within the hospital must work together on BPM decision making in order to improve BPM maturity. For the reason of developing a practically relevant model, the Delphi study will include experts with sufficient experience in healthcare. The following paragraphs describe the elements of conducting such a study, as gathered from literature.

The Delphi method is a type of study used to gather a consensual opinion from a panel of experts on a complex subject (Dalkey, Brown, & Cochan, 1969). This is done using multiple rounds of anonymised surveys. Multiple-round techniques lead to richer and more refined data than single-round techniques (Yousuf, 2007). The Delphi method prescribes that respondents remain anonymous to one another to reduce group pressures and stimulate creativity (Hsu & Sandford, 2007). For this reason, electronic distribution of surveys or individual telephone interviews are the preferred channels for conducting the study. The data collected in a round is anonymised by the researcher for use in the next round. In this respect, the Delphi method is very different from the focus group method where direct interaction between participants is encouraged. However, both the Delphi method and focus groups allow for the use of a smaller group of respondents than is the case in traditional quantitative survey-based research. This is because in a Delphi study, the focus is on the quality and richness of the collected data rather than the sample size.

The Delphi method is set up in such a way that the respondents may progress from widely-diverging opinions in the first round and converge towards consensus in the final round. For this reason, the emphasis is on collecting qualitative data in the first round and quantitative data in subsequent rounds. In the first round, the researcher may employ open-ended questions to allow for the collection of any opinions the participant may have. In subsequent rounds, the opinions are anonymised and ranked numerically by participants. By converging towards quantitative surveys, the level of consensus can be expressed statistically. A Delphi study encompasses a minimum of three rounds. More rounds may be instated in case the desired level of consensus is not yet achieved.

The general process of conducting a Delphi study is outlined as follows:

1. Problem definition: The researcher uses existing literature to frame the problem statement and provide structure to the first survey round.
2. Candidate Selection: A list of candidates for the expert panel is established on the basis of predetermined criteria. The experts are invited for participation in the Delphi study.
3. First Delphi Round: The first survey is distributed for the purpose of collecting opinions using open-ended survey items.
4. Second Delphi Round: The opinions from the first survey are summarised by the researcher into a list of statements. The summarised statements are presented in the second survey for the purpose or ranking or rating by the experts.
5. Third Delphi Round: The results of the second survey are summarised by the researcher. This shows which statements have the highest support from the expert panel. In the third survey, the experts indicate to what extent they agree with the majority opinion. Reasons may be provided for disagreeing with the majority opinion. The results of the third survey are summarised by the researcher.
6. Conclusion: When sufficient consensus is achieved, the final results are presented to the expert panel. Otherwise, a fourth survey may be initiated where reasons for disagreeing with the majority opinion are evaluated by the panel.

In the final round of the Delphi study, quantitative survey items are used to be able to derive statistical proof of consensus. For example, the researcher may consider consensus to be achieved when the majority opinion receives an average satisfaction rating of 8 on a scale of 10 from the experts. The level of desired consensus may be predetermined by the researcher.

Delphi studies have been used in earlier research to successfully gather data for the creation on a BPM maturity model (Rosemann & De Bruin, 2005b). The Delphi study is considered suitable for BPM research as it is a mature field, in which a sufficient collection of existing literature is available to frame the initial problem and identify gaps. In addition, mature fields have a sufficient number of experts that could serve as participants to the study. Literature identifies a number of benefits and challenges relating to the use of Delphi studies. The benefits are described as follows (Hsu & Sandford, 2007; Rosemann & De Bruin, 2005b; Yousuf, 2007):

- Multi-round setup enables the formation of consensus on a complex subject, using controlled feedback to reduce discord.

- Respondent anonymity may lead to the elicitation of more creative responses.
- Social pressures are eliminated by ensuring respondents do not directly communicate with each other.
- Surveys are administered via electronic means, making them more practical for eliciting data from geographically dispersed respondents.
- Consensus is tracked and measured in a statistical manner.

Challenges relating to Delphi studies are defined as follows (Hsu & Sandford, 2007; Rosemann & De Bruin, 2005b; Yousuf, 2007):

- A sufficient number of experts willing to commit to participation in multiple rounds is needed.
- The experts must allocate a significant amount of time to complete all rounds and may drop out due to survey fatigue.
- Waiting times are introduced, as the panel can only progress to the next round after the current round has finished.
- Response coding is vulnerable to the introduction of bias by the researcher.
- Coding the responses is time consuming and requires more effort as the number of participants increases.

Existing literature on the Delphi method does not impose specific minimum or maximum limits to the number of respondents that must be included in a Delphi study. Compared to traditional quantitative research, a smaller number of respondents is deemed acceptable since rich data is gathered from a targeted group of experts. In this regard, the necessary number of respondents should be compared to that of a focus group session.

A wide variety of BPM Maturity Models is available in literature. Because of the many types of maturity models, each with their own measurement instrument and design principles, it becomes difficult to specify what makes a maturity model useful and applicable in practice. Previous research has attempted to provide design principles or frameworks for the design of maturity models (Becker, Knackstedt, & Pöppelbuß, 2009; De Bruin et al., 2005; Pöppelbuß & Röglinger, 2011). Critics state that maturity models may be too rigid (not responsive to characteristics of the organisation and its environment) or oversimplified (try to provide a one-size-fits-all formula for success) (Pöppelbuß & Röglinger, 2011). Some of the basic design principles include a clear definition of the target audience, the method of application, the application domain and the intended respondents (De Bruin et al., 2005). Defining these principles helps to frame and design the Delphi study. Vice versa, the Delphi study allows us to identify agreed-upon capability factors that are relevant to and applicable within the chosen domain. By using the Delphi method for capability identification and clearly describing the research process, we attempt to overcome the limitations of some earlier models.

Study Design

The study encompasses the application of the Delphi method in the hospital domain, for the purpose of identifying relevant capabilities for a BPM Maturity Model. A panel of participants was composed using pre-existing contacts from a research group at our institution. A minimum of five respondents was considered necessary for gathering sufficient variety in opinions. Contacting potential candidates resulted in a panel composed of six experts employed at Dutch hospitals and one academic researcher with prior experience in healthcare. The panel has an average of 11.7 years' experience (s = 10.7) in the healthcare industry, with a minimum of four years' experience.

Prior to starting the Delphi rounds, the six participants from practice were asked to rate the overall level of BPM Maturity of their organisations. This was done on the basis of the five levels of maturity defined in an established general-purpose model (Harmon, 2004). The model prescribes five distinct levels of organisational BPM Maturity: (1) Initial, (2) Repeatable, (3) Defined, (4) Managed, (5) Optimised. We also asked the participants to state their expected maturity level in five years. Two of the participants indicated currently being at level 2, while four participants indicated their organisation at level 3. All participants indicated an expected increase of one maturity level in the next five years. By using this quick assessment of self-perceived organisational maturity, we gain a general understanding of the characteristics of the sample.

We use a framework to define the necessary criteria for a Delphi study (Day & Bobeva, 2005). These criteria and the related characteristics form the starting point for conducting the study. These are listed in Table 1 below.

Criterion	**Characteristic**
Purpose of the study	Building
Number of rounds	Three
Participants	Homogeneous group
Mode of operation	Remote access
Anonymity	Full
Communication media	Internet, Telephone
Concurrency of rounds	Sequential set of rounds

Table 1 Characteristics of the Delphi study

The surveys used for data collection are distributed electronically. This facilitates the anonymous collection of data from geographically dispersed respondents. The participants are invited to the study via telephone, with additional details and instructions sent via e-mail. A period of three weeks is allotted to each round of the Delphi study to both ensure continuity of the study while allowing sufficient time for the experts to provide their response. Anonymous identifiers (ID codes) are used to track each participant in the study. This allows participants to see which responses belong to the same participant. The researcher uses these ID codes to keep track of the progress of each participant. Their true identities are known only to the researcher. An online survey platform is used that provides the functionality of setting pre-filled fields, so that ID codes can be attached to each survey individually.

The Delphi study was conducted in three rounds, which were set up as follows:

1. Round one: Collection of opinions on relevant capabilities for maturity in six factors derived from literature (Rosemann & Vom Brocke, 2010): Strategic Alignment, Governance, Methods, IT, People, Culture. Also rating each factors on a scale from one to ten
2. Round two: Rating each capability provided in a previous round on a scale from one to five.
3. Round three: Presenting an overall ranking of all capability, based on a weighted score based on the capability rating multiplied by the factor rating. Participants indicate a threshold value for relevant capabilities and rate their overall agreement with the findings.

The results of the Delphi study are described in the following section.

Results

At the end of the Delphi study, we arrive at a list of the most relevant capabilities that influence BPM maturity in hospitals. This list is based on the consensus achieved throughout the survey rounds by the participants involved in the study. During the survey rounds some participants were no longer willing or able to be involved in the study and therefore dropped out. Table 2 below shows the number of participants in each round.

	Practice	**Academia**
R1	6	1
R2	4	1
R3	3	1

Table 2 Number of participants in each round of the Delphi study

In the first round, participants rated their perceived importance of each of the six factors. Table 3 below shows the ratings given by the participants. Within each of the six factors, participants provided an open-ended answer with capabilities they deem important.

Factor	**Avg. score out of 10**	**Std. dev.**
People	9.14	1.60
Culture	8.86	1.27
Governance	8.57	0.90
Strategic Alignment	8.29	1.90
IT	7.57	0.69
Methods	6.86	0.90

Table 3 Factor ratings (average out of 10)

In the second round, all collected capabilities were rated for importance by the respondents, on a scale from one to five. The capability ratings were multiplied with the factor rating (seen in Table 3) to arrive at a weighted score for each capability. The weighted score is on a scale from 1 to 50. The distribution of weighted capability scores is shown in Figure . The capabilities are colour-coded depending on the factor they belong to. This shows that cultural and people capabilities are generally the highest-scoring. Scores for governance, strategic alignment and IT capabilities are more dispersed. Methods capabilities score lowly overall.

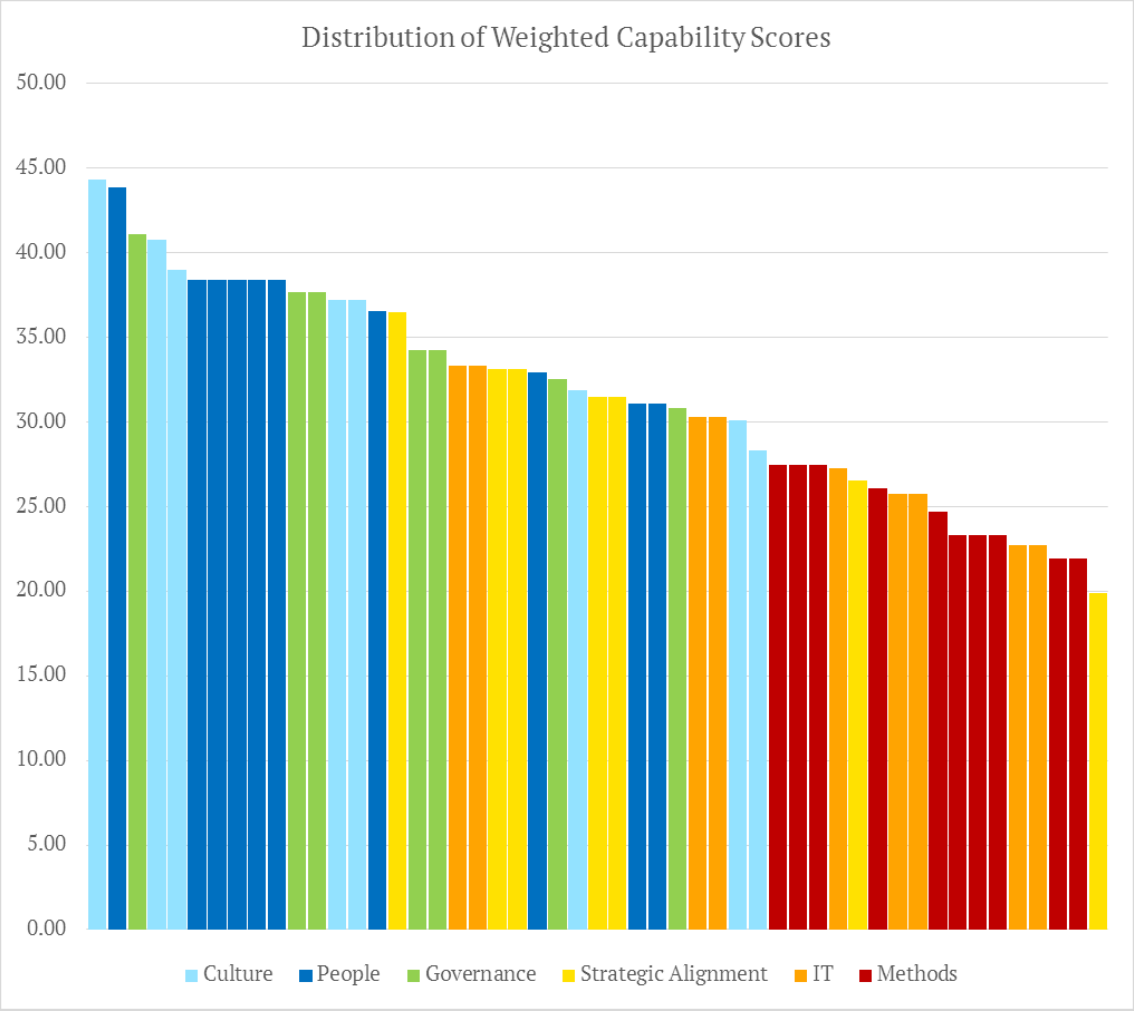

Figure 1 Distribution of weighted capability scores

In the third round of the Delphi study, participants were asked to provide an opinion on their agreement with the ranking of the entire set of capabilities. Also, they were asked to provide a threshold value for which capabilities should and should not be included in the final model. Based on the input, the threshold value was set at 30. Capabilities belonging to the methods factor are no longer included, since they all scored below 30. This results in a model with the most important capabilities across five factors. Table 4 shows the thirty-three included capabilities, grouped by factor and sorted by weighted score.

Factor	Capability	Capability Score	Weighted Score
People	Assigning Process Owners	4.8	43.87
	Availability of primary healthcare staff	4.2	38.39
	Knowledge sharing	4.2	38.39
	Training in describing and optimising healthcare processes	4.2	38.39
	Training in KPI-based steering	4.2	38.39
	Using pilot projects to foster participation	4.2	38.39

	Clarifying the importance of the individual in the process chain	4.0	36.56
	Training in combining line management and process management	3.6	32.90
	Flat organisational structure	3.4	31.08
	Freedom and responsibility to internalize processes	3.4	31.08
Culture	Management Commitment	5.0	44.30
	Involvement of Healthcare Professionals in Process Improvement	4.6	40.76
	Intrinsically motivated improvement culture and management style	4.4	38.98
	Assigning a process management ambassador within management or the board	4.2	37.21
	Creating awareness of current issues	4.2	37.21
	Culture elements from LEAN	3.6	31.90
	Open culture	3.4	30.12
Governance	Specification of tasks & responsibilities	4.8	41.14
	Use of outcome indicators	4.4	37.71
	Setting goals	4.4	37.71
	Governance based on soft skills (collaboration, behaviour, accountability)	4.0	34.28
	Prioritizing process management for high-risk business goals	4.0	34.28
	Agreeing on following process descriptions	3.8	32.57
	Frequent evaluation of progress in process management initiatives	3.6	30.85
Strategic Alignment	Providing insight into the value chain	4.4	36.48
	Process Improvement Business Cases	4.0	33.16
	Process Management Goals in organisational mission, vision and strategy	4.0	33.16
	Patient Reported Outcome Measures (PROM)	3.8	31.50
	Accreditation Standards (NIAZ, JCI)	3.8	31.50

IT	Use of BI Tools / KPI dashboard	4.4	33.31
	Securing process models in a digital quality management system	4.4	33.31
	Connecting process descriptions with working procedures	4.0	30.28
	EHRs for supporting the primary process	4.0	30.28

Table 4 Capabilities included in the proposed BPM Maturity Model for hospitals

Conclusions & Discussion

Considering the results of the Delphi study, we clearly see the human-related factors jump out (People & Culture). Participants agreed that hospitals are very people-driven organisations. Involvement and commitment of management executives as well as primary personnel (healthcare professionals) is paramount to achieving continuous process improvement. We also notice the need for soft skills such as knowledge sharing and intrinsic motivation.

When including the results of the Governance and Strategic Alignment factors, we notice that participants indicate a necessary shift towards process-based thinking. Traditionally, departments within hospitals are functionally divided. The results show that responsibilities must shift towards the process level in order to properly manage processes. Many of the hospitals included in the panel are taking steps to define the value of each activity in the process and thereby gaining insight into their value chain. This requires organisations to clearly define what exactly constitutes value for the patient.

The final two factors, IT and Methods, were rated relatively lowly. Participants agreed that these factors are supporting in nature, and should 'follow' the measures taken on other levels. Due to differing organisational characteristics, it is not possible to clearly rank a specific method or type of information technology as being the most suitable. This explains the relatively low ratings in these factors. We conclude that hospitals must select IT and Methods that best serve their strategic needs for process improvement as well as fit their organisational characteristics. In the IT factor, there was more consensus in regards to the use of business intelligence tools and electronic health records (EHRs). However, in the Methods factor, there was no sufficient consensus since Methods are deemed very situational. For this reason, the included capabilities no longer include the Methods factor and are therefore method-agnostic.

A possible limitation of this study is its limited sample size in a very specific domain. All participants came from institutions located in The Netherlands. Political, economic or demographic variables may influence the healthcare processes in other nations differently. In future research, we intend to generalise the model by testing its validity in other markets. Another caveat is the fact that the hospitals included in this study exhibit averagely developed BPM capabilities (maturity level 2 or 3). This may skew the findings towards capabilities most relevant for this level of maturity, as we have no data on hospitals with higher maturity levels. Through broader application of the model in Dutch and international markets, in institutions with different levels of maturity, we will attempt to gain a deeper understanding of the capabilities and how their maturity is improved.

Opportunities for future research include further development of the maturity model using the identified capabilities. This will require the establishment of maturity levels or stages against which an organisation can be measured. Furthermore, the actual measurement instrument must be developed and tested prior to deployment in the domain. Currently, the identified capabilities are purely descriptive. It is not yet known which interventions will lead to a higher level of maturity for a specific capability. Further applying and developing the model may

eventually lead to a prescriptive model, which does not only help to assess maturity but also supports improvement.

This research paper identified relevant capabilities for improving BPM Maturity. This was done using the Delphi method, so that consensus could be established among a panel of experts. By applying the Delphi method and clearly describing the process, we attempted to overcome the limitations of some earlier models. We also aimed to fill a gap by identifying hospital-specific capabilities that are not yet captured in existing BPM Maturity Models.

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