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IT Performance measurement for Dutch Hospitals

Master's thesis Industrial Engineering & Management

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October 2013

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Public version

Management Summary

Performance of IT is complex. So is performance of hospitals. This master's thesis studies ways to measure IT performance at a Dutch hospital, with the aim of providing management information on the functioning of hospitals.

Background: the increasing competitive hospital sector has been faced with the introduction of market mechanisms. This will shift to an increased funding per diagnosed treatment combination, instead of a steady inflow of money from the government. This in turn means that hospital's managers have an incentive to optimize hospital functions, and save money on staff functions, such as IT.

Purposes: this thesis introduces a model to measure IT performance in the specific context of Dutch hospitals. Furthermore it explores ways the constituent factors of IT performance influence each other, and how the concerning hospital can improve its IT performance. Lastly it reflects on how to optimally conduct research on hospitals.

Methodology: a case study is performed at a large Dutch academic hospital. On constituent factors of IT performance, indications are made whether the hospital has to improve, is on target, or can consider the rating as a fully achieved objective.

Findings: IT performance can be divided into four dimensions, according to a modified version of the balanced scorecard:
- IT financial aspects
- IT control
- IT innovation
- IT user's perspective

Each containing subdimensions. The balanced scorecard is an already used management information method, and is acceptable by the organization. Research on relations between the different dimensions should be conducted in longitudinal research and / or in a benchmark, in order to make the best conclusions.

Gathering data turned out to be difficult, as hospitals were reluctant to invest time and money in this investigation about IT. This could mean that hospitals currently do not value IT, or do not consider it means to more efficient functioning of the hospital. As a result this thesis is based on research at one large Dutch academic hospital. To achieve reliable data, conclusions are drawn on data obtained from multiple sources.

Practice implications: the proposed model aims to introduce an accessible and meaningful way to give a quick scan of a hospital's performance on IT. IT should not only be steered on financially, as it has benefits in control, innovation and user's perspective dimensions.

In order to achieve a high number of participating hospitals in research projects, it is important to understand their environment of monetary cutbacks and a push from the government for achieving more efficiency in hospitals with less means. Thus a research should be as simple and less time consuming for the hospital as possible.

Due to the sensitive nature of research data, a public version of this thesis is presented in which all data are anonymized that could identify the hospital.

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Preface

Information Technology is everywhere around us. While people have been working with information from the beginning of mankind, from the 1950's on IT became booming with the invention of the transistor. This invention enabled people to work with electronic information technology. And while this area of expertise started with great separation from other research and business areas, in current times IT is unarguably linked to all business departments. And when personnel is regarded: almost everybody has to work with IT in present times. IT no longer stays within the boundaries of the IT department. This provides great opportunities to organizations. And reversibly it provides great potential threats. If Information Technology is not applied correctly, many – if not all – processes and people within an organization are affected.

Information Technology is a giant possibility and at the same time a giant threat to organizations. This is what motivates me to write my master's thesis about IT performance. Besides that, hospitals form an essential part of our society. Everyday life-saving decisions are made, and quality of life of countless people is enhanced in hospitals.

Yet due to this difficult societal task of taking care of people, hospitals and most of their personnel do not have IT as their main focus. This reliance of the IT function within a hospital, combined with the attitude of personal that is not necessarily focused on IT, made me very interested in finding out what IT performance at hospitals is, and how to improve this. PricewaterhouseCoopers Accountants N.V. shared my enthusiasm and wanted to benchmark IT performance of 20 hospitals. Eventually this benchmark resulted in one case study at a large Dutch academic hospital. The scientific thesis about this case study, used literature and its conclusions about both the used model and about IT performance in the concerning hospital, are described in this report.

I want to thank my three supervisors, PwC, and the concerning hospital for making this master's thesis possible.

Robert Landheer

October 2013

1. Introduction to this project

In this chapter the research approach will be given and elaborated. As hospitals are under increased pressure to spend money more efficiently, the synergy between IT costs and IT's performance is relevant. Aim of the research project is to define the synergy between IT costs, IT control, IT innovation and the user's perspective of IT in the Dutch hospital sector. To achieve this, it is necessary to define each of these dimensions. When this is done, a case study is performed about the performance of a large Dutch academic hospital, regarding each of the four dimensions and to see what use of the dimensions lead to best practices.

1.1.   Background

This thesis has a scientific goal and a goal for the company at which it is performed for.

Scientific goal

Scientifically, the goal of this project is to create a new performance rating technique for IT of Dutch hospitals. This would be a model that fills the gap between organizational performance rating models, IT performance rating models and the healthcare sector. Ideally this model would be useful for all Dutch hospitals, by providing them a better means to get to know their own IT performance.

Goal for PwC

"PwC firms help organizations and individuals create the value they're looking for," according to PwC's international's home page (PwC, 2012). PwC is one of the worldwide big four accountancy firms, and does even far more than accounting only. PwC The Netherlands has three main divisions: Assurance, Tax, and Advice. Each division is divided further on in business units for specific tasks. All units focus on a specific market segment.

This research is performed at the Business Assurance Services (BAS) branch of PwC The Netherlands, at the business unit focusing on System and Process Assurance of Private Companies & Public Sector (SPA PC&PS).

SPA PC&PS has two main targets:
- to determine if (financial) IT systems and processes used at client companies that ask for financial assurance from the accounting branch, are in order;
- to give advice to client companies about IT systems and processes, e.g. about the implementation and performance of an ERP system.

Hospitals belong to the client segment of the SPA PC&PS group. Thus a research aiming at IT systems & processes at hospitals fits well within the profile of this group: by auditing the current status of IT systems and processes at the hospitals, PwC helps these organizations to get insight in their IT environment or to know their IT maturity.

Furthermore, PwC wanted to benchmark the different hospitals to give them an overview of their relative performance compared to other Dutch hospitals. PwC frequently audits the IT at hospitals and then determines if the environment meets requirements, that are set by PwC or the government. These guidelines are created and used in order to rely on financial information processed by the IT systems. But by the process of auditing, clients have no indication whether they perform different than their colleague hospitals. That is where the benchmarking aspects enters.

Benchmarking is defined as 'a method to compare a function, activity, or process of an organization, with best practices of other organizations, and on the basis of this to improve the own activities, in order to deliver excellence' (Vries & Togt, 1995).

For successful benchmarking, a high number of representative participating hospitals is required. This is due to the fact that random factors have to calculate out of the equations and not become part of a conclusion. So if there is a high number of participating hospitals, only numerical data is enough in order to state conclusions. If the number of participants is low, more detailed information has to be obtained from participants in order to

make sure that valid conclusions can be drawn. This can be done by performing a case study at concerning hospitals, in order to validate the conclusions that are drawn.

1.2.   Goal of the project

With this master's thesis and internship project, PwC helps hospitals to receive a better insight in their IT environment. In turn hospitals themselves are enabled to create the most value and control out of IT when they possess of this information.

Giving an insight in the hospital's IT environment is done by providing a view from outside and indicating important Key Performance Indicators about them, which previously they might not have known, and thus did not steer upon.

PwC delivers professional services to its client organizations. One of the main focuses of the SPA PC/PS department is to check the reliability and control of IT systems affiliated with (financial) data. A large added value of PwC is that they have IT audit professionals, who have a lot of experience with many different IT systems and organizations, and that these professionals have an objective view, and a view from outside the organization. This in contrast to IT employees of the hospitals, who might be subjective due to a specific concern and interest when the functioning of their department or their work is audited.

1.3.   Research questions

For this thesis, two central research questions are posed. The first central question can be divided into 5 subquestions.The goal of this thesis is to come up with an answer to this question by looking into literature and regarding the practice at hospitals. The first central research question is:

1. How can IT performance of Dutch hospitals be measured?

This leads to the sub questions:

1a. Which organizational performance models are available in literature?

1b. What is IT performance?

1c. What do differences between Dutch hospitals and 'standard organizations' imply for organizational and IT performance?

1d. How can the organizational performance models be adapted for use in IT performance of Dutch hospitals?

1e. What is the IT performance of the concerning large Dutch academic hospital?

The above research question mainly focuses on analyzing available literature. For a company as PwC and its clients it is helpful to know the perceived value of a model in reality. This leads to the second main research question:

2   What is the perceived added value by the concerning hospital using the model from the first main research question?

Table 1: Overview of research questions with chapter and page at which they are discussed

Research question	Discussed in Chapter:	Starts at page:
1. How can IT performance of Dutch hospitals be measured?	6 Four dimensions of IT Performance Management in Dutch Hospitals	23
1a. Which organizational performance models are available in literature?	3 Organizational performance management in literature	12
1b. What is IT performance?	4 IT Performance and its constituents	16
1c. What do differences between Dutch hospitals and 'standard organizations' imply for organizational and IT performance?	5 Special context of Dutch Hospitals	21
1d. How can the organizational performance models be adapted for use in IT performance of Dutch hospitals?	6 Four dimensions of IT Performance Management in Dutch Hospitals	23
1e. What is the IT performance of the concerning large Dutch academic hospital?	7 Case study: findings at a large Dutch academic hospital	37
2. What is the perceived added value by the concerning hospital using the model from the first main research question?	7 Case study: findings at a large Dutch academic hospital	37

1.4.   Relevance of this research project

The Dutch and worldwide populations are aging: more and more people will retire. Around 2039 an absolute peak in the number of seniors is expected (Garssen, 2011) (Kinsella & Phillips, 2005). Elderly people will require more medical attention, with a contradicting reducing amount of working people that is able to provide this care and pay for it through insurance. Aim of this research project is to provide insight in IT performance at hospitals; and to provide and validate a performance model for IT in hospitals.

Privacy and information security become important, with an increasing amount of patient information being digitally available. Laws and norms are created by the government and sector representative associations to regulate IT in the health care sector. This research helps hospitals get an assessment in how they are acting according to regulations, and helps them achieve this in an efficient way.

Goal for PwC is to provide hospitals insights in their IT performance. This can prove useful if hospitals want to assess their own performance.

Value for participating hospitals is achieved by providing them (anonimized) IT performance information of colleague hospitals. In turn they have to provide detailed information on their own IT performance.

1.5.   Research strategy

Firstly a literature study is performed on the topics of the research questions. Consecutively a theoretical model for measurement of IT performance is advanced.

A qualitative case study is performed at a large Dutch academic hospital to see what its IT performance is. And in order to answer the second main research question, the hospital's staff are asked if practice confirms the opinion of the hospital's IT performance given by theoretical model's outcomes.

1.6.   Outline of this report

This report consists of several sections. At first an introduction to the problem and the research question(s) are given. In the next chapter the research design and the research methodology are elaborated.

Next, a review of available literature is made. Performance models are reviewed and worked out in order to come up with a performance measurement model valid for IT performance at Dutch hospitals.

This model forms a hypothesis that is tested for relevance in the views of people working in practice at a large Dutch academic hospital. This case study will be described in chapter 7.

In the subsequent chapter a discussion is made regarding the findings of the case study.

In the last chapter, conclusions about the research project and the model are drawn, and recommendations are made for further research.

1. Introduction	**INTRODUCTION & RESEARCH QUESTION**
2. Research Design & Methodology	**DESIGN & METHODOLOGY**
3. Organizational Performance Management	
4. IT Performance Management	**LITERATURE REVIEW**
5. Special context of Dutch Hospitals	
6. Four quadrants of IT Performance managment in Dutch Hospitals	**HYPOTHESIS**
7. Case Study: findings at a large Dutch academic hospital	**RESULTS**
8. Discussion	**REFLECTION**
9. Conclusion	**CONCLUSION & RECOMMENDATIONS**
10. Recommendations	

Figure 1: schematic overview of the research structure of this report

2. Research Design & Methodology

In this chapter a description is given of the design and methodology of this research project.

2.1.   Research Design

This paragraph explains how a research set-up is made of which data is to be collected, and how to process this in order to come up with valid conclusions.

Explanatory research is conducted on factors contributing to IT (Information Technology) performance. This research answers the question how and why these factors contribute. This research is done by a literature review.

As in paragraph 1.3 'Research Questions' is given, the first main research question will be answered by consecutively answering its sub-questions. This is displayed in figure 2 below.
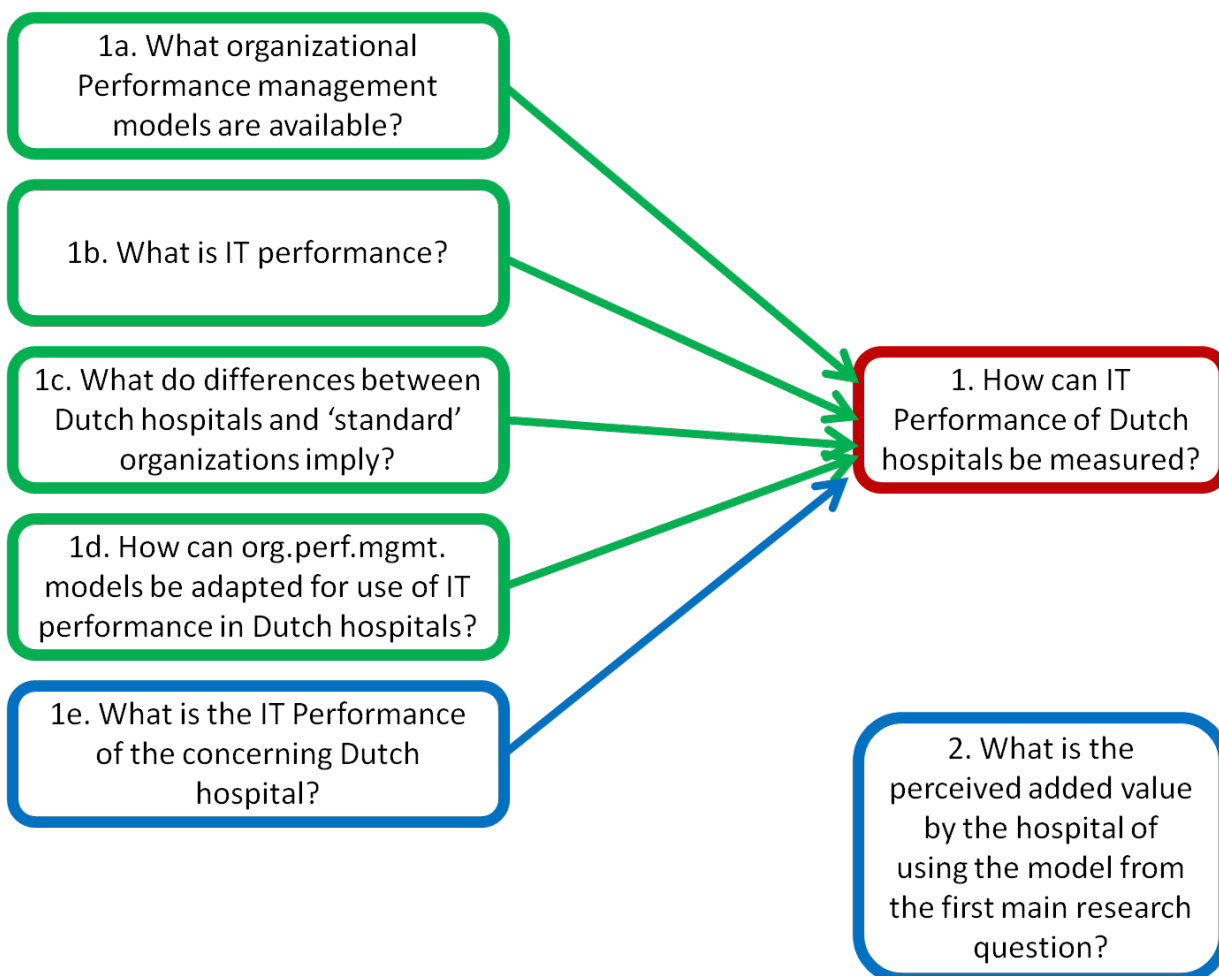
Figure 2: schematic overview of answering the first main research question. (Legend: Green indicates literature study; blue indicates case study)

Sub questions 1a through 1d are answered via a systematic literature study. The research is designed so that a systematic search on the topic of the concerning research question delivers results for the concerning question, and eventually the main question. These are thoroughly checked and if they seem plausible (for instance in a comparison with other literature) they are brought up as conclusion. The conclusions are also compared with the propositions.

Sub question 1e and main research question 2 are answered via a case study. This case study is designed to retrieve information about the whole organization from embedded units. The data collection is done at both individual and organizational level as displayed in figure 3 below. This makes the units of observation:
- some of the staff members
- some of the embedded organizational units within the organization
- the organization as a whole.
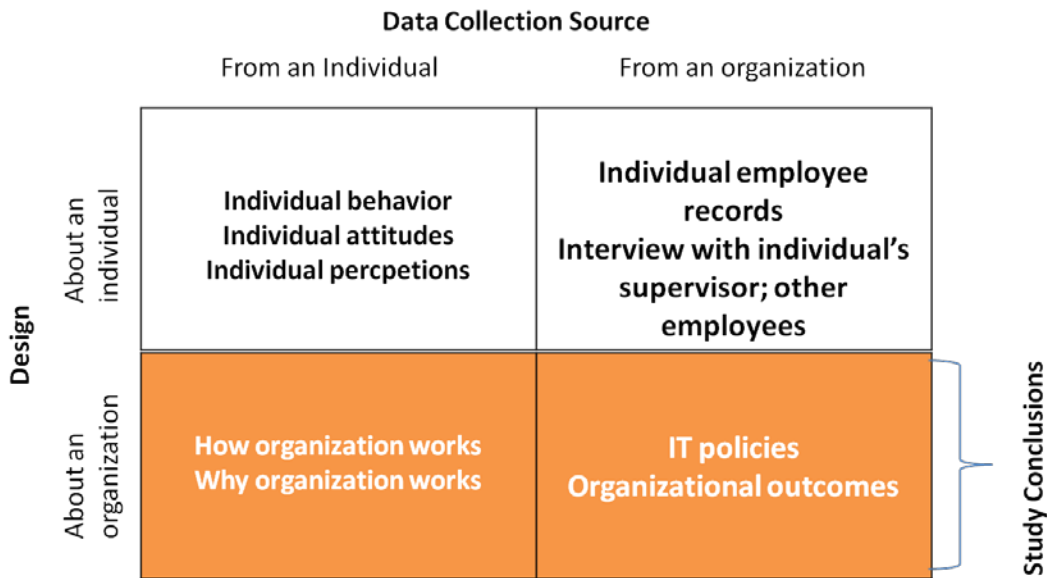
Figure 3: Design versus Data Collection and relevant units of analysis shown in the lower row (free after Yin (2009).)

Propositions
Propositions are derived from working experience of PwC IT auditors. The proposition is that the construct of IT Performance consists of four dimensions:

- IT Costs
- IT Control
- IT Innovation level
- IT User's perspective.

These four dimensions have sub dimensions, which have in their turn indicators. These subdimensions and indicators are researched in the literature study.
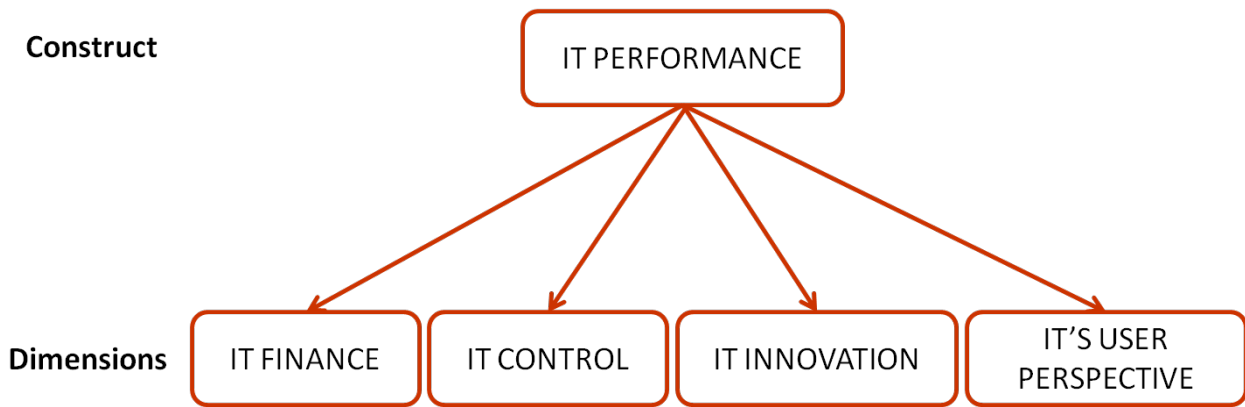
Figure 4: Research construct and dimensions displayed (free after Vaus (2001) and Kaplan & Norton (1996))

The details about this proposition will be given in Chapter 6 "Four dimensions of IT Performance Management in Dutch Hospitals." This proposition and proposed model are derived from literature in Chapters 3 till 5.

Unit of analysis
The unit of analysis is the whole organization in this project.

Case study questions
To collect data, surveys covering the distinct topics mentioned in the proposition are made. They specify the area of research of quantitative and qualitative questions that are deemed to be of importance. Interviews are held with the organization's staff in order to retrieve documentation and data and the person's own objective and subjective views of the matters asked.

Logic linking the data to the propositions
The collected data are all indicators that are related to several dependent variables, which are in turn factors of IT performance. After the literature study in chapters 3 till 5 is performed, this theoretical model and its constituent factors of IT Performance and it's indicators are elaborated in chapter 6.

When interpreting data, it is important to realize which part of an organization the variable could refer to. Essentially when looking at an organization from outside, it functions as a black box. Image a simple factory: raw materials, and personnel enter in the morning. Work is being done during the day, and at the evening the products are finished and sold. It is not necessary to know what happens inside the factory, however it is important to know whether a measured construct refers to an input, a process or an output of the factory. This is indicated in figure 5 below.

In chapter 6 the specific model and its variables are mentioned. In this chapter the distinction between these three types of variables is indicated.
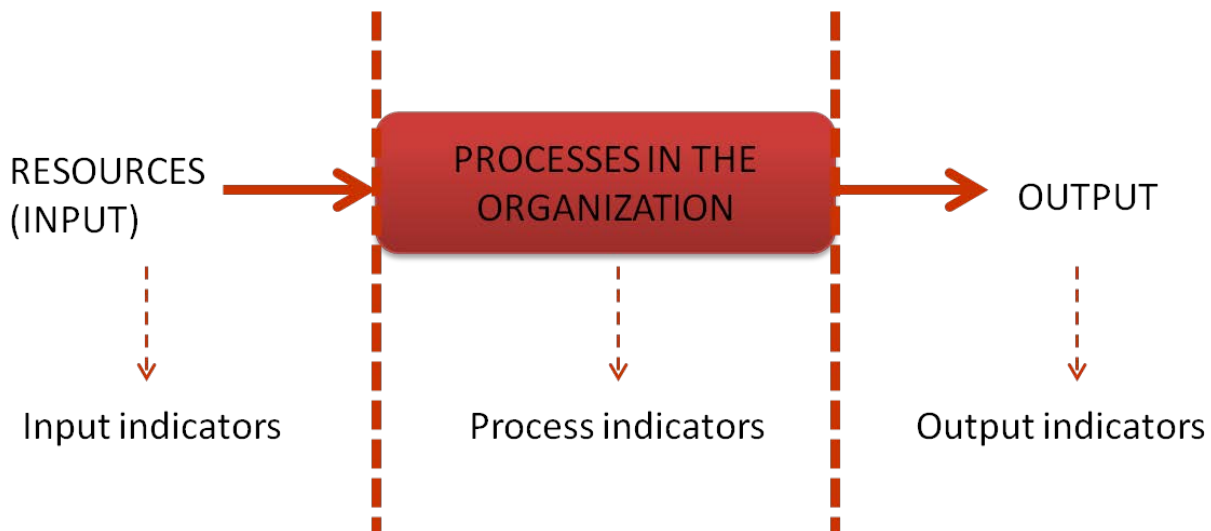
Figure 5: Input, Process, and Output indicators placed in organizational perspective

Criteria for interpreting the findings

At the end of this chapter, validity issues are described that can influence the reliability of the conclusions. As these factors of validity are identified, it is described in the corresponding sections how they can be resolved.

2.2. Research Method

To conduct this research, two methods of information gathering are used. A literature study of IT performance in history is performed. Furthermore a case study at a large Dutch hospital is conducted.

In the five paragraphs below it is described how the sub research questions are answered. Answering all sub questions, makes it possible to answer the main research questions.

Sub question 1a: 'Which organizational performance models are available in literature?' is answered by looking into libraries and internet searches for the topic of 'organizational performance models,' 'performance management,' and 'quality management.'

Sub question 1b: 'What is IT-performance?' is answered by doing a literature study on the topic of 'IT performance management.'

Sub question 1c: 'What do differences between Dutch hospitals and 'standard organizations' imply for organizational and IT performance?' is answered by performing a literature study and asking this question to people at PwC and at the concerning hospital.

Sub question 1d: 'How can the organizational performance models be adapted for use in IT performance of Dutch hospitals?' is answered by combining the knowledge from sub questions 1a, 1b, and 1c.

Sub question 1e: 'What is the IT performance of the concerning large Dutch academic hospital?' is answered by conducting a case study at a large Dutch academic hospital. How the case study is conducted is explained in the sub paragraph at the end of this paragraph about methodology.

Main question 1: 'How can IT performance of Dutch hospitals be measured?' can now be answered with the above knowledge.

Main question 2: 'What is the perceived added value by organizations of the model from the first main research question?' can be answered by interviewing hospital staff about their professional opinion of the designed model under the first research question. Also concrete advice is given based on the outcome of the model, in order to achieve added value for the participating hospital.

Conducting the case study

In this situation a case study is the preferred way of obtaining research data, because IT performance is depending on many interrelated factors, which cannot be manipulated systematically in a laboratory to conduct an experiment. The IT performance of a large Dutch hospital is crucial to its patients and staff and cannot be experimented on. So in this case there is little or no control over the set of events, but the researchers are still interested in the outcome of the events. According to literature a case study is ideal for this situation (Yin, 2009).

Also the historic literature review serves as a way to come up with significant factors and questions for the case study interview.

For the goal of identifying possible relations between factors, most of the questions asked during the case study are qualitative.
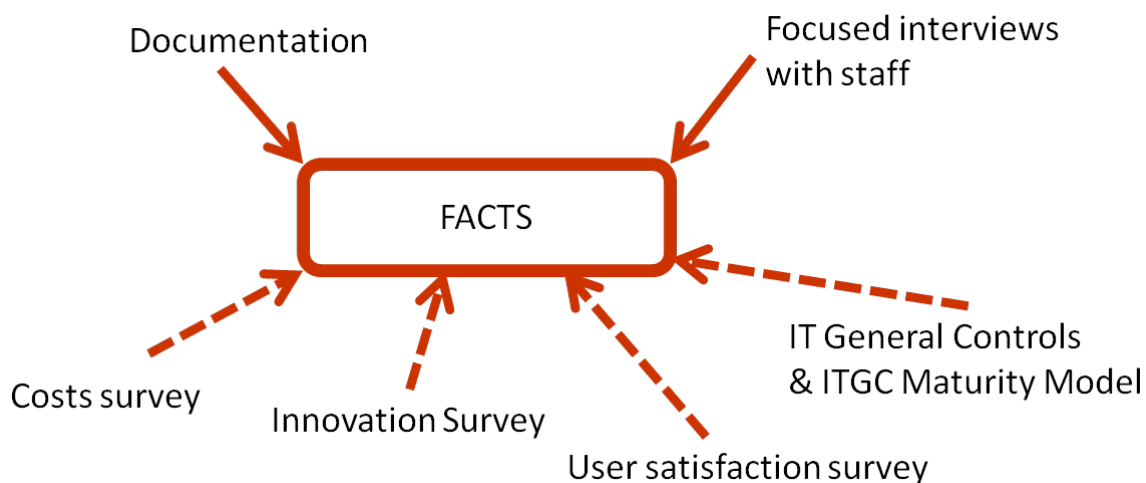
The way of data collection during the case study is displayed in figure 6 above. Evidence is obtained from at least three sources:

- Documentation
- Focused interviews with staff members
- At least one of the following:
  - Costs survey
  - Innovation Survey
  - User Satisfaction survey
  - IT General Controls & ITGC Maturity Model

This way of working to collect data from multiple sources in order to establish solid facts is essential for a single case study. Especially when performing interviews with staff members, the obtained data can be subjective. If data from multiple sources lead to the same facts, or at least do not contradict each other, then they can be considered to be true (but still applicable to discussion at the end of the thesis due to validity questions).

Grounded Theory

During the case study, large amounts of data are obtained. This data can be checked for confirmation with the theories as mentioned in the proposition. But there is a second theory of possible data explanation: grounded theory. According to Denzin & Lincoln (1998): "Grounded Theory is a general methodology for devoloping theory that is grounded in data systematically gathered and analyzed. Theory evolves during actual research, and it does this through continuous interplay between analysis and data collection." This way of gathering data and analyzing it is kept in mind in the data gathering and analyses phase, to constantly check if the obtained data could lead to other conclusions.

2.3. Data processing and analysis

When performing a qualitative case study, the goal is to understand the organization and topic being researched. "Coherence and order are searched for," according to (Kaplan & Maxwell, 2005). A very important aspect is that everything encountered in the organization is potential data. No matter how small a detail may seem, it could be an indicator of a larger variable which influences the causal chain and thus the internal validity of a research. Internal validity is elaborated on in the next paragraph. Overlooking such a detail might thus give the researcher the idea that his conclusions are based on valid causality, while in fact the conclusions might not even be based on reality. This can be overcome by making sure that the scope of data collection is not set too rigidly in advance (Kaplan & Maxwell, 2005).

"The processes of data collection, data analysis, interpretation and research design are intertwined and depend on each other," (Kaplan & Maxwell, 2005) as displayed in figure 7. This means that all these processes cannot be specified fully until the research has ended. Until this time the displayed circle keeps continuing.
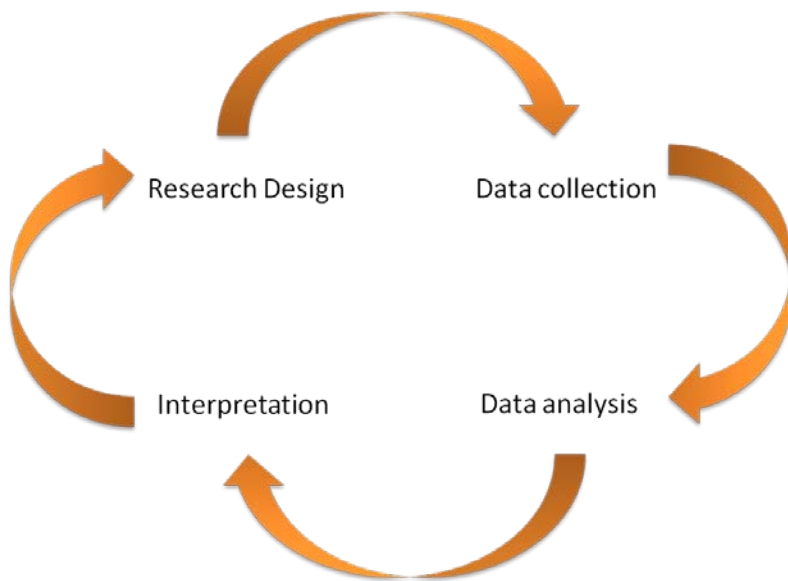
Figure 7: Data analysis should be an ongoing activity throughout the whole research (Maxwell, 2005)

Data analysis is being done on the facts obtained by using the data gathering tools in the section above (see figure 6) while being enhanced with using analytical memos and displays. With memos, writings made by the researcher based on his perception, related to the research are meant, that are not direct obtained data or transcripts. Displays are visible forms of data or ideas, such as matrices, flowcharts, and concept maps (Kaplan & Maxwell, 2005).

2.4. Validity issues

As with all research, validity of the final conclusions based on the data and its processing is a very important topic. This paragraph addresses validity issues that are occurring due to the chosen research design. In chapter 8 a discussion is made on how the research has been conducted, what the quality of the available data was, and how validity issues have influenced the final conclusions.

2.4.1. Validity influenced by subjectivity of researcher

In this case study, qualitative research is done by a researcher. This person is concerned with doing data collection and data analysis. Because in this case the researcher is the instrument for collecting and analyzing data, the study features some subjectivity. Had the researcher been another person, the gathered data, and/or the analysis could have been different.

2.4.2. Construct Validity

Construct validity is the way in which the operational measures are truly a representation of the concepts that are to being studied (Yin, 2009). By means of data triangulation (e.g. obtaining multiple sources of data that lead to the same conclusion, see figure 6) this validity issue can be mitigated (Yin, 2009).

2.4.3. Content Validity

Content validity is a measure to which a measure represents all facets of a given construct and thus actually represents the construct (Westen & Rosenthal, 2003). In this case this is of importance if the four constituents of IT Performance are collectively exhaustive and together truly represent IT Performance. If they do not, it means that an important aspect of IT performance is overlooked, and that it is more difficult to draw valid conclusions.

2.4.4. Internal Validity

The conclusions are internally valid, if the causal chain that is supposed and analyzed appears to be valid (Vaus, 2001). All the above mentioned validity issues (researcher subjectivity, construct and content validity) negatively influence the way (relevant) data are gathered and how conclusions are drawn based on this data. This makes all above validity issues an integral aspect of the internal validity of this research project. Internal validity should be assured by the research design.

2.4.5. External Validity

Several distinct groups of hospitals can be made: academic hospitals, general hospitals, and clinical hospitals. External validity is the measure in which the conclusion that can be drawn from this project, can be generalized to be applicable to the whole group of objects that belong to the group (Vaus, 2001). For single case studies external validity tends to be a higher threat than internal validity, and thus enough measures should be taken to assure a high external validity (Gerring, 2007).

Of importance is that the hospital that is being analyzed can be considered as a representation of all Dutch academic hospitals. If this is the case, than valid conclusions for the hospitals that was being analyzed can be generalized to this group.

3. Organizational performance management in literature

In the previous chapters an introduction into the problem and this thesis were given, and the research design, research methodology, and validity were elaborated. This chapter will focus on the topic of organizational performance management. Many models are discussed. In the paragraph a conclusion will be drawn on which models are used with application within hospitals in mind.

Performance management is visible everywhere. A company could check its profit, a person could check her bank balance or weight, and a pilot could check air speed. These are all examples of indicators for a greater underlying principle: success. These basic Key Performance Indicators (KPI's) vary for every entity, depending for instance on aim-for-profit, sector, or culture (Remenyi, Bannister, & Money, 2007). So for success, KPI's have to be formulated, reality has to be measured and compared with KPI's, and lastly the organizations has to act according to the findings.

Performance management is essential in answering the main research question and the first subquestion. In this chapter a review of available literature about performance management model for organizations is made. Goal throughout the chapter is to see which models are available , whilst bearing in mind that they could be used for IT performance management.

There are many models to measure performance of organizations; with each model being best suited for different situations than other models. Throughout time new models have come up in existence and others have been disused and forgotten.

The comparison can be made with an airplane: if the pilots have to measure the performance of a plane while in flight with only access to an air flow meter for measuring speed, they would not at all know if they are doing a good job. So in order to know if they are not about to collide with another airplane, or to know where they are, or to know how high they are, a lot of other instruments are required. In industrial engineering & management, business models are the used instruments to measure performance of the company in question.

3.1. History of performance management

Performance management of companies is off all ages, but has significantly changed throughout time. Prior to the 1930's, most entrepreneurs invested on basis of their expectations of making profit in the future (Remenyi, Bannister, & Money, 2007). John M. Keynes regarded an investment as something which should return a yield (Keynes, 1937), a view which became popular and is still used today in various performance measurement models. Originally this yield is regarded as solely financial.

An overview of the models used throughout the years, beginning with the oldest method:

- Possibility for the project to generate a profit (regardless of investment costs)
- Yield Calculations
- Return on Investment (RoI), Net Present Value (NPV)

At the time of writing, almost all emphasis in business performance management is placed in measuring and enhancing Return on Investment (RoI) (Cooper & Schindler, 2011). However other literature suggests that the objectives and quantities that should be measured are continually evolving, and thus performance management systems should evolve with them (Kennerley & Neely, 2002).

3.2. Quality management

Quality management is a concept related to performance management; where the latter focuses on performance of the organization, quality management focuses on achieving the best possible quality of products, through the products themselves, the business processes, or both. However quality is a concept very difficult to define (Tennant, 2001), and the different models mentioned in the following chapters define quality differently.

A difference between performance management and quality management is, that the former regards the outcome of a process. While the latter considers the process itself. In this way quality management can be

regarded as a means to achieve better performance. So these processes do not have to be mutually exclusive and organizations can benefit from implementing both.

Different methods of quality management are discussed below.

Total Quality Management
Total Quality Management (TQM) is a method to make sure all activities in a company are continuously optimized to deliver the highest amount of quality to the customer. All participants in the firm are stimulated to take customer quality in account in their actions at every stage. So at first thought the model focuses on the customer perspective, although there seems to be scientific conclusion that TQM positively affects business performance (Perdomo-Ortiz, González-Benito, & Galende, 2009). So by focusing on customer perspective, by trying to achieve to deliver the best quality for the customer, the whole business could gain an advantage.

Lean Six Sigma
Six Sigma is a quality management method aiming to deliver almost all products (with a 6σ derivation of normal distribution, or 99.99966% of products) with perfect quality. It achieves this by aiming at the employees, processes and customer (Tennant, 2001). This method is mostly aimed at manufacturing industry with a highly standardized production process.

It is often combined with Lean, which aims at minimizing waste, through eliminating money, material, and time consuming steps in a process (Lean Enterprise Institute, 2009). Lean Six sigma primarily focuses on logistical and factory processes.

Holistic view popular in recent times
In more recent theories, a more holistic view is brought up. It does not mean an organization should solely try to optimize its outcomes (by focusing on performance), neither should it only optimize its processes (by focusing on quality). It should do both by focusing on all stakeholders. In this way, performance management can be regarded as a holistic definition and its main question should be "What are the wants and needs of our key stakeholders?" (Neely, Adams, & Kennerley, 2002).

Balanced scorecard model
It can be very easy, but wrong, to consider Information Technology expenses as a way of just losing money. With this finance-only view, it would be the best option to save as much money as possible on IT. However, IT fulfills a support function for the whole organization. So an investment in IT could reduce other time and/or money consuming projects. Not to mention that a good functioning IT environment can save much frustration from users.

The above illustrates that only looking at costs and trying to minimize these, is not always the best strategy for a company in order to achieve an overall good performance. In 1996 Robert Kaplan and David Norton created a model for this and called it the *Balanced scorecard model (BSC)* (Kaplan & Norton, 1996).This model considers four aspects that should all be regarded when a vision and strategy of a company are made. This is displayed in figure 8 below.
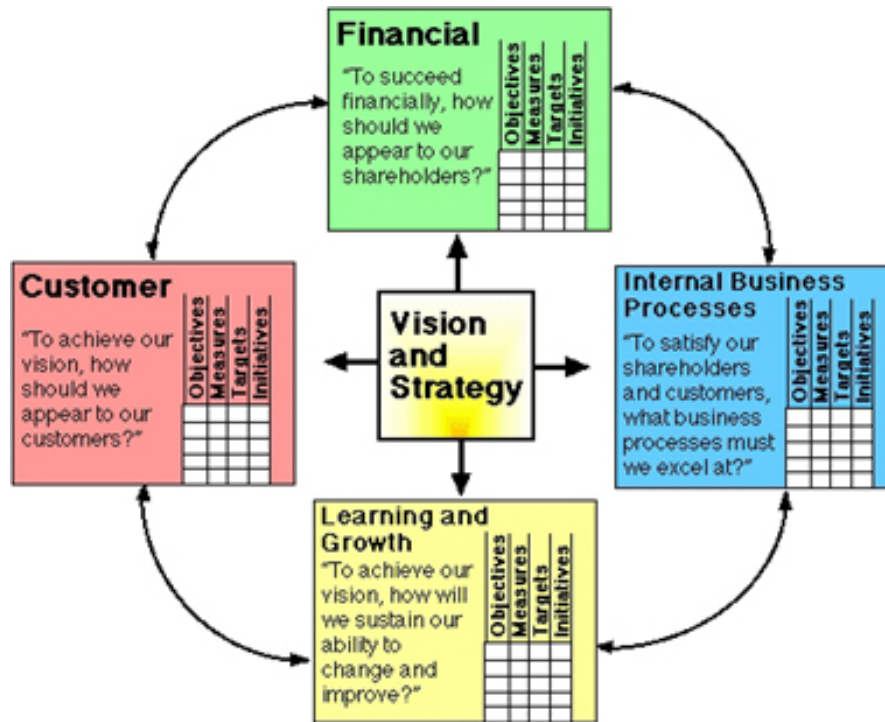
According to the Balanced Scorecard four aspects play an important role (Balanced Scorecard Institute):

- **Financial aspect.** How should the organization succeed financially and how should it appear to its shareholders.

- **Internal business processes.** Which processes should the organization consider most important and thus try to excel at.

- **Learning and growth.** How can the organization change and improve in order to achieve its vision.

- **Customer.** How to appear to customers in order to achieve the organization it's vision.

3.3. Benchmarking as performance measurement

With TQM the customer is considered when taking decisions in all layers throughout the organization. With BSC not only the customer, but three other aspects (financial, learning and growth, internal business processes) are taken into account. There is one thing these models do not take into account: the way competing organizations function. This is not a fifth aspect, but could assist the different organizational performance measurement methods by showing best practices. That way organizations that apply TQM and/or BSC do not have to start from scratch when trying to improve.

Benchmarking is an excellent tool to see how an organization is performing relative to one or more competitors. Benchmarking can also be performed with organizations active in different business sectors (Vries & Togt, 1995). Key Performance Indicators are stated for each company and comparisons are made based on these KPI's.

In order to compare correctly and draw valid conclusions out of these data, it is important to make sure the same constructs are measured within companies (Vries & Togt, 1995). This can be achieved by specifying questions, and requiring one way of answering in detail. Obtaining comparable data is also achieved by making sure the questions are asked to people in comparable functions in the organizations that are used in the benchmark group.

The context of the obtained data is of great importance when comparing organizations. In the benchmarking process itself, no judgment is made and no conclusions are drawn between the companies. But nevertheless the organization that has commissioned the benchmark would probably want to draw conclusions out of the data. For instance, if very high costs are shown at a specific area, it would be all too easy to conclude that an organization is bad-performing on that area. But if these costs are due to an investment or reorganization, it can be expected that in a short time the company will perform significantly better. In order to counter this challenge, the context of the data in the benchmark for each organization should be given. This can be achieved for instance by holding interviews with appropriate people after the question lists have been filled in (Vries & Togt, 1995)

3.4. Financial performance measurement theories

There are many financial performance measurement indicators present, because many organizations are primarily financially evaluated by their stakeholders. In the paragraphs below, the most predominant are given.

3.4.1. Average payback time

When using this measure, the total investment costs of a project are taken and divided by the average annual benefit. This indicates the time needed for a payback of the investment (Lefley, 1996).

$$Average\ payback\ time = \frac{Investment\ cost}{Average\ annual\ benefit}$$

This measure only takes into account the financial costs and benefits, assumes them to be average over time and does not let the time dimension influence the benefits, which are all substantial downsides for use in non-investment situations.

3.4.2. Net Present Value

The Net Present Value (NPV) method takes into consideration the time effect of future benefits. When this is considered and the NPV is positive, then a project can be undertaken and this will result in a total (financial) benefit (Ross, 1995).

$$Net\ Present\ Value = \sum_{t=1}^{T} \frac{(Benefit - Cost)_t}{(1+r)^t} - Costs_0$$

With t as years, T the total number of years the investment will last, r the interest rate and C_0 the investment costs at year 0.

This method only takes into account financial benefits and costs, which provide down sides.

3.4.3. Internal rate of return

The method internal rate of return (IRR) compares the project with putting money on a savings account and calculating what the amount of yearly interest would be on this savings account to break even with the investment project (Remenyi, Bannister, & Money, 2007). For financial purposes this is a good comparison.

It is calculated as the r in the NPV-formula from the above paragraph, such that the NPV is zero.

3.5. Chapter Summary

When reviewing the above-mentioned models, many models consider organizations or processes different than hospitals, or only take into account financial performance. The Balanced Scorecard model is usable as it leads to four pillars that constitute organizational performance that are together taken into account when forming an overall judgment on performance. The theory of the Balanced Scorecard will be used as a framework for the model concerning hospitals' IT performance.

4. IT Performance and its constituents

While in the previous chapter organizational performance was considered, this chapter will focus on the performance of the Information Technology function of an organization.

Traditions in organizations can date from long ago, as some organizations have existed for hundreds of years. Information Technology is a more recent business, as the word was mentioned for the first time in 1958 (Leavitt & Whisler, 1958). With the advent of Enterprise Resource Planning systems, IT systems became generally used inside corporations for virtually all administrative functions.

Furthermore IT has changed its role during the last decades. It developed from being supportive in providing information on demand, into governing processes in organizations at every level.

Due to this relatively recent advent of IT systems, performance management of IT performance is still developing rapidly. This can be seen when comparing predominantly used forms of IT performance measurement throughout the years, as is done in Remenyi, Bannister, & Money (2007). As Information Technology has been growing and transforming from a backoffice to a frontoffice role, the ways of measuring it have changed too. Most recently (since the 2000's) the advent of the Balanced Score Card has been apparent for the measurement of IT performance (Remenyi, Bannister, & Money, 2007).

4.1.   Three visions on IT

In literature, there exist three distinct ways how IT can be regarded (James G. Anderson, Kathryn J. Hannah, Carolyn E. Aydin, & Marion J. Ball, 2005):

- IT as an external force
- IT as controlled by managers and clinicians
- IT as determined by complex social interactions within the organization.

It should be noted that these visions are purely theoretical. They are explained below.

4.1.1. IT as an external force

IT can be regarded as "an exogenous force in relation to the organization, that brings about change in the behavior of individuals and organizational units (James G. Anderson, Kathryn J. Hannah, Carolyn E. Aydin, & Marion J. Ball, 2005)." When this view is applied, management sets goals, and IT systems are deployed to meet these. It then is demanded from employees that they work with these systems, or otherwise these employees are dysfunctional. When this view is adapted, IT's performance management and measurement usually focuses on technical performance, such as costs, speed, and accuracy (James G. Anderson, Kathryn J. Hannah, Carolyn E. Aydin, & Marion J. Ball, 2005).

A big downside of this way of evaluating is that the organization and social interaction is not considered at all. And at the same time organizational and technological characteristics are considered as invariant and not changing in time (Lyytinen, 1988).

This vision has disadvantages, as mentioned above, because it does not regard some influential variables. However due to the relatively easiness of availability of the required data (costs, speed, and accuracy) it is not difficult to apply this vision and determine IT's performance based on this vision.

4.1.2. IT as controlled by managers and clinicians

The second perspective assumes that managers and clinicians set the goals for and design of IT systems. This changes IT from being exogenous to being endogenous to the organization, as organization members have control over the system (James G. Anderson, Kathryn J. Hannah, Carolyn E. Aydin, & Marion J. Ball, 2005). Organizational staff can thus change the Information Technology systems in a rational fashion as needs are identified and problems solved (James G. Anderson, Kathryn J. Hannah, Carolyn E. Aydin, & Marion J. Ball, 2005).

4.1.3. IT as determined by complex social interactions within the organization

The third perspective is the most complex, and considers IT as being determined by complex social interactions within the organization (James G. Anderson, Kathryn J. Hannah, Carolyn E. Aydin, & Marion J. Ball, 2005). As people can have different ways of thinking, this means that implementation and evaluation of IT systems is subject to changing requirements for different people and culture within the organizational units.

4.1.4. Theoretical perspective of research depends on level of organization

When all three theoretical perspectives above are taken into account, it can be concluded that IT goals, and thus evaluating its performance, can differ greatly, depending on the level of influence and change the organization has directly on the IT system. This influence that organizational units and its employees have on IT systems, varies with the specific niche of the IT system. Enterprise Resource Planning and thus systems using financial data, are usually enrolled throughout the whole organization, as the whole functioning of ERP systems is based on usage in every stage of the primary process. In this case ERP systems determine the workflow and personnel should simply follow this, as they cannot influence the design. For niche sectors within an organization, such as maintaining workflow and archives of X-ray scans within the radiology department of a hospital, a smaller system could be used that is directly controlled by the medical and department's personnel. In this case evaluating the small IT system of the radiology department should use the complex third perspective (IT based on social interactions), and reviewing performance of the ERP system should use the narrow first perspective (external force).

4.2.   Financial IT Performance Measures

Several 'crude' financial investment techniques exist to ascertain financial performance of IT. When looking at IT investments they can be evaluated via the mentioned measures in paragraph 3.4 Financial performance measurement theories.

4.3.   BiSL / ASL / ITIL

These three processes primarily focus on the IT Functional Application Management department within the IT column.

A distinction is made between the demand and supply sides of the IT organization. Demand focuses on the primary business (user), and supply focuses on the IT processes and staff that supply the business with IT. BiSL is a process that focuses on the demand side of the IT organization. ASL and ITIL zoom in on specific departments within the supply side of information technology (Best, 2011).

All three measures can be very useful when auditing processes within the IT department, and the way a department reaches out to its users. However, these processes all focus in detailed level on the IT organization, instead on the managerial level taken into account in this research project.

4.4.   COBIT

Control Objectives for Information and Related Technology (COBIT) aims to assure the quality of IT for management, as it is their final responsibility. If after all the IT fails, the business function of the organization cannot function (IT Governance Institute, 2007).

In order to give this assurance, COBIT divides metrics in attributes, which can be given a maturity in six different levels from 0 (non-existant) to 5 (optimized) (IT Governance Institute, 2007).
- 0. Non-existent
- 1. Initial / Ad Hoc
- 2. Repeatable but intuitive
- 3. Defined
- 4. Managed and Measurable
- 5. Optimized

The metrics taken into account are derived from business and from IT. The IT metrics can be divided into IT General Controls, and Application Controls.

IT General Controls are embedded in every IT function and can include (IT Governance Institute, 2007):
- Systems Development
- Change management
- Security
- Computer operations

Applications are on the edge of IT and Business, as IT implements the change process required for the application, and maintains it. The Business function uses the application and defines the control environment. Therefore COBIT only takes into account the development aspects of application controls (IT Governance Institute, 2007).
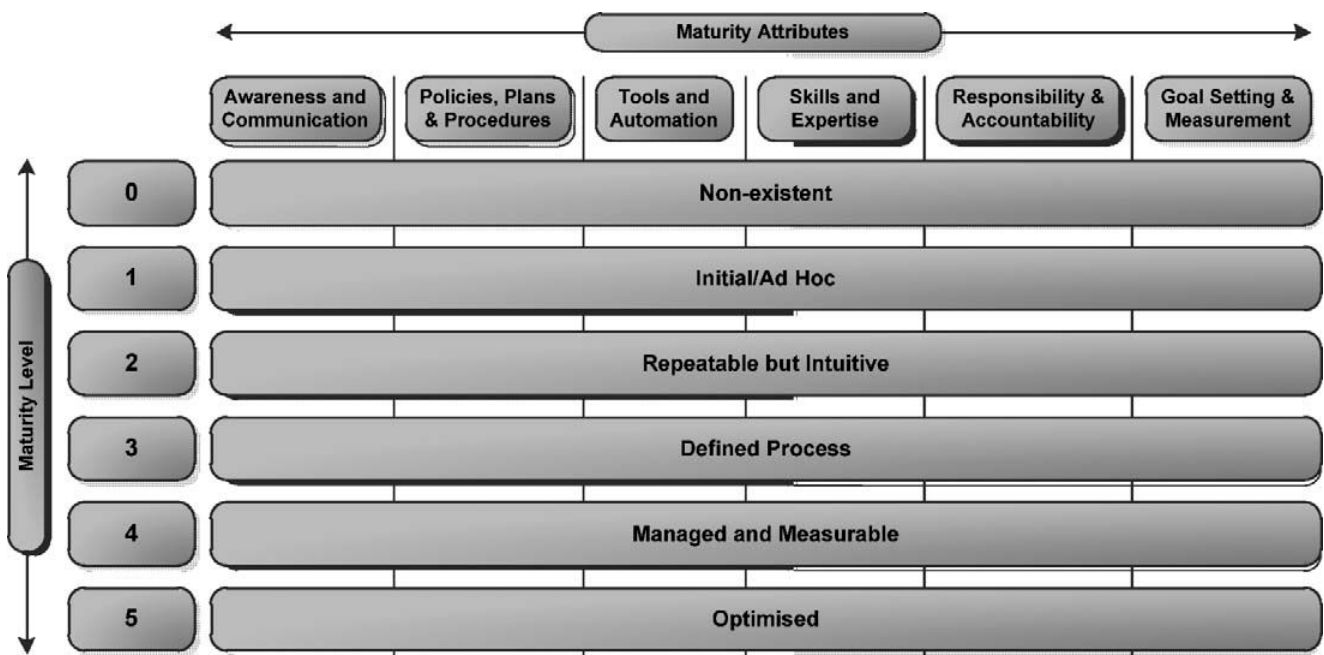
Figure 9: COBIT framework for maturity determination (Debreceny & Gray, 2013)
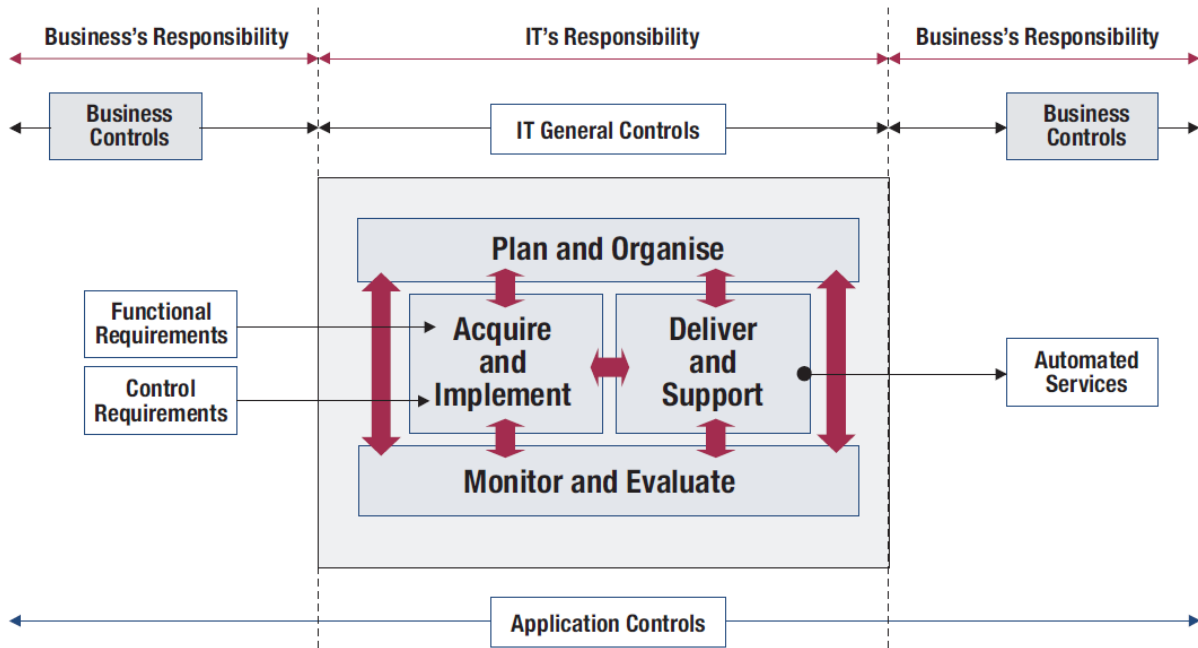
Figure 10: Boundaries of Business, IT General and IT Application Controls (IT Governance Institute, 2007)

4.5.   IT as enabler for an organization

Even when IT is seen as an exogenous factor, it is important to know if it still is in line with the organization's goals and helps realizing them. A good way of determining IT performance would be to get to know for each organization, what their objectives are and how IT could help achieve these overall business objectives (Boer, Vandecasteele, & Rau, 2001). This is connected to the next paragraph 4.6 'Alignment between business and IT.'

4.6.   Alignment between business and IT

Strategic alignment between the general organization ('business') and between the IT organization is desirable for maximum value of IT investments. This alignment must also be true at a more functional level, where IT processes should support business processes (Henderson & Venkatraman, 1993). This is the core of a very widely used model for the display of match between business and IT, at both strategic and organizational level.

In this model, a quadrant can be drawn between Business and IT at one hand, and strategic level (external) and the organizational level (internal). This gives a quadrant in which six alignments can be made. This is visible in figure 11 below.
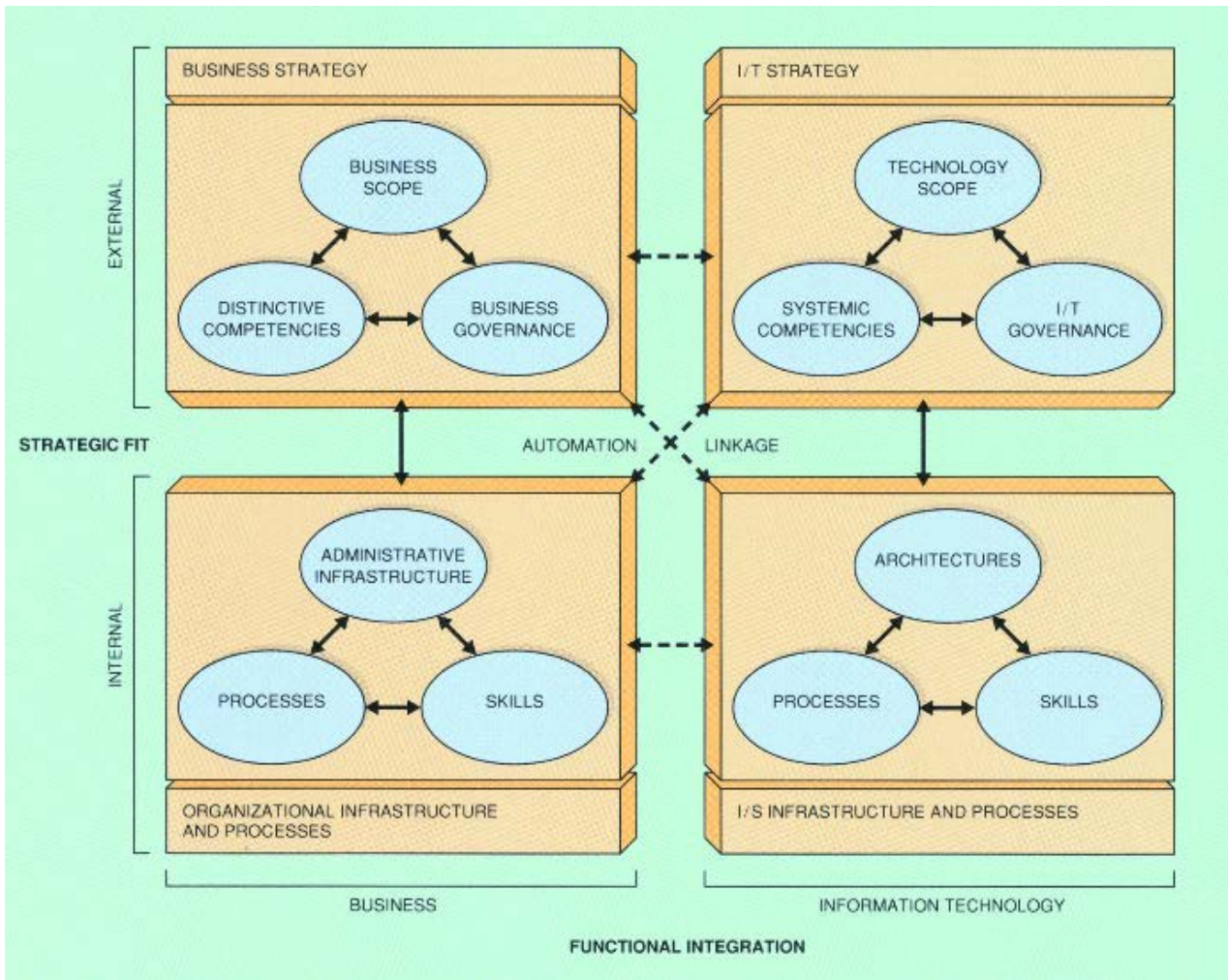
According to the model, an advantage based on IT is not solely based on the IT capabilities, it is based on the ability to continuously exploit the ability of IT. If this ability is continuously present, it is said that the both processes are functionally integrated.

A mismatch between IT externally (strategic level) and IT internally (infrastructure & processes level) is a major reason for failure to derive benefits from IT-investments (Henderson & Venkatraman, 1993). Thus the alignment between IT at both levels is a measure for IT performance.

4.7.   Chapter Summary

With the omni-presence of IT in hospitals, all personnel members are influenced by it and want to be involved in its development. Therefore, the theory that IT should be regarded as determined by complex social interactions within the organization is used further on.

Strategic alignment between Business and IT is also essential. Furthermore, IT should be aligned at internal and external contexts.

COBIT provides a framework to measure the IT performance, as it defines essential IT General Controls (Systems Development, Change management, Security, and Computer operations) and how to measure their maturity on a scale from 0 to 5. These four areas of IT performance, and maturity rating, are taken into account in this research project.

5. Special context of Dutch Hospitals

This chapter compares hospitals with traditional producing companies for which many of the previously mentioned theories are written. Aim is to see if the traditional performance management models are valid for use on hospitals, and if not, how they can be adapted.

5.1. Goal of hospitals vs. goals of traditional organizations

Hospitals consist of staff who want to cure patients. Traditional companies consist of people who create a product or deliver a service, with as goal for the company to generate a profit out of this activity. With a little effort, a hospital could be regarded as a typical production company, with as product treated patients and as production assets the medical personnel. Nevertheless it should not be forgotten that medical staff might not follow procedures all the time and may consider treating a patient as their primary objective.

5.2. Regulated market economy in hospitals

In traditional economics, if a supplier faces an increasing demand, he rises the price of his products. He can do this until the heightened price exactly makes sure the optimal profit is achieved, with an optimal amount of products being demanded for.

Currently a lot of Dutch hospitals can't offer direct treatment to patients. Most patients are put on a waiting list. If such a hospital would act according to traditional market economy, it's prices would rise and demand for treatment would drop, exactly to the point where the hospital would make the most profit. Probably the waiting lists would disappear, and rich people are treated sooner than in the current situation. But of course people who cannot pay the heightened prices are not treated.

The above example of market economy is considered undesirable in Dutch politics, as is a planned economy. That is why in The Netherlands, the government has chosen for a regulated market economy via healthcare insurers (RIVM, 2010).

5.3. Hospitals feature overall higher educated staff

In a hospital, most of the personnel has a medical background or has followed other higher education. For instance the Dutch VU hospital features approximately 70% higher educated personnel (VU Medisch Centrum, 2012). For comparison: in the process industry only 27% of the personnel has followed higher education (Breukelen, Koolhaas, & Kumpe, 2000). As many organizational performance theories are derived from traditional production or process industries, applying these theories at hospitals should take this difference into effect.

5.4. Hospitals can feature self-employed physicians

Many hospitals are consisting out of groups of physicians working together. These groups are internally based on hierarchy, with the most senior doctors being owner of the group. These senior doctors are self-employed. This comined with the hospital being dependent on these physicians, makes them very influential in the hospital's decision making process (Folland, Goodman, & Stano, 2007). So in contrast to most traditional companies, there is no hierarchical top-down decision making structure in the hospital.

5.5. Political perspectives play a role in health care

Although health and technology may be considered a private good, there is still a large public debate about the division of costs and availability of care (Lehoux, 2006). Also many Dutch health insurers were formally controlled by the government, due to the beneficial role for society. This makes healthcare institutions and especially hospitals as large hubs for healthcare subject of many public debates in politics. Thus, in contrast to most mangers, hospital mangers should be aware of the public function their organizations perform.

5.6. Patient-centered care

The patient in a hospital is the product, when viewed from an industrial engineering aspect. However in reality patients are human beings. They are 'even' gathering in patient associations.

The healthcare sector, and especially hospitals, provide a specific environment for IT performance evaluation. For patient care, a high availability of data is required. There are also strict requirements and regulations for the security and privacy of IT systems within the healthcare sector. This makes that a valid model for IT performance measurement in the healthcare sector should be adapted from overall IT performance theories.

5.7. Hospital systems transfer patient information

A hospital treats patients, by transferring them from different departments within the hospital. This can be compared to a traditional production factory, which transfers inputs to outputs via various departments. The largest difference is that in the hospital's case, people are concerned. Above all, patients should be able to trust their doctor. In order not to breach doctor – patient confidentiality, extra privacy and sensitivity must be ensured.

5.8. Laws & Regulations

Specific laws concerning privacy are made by the Dutch government, some specifically for the Dutch healthcare sector. The law concerning the protection of personal data "Wet Bescherming Persoonsgegevens (WBP)" and the law on the medical treatment agreement "Wet op de Geneeskundige Behandelingsovereenkomst (WGBO)" both impact the way hospitals should manage workflow, accessibility and availability of data, and thus how they should implement IT systems (Wet Bescherming Persoonsgegevens, 2000) (Wet Geneeskundige Behandelingsovereenkomst, 1994).

5.8.1. NEN 7510

Specifically for the Dutch healthcare sector, the Dutch institute for Normalisation, has created the NEN 7510 standard aiming at information security. This is based on ISO 27001, and written more specifically towards the healthcare sector, which has specific properties, such as the handling of sensitive patient records. It assures the availability, integrity and sensitivity of all information required to provide patients with appropriate care (NEN, Dutch Normalisation Institute, 2013).

5.9. Dutch Electronic patient record system

In Holland a country-wide electronic patient record system is being implemented at the time of writing. This system is abbreviated in Dutch as EPD (translated as "Electronic Patient Record").

The NEN 7510 is normative. Achieving compliancy is an indication that a hospital complies with the WBP, the law concerning the protection of personnel data. Compliancy with the WBP is a requirement for enabling the EPD. Thus achieving NEN 7510 compliancy is not essential for hospitals. But if a hospital does comply it automatically fulfills it's WBP compliancy. If a hospital does not comply with NEN 7510, it has to prove on another way that it confirms to WBP. NEN 7510 can thus be considered as a highly recommended standard (College Bescherming Persoonsgegevens, 2013).

In 2013, it turns out that nine Dutch hospitals do not offer adequate compartimentalisation of electronic patient records. In these hospitals all staff with access to the system can access all records. Even if staff members do not need access to the files in the course of their duties. Furthermore, the access logging system for registrating which staff members access which records, is not functioning, and thus these institutions do not comply to the WBP (College Bescherming Persoonsgegevens, 2013).

5.10. Chapter Summary

The healthcare sector has some specific properties that create significant differences when taking organizational theories into regard. Patients are at the center of the staff's attention, instead of being of minor importance. Also due to the general societal task that hospitals fulfill, politics plays a role in the sector. The featured staff is highly educated and demands autonomy from the board of directors. Finally, the Dutch government provides some specific requirements that healthcare institutions, and thus hospitals, have to confirm to. This all makes that health care organizations cannot simply apply standard organizational theories, that treat decisions as simple financial problems, treat patients as products, and treats personnel as following the board's commands. With this in mind, in the following chapter a new IT performance management theory will be written.

6. Four dimensions of IT Performance Management in Dutch Hospitals

Different organizational models have been reviewed, in combination with reviewing IT performance models and Dutch healthcare sector specific demands. In this chapter these settings are combined, in order to provide a new model, measuring IT performance for Dutch hospitals.

The balanced scorecard takes into account Financial Objectives, Business Processes, Learning and Growth, and Customer Objectives. When the business perspective is changed into IT perspective, the four dimensions change as follows.

- Financial objectives are also applicable to IT
- Business Processes change to IT Processes, which are in turn assessed in IT Control Frameworks
- Learning and Growth for IT systems, is renamed innovation
- Customer objectives of IT can be considered the user's perspective.

With this change made, and with the research questions in mind, the four areas of concern of the balanced scorecard seem to resemble the aspects of the research questions, namely the before-mentioned IT costs, control, innovation, and customer perspective.

When measuring specific IT performance (as opposed to performance of the whole organization), the Balanced Scorecard could be translated to four similar IT aspects (IT costs, IT control, IT innovation, and IT customer perspective). All other important variables of IT performance found in literature can also be categorized in one of these categories. This way a model is created based on the balanced scorecard to indicate IT performance. This is shown in figure 12 below.
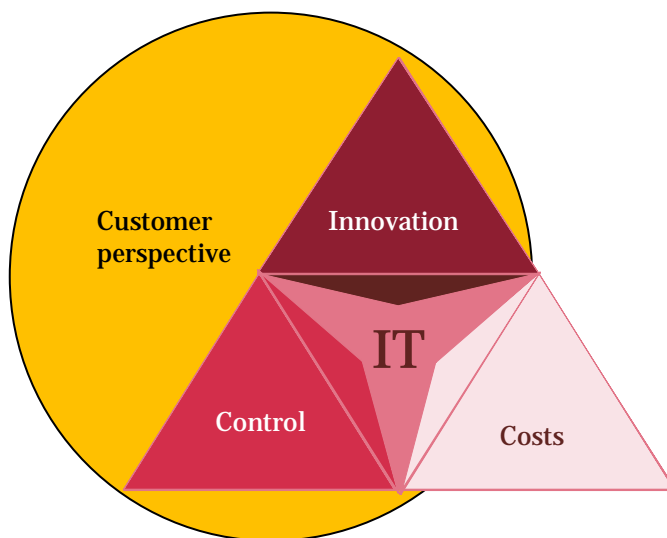
Figure 12: Model connecting IT costs, IT control, IT Innovation and IT Customer perspective (author's own)

6.1.   This case study in practice

With this model four aspects of interest are defined in order to give an indication of IT performance. A goal of this research is not only to measure IT performance, but also to *explain* it. This is essential information in order to determine if the research case can be generalized (external validity), and if the conclusions drawn on the basis of available information are correct (internal validity). Also it can be very helpful for the concerning hospital to know specifically why their IT performance is as being concluded, and how they can influence this in the future.

6.2. Four IT pillars: costs, control, innovation and customer

As mentioned above, four dimensions of IT performance can be determined, varying from measuring input, the functioning of the processes within the organization, or measuring output. This distinction is important, to ascertain their causality. The dimensions are each elaborated on in detail in the paragraphs further on in this chapter. An overview is given in figure 13. In figure 15 at the end of this section, a schematic overview is given with performance indicators per domain. Subindicators are not shown in order to keep the figure readable.

IT Performance		
IT Finance	IT Control	IT Innovation
		IT User's Perspective
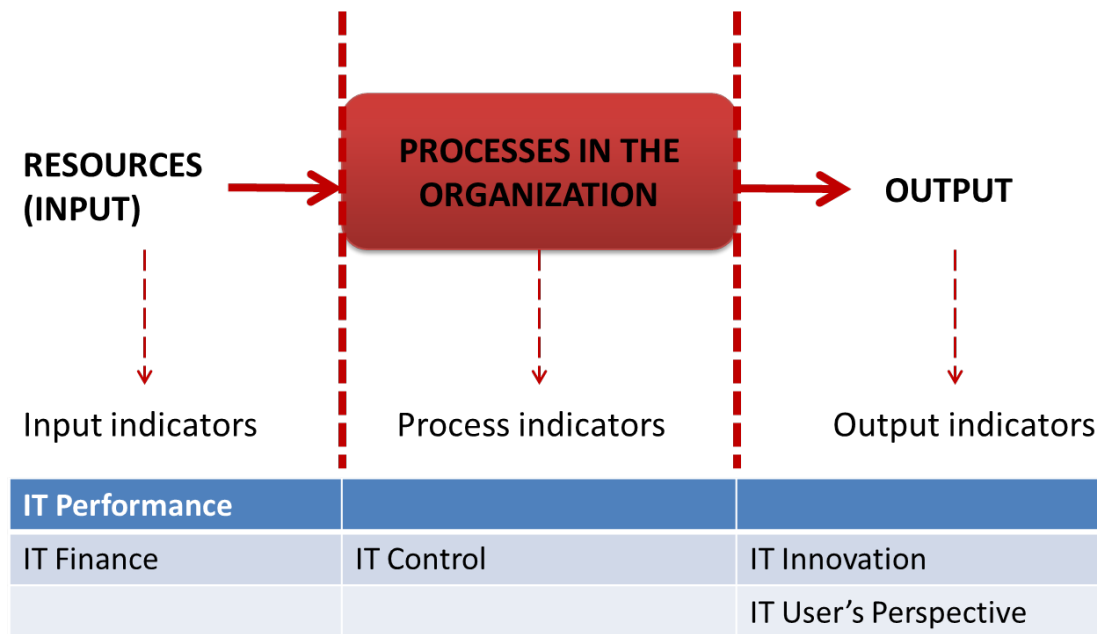
Figure 13: 3 Types of IT Performance Indicators (author's own). When processes within the organization are concerned, input indicators focus on the past and output indicators focus on the future.

6.2.1. Link between IT dimensions

As a descriptive case study is performed, it can be interesting to assess what the effect of one IT performance dimension is on another dimension. This would provide Dutch hospitals with a way of better influencing their IT performance, through knowledge of interrelations. When results are available from the case study, the relative interdependencies are stated.

6.2.2. Measuring costs of IT

Cost measurement sounds easy. However identifying costs can be very difficult for IT projects as IT costs are often accounted for as sunken costs that either way have to be made. (Remenyi, Bannister, & Money, 2007).

Financial performance indicators are generally short term. According to Boer, Vancecasteele, & Rau (2001), important financial IT costs aspects are:
- Return on Investments of projects
- Economic Value Added
- Growth in results
- Added value per employee
- Various general cost ratio's
- Internal overhead: Manager/Staff ratio

A measure that is widely used in organizations, but that is difficult to use for the sake of IT Cost in relation to performance measurement, is Total Cost of Ownership (TCO) (Remenyi, Bannister, & Money, 2007). TCO considers all current and future costs and gives all current and future costs for a project that can be expected. However this does not take into account historic costs, which is a necessity to know when wanting to evaluate IT performance.

Many financial valuation methods have one thing in common: they do not regard output of Information Technology, but only take into account money, which is considered as an input into the IT department. As return on investment, economic value added, or added value per employee might not be known in many organizations as indicated by literature (Remenyi, Bannister, & Money, 2007), on the financial basis, only input can be determined. As all organizations should have a budget this input of money for Information Technology resources can be calculated.

- The above leads to the usage of IT expenses as indicator of IT performance

Of the measures mentioned, not all are usable due to availability or way of accounting in hospitals. Return on Investment is very widespread for separate projects, with a clear defined return. But in a hospital the return is very unclear in financial terms. The same is applicable to Economic Value Added (in a hospital's case, the value added is not financial or directly economical, although without doubt everyone would agree hospitals introduce an added value to society) and added value per employee. Due to these reasons, all these mentioned methods are not used in this research project.

Growth in results is also difficult to use, because the results of the IT department are mostly non-financial. When looking at the budget and the financial figures at year-end, an indication of the level of financial control can be given. The level of financial control is taken as an indicator of IT performance, with the reasoning that when financial control is present, the environment stimulates predictability and control.

- Change between IT budget and reality is used as indicator.

Figures of IT staff supporting the IT users is available at hospitals. This can be a measure of how much effort needs to be done in maintaining the IT environment, and thus of how much costs are related. This figure should be comparable between hospitals.

- IT Staff and composition is taken as indicator

Financial accounting used to be done by hand, but in large enterprises (and thus hospitals) almost all data are gathered through the Enterprise Resource Planning (ERP) system (e.g. SAP / Oracle). Usage of this could indicate a more secure and lean workflow and thus less costs in administrative overhead. The reduction of costs is considered beneficial to IT performance.

- Usage of ERP system in financial processes is used as indicator of IT performance.

The financial indicators shown in table 2 are used in the model.

Table 2: IT Financial performance indicators used in the model

Input	Process	Output
IT Expenses • % of organization • Per IT user • Per IT staff	IT Staff and composition	
Change between IT Budget and reality	Usage of ERP system	

6.2.3. Measuring level of control of IT

If IT performance is considered, it is important that the IT strategy is in alignment with the business strategy (the hospital's management strategy). The COBIT framework assures IT at this intersection between business and IT and is therefore taken into consideration when determining this model. It follows from COBIT that the different IT controls are given a maturity from 0 (lowest) to 5 (highest and most mature), and that four different topics describe IT control:
- Systems Development
- Change management

- Security
- Computer operations

Level of control of IT can be measured at many levels, as displayed in figure 14 below. For this model a choice has to be made regarding the level to measure controls. The IT General Controls level is chosen, as derived from COBIT. When looking at this pyramid of IT internal controls, it can be seen that performance of all controls is relying on IT General Controls at the base level. This can be clarified by giving an example: if segregation of duties is will implemented, no user alone can make important transaction through the IT systems, which is good. However if the physical access to the server room is compromised, access to all systems could be gained more easily, and the user segregation would give a false sense of security.

Indicators of level of control of IT are generally short term, and can change relatively quickly (Boer, Vandecasteele, & Rau, 2001).
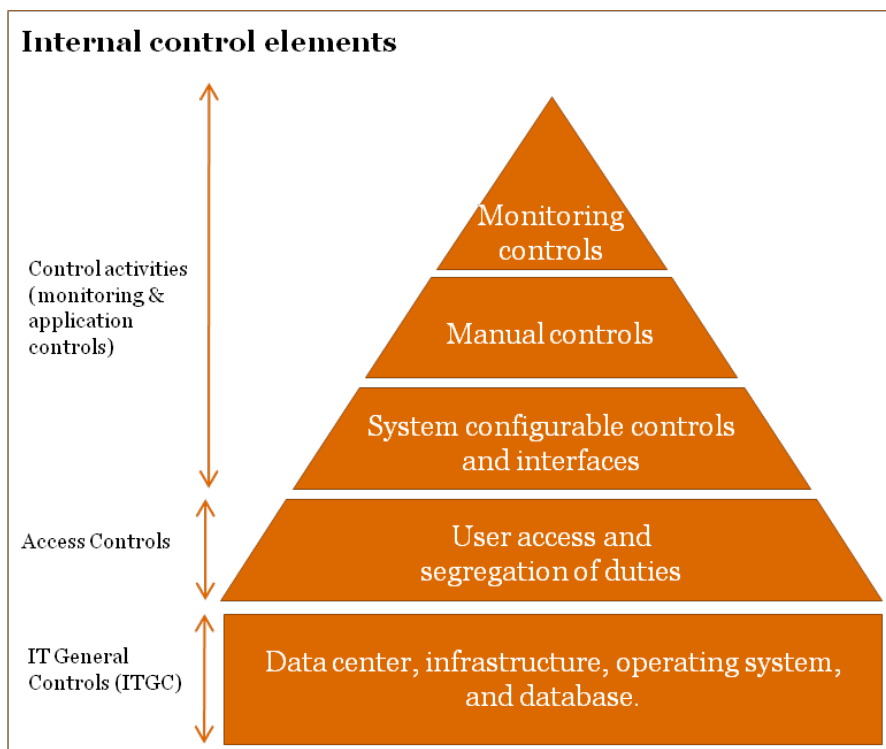
Figure 14: IT General Controls as a part of total internal control elements (PwC, 2012)

Of the four mentioned performance categories, the first two are often combined into one process, namely Change management and program development. That is why these are combined in this model. Then three categories(derived from COBIT) are chosen which represent the main IT functions and are used in the model when checking the level of control of ITGC's:

- ➢ Security and Access
- ➢ Change Management and Program Development
- ➢ Computer Operations

And each of these categories of ITGC can be subdivided into indicators as follows. An explanation of the subject is given. The maturity of each performance indicator is assessed between the following levels.
- 0. Non-existent
- 1. Initial / Ad Hoc
- 2. Repeatable but intuitive
- 3. Defined
- 4. Managed and Measurable
- 5. Optimized

Security and Access
- o Logical security: logical safety precautions are taken to protect organizational IT systems against unauthorized access. User accounts with access rights are used, so only authorized personnel can perform tasks.
- o Management of security: the organization has an information protection policy regarding integrity, sensitivity and accessibility of data. Patches and/or hotfixes are installed.
- o Physical security: physical safety precautions are taken to protect organizational IT systems against unauthorized access. Employees with physical access rights to server room is limited and in accordance to level of function and responsibility.
- o Security administration: a formal procedure exists to grant user accounts access to the network, critical applications, and databases. A procedure exists to block old accounts and the overall functioning is regularly checked.
- o Internal network security: safety precautions are taken to prevent unauthorized access to the internal network
- o Perimeter network security: safety precautions are taken for external access to the organizational network

Change Management and Program Development
- o Change management: a formal change management process is present, so only authorized and tested changes can be introduced into the production environment.
- o Implementation: only tested and accepted changes are introduced into the production environment.
- o Infrastructure changes: changes in infrastructure are deployed via a communicated schedule and aim to minimize impact on the organization.
- o Testing of program changes: different environments exist for development, testing, acceptance and production.

Computer Operations
- o Back-up management and media storage: a back-up & restore procedure exists to guarantee backups of both program files and user data. For critical applications and databases a periodical restoretest is performed. Back-up tapes are stored on an external location.
- o Real-time batch scheduling and processing: batches in production environment can be scheduled and processed in real-time.
- o Disaster recovery and business and IT continuity: a continuity plan / calamity plan is available and tested on regular basis.
- o Problem & incident management: there is an incident management process to detect, registrate, and solve operational malfunctions. Also a problem management process exists to mitigate problems in the IT infrastructure.
- o Overall management of computer operations activities: computer operations acts according to communicated schedules.

All of these indicators of IT Control take the process within the organization into account. An overview of used IT Performance indicators is given in table 3.

Table 3: IT Control Performance Indicators used in the model

Input	Process	Output
	Security and Access	
	Change Management and Program Development	
	Computer Operations	

6.2.4. Measuring IT innovation

Innovation has a broad meaning. According to the Oxford English Dictionary (2012), it is defined as: "technological innovations designed to save energy." This could be interpreted as innovation being relative to

the current state of an organization. Every technological novelty that is implemented and will save energy[1] can be accounted for as innovation, according to this.

A research variable that is relative to the current state of the organizations is difficult for research, because no objective comparison can be made. Image for example hospital A which currently has little innovation, because they implemented a system that hospital B is still working on. In that case when benchmarking the current situation, A would be given little innovation credit and B would be indicated as having a lot of innovation. This is in contract with the absolute situation in which hospital A is ahead of B because they already have implemented the system. So when measuring innovation, one must be careful not to measure subjective progress.

In the context of this research, IT innovation within Dutch hospitals is considered. It is difficult, if not impossible, to create an objective level of innovation. It can be asked to organizations what they themselves consider as innovation and to give an indication of this. But this is highly subjective research, as there is no objective standard to determine if some project is innovative or not. These topics can include areas like Electronic Health Records, or video-conferencing for specialist surgeons during surgeries. As another measure of innovation, innovation expenditure as percentage of total expenditure can be taken. But this is also highly subjective as the organization itself has to come up with the definition of innovation to determine its budget.

Four process indicators are given, to measure how a hospital turns an innovative idea into practice. Therefor the chain from idea, via the internal IT organization, via partners, and via suppliers is used as four different indicators.

- An indication of the innovative capabilities of a hospital can be given by the speed at which it adopts new technologies. As this requires long-term monitoring and/or statistics of speed of adoption, this is only applicable if the hospital itself has this information available. However it can be noted in which ways the organizational board and the different departments aim for innovation. This is called 'innovative orientation' and given as the first indicator for innovation in this research.

- Secondly, the successful implementation of innovation is not only depending on the orientation of the hospital, but also on the capabilities that are present. This is equally important as the orientation, because innovation fully depends on a positive orientation and capability.

- Thirdly, the IT department is not isolated in proceeding innovation into the hospital, it also has to rely on other factors within the hospital. For instance it is important that different departments also share the readiness for innovation, if the central IT department and board require innovation. The readiness of partners within the hospital is thus considered a third indiator.

- If all three above-mentioned indicators are fully positive, the successful implementation however still relies on implementation by service providers. These can be internal and/or external. It has to be assured that these service providers are capable and willing of innovation, in order for the hospital to be innovative.

- With these four indicators present, the process is charted. For this research, one output variable of innovation is chosen. This is e-Health usage. This contributes directly to innovation, as medical staff and patients are both influenced in their routines by the presence of e-Health.

The mentioned variables are summarized and categorized into the three categories in table 4 below.

Table 4: IT Innovation Performance Indicators used in the model

Input	Process	Output
	Innovative orientation	e-Health usage
	Organizational IT Capabilities	
	Partners' IT readiness	
	Service provider's IT readiness	

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[1] Figuratively speaking: not just electrical energy is taken into account but all forms, such as labour.

6.2.5. Measuring IT user's perspective

Organizations consist of people. And before the advent of Information Technology, people already found a way to create workflows and processes to follow. Yet with the advent of ERP systems workflow is sometimes changed to accommodate IT instead of people (an example of IT considered an exogenous factor, described in paragraph 4.1). This for instance was made apparent during a hospital case study at the University of Virginia Medical Center. However this change in working process was rated negatively by doctors, but positively by pharmacists (Massaro, 2005). So when determining user's satisfaction, different users and different categories of users should be taken into account.

- A user satisfaction survey is used as indicator of IT user's perspective

Another indicator of user's perspective is the way IT systems are accommodated to individual or team use, whatever is applicable for the users. If a system is only focused on the individual user, and does not allow collaborative use of information, this can present real difficulties or dysfunctioning of IT if the workflow requires staff to work collaboratively (Reddy & Bradner, 2005). This effect could be summarized as the level in which the IT processes follow the traditional or real-life workflows.

As mentioned in the IT Performance chapter, strategic alignment between the general organization ('business') and between the IT organization is desirable for maximum utility.

- Fit between IT strategy and the wants & needs of key stakeholders is taken as indicator of IT user's perspective

This alignment must also be true at a more functional level, where IT processes should support business processes .

- Alignment between IT internal (processes) and IT external (strategy) is taken as indicator of IT user's perspective

Lastly this alignment must also be true at internal level: there should be a match between IT processes and business processes.

- Alignment between organizational and IT processes is taken as indicator of IT user's perspective

Setting pre-defined goals for the quality of delivered products and services is one thing, but making sure the products comply with the user's expectation is as least as important in order to achieve a qualitatively good product. If customers of a hospital are content with the level of service, they will return more easily[2] or are more happy to be treated. If staff – the internal users of IT – spend time on IT issues, they cannot use this time curing patients. For medical personnel curing patients is the primary objective, thus this will lead to user dissatisfaction. (Dis)satisfaction is thus an important indicator.

Some important user aspects for the functioning of the IT department are mentioned below. These are all long term indicators (Boer, Vandecasteele, & Rau, 2001).

- User satisfaction
- Performance as viewed by user according to Service Level Agreements (SLA)
- User profitability (not used in this research project, see paragraph below for the reason)
- Image & reputation of the service / product (not used in this research project, see paragraph below for the reason)

User profitability is difficult to ascertain in an environment where profits are not measured financially. The image & reputation of the IT service / product is very subjective to measure. Therefore these two indicators are not taken into account.

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[2] Patients will only be able to choose their hospital in the case of non-urgent medical treatment, such as most specialistic treatment. In some hospital branches, such as the emergency room, patients do not usually choose the hospital with best performance, but the best available – nearest – hospital.

When looking at the Performance Prism model, it can be seen that stakeholder satisfaction and stakeholder contribution are integral aspects of this model (Neely, Adams, & Kennerley, 2002). These aspects could prove worthy and are taken into account for the determination of IT user's perspective.

- Stakeholder contribution is used as indicator of IT user's perspective

This results in the indicators of table 5 being taken into account in the model to give an indication of IT user's perspective.

Table 5: IT User's Perspective performance indicators used in the model

Input	Process	Output
Presence of Service Level Agreements	Meeting of Service Level Agreements' Specifications	User satisfaction survey grade
	How does strategy satisfy wants & needs of key stakeholders	What contribution is required from stakeholders to maintain and develop IT?
	Have IT's processes been based on the IT strategy?	
	Has IT's architecture been based on traditional well-functioning organizational processes?	
	Has IT's architecture changed organizational processes?	

6.3.   Overview of the performance indicators

With the theory, dimensions, and performance indicators stated above, a schematic overview of the performance indicators that the model should consist of, can be drawn. This is done in figure 15 below.
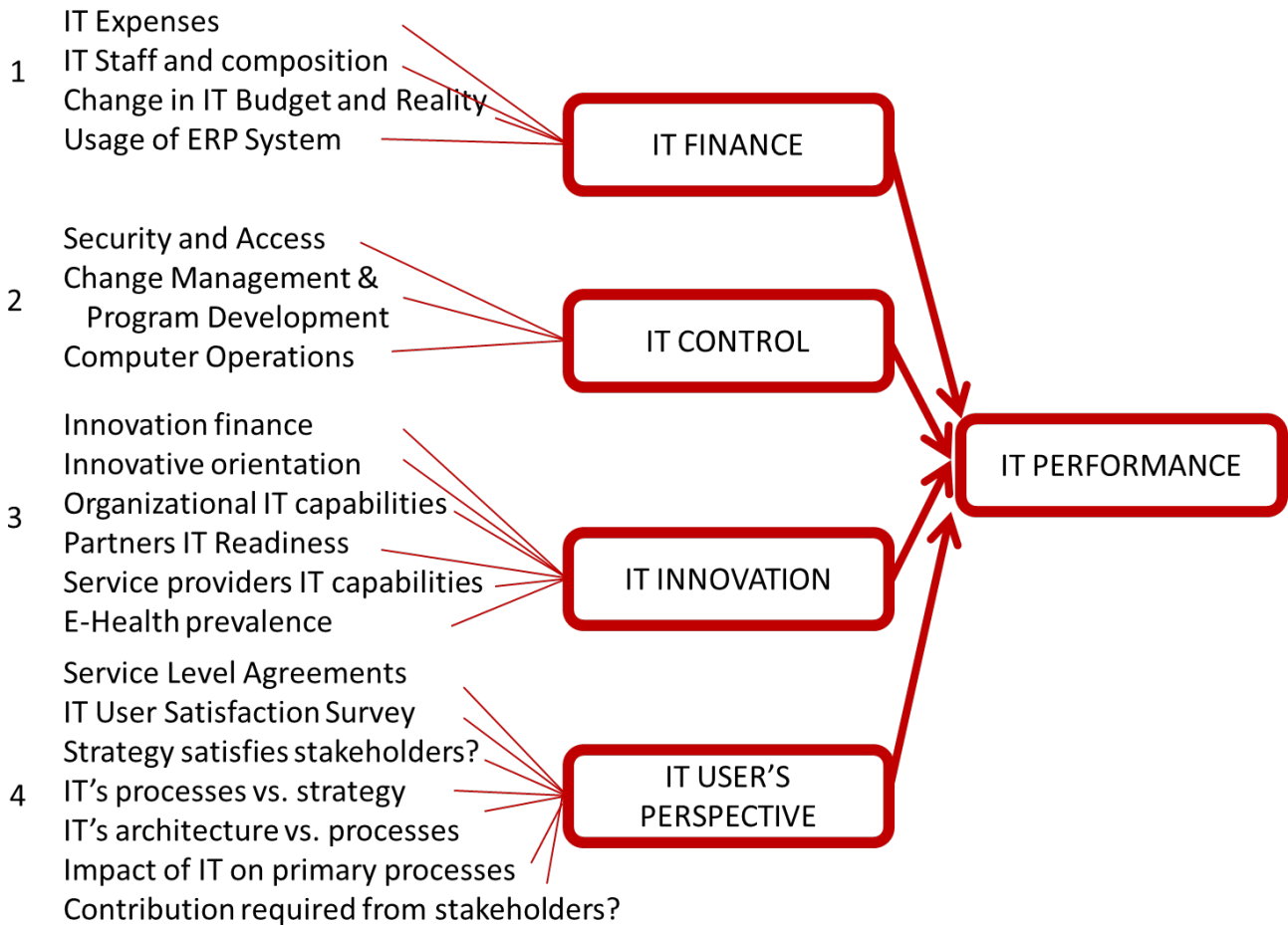
Figure 15: Overview of important dimensions and variables of IT performance mentioned in literature. Explanation is given in the respective paragraphs in chapter 6.

6.4.   Modelling: simplicity is key

An exuberance of indicators can be sought for and therefore given. However, it is desired that both a manager and IT professional can understand the model, as they are both involved in the IT auditing process, and making management decisions about IT.

Managers and professionals from different disciplines (Finance, IT, HR, R&D, etc.) all have specific targets they need to achieve. Thus they possess a different view upon IT. The model aims at understandability for all management and IT professionals.

As described earlier, IT performance is considered as existing out of four dimensions (IT Financial, IT Control, IT user's perspective, IT innovation). All four dimensions should be visible in the model.

- Requirement for the model: make the four dimensions of IT performance visible.

Decision making managers and IT professionals have demanding jobs, and do not possess time to work their way through pages of information. This makes that the model should give a summarizing indication of overall IT performance of the hospital.

- Requirement for the model: it should give a summarizing indication of overall IT performance.

To give the model impact, the message should be clear and unambiguously. This makes that the model should be normative about different score cards.

- Requirement for the model: it should be normative about performance.

If different groups of users need to use the model, they require detailed information on their field of expertise. On other fields of expertise, the extra available information should not distract them.

- Requirement for the model: it should be clear, and providing detailed information upon request.

Table 6: Requirements for the model

Requirement	Description
1	The model should make the four dimensions of IT Performance visible (IT Financial, IT Control, IT user's perspective, IT innovation).
2	The model should give a summarizing indication of overall IT performance.
3	The model should be normative about performance.
4	The model should give clear information, and provide detailed information upon request.

6.5.   IT Performance Model

With the theory behind the model explained, the model itself can now be constructed. The following paragraphs explain the construction of the model in general and in detail for each of the four dimensions.

6.5.1. Constructing the general model

A model is created in Microsoft Excel with the properties stated above. The requirements as stated in table 6 are used to design the model.

The model will take the form of a scorecard with four dimensions, as IT Performance consists out of these four dimensions. This satisfies request 1.

When filled in, each dimension is ranked from -1 (red) to +1 (green), indicating an overall rating. This is based on a weighted average of the concerning subdimensions, also ranked from -1 to 1 by the researcher based on available data obtained during the research process. There is a final judgment made based on the relative weighting of the four dimensions. This way, requirements 2 and 3 are taken into account, by giving a total summary about IT performance, and bringing this and the other dimensions in traffic light style cells, thus being normative.

Also subdimensions for each dimension are available on request, in order to make detailed information available to users with knowledge of the topic. This satisfies request 4.

The model consists of a main page with the overall IT performance scorecard visible upon opening. Upon request, four different worksheets are clickable, that contain detailed information about the dimensions and the way their rating is established. The overall scorecard can be seen in figure 16 below.
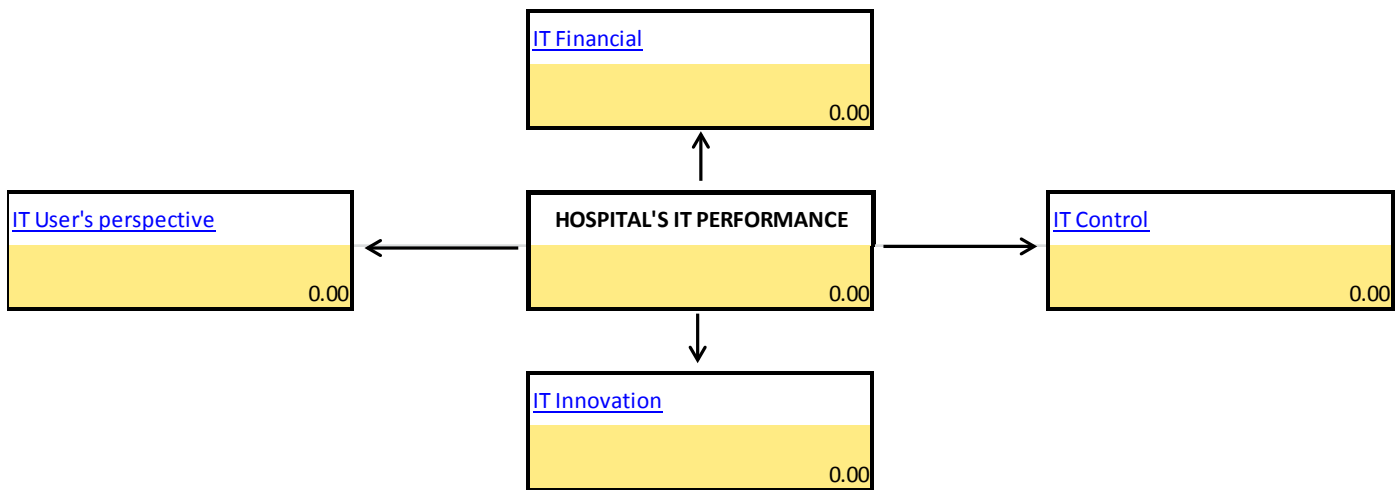
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                    ┌─────────────────────┐
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│ IT User's perspective│ │ HOSPITAL'S IT        │  │ IT Control          │
│                     │←─│ PERFORMANCE          │─→│                     │
│                0.00 │  │                 0.00 │  │                0.00 │
└─────────────────────┘  └─────────────────────┘  └─────────────────────┘
                              │
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                    ┌─────────────────────┐
                    │ IT Innovation       │
                    │                     │
                    │                0.00 │
                    └─────────────────────┘
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	Relative weighting
IT Financial	25%
IT Control	25%
IT Innovation	25%
IT User's perspect	25%

Figure 16: IT Performance scorecard for Dutch hospitals

6.5.2. IT Financial scorecard and weighting

The dimension of IT Financial aspects consists of four indicators, and three subindicators. This can be seen in figure 17 below. Indicators are weighted differently, based on their apparent contribution to the concept of Financial performance. IT Expenses (subdivided into percentual IT expenses in relation to total organizational expenses; IT expenses per IT user; IT Expenses per IT Staff member (in fte)) is weighted for 40% in the total financial performance. Whilst stability (change in IT Budget and reality) is only weighted for 10%. This weighting is based on subjective estimations.

Indicators for this dimension	Assessment on a -/-1 to 1-point scale	Weight	Explanation	Subgroup	Assessment on a -/-1 to 1-point scale	Findings	Comparison Benchmark
Total score on IT Financial Indicators	0	100%					
IT Expenses	0	60%					
				% IT Expenses	0		
				IT Expenses per IT user	0		
				IT Expenses per IT Staff (in FTE)	0		
IT Staff and composition	0	20%					
Change between IT Budget and Reality	0	10%					
Usage of ERP System	0	10%					
Back to Overview							

Figure 17: Blank IT Financial dimension scorecard for Dutch hospitals

6.5.3. IT Control scorecard and weighting

IT Control is based on three indicators, of which two exist out of four subindicators and one exists out of five. This is displayed in figure 18. All subindicators are weighted equally to create an indication of the main indicator's assessment. Subindicators are ranked in their offset relative to target maturity levels. Maturity levels are derived from the Cobit 4.1 maturity framework and the maturity targets are based on PwC's accountant practice. Achieving exactly at the maturity level results in a '0' score. Performing less than maturity level will make this difference the negative score on this subindicator, with the lowest score being -1. Performing better than maturity level will result in a positive score, based on the difference between maturity and the assessment, with a maximum score of 1. This maximum is created to stress that all subindicators should function at maturity level. A very high score on a certain level will not compensate for the ill-performance of another indicator.

Indicators for this dimension	Assessment on a -/-1 to 1-point scale	Weight	Subgroup	Maturity level from 0 to 5	Comparison Maturity level	Assessment on a -/-1 to 1-point-scale
Total score on IT Control Indicators	-1	100%				
Security and Access	-1	33%		0,00	3,25	
			Logical Security	0,00	3,00	-1
			Management of Security Activities	0,00	3,00	-1
			Physical Security	0,00	4,00	-1
			Security Administration	0,00	3,00	-1
Change Management and Program Development	-1	33%		0,00	3,00	
			Change Management	0,00	3,00	-1
			Implemenation	0,00	3,00	-1
			Infrastructure Changes	0,00	3,00	-1
			Testing of Program Change and Development	0,00	3,00	-1
Computer Operations	-1	33%		0,00	3,60	
			Back-up Management and Media Storage	0,00	4,00	-1
			Real-time Batch Scheduling and Processing	0,00	3,00	-1
			Disaster Recovery and Business and IT Continuity	0,00	4,00	-1
			Problem & Incident Management	0,00	3,00	-1
			Overall Management of Computer Operations Activities	0,00	4,00	-1
Back to Overview						

Figure 18: Blank IT Control dimension scorecard for Dutch hospitals

6.5.4. IT Innovation scorecard and weighting

IT Innovation is based on the performance of five indicators and weighted in accordance to subjective judgment. In the initial set-up, all indicators are weighted equally. This is adaptable to the organization's needs. This is shown in figure 19 below.

Indicators for this dimension	Assessment on a -/-1 to 1-point scale	Weight	Source
Total score on IT Innovation Indicators	1	100%	
Innovative orientation	1	20%	
Organizational IT Capabilities	1	20%	
Partners IT Readiness	1	20%	
Service providers IT Capabilities	1	20%	
E-health	1	20%	
Back to Overview			

Figure 19: Blank IT Innovation dimension scorecard for Dutch hospitals

6.5.5. IT User's perspective scorecard and weighting

The IT user's perspective scorecard is based on seven indicators. All seven indicators are weighted equally, but this is adaptable to the organization's needs. This and their relative weighting is displayed in figure 20.

Indicators for this dimension	Assessment on a -/-1 to 1- point scale	Weight
<u>Total score on IT's User Perspective Indicators</u>	<u>0</u>	100%
Service Level Agreements	0	14%
IT User Satisfaction Survey	0	14%
How does strategy satisfy wants & needs of key stakeholders	0	14%
IT's processes vs. strategy	0	14%
IT's architecture vs. IT processes	0	14%
Impact of IT on business processes	0	14%
Contribution required from stakeholders to maintain and develop IT	0	14%
<u>Back to Overview</u>		

Figure 20: Blank IT User's perspective dimension scorecard for Dutch hospitals

7. Case study: findings at a large Dutch academic hospital

A case study is intended to be performed at a large Dutch academic hospital, in order to test the propositions and to find the value of the proposed model in practice. Due to various reasons explained below, the research method is changed to a case study at a later stage.

7.1.   Benchmark as original research method

The original set-up of gaining data to test propositions was to perform a benchmark under 20 to 30 large Dutch hospitals. In order to make data comparable, and to fit with the knowledge within the PwC / BAS department, they would make use of one of two types of Enterprise Resource Planning systems (ERP): based on SAP or Oracle. For the healthcare sector specific ERP solutions are available, that are an adapted version of one of these ERP's. One of these examples is CareCTRL, which is a specific IT provider's solution based on SAP (Zaal, 2010).

As SAP and Oracle systems are larger-scale solutions, smaller hospitals will likely not use them. Also the way certain processes work - either within the ERP or within the organization – can be dictated by the chosen ERP. By selecting hospitals based on this common feature, an attempt is made to make the comparisons of the quantitative questionnaire relatively comparable.

Within the benchmarking concept, a lot of numerical data about around 40 Key Performance Indicators (KPI) would have been collected. The more different data available, the better the overall estimate of this KPI gets, due a reduced error. This is displayed in the formula for standard error of a series of data: (Weisstein, 2012)

$$s_e = \frac{\sigma}{\sqrt{n}}$$

With s_e the standard error of the data series, σ the sample's standard deviation, and n the sample size.

So if the sample's standard deviation is large (e.g. due to an inaccurate estimate) at an estimated 15%, and a desired error level s_e is 5% or less, the sample size n can be calculated and should be 9 or higher. This is why 30 hospitals are being asked to participate, with the goal of at least 9 participating hospitals that can deliver all the desired data. These 9 hospitals is taken as the least amount of hospitals required for continuing with the benchmark approach. A σ of 20% is an even safer estimate to take, this would result in an optimal amount of 16 fully participating hospitals or more for making good statistical conclusions. With 91 general and academic hospitals in The Netherlands, 16 participating hospitals would be 18% of the population (Panteia/EIM, 2010).

7.2.   Case study as second research method

This thesis and the assignment for PwC started with approaching hospitals at (IT) management level with the question whether they wanted to participate in the benchmark. If they would, they would have to pay a small fee in turn for detailed information and a comparing benchmark report about their IT organization. This report would be concerning IT costs, IT control, IT innovation and IT user's perspective. After a few months of approaching hospitals, it turned out that not the desired amount of 9 fully participating hospitals was reached.

Due to the benchmark approach not leading to enough hospital commitment, the project was redesigned towards performing a case study at the participating hospitals. In a case study there is more focus on the special environment and causality within this hospital.

It was a difficult decision to abandon the benchmark set-up. But with at the time two participating hospitals, it was a necessary step in order to obtain research results, and to provide the participating hospitals with the offered information about their IT organization.

A survey was conducted why the targeted hospitals did not want to participate. The reason most hospitals stated for not participating was they simply had no interest in such a research (n=9). The second most mentioned reasons were that the hospital would already be participating in a benchmark of a competitor (n=5), or was in the middle of implementing a merger project (n=5). At third place, hospitals mentioned that they were currently too busy (n=3), or that next year they would be interested in participating (n=3).

7.3.   Background and situation of this hospital's environment

In a one-case study research project, it is very important to know as much information as possible. When starting a one-case study project, all relevant details cannot be known already, cause they are depending on the situation. The background, situation and other parameters could influence the results, while it is of importance for the validity of this research to know the impact of the four IT performance dimensions instead of the influence of the background situation. Determining all relevant factors and determining causality between them and the case study results is therefore of importance to regard the true causality between IT performance dimensions and IT performance of this hospital.

7.3.1. Short introduction to the hospital

This case study is performed at a large academic hospital in a large Dutch urban area. The hospital has a long tradition of health care innovation, as described during the interviews. A trend over the past years has been the introduction of a new Electronic Patients Records system.

The hospital features an average of 6000 full time equivalent of personnel, a yearly turnover between €800 and €900 million.

7.3.2. Availability of data

Much of the requested information for benchmarking the four dimensions of IT (financial, control, innovation, and user's perspective) was not directly available at the IT auditor's department or at departments that were requested to deliver the information. It would have been possible to sort out data manually, but as this would have cost up to two weeks of data processing by a full time staff member (according to another hospital as a reason not to participate), the hospital did not allocate resources for this. In the case study set-up this did not pose a problem as less quantitative data was required and more qualitative data.

7.4.   How results were obtained

This paragraph describes the method of obtaining research data, and makes a distinction of three separate ways: information gathering via a questionnaire, via organizational documents, and via interviews with hospital staff.

7.4.1. Questionnaires

Firstly the questionnaires about IT Finances, IT Innovation and IT User's perspective were given to the hospital's head of IT audit to fill in. The IT Controls were already assessed as part of PwC's routine IT audit of this hospital. The questionnaires can be found in Appendix A: IT Costs Survey, Appendix B: IT General Controls areas of focus, Appendix C: IT Innovation survey, and Appendix D: IT User's satisfaction survey.

Many of the required information could not be given within the limited amount of time the hospital had reserved for this project. All information is available somewhere in the organization and within a special format, the challenge would be to find this information and to convert it to the desired KPI.

7.4.2. Organizational documents

Many other information was obtained through public and non-public department specific documents. These are:

- Official year report 2010
- Official year report 2011
- IT department's strategy plan 2012-2016
- Many other small documents and figures given in response to the interviews mentioned below

7.4.3. Interviews

In order to obtain enough potentially relevant data, three general interviews are held, public documents such as the organizational structure and financial year report are reviewed, and inside information is obtained about financial performance and policy of the IT General Service Department.

These interviews were held with the head of the IT audit department (two times) and the head of the IT administration department (one time). These interviews were held in September and October of 2012.

During the interviews with the head of the IT audit department, the questionnaires with the four research dimensions were discussed. They had been distributed one month before the interview and the preliminary filled-in questionnaires were used as input and guidance for the structured interviews. During the interview with the head of the IT administration department, general questions about the functioning of the IT department were discussed. With both people the preliminary findings were discussed in order to find factual errors and to give an explanation of the story behind the data.

7.4.4. Obtaining benchmark means

In the figures in the next chapter, benchmark averages are shown. The objective of displaying averages, is to give some point of orientation to the hospital.

The information is obtained from PwC's Global Best Practices Programme upon request for this research. A filter was applied on the health care sector organizations. 7 of the 12 available organizations were hospitals. The average headcount of the benchmark group was 10,997 people, with an average revenue of €625,934,369. Four out of the 12 hospitals are from European countries as well (Northern and Western Europe). A detailed schematic of the benchmark group's statistics is available in Appendix E: Detailed Benchmark group information.

A quick comparison between the hospital being researched on in this case study, and the benchmark group, shows that the hospital is roughly comparable with 6000 full time equivalent personnel (which makes a higher head count) and a yearly revenue of between €800,000,000 and €900,000,000. So the hospital has a higher employee turnover.

Given the fact that the benchmark group is composed out of different hospitals and other health care organizations, a rough comparison can be made, when bearing in mind this is an estimate. A lower or higher outcome does not automatically means the studies hospital performs worse or better.

7.5.   Findings at the hospital: four IT perspectives

In this paragraph, the findings are presented in a subparagraph categorized on each of the IT performance domains (IT Financial, IT Control, IT Innovation and IT User's perspective).

7.5.1. IT Financial perspective

Many of the KPI's that were derived from literature and requested to the hospital to report, were not available. With enough management support the exact figures could have been calculated, but for this research project, that many resources were not dedicated by the hospital. Key figures such as yearly turnover and total organizational employee numbers could be looked up in documents such as the official year report. IT specific data is not specified in the official year report, but was available by interviewing staff members.

Further on, almost all personnel in the hospital is a regular IT user, because IT systems are very common in the medical practice for almost all procedures and administration.

Personnel information could only be retrieved of personnel with an labour appointment (both temporary or permanent). For the general IT maintenance this does not provide a difficulty, as virtually all personnel is in labour appointment. But for projects in which personnel is hired via other companies, this gives a distorted image. Detailed information about management level or very specified area of expertise (such as requested in Appendix A: IT Costs Survey, was not available, due to time restraints at interviewed staff members.

Detailed IT cost statistics were not available. IT Costs are categorized as either 'Personnel costs,' 'Amortization costs,' and 'Other operational costs.' Costs are not recorded based on categories as 'Electronic Health Records,' 'Financial support,' 'Personnel administration,' and 'medical technology.'

Costs the IT department makes for support of users and delivered products and services, are on-charged expenses. There is a service/product catalogue from which all hospital departments can choose what they require and what amount is charged for the product/service.

Estimate is that the IT costs are rising, but specific information was not available. At least for three more years (until 2015), the implementation of a new Electronic Health records system requires many resources. This means that around 30 systems could be integrated further. As the project is not finished, this is yet uncertain.

7.5.1.1. Quantitative data

Enough financial data was obtained to ascertain four important figures. These are indicated in four figures below and used in the financial scorecard as displayed in figure 17. Benchmark data from the worldwide healthcare sector was used to indicate relative performance of the hospital. The hospital's position is indicated with an ◇, and the benchmark average (without the hospital) is indicated as Δ. Quartiles are displayed in different colours.

% IT Expenses: the hospital's percentual IT costs (Total IT Costs / Total Revenue) are somewhat higher than average (3.16% vs. 2.58% average). This is shown in figure 21.

Based on this, the scorecard is filled in as an opportunity.
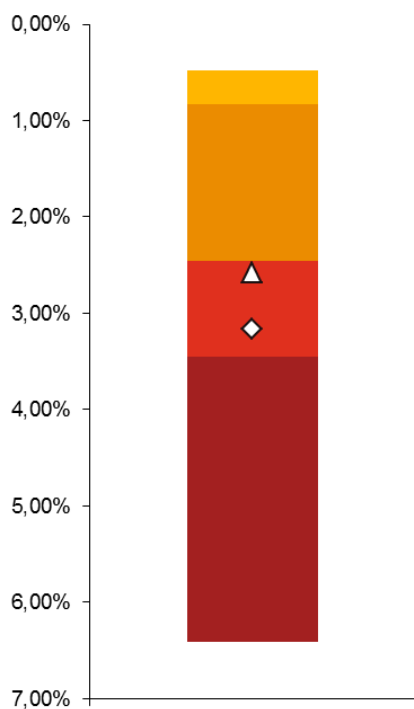
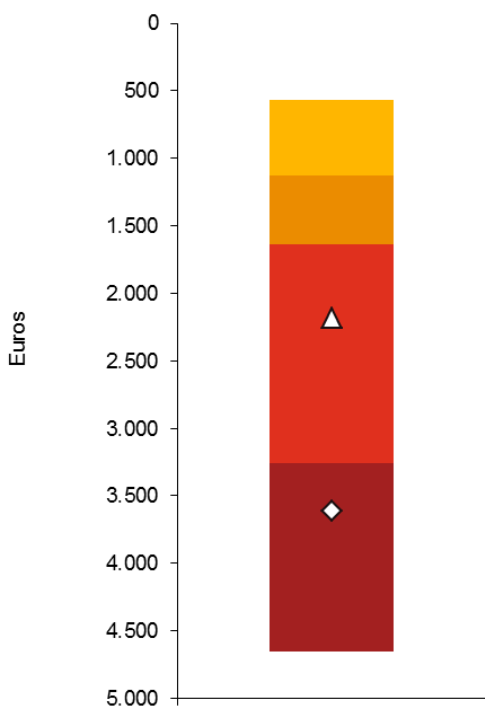**Figure 21: Hospital's total IT costs (◇, 3.16%) as a percentage of revenue is somewhat higher than average (Δ, 2.58%). A €5 Million budget was subtracted from total IT costs before comparison, due to those being project funding for a hospital-wide WiFi project, and not being regular IT costs. Source: Hospital's Annual report 2011 (p81) & budget IT department 2012 & PwC Global Best Practices.**

IT Expenses per IT user: the hospital's total IT costs per IT user (Total IT Costs / Total IT Users) are significantly higher than on average. This is shown in figure 22. With the relative IT costs roughly comparable to average (as mentioned above), this could be explained by the hospital being lower staffed than on average. The difference between staffing is 55% (6,000 employees vs. 10,997 on average). The difference between the IT costs per user are €3610 vs €2183, or 60%. So even if a correction is made, the hospital has higher IT costs per user than on average.

Based on this information, the scorecard is filled in as a major opportunity.

One final remark must be made about the obtained IT costs per user. Their large deviation from average could be caused by an IT project of medical device that is calculated in the IT budget, but does not belong there. With international accounting standards, this should not happen. But if it did, it could explain the deviation.

Figure 22: Hospital's total IT costs per IT user (◇, 3611) are significantly higher than average (Δ, €2184). Given that the percentual IT costs are roughly comparable to other hospitals (see figure 21), this could be explained by the hospital having a lower employee count than average. Still the difference is higher than the difference in personnel size). Source: Hospital's Annual report 2011 (p81) & budget IT department 2012 & PwC Global Best Practices.

IT Expenses per IT staff: the hospital's higher IT Costs per IT full time equivalent (Total IT Costs / Total IT FTEs) than average is shown in figure 23. It can be attributable to several causes.

- Outsourcement could be high, due to unfavourable contracts. Although literature suggests that when done properly, IT outsourcing does not necessarily invoke higher or lower costs (Menachemi, Burkhardt, Shewchuk, Burke, & Brooks, 2007).
- The process is decentralized, resulting in higher overhead operating expenses;
- Hardware and software annual operation costs are high.

Based on this information, the scorecard is filled in as an opportunity.
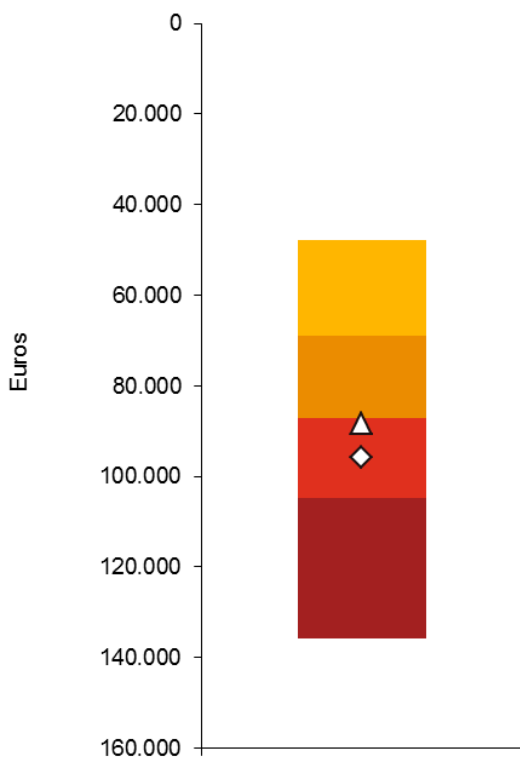
Figure 23: Total IT costs per IT full time equivalent (◇, €95,944) are somewhat higher than average (∆, €88,249). This could be due to three possibilities:
- **high outsourcement level;**
- **highly decentralized processes resulting in high overhead costs;**
- **high operation costs of hardware and software.**
Source: Hospital's Annual report 2011 (p81) & total staff information of the IT department through interviews & PwC Global Best Practices.

IT Staff and composition: total IT users per IT full time equivalent (Total IT users / Total IT FTEs) is shown in figure 24. The hospital has comparable figures (27 IT users per IT FTE versus 25 on average). This could indicate that the hospital's staff is either working more productively, or that more systems are outsourced. Outsourced personnel is not taken into account in the IT FTEs.

From the annual report and IT department's budget, it can be calculated that 3.76% of total hospital staff works within the IT department.

Based on this information, the scorecard is filled in as on target.
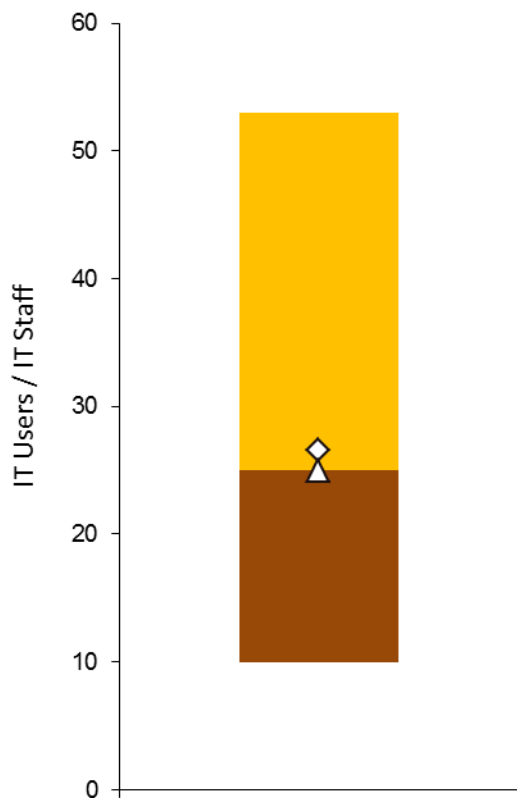
Figure 24: Total IT users divided per IT fte (◇, 27) scores above average (△, 25). This could either indicate above-average productive IT staff, or that the hospital is outsourcing IT functions, as outsourced personnel is not taken into account in the figures. Source: Hospital's Annual report 2011 (p6 average employment numbers) & budget IT department 2012 & interview with director of administration office of the IT Department.

Change between IT budget and reality: according to an interview with the head of the administration bureau of IT, IT Budget and end-of-year closing figures did not differ that much in 2011. This is a stable situation according to the interviewed person.

Based on this, the scorecard is filled in as an almost fully achieved objective.

Usage of ERP system: lastly, an ERP system is fully implemented, and financial figures are based on this. Thus they are deemed reliable. Based on this, the scorecard is filled in as a fully achieved objective.

7.5.1.2. *IT Financial scorecard*

With the information given in this paragraph, the IT Financial scorecard of the model can be filled. This is done in figure 25. As can be seen, IT Financial provides an opportunity for future development.

Indicators for this dimension	Assessment on a -/-1 to 1-point scale	Weight	Explanation	Subgroup	Assessment on a -/-1 to 1-point scale	Findings	Comparison Benchmark	Source
Total score on IT Financial Indicators	-0.22	100%						
IT Expenses	**-0.66666667**	60%						
				% IT Expenses	-0.5	3.16%	2.58%	Source: Hospital's Annual report 2011 (p81) & budget IT Department 2012 subtracted with M€5 for the project costs of WiFi access that was submitted into the IT budget.
				IT Expenses per IT user	-1	€ 3,610.93	€ 2,183.90	"
				IT Expenses per IT Staff (in FTE)	-0.5	€ 95,943.76	€ 88,249.00	277 permanent appointment IT dep't employees in 2012, almost no personnel with temporary appointments.
IT Staff and composition	**0**	20%	3.76%	of total employees works on maintaining IT; and slightly above average IT Users / IT FTE ratio.				Source: Hospital's Annual report 2011 (p6 average employment numbers) & budget IT department 2012 & interview with director of administration office of IT
Change between IT Budget and Reality	**0.8**	10%	Stable					Budget and real figures at the closing of the book year do not differ that much according to the interview with head of administration bureau.
Usage of ERP System	**1**	10%	SAP					Financial information is directly obtained from SAP in 2013
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Figure 25: IT Financial scorecard filled in. Percentual IT Expenses, IT Expenses per IT user and costs per IT staff fte provide areas for improvement.

7.5.2. IT Control perspective

An assessment of the IT General Controls at the hospital is made for the yearly annual accounts check. Systems and applications that affect the financial workflow are taken into account. The results are quite interesting and are shown in figure 26 below.

It turns out that on two areas the hospital exactly functions at the desired maturity level. On three areas (indicated by green bars) the hospitals ranks above maturity level. On the remaining 8 areas, the hospital underachieves.

The performance of the hospital on maturity level can be explained by legal requirements for hospitals, due to the sensitivity of patient data.

The hospital's performance was lower than required in the areas of IT Continuity, Real-time batch scheduling and processing; Back-up Management; Testing of Program Change and Development; Implementation of changes; Change Management; Security Administration; Logical Security.

The most important findings on control perspective are:
- The hospital has a business calamity plan but no specific IT calamity plan. With many IT infrastructure being critical to the medical process, the hospital should provide this calamity plan (disaster recovery and Business and IT Continuity).
- The hospital has two datacenters, which provide back-up for each other. However both are situated in the basement. In the extreme event of a calamity due to flooding, both datacenters would not function anymore (disaster recovery and Business and IT Continuity)
- The area of testing of program change and development has this development deficit, due to a lack of documentation (Testing of Program Change and Development).
- For most systems the hospital has no clear and uniform way to assure only tested and accepted program changes are introduced into the production environment (Implementation of Changes).
- The hospital sporadically uses general accounts that are not traceable to an individual employee. Also some users have more rights in the system than required in the line of their duty. This provides a potential risk (Security Administration).
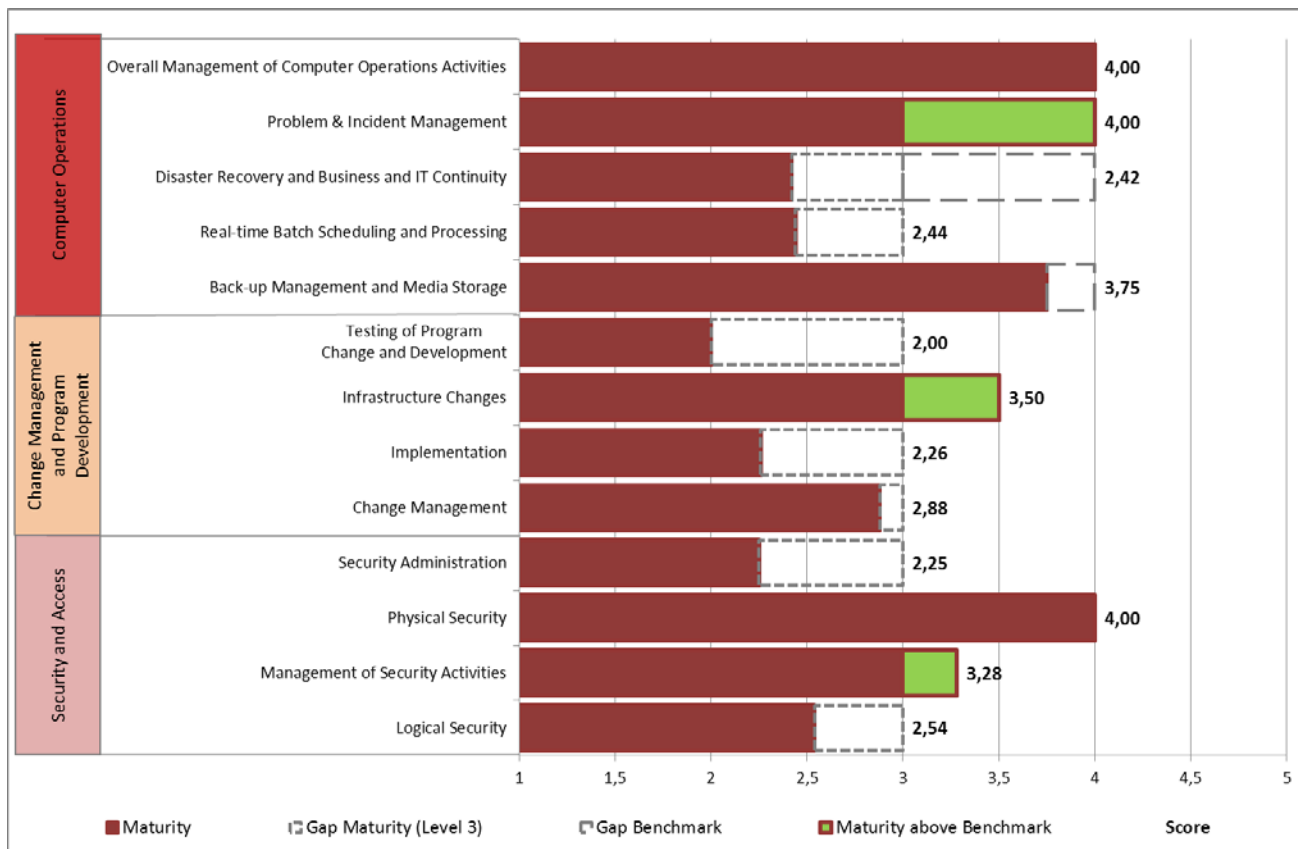
Figure 26: Outcome of the ITGC audit. Serious gaps are shown. Source: PwC Accountants, 2012

7.5.2.1. IT structure

There is a central IT policy plan. Many departments and medical disciplines want and take the responsibility for their own (small scale) IT systems. Some medical disciplines de facto require the use of a specific IT solution. In many cases these departments hire their own IT personnel, as a researcher. An example is the MRI department.

There are rules concerning outsourcing of IT services. It is possible to outsource, but when patient data leaves the hospital, a hospital administrator should monitor the whereabouts and usage of the data specifically.

The hospital has an emergency power generator which is tested every month. IT systems can also use this emergency power. Figures about downtime is available and used in SLA's. It cannot be disclosed as many internal contracts are financially dependent on this data.

An estimation is made that there are some 2000 applications. About half of it standard applications and about half of it is tailor-made. There is no difference between central and departmental level on this level of standard applications and tailor-made applications. The amount of legacy systems is not known at a central level. Also the number of hardware suppliers is decentralized and not known on a central level.

The ERP system SAP is being implemented, with the specific solution of CareCTRL. All financial data is delivered by this system. From 2013 on, also all budgeting information flows through the ERP. A specific implementation partner was sought via a tender for this project.

There are around 1200 servers. 2/3 of them running on windows and 1/3 on Linux. There is no standard version of these operating systems. A normal workstation has a lifetime of 3 years.

7.5.2.2. IT Control scorecard

With the information given in this paragraph, the IT Control scorecard can be filled in. This is done in figure 27. In general IT Control provides an opportunity for future development.

Indicators for this dimension	Assessment on a -/-1 to 1-point scale	Weight	Subgroup	Maturity level from 0 to 5	Comparison Maturity level	Assessment on a -/-1 to 1-point-scale
Total score on IT Control Indicators	-0.2835	100%				
Security and Access	**-0.2325**	**33%**		**3.02**	**3.25**	
			Logical Security	2.54	3.00	-0.46
			Management of Security Activities	3.28	3.00	0.28
			Physical Security	4.00	4.00	0
			Security Administration	2.25	3.00	-0.75
Change Management and Program Development	**-0.34**	**33%**		**2.66**	**3.00**	
			Change Management	2.88	3.00	-0.12
			Implemenation	2.26	3.00	-0.74
			Infrastructure Changes	3.50	3.00	0.5
			Testing of Program Change and Development	2.00	3.00	-1
Computer Operations	**-0.278**	**33%**		**3.32**	**3.60**	
			Back-up Management and Media Storage	3.75	4.00	-0.25
			Real-time Batch Scheduling and Processing	2.44	3.00	-0.56
			Disaster Recovery and Business and IT Continuity	2.42	4.00	-1
			Problem & Incident Management	4.00	3.00	1
			Overall Management of Computer Operations Activities	4.00	4.00	0
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Figure 27: IT Control scorecard filled in. There is much room for improvement at security administration, implementation of changes, testing of program change and development, and disaster recovery.

7.5.3. IT Innovation perspective

Different large scale project are running with the goal of creating an Electronic Health Records system together with another hospital. It is planned to have this system running in 2014. A tender is active to find a system and implementation partner. Currently the used health records system is second generation, or an administrative system, in which nurses and doctors file patient data. There is no process support. It proves a difficult issue to change from a custom-made system to a standard solution.

Since 2012 many divisions also use an electronic nursing record parallel to the electronic health records system. This separation is historically caused, due to the different requirements of doctors and nurses when using a system. The ultimate goal of the new Electronic Health Records tender is to come to one system for the electronic health records, electronic nursing records, and to make this available to other hospitals if required (Inter Colleague System). These projects are running for some time, and there is no specific financial information available on costs.

A WiFi project just was completed, making WiFi available at the hospital's premises. Also Bring Your Own Device (BYOD) is supported for the use of employees' own devices (e.g. iPad's). Also sharepoint is used.

Business intelligence is used at the hospital. It is used for steering information on every level of decision making, based on financial data, diagnosis-treatment combination data, and non-financial data. The Cognos IBM system is used, which has some historic advantages for the hospital, compared to using the ERP solution SAP / CareCTRL, such as better Excel transportation.

Social media is used, the hospital used Facebook, Twitter, YouTube and Yammer, as an internal system for employees. This is done to deliver information to (potential) patients, to make the hospital recognizable for (potential) patients, and to recruit potential new personnel.

Every large organization features large bureaucracy. When employees feel stuck in the bureaucracy, they can make use of a 'Kafka button.' In that case their complaint is directly sent to the Chairman of the board of directors, who acts within one week of reception of the complaint.

Cloud computing is not used within the hospital, due to privacy and security issues.

With outsourcing contracts, normally no objective party gives an expert opinion. With the implementation of a new salary system, an ISO 9001 certification was sought.

There is cooperation with other hospitals, both on the basis of medical treatments and when implementing the new electronic health records system.

HealthVault is a Microsoft system for electronic patient records maintenance and sharing. It is not used at the hospital, primarily due to doctors who wish not to use it.

e-Health is used as telecoaching. This way a consultation is made via telephone or the internet.

Innovative orientation: the hospital is an academic hospital, and has education as one of its primary objectives, according to interviews and the annual report. This makes innovation a true goal of the organization. To facilitate IT innovation, many departments have specific IT staff for the maintenance and development of their proprietary systems. This makes the indication for 'innovative orientation' in the Innovation scorecard as a fairly achieved objective.

Organizational IT Capabilities: with a clear division of tasks between IT divisions and staffing levels at average, the IT organization should be able to facilitate innovation. This is indicated as a fairly achieved objective.

Partner's IT Readiness: within the hospital, all partners are looking into ways to innovate their care process. This is indicated as on target.

Service provider's IT Capabilities: for IT projects in which an implementation partner is sought, one of the tender criteria is selecting the best IT capable provider. For in-house projects the separate departments have the technical knowledge available. This is indicated as a fairly achieved objected.

E-health: on this area, the hospital leaves room for development. Only e-consult is used. This leaves much improvement to be made.

7.5.3.1.   IT Innovation scorecard

With the information given in this paragraph, the IT Innovation scorecard can be filled in. The filled in chart is visible in figure 28.

IT Innovation is considered a moderately fulfilled objective with room for future development. The capability of IT innovation should be present in the hospital, however e-health is not yet fully utilized.

Indicators for this dimension	Assessment on a -/-1 to 1-point scale	Weight	Source
Total score on IT Innovation Indicators	0.18	100%	
Innovative orientation	0.5	20%	Case study interviews & annual report indicate that the primary process is focused on innovation of healthcare. This goes as far that many groups have dedicated IT systems and IT project personnel to take care of the systems
Organizational IT Capabilities	0.2	20%	There is a clear distinction between the 5 IT Divisions (Staff; Development & Projects; Operations & Application Management; Service Management; division bureau). With 178 permanent and 300 employees in total (at average level) the division's staffing should be competent
Partners IT Readiness	0.2	20%	All divisions and sub groups in this academic hospital are constantly looking for ways to innovate their care process.
Service providers IT Capabilities	0.5	20%	Much innovation projects are performed in-house. For large projects a tender is set out, with one of the criteria being that the best implementation provider is being sought. For specialistic medical equipment, mostly the departments themselves implement the equipment, because
E-health	-0.5	20%	E-health is used in just one form: e-consult.
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Figure 28: IT Innovation scorecard filled in. The hospital has a highly innovative orientation, but could make use of more e-health innovation possibilities.

7.5.4. IT User's perspective

When products are delivered and maintained via the service/product catalogue, Service Level Agreements (SLA) are made. These SLA's can differ per division of the hospital, due to other circumstances. SLA's are generally met, but no official numbers are given, due to sensitivity issues. These numbers are used in internal charging of expenses. User's complaints should be acted on within 4 hours of reporting, however this does not mean they should be resolved within this time. An IT user's satisfaction survey is conducted under random employees who submit tickets. On average the department scores a 7 on user satisfaction. Given that this is under people who file complaints or issues, this can be regarded positive.

Service Level Agreements: SLAs are clearly defined and used to report upon. This makes it a fully achieved objective.

IT User Satisfaction Survey: in a regularly conducted survey, the department gets a 7 out of 10 rating on resolving tickets to satisfaction. This can be considered a positive ranking and constitutes to an almost fully achieved objective with little room for future improvement.

How does strategy satisfy wants & needs of key stakeholders: the IT department specifically mentions in its mission statement, that it exists to satisfy stakeholders. This indicates a fairly achieved objective.

IT's processes vs. strategy: process alignment between IT processes and IT strategy is being done unconsciously. It is a regular item on the agenda. Considering that strategy is mostly intangible, this indicates a fairly achieved objective.

IT's architecture vs. IT processes: there are two distinct situations possible depending on the size of the projects. In the case of a large project, architecture of IT is changed when required for successful implementation in business processes. In other large projects, the architectural demands are listed as requirements, such as the mandatory support of Microsoft Windows. For small changes, no architectural changes are made. Due to the difference in both situations, this indicates an on target situation.

Impact of IT on business processes: another situation in which a twofold is presented. For the purchase of medical equipment, medical personnel is leading, and thus IT follows business. For large IT projects, the IT department is leading, thus IT leads business. This is an on target situation.

Contribution required from stakeholders to maintain and develop IT: The IT department performs all necessary work to guarantee IT functioning for users within the hospital. The only pro-activity requested from users is reporting incidents. Only on explicit request of departments, IT administration is handed over to departments themselves. This indicates a fairly good example.

7.5.4.1. IT User's perspective scorecard

With the information given in the above paragraph, the It User's perspective scorecard can be filled in. This is done in figure 29.

IT User's perspective is considered a relatively fulfilled objective.

Indicators for this dimension	Assessment on a -/-1 to 1-point scale	Weight	Source
Total score on IT's User Perspective Indicators	0.485714286	100%	
Service Level Agreements	1	14%	SLAs are clearly defined and used to report upon
IT User Satisfaction Survey	0.9	14%	Scores 7 out of 10 points on an IT user satisfaction suvey that is set out every 2 months to all ticket requestors of the past time. The question asked is how satisfactory the ticket was resolved.
How does strategy satisfy wants & needs of key stakeholders	0.5	14%	The IT department's main mission statement mentions that this department exists to satisfy the stakeholders. No practice examples given.
IT's processes vs. strategy	0.5	14%	Process alignment with strategy is unconsciously being done by personnel, during management team meeting this is being discussed as item on the agenda.
IT's architecture vs. IT processes	0	14%	Two distinct situations for small and large situations. For large new projects it is possible that architecture is changed when required for succesful implementation. However some large architectural decisions are written down in tenders: such as the mandatory support of Microsoft Windows. For small changes no architectural changes are made.
Impact of IT on business processes	0	14%	Twofold: when medical equipment is purchased, the medical staff is leading. With large IT Projects, the IT function is leading in impact on working processes.
Contribution required from stakeholders to maintain and develop IT	0.5	14%	The IT department performs all necessary work to make sure IT of users in the hospital is functioning. Only pro-activity when it comes to malfunctions reporting is required from users. Only on explicit request of departments, administration of IT is handed to departments themselves.
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Figure 29: IT User's perspective scorecard. The hospital makes good use of SLAs and performs a regular IT user satisfaction survey. It could perform better on aligning IT architecture with IT processes, and by letting the medical staff influence IT, instead of IT impacting the primary process.

7.6.   Overall IT Performance of the hospital

When all the above information is taken into account, the hospital's overall IT performance can be indicated on the scorecard. This is done in figure 30 below.
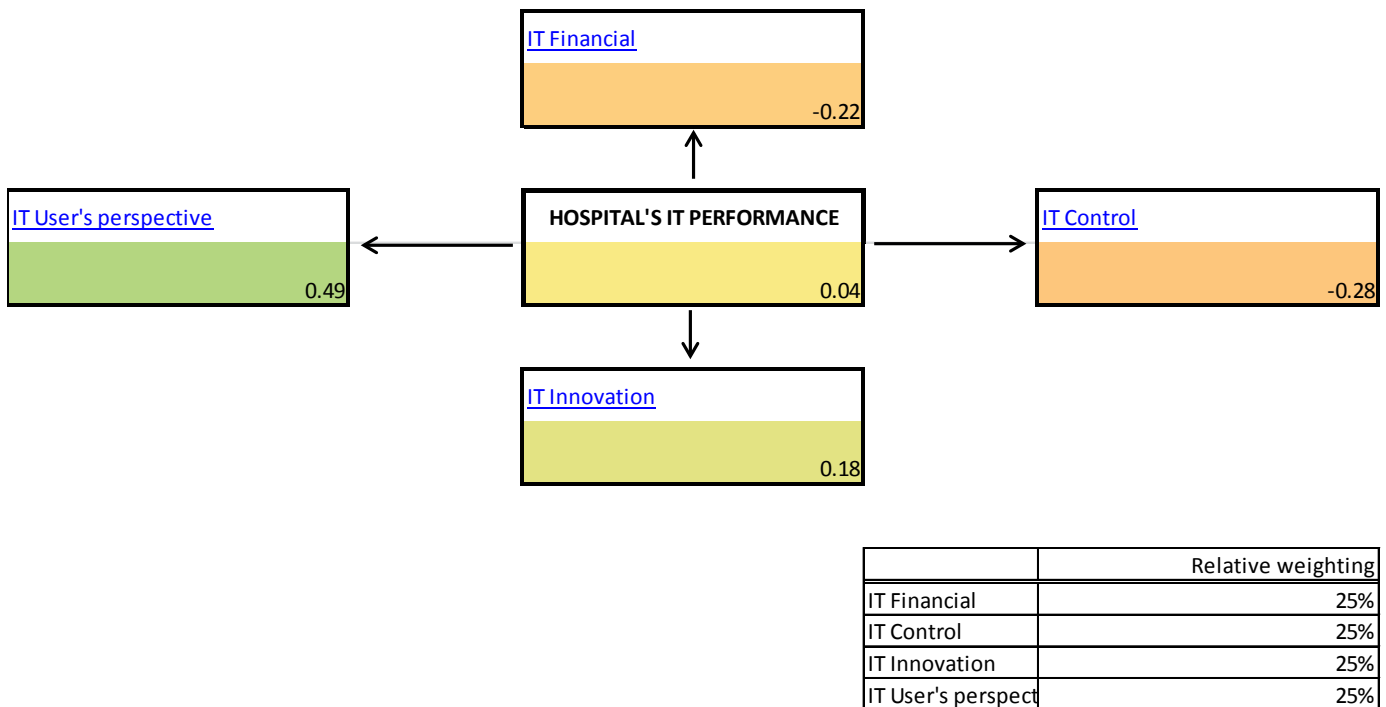
On the financial aspect the hospital provides room for future improvement.

On the control side, it scores negative due to large gaps on the ITGC level.

On the Innovation side, the hospital scores moderately positive due to the attention that is given to innovation and help of external implementation partners.

On the IT user's perspective side the hospital scores positive, especially due to the managerial attention to user's requests and problems (e.g. 'Kafka button').

With the ratings of the four dimensions of the hospital's IT Performance given, the model gives an overall rating. The relative scoring of the dimensions into the main construct, is set so all four dimensions have an equal contribution. The concerning hospital scores a 0.04 on a scale from -1 to 1. This indicates that the hospital has its overall IT performance on target, and room is left for further improvement.

	IT Financial
	-0.22

IT User's perspective	HOSPITAL'S IT PERFORMANCE	IT Control
0.49	0.04	-0.28

	IT Innovation
	0.18

	Relative weighting
IT Financial	25%
IT Control	25%
IT Innovation	25%
IT User's perspect	25%

Figure 30: Hospital's overall IT Performance scorecard filled in. Overall Hospital's IT Performance is 0.04 on a scale from -1 to 1, which rates mediocre. Financial and Control perspectives score relatively low, while Innovation and User's perspective score high.

7.7.   Advice to the hospital

When examining the outcomes of the model, IT Financial and IT Control aspects provide the areas that are open to the largest improvement.

When examining the IT Financial scorecard (see figure 25), three subdimensions cause the negative assessment:
- Percentual IT expenses
- IT Expenses per IT user
- IT Expenses per IT staff (in fte)

Lowering IT expenses
So in order to perform better on the financial aspect, the hospital should decrease one or more of these three expenses. The common factor in the three dimensions is total IT expenses. If these can be lowered, the IT Financial aspect will perform much better. In the current situation the hospital features a very diverse IT environment, with decentralized service portfolios, devices and staff. Lowering IT expenses could be achieved by higher centralization of IT services, offering a more standardized service portfolio, and using benefits of scale by centralizing staff.

Servicing more IT users without increasing budget
If the hospital manages to service a higher amount of IT users, without increasing the total IT expenses required for this, the IT Financial aspect will also perform better. This could be achieved by keeping the IT budget stable when the hospital is growing in size. This forces IT management to be more creative or make concessions, but will let the hospital rank better on the financial aspect. Again centralization of IT services, a more centralized service portfolio, and centralized staff will make the hospital perform better.

Make IT staff work more efficiently per euro
The hospital features somewhat higher costs per IT employee than average. This could be due to inefficient functioning, and thus requiring more staff than average for the same amount of work. It could also be due to an average older age of personnel and the combined higher pay. Strictly when only the metric is taken into account, it can be increased by hiring more IT staff, as increasing the nominator, decreases the total KPI figure. This would be management by KPIs though and is not a real way of increasing hospital performance. Centralization of IT services, a more centralized IT portfolio, and centralized staff will increase efficiency and make the hospital perform better.

When examining the IT Control scorecard, it can be seen that the largest gaps are existing at the following areas:
- Disaster recovery combined with business and IT continuity
- Testing of program change and development
- Implementation of changes and development
- Security administration

Preparing for the worst: making an IT calamity plan and act accordingly
The hospital has a business calamity plan but no specific IT calamity plan. With many IT infrastructure being critical to the medical process, the hospital should provide this calamity plan. This would increase the score on disaster recovery.

Build datacenters on separate locations with a spread of vulnerabilities in the design
The hospital has two datacenters, which provide back-up for each other. However both are situated in the basement. In the extreme event of a calamity due to flooding, both datacenters would not function anymore. So this weakness could be mitigated by building one datacenter on a different location than the basement.

Provide documentation of program testing and development
The area of testing of program change and development has this development deficit, due to a lack of documentation. By creating and archiving documentation at all steps within the program change process, the hospital would perform far better.

Have a clear systematic way of assuring reliant change implementations
For most systems the hospital has no clear and uniform way to assure only tested and accepted program changes are introduced into the production environment. Introducing a clear and uniform system throughout the hospital's IT development department for testing all changes in a separate test and acceptation environment would make the hospital perform better on the IT Control area.

Provide users authorization procedures and traceability
In IT systems, labor is performed by people who are separately authorized for access. The hospital uses general accounts that are not traceable to an individual employee. Also some users have far more rights in the system than required in the line of their duty. This provides a potential risk. The hospital could rank better on the area of security administration, by creating a system to assure access to vital systems is only granted to personnel which actually needs these right. Also all accounts should be traceable to individuals.

Also the better scoring dimensions of IT Innovation and IT User's perspective can be taken into account when giving an advice. The following advice is given.

Keep considering IT as enabling the hospital in being innovative
Due to being academic, the hospital features an innovative and open environment. The IT also reflects this, as departments have a high autonomy in personnel and IT systems choice. This open and innovative approach should be maintained or even enlarged in order to achieve a higher ranking on innovation.

Make more use of e-Health applications
E-health has many possible applications. The hospital currently only uses e-consult. The hospital could increase its innovation by participating in more e-health initiatives.

Measure innovation concretely
Innovation can also be program changes. As mentioned in the IT Control advices, there is no archive of implementation documents. If the hospital wants to be more innovative, the building of such an archive to enable staff to learn from past projects would provide a higher ranking within the innovation dimension.

Lastly on the dimension of IT User's perspective some advices are given.

Make the medical staff leading for the IT role
IT enables the medical staff in performing the main task of a hospital: curing patients and performing research. IT should have a submissive role. Currently for large projects the IT is setting requirements for the whole hospital. By assuming a more submissive role, IT user's perspective could be increased.

Make architecture follow processes, that in turn follow users
In smaller projects, the existing IT architecture is leading in decisions on how staff has to work. From a control and financial aspect this seems logical. However in order to achieve the best possible user's perspective rating, architecture should follow processes, and processes should follow the medical users.

Let all dimensions weigh equally
If management desires, they can prioritize dimensions, by adjusting relative weighting. By giving more weight to dimensions in which the hospital achieves a good rating, the overall score could be increased. Advice would be not to do that, as the model functions on the assumption that other aspects than sole financial aspects are important when determining IT performance. Also the model should reflect the opinion of management on weighting of dimensions regardless of the outcome. Making large changes to the relative weighting would bring the model back to this, or a comparative, situation. All four aspects are important and should be taken into account when considering IT.

When the advice given above, is implemented in the hospital, it should achieve a significantly better rating on IT Financial and IT Control perspective, and therefore achieve a better total IT Performance.

7.8.   Relations between the dimensions

In paragraph 6.2.1 'Link between IT dimensions,' relations between the different dimensions were announced to be assessed. With the research data available, it can be checked what the relation would be. This information is based on the qualitative data. As the model's dashboard only shows a static snapshot of the rating, no time effects can be seen. Thus the model cannot be blindly used to confirm these relations.

1) Better IT Control leads to better (lower) IT costs (Financial). This is considered based on the case study. During the interview with the head of the IT administration department, it turned out that when IT Control is higher, in the past years more effort has been placed on these areas of concern, and costs have been reduced. So in this hospital's case, there is a positive relation between IT Control and IT costs.

2) Better IT Control has limited effect on IT Innovation possibilities. With better IT control there is more knowledge to start IT innovation projects. However there is also less need to start an innovation project. This turned out during the interview with the head of the IT administration department.

3) Better IT Control leads to worse IT user's perspective. It turns out that IT control is at a level that normal users do not regularly see. If a hospital wants to increase IT user's perspective, they can better focus on customer service through account managers and quickly resolving tickets of user requests.

However a certain IT Control level should be present to offer a minimum amount of service on areas visible for users, such as incident management. So this relation is mostly valid when looking at subratings of IT Control, that are valuable to IT users.

4) <u>Better (lower) IT costs (Financial) leads to better IT Innovation capabilities.</u> When the maintenance of the regular IT activities takes less money, more is available for projects. However, if an IT project is essential to the organization, it is executed, no matter the costs. This is true for many projects that the hospital performs.

5) <u>Better (lower) IT costs (Financial) lead to worse IT user's perspective.</u> As the IT costs are used for maintaining the vital IT environment, a reduction in it is almost impossible to implement. When it would be implemented, the non-essential parts such as the quick resolving of tickets would become available for a higher internal price, and thus the end user is negatively impacted.

6) <u>Higher IT Innovation leads to higher IT user's perspective.</u> This depends on the type of innovation project and whom is asked the question. But in general there must be a need for an innovation project, before management agrees with implementing it. This need can be that users miss a certain functionality, or want another way of working. In specific cases it is found that people dislike innovation due to different working procedures.

Table 7: Indication of relation between dimensions of IT Performance; with this knowledge hospital's IT management can determine how to optimize IT performance by altering dimensions

Proposition #	Dimension #1	Dimension #2	Found relation
1	IT Control	IT costs (Financial)	+
2	IT Control	IT Innovation	0
3	IT Control	IT User's perspective	-
4	IT costs (Financial)	IT Innovation	+
5	IT costs (Financial)	IT User's perspective	-
6	IT Innovation	IT User's perspective	+

7.9. Perceived added value of the model

During the three interviews, the question was asked if the interviewed person sees an added value in the model. It turned out that the most common reaction was that all departments have a high degree of autonomy, and that on the central board level a balanced scorecard was already used. This indicates that the use of a scorecard is effective for a hospital. Whether this is due to a larger attention to strategy that leads to the introduction of the scorecard, or the scorecard itself, remains the question in literature and practice.

It also turned out that people are quite 'scared' it their own functioning is assessed and might be scoring negatively. This model uses the color red as an assessment that performance at a certain dimension or indicator is less than expected. This might turn out to be not the optimal way to present areas of required improvement.

8. Discussion

When drawing a conclusion of this research project, it is very important to mention the validity issues that are present. This does not mean that the conclusion is wrong or should not be drawn. It does mean that the issues mentioned below should be taken into account when applying the conclusion.

8.1. Limitations

One hospital case provides challenge to external validity
This case study was conducted at one hospital. This provides a challenge for the external validity of the research. One case is not much to base conclusions on, however this is counteracted by trying to understand the IT environment thoroughly and speaking to different staff members in different functions and departments.

Self-selection challenge to internal validity
A threat for the internal validity is posed by the self-selection of the participating hospital. This is true both for the benchmark and the case study method. Participating hospitals need to provide financial and personnel effort in order to participate with this research. A manager who has to decide this, might be more willing to participate if IT performance in her eyes is uncommon. This can be better than average (in order to reassure they are good-performing) or below average (in order to get higher management support for more projects). If everything is going as planned, there might be little need for participating in a IT Performance research project. As 9 out of 28 hospitals indicated they did not want to participate due to lack of interest, self-selection could be a real challenge.

'Arbitrarily chosen' four dimensions challenge to content validity
In general speaking, organizational performance management could be regarded as an art. It is not exact science in the way that there is no right or wrong answer, and multiple solutions can provide the best depending on the situation. This is especially true for the balanced scorecard (BSC). As being used for almost 20 years in practice, a lot of proponents and opponents exist, mentioning different reasons pro and contra. One of the comments is that it can be regarded quite arbitrarily how the BSC choses its four dimensions, are these four domains collectively exhaustive, is what Kraaijenbrink (2012) wonders. This is a threat to content validity.

Model itself a threat to construct validity
Also there is a threat for construct validity. Is an increase in firm performance due to implementing the BSC, or could this simply be due to the better attention management and personnel pay to strategy (Kraaijenbrink, 2012)? Applying this to this research project: is it the model itself that makes IT performance of Dutch hospitals better, or the fact that they are openly trying to discuss their IT strategy.

Time-consuming to install
It takes up a lot of time to set-up the ERP and performance management within the hospital to match the model. This might provide a threshold for hospitals.

8.2. Possibilities

Model usable for decision making management
The model provides a quick scan into the hospital's IT performance. This provides a welcome feature for decision making management, as these people are often time limited and need only the most relevant information.

Model fit for specific IT managers
The model also provides more details about the scorecards, when this is desired. This way not only high level management, but only IT managers wanting to know more about how to specifically improve performance are serviced.

Model fit for complex environment
The participating hospital is a large academic hospital. This provides a challenging and non-uniform environment. If an IT performance rating model works at this hospital, it will probably also prove worthy in less challenging and more uniform settings. This means that the findings and conclusions based upon them are of value for the whole Dutch hospital sector.

Model with four dimensions offers a good alternation between considering input, process, and output
The financial aspect of the model regards input, or past, measures. The control dimensions regards the process within the hospital, or the present. The Innovation and User's perspective dimensions both regard outcome, or future measures. This provides for a good alternation between measures managers can use to steer with (finance), influence themselves (IT control / processes) and are themselves held accountable for (IT Innovation and user's perspective), which should increase usability and recognizability of the model.

Can be used regularly and easily
Once the hospital has matched its ERP and performance management to match the model, it is only a matter of minutes to fill the model and determine the performance of IT. This ensures the model can be used on a monthly basis to ascertain the hospital's progress.

9. Conclusions

With the gathered data, conclusions regarding the research questions and conclusions regarding performing research on Dutch hospitals can be drawn.

9.1.   IT Consists of four aspects

The first main question (*How can IT performance of Dutch hospitals be measured?*) was answered in chapter 6 (Four dimensions of IT Performance Management in Dutch Hospitals) by stating that IT performance of Dutch hospitals can be regarded as consisting out of four dimensions:

- IT Financial aspects
- IT Control aspects
- IT Innovation
- IT User's perspective

This implicates that the best strategy for IT in hospitals is not to minimize costs, but to search for the optimal division between IT financial aspects, IT Control, IT Innovation and IT user's perspective. This optimal division should be aligned with hospital's strategy.

Subquestion 1a (*Which organizational performance models are available in literature?*) is answered in the text of chapter 3 'Organizational performance management in literature.' All the models consider organizations as simple profit seeking organizations, or as organizations with personnel that performs exactly as management sets out. As hospitals are complex and difficult environments, an organizational performance model is used that makes no immediate ranking but allows the reader (manager) to do this: the balanced scorecard.

Subquestion 1b (*What is IT performance?*) is answered in the text chapter 4 'IT Performance and its constituents.' As IT has dramatically evolved during the last decades, it's performance measurement is also changing. It is a trend however that the performance measurement is less financially based, and more taking into concern all stakeholders of the company.

Of the available models, IT is taken as determined by complex social interactions within the hospital; COBIT is taken as starting point to derive IT General Controls; and Strategic alignment between business and IT is chosen as important criterion.

Subquestion 1c (*What do differences between Dutch hospitals and 'standard organizations' imply for organizational and IT performance?*) is answered in the text of chapter 5 'Special context of Dutch Hospitals.' As hospitals feature an environment that is mostly non-financial driven, when comparing to 'standard organizations,' many changes have to be made regarding the performance measurement. Hospitals are complex social organizations that do not allow for simple financial steering. They do not feature a simple product, but patients. This makes that a model should not be normative overall, but allow the user to draw own conclusions.

Subquestion 1d (*How can the organizational performance models be adapted for use in IT performance of Dutch hospitals?*) is answered in chapter 6 'Four dimensions of IT Performance Management in Dutch Hospitals.' The Balanced Scorecard is taken and combined with IT performance models and adapted to the Dutch hospitals situation, with mostly non-financial indicators taken to assess the four constituent dimensions.

Subquestion 1e (*What is the IT performance of the concerning large Dutch academic hospital?*) is answered in chapter 7 'Case study: findings at a large Dutch academic hospital.' In figure 30 a general overview of the hospital's IT environment is given regarding the four dimensions stated above. As stated in conclusion 1c, no total normative answer can be given, instead the IT performance is categorized into IT Financial aspects, IT control aspects, IT Innovation and IT user's perspective.

9.2.   The model used in practice

The second main research question (*What is the perceived added value by the concerning hospital using the model from the first main research question?*) is answered in chapter 7 'Case study: findings at a large Dutch academic hospital.' The model gives a good overview, as the Balanced Scorecard itself is already used and the custom model is derived from it. The specific functioning of this new model could not be tested.

The model is suited for decision making management, because it gives a clear and normative indication of IT performance on a scale from -1 to 1, with a matching color. Also it provides more in depth discussions and insights as it provides the scoring on the four IT performance dimensions in the same conclusive manner.

Suitable for steering by management
Two of the four IT performance dimensions are input or process indicators. This means that management has direct influence over them. This allows management to directly allocate financial means, or change control processes in order to achieve better IT Financial and IT Control perspectives.

Effects between the four dimensions are of importance
The four dimensions affect each other. If performed on regular basis, the model gives insight and understanding in how management can achieve better performing IT with not only changing the directly concerned dimension, but also adapting one of the other three dimensions.

Do not state KPIs that lead to ambiguous conclusions
As mentioned in the advice to the hospital in paragraph 0, some performance indicators lead to adverse actions. As they provide more discussion than certainty under management regarding action to be taken, these KPIs should be removed.

Within the financial dimension, the measuring of costs per IT employee is such a KPI. More employees lead to lower spendings per employees, so makes the rating look better. However it will lead on the long term to higher costs and will not increase real IT financial performance. Retrospectively, the costs per IT staff member should be left out of the model.

Do not state KPIs that are always present
Soms performance indicators are virtually always performed at hospitals. One of those is the presence of SLAs. All large hospitals will use these, so it will only boost the rating on innovation, instead of providing insight in the hospitals IT performance. This indicator should be removed from the model.

Frequency easy to use
Once the organization has adapted to and accepted the model, it is very easy to use. Therefore it can be used on a monthly basis. This way management can ascertain the IT performance quickly and take appropriate actions.

9.3. Conclusions on the benchmark

The participation of a large group of hospitals in the benchmark did not succeed, mostly due to the reasons below.

- Administrative burden. The required data turned out to be too elaborate and was a burden too high for hospitals already under stress. Ironically this stress would be a large motivator for hospitals to participate, as this benchmark would directly have indicated their performance and points for improvement relative to other hospitals.

- Too many questions were asked. For hospital's IT management information should be short and simple.

- A fee was asked for participation. Combined with the high administrative burden, this proved to be a large hurdle for hospitals.

If a benchmark is successfully deployed, it provides hospitals with a useful comparison on their performance, with relatively little effort. However it should always be noted that the side notes to the data might be more relevant than the data itself. As comparing raw data provides the challenge that the data could be collected in a different way, or have different causes.

9.4.   Conclusion: beneficial that case study views different aspects

The concerning hospital provided an open environment to study its performance. Many questions to multiple persons could be asked, and multiple documents and information was given. This is essential for a qualitative case study.

As the hospital is a complex organization with many actors that operate in a political environment and with different points of view, it is beneficial that the model considers IT from different points of view. As IT has to satisfy all those people with different needs, it is successful that the model provides subscores and details. As decision making managers need a clear and summarized view, it is advantageous that the model gives an overall score with indicative color from red to green.

Also from an external point of view, such as a consulting or auditing firm, it is essential to give a short and firm opinion based on facts that are available in detail upon request.

9.5.   Conclusion: Dutch hospitals difficult to reach

Summarizingly, it can be stated that benchmarking could provide a very powerful tool for hospitals. In the current stressful situation in which hospitals have to act, there is little time and money available for extracting the data, comparing it with other hospitals, and draw valid conclusions on it.

10. Recommendations

In this chapter several recommendations are made for future research. Each paragraph will discuss a recommendation thematically. Many recommendations are based on topics mentioned at the discussion earlier, in chapter 8. 'Discussion.'

Ensure participation of many hospitals

If many hospitals (either by benchmarking or as subject of a case study) are taken into account, the conclusions that are drawn from a research project are more solid.[3] Thus enlarging the sample size, will increase the external validity of this research by reducing the error.

Take time and make questions uncomplicated

As was advised in the beginning of this project by the supervisors, the complicated and time-consuming process of conducting an extensive benchmark at 20 hospitals is not to be underestimated. In order to get a good overview of the four research dimensions (IT Financial, IT Control, IT Innovation and IT User's perspective), many questions and specific data have to be obtained. For the use of benchmarking, the data should be comparable, therefore it was asked very precisely. This made that is was a lot of effort for hospitals to find the data and convert it to the required format. Some mentioned that it would take a professional up to two full time weeks to gather and convert all the required data. Making questions less complicated provides less interesting data, but would reduce the burden at hospitals' side and makes it likely more hospitals would participate, therefore enlarging the accuracy of the research.

Do not take too many dimensions into account

Due to the limited time of a research project, choices have to be made how to use this amount. It is logical to construct the concept of IT performance of the four constituent dimensions; however this also meant that a lot of research time had to be invested in these four separate areas of research. There is very limited overlap between IT Financial models, IT control evaluation, IT innovation perspective, and IT user's satisfaction. Research data has to be collected for all of these research dimensions.

KiSS: Keep it Short and Simple

It is better to collect much quantitative data, than little qualitative data. To rely on participation of management and highly occupied staff, questionnaires should be kept very simple and short, so they do not consume much time. This eliminates a major source of organizations dropping out of the benchmark.

Gain support of management

Cooperation from many hospitals is required in order to make solid conclusions about hospitals' IT functioning in general. Especially when hospitals are requested to deliver information in a specific format, it is important that management support this time-consuming task. Without manager's support, it is virtually impossible to acquire data and conduct interviews with staff members.

Do not judge based on the available data

Data is just simple data. It might be tempting to draw conclusion on available data, but without all the background information this might be very inaccurate. Moreover hospital personnel does not like to be judged upon. So judging make feel personnel less participative if they know that based on what they tell, a negative conclusion might be drawn. This can be provided by just stating the data as it is, and letting managers / directors of the concerning hospital do the judging work.

Conduct longitudinal research on dimensions' relations

To get an indication of behavior of the different dimensions with regard to each other, longitudinal research should be performed. The balanced scorecard approach in this thesis takes a snapshot. In order to measure relative performance, an ideal situation would be to measure long-term effects between two dimensions, with the other two dimensions being stable.

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[3] From the definition of the standard deviation of the mean (Kenny & Keeping, 1954), it can be derived that for a series of measurements with sample size n, the standard error of the composed mean is proportional to $1/\sqrt{n}$ times the standard deviation of the population.

Conduct a large scale benchmark

Performing a case study is essentially different than benchmarking. The latter requires loads of quantitative data, and allows for statistical comparisons to be made between hospitals. Whilst performing a case study requires far more data in order to make objective statements.

A benchmark also would have increased certainty in research on dimensions' relations, as a random factor filters out of the comparison.

Allowing participation ideally should be easier when benchmarking. Less time is required from an organization, than when performing a case study in which many information has to be collected, mostly on site.

The project could have been carried out with a benchmark, if little effort was truly requested from organizations and their staff. This is where this project initially went wrong. By both requesting a financial compensation, and much detailed information, hospitals did not considered it worth the effort. Also when it turned out a competitor with years of experience in this area was active, the business case for this benchmark diminished.

As recommendation for future research: try to benchmark data, in order to compare hospitals, and to discover trends.

Examine the relations between the four constituent dimensions of IT performance

IT performance consists of four dimensions. As briefly mentioned in paragraph 7.8 'Relations between the dimensions,' the interdependencies between the dimensions can help management to achieve goals more easily, by not only influencing the directly affected dimension, but also by influencing the other dimensions with positive or negative effects.

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Appendix A: IT Costs Survey

IT-Kosten vragenlijst

Dit formulier niet invullen, gebruik s.v.p. de digitale tool. Deze print is slechts bedoeld ter indicatie van de vragen.

Welkom bij de IT-kosten vragenlijst voor het in kaart brengen van de prestatie van uw ziekenhuis. Dit onderzoek wordt uitgevoerd door PwC. In dit onderzoek worden uw kosten, beheersingsniveau en innovatie op het gebied van IT in kaart gebracht. De resultaten zullen we met u doornemen.

De vragenlijst bestaat uit 42 vragen die de kosten van IT-gerelateerde aspecten binnen uw ziekenhuis in kaart brengen. Het verzamelen van informatie en het invullen van de vragenlijst kost u ongeveer 6 - 8 uur, afhankelijk van de mate waarin u direct de benodigde data beschikbaar heeft.

Indien u op dit symbool klikt, verschijnt extra informatie en uitleg over de betreffende vraag.

Probeert u deze vragen zo nauwkeurig mogelijk in te vullen.

Algemene informatie

Uitgangspunten:

- Gebruik data vanuit het meest recent gesloten volledige jaar (2011);
- Gebruik een komma als decimaalscheidingteken;
- Geef bedragen aan in Euro's;
- Laat de regel leeg indien u de vraag niet kunt beantwoorden. Gebruik alleen '0' als het antwoord daadwerkelijk nul moet zijn;
- Wanneer er getallen moeten worden ingevuld, gebruik hierbij geen punten, tekst, symbolen, en dergelijke. Bijvoorbeeld schrijf één miljoen als 1000000 en vijf en een halve dag als 5,5 dagen.

1a. Definieer de naam van het ziekenhuis dat op uw persoonlijke rapport moet komen te staan. Uiteraard wordt vertrouwelijk omgegaan met uw gegevens.

1b. Datum van invullen van de vragenlijst (dd/mm/jjjj)

 Vul de datum in waarop u de vragenlijst heeft ingevuld.

2. Naam contactpersoon

 Vul gegevens in waarop we u kunnen bereiken voor eventuele vragen over de door u ingevoerde gegevens.

3. Telefoonnummer contactpersoon (vul het volledige 10-cijferige nummer in a.u.b.)

4. Functie contactpersoon

5. E-mailadres contactpersoon

6. Met welke persoon van uw organisatie zal PwC de uitkomsten van deze vragenlijst gaan bespreken?

Deel A: Algemene informatie

7. Wat is het totaal aantal werknemers? Het betreft hier zowel parttime als fulltime medewerkers, werkzaam binnen uw gehele organisatie.

8. Wat is uw totale omzet?

⚠ *Met totale omzet wordt alle omzet bedoeld die in het meest recente afgesloten boekjaar (2011) is geboekt door de volledige organisatie.*

9. Wat is uw totale IT-begroting?

⚠ *Geef het totale bedrag dat op de begroting van uw organisatie voor 2011 is gereserveerd voor IT.*

10. Wat is de totale realisatie van IT-kosten?

⚠ *Geef de totale kosten op die uw organisatie in 2011 heeft gemaakt voor IT.*

11. Wat is het totaal aantal IT-gebruikers met een eigen werkstation?

12. Classificeer IT-gebruikers in de onderstaande categorieën (totaal moet 100% zijn).

⚠ *Niet-veelvuldige gebruikers zijn gebruikers die IT voor hun werkzaamheden in minder dan 25% van hun tijd gebruiken. Meestal gebruiken zij IT voor e-mail en tekstverwerking. Veelvuldige gebruikers gebruiken IT voor hun werkzaamheden 25% of meer van hun tijd.*

_____ a. Niet-veelvuldige gebruikers (incidenteel gebruik voor uitvoering van de werkzaamheden, bijvoorbeeld alleen voor het checken van e-mail en wat tekstverwerking)
_____ b. Veelvuldige gebruikers (afhankelijk van IT voor hun werzaamheden, bijvoorbeeld data-invoer, dagelijks gebruik van spreadsheets, databases, enzovoorts)

13. Op hoeveel locaties zijn IT-gebruikers aanwezig?

⚠ *Neem alleen locaties mee waar IT-gebruikers werken, maar geen locaties van de IT-afdeling of service centers.*

	Aantal
a. Grote locaties (gebouw met meer dan 75 gebruikers)	
b. Kleine locaties (gebouw met minder dan 75 gebruikers)	

Deel B: Personeelsinformatie

14. De onderstaande vragen moeten beantwoord worden in termen van fulltime equivalents (FTE's). Stel het gemiddelde jaarlijkse salaris voor iedere IT positie vast. De definities van de IT categorieën zijn als volgt:

- **Applicatieontwikkeling:** systemen, applicaties, database ontwikkeling, programmering, management en onderhoud van applicaties
- **Technisch en gebruikerssupport:** interne gebruikers, operationele dagelijkse support (helpdesk)
- **Netwerk services:** mainframe, local area network (LAN), wide area network (WAN), telefonie (geluid en data) en support en onderhoud van draadloze communicatie.
- **IT-beleid en administratie:** vaststellen van IT-beleid, -protocollen en het managen van IT-administratieve functies.

- Neem geen onderdelen mee van IT-functies die gericht zijn op het ontwikkelen, bouwen, verkopen, distribueren of ondersteunen van software en hardware voor externe klanten.
- Neem contractanten mee als FTE's in deze vraag.
- Bereken FTE's op basis van de lengte van de werkweek van uw organisatie als volgt: indien een medewerker 20 uur per week werkt op basis van een 40-urige werkweek, dan is dit 0,5 FTE (20 / 40). Een medewerker die 60 uur per week werkt, staat voor 1,5 FTE (60 / 40).
- Als controle moeten de totale salariskosten vanuit deze vraag redelijkerwijs overeen komen met de bij vraag 18 berekende kosten van directe arbeid en gecontracteerde services opgeteld. Bijvoorbeeld: in vraag 14 moeten de FTE's per categorie (bijvoorbeeld applicatieontwikkeling) vermenigvuldigd met het gemiddeld jaarlijks salaris per functiecategorie, en vervolgens opgeteld, redelijk overeen komen met de in vraag 18 ingevulde 'directe arbeid' en 'gecontracteerde / geoutsourcde services' kosten opgeteld voor applicatieontwikkeling.

a. Applicatieontwikkeling

(systemen, applicaties, database ontwikkeling, programmering, management en onderhoud van applicaties). Onder de functies wordt verstaan:

i. **Projectleiders.** *Managen van een project gebaseerd op klanteisen. Verantwoordelijk voor het ontwikkelen van scope, personeelseisen, budgetten, planning en projectmanagement. Verantwoordelijk voor communicatie met de interne klant en de samenwerking met de klant om de eisen te noteren die de scope van het project definiëren. Een projectleider vertegenwoordigt de klant in interne vergaderingen en zorgt dat de klant periodiek op de hoogte wordt gebracht van de projectvoortgang. Ondersteunt de klant in het beheersen van de risico's binnen het project en zorgt dat een uitgebreid testplan en -schema zijn opgenomen in het hoofdschema en -plan. Zorgt ervoor dat aan omgevingsvereisten wordt voldaan, zoals hardware, bestursingssysteem software niveau, etc.*

ii. **Ontwikkelaars / ontwerpers.** *Verantwoordelijk voor het vertalen en documenteren van de functionele eisen die de interne klant stelt. Hier valt ook onder het ontwikkelen van testscenario's voor gebruikers en de acceptatietestfase.*

iii. **Programmeurs.** *Implementeren van de functionele en technische specificaties tot de daadwerkelijke programmeercode. Verantwoordelijk voor unit en module tests. Betrokken bij systeemtesten en stresstesten.*

iv. **Systeem / technische specialisten.** *Ondersteunen in het verzorgen van de technische- en systeemarchitectuur die benodigd is om de applicatie volgens klanteisen te laten functioneren. Handelt als configuratiespecialist en is daardoor verantwoordelijk voor versiebeheer en bronbeheer van de applicatie (software code). Ook verantwoordelijk voor het maken en testen van de eerste*

productieversie die uitgegeven wordt aan de klant, met als hoofdpunt het nagaan dat er geen specifieke referenties in de code staan die ervoor zorgen dat de applicatie weigert.

v. **Andere.** *Medewerkers werkzaam in applicatieontwikkeling die redelijkerwijs niet in bovenstaande categorieën kunnen worden ingedeeld.*

	FTE's (in aantallen)	Gemiddeld jaarlijks salaris (in EUR)
i Projectleiders		
ii Ontwikkelaars / ontwerpers		
iii Programmeurs		
iv Systeem- / technische specialisten		
v Andere		

b. Technisch- en gebruikerssupport

⚠️ *Dagelijkse eindgebruikerondersteuning voor interne gebruikers (zoals helpdesk). Afhankelijk van uw organisatie kan dit gespecialiseerd zijn (zoals ondersteuning van netwerk, telefoon, applicaties, besturingssystemen, hardware, middleware, en back-office). Onder de functies wordt verstaan:*

i.   **Management.** *Verantwoordelijk voor inzet van personeel bij de helpdesk, inclusief alle management en administratieve taken. Dit omvat zowel inzet van personeel op de eerstelijnshelpdesk, als het stellen van eisen aan technisch personeel. Management is eindverantwoordelijk voor het op tijd oplossen van zaken en onderneemt actie indien zaken voor lange tijd openstaan. Houdt zowel helpdesk service levels, houding en beantwoordingstijden in de gaten. Onderzoekt op periodieke basis de ervaren servicekwaliteit bij eindgebruikers.*

ii. **Eindgebruikers-helpdeskmedewerkers (1e lijn).** *Eerstelijnsondersteuning voor eindgebruikers. Indien mogelijk moet een oplossing tijdens het eerste contact met de eindgebruiker worden gegeven. Als het probleem niet snel op te lossen is, moeten deze mensen terugbeltijden inschatten en het verdere proces uitleggen. Verantwoordelijk voor het zodanig documenteren van het probleem, dat de technische staf het kan nabootsen en gemakkelijker een oplossing kan vinden. Indien eindgebruikers terugbellen met een statusverzoek, kunnen deze mensen vertellen wie van de technische staf bezig is met een oplossing.*

iii. **Technische-helpdeskmedewekers (2e lijn).** *Tweedelijnsondersteuning voor eindgebruikers. Technische staf probeert een probleem van eindgebruikers over de telefoon, internet of e-mail op te lossen. Indien nodig kunnen deze mensen langsgaan bij de eindgebruiker om het probleem op te lossen. Indien ook zij het probleem niet kunnen oplossen, contacteren ze ontwikkelaars of programmeurs van de betrokken applicaties. Deze helpdeskmedewerkers blijven echter verantwoordelijk voor het contact met de eindgebruikers.*

iv. **Andere.** *Medewerkers werkzaam bij technische ondersteuning die redelijkerwijs niet in bovenstaande categorieën kunnen worden ingedeeld.*

	FTE's (in aantallen)	Gemiddeld jaarlijks salaris (in EUR)
i Management		
ii Eindgebruikers-helpdeskmedewerkers (1e lijn)		
iii Technische-helpdeskmedewerkers (2e lijn)		
iv Andere		

c. Netwerkservices

 (mainframe, local area network (LAN), wide area network (WAN), telefonie (geluid en data) en support en onderhoud van draadloze communicatie). Onder de functies wordt verstaan:

    i.   ***Mainframe, LAN, WAN, telefonie administrators.*** *Verantwoordelijk voor het implementeren, onderhouden en upgraden van mainframes, grote applicaties (zoals Enterprise Resource Planning (ERP) systemen), netwerk- en telefoniesystemen (voice, data, wireless). Houdt overzicht over het ontwerp en de installatie van deze systemen. Beheer van gegevensback-up, -archivering en -uitlezen.*

    ii.   ***Infrastructuur administratieve medewerkers.*** *Medewerkers die de eerder genoemde administrators ondersteunen. Bij deze vraag neemt u geen technische helpdeskmedewerkers of medewerkers die eindgebruikers ondersteunen mee in het aantal FTE en gemiddeld salaris.*

    iii.   ***Andere.*** *Medewerkers werkzaam bij netwerk services die redelijkerwijs niet in bovenstaande categorieën kunnen worden ingedeeld.*

	FTE's (in aantallen)	Gemiddeld jaarlijks salaris (in EUR)
i Applicatiebeheerders (mainframe, LAN, WAN, telefonie)		
ii Infrastructuur administratieve medewerkers		
iii Andere		

d. IT-beleid en -administratie

vaststellen van IT beleid, protocollen en het managen van IT administratieve functies. Onder de functies wordt verstaan:

i. ***Chief Information Officer (CIO).*** *Verantwoordelijk voor de gehele informatie-infrastructuur en -architectuur. Ontwikkelt en bepaalt de strategische richting van de organisatie en laat de dagelijkse operationele zaken over aan een tweede persoon.*

ii. ***IT-beleidsmanagers.*** *Managementondersteuning voor de CIO. In grotere organisaties zal dit de architectuurafdeling zijn, die de strategische richting van de technologie die de organisatie gebruikt, ontwikkelt en bepaalt. Bepalen van beleid en procedures, en in zekere zin kwaliteitsbewaking uitvoeren, zodat alle onderdelen van de organisatie het beleid en de procedures volgen.*

iii. ***IT-beleidsondersteunende administratieve medewerkers.*** *Administratieve medewerkers die de CIO en het IT-beleid-managementteam ondersteunen.*

iv. ***Andere.*** *Medewerkers werkzaam in IT-beleid en -administratie die redelijkerwijs niet in bovenstaande categorieën kunnen worden ingedeeld.*

	FTE's (in aantallen)	Gemiddeld jaarlijks salaris (in EUR)
i CIO's		
ii IT-beleids- / administratieve managers		
iii IT-beleids- / administratieve medewerkers		
iv Andere		

15. Welk percentage van de huidige IT-medewerkers bestaat uit contractanten?

⚠️ Contractanten zijn mensen die niet direct bij het ziekenhuis in dienst zijn. Neem onder elke categorie het percentage contractanten op het gehele aantal medewerkers in deze categorie. IT-contractanten zijn IT-professionals of medewerkers die bij de IT-afdeling werken die niet op de loonlijst van uw organisatie staan, maar op die van een externe organisatie, of werkzaam zijn als zelfstandige. De IT-categorieën zijn gelijk aan de hiervoor gehanteerde, namelijk:

- ***Applicatieontwikkeling:*** *systemen, applicaties, database ontwikkeling, programmering, management en onderhoud van applicaties.*
- ***Technisch en gebruikerssupport:*** *interne gebruikers, operationele dagelijkse support (helpdesk).*
- ***Netwerk services:*** *mainframe, local area network (LAN), wide area network (WAN), telefonie (geluid en data) en support en onderhoud van draadloze communicatie.*
- ***IT-beleid en -administratie:*** *vaststellen van IT beleid, protocollen en het managen van IT administratieve functies.*

a. Applicatie-ontwikkeling b. Technisch- en gebruikerssupport c. Netwerkservices d. IT-beleid en -administratie	

16. Wat is het jaarlijkse verloop op uw IT-afdeling?

Bereken het verloop door gebruik te maken van de volgende formule: totaal aantal IT-medewerkers die de organisatie in 2011 hebben verlaten, gedeeld door het gemiddelde aantal IT-medewerkers binnen de organisatie in 2011. Contractanten en consultants zijn hiervan geen onderdeel.

⚠️ Verloop beschrijft het percentage IT-medewerkers (exclusief contractanten en consultants) dat het afgelopen jaar uw organisatie heeft verlaten. Neem geen medewerkers mee die overgeplaatst zijn binnen uw organisatie; het gaat hier uitsluitend om medewerkers die uw organisatie in zijn geheel hebben verlaten.

17. Hoeveel IT-medewerkers en hoeveel IT-FTE's heeft u in dienst?

- *Neem geen onderdelen mee van IT-functies gericht op het ontwikkelen, bouwen, verkopen, distribueren of ondersteunen van software en hardware voor externe klanten.*
- *De ingevulde cijfers moeten overeenkomen met eerder ingevulde gegevens over IT-FTE's. Het totaal aantal FTE moet dus overeenkomen met de totalen uit vraag 14.*
- *Bereken FTE's op basis van de lengte van de werkweek van uw organisatie als volgt: indien een medewerker 20 uur per week werkt op basis van een 40-urige werkweek, dan is dit 0,5 FTE (20 / 40). Een medewerker die 60 uur per week werkt, staat voor 1,5 FTE (60 / 40).*
- *Headcount beschouwt het totaal aantal personeelsleden, ongeacht het aantal uren dat medewerkers werken.*

	Head count	FTE's
a. Management (degenen die supervisorverantwoordelijkheden hebben)		
b. Personeel (degenen die geen supervisorverantwoordelijkheden hebben)		

Deel C: Kostenstatistieken

18. Schat voor elk van de onderstaande categorieën de totale jaarlijkse kosten (2011) voor de IT functie in. Definities van de categorieën zijn zoals eerder gegeven als volgt:

- **Applicatieontwikkeling:** systemen, applicaties, database ontwikkeling, programmering, management en onderhoud van applicaties
- **Technisch en gebruikerssupport:** interne gebruikers, operationele dagelijkse support (helpdesk)
- **Netwerk services:** mainframe, local area network (LAN), wide area network (WAN), telefonie (geluid en data) en support en onderhoud van draadloze communicatie.
- **IT-beleid en -administratie:** vaststellen van IT-beleid, protocollen en het managen van IT-administratieve functies.

Neem eenmalige materiële investeringen in nieuwe systemen en buitengewone kosten niet mee. Probeer zo goed mogelijk de IT-afdelingskosten te berekenen die gewoonlijk optreden in een periode van 12 maanden. Bereken jaarlijkse gemiddelden uit een periode van 1 tot 3 jaar om tot een gemiddeld jaar te komen. Neem jaarlijkse afschrijvingskosten van investeringen mee.

Gebruik de volgende categorieën om kosten in te delen:

- *Directe arbeid: loon, overuren, en tegemoetkomingen voor IT-management en -personeel.*
- *Gecontracteerde / geoutsourcde services: tijdelijke arbeid en contractarbeid, inclusief consultants.*
- *Aankopen hardware, lease, huur, onderhoudskosten en afschrijving: deze kosten die normaal in een jaar optreden.*
- *Aankopen software, lease, licenties, royalties, onderhoudskosten en afschrijving: deze kosten die normaal in een jaar optreden.*
- *Overheadskosten, bevoorrading, overige kosten: supplies en andere lokaal beheerde uitgaven.*

Als controle moeten de totale kosten uit directe en gecontracteerde arbeid / geoutsourcde services hier berekend redelijkerwijs overeen komen met de bij vraag 14 berekende kosten per IT-categorie. Bijvoorbeeld: in vraag 14 moeten de FTE's per categorie (bijvoorbeeld applicatieontwikkeling) vermenigvuldigd met het gemiddeld jaarlijks salaris per functiecategorie, en vervolgens opgeteld, redelijk overeen komen met de in vraag 18 ingevulde 'directe arbeid' en 'gecontracteerde / geoutsourcde services' kosten opgeteld voor applicatieontwikkeling.

Een tweede controle op redelijkheid is om de percentages contractanten per IT-categorie te bekijken. Bijvoorbeeld als het percentage van medewerkers bij applicatie-ontwikkeling 70% is bij vraag 15, dan is er bij vraag 18 te verwachten dat meer kosten worden gemaakt voor gecontracteerde arbeid / geoutsource services bij applicatie-ontwikkeling dan bij directe arbeid voor applicatie-ontwikkeling.

	Kosten applicatie-ontwikkeling	Kosten technische- en gebruikerssupport	Kosten netwerkservices	Kosten IT-beleid / administratie
a. Directe arbeid				
b. Gecontracteerde / geoutsource services				
c. Aankopen hardware, lease,				

huur, onderhoudskosten en afschrijving d. Aankopen software, lease, licenties, royalties, onderhoudskosten en afschrijving e. Overheadkosten, bevoorrading, overige kosten			

19. Neem het totaal van alle IT-kosten in beschouwing. Welk percentage van de IT kosten zijn gerelateerd aan het onderhoud en support van de volgende afdelingen / functionele gebieden? (Totaal moet gelijk zijn aan 100%)

_____ a. Productieregistratie
_____ b. Cliëntregistratie (EPD)
_____ c. Dienstroosterplanning
_____ d. Financiën
_____ e. Personeelsadministratie
_____ f. Facturering
_____ g. Salarisadministratie
_____ h. Inkoop
_____ i. Medische technologie
_____ j. Overige, namelijk:

20. Op welke manier wordt de IT-afdeling bekostigd? (selecteer één welke het beste aansluit bij uw situatie)

○ Centraal bekostigd uit overhead
○ Deels doorbelast aan afdelingen
○ Volledig doorbelast aan afdelingen

21a. Is het IT-budget in 2011 ten opzichte van 2010 (slechts één antwoord mogelijk):

○ Toegenomen met meer dan 50 %
○ Toegenomen met 26 - 50 %
○ Toegenomen met 16 - 25 %
○ Toegenomen met 6 - 15 %
○ Toegenomen met 0 - 5 %
○ Afgenomen met meer dan 50 %
○ Afgenomen met 26 - 50 %
○ Afgenomen met 16 - 25 %
○ Afgenomen met 6 - 15 %
○ Afgenomen met 0 - 5 %

21b. Is de realisatie van IT-kosten in 2011 ten opzichte van 2010 (slechts één antwoord mogelijk):

- ❍ Toegenomen met meer dan 50 %
- ❍ Toegenomen met 26 - 50 %
- ❍ Toegenomen met 16 - 25 %
- ❍ Toegenomen met 6 - 15 %
- ❍ Toegenomen met 0 - 5 %
- ❍ Afgenomen met meer dan 50 %
- ❍ Afgenomen met 26 - 50 %
- ❍ Afgenomen met 16 - 25 %
- ❍ Afgenomen met 6 - 15 %
- ❍ Afgenomen met 0 - 5 %

22. Verwacht u dat uw IT budget voor 2013 ten opzichte van 2012 (slecht één antwoord mogelijk):

- ❍ Toeneemt met meer dan 50 %
- ❍ Toeneemt met 26 - 50 %
- ❍ Toeneemt met 16 - 25 %
- ❍ Toeneemt met 6 - 15 %
- ❍ Toeneemt met 0 - 5 %
- ❍ Afneemt met meer dan 50 %
- ❍ Afneemt met 26 - 50 %
- ❍ Afneemt met 16 - 25 %
- ❍ Afneemt met 6 - 15 %
- ❍ Afneemt met 0 - 5 %

Deel D: IT-structuur, -support en -strategie

23. Geef de organisatiestructuur aan van ieder van de volgende IT-functies (selecteer één optie per functie).

⚠️ *De IT-functies zijn gelijk aan de hiervoor gehanteerde functies, namelijk:*

- *__Applicatieontwikkeling:__ systemen, applicaties, database ontwikkeling, programmering, management en onderhoud van applicaties.*
- *__Technisch en gebruikerssupport:__ interne gebruikers, operationele dagelijkse support (helpdesk).*
- *__Netwerkservices:__ mainframe, local area network (LAN), wide area network (WAN), telefonie (geluid en data) en support en onderhoud van draadloze communicatie.*
- *__IT-beleid en -administratie:__ vaststellen van IT-beleid, -protocollen en het managen van IT-administratieve functies.*

	Eén locatie	Enkele locaties (2 of 3)	Meerdere locaties (4 of meer)
a. Applicatie-ontwikkeling	○	○	○
b. Technisch- en gebruikerssupport	○	○	○
c. Netwerkservices	○	○	○
d. IT-beleid en -administratie	○	○	○

24. Is er binnen uw organisatie een formeel gedocumenteerd, up-to-date IT-beleidsplan aanwezig?

⚠️ Een IT-beleidsplan is een formeel vastgesteld document dat de korte- en langetermijn visie, missie, doelen en acties van de IT-afdeling benoemt. Dit is niet het strategisch plan van de gehele organisatie.

○ Ja
○ Nee

25. Welke regels betreffende IT-outsourcing hanteert men binnen de IT-organisatie (selecteer alle opties die voor uw organisatie gelden)?

⚠️ *Bepaal van de gegeven mogelijkheden, welke opties momenteel door uw IT-afdeling worden gehanteerd voor het strategisch outsourcen van diensten of het maken van joint venture-afspraken.*

a. *De afspraken zijn gemaakt voor een vooraf gedefinieerd aantal jaar: dit impliceert dat de afspraken vooral op basis van tijdsduur worden gemaakt.*
b. *De afspraken moeten vallen binnen een vooraf gedefinieerde set aan waarden: dit geeft aan dat als voorwaarde voor een afspraak het bedrijf moet voldoen aan vooraf bepaalde specifieke waarden. Bijvoorbeeld: een outsourcer moet minimaal 20% van de tijd aan on-line technische support besteden, maar niet meer dan 30%.*
c. *De afspraken moeten overeenkomen met een vooraf gedefinieerde set aan Key Performance Indicators (KPI's): dit geeft aan dat functioneringsstandaarden worden afgesproken.*

Bijvoorbeeld: een outsourcer moet elk jaar de volgende doelen halen: 90% van de calls moet in een eerste gesprek afgehandeld worden en dat binnen 2 minuten per call.

❑ a. De afspraken zijn gemaakt voor een vooraf gedefinieerd aantal jaar.
❑ b. De afspraken moeten vallen binnen een vooraf gedefinieerde set aan waarden.
❑ c. De afspraken moeten overeenkomen met een vooraf gedefinieerde set aan Key Performance Indicators (KPI's).
❑ d. Binnen uw organisatie is geen sprake van outsourcing.
❑ e. Andere afspraken. Specificeer: _____

26. Wat is het percentage netwerk downtime van het afgelopen jaar?

(Downtime is in deze benchmark gedefinieerd als een periode van tijd waarbij een grote groep van gebruikers het netwerk niet kan bereiken of gebruiken).

○ 0 %
○ 1 - 5 %
○ 6 - 10 %
○ 11 - 20 %
○ 21 - 30 %
○ 31 - 40 %
○ meer dan 40%

Deel E: Systeemomgeving

27. Categoriseer het percentage van huidige software applicaties (totaal moet 100% zijn):

_____ Standaardsysteem (geen maatwerk)
_____ Deels maatwerk (standaardsysteem met aanpassingen)
_____ Volledig maatwerk (volledig ontwikkeld voor een bepaald doel)

28. Welk percentage van uw huidige software applicaties zou u kunnen beschrijven als 'legacy' systemen?

⚠ *In deze vragenlijst definiëren wij 'legacy' als deze systemen die zijn vervangen, maar nog steeds gebruikt en onderhouden worden. Neem ook gevallen mee waarin een nieuw systeem ingevoerd wordt door een nieuwe applicatie te integreren met de oude applicatie nog in gebruik.*

29. Hoeveel afzonderlijke software applicaties (standaard en maatwerk) worden op dit moment in de volgende functionele gebieden gebruikt?

⚠ *Bepaal voor elke genoemde afdeling of functioneel gebied, hoeveel verschillende software applicaties (zowel standaard als maatwerk) gebruikt worden. Algemene applicaties, zoals Word en Excel, moeten worden meegeteld als afzonderlijke applicaties in elk functioneel gebied waar zij gebruikt worden. Dus als uw cliëntregistratie-afdeling gebruik maakt van Word, Excel en een clientregistratiesysteem, dan is het antwoord voor deze afdeling 3.*

	Aantal:
a. Productieregistratie	
b. Cliëntregistratie	
c. Dienstroosterplanning	
d. Financiën	
e. Personeelsadministratie	
f. Facturering / declarering	
g. Salarisadministratie	
h. Inkoop	
i. Medische technologie	
j. Overige, namelijk:	

30. Kijkende naar uw huidige in gebruik zijnde mainframes, servers, laptops en desktops, met hoeveel hardwareleveranciers doet u dan zaken?

⚠ *Vul het totale aantal hardwareleveranciers in waarvan uw organisatie momenteel bestaande hardware heeft. Neem hardwareleveranciers die een outsourcingpartner gebruikt niet mee. Bijvoorbeeld als uw organisatie een IBM-mainframe heeft, HP-desktops en Dell-laptops, dan is het antwoord op deze vraag 3.*

31. Kijkende naar uw huidige in gebruik zijnde softwaresytemen (standaard en maatwerk), met hoeveel softwareleveranciers doet u dan zaken?

⚠️ *Vul het totale aantal softwareleveranciers in waarvan uw organisatie momenteel bestaande software heeft. Neem softwareleveranciers die een outsourcingpartner gebruikt niet mee. Bijvoorbeeld als uw organisatie Microsoft Office suite gebruikt en een maatwerk registratiesysteem van een andere softwareleveranicers, dan is het antwoord op deze vraag 2.*

32. Welk percentage van desktop- / laptopgebruikers hebben toegang tot de volgende bronnen?

	Percentage
a. Netwerk	
b. Internet	
c. Intranet (exclusief e-mail)	
d. E-mail	
e. Inloggen vanaf afstand op het netwerk van de organisatie	

33. Heeft uw organisatie een Enterprise Resource Planning (ERP) systeem?

⚠️ *Enterprise Resource Planning-systemen (ERP) zijn functionele, client/server, of web-gebaseerde ondersteunende software applicaties, ontworpen om de gehele organisatie te ondersteunen. Voorbeelden zijn SAP- en Oracle-systemen.*

◯ Ja
◯ Nee

34. Welk ERP-systeem gebruikt uw organisatie? (selecteer alle systemen die in uw organisatie aanwezig zijn)

❑ a. SAP
❑ b. Oracle
❑ c. Overig, namelijk: _____

35. In welke functionele gebieden wordt dit ERP-systeem gebruikt? (selecteer alle gebieden die voor uw organisatie van toepassing zijn)

- ❑ a. Productieregistratie
- ❑ b. Cliëntregistratie
- ❑ c. Dienstroosterplanning
- ❑ d. Financiën
- ❑ e. Personeelsadministratie
- ❑ f. Facturering / declarering
- ❑ g. Salarisadministratie
- ❑ h. Inkoop
- ❑ i. Medische technologie
- ❑ j. Overige, namelijk: _____

36. Wat is de gemiddelde leeftijd van de hardware die u in uw huidige omgeving aanwezig heeft?

🔶 *Geef uw antwoord in afgeronde hele jaren. Indien het antwoord minder dan 1 jaar is, rond u dit af naar 1 jaar. Informatie over de genoemde categorieën:*

- *Mainframe: een krachtige computer die in staat is om grote groepen gebruikers te faciliteren die een wijd gebied aan programma's tegelijk draaien.*
- *Midrange servers: een computer die kleinere gedeeltes van een netwerk aanstuurt, met minder rekenkracht dan een mainframe, maar meer dan een desktop/laptop. De meeste grote bedrijven en instellingen werken met een of meer midrange computers, waarop de bedrijfssoftware draait.*
- *Desktop / laptop: een persoonlijke computer die door medewerkers gebruikt wordt op kantoor of thuis.*

	Leeftijd
a. Mainframe	
b. Midrange Servers	
c. Desktop / Laptop	

37. Wat is de gemiddelde leeftijd van de softwaresystemen die u in uw huidige omgeving aanwezig heeft?

Geef uw antwoord in afgeronde hele jaren. Indien het antwoord minder dan 1 jaar is, rond u dit af naar 1 jaar. Informatie over de genoemde categorieën:

- ***Standaardsystemen:*** *applicaties die niet zijn aangepast aan de specifieke situatie van de organisatie.*
- ***Maatwerksystemen:*** *applicaties die volledig ontwikkeld zijn voor een specifiek doel of functie binnen de eigen organisatie.*

	Leeftijd
a. Standaardsystemen	
b. Maatwerksystemen	

Appendix B: IT General Controls areas of focus

The IT General Controls model focuses on several topics:

Program Changes:

Nr.	Onderwerp
1	Overall management
2	Change requests
3	Construction
4	Testing and QA
5	Program implementation
6	Segregation of duties
7	Documentation & training
8	Emergency changes

Access to Programs and Data

Nr.	Onderwerp
1	Overall management
2	Security administration
3	Data security
4	Operating system security
5	Application security
6	Intern netwerk security
7	Perimeter security
8	Physical security

Computer Operations:

Nr.	Onderwerp
1	Incident Management
2	Back-up & Recovery

3	Disaster recovery

Program Development:

Nr.	Onderwerp
1	Overall management of program development activities
2	Analysis and design
3	Construction/Package selection
4	Testing and quality assurance
5	Data conversion
6	Program implementation
7	Documentation and training

Appendix C: IT Innovation survey

IT-Innovatie vragenlijst

Dit formulier niet invullen, gebruik s.v.p. de digitale tool. Deze print is slechts bedoeld ter indicatie van de vragen.

Welkom bij de IT-innovatie vragenlijst voor het in kaart brengen van de prestatie van uw ziekenhuis. Dit onderzoek wordt uitgevoerd door PwC. Met behulp van dit onderzoek worden uw kosten, beheersingsniveau en innovatie op het gebied van IT in kaart gebracht. De resultaten hiervan zullen we met u doornemen.

De vragenlijst bestaat uit 22 vragen die innovatie van IT-gerelateerde aspecten binnen uw ziekenhuis in kaart brengen. Het verzamelen van de informatie en het invullen van de vragenlijst kost u ongeveer 15 minuten tot een uur, afhankelijk van de mate waarin u direct de benodigde data beschikbaar heeft.

Indien u op dit symbool ⚠ klikt, verschijnt extra informatie en uitleg over de betreffende vraag.

Probeert u deze vragen zo nauwkeurig mogelijk in te vullen.

Algemene informatie

Uitgangspunten:

- Gebruik data vanuit het meest recent gesloten volledige jaar (2011);
- Gebruik een komma als decimaalscheidsingteken;
- Geef bedragen aan in Euro's;
- Laat de regel leeg indien u de vraag niet kunt beantwoorden. Gebruik alleen '0' als het antwoord daadwerkelijk nul moet zijn;
- Wanneer er getallen moeten worden ingevuld, gebruik hierbij geen punten, tekst, symbolen, en dergelijke. Bijvoorbeeld schrijf één miljoen als 1000000 en vijf en een halve dag als 5,5 dagen.

1. Wat is het totale bedrag voor IT-innovatie dat uw organisatie op de begroting voor 2011 heeft opgenomen?

2. Is de begroting rondom de IT-innovatie in 2011 ten opzichte van 2010:

- ○ Toegenomen met meer dan 50 % (1)
- ○ Toegenomen met 26 - 50 % (2)
- ○ Toegenomen met 16 - 25 % (3)
- ○ Toegenomen met 6 - 15 % (4)
- ○ Toegenomen met 0 - 5 % (5)
- ○ Afgenomen met meer dan 50 % (6)
- ○ Afgenomen met 26 - 50 % (7)
- ○ Afgenomen met 16 - 25 % (8)
- ○ Afgenomen met 6 - 15 % (9)
- ○ Afgenomen met 0 - 5 % (10)

3. Wat is het totale bedrag dat uw organisatie in 2011 aan IT-innovatie heeft uitgegeven (als realisatie opgenomen voor IT-innovatie in de jaarrekening 2011)?

4. Zijn de kosten van IT innovatie die daadwerkelijk gemaakt zijn in 2011 ten opzichte van 2010:

- ○ Toegenomen met meer dan 50 % (1)
- ○ Toegenomen met 26 - 50 % (2)
- ○ Toegenomen met 16 - 25 % (3)
- ○ Toegenomen met 6 - 15 % (4)
- ○ Toegenomen met 0 - 5 % (5)
- ○ Afgenomen met meer dan 50 % (6)
- ○ Afgenomen met 26 - 50 % (7)
- ○ Afgenomen met 16 - 25 % (8)
- ○ Afgenomen met 6 - 15 % (9)
- ○ Afgenomen met 0 - 5 % (10)

5a. Wat is het totaal aan kosten en uren dat u tot nu toe heeft geïnvesteerd in uw Elektronisch Patiënten Dossier (EPD)? (inclusief personeelskosten intern en extern, projectkosten, ontwikkelkosten, enzovoorts)

	In Euro's	In uren
Totaal uitgegeven aan EPD		

5b. Welke generatie EPD heeft u op dit moment binnen uw ziekenhuis geïmplementeerd?

- ○ Generatie 1: er is alleen inzage van patiëntgegevens mogelijk (informatief)
- ○ Generatie 2: artsen en verpleegkundigen hebben de mogelijkheid om patiëntgegevens vast te leggen in het EPD (registratief)
- ○ Generatie 3: gedeelten van de zorgprocessen worden door het EPD ondersteund, bijvoorbeeld ordermanagement en klinische paden (procesondersteunend)
- ○ Generatie 4: medische kennis wordt door het EPD gekoppeld aan het specifieke ziektebeeld van een patiënt. Hierdoor wordt een advies gegeven door het EPD over bijvoorbeeld medicijnen of behandelingen en is er sprake van een nieuwe beroepsgroep die taken van de arts of specialist overneemt doordat deze medewerker gecoacht wordt door het EPD (collegiaal systeem)
- ○ Generatie 5: dit EPD bestaat nog niet, maar deze moet het mogelijk maken om rekening te houden met de specifieke situatie van de patient, maar ook met de kennis en ervaring van de hulpverlener die gebruik maakt van het EPD. Dit helpt bij het nemen van beslissingen over de behandelingen (mentorsysteem)

5c. Is uw Elektronisch Verpleegkundig Dossier (EVD) onderdeel van uw EPD?

- ○ Ja
- ○ Nee, het is geen onderdeel van het EPD
- ○ Wij werken nog niet met een EVD

6. Wat is het totaal aan kosten en uren dat u tot nu toe heeft geïnvesteerd in DOT (DBC's Op weg naar Transparantie)? (inclusief personeelskosten intern en extern, projectkosten, ontwikkelkosten, enzovoorts)

	In Euro's (1)	In uren (2)
Totaal uitgegeven aan DOT (1)		

7. Maakt u gebruik van Business Intelligence?

⚠️ *Onder Business Intelligence wordt verstaan het verzamelen van informatie over de (kern)activiteiten van uw organisatie om inzicht te verkrijgen in de belangrijkste KPI's (Key Performance Indicators) van het ziekenhuis en om over deze KPI's te rapporteren zodat stuur- en verantwoordingsinformatie (zowel intern als extern) beschikbaar is.*

⭘ Ja (1)
⭘ Nee (2)

8. Voor welke doeleinden gebruikt u Business Intelligence? Meerdere antwoorden mogelijk.

⚠️ *Geef aan voor welke doeleinden u gebruikt maakt van Business Intelligence. Dit is een combinatie van niveau waarop de informatie gebruikt wordt (Raad van Bestuur-niveau, directieniveau, managementniveau, of in de lijn), en de aard van de gegevens (financieel, DBC-gerelateerd, niet-financieel).*

❑ Stuurinformatie op Raad van Bestuur-niveau (financiële gegevens) (1)
❑ Stuurinformatie op Raad van Bestuur-niveau (DBC-gerelateerde gegevens) (2)
❑ Stuurinformatie op Raad van Bestuur-niveau (niet-financiële gegevens) (3)
❑ Stuurinformatie op directieniveau (financiële gegevens) (4)
❑ Stuurinformatie op directieniveau (DBC-gerelateerde gegevens) (5)
❑ Stuurinformatie op directieniveau (niet-financiële gegevens) (6)
❑ Stuurinformatie op managementniveau (financiële gegevens) (7)
❑ Stuurinformatie op managementniveau (DBC-gerelateerde gegevens) (8)
❑ Stuurinformatie op managementniveau (niet-financiële gegevens) (9)
❑ Stuurinformatie in de lijn (financiële gegevens) (10)
❑ Stuurinformatie in de lijn (DBC-gerelateerde gegevens) (11)
❑ Stuurinformatie in de lijn (niet-financiële gegevens) (12)

9. Maakt u gebruik van social media?

⚠️ *Social Media zijn tools en technieken om te communiceren met anderen, bijvoorbeeld klanten, op plekken waar zij samen komen.*

⭘ Ja (1)
⭘ Nee (2)
⭘ Nee, maar intentie om binnen een jaar deel te nemen aan social media-mogelijkheden (3)

10. Van welke vormen van social media maakt u gebruik / bent u van plan te gaan gebruiken? Meerdere antwoorden mogelijk.

⚠️ *RSS staat voor Really Simple Syndication: een manier om geïnteresseerden snel op de hoogte te stellen van uw nieuwsberichten via een RSS-feed. RSS is te lezen via speciale RSS-readers of moderne browsers.*

- ❑ Website (1)
- ❑ YouTube-kanaal (2)
- ❑ Twitter (3)
- ❑ Hyves (4)
- ❑ Facebook (5)
- ❑ LinkedIn (6)
- ❑ Weblog (7)
- ❑ RSS (8)
- ❑ Overig, namelijk: (9) _____

11. Voor welk(e) doel(en) maakt u gebruik van social media?

- ❑ Informatieverschaffing aan (potentiële) patiënten (1)
- ❑ Informatieverschaffing aan medewerkers (2)
- ❑ Informatieverschaffing aan overige groepen (3)
- ❑ Zichtbaarheid en herkenbaarheid van de organisatie bij (potentiële) patiënten (4)
- ❑ Werving en selectie voor potentiële medewerkers (5)
- ❑ Overig, namelijk: (6) _____

12. Kent u Cloud Computing en maakt u hiervan gebruik?

⚠️ *Cloud Computing is een model dat het mogelijk maakt om door middel van een computernetwerk gedeelde computermiddelen (zoals netwerken, servers, opslag, applicaties en diensten) beschikbaar te stellen op aanvraag en op een snelle en gemakkelijke manier met minimale interactie van een serviceprovider.*

- ○ Ik ken het niet (1)
- ○ Wij maken hiervan nog geen gebruik (2)
- ○ Wij maken hiervan nog geen gebruik, maar zijn voornemens Cloud Computing binnen een jaar te implementeren binnen onze organisatie (3)
- ○ Wij maken hiervan gebruik (4)

13a. Welk percentage van het totale IT-landschap werkt via clouddiensten?

- ○ 76 % - 100% (1)
- ○ 51 % - 75 % (2)
- ○ 26 % - 50 % (3)
- ○ 10 % - 25 % (4)
- ○ < 10 % (5)
- ○ Niet bekend (6)

13b. Van welke vorm van Cloud Computing maakt u gebruik? Meerdere antwoorden mogelijk.

Omschrijving van de modellen:

a) *SaaS - Software as a Service: software die als een on-line dienst wordt aangeboden, waardoor uw organisatie geen software en benodigde hardware hoeft aan te schaffen. De hardware is geplaatst bij de provider, die voor het onderhoud hiervan verantwoordelijk is. De provider draagt ook zorg voor applicatiebeheer, back-ups, installatie van updates en beveiliging. Gebruikersbeheer kan of bij uw organisatie liggen of bij de provider.*
b) *PaaS - Platform as a Service: een provider verschaft toegang tot een platform (zoals database of webserver) en is verantwoordelijk voor het fysieke en softwarematige onderhoud hiervan.*
c) *IaaS - Infrastructure as a Service: een provider verschaft fysieke infrastructuur op afstand, zoals servers (via virtuele diensten benaderbaar) of netwerkinfrastructuur, geplaatst in datacenters. Fysiek onderhoud en beheer wordt door de provider verzorgd. Uw organisatie is verantwoordelijk voor het softwarematige beheer van de apparatuur.*

- ❑ SaaS - Software as a Service (1)
- ❑ PaaS - Platform as a Service (2)
- ❑ IaaS - Infrastructure as a Service (3)

14. Voor welke specifieke processen binnen uw organisatie maakt u gebruik van een oplossing die door middel van Cloud Computing is gehost? Meerdere antwoorden mogelijk.

- ❑ Productieregistratie (1)
- ❑ Cliëntregistratie (2)
- ❑ Dienstroosterplanning (3)
- ❑ Financiën (4)
- ❑ Personeelsadministratie (5)
- ❑ Facturering / declarering (6)
- ❑ Salarisadministratie (7)
- ❑ Inkoop (8)
- ❑ Medische technologie (9)
- ❑ Business Intelligence (10)
- ❑ Overige, namelijk: (11) _____

13c. Zou u overwegen om Cloud Computing te gebruiken, als zekerheid hierover gegeven kan worden door onafhankelijke IT-auditors?

- ○ Nee, dit verandert mijn mening niet (1)
- ○ Dit verandert mijn mening enigszins (2)
- ○ Ja, dit verandert mijn mening sterk (3)
- ○ Ik weet het niet (4)

15. In welke mate beïnvloeden onderstaande factoren u in uw besluit over cloud computing.

	Erg onbelangrijk (1) (1)	(2) (2)	Enigszins belangrijk (3) (3)	(4) (4)	Erg belangrijk (5) (5)
(On)beschikbaarheid van de dienst (1)	❍	❍	❍	❍	❍
Data lock-in / afhankelijkheid van de cloud computing provider (2)	❍	❍	❍	❍	❍
Potentieel risico qua vertrouwelijkheid en auditing van gegevens (3)	❍	❍	❍	❍	❍
Gegevenstransferkosten (hoge kosten om data te versturen) (4)	❍	❍	❍	❍	❍
Afhankelijkheid van bug fixes van provider bij grote-schaal systemen (5)	❍	❍	❍	❍	❍
Legale verantwoordelijkheidseisen (6)	❍	❍	❍	❍	❍

16. Heeft u bij uw outsourcingscontracten afgedwongen dat een derde partij een onafhankelijk oordeel heeft gegeven? Hierbij kan gedacht worden aan ISAE3402 (voorheen SAS70) of eventuele andere manieren van het verkrijgen van zekerheid.

❍ Nee (1)
❍ Niet structureel, echter bij de volgende case was een dergelijk rapport aanwezig: (2)
_____
❍ Ja, wij hebben in ons beleidsplan opgenomen dat outsourcing samen gaat met een audit van een derde, onafhankelijke partij op dat gedeelte. (3)
❍ Ja, wij hebben in ons beleidsplan opgenomen dat outsourcing samen gaat met een interne audit of audit van onze accountant. (4)

17. Op welke manieren werkt u samen met andere ziekenhuizen?

❍ Wij werken niet samen met andere ziekenhuizen (1)
❍ Ten aanzien van uitwijk (2)
❍ Gezamenlijk uitvoeren van aanbestedingstrajecten (3)
❍ Wij hebben een shared service center (SSC) opgericht met een ander ziekenhuis op het gebied van: (4)
_____
❍ Samenwerking rondom het EPD (5)
❍ Overig, namelijk: (6) _____

18. Kent u HealthVault en maakt u hiervan gebruik?

HealthVault is een webgebaseerd systeem van Microsoft om persoonlijke medische dossiers te bewaren en eventueel toegankelijk te maken voor derden (huisarts, tandarts of ziekenhuis bijvoorbeeld).

- ○ Ik ken het niet (1)
- ○ Wij maken hiervan nog geen gebruik (2)
- ○ Wij maken hiervan nog geen gebruik, maar zijn voornemens HealthVault binnen een jaar te implementeren binnen onze organisatie (3)
- ○ Wij maken hiervan gebruik (4)

19. Ondersteunt uw organisatie het fenomeen 'Bring Your Own Device'?

BYOD is een verzamelnaam voor diensten waarbij medewerkers of patiënten hun eigen apparatuur kunnen gebruiken, in plaats van ziekenhuisapparatuur, voor het vervullen van hun werk, of opvragen van gegevens. Denk hierbij aan het mogelijk maken van het uitlezen van werkgerelateerde e-mail, agenda, contactpersonen en taken via een eigen mobiele telefoon of het toestaan van eigen laptops op het interne netwerk van uw organisatie.

- ○ Ik ken het niet (1)
- ○ Wij maken hiervan nog geen gebruik (2)
- ○ Wij maken hiervan nog geen gebruik, maar zijn voornemens 'Bring Your Own Device' binnen een jaar te implementeren binnen onze organisatie (3)
- ○ Wij maken hiervan gebruik (4)

20. Maakt u gebruik van een of meerdere van onderstaande varianten van e-health?

eHealth is het gebruik van nieuwe informatie- en communicatietechnologieën, en met name internettechnologie, om gezondheid en gezondheidszorg te ondersteunen of te verbeteren.

- ❑ Het op afstand toezicht houden op patiënten die niet op dezelfde locatie zijn als de zorgverlener (telemonitoring) (1)
- ❑ Begeleiding op afstand (telecoaching). Dit is meestal een langer proces met diverse contactmomenten (2)
- ❑ Het raadplegen van een zorgverlener op afstand door een patiënt of andere zorgverlener (teleconsultatie) (3)
- ❑ Diagnose stellen op afstand (telediagnose) (4)
- ❑ Het op afstand beoordelen van radiologische onderzoeken (teleradiologie) (5)
- ❑ Chirurgie op afstand met behulp van robots (telechirurgie) (6)
- ❑ Aangesloten bij een netwerk waar patiënten en specialisten elkaar kunnen vinden en ervaringen kunnen delen (7)
- ❑ Overig, namelijk: (8) _____

21. Hoe ziet uw top 5 eruit van zorgen die u op dit moment heeft over uw IT in de breedste zin? Denk hierbij aan zowel de kostenkant, innovatie en beheersing.

Dit is het einde van de vragenlijst. Door op volgende te klikken slaat u uw ingevulde gegevens op en sluit u de enquête af. Bedankt voor uw deelname!

Appendix D: IT User's satisfaction survey

38. Zijn er in uw organisatie afspraken gemaakt tussen de gebruikersorganisatie en de IT-organisatie over de na te leven service-niveaus?

Het gaat hier om algemene afspraken, die kunnen gaan over zaken zoals een minimale afhandeltijd van incidenten die ingediend worden door medewerkers van uw ziekenhuis.

- ○ Ja
- ○ Nee

39. Liggen deze afspraken vast in een interne SLA (Service Level Agreement) met de gebruikersorganisatie?

Een Service Level Agreement is een contract, waarin afspraken en prestatie-indicatoren tussen de IT-organisatie en de gebruikersorganisatie zijn beschreven. Door het opnemen van de prestatie-indicatoren is hiermee het te behalen minimumniveau van dienstverlening vastgesteld.

- ○ Ja
- ○ Nee

40. In hoeverre worden de minimum service levels die in de SLA of het contract zijn opgenomen, behaald door de IT-afdeling?

- ○ 90 % - 100 %
- ○ 76 % - 89 %
- ○ 51 % - 75 %
- ○ 25 % - 50 %

41. Heeft u recentelijk onder uw interne klanten (IT-eindgebruikers) een IT-klanttevredenheidsonderzoek uitgevoerd?

In een IT-klanttevredenheidsonderzoek wordt onderzocht hoe tevreden de eindgebruikers vanuit de gehele organisatie zijn met de tot hun beschikking staande IT-systemen en diensten van de IT-afdeling.

- ○ Ja
- ○ Nee

42. Wat was de uitkomst van dit klanttevredenheidsonderzoek onder uw interne klanten (IT-eindgebruikers)?

Specificeer hier de uitkomsten van het in 2011 uitgevoerde IT-klanttevredenheidsonderzoek.

a. Gemiddeld beoordelingscijfer op een schaal van 1 tot 10	
b. Percentage medewerkers dat de IT-dienstverlening als 'voldoende' beoordeelt (% medewerkers die gemiddeld tussen het cijfer 6 en 8 heeft ingevuld)	
c. Percentage medewerkers dat de IT-dienstverlening 'goed' of hoger beoordeelt (% medewerkers die gemiddeld een 8 of hoger heeft ingevuld)	
d. Percentage medewerkers dat de IT-systemen als 'voldoende' beoordeelt (% medewerkers die gemiddeld tussen het cijfer 6 en 8 heeft ingevuld)	
e. Percentage medewerkers dat de IT-systemen 'goed' of hoger beoordeelt (% medewerkers die gemiddeld een 8 of hoger heeft ingevuld)	

Dit is het einde van de vragenlijst. Door op volgende te klikken slaat u uw ingevulde gegevens op en sluit u de enquête af. Bedankt voor uw deelname!

Appendix E: Detailed Benchmark group information

The following details about the Global Best Practices IT health care benchmark group are available.

Information technology benchmarking PwC
Global Best Practices
Total number of respondents in benchmark group: 12

Revenue range

	Euro
Maximum	2.969.884.170
Average	625.934.369
Minimum	40.391.147

Employee head count

Maximum	50.000
Average	10.997
Minimum	661

Industries represented (NAICS)

Industry name and code	Number of company responses
Health Care and Social Assistance	**12**
621 - Ambulatory Health Care Services	3
622 - Hospitals	7
623 - Nursing and Residential Care Facilities	1
	1
624 - Social Assistance	

Geographic regions represented

	Number of company responses
Africa	**1**
Southern Africa	1
South Africa	1
Americas	**4**
Northern America	4
Canada	1
United States of America	3
Asia	**1**
Eastern Asia	1
Hong Kong Special Administrative Region of China	1
Europe	**4**
Northern Europe	3
Denmark	1
Ireland	1
United Kingdom of Great Britain and Northern Ireland	1
Western Europe	1
Germany	1
Oceania	**2**
Australia and New Zealand	2
Australia	2