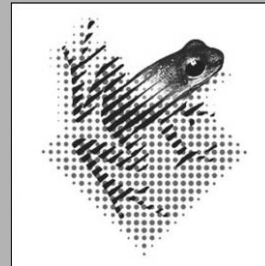


Guidelines for information system implementation in hospitals

Towards a fit between context and IS project characteristics

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1. Introduction

Information systems are being implemented on a daily basis. These systems vary from small applications for only a few employees, to large, complex systems that change everyday tasks for ever. Even though many models, best practices and books are available as guidelines for the successful implementation of an information system, many organizations still struggle with having a new information system used to its full potential by its employees.

The health care sector holds a special position within the area of businesses that use information systems. The reason for this is that the tasks of health care professionals are complex and involve a lot of communication among colleagues from (sometimes many) different disciplines which causes cognitive and social barriers (Fitzgerald & Ferlie, 2002). In addition, information systems in for example hospitals are used as databases to add and retrieve information about patients everywhere at any time. New applications have to be able to connect with the existing systems, in order to be useful. Because the information in such a system is essential for the well being of the patients, disturbance of the system could be potentially life threatening. This adds another specific feature to health care information systems; they have to be as reliable as possible. At last, a hospital information system has to provide as much security as possible, because medical information has to remain private. When considering all the requirements stated above, it is no wonder that it is very hard to develop or select an information system that fits within a complex environment such as a hospital. Moreover, it may be even harder to get the system accepted and consistently used on a sustainable basis by all involved as intended by management.

In addition to the generally known success factors in implementing an information system, it is therefore interesting to study factors that are specific to such kind of situation. Different authors have studied variables in information system implementation that are context specific. Variables during the decision process (Boonstra, 2004), risks that are context specific (van Offenbeek, 1996b) and variables surrounding the entire implementation process (Greenhalgh, 2003) are presented in literature. These variables can help hospital management to improve the outcome of information system implementation.

In 2005, the University Medical Centre Groningen (UMCG) implemented a new information system for the planning, monitoring and registration of surgical procedures. Until then, surgical procedures were planned by hand and the registration of data during the surgery occurred afterwards. Implementing a digital system would enhance the efficiency of the operating rooms, improve the reliability of the operation scheme and it should improve the quality of post-surgery registrations.

Initiated by among others the director of information systems, a plan of requirements was created. This plan was reviewed and adjusted by several members of involved stakeholders, until it fitted with everyone's requirements. Based on the plan of requirements, a project group had started in 2002 with a European call for tenders. After analyzing the possible IT solutions, one application was chosen. This system, called OKplus, was implemented in the

spring of 2005 and several new features have been added since. Although not everyone was enthusiastic about OKplus right away, the project group now regards the implementation of the system as a success. In the future, the UMCG wants to implement several other new information systems with such success.

The UMCG wants to learn from its own experiences with the implementation of large information systems in its organization. In addition to known variables that promote or constrain an information system implementation, the UMCG wants to know which specific variables in the implementation of OKplus were present and how they influenced the outcome of the implementation. Information derived from studying these questions can help the hospital in successfully implement information systems in the future.

This thesis is composed in the following order. First, in chapter 2, literature will be reviewed to provide an overview of the available information about the relation between contextual factors, project characteristics and the outcome of information system implementation. This literature overview will be used to form a model. This model is presented in the concluding part of the literature study. The methodology to apply this model empirically is presented in chapter 3. In chapter 4, the results of the empirical study are described. The relation between the contextual factors, project characteristics and outcome is analyzed in chapter 5. The results are concluded in chapter 6 and discussed in the last chapter.

2. Literature study

2.1 Introduction

Whether an information system will be successfully implemented in an organization, depends on many variables. Many authors have described general variables that promote or constrain information system implementation in organizations (Pinto, 2007 and Boddy et al, 2008). This results in long lists of do's and don'ts about how an information system should be implemented. Examples of do's are the need for trust between project members (Coutu, 1998) and creating a project budget that suits the needs of the project (Needy & Petri, 1998). However, even with the knowledge of these success factors and traps, many organizations still struggle to successfully implement an information system. On the one hand, organizations do not always choose to control all known variables that can lead to success or failure of information system implementation. On the other hand, there can be other variables present that promote or constrain information system implementation dependent on the situation, which are unknown by project management and therefore are not controlled.

Very few authors have described these variables in information system implementation that are dependent on the situation in which it is implemented. Some variables can promote a desirable outcome of implementation in certain organizational contexts, while in another context the implementation would result in a failure. These dependent variables can be defined as being contextually sensitive. For the health care sector, these variables have yet to be identified and placed in a variable model for information system implementation. This study focuses on creating and applying such a model empirically.

This literature study is built up as follows. First, literature is presented that handles about contextual variables in information system implementation. Five articles are discussed that describe contextual variables that require specific project characteristics in order to make the information system implementation succeed. The main contextual variables that have a relation with project characteristics are summarized in a model at the end of the literature review.

2.2 Literature overview

The literature search produced five articles that handle about contextual variables that influence the outcome of an information system implementation in service organizations. Three of these articles provide the majority of the contextual variables that are used in this study. These three articles will first be discussed below. After that, the contextual variables are presented that form the basis of the model, provided at the end of the chapter.

The first article regards information system implementation in the light of risks that can be avoided with the aid of specific project characteristics. Van Offenbeek (1996a) found that user participation is rated highly by system developers, although this did not necessarily imply high user participation in these organizations. In addition to this paper, the authors studied the interaction among parties in system development instead of just user participation.

This study showed that effective system development derived from a fit with the context of system development and interactions between users. The outcomes of this study led to the development of an interaction model (1996b), in which contextual variables determine five risk types (functional and technical uncertainty, conflict and resistance potential, and material resources). Each of these risk types, to the extent that they are present, has to be addressed separately in order to make the information system implementation successful. This assumption has led to five propositions how risks should be handled (appendix 1). For every type of risk specific project characteristics are defined that need to be present in order to make the information system implementation successful. All these propositions have received some empirical support.

The second article is an extensive systematic review by Greenhalgh et al (2004) in which a conceptual model is provided in which the variables of diffusion, dissemination and implementation of innovations in health care organizations are discussed. These variables are split in ones that are present in the inner context (the majority) and in the outer context (see figure 1).

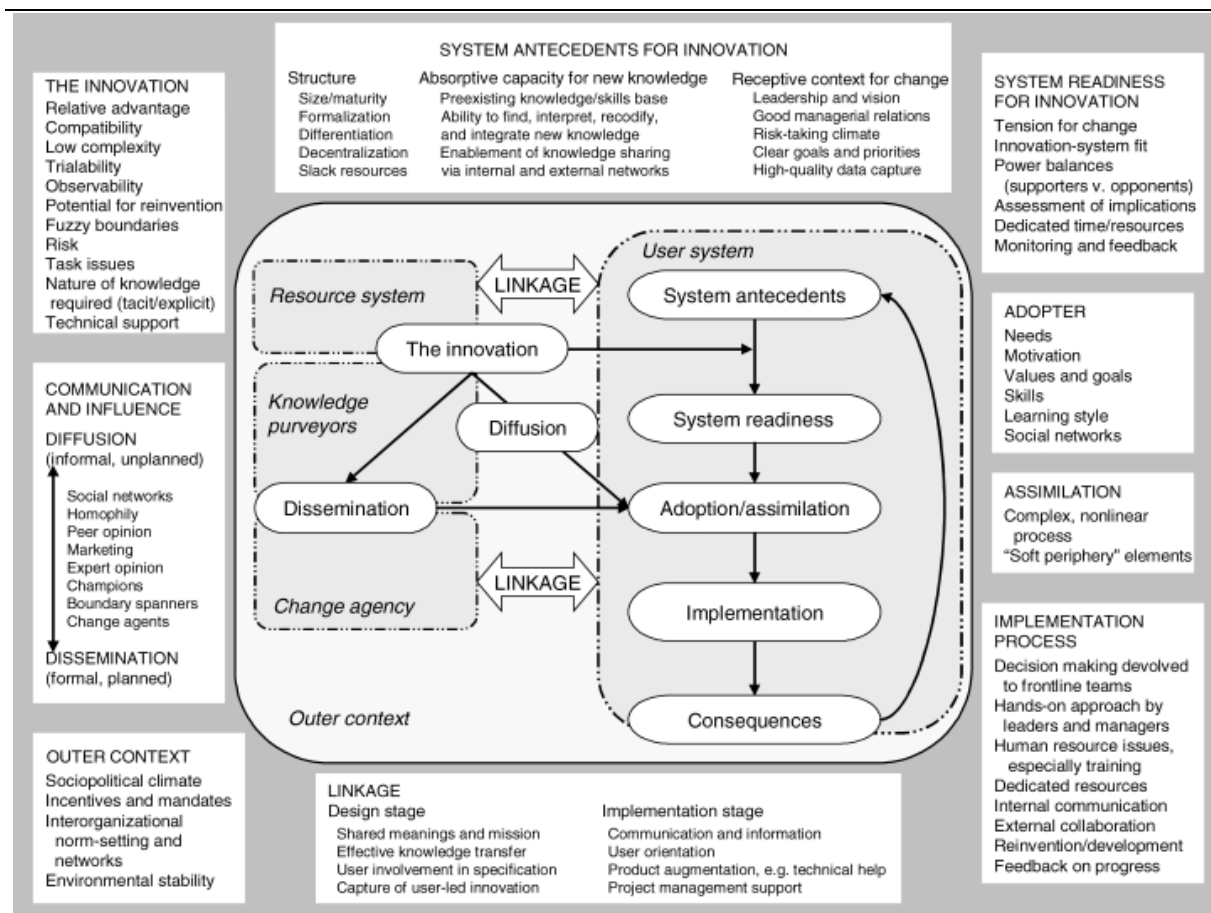


Figure 1: Conceptual model, adopted from Greenhalgh et al (2004)

An essential part of this model is the importance Greenhalgh addresses to the linkage between different elements of information systems. For a desirable outcome, there has to be a proper fit between the information system and the context in which it is introduced and implemented.

Although this model contains many variables that are always supporting or constraining, regardless of the context, some others can be considered to be contextual. In the implementation phase for example, the degree of alignment of organizational communication with the process of introducing the information system can lead to better or worse acceptance of the system.

The third article deals with the process of deciding which information system has to be implemented. This decision-making process is also subject to a proper fit with the context in which that decision is taken. Boonstra (2003) categorized these decision-making processes within four contextual archetypes (figure 2). The archetypes are categorized based on whether the decision is made subjectively or objectively (horizontal axis) and if the decision is an offensive or defensive reaction to the environment (vertical axis). The model explains how different contexts ask for a specific type of decision-making process.

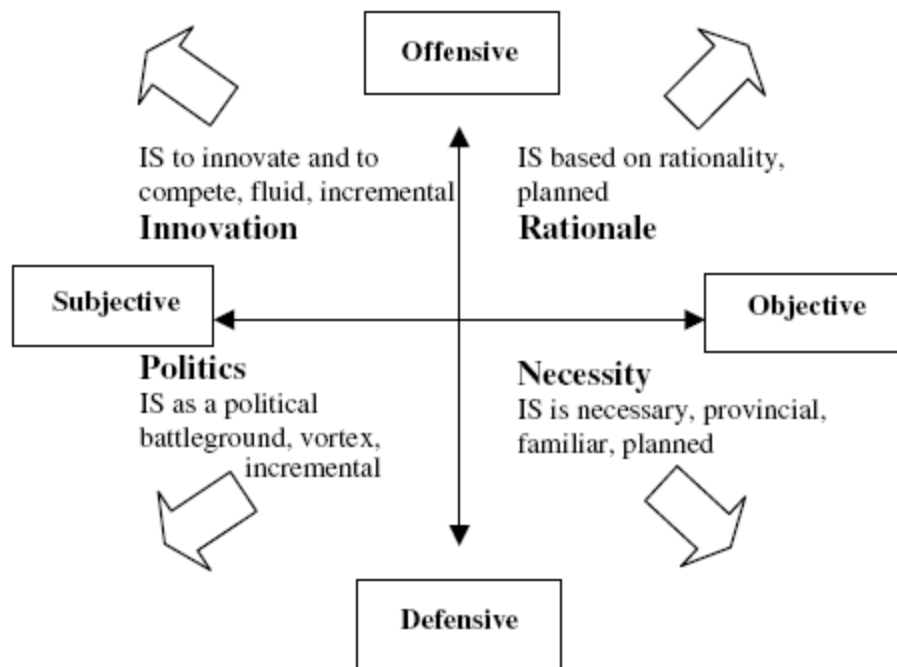


Figure 2: Archetypes in decision-making processes (adapted from Boonstra (2003))

In addition, Boonstra discusses how the decision-making process relates to the archetypes. He uses the three-phase model as created by Mintzberg et al (1976) to show that different archetypes require different decision-making processes. This model, presented in figure 3, also provides a contextual variable in the implementation of information systems.

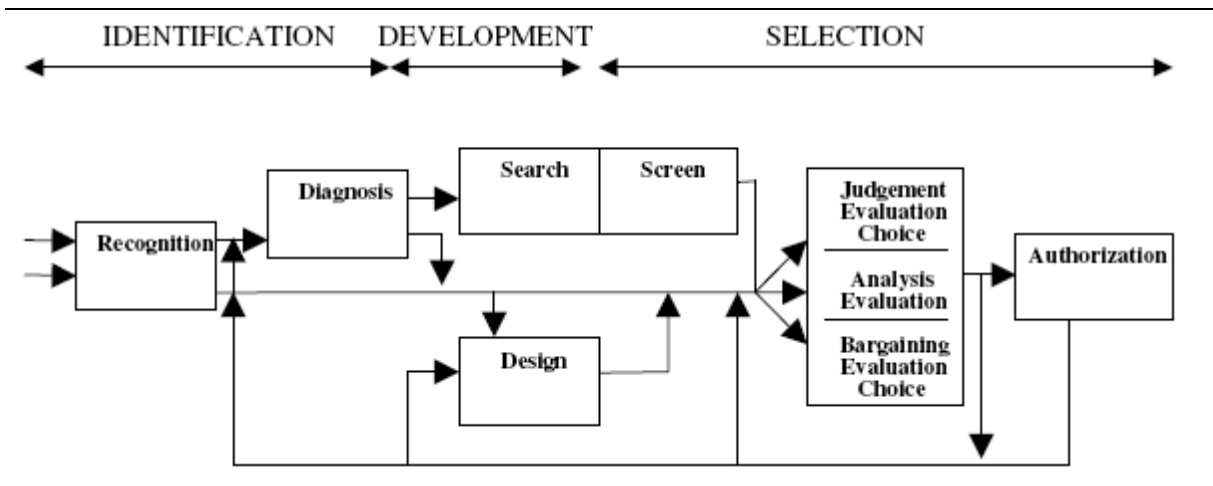


Figure 3: General model of a decision-making process (adapted from Mintzberg et al. (1976))

From the three articles presented, all contextual variables that require a fit in an information system implementation have been taken together in a model. The article of Van Offenbeek (1996b) provided four variables, Greenhalgh (2004) two and Boonstra (2003) four. Many of the variables in the article of Greenhalgh (2004) were not context specific, and were thus not selected for the model.

2.3 Model

Contextual variables from the three authors presented above have been extracted and positioned in the model below (figure 4).

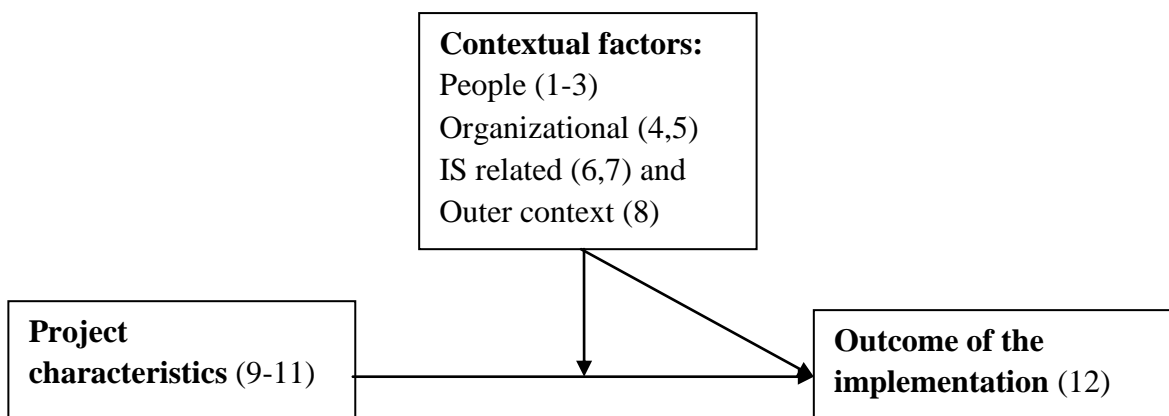


Figure 4: Model

The variables will consecutively be discussed. Every variable is emphasized with italic font and numbered in a question category and sub questions. These numbers relate to the questions in the interviews as presented in appendix 1 and are provided between brakes. The background of these interviews is explained in the next chapter. For the sake of a logic interview, the variables are numbered in a disordered manner. After the contextual variables, additional variables about the project characteristics and the outcome of the implementation,

promoting and restraining variables and the role of every stakeholder in the implementation are presented. These elements are required for the sake of completeness of the model and this study.

2.3.1 People related variables

When the proposed implementation of an information system causes disagreement among people, regarding their needs and interests, this is called *conflict potential* (van Offenbeek, 1996b) (1.1-1.4). The risk of conflict potential increases when the implementation involves more and heterogeneous groups of people, when integration of these groups is required and when the information system is implemented by a third party. When this type of risk arises, the implementation management needs particular adjustments to ensure the desired outcome of the implementation process.

The second people-related variable is *resistance potential* (2.1-2.4). When employees resist the actual implementation of an information system, because they feel that it reduces the quality of their working life, resistance occurs. Resistance potential increases when the information system has a major impact on the tasks, when employees have a low change potential and a low readiness to change. The implementation management has to be adapted when there is a risk of resistance among employees.

This variable was also described by Boonstra (ibid.). He argues that agreement among the *objectives and means* of the project implies that the choice for an information system can be made in a rational way (3.1). A rational decision process requires a different procedure than when employees do not agree on the objectives and means of the project.

The *number and influence* of participants or stakeholders involved in an information system implementation also influences the process of decision making (1.1). Different parties can be the dominant force in a systems implementation, such as the top management and the IS department. When this is the case, the decision process will be different than when many parties are involved or when there are just a few, alike participants.

2.3.2 Organization related variables

Different aspects of the organization can influence the success of the implementation of an information system. Some of these variables always contribute to implementation success, such as organizational readiness for change as described by Kotter (1996). With other variables, their contribution to implementation success depends on their fit with other aspects of the implementation project.

The first contextual variable is *innovation-system fit* (4.1). This variable describes how well the new information system matches with the organization it is implemented in. This can be defined in terms of fit of the information system with the strategy, goals, existing values and norms, way of working, and supporting technology (Greenhalgh, ibid.). A fit between the innovation and the system in which it is implemented will enhance the outcome success.

The second variable that is contextual, is *innovation-structure fit* (5.1). Morton and Hu (2008) describe in their paper how a fit between the information system and the organizational structure it is implemented in, can enhance its effectiveness. The propositions they make are based on five archetypical organizational structures, namely the simple form, machine bureaucracy, professional bureaucracy, divisionalized form and adhocracy. The archetype should fit with the information system on elements such as degree of formalization, centralization and structural differentiation. Better fit with the information system produces better outcome results.

These two contextual variables relate directly to the outcome of the project. They do not require certain project characteristics to ensure implementation success. Thus, the arrow that points directly from the contextual box to the outcome box belongs to these two variables.

2.3.3 Information system related variables

Whether the information system implementation will be successful, depends on many contextual variables. First, when there is *functional uncertainty*, this asks for a different implementation method than when this type of uncertainty is absent (van Offenbeek, 1996b) (6.1-6.5). Functional uncertainty means that the functionality of the information system within the situation it is introduced, is not clear. If so, there is a risk that the information system will be inaccurate for the situation or tasks it is designed for. A definite match between the problem and the solution is missing. The risk of functional uncertainty is higher when tasks are complex and changing, experience with information systems is lacking and goals are unclear. Whenever this situation occurs, it asks for a different approach in the implementation process than if there was no functional uncertainty.

Second, *technological uncertainty* requires an adjusted implementation process (van Offenbeek, 1996b) (7.1-7.4). This type of uncertainty occurs when there is a risk that the information system will not be implemented at all. This can be due to the information system, because the technology being used is too complex, unknown, and not compatible with other information systems that are present in the organization. Or because the technicians are unfamiliar with the information system or not motivated to implement it, and the implementation is too difficult to bring about. In the case of technological uncertainty, a different approach of implementing the information system is needed.

2.3.4 Outer context

The contextual variable in the outer context is the existence of an *informal inter-organizational network* (Greenhalgh, *ibid.*)(8.1). When other, comparable organizations in the environment already work with the information system, this will have an important influence on the likeliness that it will be chosen by the organization that wants to implement a new system. When a certain information system is considered to be the 'norm' in the industry, organizations are more likely to implement it successfully.

2.3.5 Project characteristics

From deciding that a new information system is needed up to the actual usage of an information system, different aspects of the process of implementation can influence the outcome of a project. First, contextual variables in the decision making process will be discussed. Second, other contextual variables connected to the implementation process are presented. Upfront, the stakeholders are asked how they would describe the decision process themselves (1.5). Next, questions related to specifications of the decision process are asked.

Boonstra (ibid.) listed contextual variables that influence the decision making process. First, the *stimulus* that is the motive behind the information system change influences decision making (9.1). When the stimulus is an acute crisis, a different pathway of decision making is followed then when a new information system creates an opportunity for an organization to innovate.

Second, the *solution* influences the decision making process (10.1). If the solution is customized, it asks for a longer and more intense process of adjusting the information system to the needs of the organization. When a solution is ready-made, it will take longer to choose the best solution. A third option is an information system that can be modified. However, if there is only one possible and reasonable solution, the process of decision making will be shortened.

A third contextual variable is the *style* of decision making (11.1). The possible styles mentioned by Boonstra (ibid.) are a planned or incremental style. Planned change involves a decision made right at the beginning of the project, leading to a structured implementation process. This style is feasible when the goals of the project are clear from the start and the stakeholders don't have conflicting interests. Planned decision making involves a process outline with deliverables and a time and budget structure. On the other hand, incremental change evolves out of a series of decisions that are made during the decision process. This type of change requires more elaboration and changes during the process and is feasible when the goals are not clear at the start of the project or when there are conflicting interests among stakeholders.

2.3.6 Outcome of the implementation

One of the most challenging variables to define in this model is the outcome of the implementation (12.1-12.2). Whether an information system is successfully implemented can be viewed from different perspectives. Van Offenbeek (1996b) views success as a fit between the contextual variables and characteristics of the implementation process. In specific situations, she argues, there is a need for a specific approach. The actual success of an information system implementation was defined as the actual usage of the system on a regular basis by its destined end-users.

Other measures of information system outcome success originate from the behavioral and psychological sciences. Acceptance, intention to use and user satisfaction are outcomes used by various authors. At last, technological performance can be used as an outcome measure.

The impact of the system on the individual and organizational level is often used as a measure for success (Larsen, 2003). However, this outcome measure is hard to demonstrate.

In this study, we will use the simple but robust outcome measurement as proposed by van Offenbeek (1996b). Regular actual usage of the system will be used as the measurement of outcome success of OKplus.

2.3.7 Model

The model, as presented on page 9, implies that the project characteristics of an information system implementation has an effect on its outcome. This relationship is influenced by contextual variables (people, organizational, and IS related and the outer context). The numbers refer to the question categories in the interview.

This model provides the start for empirically visualizing the relation between project characteristics, contextual variables and the outcome of an implementation project. This empirical study is derived from the research objective that is provided below.

2.4 Research objective

The objective of this study is to provide guidelines to the ICT implementation management of the UMCG by analyzing OKplus on project characteristics, contextual elements and outcome with a combined model derived from literature.

To provide these guidelines, the following research question and sub questions are composed.

2.5 Research question

The research question that is studied in this thesis is:

To what extent does the fit between contextual variables and project characteristics explain the outcome of the OKplus implementation?

The sub questions related to this research question are:

1. What are contextual variables that influence the outcome of information system implementation in the health care sector?
2. Which contextual variables and project characteristics were present in the implementation of OKplus?
3. What was the outcome of the OKplus implementation?
4. Which guidelines can be derived from the implementation of OKplus for the future?

These research questions will be answered in the continuation of this study, with the aid of the empirical study in the UMCG. In the next chapter, the method of this study is presented.

3. Method

The model as presented above provides a start for studying the relation between project characteristics, contextual variables and the outcome of an information system implementation. This model will be applied empirically with the use of the implementation of OKplus in the UMCG.

First, the implementation process and the project characteristics of OKplus are described with the aid of written reports, minutes and news bulletins that are present in the files of the UMCG. The implementation process is reported in the form of a timeline, in which the main characteristics are presented. With the aid of the interviews (see below), gaps in the available information about the course of the project are filled up.

From the written information sources, and with the help of the former project manager of OKplus, a list of ten important stakeholders was created who can provide information about the project characteristics, contextual variables and project outcome from different perspectives. These stakeholders were approached for an interview, and all accepted this invitation. A total of ten interviews were held with among others project team members, the project leader and the initiator of the project.

The stakeholders were interviewed separately during an interview of approximately one hour. From the variables in the model, a questionnaire was created. Every contextual and non-contextual variable is discussed during these interviews, with the aid of the semi-structural interview scheme presented in appendix 1. In addition, open questions were asked regarding the role of the stakeholder in the project, the timeline of the project, promoting and restraining variables of the implementation, and success variables of OKplus. There was also a question about the role of the stakeholder during the project.

The outcomes of the interviews are presented and discussed in the two separate results chapters. In the first chapter, the main variables in the boxes of the research model are described. To every variable in the model, a section is dedicated in which the answers of stakeholders are discussed. This discussion leads to a conclusion about that variable.

In the second result chapter, the relationships between the variables are presented and discussed. For every contextual variable it is determined whether it fitted the project characteristics of OKplus. The influence of the resulting fit on the outcome of the implementation of OKplus is also discussed in this chapter.

At last, the outcomes of the study and the answers to the research questions are summarized in the conclusion chapter. The added value of the model will be discussed in the last chapter, just like the implications and the shortcomings of this research.

4. Descriptive results

In this section, the outcomes of the interviews with stakeholders in the OKplus implementation are presented. All variables that are discussed previously are presented and discussed separately below. Due to provide a logical order, the questions are not presented in the hierarchy they were asked or presented above. First, an overview of the process of the implementation of OKplus is provided. Next, the answers on the questions about the variables in the model are presented. At last, the roles of the stakeholders in the implementation and the open questions regarding the implementation of OKplus are discussed. An overview of the answers of the interviewed stakeholders is provided in table 1 on page 22. A list of interviewed stakeholders is provided in table 2 on page 23. Due to anonymity, the stakeholders have been numbered in a random order so that the identity of the stakeholders cannot be retrieved.

4.1 Process of implementation

The process of implementation is constructed from reports, minutes and interviews with the stakeholders. This process is visualized through a timeline, provided below. Information for this timeline is retracted from the report on progress (2005). The grey boxes refer to a phase, which is described to the nearby box.

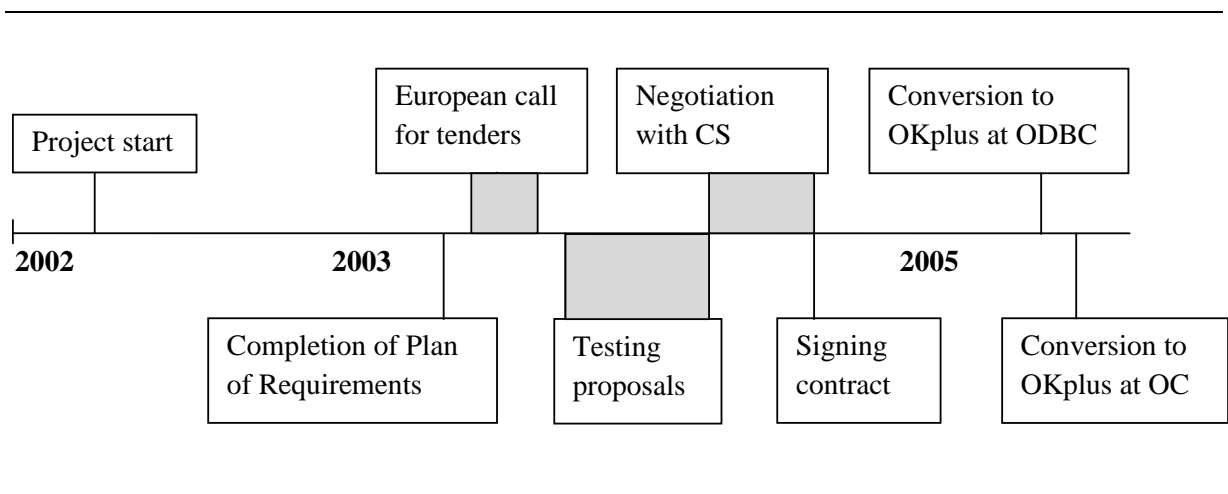


Figure 5: timeline process of implementation

During the first years of the twenty-first century, the UMCG started off a series of projects that promoted the digitalization and automation of its processes. Up to then, procedures in the operating centers were planned and registered with the aid of a system called Opera. This system was not used up to its full potential, and was prone to making mistakes. Planners had to import data manually in the system, and then transfer the data for the operating schedules in another application (Microsoft Word). The planning was produced by hand, and was written down on a large white board in the reception area of the operating centers. When a surgeon wanted to know when a surgery was expected to start, he or she had to call to the reception desk and ask whether the schedule was still on time. The postoperative registration was often delayed, because it required the surgeons to dictate a report on tape and hand it over to the

registration nurses. Often, this process caused problems because tapes were missing or the registration contained errors. Concluding, Opera was not an ideal solution for the planning and registration requirements of the operating centers in the UMCG.

Already in 1996, the first signals from employees and management arose that asked for a new planning and registration system in the operating centers. Unfortunately, through shifts in the positions of enthusiastic initiators, this process died out.

Problems with the capacity and loading of the operating centers in the next years shed the light again on the problems of Opera. The wish for a new planning and registration system became louder until it was made a project by the director of care facilities in 2002.

At the start of the project, the project leader(s) started writing a list of requirements the new system had to possess. Many users were drawn into this process to enhance their participation, improve the set of requirements and to reduce potential resistance among them. At last, a Plan of Requirements (PvE) was produced and a European call for tenders started. After a couple of months, five suppliers had handed in a proposal. The next step was to have as many participants as possible read these proposals and test them against the Plan of Requirements. After this process, three potential suppliers remained. They were asked to demonstrate the system in the UMCG in front of an audience of users and the project members. This demonstration phase pointed ChipSoft with its application OKplus out as the supplier of first choice.

However, a previous project of ChipSoft in the UMCG a couple of years earlier had turned into a disastrous failure. This project broken down on the deteriorating relationship between supplier and client. The UMCG had lost its confidence in ChipSoft and was unwilling to start off a new project with them. *“It took a lot of time and discussion before we were willing to start off a new project with them”* as one of the stakeholders recalls. However, since OKplus was the only true solution to the problems the UMCG faced, there had to be found some way to ensure the past problems would not come across again. Thus, the project members negotiated with ChipSoft that an outline of the implementation of OKplus was constructed upfront signing the contract between both parties. At last, in October 2004, the contract was signed and the implementation of OKplus could start.

During the period between signing the contract and converting the operating centers to OKplus in May and June 2005, the project team executed three major tasks. First, the functional and technical controllers created the links between OKplus and all the other applications and systems that were used in the UMCG with which the system had to be able to communicate with. Second, the users were being involved in training and testing the system to ensure a smooth implementation and the use of the system up to its full potential. At last, the system had to be adjusted to the needs of the users, in terms of functionality.

During the final steps of the project, the project group needed more time to test the linkages of the system. The steering committee however did not want to wait any longer with conversion to OKplus, and pushed the project group to keep up with the original planning. Even though

the project group did not agree, it was decided that the conversion would take place on its planned date. In May 2005 the ODBC converted to OKplus, followed by the OC six weeks later. The conversion took place during the weekends and did not cause any major problems.

4.2 Project characteristics

First, the stakeholders were asked to describe the decision process for the new information system by themselves. All mentioned here that there was only one search round for a new application, and that was with the European call for tenders. This also shows from the project assignment, which states that from the call for tenders, one information system will be selected and implemented (Mulder, 2003). Because this call resulted in a satisfying solution for the problem, this was the only search and screen loop in the decision process.

The *stimulus* for change is the second project characteristic. In 2005, there was an urge to change the registration and planning tool for surgical procedures. This stimulus is described as a problem by most interviewed stakeholders and is also mentioned in the project assignment (Mulder, 2003). There was not an acute crisis to convert to a new system, since the old system still worked reasonable. On the other hand, the stimulus was not just an innovative step, while there were some problems that had to be solved. A stakeholder mentions: *“we could not have stretched the possibilities of Opera much further. It simply was not suitable anymore in a digitalizing organization.”* Concluding, the stimulus for this project was a problem.

The *solution* for the problem is defined by all interviewed stakeholders as an information system that could be modified. Even though the supplier presented OKplus as a ready-made solution, many small and large features could still be adapted to the needs of individuals. Some of these adaptations were done by the UMCG and others by the supplier. The principle was, according to one of the stakeholders: *“Whether the supplier would change things in the system on our request, depended on the question whether other hospitals could benefit from these changes. For our benefit only, they would not adapt the system.”* The core of the system remained the same, regardless of changes in the periphery. Thus, the solution can be characterized as a modified information system, because adjustments could be made, but the basis of the system stayed the same.

The *style* of decision making was planned, not incremental. All stakeholders agree that the important decisions and outlines were made at the beginning of the project. The planned style of decision making is also visible in the projects' starting document, in which an outline of the steps towards selecting an information system are outlined (Mulder, 2003). No major changes were made during the process of selecting and implementing the new information system.

All interviewed stakeholders agree that the *decision* for changing the planning and registration tool was a rational one. The decision was thought over and discussed with various stakeholders. The selection of OKplus was analytical, i.e. it was chosen through rating the presence of multiple features. Three stakeholders argue that the decision to change the IT also had an innovative character. It provided the UMCG better management information, which

was not included in the project goals. Two stakeholders mentioned that it was really necessary to change the planning and registration tool, otherwise the UMCG would come across major problems in the future.

4.3 Contextual variables

4.3.1 People related variables

The interviewed stakeholders do not agree about the existence of the two main sources of *conflict*, namely different groups and a required integration between these. Remarkably, the project group members state that the users of OKplus are very distinct, while the other stakeholders regard the users as a more coherent group. The homo- or heterogeneity of the users has never led to any problems, because the users all requested a new system and OKplus provided a solution to all the problems the UMCG had. Only the operating assistants had trouble with their new responsibilities, which led to some troubles during the implementation process. That this risk could occur, was already mentioned in the starting document of the project (Mulder, 2003).

The stakeholders do agree that there was no strong request from the supplier to integrate these groups, which lessened the potential for conflict. This was also due to the fact that a lot of adjustments could be made for every department and user. One project member recalls: “*At some point, I wished we sometimes would not honor all the requests that were placed on our to-do list. There were so many individual changes that were asked for.*” All in all, the risk for conflict was moderate.

The tools to prevent conflicts from arising, are to have early representative interaction between groups of users and to formally coordinate this interaction. All stakeholders agree that these two prerequisites were met by involving users in the Plan of Requirements and by having them participate in demonstrations and testing rounds. This is also mentioned in the *décharge* report (2006). Together, this ensured that no conflict arose during the project of implementing OKplus.

The first organizational feature that can be a source of *resistance* is the organizations’ potential to change. This question referred to culture, transparency, leadership, decentralization and other elements of change potential. The stakeholders hold different views towards the change potential of the UMCG. Some recall that the urge to implement a new planning tool was so high, that everyone was willing to change in order to improve the process. Whenever the right tool with the desired functionality is presented, people are willing to give it a try. Others view the UMCG as “*a sluggish organization that wants to provide state-of-the-art health care but is unwilling to change its operations and management.*” Putting these statements together, the change potential of the UMCG is mediocre.

The second source of resistance is the willingness to change for this particular project. Successful predecessors, solidarity and readiness were elements that were referred to with this question. All stakeholders answered this question positively, i.e. they perceived a lot of

willingness to change for this project. Some also mentioned that specific groups were lacking this willingness, because their tasks changed markedly and the process was computerized. Especially the OR-assistants “*did not want to add new tasks to their responsibilities, because they already had a lot of work to do*”.

Impact on tasks is the next source of resistance. All stakeholders perceived the impact on the tasks OKplus had as being high. OKplus changed the tasks of planners and OR-assistants for a great deal, which caused some resistance among these employees. Planners had to plan all surgeries in computers, instead of on paper and whiteboards. In addition, they had to suddenly rely on computers and IT, which could potentially crash and destroy all schemes. One stakeholder recalls: “*Some of the planners simply couldn’t stop writing the schemes down. They were so anxious that the IT wouldn’t be reliable and that their operating scheme would be lost. They had no trust in the system at all.*” OR-assistants required to register times and actions in the computer on the OR, before they could close the patients’ electronic file and start with a new patient. Registration became an additional task for them, which made them resist OKplus. On the other hand, many user groups and management welcomed the change. OKplus provided a great management tool and would simplify the tasks of physicians (Mulder, 2003). These groups did not resist the launch of OKplus at all, because it didn’t have a negative impact on their tasks. Taking these two points of view together, the impact on tasks was mediocre.

Resistance requires a step-by-step approach with interaction between management or system developers with users, which is focused on motivation and exchange of information, focused on social and organizational impact. This approach was not present during the implementation of OKplus. Even though a lot of information was exchanged between the project group and the users, this exchange was merely focused on what the new tasks and processes would be, and not what the impact of changing tasks was on the employees. In addition, there was no motivational interaction between the project group and users. Thus, this step-by-step approach was lacking.

Another way to reduce resistance, is training the employees to use the implemented information system. In the OKplus project, all users were drawn into testing and training sessions in which they got familiar with the system and in which they could propose adjustments to the system (Project evaluation, 2005). These characteristics of the OKplus implementation reduced the resistance potential, and were appreciated by the involved user groups (décharge report, 2006). Concluding, project characteristics that reduced resistance were only partly present.

4.3.2 Organization related variables

The *fit between the innovation and the organization* is rated positively by all - except one – stakeholders. The tasks required to perform in OKplus are similar to those in Opera, and the layout has many similarities with other applications. In addition, OKplus provides the ability to be adjusted to the needs and wishes of every individual user. This possibility matches the culture of the UMCG of individuality, where work is performed in departments and where

everyone wants to have it right the way he likes it. The stakeholder that did not regard OKplus compatible with the UMCG mentioned that “*the technology that was already present was not compatible with OKplus, thus required many linkages to make the systems communicate. There also major differences in lay-out.*” However concluding, the fit between innovation and organization was proper and should enhance the success of implementation.

The *fit between the innovation and the structure of the organization* on elements such as degree of formalization, centralization and structural differentiation is rated positively by all stakeholders. OKplus is accessible from every workstation, which fits the structural differentiation of the UMCG. The tool did not change the degree of centralization in the organization. It provides information and overview at central and departmental level. In addition, the degree of formalization remained the same after the implementation of OKplus. This fit of OKplus with the organizational structure of the UMCG positively influences the outcome of the implementation.

4.3.3 Information system related variables

The risk for *functional uncertainty* is higher when there is no clear problem definition. The stakeholders all state that the problem definition was absolutely clear from the beginning on. A project assignment was written with the goal to list which problems the new application had to solve and to provide a clear delimitation of the project. This is also visible in the project assignment (Mulder, 2003), in which a clear goal and desired end result is stated.

The risk for functional uncertainty will also be higher when there is no previous experience with implementing information systems. In this project most stakeholders had experience with this, but two of them were newly hired in the UMCG to implement OKplus. However, they compensated this lack of experience with enthusiasm and determinism. In addition, the UMCG just had implemented another major IT system, PoliPlus, which had improved the openness of the employees to IT innovations. The UMCG was implementing other information systems at that time as well (Mulder, 2003). Concluding, the experience of the organization with implementing IT innovations was present.

At last, the risk for functional uncertainty is enlarged when the implementation of the IT application is complex and leads to major changes in tasks. The most challenging part of implementing OKplus was to create stable linkages with other applications. Although this was a large task which was time consuming, it was not too complex and did not lead to major problems. Some project members did have sleepless nights over the outcome of the implementation, especially when the conversion date came closer and the time pressure became high. To prevent too much complications with the conversion in the OC, the project group started with the conversion at the ODBC because this was much easier and clearer (décharge report, 2006). This reduced the complexity and uncertainty of the implementation.

Functional uncertainty can be reduced through early interaction between end users and system developers. In this project, all stakeholders confirm that this early interaction was present. The end users were involved in determining the requirements of the new system and had the opportunity to participate in demos and tests. In doing this, they were formally and informally

drawn into the development of OKplus. Requests for changes in the system were negotiated with the supplier, which would adapt the system whenever these changes were useful for other organizations as well. This ensured the interaction between the system developers and the end users.

The second element that reduces functional uncertainty is an iterative process focused on learning to use the system and the sharing of information between users. This iterative process was present during the implementation of OKplus, according to the interviewed stakeholders. To make users familiar with the system and to reduce resistance, they had to participate in an instruction session, for which they got time off. Concluding, functional uncertainty was low.

The degree of *technological uncertainty* is enlarged when there is a risk that the information system will not be implemented at all, because the system is too complex and unknown. According to almost all stakeholders, this never occurred. There was enough experience to deal with the challenges of the system. Only one stakeholder was uncertain whether the implementation would succeed, because there were many errors in the system which required constant adjustments. *“Because the time pressure was so high, and we were not a hundred percent sure whether the conversion would succeed, I doubted the success of the conversion.”* In general however, the implementation of OKplus did not encounter the phase of failure. However, when stakeholders were asked what could have caused potential failure of the implementation of OKplus, one stakeholder came up with the amount of complex linkages they had to create in order to make OKplus connect to the other existent technology. This was such a complicated operation, that it could ruin the entire project (see paragraph 4.5.3). However, since this was a comment of only one stakeholder, the degree of technological uncertainty is rated low. This stakeholder also mentioned that amount of registration codes and the simultaneous conversion from Windows '98 to XP was a potential danger to the project. This risk was also pointed out in the starting document (Mulder, 2003). The technological uncertainties are also mentioned and invalidated in the décharge report. According to this report, the project group could easily prevent all technological problems that OKplus entailed.

Unfamiliarity of technicians with the information system and lack of motivation can also enhance the degree of technological uncertainty. All stakeholders are convinced that the technicians that worked on OKplus had enough knowledge, experience and motivation to make the implementation succeed. Even though the primary technician was newly hired for this project. This person compensated his experience gap with asking help from colleagues and by putting maximum effort in the project. Thus, this element did not cause technological uncertainty.

To reduce the technological uncertainty, the implementation process requires a blue print of the functional design. According to most interviewed stakeholder who were involved in project group, this blue print was available. Upfront the implementation of OKplus, the supplier had demonstrated the application in front of the users and project group. Thus, everyone was familiar with what OKplus looked like. This blue print did not change markedly during the implementation phase.

Iterative realization activities with intense formal and informal coordination also reduce the technological uncertainty of an information system implementation. The implementation of OKplus can be defined as iterative in some aspects, such as the building and testing of linkages with other applications and the involvement of users in demo's and tests (progress report, 2005). However, other aspects, like the conversion from Opera to OKplus, were not iterative. This is why some stakeholders do not agree that the whole project was made out of iterative activities. All in all, this reducing element can be ranked as moderately present in the implementation of OKplus.

4.3.4 Outer context

The contextual variable in the *outer context* was defined as the presence of other organizations that already work with the information system that is implemented. In the case of OKplus, only one other academic hospital was implementing this system when the UMCG selected it. The project group visited this hospital to learn from their experiences so far. However, according to the interviewed stakeholders, they did not implement the system thoroughly enough. *"We found many errors and inconsistencies in the OKplus system, which did not rise during the implementers in the other academic hospital"* was a comment of one of the stakeholders.

At the time, OKplus was the standard planning and registration tool in non-academic hospitals, but not in academic hospitals because the system had no proper solutions for the multidisciplinary character of many surgical procedures which are performed there.

4.4 Outcome

All stakeholders agree on one thing, which is the success of the implementation and use of OKplus. The realized situation corresponds to the desired outcome as determined at the start of the project (Mulder, 2003). All stakeholders mention that OKplus has become a critical application in the chain of providing health care. Even the most critical employees start to complain when OKplus is not working for a short period of time. *"During a period of computer problems a couple of weeks ago, OKplus did not work properly. Instantly, we received complaints from employees that they couldn't do their job without OKplus."* Other measurements of outcome success have been listed as well. The fact that the project has stayed within time and budget, is mentioned by three stakeholders as a success factor. The small amount of complaints about OKplus is for two others a signal that its implementation has been successful.

Even though everyone is enthusiastic about the outcome of implementing OKplus, there are still a few things that could have been improved. Aside from some small technical and functional problems, some of the project group members recall the amount of individual requests for changes they received. These adjustments took (and still take) a lot of time and costs the hospital a large sum of money every time a new release is implemented.

4.5 Summary of descriptive results

All statements made by the stakeholders are graphically represented in table 1. All contextual variables, project characteristics and outcome measures are presented here. A plus sign refers to a positive answer, i.e. the variable is present or the question is confirmed. A minus sign refers to the opposite. The answers to question 3.1 are Rationale (R), Necessity (N), Politics (P) and Innovation (I). The answers to question 9.1 are Problem (P), Crises (C) and Opportunity (O). The answers to question 10.1 are Customized (C), Modified (M) and off the Shelf (S). The answers to question 11.1 are Planned (P) and Modified (M). Whenever there is an empty cell, the stakeholder wasn't able to answer the question, due to information shortage.

Table 1. Summary of descriptive results

Variable	Code	Question	1	2	3	4	5	6	7	8	9	10
Conflict potential	1.1	Different groups	±	-	-	+	±	+	+	±	±	
	1.2	Integration	-	-	-	-	-	-	-	-	-	
	1.3	Early interaction		-	++	+	+		+	+	+	
	1.4	Formal coordination		-	+	+	+		+	+	+	
Resistance potential	2.1	Change potential	+	-	±	±	-	+	+	±	+	-
	2.2	Willingness to change	+	+	±	±	+	+	±	±	+	+
	2.3	Impact on tasks	-	+	+	+	+	+	+	+	+	
	2.4	Step-by-step approach	-	-	±	±	±		-	-	-	
Goals and means	3.1	Type of decision		R/I	N/I	R/I	R		R	R	R/N	R
Innovation-org fit	4.1	Fit within organization	+	-	+	+	+	+	+	+	+	+
Innovation-structure	5.1	Fit with structure	+	+	+	+	+	+	±	+	+	
Functional uncertainty	6.1	Clear problem definition	+	+	+	+	+		+	+	+	
	6.2	Previous experience	+	-	±	+	+		?	±	-	
	6.3	Complex implementation	-	-	-	+	±	±	±	-	+	
	6.4	Early interaction	+	-	+	+	+	+	+	+	+	
	6.5	Iterative process	-	-	+	+	+	+	+	+	±	
Technological uncertainty	7.1	Too complex to implement	-	-	-	+	±	-	-	-	-	
	7.2	Knowledge	+	+	±	+	+		+	+		
	7.3	Blueprint	+	+	+	+	+		+		+	
	7.4	Iterative process	-	-	+	+	+		+	+	±	
Outer context	8.1	Comparable others	-	-	-	±	+		+	+		
Stimulus	9.1	Stimulus		P	P	P	P	P	P	P	P	P
Solution	10.1	Solution		S	M	M	S/M	S	M	M	M	M
Style of decision making	11.1	Style Planned/Incremental	P	P	P	P	P		P	P	P	P
Outcome	12.1	Regular use	+	+	+	+	+	+	+	+	+	+
	12.2	Other success factors		+	+	+	+	+	+	+	+	

4.5 Additional information

4.5.1 Roles within the implementation

The ten interviewed stakeholders occupied different positions in the OKplus implementation. In addition to the project members, the managers of the two operating centers and members of the steering committee were interviewed. An overview of the interviewed stakeholders is provided in table 2.

Table 2: List of interviewed stakeholders

No.	Role in OKplus implementation	Department
1.	Initiator of project as director of health facilities	Board of Directors
2.	Project group member and present OKplus manager	Functional facilities control
3.	Project group member	Functional facilities control surgery
4.	Former manager of Operative Day Care Centre / project group member	Operative Day Care Centre / functional control
5.	Present manager of Operative Day Care Centre	Operative Day Care Centre
6.	Steering group member	Surgery
7.	Project group member	Functional facilities control
8.	Manager of Operation Centre	Operation Centre
9.	Former project group leader / intermediary between project group and steering committee	Functional facilities control
10.	Project group member	Technical control

The steering committee was keeping an eye on the progress of the implementation of OKplus, and the project team executed all the tasks necessary to implement and use the system. While the steering committee members were participating in the project on top of their common job, many of the project members had a full time position in the project and were exempted from other tasks. The two managers of the operating centers regarded their task as facilitators of the implementation, and they stayed off the project implementation itself.

The interviewed stakeholders from the project team comprised of a project leader, a functional controller, a technical controller and a staff member of care facilities. Members of the steering committee that were interviewed, were the initiator of the project and the manager of the Operating Centre (OC). In addition, the former and the present manager of the Operative Day Care Centre (ODBC), a surgeon that arranged registration issues and a functional controller of the surgical department were interviewed. These project members were selected by the project leader of OKplus because they were regarded as important stakeholders in the project.

4.5.2 Promoting variables

Almost all interviewed stakeholders mention that the key promoting variable for the successful implementation of OKplus lied in the small, enthusiastic and motivated project group. This is also mentioned in evaluation of the OKplus implementation that the project group performed internally (evaluation OKplus, 2005). The project group worked intensively together and did not have lot of other duties besides implementing OKplus. They were physically working near each other and communicated a lot with each other and with people outside the project group. Two members of the project group were newly assigned in the UMCG specifically to implement OKplus, and they were thus very motivated to make it succeed. As one of them mentioned: *“We did everything that was necessary to make the project succeed, even if the tasks were not our responsibility.”* In addition, all project members possessed knowledge about the functional and / or technical features of hospital systems and knew how to implement such projects.

A second promoting variable that is mentioned by almost all stakeholders, was the functionality of the system. The system made the work easier and more transparent and was a great solution to the problems with Opera. The project came at the right moment, there was a momentum for change. Everyone was asking for an innovation and was willing to participate in the project. One stakeholder mentions: *“Right now, we could not work anymore without OKplus, it is such an important tool in the process of surgical procedures.”* This emphasizes the importance and functionality of the tool for the UMCG.

Other promoting variables that were mentioned only once were the large budget that was available for the project, the delimitation of the projects' objectives, and holding on to the timeline of the project. The first one can be regarded as a material resource, as described by van Offenbeek (1996b) and is also mentioned in the décharge report (2006). The latter one ensured that the conversion of OKplus took place when there was still momentum for change. The ability to support users in the OC after conversion and the proper preparation of the project were also listed by one project member.

4.5.3 Constraining variables

Several variables that could have potentially harmed the implementation and outcome of OKplus were recalled by the interviewed stakeholders. Almost all stakeholders referred to the time constraint for the conversion to OKplus as an event that could have potentially harmed the implementation. This is also mentioned in the project evaluation (2005) and the report on progress (2005). The project group was urged by the steering committee to keep on track with the conversion date, because postponing it would lead to unnecessary delay and potential failure. However, the project group had not finished testing all linkages between OKplus and other applications and was not concerned with the success of the conversion yet. One project member recalls: *“At some point, I really had sleepless nights over the question whether we were going to make it or not.”* Fortunately, the conversion did not lead to any major problems. The time constraint also refers to the material resources as described by van Offenbeek (1996b).

A second constraining variable is the lack of discipline among operating personnel to precisely register data during and after a procedure. This leads to false, insufficient and lacking information at managerial level. Although this lack of carefulness could have caused many problems, it did not undermine the success of OKplus. Part of this is due to the functionality of the planning tool of OKplus. In addition, the disciplinary problems have been reduced through measures that have been taken to improve the registration of surgical procedures.

The amount of linkages that had to be created to have OKplus communicate with other applications also potential created danger for the success of the tool. This created technological uncertainty, which is referred to by van Offenbeek (1996b). The extensive linkages could be instable and had to be tested to determine their reliability. Many of the stakeholders suggested that linkages would not be necessary if all applications would come from the same supplier. This phenomenon is also called 'best of sweet'. However, the UMCG had decided long ago that for every problem, the best possible application on the market would be purchased. This is mentioned to as 'best of breed'. Selecting all applications from one supplier would reduce the technical costs and make the hospital IT system more reliable. This lack of fit with the applications will also be mentioned in the model. It is included in the contextual variable 'outer context' (par. 4.3.4).

Other constraining variables that could have led to problems were the simultaneous conversion from Windows '98 to XP and the accompanying hardware problems, and the great amount of registration codes that came along with the new registration system. These did not raise the technological uncertainty of the project according to the stakeholders.

5. Analytical results

After presenting the results of the interviews, we will now link the variables of the model with each other to make a statement about the effect that the contextual variables have had on the relationship between the project characteristics and the outcome of the implementation of OKplus. These effects will be discussed per category of contextual variables, i.e. people-, organizational-, IS related and outer context. The results of the interviews are presented in table 3, which can be used as a bookmark for the discussion of the analytical results. In this table, the variables and their result in the OKplus implementation are presented. In addition, it provides an answer to whether the necessary project characteristics to control these variables were present. In three cases, these variables did not require specific project characteristics, which is why there are empty cells.

Table 3. Contextual variables, results and presence of project characteristics

No.	Variable	Result	Presence of necessary project characteristics
1	Conflict potential	Moderately present	Present
2	Resistance potential	Moderately present	Partly present
3	Type of decision	Rational	Present
4	Innovation-organization fit	Positive	
5	Innovation-structure fit	Positive	
6	Functional uncertainty	Moderately present	Present
7	Technological uncertainty	Not present	Present
8	Outer context	Positive	

At last in this chapter, conditions that can also have affected the positive outcome of OKplus are discussed.

5.1 People related variables

The *conflict potential* within the implementation of OKplus was moderately present. Thus, as discussed in the literature review, specific project characteristics are necessary to ensure that the IS implementation project will not fail. These necessary conditions are early interaction with the end users and to formally coordinate this interaction to prevent conflict. In the implementation of OKplus, these characteristics were present. No conflict arose and the project outcome was a success, which can partly be the result of a proper match between conflict potential and the right implementation process, but this will not have resulted in the final positive outcome of the IS project implementation.

The second people related variable was also moderately present. *Resistance* can be caused by a lack of potential to change among employees in an organization. In the UMCG, the change potential was rated mediocre. Another cause of resistance, the willingness to change for this particular project, was for the greater part present in the implementation of OKplus. The last cause for resistance is the impact an information system has on the tasks of employees. In the

case of OKplus, this impact was relatively high for a few user groups. The potential for resistance was therefore moderately-high present.

To prevent resistance behavior from occurring, a step-by-step approach is a necessary project characteristic, in which the management and system developers interact with users, and focus on motivation, exchange of information and social and organizational impact. This project characteristic was not present in the implementation of OKplus. However, there were testing and training sessions in which the users got involved. There was thus a moderate presence of project characteristics that could reduce resistance. In the end, the project did not fail. Thus the presence of resistance potential did not affect the outcome of the implementation of OKplus, probably because the resistance was lessened by involving users.

The third people related variable was the *decision type* to change the planning and registration tool. This decision fitted with the rest of the search and screen loops that led to the selection of OKplus. The creation of the Plan of Requirements, the European call for tenders and the demonstrations of potential suppliers all concord with this rational decision making process, as proposed by Boonstra (2003). The stimulus of the project (a problem) and the planned style of implementation also fit with a rational decision making process. Since these are in conformity with each other, this variable can have a share in the successful outcome of the OKplus implementation.

5.2 Organizational-related variables

The two variables that are organization-related, namely the *fit between the innovation and the organization* and the *fit between the innovation and the structure of the organization* were both present in the implementation of OKplus. This can have enhanced the successful outcome of the OKplus implementation. These variables do not have a necessary project characteristic to enhance their effect on the outcome of the implementation. The relation between these variables and the outcome of the project is thus a direct one. This is illustrated in the model (figure 4) with the direct arrow from the contextual variables box to the outcome box.

5.3 Information system related variables

Almost all elements that could have led to *functional uncertainty* were absent in the implementation of OKplus. The problem that had to be solved with the new information system was clear, there was enough previous experience and commitment among project members and the information system was not too complex to implement. Even though there was no risk for functional uncertainty to cause the project to fail, the necessary elements to prevent this uncertainty from occurring were present. All in all, the absence of functional uncertainty may have helped the implementation of OKplus to be a success. The presence of the necessary project characteristics will not have had a positive influence on the outcome of the implementation of OKplus, since there was no functional uncertainty.

The elements to cause *technological uncertainty* are an information system that is too complex and unknown and unfamiliarity and lack of motivation among the technicians. These

elements were not present in the OKplus implementation and therefore, there was no risk for technological uncertainty. Thus, the absence of technological uncertainty can have positively influenced the successful outcome of the OKplus implementation. Project characteristics that reduce technological uncertainty were moderately present, but will have not have had influence on the outcome of implementing OKplus, because technological uncertainty was absent.

5.4 Outer context

Other comparable organizations had no real experience with OKplus. The OKplus application was not the norm for planning and registration of surgical procedures in academic hospitals. This fact potentially could have harmed the outcome of OKplus, but it did not. However, it did give the project group a lot more work to do in order to prevent mistakes from occurring. In addition, it can have had a hand in the resistance among operating assistants.

5.5 Promoting and constraining conditions

Variables that did not influence the relation between the project characteristics and the outcome of implementing OKplus, but that can have had a positive or negative impact on the outcome, are presented in this paragraph. Promoting variables were the close and enthusiastic project group and the desired functionality of the information system. Constraining variables were the time pressure on the project group to meet the conversion date of the system and the lack of discipline among operating personnel to conform to their new tasks. In addition, the complexity of linking OKplus to other applications in the UMCG was also a constraining variable. These constraining variables however did not prevent the implementation of OKplus to become a success.

6. Conclusion

This study has provided a model, which explains the relationship of project characteristics and contextual variables with the outcome of the implementation of an information system. This model is applied in practice with the case of the implementation of OKplus in the UMCG.

The research question that is studied in this thesis is:

To what extent does the fit between contextual variables and project characteristics explain the outcome of the OKplus implementation?

There are several contextual elements that have contributed to the successful outcome of implementing OKplus. In addition, a couple of other promoting conditions that were present can also have had a positive impact on the outcome of the implementation.

The sub questions that have been answered are:

1. What are contextual variables that influence the outcome of information system implementation in the health care sector?

The contextual variables are people, information system, and organizational related and the outer context of the implementation. These variables influence the outcome of the implementation of an information system through the presence or absence of certain project characteristics.

2. Which contextual variables and project characteristics were present in the implementation of OKplus?

In the implementation of OKplus, there was resistance potential (people related), innovation-organization fit and innovation-structure fit (organization related) and functional uncertainty (information system related) present as contextual variables. The project can be characterized by the presence of early interaction between system developers and end users, which was formally coordinated. It also consisted of iterative realization activities and withheld a blueprint of functional design. At last, the project originated from a problem, which was solved in a planned matter with a modified information system tool.

3. What was the outcome of the OKplus implementation?

The outcome of the implementation of OKplus in the UMCG was successful, which is visible in the frequent use of the system for the tasks it was designed for. The low rate of complaints and the fact that the project stayed within time constraints and budget also indicated a positive outcome.

4. Which guidelines can be derived from the implementation of OKplus for the future?

This study provides couple of guidelines for the IT implementation management of the UMCG. A successful outcome of an information system implementation can be reached when

the following guidelines are pursued. These guidelines are categorized per group of contextual variables and are deducted from the results in the results and conclusion section:

People related:

1. When the potential for conflict is high, necessary measures have to be taken to prevent conflict to arise. These are early interaction with the end users and a formally coordination of this interaction.
2. When the potential for resistance is high, necessary measures have to be taken to prevent resistance to occur. The first one is a step-by-step approach in which the management and system developers interact with end users, and focus on motivation, exchange of information and social and organizational impact. The second one is involving users in testing the new information system and training them to make them more familiar with the system.
3. The archetype of the decision process to come to the information system implementation has to match the amount of search and screen loops, the style of implementation and the solution type of the problem.

Organization related:

4. There should be a fit between the innovation and the culture, norms and values of the organization.
5. There should be a fit between the innovation and the structure of the organization.

Information system related:

6. When functional uncertainty is high, measures to lower this uncertainty have to be taken. These are early interaction between end users and system developers and an iterative process focused on learning to use the system and the sharing of information between users.
7. When technological uncertainty is high, this uncertainty has to be prevented by taking measures as having a blue print of the functional design and using iterative realization activities.
8. The new information system should be the norm in the sector in which the organization operates, because this is motivating for the employees and can be a source of experience for the implementing project group.

Overall promoting:

9. The project group should cooperate close and intensely, and should consist of experienced and motivated project members that all connect well with each other;

10. The information system that is implemented should have the desired functionality, of which all users are convinced that it will make their tasks better and easier to perform.

The people and information system related guidelines are specific to health care, since they are deducted from articles that handle about health care and service organizations. The organization related guidelines apply to all information systems that are implemented in organizations, just as the overall promoting guidelines.

7. Discussion

The aim of this study was to provide guidelines to the ICT implementation management of the UMCG by analyzing OKplus on information system project management with a combined model derived from literature. These guidelines have been provided in the conclusion section of this report. Even though this list of guidelines provides many tools for the implementation management to successfully implement information system, this list will not be exhaustive. However, it was not the aim of this study to provide all good practices in implementing information systems, but only those that are influencing the relation between the project characteristics of an information system implementation and the outcome of it.

Some conditions that were not contextually relevant, but that were mentioned by the interviewed stakeholders themselves, can provide an explanation why the implementation of OKplus was such a success. With an enthusiastic, motivated and experienced project group, many hurdles can be taken that otherwise could have caused the project to fail. Whenever a project group is not motivated to bring a project to a successful end, it is very unlikely that the project will be completed at all.

In addition, the high functionality of the tool also will probably have had a major impact on the outcome of implementing OKplus. Since many employees wanted a new planning and registration system, in which they were involved to select, there was a lot of momentum to change. The tool provided the staff with an easier method to perform their work, which enhanced the usage of it. The benefits of the new information system weighed up to the costs of changing the behavior of employees, which made the conversion to the new system a success. Thus, much of the outcome will be due to the functionality of OKplus.

Some shortcomings of this study can undermine its results. Only ten stakeholders have been interviewed, which is not many considering the size of the project of implementing OKplus. However, these stakeholders represent different parties that were involved in the project. Some important stakeholders unfortunately could not be interviewed, because they had switched position to another organization or had retired. This cannot have had a major bias on the results of this study, since most stakeholders agreed with each other on whether variables were present or absent in the implementation of OKplus. In addition, the statements of the stakeholders were confirmed by written data sources.

Another shortcoming can be the fact that the model that is used in this study is based on five articles, instead of more. Three of these articles have produced the majority of the theory in this study. However, one of these articles is a major review of all available literature on information implementation in service organizations. This study includes many articles, which creates greater evidence for the correctness of the literature. Thus, the lack of quantity in literature should not be a bias for the results of this study.

In conclusion, this study has provided guidelines for the implementation of information systems in a health care setting. Hopefully these guidelines will ensure better implementation success of information systems in hospitals in the future. To further provide good practices in

implementing information systems, more research is needed to create more theoretical and empirical evidence.

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Appendix 1

Table 4: Propositions to handle risks in information systems implementation (Van Offenbeek, 1996b)

Proposition 1	High functional uncertainty requires an early interaction between knowledgeable users and system developers, and an iterative process model aimed at the exchange of information and learning.
Proposition 2	A high conflict potential requires early and representational interaction among the user groups involved, aimed at negotiating and learning, and formal coordination of these interactions.
Proposition 3	High technical uncertainty requires a blueprint of the functional design, followed by iterative realization activities, during which intensive coordination takes place through both formal and informal mechanisms.
Proposition 4	A high resistance potential requires a step-by-step approach with some interaction of the responsible management and / or system developers with all users, aimed at motivating and information exchange and a social-organizational orientation.
Proposition 5	In so far as the context is characterizes by low substantial risks, the corresponding control measures as specified in propositions 1 to 4 are not needed for system development to be successful.

Appendix 2

Questionnaire

	Code	Vraag
Open vraag	0.1	Wat was uw functie of rol binnen de implementatie van OKplus?
	0.2	Wat was volgens u de reden dat de implementatie van OKplus slaagde of juist faalde?
Conflict potential	1.1	Risico: Waren er in de OKplus implementatie veel verschillende groepen met verschillende ideeën, belangen, achtergronden en machtsverdeling vertegenwoordigd?
	1.2	Was er (volgens de opdrachtgever) integratie nodig tussen deze groepen?
	1.3	Was er sprake van vroege interactie met eindgebruikers (gericht op onderhandelen en collectief leren)
	1.4	Werd deze interactie formeel gecoördineerd?
	1.5	Hoe omschrijft u het beslissingsproces? (search en screen loops, bijstellen doelstellingen)
Weerstand potentieel	2.1	Risico: Hoe omschrijft u het veranderpotentieel van het UMCG? (vertrouwen in de leiding, doelstellingen/strategie, transparantie, decentralisatie, homogene cultuur, opleidingsniveau)
	2.2	Hoe omschrijft u de veranderbereidheid? (succesvolle voorgangers, solidariteit, bereidheid voor dit project)
	2.3	Wat was de mate van impact van OKplus op de taken en kwaliteit van werk?
	2.4	Was er een stap-voor-stap benadering met interactie tussen het verantwoordelijke management en/of de systeem ontwikkelaars met alle gebruikers gericht op het motiveren en uitwisselen van informatie met een sociaal-organisatorische oriëntatie (gericht op impact van verandering van taken/functies)

Doelen en middelen:	3.1	Wat voor soort beslissing was het besluit om OKplus te implementeren (rationeel, politiek, innovatief of noodzakelijkheid)
Innovatie – organisatie fit:	4.1	Past OKplus in de organisatie? Past het bij de strategie, doelen, normen, waarden, werkwijze en aanwezige technologie?
Innovatie – structuur fit	5.1	Past de organisatie structuur van het UMCG bij OKplus? (formalisatie, centralisatie en structurele differentiatie)
Functionele onzekerheid	6.1	Risico: was er (on)duidelijkheid over welk probleem OKplus op moest lossen?
	6.2	Was er vooraf ervaring met het implementeren van dergelijke systemen als OKplus?
	6.3	Was de implementatie van OKplus complex en veroorzaakte het grote veranderingen in taken?
	6.4	Was er sprake van vroege interactie tussen eind-gebruikers met kennis van zaken en systeemontwikkelaars?
	6.5	Was er sprake van een iteratief proces gericht op leren en informatie uitwisseling?
Technologische onzekerheid	7.1	Risico: was er een risico dat OKplus niet ingevoerd kon worden omdat de implementatie te complex of onbekend was?
	7.2	Hadden de technici voldoende kennis en motivatie om OKplus te implementeren?
	7.3	Was er een blauwdruk van het functionele ontwerp aanwezig?
	7.4	Waren er iteratieve realisatie activiteiten met intensieve formele en informele coördinatie?
Outer context: Informeel interorganisationeel netwerk	8.1	Werken andere, vergelijkbare organisaties met OKplus? Is dit systeem de norm in de sector? Heeft dit invloed gehad op het beslissingsproces?
Stimulus	9.1	Wat was de stimulus voor verandering: een crisis, probleem of kans?
Oplossing	10.1	Was OKplus customized, modified of kant-en-klaar?
Stijl van	11.1	Was het beslissingsproces planned (beslissing aan het begin,

beslissingsproces		leidend voor de rest van het project) of incremental (serie beslissingen tijdens het proces)?
Uitkomst	12.1	Wordt OKplus regelmatig gebruikt voor de functie waarvoor het bedoeld is?
	12.2	Wat zijn volgens u andere variabelen die het succes of falen van OKplus aantonen? (technische prestaties, acceptatie, tevredenheid)