MASTER

Purchasing diagnostic equipment
an investigation of practices

Ronner, F.

Award date:
2012
PURCHASING DIAGNOSTIC EQUIPMENT;
“An investigation of practices”

by

Freek-Jan Ronner

BSc Industrial Engineering and Innovation Sciences
Student identity number 0571546

in partial fulfilment of the requirements for the degree of

Master of Science
in Innovation Management

Supervisors:
Prof.dr. A.J. van Weele, TU/e, ITEM
Dr. ir. J.J. Berends, TU/e, ITEM
P. Bender (Manager Sourcing, Maasstad Ziekenhuis)
ing. K.J. Peters (Head of Purchasing Department, Sint Lucas Andreas Ziekenhuis)
TUE. School of Industrial Engineering.

Series Master Theses Innovation Management

**Subject headings:** Purchasing, Capital Equipment, Services, Healthcare
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<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>BoD</td>
<td>Board of Directors</td>
</tr>
<tr>
<td>DMU</td>
<td>Decision Making Unit</td>
</tr>
<tr>
<td>Maasstad</td>
<td>Maasstad Hospital</td>
</tr>
<tr>
<td>PBC</td>
<td>Performance Based Contracting</td>
</tr>
<tr>
<td>SLAZ</td>
<td>Sint Lucas Andreas Hospital</td>
</tr>
<tr>
<td>STZ Hospitals</td>
<td>Teaching hospital or specialized clinical care hospital</td>
</tr>
<tr>
<td>TCO</td>
<td>Total Cost of Ownership</td>
</tr>
<tr>
<td>TVO</td>
<td>Total Value of Ownership</td>
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IV ACKNOWLEDGEMENT

I’d like to take this opportunity to express my gratitude to the persons who made it possible for me to realize this thesis.

First of all, I am particular grateful to my first supervisor of the TU/e, Prof. dr. Arjan van Weele, for guiding me through this journey of graduation. He supported me with my choice to conduct my thesis within healthcare, and I’ve felt inspired by his enthusiasm and visionary view in the field of purchasing. Also, my thanks go out to Dr. ir. Hans Berends for his valuable feedback in the latter phase of this graduation project.

This period at Maasstad and Sint Lucas Andreas has been very valuable in terms of self-development, and increased my interest in the challenges healthcare is dealing with even more. I would like to thank Maasstad and Sint Lucas Andreas for giving me the opportunity of conducting my thesis at these organizations. I want to thank Ing. Karin Peters for her support at Sint Lucas Andreas. The time dedication and critical evaluations by her careful reading and listening were the right driver to continue and improve my thesis. Also, I would like to thank Peter Bender who supported me at Maasstad hospital. Many meetings took more time because of his enthusiastic stories about healthcare and the organization of hospitals, which was inspiring and valuable for me.

I would like to thank my colleagues from the purchasing/sourcing departments at both hospitals for their interest, and showing me the daily business of purchasing in hospitals. A special word of thanks is for the persons who were attending at the kick-off meeting of my project: Aloys Wüst, Corine te Winkel, Bert Prins, Hans van der Lelij, Sjoerd Huijbertsen en Ido de Boer. The open discussions provided me with a great insight in the organization of hospitals.

Furthermore, I want to thank my friends who made it possible for me to distract my attention from my graduation project, and were there for discussion and feedback when I needed it. Last, but not least, I am grateful to have a family, who supported me during my whole student life, and provided me with advice, support and trust whenever that was helpful.

Freek-Jan Ronner, June 2012
**V MANAGEMENT SUMMARY**

The role of purchasing has become more important for hospitals, because of the expected increase of purchasing costs in the coming years. Despite the need for cost reduction, hospitals are challenged to increase their quality, efficiency and transparency by health insurance companies and government regulation. One of the main reasons for the increase in purchasing costs is the rapid technological innovation and medical equipment (de Ruiter, 2011). As a result, successful management of purchasing diagnostic equipment has become of importance for hospitals.

Purchasing diagnostic equipment includes a large service part. Different authors agree that purchasing services is quite different from buying goods. In this research different purchasing methods were combined to generate an overview of the overall purchasing process of diagnostic equipment. This included buying capital equipment, buying services, and performing contract management during the operational/maintenance phase over the life time of the equipment. Further, a new paradigm of best value procurement arises within scientific literature. This research is initiated to learn more about possibilities of increasing added value during the purchasing process of diagnostic equipment, within hospitals. Complex organizations, where increasing value and cost reduction are vital to offer care to everyone who needs it.

This research focuses on the organization of purchasing diagnostic equipment at two hospitals, the Maasstad hospital and Sint Lucas Andreas hospital. This study was aiming for insight in relevant factors for value for money performance in organizing the purchasing of diagnostic equipment within healthcare. Therefore, the following problem definition was researched:

*How should hospitals organize purchasing diagnostic equipment to create better value for money, considering the developments in healthcare?*

A literature review was conducted to build a conceptual model based on different theoretical perspectives. These included value based sourcing, buying services, purchasing and capital goods. Our conceptual model served as a basis for the case studies that were conducted. The case studies revealed several weaknesses in the actual practice of buying diagnostic equipment. Most important weaknesses that were found included: 1) lack of mutual and clear objectives, 2) difficulties of specifying for technical requirements and investment costs, 3) lack of suppliers’ performance measurement and mutual agreements with suppliers for the operational/maintenance phase, 4) no link between the purchasing process and the exploitation phase and, 5) unclear tasks and responsibilities during the overall investment procedure.

Main recommendations for the hospitals aimed at structuring their purchasing diagnostic equipment process include: 1) a (multi-annual) alignment of the objectives from the medical business unit with the staff departments- and hospital’s overall objectives, 2) involving necessary stakeholders and capabilities for the purchasing
process and the exploitation phase before the start of the project, 3) using functional specifications and output performance indicators with special attention for added value and risks and, 4) evaluating and monitoring the agreed performance within a pro-active time frame.

One of the overall conclusions of this study is that the focus of the purchasing departments within both hospitals, lay on the technical specifications and the investment costs. This research is a first attempt to move towards a cooperative and transparent purchasing process, where different departments work on mutual determined objectives, with a strong focus on added value.

This study gives insight in the maturity of the purchasing organization of hospitals and provides a blueprint of a purchasing diagnostic equipment process with influencing factors for a value based perspective. For the short term this will result in better communication, coordination and cooperation between stakeholders, improved description of expected value and organizational learning capabilities. For the long term a more grounded decision can be made for a possible transition to integrated solutions or different business models together with suppliers, for an improved value for money performance.
1 PURCHASING DIAGNOSTIC EQUIPMENT IN HEALTHCARE

Healthcare in the Netherlands is subject to many developments that have influenced the positioning of hospitals. The current trends and developments within healthcare and the implication this has on hospitals is discussed. The increasing interest in the purchasing function and the purchasing of diagnostic equipment will be elaborated.

1.1 CHALLENGES AND DEVELOPMENTS WITHIN HEALTHCARE

First, an introduction of the Dutch healthcare is given with a description of its main stakeholders. Second, the different types of Dutch hospitals in the Netherlands are presented. Third, the (political-) trends and developments in the Dutch healthcare are discussed. Finally, the importance of the role of purchasing in hospitals, and specific for the purchasing of diagnostic equipment, is presented.

1.1.1 THE DUTCH HEALTHCARE

The healthcare sector in the Netherlands presented in this research is the medical specialist care (MSZ), which is part of the ‘cure’ part of healthcare. The main stakeholders on the MSZ market are patients, health insurance companies and health providers (Figure 1.1). Normally, patients are redirected by medical (or general-) practitioners, and can choose different health providers for their cure. Patients are compulsorily insured by medical insurance companies for most of the MSZ.

The health insurance companies have budget agreements for the regulated part of the MSZ, the A-segment. For the other part, the B-segment, there are five purchase combinations of health insurance companies who perform the contract negotiations with the health providers about the price, volumes and quality of the cure. Since 2005, a transition is made to performance based funding, where integral prices are developed for health paths, which are called Diagnose Treatment Combinations (DBCs). There are 84 hospitals (including 26 STZ Hospitals), 8 university medical centers and 59 categorical organizations for specific patient groups, for example revalidation- (23) and dialysis centre (3) (Table 1.1). Furthermore, there are hundreds of independent treatment centers (ZBCs) which offer different services, for example MR- or CT scans.

1.1.2 MAIN DEVELOPMENTS WITHIN HEALTHCARE

There are two main trends within the Dutch healthcare industry which must be explained first, before the role of purchasing can be described:

- The increasing competition within healthcare;

<table>
<thead>
<tr>
<th>Type</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular Hospitals</td>
<td>68</td>
</tr>
<tr>
<td>STZ Hospitals</td>
<td>26</td>
</tr>
<tr>
<td>Categorical</td>
<td>2</td>
</tr>
<tr>
<td>UMCs</td>
<td>8</td>
</tr>
<tr>
<td>Total # of hospitals</td>
<td>94</td>
</tr>
<tr>
<td>ZBCs</td>
<td>221</td>
</tr>
</tbody>
</table>

Table 1.1 Number of hospitals
The transition to a demand oriented healthcare; First the increasing competition within the Dutch healthcare is described. Health insurance companies receive more responsibility from the government to coordinate the flow of patients within healthcare, sending them to the hospitals with the best price-performance ratio. The negotiable B-segment stimulates hospitals to reduce their costs, and increase their performance to remain competitive in the market. Second, in order to be competitive during the changing demand of treatments, a transition of hospitals from supply oriented- to demand oriented treatment arises. Hospitals are developing patient-centered health paths or processes, and have to listen to the demands of patients to adapt their treatments to the market. With the current political limitation of zero volume growth, the hospitals need a critical view on their own processes and treatments to be competitive. The developments lead to a patient centered healthcare, with competition between hospitals to deliver the best price-performance ratio and a government which reduces its influence in the market.

1.1.3 THE INCREASING IMPORTANCE OF PURCHASING

The trends and developments in healthcare lead to the question, why is the purchasing function relevant and which role can it play? There are a couple of interesting and relevant aspects for the purchasing function. First, the costs within healthcare will increase the upcoming years, and there will be a focus on cost reduction for hospitals based on the savings of the government on healthcare and the increased competition. The percentage of costs that is related to purchasing for hospitals is between 25% and 30% (NVZ, 2008) and (Figure 1.2 and 1.3) according to de Ruiter et al (2010) the purchasing costs will increase the upcoming years as well. As a result of the focus on cost reduction and the increase in purchasing costs, the importance of managing and reducing costs within the healthcare sector increases. Second, performance based funding of hospitals leads to transparency in quality and costs of hospitals. This has consequences for the relationship between hospitals and their suppliers. Hospitals have to demand quality, efficiency and transparency from their suppliers too. A Dutch research performed by de Berenschot and NEVI (de Ruiter, 2011) states that most purchasing decisions are ad hoc decisions based on capacity or costs and made on short term considerations. The developments in healthcare force hospitals to make strategic decisions to maintain their competitiveness. The development of a purchasing strategy is for many hospitals
unknown terrain, but should gain attention to fit with the long term strategy of the hospitals, to optimally use the market conditions and capabilities of their suppliers. Because of the need for cost reduction and accountability of suppliers, an increasing interest in the purchasing function of hospitals arises.

Third, funding of hospitals will increasingly be based on their price/performance ratio, with attention for quality and patient safety; however the transparency of price/performance relation of the supplier is missing. Hospitals have their medical equipment for a large part under their own management. A large part of the costs lie in the exploitation phase, where suppliers are the service providers for hospitals. With technical life times of over ten years, the selection of a poorly qualified supplier can have consequences for many years. The reverse is also true, you can benefit for many years from well supporting suppliers (Handfield et al, 2011).

1.2 MAIN PROBLEMS TO OVERCOME

In the previous section three main developments or challenges within healthcare were mentioned. The increasing competition between hospitals, the transition to a demand oriented treatments and the increasing costs within healthcare. The increasing competition motivates the hospitals to deliver the best performance for a competitive price. The demand oriented cure stimulates hospitals to make choices about which treatments to perform for the patients. The increased costs within healthcare leads to cost reduction activities for the hospital.

Here the link with the increased attention for purchasing is made. The progressive innovation of diagnostic equipment, expansion of technical solutions and growing capabilities of medical sciences is one of the main reasons for increased costs for hospitals (de Ruiter, 2011). The increased purchasing costs in combination with the financial shortages of hospitals emphasizes on cost reduction. However, the increased competition and demand oriented cure demands quality, transparency and efficiency of the hospitals. The question is raised how purchasing can support the business to overcome those challenges. This leads to the main problem statement which will be investigated during this research:

“How should hospitals organize purchasing diagnostic equipment to create better value for money, considering the developments in healthcare?”

1.3 WHAT TO EXPECT FROM THE RESEARCH

This research is a case study based research performed at two hospitals; Maasstad Ziekenhuis at Rotterdam (Maasstad) and Sint Lucas Andreas Ziekenhuis at Amsterdam (SLAZ). A pre-investigation is held at both hospitals to uncover the real problems and challenges concerning the main problem statement. Based on the pre-investigation a case study based researched is performed of two purchasing diagnostic equipment projects (one at each hospital) within the business unit radiology. A cross case analysis is performed to uncover similarities and differences, to use for general conclusions and recommendations. This research uncovers key issues and challenges when purchasing diagnostic equipment today. Furthermore, it will provide ideas and suggestions for
improving the actual purchasing process of diagnostic equipment, and define factors for supplier accountability.

1.4 DESCRIPTION OF MAASSTAD HOSPITAL ROTTERDAM

1.4.1 ORGANIZATION OF MAASSTAD HOSPITAL

Maasstad hospital is one of the prospective members of the 28 STZ hospitals in the Netherlands and opened its new facility in May 2011. In Figure 1.4 the organizational chart is presented. Maasstad has a dual management at the tactical level. This means that the health care units in the organization fall under the joint responsibility of a health care manager and a medical manager (specialist). The operational departments are under the responsibility of a manager. In addition to the regular basic functions, Maasstad offers specialized clinical care in a number of fields. In Appendix A the organizational figures of Maasstad are presented. The mission of Maasstad is to be leading, professional and customer oriented. The vision of Maasstad is that patients, family members, visitors, employees, general practitioners and health insurers experience Maasstad Hospital as ‘MY’ hospital.

1.4.2 THE PURCHASING DEPARTMENT OF MAASSTAD

The purchasing department is part of the Sourcing department (Figure 1.5). Manager Sourcing is the executive of three senior account managers, three account managers and the purchasing administration. The account managers are part of the strategic purchasing team. They have contact with internal clients, and play a coordinating and advising role. Sourcing divided the (medical) business units of the hospital over the different account managers. Every account manager has periodical contact with his internal clients. The account managers are the project leader when it comes to investment projects.
1.5 DESCRIPTION OF SINT LUCAS ANDREAS HOSPITAL AMSTERDAM

1.5.1 ORGANIZATION OF SINT LUCAS ANDREAS HOSPITAL

Sint Lucas Andreas Hospital is one of the twenty-eight STZ hospitals in the Netherlands and is the result of a merger of Sint Lucas Hospital and Andreas Hospital in 1996. In 2004 SLAZ was renovated and the new building was opened. In Figure 1.6 the organizational chart is presented. Sint Lucas Andreas has a dual management at the tactical level. This means that the health care units in the organization fall under the joint responsibility of a health care manager and a medical manager (specialist). The health care manager, or business unit manager, is the executive for multiple business units. Every business unit has an organizational manager for the daily functioning of the business unit. The operational departments are under the responsibility of a manager. Sint Lucas Andreas has twenty-three specialisms. In Appendix B the organizational figures of Sint Lucas Andreas are presented. The mission of SLAZ contains special attention for the specific expectations from its patients and employees, optimal quality of care and safety, integration with first line health care, top clinical health functions and financial results.

Figure 1.6 Organizational chart SLAZ

1.5.2 THE PURCHASING DEPARTMENT OF SINT LUCAS ANDREAS

The purchasing department is part of the Purchasing and Logistics department (Figure 1.7). Manager Purchasing and Logistics is the executive of one head of Purchasing, three purchasers and the purchasing administration. The head of Purchasing is responsible for the purchasers, the administration, and the strategy of purchasing. The purchasers divided the (medical) business units of the hospital over the different purchasers. There is no regular periodical contact with the internal clients. The purchasers perform a coordinating and advising role when it comes to investment projects, where moreover the MT department performs the project leadership.

Figure 1.7 Organizational chart Purchasing and Logistics
1.6 OUTLINE OF THE RESEARCH

In this master thesis research project the organization of purchasing diagnostic equipment at Maasstad Hospital (Rotterdam) and Sint Lucas Andreas Hospital (Amsterdam) is examined. An outline of this thesis of what to expect from the following chapters is provided in this introduction.

In chapter 2 a ‘literature study’ on the purchasing of diagnostic equipment is presented. Before discussing the main research subject of this master thesis, an introduction in purchasing, life cycle management and buying services is desired to understand the theoretical environment.

In chapter 3 the ‘research plan and methodology’ is presented. A preliminary research is performed in order to derive the problem definition. Based on the literature study and the preliminary research, a conceptual model is conducted. Then the methodology used in this master thesis will be explained.

In chapter 4 the ‘analysis’ is conducted on the case studies. The case study descriptions are presented and the current investment- and purchasing procedures are described. The case studies are performed based on the structure of the conceptual model. The cross case analysis is performed to make a comparison of the evaluations of the individual case studies, leading to causes and effects of the organization of purchasing diagnostic equipment in hospitals. Main comparisons and differences are discussed and the main observations during the analysis are reflected by scientific literature.

In chapter 5 the object model is derived based on the conceptual model and the analysis done. The object/solution model is a blueprint for the desired situation when purchasing diagnostic equipment.

In chapter 6 the conclusions of the thesis are presented in the ‘Conclusions and recommendations’. Recommendations based on the conclusion are presented and a reflection on literature is given. Finally, limitations and implications of this thesis are presented.
2 LITERATURE

In this chapter an introduction of the purchasing process and capital goods is provided. First an introduction of the purchasing process and the life cycle of capital equipment are presented. Additional, success factors for purchasing diagnostic equipment, derived from literature, are discussed. Here it will be explained why purchasing has to be involved in the purchasing of diagnostic equipment process.

2.1 INTRODUCTION OF THE PURCHASING PROCESS

Before introducing the purchasing process, a definition of purchasing is presented. Purchasing is “the management of the company’s external resources in such a way that the supply of all goods, services, capabilities and knowledge which are necessary for running, maintaining and managing the company’s primary and support activities is secured under the most favorable conditions” (van Weele, 2010, p3). The added value of purchasing for the organization depends, among other things, on the fit of purchasing with the organizations strategy as a whole (Freeman and Cavinato, 1990). In the rapidly changing healthcare, hospitals have to adapt to the changing environment and purchasing strategies and activities should be aligned or synchronized with the strategy of the hospital (Rietveld, 2010).

The purchasing process covers activities aimed at determining the purchasing specifications, selecting, contracting and evaluating, and traditionally encompasses the process of purchasing. The steps in the process are connected and the output of the previous process determines to a large extent the quality of the following process steps. The six step model of Van Weele (2005) provides us with a general model for purchasing (Figure 2.1).

![Figure 2.1 Six step model of van Weele (2005)](image)

The purchasing process has business needs and requirements of the internal customer as input. During the specification phase the organization starts to define the requirements by means of a purchase specification. Then a step of selecting and assessing suppliers is done. A contract is negotiated and the physical product and/or service are ordered. During the expediting phase the organization makes sure that the supplier works in respect to the agreements. Finally different types of evaluations are performed. A more elaborated description of the six step model of van Weele is given in Appendix C. According to van Weele (2010) the purchasing manager should support each of the six activities mentioned above. However, this does not necessarily imply that all these activities should be performed by the purchasing department. In this way the purchasing power of the organization can be combined, and delegated in a controlled way, with the optimal efficiency for the internal user.

Many researchers find that purchasing advanced capital goods, with a service part included, is different than the regular purchasing goods process (Fitzsimmons et al, 1998; Smeltzer and Ogden, 2002; Van der Valk and Rozemeijer, 2009). For a better
understanding of services this research follows the definition of Gronroos (2000): “a process consisting of a series of more or less tangible activities that take place in interaction between the organization and the supplier”. It is difficult to define the exact difference between goods and services and almost all services are accompanied by facilitating goods (Cook et al., 1999; Van Weele, 2010). Diagnostic equipment (product) can be delivered by a supplier with an economic lifetime service arrangement (maintenance, software and spare parts) and training of maintenance workers and medical employees to work with the equipment (service). The implementation phase of the equipment and the buyer-supplier collaboration during the pre-contract phase could be called service as well.

Within purchasing, a transition from a product-oriented to a function-oriented market can clearly be seen for many types of capital equipment (Figure 2.2). Organizations no longer wants to own the capital equipment, but maximize its functionalities, for example with copiers (price per copy) and transport (all-in rate per km) (van Weele, 2010). This is based on the added value of suppliers for the buyers. Buying goods and services are the first steps. The third phase is where a solution is bought for the organizational problems, which improves the entire supply chain. The product and service are specified for the process of the buying organization. The last phase is the integrated solution phase. Not a specified product with service is bought, but functions are bought. The buying organization makes use of the functionalities and the supplier is responsible for the performance of those functionalities. According to Oliva and Kallenberg (2003) the supplier begins to become a solution provider, instead of a product, or service provider.

2.2 INTRODUCTION OF THE LIFE CYCLE OF CAPITAL GOODS

The main fields of research related to diagnostic equipment are found to be maintenance management and the life cycle of capital goods. In order to understand the background of purchasing diagnostic equipment, a brief introduction on capital goods is provided in this paragraph. The definition of capital goods used in this research is “products which are not consumed immediately, but whose purchasing value depreciated during its economic life cycle” (Van Weele, 2010). Capital equipment requires services and have associated a cost of ownership beyond their acquisition price (Oliva and Kallenberg, 2003). Diagnostic equipment used by hospitals to diagnose and treat patients, like CT scanners, are capital goods which are very crucial for the primary production process. Capital goods have a lifecycle consisting of five phases (Figure 2.3).
Two important issues during the exploitation phase will be elaborated more in this paragraph, namely maintenance management and the total cost of ownership.

First, the maintenance of diagnostic equipment is often performed by the manufacturer or a third party. Normally, the more complex the equipment, the more maintenance is done by the supplier. This is based on the repetition rate; the knowledge, efficiency and costs, change as a function of repetition. Systems become more complex and advanced, which makes their maintenance increasingly complex, especially for buyers with a limited number of systems. The buyers demand ever-higher system availability levels (less downtime), which implies that the whole maintenance function should be executed at a higher level (van Houtum, 2010). When services are completely outsourced, explicit subject matter expertise should still be available in house, to be able to manage the outsourcing partner (Akkermans and van Oppen, 2006).

The second important issue relates to the integrated cost aspect or the total cost of ownership. Many hospitals only use a part of the total cost of ownership, by taking the maintenance costs during the life time of the capital equipment. Integral costs in the supply chain can be reduced, or value can be added by working together with key suppliers. With a complete TCO, decisions for full package service, lease constructions, or in-house equipment and maintenance could be supported with financial figures. TCO is a basis for predictions when alternatives for a new system have to be compared. (Van Houtum, 2010). Specifying the cost breakdown structure is interesting, but even more interesting is the allocation of costs to processes or activities, in order to identify cost drivers and gain insights in the cost development of the processes in hospitals.

The TCO aims at reducing the total integrated costs with a purchase. There are certain aspects that are never considered in TCO calculations, which are the possible ‘revenue-enhancing’ effects of buying a certain item. Using the total value of ownership (TVO) approach, also performance advantages gained by the purchasing organization to create value and receive additional revenues are captured (Anderson and Wynstra, 2004). In the most elementary stage, the only criterion is price. After including other costs, and the total cost of ownership, the next step is to consider the downstream revenue generating aspects.

### 2.3 DISCUSSION ON THE ORGANIZATION OF PURCHASING CAPITAL GOODS

Additional to the brief introduction of both the purchasing process and the life cycle of capital equipment, influencing factors for organizing purchasing of diagnostic equipment, as derived from literature, are discussed.

#### 2.3.1 BUSINESS ALIGNMENT AND GOALS

Before the actual start of the purchasing process, alignment between business units and purchasing is essential. Purchasing should focus on the business objectives and strategies, and help the business management to realize their objectives to create business impact (Rietveld, 2009). One of the main findings in the research by Berenschot...
and NEVI (2011) is the urgency to gain attention for the purchasing strategy in hospitals and to integrate the purchasing strategy with the goals of the business units in the hospitals. When considering the lifetime of capital goods, a purchase has to fit the strategy for many years and should be based on long-term considerations.

Main condition for business alignment is a cross-functional sourcing team in which users are in the lead and a facilitating role for procurement is initiated before the pre-contract phase starts (Axelsson and Wynstra, 2002). Purchasing decisions cannot be made in isolation (van Weele, 2010) and the choice which members should take a seat in the decision making unit (DMU) is important for the success of the purchasing process (Day and Barksdale, 1994). Many levels in the organization are usually involved, and the tasks, responsibilities, and authority of each department should be indicated in each phase to prevent misunderstandings and role conflicts (van Weele, 2010). The different roles can be defined on a consideration set of Hughes (2005), which enables the communication about the creation of a shared vision and goals and the most effective use of each other’s capabilities and knowledge. The consideration set consists of market perspective, leadership perspective, performance perspective, cultural perspective, and competence perspective.

2.3.2 SPECIFICATION PHASE

First detail specifications, where relevant stakeholders are identified, how these people are affected by the service, and objectives for the individual shareholders are made (van der Valk and Rozemeijer, 2009). Jointly detailing the specifications with the supplier, creates shared understanding and mutual fit. Axelsson and Wynstra (2002) have four types of how to specify services and Martin (2005) added the characteristic quality. The input criteria are used to describe the resources and requirements of the supplier necessary to produce the required service. The throughput criteria are used to describe a general description of work and activities that will be performed by the supplier and how the goal or assignment should be fulfilled. The output criteria are used to make the results that need to be delivered explicit, this relates to the functionality of the service. The quality criteria are different aspects related with quality like timeliness or reliability. The outcome criteria are used to measure economic value to the customer by the service supplier; the value of the service in monetary terms. The input and process specifications are the design specifications, while the output, quality, and outcome specifications are the performance measures (specifications that can be evaluated). Using this model, specifying the capital good in the different stages in a different way will create alignment between the buyers’ and suppliers’ interest and will result in lower organizational costs and creates extra value for the end customer (van Weele and van der Valk, 2010). Technical specifications describe technical properties and characteristics of the product and usually lead to over-specification and higher costs, but no better functionality (van Weele, 2010).

The phase to qualify suppliers is added to the initial purchase model of van Weele (2005). To be surer about the promised performance of functionalities, technical specifications and capability for a long-term relation, a qualification on the supplier can be held. A process where suppliers share their vision and ideas with the buyer gives
insight in the relation between both in the ongoing process, and should be a critical supplier capability. This can be done with input and throughput criteria. Define the cultural, strategic and organizational fit of the supplier and the hospital, and check on important supplier capabilities to realize objectives (van Weele, 2010; Handfield et al, 2011; Van de Rijt and Santema, 2011).

Specification for added value is the possibility for the suppliers to distinct themselves from the other suppliers by presenting added value in terms of cost reduction, patient- or internal client satisfaction, shorter waiting lists and other innovative ideas and proposals. A visionary view and responsibility of the supplier is shown. The specification of risks is done by discussing potential threats and weaknesses and the most important risks. Types of risks that should be minimized are technical risks, commercial risks, contractual risks and performance risks (van Weele, 2010). Challenging suppliers for added value and risk minimization is used in best value procurement (Van de Rijt and Santema, 2011). The specification of the nature of interaction between the service suppliers and the buying organization becomes highly important. The joint production of the service requires a high level of customer contact and collaboration (Van der Valk, Wynstra and Axelsson, 2009). During the specification phase attention should be paid to the ongoing interaction of the service phase (Van der Valk et al, 2009)

2.3.3 CONTRACTING CAPITAL GOODS AND SERVICES

Service contracts normally are based on input or activity based contracts. The suppliers are paid for the activities, the budget spend on service or the agreed number of hours for service. However, outcome measures are increasingly important in the fulfillment of the contract nowadays (Morse et al, 2008) and there is an increasing interest in linking payment to performance (Petersen et al, 2006) instead of linking payment to input factors or activities performed. Detailed service level agreements (SLA’s) with specific arrangements on time of delivery, tests, maintenance, guarantees are appropriate when contracting for capital equipment and also for purchasing services SLAs have become increasingly popular (van Weele, 2010).

Performance based contracting (PBC) is a change from the historical contracting based on input and process specifications in favor of output and outcome specifications (Martin, 2005). It is a change in the buyer-supplier relation where buyers are telling the suppliers how to perform the work by telling suppliers what they expect and leaving the how up to them. As a definition of performance based contracts we use the one of Martin (2005): “performance based contracting focuses on the outputs, quality and outcomes of service provision and may tie at least a portion of a contractor’s payment as well as any contract extension or renewal to their achievement.”

The movement to performance specifications is more expansive and less restrictive, which implies more freedom for innovativeness and creativity of the supplier and it should change the behavior of contractors to focus more on performance (Martin, 2002). Next to innovation there are more advantages of PBC over the traditional input or activity based contracting (Martin, 2003):

- The outcome is specified and because of the mutual interest in the result instead of the process, there is more certainty that the result will be achieved;
• The risks are for the party who is best able to manage them and performance failure is transferred to suppliers to encourage the latter to focus more on performance;
• Only activities directly related to the goals/expected results should be performed;
• Collaboration with suppliers could lead to a more commercial way of working, by improving work processes by combining skills and knowledge of the supplier.

2.3.4 CONTRACT MANAGEMENT AND EVALUATION
Active contract management is a key success factor for successful purchasing diagnostic equipment based on the specifications determined during the earlier stages. According to Handfield et al. (2011) the measurement system of suppliers must consider business goals and strategies, and the corresponding purchasing goals. When the buyer needs to achieve its goals, by the use of the capital good of the supplier, it is important to work with collaborative KPIs. Collaborative KPIs are set, and the supplier and buyer are both measured on KPIs that will influence the collaborative KPIs, where not only the supplier, but the buyer as well has to conform to certain performance criteria (Akkermans and van Oppen, 2006). This ensures that the buyer is evaluated on its effort to create the necessary conditions for the supplier to perform its service.

Evaluation of the purchasing activities and performance has different results; it supports better decision making, better communication, provides performance feedback internally as well to the supplier, and motivate and direct behaviour (Handfield et al, 2011). According to Van der Valk and Rozemeijer (2009) the evaluation phase is one of the main problem areas in the purchasing process. In too many cases organizations expect that what they intended to do with an investment is the real result without evaluating. There are different evaluation measures which can be used and are relevant for hospitals (Handfield et al, 2011):

• **Price performance measures:** The evaluation of the price performance measure is how effectively a purchase euro is spent.
• **Technology or innovation measures:** When the quality measure is linked to contractual agreements, the hospital may be one of the first with who the technological development is shared with.
• **Supplier performance measures:** With diagnostic equipment, start quantifying the associated costs with the suppliers’ non-performance as well. Performance overviews can be helpful when motivating or developing suppliers’ performance.
• **Strategic performance measures:** These measures reflect the ability of the purchasing organization to support overall corporate and functional goals (financial or productivity), both in efficiency and effectiveness measures.

2.3.5 LIFE CYCLE MANAGEMENT OF DIAGNOSTIC EQUIPMENT
The most interesting phase in this research is the exploitation phase, where the operational and maintenance activities are performed. There are different types of relations between buyer and supplier. Two types will be discussed, namely the transaction oriented approach and the relational oriented approach (Axelsson and Wynstra, 2002).
The purchasing model of *transaction oriented approach* is based on market thinking, where efficiency is created within the organization given by the input and output prices, by choosing the right product, at the right moment of delivery, right quality and right supplier. Within hospitals the main focus is indeed based on market thinking and competition. In the *relation oriented approach* the price should not be predominantly reflect the given production conditions, but the entire functional relationship between buyer and supplier. When all the costs have been accumulated the chain of activities has reached a final and total cost. Here it is showed that the price of the product shouldn’t be the only cost factor to minimize.

There are different strategies for supplier relationships which are based on different characteristics. Long term relationship during the service delivery for the diagnostic equipment, with technology developments and the developments within healthcare, an unforeseen future is ahead. According to Webster (1992) a long term relationship between a buying organization and the supplier doesn’t mean the focus is on relation. It is possible that long term contractual commitment, goes along with arms’ length distance and purchasing battles focused on the lowest price.

Next to the supplier relation, the supplier measurement system must be compared against pre-established standards or goals, so the actual supplier performance can be evaluated. A number of quantitative factors are mentioned in the paragraph about contract management, but there are qualitative factors which can be useful as well. A number of qualitative factors to assess the performance can be used. For a hospital the following qualitative factors can be derived (Handfield et al, 2011):

- **Problems resolution ability**: Attentiveness to problem resolution;
- **Technical ability**: Manufacturing and maintenance ability compared to industry;
- **Ongoing progress reporting**: Ongoing reporting of existing problems or recognition and communicating a potential problem;
- **Corrective actions response**: Timely response on downtime of capital equipment;
- **Supplier cost reduction ideas**: Willingness to find ways to reduce total cost of ownership;
- **Supplier new product support**: Develop product design to support organizational processes;
- **Buyer seller compatibility**: Rating concerning how well a buying firm and a supplier work together.

The report frequency should use a time frame which is short enough to pro-actively act with the supplier to prevent the risk and to steer on the discrepancy of the result with the goals. Poor performance must be addressed as soon as it is recognized to avoid financial and operational repercussions, especially when it affects day to day performance operations (Van de Rijt and Santema, 2011).

### 2.4 WHAT DID WE LEARN FROM LITERATURE?

Literature gave an overview of different influencing factors for purchasing services, goods and how to specify for value. In this research the subject is capital equipment with a life time around the 10 years and a large service part included. We learned that
the six-step purchasing process (van Weele, 2005) is lacking criteria for specifying services and has minimal attention for the duration of the exploitation phase. A transition to a function oriented market which emphasize on value instead of costs is arising within literature. Instead of buying the product, literature emphasizes on maximize functionalities, focus on added value, and measure the performance instead of technical specifications. Together with jointly operating with the supplier to specify the desired performance and use supplier creativity and innovation. Those are aspects of a transition to buying functionalities and best value procurement.

2.5 THEORETICAL MOTIVE FOR RESEARCH

Although some theoretical models exist to generalize the buying services process and determine success factors, the question how to buy capital equipment with a large service part remains unclear.

From theoretical perspective an overview of the whole purchasing process, including the operational phase of the diagnostic equipment, is interesting. Normally the purchasing of goods, or the purchasing of services is investigated. In this research a combination of different purchasing methods is combined to generate an overview of the total purchasing process of the diagnostic equipment, the service, and the operational phase of the equipment.

Another interesting theoretical aspect is the choice for healthcare. First, the organizational complexity of hospitals during the purchasing process is interesting. The power of medical specialists for the choice of medical equipment differs from other fields of industry. This could influence the purchasing process. Second, the increased competition and costs within healthcare puts pressure on the purchasing function. The choices made within the purchasing process give an overview of the purchasing maturity of the purchasing function within healthcare. Especially considering the different trends concerning value based sourcing and a transition to buying functionalities.
3 RESEARCH PLAN AND METHODOLOGY

In this section the problem with regard to the purchasing of diagnostic equipment by hospitals is defined. A problem solving framework is presented to derive a problem statement. Research questions needed to solve the problem are presented. In this way the deliverables for the project become clear.

3.1 PROBLEM SOLVING FRAMEWORK

The type of research approach will be discussed based on the research methodology of van Aken et al. (2007). In this research a design focused and theory based business problem solving methodology (BPS) is used to improve the performance of a business system, in this research the performance of the purchasing process. BPS projects are undertaken to “improve the performance of certain business systems or organizational units” (Van Aken et al, 2007, p.8). Following van Aken et al. (2007), a distinction is made between explanatory sciences and design sciences. Explanatory science develops knowledge to describe, explain and predict phenomena within the scope of the science in question. Design science develops valid knowledge, which can be used by professionals in the field in question to design solutions (Van Aken et al, 2007). This research can be qualified as design science, because the outcomes of this research can be applied in the field of the conducted research, i.e. Maasstad Hospital and Sint Lucas Andreas Hospital.

3.1.1 REFLECTIVE AND REGULATIVE CYCLE

Research based on design sciences, aimed at developing prescriptive knowledge in the form of technological rules, generally follows the reflective cycle (Van Aken et al, 2007). In this research the reflective cycle of Van Aken et al. (2007) is elected because a solution design will be developed. This is done by developing technological rules based on the reflection on the results derived from the first steps of the regulative cycle. The logical set-up for business problem solving is the regulative cycle by Van Strien (1997). The first three process steps of the regulative cycle are the design part. The change part and the learning part of the regulative cycle (step 4 and 5) are usually not performed during the master thesis project, and therefore the next step after the analysis and diagnosis is the reflection on results in the reflective cycle. Conclusive, the reflective cycle (van Aken et al, 2007) is elected because a solution design will be developed based on the reflection on the results derived of (a part of) the regulative cycle (Van Strien, 1997) (Figure 3.1). Following the integrated reflective cycle (Van Aken et al, 2007) and the regulative cycle (Van Strien, 1997), the Problem mess as visualized in the first step of the regulative cycle, starts with the initial problem statement of the hospitals. Consequently by the use of explorative interviews with the stakeholders and the creation of a cause and effect diagram, a Problem Definition is derived from the problem mess. The Analysis and Diagnosis is the analytical part of the project. The case study approach is a method to analyze the organization of purchasing diagnostic equipment at both hospitals, and will be explained in the following paragraphs. This analysis and diagnosis step produces specific knowledge on the context and nature of the problem.
Based on the paradigm of the design sciences, aimed at the development of prescriptive knowledge, the reflective cycle is followed. The preceding steps reflection on results and developing of technological rules will be found in the conclusion and recommendation.

3.1.2 SOLUTION APPROACH
Designing is a key activity in design focused problem solving. A design can be defined as a model of an entity to be realized, as an instruction for the next step in the creation process (Van Aken et al, 2007). A model is an abstraction of reality and in case of a design it is a possible future reality which gives all the information the makers need to realize the entity. A definition of designing is the process of determining the required function of an object to be designed, combined with making a representative model (Van Aken et al, 2007).

Designing involves three designs (Figure 3.2):
- Object design: The model of the system or process to be realized;
- Realization design: A model of the material process through which the object design is to be realized and;
- Process design: A design of the process of analysis and design that is used to create the object and realization design.
First, the process of purchasing diagnostic equipment is regarded as the object design in this research. The object design, or solution design is derived from the analysis and explained in chapter 5. Second, the realization design is the conceptual model that will be defined and described. The conceptual model is derived by combining the purchasing diagnostic equipment process of both hospitals and relevant literature from the exploratory literature research conducted in the previous part of this research project. The focus of the conceptual model will be on the purchasing process, the operational and maintenance phase during the life of diagnostic equipment and their interaction. Third, the process design is the process of analysis and design, which is the methodology of this research, and will be elaborated in the paragraph 3.4 ‘Methodology’.

3.2 PROBLEM DEFINITION

In this section, the defined research problem in regard to the organization of purchasing diagnostic equipment at both Maasstad and SLAZ is described. In order to do this, it is first explained what the problem statement is and how the actual research problem is derived from this. Based on this initial statement the research question and sub questions are presented in the following paragraphs.

3.2.1 PRE-INVESTIGATION AT MAASSTAD AND SINT LUCAS

According to the trends and developments within healthcare, the initial research problem was described by both hospitals as ‘how to structure the role of purchasing in the organization of purchasing diagnostic equipment, to make the right investments for the right price’.

In order to derive the actual problem statement the research started with a general exploration, which consisted of a preliminary investigation of both organizations and the problem context, leading to a problem definition. Orientating interviews with supervisors, principles, experts and stakeholders were held and documentation of processes performed by the hospitals was reviewed. At the end of the orienting interviews, a workshop with a steering group, existing of the supervisor and the different stakeholders of the two hospitals, was performed. The steering committee, experts and other interviewees contacted are presented in Appendix D. The results of the orientation interviews and preliminary investigation of the initial research problem, are visualized and supported by an Ishikawa diagram (Figure 3.3). A categorization is made in different perspectives on the value chain of capital goods. According to Roberts (2002) every supply chain exists of four individual supply chains; physical-, financial-, informational- and relational supply chain (Appendix E). By using these different perspectives analyzing the process, more possibilities to uncover problems and generate improvements exists. Based on the preliminary research and the steering group meeting the causes and effects uncovered according to the above discussed categorization, will be elaborated.

Lack of information (-sharing)

A significant finding related to the information supply chain is the lack of a clear strategy of the purchasing department. The purchasing of diagnostic equipment isn’t
incorporated in the purchasing strategy and a purchasing strategy is completely missing. With this, information sharing about long term planning of investments in diagnostic equipment between (and within) the purchasing department, business units, BoD and staff divisions is not sufficient. This is because investment budgets are unclear, medical and staff department strategies still have to be made, formal consultation between medical business units about their strategy is minimal and a clear planning and kick off is missing. Another aspect concerning information is the contact and understanding between the hospital and the supplier considering diagnostic equipment. Within healthcare, there is a tension between the quality demands of the medical specialists and the financial resources of the hospital.

Lack of evaluation
The physical part focuses on the purchasing process, which is reactive in the post contract phase. No evaluations are done with suppliers or the project team, and communication between the purchasing department and suppliers or internal customers about capital goods is considered to be reactive. Therefore caveats in earlier projects are not documented or used for process improvement for further projects. The lack of evaluation of the process, the results and the reactive contract management makes it hard to control the suppliers and pro-actively manage risks during the purchasing process. No criteria for suppliers are set to work on continuous improvement.

No clear decision making units
The main problem throughout the perspective of relation is a lack of clear roles and responsibilities during the purchasing process. Stakeholders have a feeling of ad hoc decision making, difficulties with the availability of team members and unplanned involvement of the Board of Directors. Different departments have the feeling to be bypassed in the project and to be involved (too) late in the process. Next to the management of the DMU, the diffuse relation with suppliers is hard to manage where medical business units have contact with suppliers without the knowledge of purchasing. This has its influence on the objectivity of the purchasing process and the strategic criteria of the hospital.

Lack of total cost of ownership
The main problems concerning the financial supply chain have to do with the TCO, or the lack of this. Figures of the business cases are not checked with the realization of the project, and therefore it is unknown if the total cost of ownership used is a representative view of the final real situation. One of the hospitals doesn’t have a format for the TCO which makes the quality of it fluctuate. Hospitals make use of partial total cost of ownership and sometimes very limited total cost of ownership calculations. No allocation to processes or different departments is made. This makes it more difficult for hospitals to compare different types of sourcing, because a financial background is missing. Purchasing is mainly assessed on the savings on initial investment.
Figure 3.3 Ishikawa diagram Maasstad and SLAZ
The causes all pointed to a purchasing department which only guides the purchasing process based on standard documents and cost reduction, from specification until the contract phase. The performance of the diagnostic equipment is not evaluated based on the added value for the business. The practical problem statement based on the preliminary research is:

*At both hospitals there is a lack of a cooperative purchasing process and accountability of the supplier’s performance.*

### 3.2.2 RESEARCH QUESTION AND SUB QUESTIONS

Main research question and sub research questions
Subsequent to the research context, the research question is defined. From the research context, accountability for the right price/performance ratio based on long term considerations needs to be translated to the performance of suppliers. Based on the initial problem statement and the preliminary research at Maasstad Hospital and Sint Lucas Andreas Hospital, the following research question is defined:

*How should hospitals organize purchasing of diagnostic equipment to create better value for money, considering the developments in healthcare?*

Based on the preceding sections in this research and the explorative literature study conducted for this research, the following sub questions are derived:

- How is diagnostic equipment actually purchased today in healthcare?
- How to increase the transparency and control of the purchasing process?
- What improvements can be made in the purchasing, operational and maintenance phase of diagnostic equipment?
- How to increase the transparency and control over the performance of suppliers?
- How to engage suppliers effectively in the life cycle management of diagnostic equipment?

**Deliverables**

The deliverables of this master thesis are derived based on the research question and sub questions, are given in this section. The following deliverables for both hospitals are derived:

- Uncover key issues and challenges when purchasing diagnostic equipment;
- Ideas and suggestions for improving the:
  - actual purchasing process of diagnostic equipment;
  - operational activities of diagnostic equipment;
  - maintenance activities of diagnostic equipment.
- Define factors for supplier accountability in regard to purchasing of diagnostic equipment;
- Derive a framework to structure the purchasing diagnostic equipment process.
3.3 CONCEPTUAL MODEL

In this section a conceptual model for the organization of purchasing diagnostic equipment is derived. The conceptual model is constructed from relevant aspects of the organization of purchasing diagnostic equipment from literature. It is presented in two dimensions, namely the purchasing process of diagnostic equipment and the life cycle model of diagnostic equipment.

The influencing factors are derived from literature and support a controllable, transparent purchasing process for an improved value for money result. The value for money result in this research is defined as ‘the worth in monetary terms of the economic, technical, service, and social benefits a customer firm receives in exchange for the price it pays for a market offering’ (Anderson et al, 1993). To increase the value for money, the emphasize in this research focuses on the added value, instead of cost reduction. The conceptual model serves as a framework for the analysis in this research project. The conceptual model presented in Figure 3.4, in combination with the research question, creates a good understanding of the current situation and can be compared with the existing literature in a consistent manner. This analyzes how the purchasing process is performed by the hospitals, and if the influencing factors for the purchasing process indeed lead to the expected operational and maintenance performance during the life cycle of the capital good. At this moment it is to decide which influencing factors are important to increase accountability of the suppliers and stimulate a cooperative process in order to improve the value for money result of the purchasing process.

Figure 3.4 Conceptual model

The influencing factors of the initial phase are the business alignment between the purchasing strategy with the objectives and goals for the business, and the decision making unit. During the pre-contract phase the use of functional specifications, added value and risk and qualification criteria for suppliers are derived from literature.

During the contract phase the outcome performance of the supplier and linking the payment to the performance of the supplier is gathered in performance based contracting. The post contract phase contains the suppliers performance, which must be monitored by contract management and the evaluation of the diagnostic equipment.

During the exploitation phase the cost profiles and breakdown structures are useful for the total cost of ownership. The supplier measurement system must be compared against pre-established standards or goals of the business unit or purchasing. The
supplier relation strives to cooperation and long term relationships to achieve the lowest integral price, and highest added value of the supplier. Not that in regard with this model, certain influencing factors during the purchasing process, which can possibly be initiated during the purchasing phase, are discussed to uncover which (missing-) influencing factors are leading to a better accountability of suppliers, a more cooperative purchasing process and a better value for money result.

3.4 METHODOLOGY

As the research problem is defined and the project approach is clear, a more detailed methodology is needed for the empirical part of the research (Van Aken et al, 2007). First, the research type is discussed and next, the chosen method – case study analysis – is explained.

3.4.1 RESEARCH TYPE

The empirical part of the project serves to get an in-depth understanding of the purchasing process and the exploitation phase of diagnostic equipment. Especially in situations where change of a current situation is the objective, it is important to get a thorough understanding of the situation and its complexity. A case study enables an investigator to get this necessary in-depth knowledge (Verschuren & Doorewaard, 2007). Case study research is the most appropriate research in answering “how and why” questions (Yin, 2009). For the research purpose of creating understanding in the purchasing process of diagnostic equipment, it allows the researcher to study examples and experiences from the practical context and eventually to translate them into generic statements (Yin, 2009). The case design was selected to compare the different case studies on purchasing diagnostic equipment within healthcare.

3.4.2 CASE STUDY DESIGN

The case study is based upon the multiple embedded case study design (Yin, 2009; Figure 3.5). The case study design was selected to compare the different case studies on purchasing diagnostic equipment within healthcare and to draw general conclusions based on the influences of different aspects on both Maasstad and SLAZ within the purchasing diagnostic equipment process.

Unit of Analysis

One of the first steps is to determine the unit of analysis in order to be able to select data and guide analysis. The organization of purchasing capital equipment of hospitals is
considered different than other industries, because of the complex organization. To gain insight in healthcare, two hospitals were chosen. To be able to compare the cases of the hospitals, the purchasing of diagnostic equipment of the business unit radiology was chosen. The importance and role of the business unit radiology is similar in both hospitals. Diagnostic equipment is both an expensive as well as strategic good for hospitals and includes a large service part. For the unit of analysis similar diagnostic equipment bought by the hospitals is chosen. This results in the purchasing process of diagnostic equipment for the business unit radiology as unit of analysis.

Case selection criteria
After the selection of the unit of analysis, specific cases of the type of object are selected for further research. A cross case analysis is done to compare different purchasing processes of diagnostic equipment. Cases can be selected based on theoretical grounds or driven by considerations about independent or dependent variables. The following criteria were attained, when selecting the case studies:

- The scope of the purchased good is diagnostic medical equipment;
- The purchasing process is performed with the business unit Radiology;
- The purchasing diagnostic equipment projects are completed;
- Stakeholders of the projects are available.

This resulted in one case study performed at each hospital of recent purchasing projects of diagnostic equipment, which will be explained in section 4.2 Case description.

Data collection methods
The following research methods have been applied:

- Semi-structured interviews;
- Analysis of documents;
- Informal conversations/observations;
- Workshop.

As mentioned before, not all the research methods are based on case studies. The workshops and informal observations and conversations are based on the general process, instead of specific cases. Interviewing is one of the main methods of data gathering. In most cases semi-structured interviews of 60 minutes are used, using a list of specific questions set up in advance but leaving sufficient room for additional information. In preparation the perspective of the informant on the problem was analyzed, in order to be sensitive to positional and personal bias in the answer. All main stakeholders of the purchasing process and during the life cycle of the capital goods were interviewed. Next to interviews, documentation is a helpful source of information. Documents are important to confirm the evidence of other sources (Yin, 2009). Information about decision making, authorization within the process and other related organizational aspects of the purchasing process of diagnostic equipment was used. Observations are an important source for information as well. As a member of the purchasing department of the hospitals, organizational processes and activities were experienced and a meeting at both the investment committees was attended. A workshop was held with the steering committee attending, with two main objectives: first, to uncover specific difficulties of the purchasing diagnostic equipment process and
second, to validate the results of the preliminary research and generation of ideas for improvement. The workshop was not only for analysis and validation, but served as well as contribution to the anchoring process of recommendations in the organization. The problems found during the orientation phase were discussed and resulted in the problem statement.

Analyzing case study data
The aim of data analysis is to derive general theories from the process data. The collection of qualitative data often is a huge amount of raw material. To assure the analysis of the data isn’t an intuitive and subjective process, the way how raw data is turned into findings and conclusions is explained. The grounded theory approach is a method to develop theory out of raw qualitative data in a systematic way. There are three central procedures to employ: open coding, theoretical coding and selective coding. Coding could be described as labeling or categorizing. Open coding does not use an existing coding scheme. The data and answers to questions you receive should be framed in codes that fit the data. Two methods used for open coding are 1) asking questions during the interviews and comparing data and 2) comparing data and put the similarities or differences into words.

Theoretical coding consists of putting relationships into words. Concepts are developed in open coding, and relationships between concepts are discovered through theoretical coding. Selective coding is about elaborating concepts and relationships found during open- and theoretical coding. Extra specific data collection can be done to crystallize the results of the coding process and the process of selective coding will stop when the local theory is saturated. In this research, software is used for the analysis. The application used is NVivo, which allows the researcher to manage, code, and model data (Richards, 1999). NVivo is able to reduce bias through systematic analysis of large volumes of data and to automatically conceptually map text data to predict associations (Mena, 2003). Because the semi structured interviews follow the same outline, transcribed interviews were grouped in the different process steps, and influencing factors of the conceptual model. Here, the causes and effects were related to the different influencing factors, which structured the performed case studies and the cross case analysis.

Quality of the research
The quality of the empirical analysis, or the case study, is influenced by the following criteria (Van Aken et al, 2007; Yin, 2009): controllability, reliability, construct validity, internal validity and external validity.

The first requirement, controllability, means the research must be controllable, and the researcher must reveal how the study was executed. A rule of thumb is that the study must be described in a way that it could be replicated. This detailed description makes it possible to judge the reliability and the validity of the research. Reliability means that the results of the study are independent of the particular characteristics of that study and can therefore be replicated in other studies. There are several causes of bias: the researcher, the instrument, the respondent and the situation. Doing more measurement is a common strategy to improve reliability. Because of the
minimal number of case studies, a combination of interviews, documents, observations and workshops were used as a remedy for shortcomings of multiple case studies and biases of these instruments, and complement and correct each other. In this research NVivo is used to help the researcher to work systematically.

The validity refers to the relation between a research result or conclusion and the way it has been generated. There are three types of validity, construct-, internal- and external validity. Construct validity is the extent to which a measuring instrument measures what it is intended to measure, it refers to the quality of the operationalization measures for the concepts being studied. In this research the research model is derived from both literature and people from the field. Second, managers from both hospitals and the supervisor of the project have evaluated the measurement instruments. And third, the indicators for the organization of purchasing diagnostic equipment are verified by the supervisors.

Internal validity concerns conclusions about the relationship between phenomena. Theoretical triangulation is used, by viewing the problem from different theoretical perspectives, in this case theoretical perspectives from purchasing, buying services, maintenance management and contract management. Different experts were contacted at the start of the project to discuss different perspectives. However, there is limited quantitative data to validate the results. External validity refers to the generalizability of the results and conclusions to other organizations. Based on the theoretical origin of the model, the general results could be verified for other organizations within healthcare. However, public tendering, which happens for example at academic hospitals, is not taken into account.

3.4.3 CONCLUSION

The problem definition is described and based on the literature research a research model is derived with influencing factors for a better value for money result of the purchasing process, which emphasizes on added value instead of cost reduction. Case studies are used to uncover the influence of the derived factors on the performance of the purchasing process. Semi structured interviews derived from the structure of the conceptual model are held in two purchasing diagnostic equipment processes within the business unit radiology. The preliminary investigation uncovered a similar pattern of purchasing diagnostic equipment and similar difficulties which make both case studies appropriate for comparison. In the next chapter the chosen case studies will be elaborated, and the analysis based on the conceptual model is performed.
4 THE ORGANIZATION OF PURCHASING DIAGNOSTIC EQUIPMENT

4.1 INTRODUCTION

In this section, the organization of the purchasing of diagnostic equipment is analyzed by two case studies at two business units of radiology. The case studies will be conducted as described in paragraph 3.4.2. First, the case studies for the purchasing of diagnostic equipment are described and information is provided about the business unit radiology. Second, the current procedures considering the investment cycle and the purchasing process. Third, the analysis will be conducted by applying within case studies and a cross-case analysis. Each case study is performed separately, following the structure of the research model. Each case study is completed with a conclusion with regard to the purchasing diagnostic equipment process. The second analysis is the cross case analysis, in regard to derive more general conclusions in regard to the organization of purchasing diagnostic equipment. Here, the similarities and differences of the two case studies are evaluated and finally concluded upon. Final part is the observation part, where the conclusions of the cross case analysis are reflected to the conceptual model.

4.2 CASE DESCRIPTION

Two case studies are conducted of the purchasing of diagnostic equipment at the business unit radiology and the activities during the operational and maintenance phase of the diagnostic equipment. The same set of topics needs to be addressed in order to maintain consistency throughout the multiple case study (Yin, 2009). Therefore, the case study outline is determined in advance of the data collection and analysis. The outline of the case study is based on the different steps of the conceptual model. The influencing factors mentioned in the conceptual model are represented in the case studies; business alignment, clear decision making unit, functional specifications, added value and risks, supplier qualification criteria, performance based contracting, contract management, evaluation measures, total cost of ownership, supplier measurement, and supplier relation. At the end of each case study an overview of the mentioned influencing factors is given.

The case descriptions give a description of the business unit radiology in both hospitals. But what does the business unit radiology do? The business unit radiology uses imaging techniques to diagnose the inner body. Different types of imaging techniques are used. With X-rays, sound waves (ultrasound) or magnetic waves (Magnetic Resonance Imaging (MRI)) the human body can be visualized and analyzed. Because the images of the inner body normally are used by other medical business units, the business unit radiology is a supportive department for other medical business units. Within the business unit radiology, different persons are working. The two main medical users of the diagnostic equipment are described:

The radiologist is a medical specialist, specialized in the evaluation of imaging techniques. He determines whether there is a particular disorder or disease of the body. If necessary the radiologist does treatments, such as widening a narrowed blood vessel, or stems a severe bleeding. Furthermore, he provides radiological education for co-assistants and junior doctors, and has meetings with medical specialists of other fields of
practice. The radiographer takes the pictures of the skeleton, heart and lungs. Radiographers are educated to perform standardized radio diagnostic investigation; they are responsible for the quality of the photos taken and support the radiologist with investigations. In the next paragraphs, the organization of the business unit’s radiology of both hospitals is explained, and the specific context of the case studies is presented.

Political context within hospitals
An important aspect which make the case study even more interesting is the complex and political situation at hospitals. There are different political aspects that should be considered within healthcare. The alignment and sharing of knowledge between medical business units is minimal. Medical business units can be seen as different islands working on their own. The differences between medical business units in management capabilities is large, which is shown by the differences in quality of annual plans or investment requests. This is partly because the management functions are performed by people with a healthcare background. Thereby a continuous tension between the quality demands of medical specialists and the financial resources of the hospital leads to different interests. The interest of the medical specialists is very important because the primary process is performed by medical specialists who are responsible for the patient care and safety. Finally, suppliers do have contact with medical specialists by medical fairs and workshops which can lead to certain preferences of medical specialists for suppliers. Which makes the purchasing process less objective.

4.2.1 CASE 1: MAASSTAD HOSPITAL
At Maasstad hospital the process of purchasing different diagnostic equipment (Appendix F) for the business unit radiology in 2010 is investigated. The business unit radiology works with 11 radiologists, 66 radiographers and 10 interns and performs 170,000 investigations yearly. In 2010, 15,376 CT scans were performed on two CT scanners by the business unit radiology. The cost structure of the business unit radiology is largely based on the personnel costs (Figure 4.1 and 4.2). The maintenance costs paid to the supplier are based on service contracts. In 2010 this was €1,898,985 and in 2011 this was €1,200,136. The costs of the investment for the business unit radiology are not allocated to the business unit radiology, but counts as investment for the whole hospital. Here is shown that the maintenance costs is a considerable part of the

![Figure 4.1 Cost structure BU radiology Maasstad 2011](image1)
![Figure 4.2 Cost structure BU radiology Maasstad 2010](image2)
exploitation costs of the business unit radiology. When different patient oriented costs related to the diagnostic equipment, like disposables are included, this percentage will only increase.

To illustrate the ratio between the investment and the exploitation of diagnostic equipment, the price of investment and the maintenance costs (service contract) for the different diagnostic equipment further elaborated in this research are given in Figure 4.3. The investment costs and service costs are based on the year of purchasing. We assume a maintenance period of ten years to illustrate the total service costs. The investment costs could be considered low because of the multi-package deal with the supplier. The exploitation costs for the CT scans are outreach the investment costs and for the MRI scan they come close to the investment costs.

4.2.2 CASE 2: SINT LUCAS ANDREAS HOSPITAL

At Sint Lucas Andreas hospital the process of purchasing a CT scanner for the business unit radiology in 2011 is investigated. The business unit radiology works with 10 radiologists and 56 radiographers and perform 110.000 investigations yearly. In 2010, 10,822 CT scans were performed on one CT by the business unit radiology.

The cost structure of the business unit radiology is for a largely based on the personnel costs and second the maintenance costs (Figure 4.4 and 4.5). These are the maintenance costs paid to the supplier, often based on service contracts. In 2010 this was €895.000 and in 2011 this was €955.000. The costs of the investment for the business unit radiology are not allocated to the business unit radiology, but counts as investment for the whole hospital. The patient oriented costs are for example catheters and probes. Here is shown that the maintenance cost is a considerable part of the exploitation costs of the business unit radiology.

To illustrate the ratio between the investment and the exploitation of diagnostic equipment, the price of investment and the maintenance costs (service contract) for the
different diagnostic equipment elaborated in this research are given in Figure 4.6. The investment costs are based on the year of purchase, the service costs are based on 2011 and assumed is a technical life time of ten years. The exploitation costs over ten year for the new CT scan are larger than the investment costs, and in the other examples it is close to the investment costs.

4.3 CURRENT PURCHASING DIAGNOSTIC EQUIPMENT PROCES

In this section the current purchasing diagnostic equipment process, or investment process, of the hospitals is presented. First, a brief introduction is given of the organization around the investment cycle. Second, the purchasing process of diagnostic equipment is briefly explained. To present the purchasing processes of the hospitals in a structured manner, the earlier mentioned six step purchasing model of van Weele (2005) serves as the underlying model. The description is based on the existing procedures and provides the reader with some background knowledge of the purchasing process within both hospitals before continuing with the case studies. A more elaborate description for both hospitals can be found in Appendix G.

4.3.1 MAASSTAD HOSPITAL

The move to the new facility has brought many changes regarding investment procedures. An investment committee was founded in 2006, and in 2008 they developed a multi-annual investment plan until 2013. The investment committee assesses the investment requests and consists of a member of the board of directors, manager sourcing, clinical physician, president and a member of the medical staff.

The investment cycle of Maasstad is based on 5 steps (Figure 4.7). First, the development process, where managers follow the market developments in their field of profession, possibly supported by purchasing, can lead to ideas for investments. Second, the multi-annual investment plan (MJIB), which covers a period of ten years, gives an overview of which medical equipment should be replaced. During the third phase, the annual plan, the budget for investments for the next year is decided. This will be decided based on the MJIB and the requests for investment from the managers of the business units. The investment committee prepares an investment advice to the Board of Directors including a prioritization, argumentation and consequences of the investments in relation with the available investment budget.

The Marketing, Communication & Sales department must approve the request for investing for the strategic value for the hospital and Finance and Control must approve
the request for the calculation of the NPV. The manager is responsible for both approvals and should deliver the business case fully filled out.

The Board of Directors makes the final decision. During the fourth phase, the realization phase, the account managers of Sourcing are the project leaders and prepare a planning for the purchasing process. In the fifth phase, the user phase, the investment is evaluated against the original plan. This is done with the responsible manager, Finance and Control, and is reported to the investment committee. This evaluation is done six months after the commissioning of the equipment. After the approval for the investment the purchasing process starts.

The specification phase starts with the preparation of a cross functional project-team composed by the account manager and the business manager, following the project management steps of CCPM. Then a program of requirements (PVE) including requirements for safety, quality and maintenance, and a market research is performed. Standard formats for the PVEs are used, and sent to the suppliers. In the selection phase the supplier’s selection is made by weighing of the received quotations of the suppliers (at least 3). Possibly a test period is included before the selection/decision for a supplier is made. In the contract phase the contract is negotiated and signed by the sourcing department. The order phase is the ordering and delivery of the advanced medical equipment. An implementation project team is formed for the implementation of the equipment. After the implementation, the personnel (medical and technical) receive training and education. The medical equipment is delivered and tested before the commissioning. The business manager is responsible for the application training, while KFT is responsible for the final check on the equipment before usage. Finally the invoice will be paid. The expediting phase is based on annual meetings where the performance of the suppliers is discussed based on the (service-) contract. The evaluation phase is considered to be the check of the investment against the original business plan, performed by Finance and Control. This multi-annual investment plan is revised four times a year by the account manager sourcing and Finance and Control. Business units can change this MJIB by a request for investment, and the investment committee, when approved, changes the MJIB.

4.3.2 SINT LUCAS ANDREAS HOSPITAL

In 2009, the investment committee was founded for the investment procedure. The investment committee assess the investment requests, and consists of the manager logistics and purchasing, manager technology, manager ICT, manager hotel services, and the manager finance. The investment committee advises to the steering committee,
which consists of a member of the board of directors, manager finance, two medical specialists and the president of the investment committee.

The following investment model is used in SLAZ (Figure 4.8). Business units can annually (once a year) request investment according to a fixed format to the investment committee. The investment committee receives, reviews and complements the requests. If necessary, meetings with the applicants are held by the investment committee. The investment committee monitors the budget and gives an advice to the investment steering committee based on:

- Necessary replacements and prioritization;
- Standardization of the equipment;
- Multidisciplinary use of the equipment;
- Relevance with regard to the priority areas of the hospital;
- Award and reservation of the budget and the way of processing and planning.

The investment committee sent the advice to the steering committee and the managers ask their staff departments to come up with a concept planning for the purchasing processes. The steering committee advises the Board of Directors about the investment requests, and if the need for investments exceed the resources, they choose between investments. Furthermore the steering committee monitors the progress of the project and report to the Board of Directors about the progress and the budgets. The Board of Directors determine the annual priority areas and the annual budget for investments on which the decision for investments is based on. The Board of Directors makes the final decision for investments based on the advice of the steering committee. After the approval for the investment the purchasing process starts.

The specification phase starts with a cross functional purchasing team founded by the Board of Directors with purchasing, relevant staff departments and the applicant (project manager), when the budget of the investment is above €50,000. This purchasing team prepares a program of requirements (PVE) and a supplier ranking. Then a pre-selection of suppliers is made and minimal two quotations from suppliers are received by purchasing. During the selection phase the purchasing team evaluates the quotations by weighing and decides if a test setting is necessary. The relevant staff department is responsible for the test setting. The test setting is evaluated and a supplier ranking is made based on the PVEs and the test settings. In the contract phase
the negotiating about the supply conditions is done by purchasing, the staff department and the project team. The MT department is responsible for the service contract, and the purchasing department is responsible for the investment contract. An advice from the project team is presented to the Board of Directors which makes an investment decision. The project team in combination with purchasing and the relevant staff department prepares the agreement. The order phase starts after the signed contract and the MT department fills out the order with the medical business unit and sent this to the manager Technology. The applicant and the MT department have to sign before the Board of Directors signs the order. Afterwards the purchasing department checks the order and an implementation project team is formed for the implementation of the equipment. The expediting phase is the responsibility of the MT department. Contract management is based on the criteria in the service contract and at least a yearly management report about the functioning of the equipment is held by MT and the supplier. No evaluation of the purchasing process or the compliance of the investment request with the real situation is formalized in a procedure.

4.4 CASE STUDY MAASTAD HOSPITAL

4.4.1 PURCHASING PROCES

In Figure 4.9 the timetable of the purchasing process of the CT scan is visualized and the different steps will be discussed. In Appendix H an overview of the involved stakeholders is presented.

![Figure 4.9 Timetable purchasing process Maastad](image)

Radiology hired an external consultant in 2004-2005 to analyze the prognoses of growth of treatments within healthcare. The business manager argued that “the choice for diagnostic equipment was largely based on production figures, and less on the hospitals or business unit’s strategy”. The business unit made a request for different investments based on the MJIB in 2008 and the reports by external consultants. During a meeting with the investment committee, the business unit radiology represented, by the medical manager and business manager explained the plans and thoughts of purchasing the diagnostic equipment based on the reports of the external consultants (today these visits don’t happen anymore). The account manager was involved during this meeting to understand the philosophy and developments of the business unit radiology. The investment committee approved the investment request in 2009, and the Board of Directors gave a final approval for the business unit Radiology.
The pre contract phase started when the business manager initiated a project group, with a steering group and subgroups for the different modalities of the diagnostic equipment. In Table 4.1 the members of the steering group are presented. There was periodical contact with the Board of Directors and the project leader about the process and global planning. The Sourcing department was responsible for the project planning of all investments, and monitored the progress of the purchasing process of radiology and others. The program of requirements (PVE) was made by the subgroups and approved by the steering committee in October 2009. The structure of the PVE was made by the steering committee, and based on earlier PVEs. The steering committee determined which suppliers should be contacted, primarily based on the experience of purchasing. The request for quotation (RFQ) was sent to 5 suppliers (3 suppliers for the CT scan) by the account manager. The expected deadline of the purchasing process was set for February 2010.

The weighed PVE resulted in questions by the hospital and the suppliers were invited to answer those questions. After the PVE and the weighing, site visits were done by the subgroups to see new modalities, software packages, user friendliness of the systems and to ask questions to create a better understanding of the PVE. Site visits with or without suppliers were both done before and after the preparation of the PVE. Suppliers were invited to present themselves again after the PVE and weighing. In January 2010 a choice was made to negotiate further with a maximum of two suppliers per modality. The suppliers which were rejected received a notification and a meeting in which the choice for rejection was explained by the account manager was held. The project team made an advice for the investment committee, and together they made a letter of intent and sent this to the supplier. They notified the supplier that the Board of Directors had to make a decision in March 2010.

The service and warranty period was discussed within the subgroups. The negotiating of the service contract was done by Sourcing, however, the preparation for the service contract was done by the clinical physician and the business unit radiology. In the service contract, first line service of the KFT department was negotiated, which led to a discount for the delivered service. Maasstad uses umbrella agreements for the service. The service is contracted with a standard WIBAZ contract and negotiated at the same time as the investment contract. The FHI/NEVI contract model is used and signed by the BoD. A reference site document is made by the supplier which includes promises of possible extra education and training for radiographers, and is called a ‘living’ document. The ordering and implementation of the medical equipment must be done in agreement with the departments of Building and Technology, KFT and IT. The implementation plan of the supplier was discussed with the business manager and a new project team was organized. An external organization helped with the
implementation of the diagnostic equipment. After a few months the supplier and Maasstad approved the equipment and the invoice could be paid. Monthly meetings about the service with the supplier, the KFT department and the business unit radiology were held. There were two evaluations a year with the supplier and the account manager where the present situation and the developments of both were discussed. There were no formats about what to discuss. The business manager has a meeting once every three months with the supplier. Every quarter there are meetings between the business manager radiology and the KFT department to discuss the functioning of the diagnostic equipment.

4.4.2 EXPLOITATION PHASE
The business unit radiology is responsible for the diagnostic equipment, but it is unclear for the KFT department if the information of failures and response time are discussed by the business unit radiology with the supplier. The life time of the diagnostic equipment is determined by the KFT department. Although a multi-annual planning for the diagnostic equipment exists, the replacements are based on the economic life cycle. Therefore, the multi-annual planning could be seen as leading, when it came to investments. According to the business unit radiology, the replacement should be based on the medical life time of the diagnostic equipment. The functioning of the diagnostic equipment isn’t based on performance criteria discussed with the business unit radiology. When specifying for the equipment, not much is expected from the relation with the supplier or the output delivered during the exploitation phase. The only criterion regarding the diagnostic equipment measured by the KFT department is the number of failures. The uptime and response time are measured by the supplier based on their own definition. These figures are stored within the own departments, and Sourcing isn’t familiar with performance criteria of the radiology department or KFT department. The budget for maintenance lies within the business unit radiology. The costs of personnel of the KFT department are not allocated to the business unit, although they perform the first line maintenance.

4.4.3 INFLUENCING FACTORS
A process description of the purchasing process and exploitation phase in real-life was presented in the previous paragraph. In following paragraphs the most important implications of the influencing factors from the conceptual model are discussed.

Business alignment
• **No formal alignment of the medical business units**
A formal process of sharing information between business units was missing. Annual policies, or plans, are lacking at other (medical) departments. Limited input about vision, technological needs and developments of other medical business was received. This made it more difficult to specify for diagnostic equipment useful for the whole hospital.
• **No business alignment during exploitation**
The responsibility of suppliers’ performance for the service and the service costs is ambiguous. The business unit radiology is responsible for the diagnostic equipment and
the exploitation costs. However, the KFT department is performing the first line service and contact with the service supplier. The business unit radiology doesn’t have a driver to optimize the service contract, because the contract is signed and functions. And the KFT department doesn’t have the power to optimize the service contract. There is no mutual benefit or goal, to be critical of the service contract and the performance of the supplier.

Decision making unit
- **Involvement during the purchasing process**
The business manager (project leader) was responsible to involve all stakeholders for the purchasing team. The medical technicians were not involved, although they have to perform the service during the exploitation phase. This could happen because when the KFT department was involved, it was expected that the different roles within the KFT department (clinical physicians and medical technicians) would communicate. However, when miscommunication occurs or departments make choices on their own who to appoint, specialists can be missed.
- **Clear roles and responsibilities**
The investment committee consists of different roles. There is a lack of health perspective within the investment committee. No business managers or specialists are involved, only two members of the medical staff. Despite the growing importance of ICT within healthcare, no ICT role is involved.

Specifying
- **Technical specifications used**
The most time consuming performance of the radiologists is preparing the technical specifications. It wasn’t clear for the radiologists what to expect from the amount of technical specifications. This became clearer during demonstrations of the suppliers. According to different people from the business unit radiology, the technology of diagnostic equipment develops so fast, that process descriptions will limit the radiologist to perform in a better way. The general thought was that when the specifications are not that precise and technical, the supplier cannot meet the quality criteria of the hospital.

Performance based contracting
- **Functional contracting**
Sourcing negotiated a functional contract for the diagnostic equipment. The contract is primarily based on the modalities bought and the activities to be performed by the supplier. Standard performance indicators or output measures for the desired performance are described in the contract. There are no consequences for failure and no SLA’s are available.
- **Missing spots in service contract**
The service contract mentioned different aspects or performance indicators which were not filled out. A meeting was scheduled afterwards to finish the agreed service contract.
Contract management

- **Insufficient check on functionalities**
  Before the functioning of the diagnostic equipment, there was an insufficient check on the functionalities. The program of requirements was used as a checklist, but it did not provide an overall check for the functionalities, which led to software packages that weren’t available, and functionalities which had many start-up problems. This had no consequences for the supplier.

- **No contract monitoring**
  Sourcing monitors the contract only on the expiration date. The only check performed by the purchasing department is the financial check, if the service performed is included in the service contract. The KFT department is responsible for the monitoring of the service aspects, but KFT only monitors the number and description of the failures. The hours of internal maintenance is not monitored consequently. The performance indicators from the contract like uptime and response time are measured by the supplier, but without mutual agreed definitions of the performance indicators. If the performance of the supplier drops down the performance measurement, which is almost impossible, no consequences for the supplier are described in the contract.

Evaluations

- **No evaluation performed on the result**
  There is no evaluation after six months by the Finance and Control, to evaluate the assumptions of the business case with the real figures. No criteria for evaluations are determined and no formats are found. The investment committee didn’t evaluate the purchasing projects either, only the progress of the project and a financial check is performed.

- **No central evaluation of the purchasing process**
  There is no central point where all the evaluations are gathered. All departments report and (informally) evaluate by themselves. This means that improvements for the investment procedure cannot be steered from a central point. An evaluation of the purchasing team together isn’t performed.

Supplier relation and measurement

- **Supplier relation of business unit radiology**
  The business unit radiology has contact with the application specialists of the supplier. This regards the optimization of the use of the application, discuss the need for education and improvements of the application for a better performance. This is based on trust and relation, since no performance indicators are used for the performance.

- **Supplier relation of KFT department**
  The KFT department has contact with the service organization of the supplier, and discusses the failures and maintenance of the diagnostic equipment. This is based on the number and type of failures monitored by the KFT department. The relation with the service engineers of the supplier is fine; however, the relation with the organization
behind the service engineers has some troubles because of the lack of responsibilities described. In Appendix I the different performance indicators are described.

Total cost of ownership

- **TCO calculation**

The total cost of ownership is based on the investment costs and the maintenance costs. A service contract is negotiated where almost all service is covered. This makes the services arrangement expensive, but it is worth the certainty of costs and avoid unexpected expenses. Maasstad has a format to calculate the total cost of ownership, where revenues, disposables, personnel and external costs are included, but this wasn’t used during the calculations. In Appendix J the investigated criteria for the total cost of ownership are described.

Total value of ownership was not performed and no formats exist of reducing the related operating costs or increasing the effectiveness and efficiency of the diagnostic equipment. It was not shown if different modalities will gain different revenues for the hospital.

### 4.4.4 Conclusion

Based on the influencing factors of the conceptual model summarized in Table 4.2, conclusions of the purchasing process are drawn. Because of the unusual process, no business case was performed and different capacity planning’s were discussed with the investment committee. This resulted in a clear objective for the business unit radiology. Medical business units lack annual plans, vision and formal contact which resulted in an island culture. Between the business and the staff departments mutual/aligned benefits or goals for the exploitation phase were unknown.

The roles and responsibilities of the involved stakeholders should be clearer for the purchasing process and the exploitation phase. Unknown responsibilities and problems during the exploitation phase were the result of uninvolved stakeholders during the purchasing process. The specifications were partly functional, which differ between the sub-purchasing groups. The technical specifications resulted in less specifications for the desired result of the equipment. There was no qualification of the supplier; this was primarily based on the product specifications. Because of the partly functional specifications, no (other than standard) performance criteria related to the output of the diagnostic equipment were mentioned in the contract. This is shown in the contract management phase as well. This results in reactive and problem solving maintenance instead of pro-actively improving the performance of the equipment.

Evaluations of the purchasing process, or a check of the assumptions and figures expected based on the business case, are not conducted. Only within business units learning points are discussed of projects, but often this is in an informal manner. There is no central point where all the evaluations come together, which could result in the dependency of people to prevent mistakes.

The use of total cost of ownership was based on the maintenance and the investment costs. Costs of personnel of the KFT department, the ICT department or radiographers
were not taking into account. The standard format of calculating the total cost of ownership wasn’t used, and no revenue enhancing calculations were performed. The performance criteria are mentioned by the supplier during the management reports, and performance criteria for the medical functioning of the diagnostic equipment are not written down, except for the requirements in the PVE. Responsibilities of the supplier and the KFT department are not clearly described, which results in discussions and extra time until a solution is reached. The relation between the supplier and the business unit radiology is based on relation, while Sourcing mainly focusses on the costs and KFT on the service contract.

<table>
<thead>
<tr>
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<tbody>
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<td>Business Alignment</td>
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<td>Suppliers criteria</td>
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<td>Evaluation</td>
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</table>

Table 4.2 Summary purchasing process Maasstad

4.5 CASE STUDY SINT LUCAS ANDREAS HOSPITAL

4.5.1 PURCHASING PROCES

In Figure 4.10 the timetable of the purchasing process of the CT scan is visualized and the steps will be discussed. In Appendix K an overview of the involved stakeholders is presented.

Figure 4.10 Timetable purchasing process SLAZ

In the purchasing process the initiated request for investment came from the business unit radiology. For the business unit radiology this was based on the technical and medical limitations and the increasing failure rate of the equipment. As mentioned by the medical manager: “We were the last hospital in the Netherlands working with a CT scan of this type”.

In 2008 a business case by the business unit radiology for MR systems and ultrasounds systems was conducted, with a small CT scan paragraph included. They decided to prepare a business plan in the near future, specific for the CT scan, because of the
technical life time until 2010. In 2009 a mutual vision document was created by the medical specialists and organizational managers for the investment of a CT-scan, SPECT-CT and a CATH-room, by the department’s radiology, nuclear medicine and cardiology. No shared vision or combination of the diagnostic equipment could be made and they decided, in consultation with the Board of Directors (BoD), to specify and request the medical equipment separately.

Presentations of potential suppliers were held, and site visits were conducted by the radiology department and the MT department, before an official investment request from the organizational manager and the medical manager of radiology for a CT scan was presented to the investment committee in February 2010. This request was supported by the medical technology (MT) department. The investment request was discussed in the investment committee. The request never received a formal approval. Five months after the investment request, the applicants received a letter that the investment was placed for 2011, and a pre-investigation for the investment could be started, before the steering committee could make a final decision. The organizational manager started the purchasing team as project leader, together with a medical specialist of radiology and a medical instrumentation technician. During the process the purchasing department and the clinical physician were contacted and added to the purchasing team by the start of the preparation of the program of requirement. The departments Projects, Advice and Support (PAS) and IT were consulted during the pre-contract phase, but were not part of the purchasing team (Table 4.3).

The business unit radiology started to develop a vision and specifications with the MT department. The radiologists wanted to know the differences in functionalities between a high end and a basic CT scan, and two PVEs were prepared. The purchasing department was involved when the programs of requirements (PVEs) had to be made. When the PVEs were finished, a request for quotation (RFQ) was sent to four suppliers by the purchasing department. The quotations from the suppliers were received in March 2011 and weighed. After the RFQ, the purchaser is the contact person for the suppliers, and all external communication is performed by purchasing. Next to the criteria for the product and the service, SLAZ used open questions to assess the supplier on their vision for the future technology developments, and their specific vision on the diagnostic equipment for SLAZ. According to the clinical physician “a better relation with the suppliers emerged because of the open questions. The suppliers were asked to show their knowledge, which increases the value of the supplier for the hospital”.

<table>
<thead>
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<th>Members</th>
</tr>
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<td>Organizational Manager</td>
</tr>
<tr>
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<td>Purchaser</td>
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<tr>
<td>Member MT</td>
<td>Medical Technicien</td>
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<tr>
<td>Member Business Unit</td>
<td>Medical Specialist</td>
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<tr>
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<td>Radiodiagnostic specialist</td>
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<tr>
<td>Member</td>
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<tr>
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<td>IT</td>
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<tr>
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<td>PAS</td>
</tr>
<tr>
<td>Consulted</td>
<td>Medical Specialisms</td>
</tr>
</tbody>
</table>

Table 4.3 Purchasing team SLAZ
First a weighing of the PVEs was done for the choice of a high end or basic CT scan and a decision was made for the high end diagnostic equipment. The purchasing team decided to add different knock out criteria. Those criteria came mainly from the need of the radiologists who, according to the medical manager “preferred a short list of most important criteria for the decision making over the PVE”. Dual energy was chosen by the purchasing team as knock out criteria and only two suppliers could satisfy this requirement and were invited further in the purchasing process. The criteria to reduce the number of suppliers were discussed with the Board of Directors and the purchasing team. In July 2011, exit conversations were held with the two suppliers on their request. Different site visits were conducted to clarify the functionalities of the diagnostic equipment. Based on the weighing of the open questions, the PVE and the total cost of ownership a choice for one supplier was made by the purchasing team. The radiologists didn’t agree with the choice of the purchasing team, and the politics in hospitals was shown. They send a letter of their own preference (another supplier) directly to the Board of Directors, without informing the organizational manager or the purchasing team. The radiologists were concerned that the most important criteria were lost in the large amount of data of the PVE. In a meeting with manager Technology, the Board of Directors and the radiologists, they decided to follow the choice of the purchasing team, and notified the suppliers at the end of September 2011 of their choice. The choice of supplier was set for June 2011, which is a delay of four months since the start of the RFQ. When the initial phase id included, a period from the start of the 2009, until around May 2010, the business unit radiology lived in uncertainty about the preferred investment of the CT scan.

Purchasing took the lead during the negotiating and contracting phase. The organizational manager was involved during the negotiations with the supplier. From October till December the investment-, service- and reference site agreement were negotiated in more detail. The options list of the CT scan was checked by the clinical physician before the negotiations. The FHI/NEVI contract model is used and signed by the Board of Directors. The service contract was negotiated by the MT department, and the highest service level agreement was negotiated, where the first line service of the MT department led to a 5% discount. The costs and choice for service are determined simultaneously with the negotiating of the investment contract. For the implementation another project team was started with the manager technology as project leader, together with members of the ICT department, MT department and Projects, advice & support. When the supplier for the medical equipment was chosen by the purchasing team, the implementation team started with the planning of the implementation. The medical implementation and the preparation of the protocols were supported by the clinical physician. At the end of December the CT scan was accepted by the hospital and started functioning. The contract management is performed by the MT department. The management report meeting is once a year and with large service suppliers, meetings are scheduled twice a year with the MT department and the organizational manager. The organizational manager has regular contact with the IT (since this year) and MT
departments to discuss the functioning of the equipment. The ICT department focuses on the role of the ICT department and the planned investments of the radiology department where ICT is a part of the budget. Since this year the purchasing department has a meeting scheduled every quarter with the organizational manager. The business unit radiology has intern meetings with radiologists and radiographers per modality, where the medical functionality of the diagnostic equipment is discussed. For the first time an evaluation of the purchasing process with the purchasing team is conducted. Points for improvement are discussed, but the follow up still has to take place and isn’t formalized. Before, no evaluations with the purchasing team were held.

4.5.2 EXPLOITATION PHASE
When the diagnostic equipment is functioning, there are three different life times; the technical life time, the economic life time and the medical life time. The economic life time is used by the hospital and the MT department for the depreciation of the diagnostic equipment. The technical depreciation however is used as an indicator to invest in new equipment by the MT department. The medical depreciation is the life time of the diagnostic equipment considered by the radiologists when research cannot be performed anymore according to the medical standards at that time. There is a different perspective of the stakeholders which depreciation method to use, and the life time of the equipment is unsure. According to the organizational manager “the different life cycles used for the diagnostic equipment don’t match with each other and reality”. The MT department does the first line service of the CT scan by themselves. This means that the technical instrumentation employees receive an education by the supplier to perform first line maintenance by themselves. Different departments like the MT department and IT department make costs to perform maintenance for the diagnostic equipment in the right condition. For the MT department, the costs of the service are allocated to the exploitation phase of the business unit radiology. There is no allocation of costs of personnel of the MT department to the medical departments or the diagnostic equipment. The costs of the IT related services and the personnel performing activities for the medical business units are allocated to the IT department.

4.5.3 INFLUENCING FACTORS
A process description of the purchasing process and exploitation phase in real-life was presented in the previous paragraph. In following paragraphs the implications of the influencing factors from the conceptual model are discussed.

Business alignment and goals
  • Alignment with goals of the hospitals
The vision of the hospital is considered too broad to determine an aligned vision for the business unit radiology. The business unit radiology is unable to determine clear objectives to turn the vision of the hospital into reality. Just annual strategies are yearly discussed between the Board of Directors and the business unit radiology. The clinical physician stated “I’ve been working the whole project to create a clear picture of the needs and requirements of the radiology department”.

• **Different perception of life time diagnostic equipment**
  The life time of the diagnostic equipment is measured in different definitions. The financial life time is based on the economic life time (10 years), while the indicator to replace diagnostic equipment is mainly based on the technical life time (>10 years) decided by the MT department. The importance of the medical life time of the equipment isn’t communicated with the business unit radiology, which lead to uncertainty about the moment of replacement.

• **No formal alignment between medical business units**
  No formal procedures to receive information of medical strategies and create a mutual medical vision with other medical business units is lacking. This results in lack of information from other medical business units which are influenced by the investment decision, and stimulates medical business units performing like islands.

• **No alignment between different departments**
  When the radiology department created their vision document in cooperation with two other medical business units. No support was asked for or provided by the staff departments preparing the business case. The objectives for the business unit radiology were ambiguous for the staff departments and a clear vision was lacking. This led to multiple PVEs, added criteria during the process and different opinions between the radiologists and the purchasing team at the end of the project.

**Decision making unit**

• **Responsibilities and tasks unclear**
  The process and responsibility for approval or decline of the investment request is experienced ambiguous by the purchasing team. The lack of formal approval from the Board of Directors and miscommunication led to uninformed staff departments. The purchasing project wasn’t planned, because the staff departments were not informed by the Board of Directors.

• **Involvement of stakeholders**
  Different stakeholders were lacking, involved rather late, or didn’t receive information on time. The radiologists did have another opinion then the purchasing team, which led to delay and annoyance, because no indications were given that the radiologists wouldn’t agree with the purchasing team. The radiologists were not informed properly during the purchasing process, which led to the disagreements at the end of the project. The IT department wasn’t involved until the implementation of the diagnostic equipment, and different risks concerning the IT couldn’t be discussed anymore.

• **Monitoring the process and progress**
  The organizational manager was responsible for the progress of the purchasing project, and no monitoring of the purchasing team was performed by the management. This led to different moments of delay. The MT department is responsible for the start of the purchasing team and often the project leader. The contact with the Board of Directors wasn’t regular or based on a planning. The Board of Directors had a big influence at the end of the project, which wasn’t planned upfront.
Specifying

- **Difficulties determine objectives**
The specification process of the purchasing team was a difficult process. The supplier stated “the purchasing process was more complicated because of the different specifications, which sometimes led to confusion”. According to the radiologists the PVE wasn’t concrete enough to make a decision. The weighing of the large amount of factors made that the few important factors were overruled by the amount of data. A shortlist with criteria was used by the purchasing team, after the weighing of the PVE, to make a final decision.

- **Use of technical specifications**
The radiologists found it difficult to specify the functional specifications and the output they need for their investigations. The clinical physician had an important role during the specification phase translating the technical specifications of the supplier to functional terms. According to the medical manager “the clinical physician provided a helicopter view over the present and required information, to specify in a structured manner”. However, the technical specifications led to an overwhelming amount of technical criteria instead of performance criteria for the exploitation phase of the equipment.

Performance based contracting

- **Functional contracting**
The performance criteria mentioned in the contract like uptime and response time serve as a last resort when the supplier is underperforming. The desired performance of the diagnostic equipment isn’t described by performance criteria. The contract is based on the description of the bought modalities and activities to perform by the supplier.

Contract management

- **Unclear description performance criteria**
The performance criteria and consequences for the supplier if the performance criteria are not met, are described in the contract according to the suppliers standards.

- **No monitoring**
The performance indicators used in the contract like uptime and response time, are not monitored by the MT department. They monitor the number of failures and the duration of the maintenance. The performance of the diagnostic equipment is based on the experiences of the medical technicians and the number of failures. No other criteria are pro-actively monitored by the MT department. No overview of the performance criteria by the business unit radiology and the MT department are available by purchasing.

Evaluation

- **No formal evaluation of the purchasing process**
Evaluation of the purchasing process isn’t considered a step in the purchasing process. During this research, and possibly because of this research, for the first time an
evaluation was performed. The purchasing team, under supervision of the manager technology, evaluated the purchasing process. The formal follow up of this evaluation is unclear, since no communication about the result of the evaluation is performed.

- **No evaluation of the result**
  The assumptions made during the investment request and the desired result are not evaluated based on the actual result. The value the diagnostic equipment generates for the business, and whether or not the purchasing function made the right decision cannot be said without such an evaluation.

**Supplier relation and measurement**

- **Supplier relation of business unit radiology**
  The supplier relation is based on personal relationship and trust. If the radiologists and radiographers have the feeling that they can improve the investigation times, or activities of performing the investigation, they contact the supplier to discuss this.

- **Supplier relation of MT department**
  The relation of MT department and the supplier is based on the contractual agreements, and the criteria like failures, uptime and response time. The downtime and the response time of the supplier are the two main performance indicators measured by the supplier based on their definitions. In Appendix L the different supplier measurements are described.

**Total cost of ownership**

- **TCO calculations**
  No fixed format for TCO is used. The following topics were mentioned in the PVE to the supplier concerning the TCO: diagnostic equipment, disposables and accessories, maintenance and service, implementation costs. The cost of personnel is the biggest cost for the ICT department. Costs of staff departments or project costs were not taken into account. In Appendix M the investigated criteria for total cost of ownership are described. There were no revenue enhancing calculations performed for the different possible diagnostic equipment.

**4.5.4 CONCLUSION**

Based on the influencing factors of the conceptual model summarized in Table 4.4, conclusions of the purchasing process are drawn. The purchasing process took from the start of the specification phase almost two years. There was hardly any business alignment within the hospital when purchasing diagnostic equipment, which resulted in an ambiguous objective for the staff departments. This was the result of an investment request without the help of other departments. Even within the business unit radiology the lack of a shared vision finally led to a statement to the board of directors of another vision considering the diagnostic equipment. The tasks and authorization during the investment procedure were ambiguous. The unknown responsibilities of the staff departments made the investment procedure ambiguous for the business unit radiology, as well as for staff departments. This resulted in a delay for the project and missing stakeholders during the process.
The specifications were mainly based on technical specifications. The amount of specifications and the technical content made it difficult for the radiologists to determine their requirements and the output they expected from the diagnostic equipment. The open questions, which were based on the vision of the supplier, gave insight in the ability of the supplier to give specific advice for the situation of SLAZ and their vision on the technological developments for the diagnostics equipment.

SLAZ made use of a traditional contract. The only performance criteria measured was the number of failures. No performance criteria for the usage of the diagnostic equipment by the business unit radiology were described.

There is no contract management performed by the purchasing department. This is done by the MT department for the service, and only reactive performed on the number of failures. The evaluation is performed for the first time by the purchasing team. Evaluations about the performance of the diagnostic equipment reflected to the assumptions and expected figures during the purchasing process are not performed.

The total cost of ownership was based on the investment costs and the service contract, where a check on the total cost of ownership isn’t performed. The MT department has certain criteria for the service delivered by the supplier. The purchasing department does not have contact with the supplier, and doesn’t have contact about the measurement or relation between the supplier and the hospital.

<table>
<thead>
<tr>
<th>Purchasing process</th>
<th>Exploitation phase</th>
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<tbody>
<tr>
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<tr>
<td>Clear DMU</td>
<td>Supplier measurement</td>
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<td>Functional specifications</td>
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<td>Risk description</td>
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<tr>
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<tr>
<td>Type of contract</td>
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<td>Contract management</td>
<td>Reactive</td>
</tr>
<tr>
<td>Evaluation</td>
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</table>

Table 4.4 Summary purchasing process SLAZ

4.6 CROSS CASE ANALYSIS

The cross case analysis is performed after the individual case studies. A comparison of the evaluations of the individual case studies is performed. Next, the most important similarities and differences are analyzed and discussed, leading to causes and effects of the organization of purchasing diagnostic equipment in hospitals. Finally, the observations will be reflected to the conceptual model and conclusions are drawn for the purchasing process of diagnostic equipment.

4.6.1 PURCHASING PROCESS

In Table 4.5 the influencing factors of the purchasing process for both hospitals are summarized. The business alignment of the hospitals was considered different. The cooperation between the business unit radiology and staff departments to prepare an
investment request created a clear objective. The investment request was checked by the investment committee whether the information was gathered through the support of the staff departments. Objectives of different departments were more aligned during the investment request in this case. Without a well prepared and approved investment request the lack of mutual goals resulted in delay.

The decision making unit resulted in delay because the lack of a gatekeeper or management’s attention. A project management structure with a project leader, gatekeeper, and accountable person provided the management’s attention to finish the project in time. Incorrect use of the DMU resulted in persons lacking or lately involved in the purchasing team and uninformed managers. This in turn resulted in unclear responsibilities or problems during the exploitation phase.

<table>
<thead>
<tr>
<th>Influencing factor</th>
<th>Maasstad</th>
<th>SLAZ</th>
</tr>
</thead>
<tbody>
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<td>Business Alignment</td>
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<tr>
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<tr>
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<td>Added value description</td>
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<td>Risk description</td>
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<td>Suppliers criteria</td>
<td>No</td>
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<tr>
<td>Type of contract</td>
<td>Cost based</td>
<td>Cost based</td>
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<tr>
<td>Contract management</td>
<td>Reactive</td>
<td>Reactive</td>
</tr>
<tr>
<td>Evaluation</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Table 4.5 Comparison purchasing process

The use of functional specifications was partly done by Maasstad, and sufficient according to the supplier explaining the hospitals objectives. The rather technical specifications and the amount of them made it difficult to understand the expected output.

The qualification of the supplier is in both hospitals largely based on the experience of the stakeholders. Open questions for the supplier used by SLAZ, gave suppliers the opportunity to demonstrate their vision and developments for the future, and a specific proposal for the best diagnostic equipment.

The added value and risks are underexposed in the request for investment and program of requirements. Only SLAZ challenged the supplier with open questions to provide added value specific for their situation.

The type of contracting and contract management is traditional, based on costs and reactive. An investment was done for the described modalities. The service contract was based on a pre-determined offer by the supplier using their standards for performance criteria.

Evaluation of the purchasing process with the purchasing team resulted in different learning points and an open discussion between involved departments. The assumptions of the business case or investment request were not evaluated which made it impossible to know whether or not the used assumption and the purchasing process functioned well.
4.6.2 EXPLOITATION PHASE

In Table 4.6 the influencing factors of the exploitation phase for both hospitals are summarized. The use of total cost of ownership was limited and based on the investment costs and the maintenance costs. Both hospitals perform the first line maintenance themselves. Costs of staff departments related to diagnostic equipment by medical technicians or IT employees were not taken into account, and the costs made during the exploitation phase are not related to the diagnostic equipment.

The supplier measurement criteria used during the exploitation phase were minimal and focused on the service part of the diagnostic equipment. No criteria were set for the functional performance of the diagnostic equipment. The criteria used for measurement of the supplier were partially monitored by the technical department and not pro-actively discussed with the supplier. Agreements about responsibilities and tasks between the business unit radiology and the technology department, or with the supplier were not defined.

<table>
<thead>
<tr>
<th>Influencing factor</th>
<th>Maasstad</th>
<th>SLAZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total cost of ownership</td>
<td>Limited</td>
<td>Limited</td>
</tr>
<tr>
<td>Supplier measurement</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Supplier relation</td>
<td>Relational</td>
<td>Relational</td>
</tr>
</tbody>
</table>

Table 4.6 Comparison exploitation phase

The business unit radiology did not have criteria to measure the performance of the supplier. So when there were questions or problems at the business unit radiology, this was answered by the supplier based on the relationship they have. The contact regarding the service was mostly based on the specifications in the contract.

4.6.3 MAJOR SIMILARITIES

In this part the major similarities between Maasstad and Sint Lucas Andreas are summarized based on the conducted case studies.

1. Performance of the exploitation phase unspecified during the purchasing process;
   The hospitals did not measure the performance indicators that were agreed upon with the supplier. The most important criterion, the uptime, was according to the suppliers standard. No output criteria were used to describe the desired and expected performance of both the diagnostic equipment and the supplier. This made it impossible to pro-actively monitor the performance of the supplier and to cooperate on improvements.

2. Difficulties when specifying for technical specifications;
   The specifications were based on both the input criteria and the technical specifications the diagnostic equipment must possess. The technical specifications were difficult to understand for the radiologists.

3. Process based on investment price or cost reduction
   The focus on costs of the investment is on the investment price and less on the integrated investment costs. Furthermore, attention was paid to the cost reduction and
modalities of the diagnostic equipment, but less on the possible added value of different modalities and the added value of the supplier during the exploitation phase. The focus on costs and modalities resulted in a lack of willingness to think about the desired performance.

4.6.4 MAJOR DIFFERENCES
In this part the major differences between Maasstad and Sint Lucas Andreas are summarized based on the conducted case studies.

1. **Difficulties to determine the strategy**;
Because of the construction of the new hospital, different departments at Maasstad were together discussing the objectives for the new diagnostic equipment. This started with the business unit radiology, but KFT and Purchasing were involved as well. With the accepted investment request, the start of the purchasing process had clear objectives for the different stakeholders. Although no multi-annual strategy exists, the conversations with the investment committee and the multi annual investment planning served as guidance and strategy for the purchasing process. This resulted in no delay during the process because uncertainty of the objectives.

2. **Monitoring process and progress**;
The monitoring of the progress of the purchasing process prevented delays and led to management attention when the project was not developing according to plan. The lack of a deadline and process monitoring at SLAZ led to different breaks. This resulted in management intervention at the end of the project.

3. **Short term versus long term vision**;
The economic life time was according to national standards, 10 years for diagnostic equipment. At Maasstad the life time of diagnostic equipment was in agreement with the medical business units shortened, based on the medical life time of diagnostic equipment. A multi-annual planning was used by the investment committee for replacements and expansion of investments which provided the business unit with a more realistic term for replacement, and more transparency for future investments. At SLAZ the different perception of a realistic life time of diagnostic equipment, and an annual investment planning led to uncertainty of investments.

4. **Learning from earlier projects**.
Evaluation of the purchasing process led to a change of project management for the next project at SLAZ. Misunderstandings of the investment procedure and different opinions were discussed. The same kind of misunderstandings were observed at Maasstad, but the lack of evaluation prevented improvement of the cross functional purchasing process.

4.6.5 OBSERVATIONS
Based on the major similarities and differences the most important observations are described and a reflection is given based on literature and the conceptual model. Observations about the purchasing process (Figure 4.11), the exploitation phase (Figure
4.12), and the interaction between both phases (Figure 4.13) is presented and elaborated.

Purchasing process

![Diagram](image)

Figure 4.11 Purchasing process

1. **Business alignment**
   Determine mutual medical requirements for the diagnostic equipment was considered difficult by the business unit radiology. No formal procedures were followed to determine the medical objectives for the hospital. The lack of an aligned strategy of the business unit and the hospital made it unclear for the business unit radiology when investments could be initiated and what specifications were necessary to realize the objectives of the hospital and the business unit.

   According to Cavinato (1999), Rietveld (2009) and van Weele (2010) the purchasing strategy must be aligned with the objectives and goals for the business, in accordance with the hospital’s strategy and other businesses strategies to create value for the business. The lack of clear objectives and business alignment between medical- and staff departments resulted in delay in the purchasing process. Another result of working without a multi annual strategy was the impossibility to assess the performance of the diagnostic equipment according to the business unit’s strategy. The value of the purchased diagnostic equipment could not be measured and reflected to the initial plan.

2. **Purchasing buys technical specifications instead of functionalities**
   The radiologists state that the most time consuming and difficult aspect of specifying was to understand the technical specifications of the diagnostic equipment described by the supplier. The amount of information and the technical content had to be understood before the PVE could be build. The PVE is created based on the technical specifications it must possess. According to van Weele (2010) technical specifications describe technical characteristics of the diagnostic equipment and usually leads to over specification and higher costs, but no better functionality. Over specification is acknowledged by the clinical physicians and radiologists of both hospitals. The supplier stated: “functional specifications make you think about the desired output, the technical specifications are the specifications based on the research of the supplier to achieve that performance”. There are different technological opportunities to achieve a desired outcome, but the technology is just the resource, and not the objective.
3. Investments are based on annual plans and technical life time

The medical business units’ worked with annual plans. A mutual vision and consensus between medical business units was missing. Because of the lack of a multi annual strategy, the vision had to be constructed for every investment again. Different stakeholders mention the feeling that the technical life time of the equipment is used as indication for a replacement and opportunity of investment. The multi-annual investment planning at Maasstad and the technical life time at SLAZ could be considered leading over the strategy, in conducting new investments.

4. Involvement of stakeholders

The purchasing department had insight in which stakeholders to involve. Despite of this, different stakeholders were missing, uninformed, or involved in a latter stadium. According to van der Valk and Rozemeijer (2009) relevant stakeholders had to be identified in an early stadium. Objectives for the individual shareholders have to made and how these people are affected by the service must be discussed. Based on the influence for the stakeholders, it was hard to explain why medical technicians who have to work for 10 years with the equipment were not heard during the purchasing process. The risks with IT related investments for the business unit radiology was an important factor for the hospital, however, the IT department was not involved during the purchasing process. Both examples resulted in problems about responsibilities during the maintenance of the diagnostic equipment, and capacity problems related to the IT during the exploitation phase.

5. Evaluation of the purchasing process results in improvement

Evaluation results in better decision making, better communication, provide performance feedback both internally and externally, motivate and direct behavior (Handfield, 2011). The evaluation of the purchasing process at SLAZ resulted in at least better communication, performance feedback and motivation for the next project. Next to the evaluation of the purchasing process, other types of evaluation exist. Evaluation by business cases with scenario- and risks analysis, and the goal and business drivers for the purchase should be evaluated. This was only partly done, which resulted in ambiguous objectives. The evaluation is used to measure the effect or result of the purchased diagnostic equipment, or the purchasing process. In too many cases organizations expect that what they intended to do with an investment is the real result without evaluating (Axelsson and Wynstra, 2002). This is the case in Maasstad and SLAZ, where no performance is evaluated, and a first step of evaluating the purchasing process already led to informal improvements for the next purchasing process.
6. **Supplier performance is not pro-actively monitored**

Considering the large service part of the diagnostic equipment, there were two main aspects of supplier performance discussed; the maintenance aspect and the functioning of the diagnostic equipment concerning the medical performance.

The service part was performed by the technical department of the hospital and performance of the diagnostic equipment was discussed with the supplier. The criteria mentioned in the contract were not measured by the technical departments. The number of failures was a reason to discuss the performance with the supplier. For the number of failures no target was set, and contact with the supplier is sought based on a ‘feeling’. According to Van de Rijt and Santema (2011) the report frequency is important, and a time frame is necessary in which it is possible to pro-actively react on changes in the agreed performance. The functional medical performance of the diagnostic equipment and the supplier was not measured at all. Only the numbers of days of the application training and the modalities to be delivered by the supplier were negotiated. Because the existing performance criteria were only listed in the unmanageable contract, the involved stakeholders could not provide a quick overview of the criteria. The hospital did not discuss performance criteria they think are necessary, but chose from fixed criteria from the supplier.

7. **No mutual agreed responsibilities**

There were no performance criteria for the first line maintenance performed by the technical departments. This led to discussion about responsibilities and actions between the supplier and the technical department, and even between the business unit radiology and the technical department. Often it is impossible to delineate precisely the actions and responsibilities of the suppliers and the buyers, but two way KPIs (Akkermans and van Oppen, 2006) or a statement of responsibilities can be used to effectively communicate responsibilities of both parties (Handfield, 2011).
**Interaction phase (Figure 4.13)**

**8. No feedback from the exploitation phase to the purchasing phase**

No formats existed for historical information of the performance during the exploitation phase, which could serve as past performance of suppliers and diagnostic equipment for the purchasing phase. According to Van de Rijt and Santema (2011) past performance is an important supplier qualification criteria. Knowledge possessed by persons is not sufficient working with equipment with a life time over 10 years. There is a realistic chance that the involved person will leave the organization before the next investment. Important information like the costs of the diagnostic equipment during the exploitation phase, contract management of the service contracts and troubles with the functioning of the diagnostic equipment were not discussed in the purchasing function. No performance criteria were derived upfront, to discuss and monitor during the exploitation phase. This could lead to an improved purchasing process, because performance is measured, and it is known 'what' to improve, instead of reactively solving existing problems.

**9. Nobody is responsible for the whole investment procedure**

No one of the stakeholders of the investment process was responsible for the entire process, and received information from both the purchasing process and the exploitation phase. This led to a disability to learn from earlier projects as a cross functional team. According to van Weele (2010), concerning the purchasing process, the purchasing department should support all the six steps of the purchasing model. However, this does not necessarily imply that all these activities should be performed by the purchasing department. In this way the purchasing power of the organization can be combined, and delegated in a controlled way.

In both cases the investment committee organized the investment procedure. They assessed the investment request and the Board of Directors approved it. Then the purchasing process started, where the business took the lead with support of Sourcing (Maasstad) or the MT department (SLAZ). The result of the purchasing process until the ordering was approved by Sourcing (Maasstad) or the MT department (SLAZ). This meant that the department in charge approved its own purchasing process, before the Board of Directors gave the final approval. The investment committee, who approved the investment request, did not perform a check on the result of the purchasing process and the initial investment request. There were no responsible persons for the evaluation of the purchasing process, and the evaluation of the performance of the diagnostic equipment.
equipment. Finally, the contract management during the exploitation phase was monitored by the business unit radiology and the technological department, but was not reflected to the initial investment request.

4.6.6 CONCLUSIONS
The cross case study is performed to make a comparison of the evaluations of the individual case studies, leading to causes and effects of the organization of purchasing diagnostic equipment in hospitals.

The lack of mutual objectives and annual plans for multi-annual investments led to an ambiguous vision and different departments working for their own good. To clarify the vision and set a mutual objective the purchasing process was delayed.

The lack of involvement of different stakeholders in an early phase, specifying for technical specifications and the lack of mutual responsibilities for the exploitation phase resulted in difficulties and problems during the exploitation phase with the performance of the equipment. The purchasing process for the diagnostic equipment focused on the goods, less on the service, but not on the solution or integrated solution. The added value of suppliers during the exploitation phase was minimal specified. This resulted in less performance than expected and unnecessary internal activities for the technical department.

The learning capabilities of the organization to increase or measure the value of the diagnostic equipment was limited because the lack of pro-actively monitoring performance indicators (no indicators exist), the lack of performance evaluation and no evaluation of the purchasing process. This resulted in a reactive organization which did not have the ability to improve itself and the purchasing process.

This resulted in a purchasing process of diagnostic equipment which was based on the ‘good’, the diagnostic equipment, and cost reduction for that good. The service was considered to be above a minimal performance accordance to the standards of the supplier. Responsibilities and agreements for the ongoing interaction during the exploitation phase were minimal. When the diagnostic equipment was purchased, it was the end of the purchasing process. No formal role for purchasing existed for contract management or evaluations.

In the next chapter the solution design is derived and explained based on the analysis performed. The conceptual model is adjusted and the most important influencing drivers and steps in the purchasing process are presented.
5 SOLUTION DESIGN

This chapter presents the object design (Figure 5.1) for the purchasing of diagnostic equipment. The model is derived based on the conceptual model and the results of the analysis. By means of theoretical- and practical insights, solutions are provided for the main problems and opportunities found during the analysis. The main influencing factors of each step will be explained and the model is presented in a flowchart.

Every subsequent step should start when the previous step is finished and discussed from the perspective of the exploitation phase; what will be the result of the decisions for the exploitation phase. The exploitation phase is enlarged to emphasize the importance of the functional specifications and performance during the exploitation phase. The feedback loop draws attention on the continuous feedback between the purchasing process and the exploitation phase, in both directions. Problems during the exploitation phase have to be known by the purchasing function, to possibly prevent such problems in the future and to be able to perform contract management. The purchasing process and exploitation phase are a loop in evaluating and continuously improving the performance delivered to the customer.

Figure 5.1 Solution design

The main criteria for the initial phase:

- The multi annual strategy and vision of the business unit has to be aligned with the hospitals multi-annual vision, and strategic objectives are set;
- The staff departments adapt their strategy to add the most possible value in achieving the goals of the business;
- There is agreement about the lifetime of the diagnostic equipment. This is based on the medical life time derived from the business unit’s strategy;
- Objectives for the performance of the diagnostic equipment in relation to the strategy of the business unit are set;
- By comparing the exploitation phase with the strategy, occupation rates, uptime, costs and added value of diagnostic equipment insight is provided in the strategy followed by the business unit;
- Identify stakeholders of the purchasing process, as well as stakeholders of the exploitation phase and prepare an overview of roles, tasks and responsibilities of each step for the stakeholders (suppliers are stakeholders as well);
- An investment request or business case is prepared with the most important stakeholders containing at least the above described criteria;
- The start of the project is communicated with all stakeholders and a kick off meeting is planned with the purchasing team where the project plan is discussed;
The main criteria for the *specification* phase:
- The specifications are based on functional specifications instead of technical specifications;
- The specifications are based on performance measures of output, quality and outcome;
- Specifying the nature of interaction between the service supplier and the buying organization;
- The total cost of ownership structure is used to show the financial (costs-) consequences of the diagnostic equipment over the life time;
- The total value of ownership structure is used to show the (financial) added value of the diagnostic equipment for the business unit’s strategy over the life time.

The main criteria for the *qualifying suppliers* phase:
- The supplier is challenged to create added value for the exploitation phase;
- The supplier is challenged to derive possible risks during the exploitation phase;
- Input and throughput criteria are used to qualify the resources of the supplier and to specify the work and activities to be performed by the supplier and the buying organization.

The main criteria for the *contracting* phase:
- The investment contract and the service contract are negotiated and signed together;
- SLA’s are developed to summarize the main objectives for diagnostic equipment.

The main criteria for the *expediting/exploitation* phase:
- Objectives determined by the output, quality and outcome performance criteria are pro-actively measured by the technology department and the medical business unit;
- Performance indicators of the mutual agreed responsibilities of both parties are proactively measured;
- The purchasing department gathers the measured performance criteria of the different staff departments.

The main criteria for the *evaluation* phase:
- The purchasing process should be evaluated by the purchasing team;
- The investment request or business case is evaluated based on the real time performance of the diagnostic equipment.
6 CONCLUSION AND RECOMMENDATIONS

6.1 INTRODUCTION

In this section, the main conclusions in regard to the organization of purchasing diagnostic equipment within healthcare are presented. First, we will return to the research question as defined in the problem definition:

*How should hospitals organize purchasing diagnostic equipment to create better value for money, considering the developments in healthcare?*

Before answering the main research question, the current conclusions of the organization of purchasing diagnostic equipment are discussed, together with the implications for the future organization of purchasing diagnostic equipment. Next, in the recommendation paragraph, the main research question and sub research questions will be answered by providing council to both hospitals in regard to the future organization of purchasing. The implications on literature and the research model are discussed in the paragraph reflection on literature. Finally the limitations of this research project, both the practical implications as for literature, are presented.

6.2 CONCLUSION

In this section main conclusions are drawn concerning the purchasing process (P), the exploitation phase (E) and the interaction between the purchasing process and the exploitation phase (I) of diagnostic equipment.

- **Lack of mutual and clear objectives between medical- and staff departments (P)**
  The lack of mutual agreed and clear objectives led to delay in the purchasing process and conflicts at the end of the process between medical specialists and staff departments. Objectives of business units without alignment with other medical business units stimulated autonomous performance of medical business units. Which is not always best for the hospital as a whole.

- **The use of technical specifications (P)**
  The use of technical specifications led to a large amount of specifications, which overshadowed the main criteria that were important for the radiologists. It was time consuming and difficult for the radiologists to understand and develop technical specifications. Technical specifications restrict suppliers to be creative and innovative with their technology in achieving the desired performance. They used input specifications, which can only be measured in terms of present or missing and distract the attention from the desired performance, or functional specifications. Thus, specifications should be rather functional than technical.
• **No evaluation of the purchasing process (P)**
No criteria were developed to evaluate the investment procedure. The purchasing process was performed in cross functional teams, with many departments involved. Miscommunication and difficulties during the process were not evaluated. This results in the disability of learning from each other, no improvement of the purchasing process, and misunderstanding of the intentions of the different business units.

• **No evaluation of the diagnostic equipment’s’ business case (I)**
No criteria were developed to evaluate the performance of the diagnostic equipment reflected to the desired performance. Without such evaluations, no judgment could be made about the performance of the purchasing team. This was only possible when a business case was made for the investment request to visualize the intentions and objectives of the investment.

• **Performance measurement isn’t based on mutual agreements (E)**
No performance measurement was performed by the technical department except the number (and duration) of failures. The downtime and response time was measured by the supplier based on their definition. No targets were determined to improve the performance of the diagnostic equipment and no (financial) consequences existed for the supplier in case of non-performance. Responsibilities and performance criteria between the technical departments and the supplier were not described. The first line maintenance of the technical department had a fixed percentage of discounts, despite of the number of failures and the performance of the department. The performance of the service from the supplier nowadays was based on feelings, and is considered a black box for the hospitals.

• **No link between the exploitation phase and the purchasing process (I)**
Past performance of diagnostic equipment and suppliers’ performance was not documented in a format that can serve as qualification criteria for suppliers. The desired performance of the diagnostic equipment both for the business unit radiology and the technical department were not described during the purchasing process.

• **Responsibility and tasks unclear for overall investment procedure (I)**
There is no responsible organ for the entire investment procedure. The responsibilities per phase are divided over different departments. The responsibilities and tasks during the investment procedure are not clearly mentioned. The responsibilities and interaction during the exploitation phase was hardly mentioned and different roles were ignored or contacted ad hoc. This led to miscommunication and problems during the exploitation phase, because the lack of discussion during the purchasing phase.

### 6.3 RECOMMENDATIONS
The analysis, cross case analysis and the conclusion of Maasstad and Sint Lucas Andreas, provide insight in how diagnostic equipment is actually purchased today in healthcare.
In this section, based on the conclusion, recommendations will be made for the future organization of purchasing diagnostic equipment. Finally, this will lead to an answer of the research question, mentioned at the start of this chapter.

6.3.1 GENERAL RECOMMENDATIONS AND IMPLICATIONS
In this section, first the general recommendations and implications based on the conclusion will be provided. Council is provided for the organization of purchasing diagnostic equipment at Maasstad and Sint Lucas Andreas specific by means of an investment procedure and purchasing process.

- **Multi-annual alignment of the business unit radiology with the medical objectives of the hospital (P)**
  The creation of a multi-annual medical strategy for the hospital provides guidelines for the preparation of medical objectives for the medical business units. Formal procedures for sharing information and vision between the medical business units must be initiated. This will stimulate the business unit to make long term decisions aligned with the overall hospital objectives. Alignment of the strategy provides the medical business units with aligned planning for future investment. Not the technical life time of the diagnostic equipment, but the strategic alignment must function as the driver for investments.

- **Involve necessary stakeholders and capabilities (I)**
  The involvement of the stakeholders who are influenced by the investment must be decided at the start of the project. This starts with alignment before the investment request, providing the investment committee with the necessary information regarding the investment. Uninformed, missing or lately involved stakeholders were the result of miscommunication or ignorance, and can be prevented by mentioning and informing the stakeholders in an early phase. A description of the decision making unit, with tasks and responsibilities during the start of the project prevents uninformed departments. According to van der Valk and Rozemeijer (2009) the responsibilities during the service part of the investment must be determined as well. The RASCI-model is a practical approach to decide the role and responsibilities. The composition of the decision making unit can be different for each situation. According to Hughes (2005) there are five considerations to be made to decide the roles of the people who are influenced by the investment; the market perspective, performance perspective, cultural perspective, leadership perspective and competence perspective (Appendix N).

- **Specifying for functional specifications based on output performance (P)**
  The knowledge of the radiologists and radiographers lays with the functional specifications of the diagnostic equipment. With objectives set in line with the strategy, medical performance can be described by the business unit radiology in a clinical manner. The suppliers’ freedom to demonstrate value and apply their expertise increases, because no technical specifications will obstruct the supplier achieving the objective. Specifying for the desired output, can result in the description of performance criteria for quality and outcome of the diagnostic equipment, instead of design
specifications. Design specifications can be used as input specifications for the qualification of the supplier. The input and throughput criteria describe the resources and requirements necessary and a general description of work and activities performed by the supplier. The output, quality and outcome criteria focus on the number of service, the reliability necessary, timeliness, and the results and impact of the supplier on the business unit objectives (Axelsson and Wynstra, 2002). Those specifications can be evaluated and force the business unit to think about the desired result of the supplier and the diagnostic equipment. This will create alignment between the hospitals and suppliers interest, and extra value for the end customer (van Weele and van der Valk, 2010).

• Evaluate process and performance (I)
In too many cases organizations expect that what they intended to do with an investment is the real result without evaluating (Axelsson and Wynstra, 2002). This is the case in Maasstad and SLAZ, where no process or performance was evaluated. There are different measures and moments to evaluate. Assumptions of the investment request or the business case must be evaluated to check the delivered performance of the diagnostic equipment. During the exploitation phase, benchmarks can be used to see whether the delivered performance is comparable with other hospitals and suppliers. The hospitals use the price performance measures by measuring the actual purchasing price with the planned price. The supplier performance measure should track the quality and delivery of services and products and hospitals should quantify the associated costs of non-performance of the supplier as well (Handfield et al, 2011).

• Monitor performance of diagnostic equipment (E)
For the number of failures no target is set, and when to contact the supplier is based on a ‘feeling’. Mutual agreements and responsibilities for the hospital and the supplier about the performance is used to effectively communicate the responsibilities of both parties (Handfield et al, 2011). Next to the mutual set quantitative performance measures, different qualitative factors can be derived to measure the performance of the supplier. Supplier cost reduction ideas, corrective actions response, ongoing progress reporting, technical ability and problems resolution ability are indicators that increase the added value of the supplier (Handfield et al, 2011). According to Van de Rijt and Santema (2011) the report frequency is important, and a time frame is necessary in which it is possible to pro-actively react on changes in the agreed performance.

• Determine responsibilities during entire process (P)
The decision making unit is discussed in the involvement of stakeholders. Here the main responsibility of the entire investment process is discussed. The business unit radiology is the main stakeholder in the investment process and should provide a project leader. Purchasing should focus on the business objectives and strategy should help the business realize their objectives to create business impact, supporting the project leader through the different phases. According to van Weele (2010) and this research, the purchasing manager should support each of the different phases to coordinate the
different steps to be taken. The investment committee can discuss the different evaluations as central organ for improvement and progress monitoring of the process (Appendix O).

6.4 WHAT TO EXPECT FROM THE RECOMMENDATIONS?

In this section the implications of the recommendations of this thesis are presented. First, the business alignment, involvement of all stakeholders and the evaluation of the purchasing process will increase the communication between departments. The use total cost of ownership, discussion about added value and risks, use of different scenarios, and functional specifications will lead to an improved description of the expected value of the diagnostic equipment for the hospital. By evaluating the purchasing process, the initial business case with the results, and the performance of the suppliers, the hospitals become learning organizations. A blue print for the purchasing process of both hospitals and the investment cycle, based on the analysis and recommendations is provided in Appendix P (Maasstad) and Appendix Q (SLAZ).

6.5 IS THE RESEARCH QUESTION ANSWERED?

The research question and sub questions derived at the start of this research were investigated during this thesis. In this section the question if the derived research questions are answered is discussed. First the sub questions will be discussed. The following sub questions were derived at the beginning of this thesis:

- How is diagnostic equipment actually purchased today in healthcare?
  The actual purchasing process of diagnostic equipment is described in chapter 4 of this thesis. Both the procedural steps of two hospitals are described, as well as the description of the actual process based on the case studies performed.

- How to increase the transparency and control of the purchasing process?
  The transparency and control of the purchasing process is limited because of the many stakeholders present during the process. The use of an aligned purchasing process with the business units and hospitals objectives, in combination with a clear decision making unit for the overall process increases the transparency and control of the purchasing process.

- How to increase the transparency and control over the performance of suppliers?
  The use of input criteria, and the non-measurement of the output criteria results in a low transparency and control over the performance of suppliers. The recommendations concerning the specification for output performance and monitoring of supplier performance increases the transparency and control over the performance of suppliers.

- How to engage suppliers effectively in the life cycle management of diagnostic equipment?
  The engagement of suppliers in the life cycle management of diagnostic equipment isn’t researched in detail. The suppliers were outside the scope of this research, and only two interviews were held. The preference of functional specification over technical specifications were mentioned by both suppliers. Recommendations are
based on the perspective of the hospital concerning the alignment with the supplier based on mutual responsibilities.

- **What improvements can be made in the purchasing, operational and maintenance phase of diagnostic equipment?**
  Improvements are mentioned both for the purchasing phase and the exploitation phase. The primer focus of the research was the organization of the purchasing process.

### 6.6 LIMITATIONS AND IMPLICATIONS FOR FUTURE RESEARCH

This research focused on the organization of buying diagnostic equipment for a better value for money performance. From a theoretical perspective, the use of only two case studies is insufficient to generate general statements. However, the similarities in the results of the case studies between the two hospitals may predict a certain level of purchasing maturity within the Dutch healthcare. The limited availability and use of quantitative data of the (financial) performance of the diagnostic equipment made it hard to support the qualitative results with figures. Measurement of the present situation must be compared with measurement of future situation, when the recommendations are taken into practice. The limited influence and input of the suppliers in this research make this research primarily based on the perspective of hospitals. Therefore the willingness of suppliers to cooperate and change the present manner of working is unknown.

No theoretical argumentation is provided about the trend in industry to buy functionalities instead of products. Because of the lack of description and measuring the exploitation phase, the value of the service is considered a black box by the hospitals. First measurement of the present situation must gain attention from the suppliers, and stimulate them to use their creativity and innovation for added value. In future research these measures can be used for comparison with pay per view developments, or different business models in cooperation with the suppliers.

This research has certain implications for the existing theory within the area of purchasing. Different theoretical perspectives together form a model for purchasing products with a large service part. The focus must lie on the performance during exploitation phase. Past performance, ongoing interaction, possible risks, added value, desired performance of the exploitation phase are all aspects that should be considered during the purchasing phase. The processes are not sequential processes, because the exploitation delivers useful information for future purchasing processes. The interaction between the actual performance of the equipment and the purchasing process must be aligned. Further, the end of the purchasing process is not the end, it is the start of a mutual delivered performance of the diagnostic equipment by the supplier and the hospital.
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APPENDITIES

APPENDIX A  FIGURES MAASSTAD

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Table 7.1 Organization figures Maasstadd

APPENDIX B  FIGURES SINT LUCAS ANREAS

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Table 7.2 Organization figures SLAZ

APPENDIX C  SIX STEP MODEL VAN WEELE (2005)

Specify
During this phase the organization starts to define the requirements by mean of a purchase specification. This relates to the needed specifications to select the right supplier in the follow up step. This phase contains at least the following aspects:
1) Quality specifications;
2) Logistic specifications;
3) Maintenance specifications;
4) Legal and environmental requirements;
5) Target budget.

Select
The step of selecting and assessing suppliers contains a number of separate steps.
1) Preliminary qualification of suppliers: summarizing the prequalification criteria/requirements based on the purchase order specifications to generate a
bidders’ long list. A request for information (RFI) is sent to the listed suppliers and this information will reduce the long list to a supplier short list;

2) Request for quotation: the short list suppliers receive a request for quotation (RFQ) and submit a bid which meet the requirements of the RFQ;

3) Selection of supplier: principles like TCO and risk analysis plays a role for the supplier selection proposal. Suppliers who are not selected are informed about the reason for rejection.

Contract
The most important aspects of negotiating and contracting are:
1) Prices and terms of delivery;
2) Terms of payments;
3) Penalty clauses and warranty conditions;
Additional terms and conditions are based on the industry.
When buying advanced medical equipment, it’s advisable to agree on future prices for spare-parts, maintenance and software updates during the negotiation. The contract (management) phase will be explained in more detail further on in this research.

Order
When the previous phases are closed it is very important to use specific information and instructions with the supplier. A purchase order will include at least the following aspects:
Order number, description of the product, unit price, number of units required, expected delivery time, delivery address and the invoicing address.
The supplier is normally asked to send a confirmation for the purchase order received.

Expedite
Expediting means that the organization makes sure that the supplier works following the agreements. Problems that occur can be discussed with the supplier to make improvements for future deliveries. Three types of expediting are known:
1) Exception expediting: internal customers report late deliveries and other errors ‘after the fact’;
2) Routine status check: a preventive approach is done when the organization contacts the supplier before the delivery to discuss situation to prevent unpleasant surprises;
3) Advanced status check: the status of the progress by the supplier will be checked on regular intervals. When inspectors are used to check the supplier’s production site they call it ‘field expediting’.

Evaluate
Supplier and projects should be evaluated and performance measures of suppliers should be stored so it can be used in the earlier phases of the purchasing process model for future projects. This information can also be used to settle the warranty claims and penalty clauses.
APPENDIX D  EXPERTS AND INTERVIEWED PERSONS

Experts:
Prof. dr. ir.G.G.J. van Houtum  Reliability, Quality and Maintenance
Prof. dr. F. Langerak  Management of Product Development
Dr. ir. W. Van der Valk  Purchasing and Strategic Sourcing
A. Slingerland  Chairman NEVI Healthcare and member NEVI Board

Maasstad Hospital:
Chairman investment committee  Arnout Weermeijer
Member investment committee  Henk Spijker
Manager Sourcing  Peter Bender
Account Manager  Bram van den Toorn
Account Manager  Sjoerd Huijbertsen
Clinical Physicist  Ido de Boer
Mechanic  Govert van Hooijdonk
Medical specialist  Hans van der Lelij
BU Manager  Winanda Buijserd
Team leader  Annemiek van Zelm

Sint Lucas Andreas Hospital:
Chairman investment committee  Peter Koehl
Head of Purchasing department  Karin Peters
Purchaser  Corine te Winkel
Purchaser  Rien Hilderink
Manager Medical Technology  Ton Döpp
Head of Medical Technology  Bert Prins
Head of Informatization  Onno Gabel
Mechanic  Jeroen van den Berg
Clinical Physicist  Jaap Groen
Medical specialist  Aloys Wüst
BU Manager  Femke Fleur Lamkamp
Organizational Manager  Monique van der Wardt

Suppliers:
Supplier Sint Lucas Andreas
Supplier Maasstad
APPENDIX E  INDIVIDUAL SUPPLY CHAINS OF ROBERTS (2002)

For the strategic alignment of purchasing business plans can be used to uncover the drivers of the business. Twenty-one general drivers collected by Rietveld (2009) in more than 10 years can be used as examples for drivers of the business. Those drivers could be viewed throughout different perspectives. Within the value chain of capital goods, those perspectives will generate more opportunity for improvement on the chosen drivers. Roberts (2002) created the value x 4 equals excellence principle, where every supply chain exists of four individual supply chains; the physical, financial-, informational-, and relational supply chain:

- The physical supply chain is defined as the actual movements and flows of goods and services.
- The financial supply chain is defined as the flows of cash from firm to firm, investments, incurred expenses, and costs of processes involved in the creation of goods and services.
- The informational supply chain is the process and electronic systems, the movement of data, the capture of data, the creation of information, knowledge management, market intelligence that drive the flow of products and services throughout the supply chain.
- The relational supply chain is defined as the linkage between the supplier, the organization, and the customer for maximum benefit.

This includes the internal supply relationships within the organization. Not every individual supply chain is equally important in different situations. But using them provides different perspectives and the most valuables can be further developed. For the strategic alignment of purchasing business plans can be used to uncover the drivers of the business. The following twenty-one general drivers collected by Rietveld (2009) in more than 10 years can be used as examples for drivers of the business:

Corporate values:
- Integrity;  Transparency;
- Sustainability;  Reputation;
- Safety;  Employership.

Operational excellence:

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APPENDIX F  PURCHASED DIAGNOSTIC EQUIPMENT

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Table 7.3 Purchased diagnostic equipment Maasstad

APPENDIX G  DESCRIPTION INVESTMENT PROCEDURE

MAASSTAD
The multi-annual investment plan is a yearly actualized review of the planned and needed investments in medical equipment (and other investments) for the upcoming ten years. To be in the medical technology top 10 of hospitals in the Netherlands, a budget of €14 million is available yearly for investments. With the movement in 2011 to the new building a peak in spending (€43 million) occurred in the investment budget of 2010 and the following years fewer budget is available to stay below the yearly budget of €14 million on average. Although in this research the focus lies on diagnostic equipment, Maasstad has the following definition of investment goods:

- A life time of more than one year;
- An amount of at least €1.500 including VAT;
- A standalone entity or functionality (no part of something else).

There are four types of investments:

- Replacement investments, based on the technical or economical lifetime;
- Innovations or expansion investments, can be requested anytime at the investment committee, and must be based on a business case;
- Crash investments, based on a rejection report by KFT and when the functionalities change, a business case must be included;
- Investments determined by law, and a business case included.

Investments above the €50.000 will follow the CCPM project management methodology and a business case for the investment request is necessary. The purchasing process of diagnostic equipment consists of different phases. The purchasing process is based on the strategic function (the purchasing policy), the tactic process (with the specification, selection and contracting phases), and the operational process of order, expedite and evaluation.
SINT LUCAS ANDREAS
The described investment procedure came because of several problems occurred during
earlier investment procedures:
• The need for investments exceeds the resources;
• Investment requests were filled out incomplete;
• The procedure of investment requests and award was ambiguous;
• No transparency about approval and processing and no clear agreements between
  staff and business unit when to start.
The new organization for investments is focused on the expansion investments, because
the MT department is responsible for the replacement investments. Replacement of
strategic equipment, like the diagnostic equipment, is assessed different then
replacement or expansion investments, and is discussed directly with the Board of
Directors, but should follow the same procedures. Although in this research the focus
lies on diagnostic equipment, SLAZ has the following definition of investment goods:
• A life time of more than one year;
• An amount of at least €1.000 per article excluding VAT;
• Repair costs will be charged to exploitation;
• Acquisitions below €1.000 excluding VAT when part of a larger project;
Table 7.4 visualizes a few interesting things already mentioned in the analysis. Here a short overview is provided:

- Many different stakeholders were involved during the initial phase;
- The qualification- and evaluation phase were not performed;
- No (or partial) involvement of Sourcing during the expediting and exploitation phase;
- No check by Finance and administration after six months;
- Other medical business units are missing in this model, no formal procedures are known. Contact about investments between medical business units is informal and based on own initiative.
APPENDIX I PERFORMANCE INDICATORS MAASSTAD

The service contract of Maasstad isn’t completely filled out and a meeting between purchasing and the supplier is planned. The performance indicators for both CT scans of Maasstad with the supplier are presented in Table 7.5 and 7.6.

### Table 7.5 Key performance indicators supplier CT1

<table>
<thead>
<tr>
<th>KPI CT</th>
<th>Agreed</th>
<th>Measured</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response time</td>
<td>30 minutes</td>
<td>?</td>
</tr>
<tr>
<td>Time to arrive</td>
<td>PRIO BASED: 4,6,6,6</td>
<td>?</td>
</tr>
<tr>
<td>Uptime</td>
<td>95%</td>
<td>98,2%</td>
</tr>
<tr>
<td>Hours</td>
<td>8:30-17:00 Mon-Fri</td>
<td>-</td>
</tr>
<tr>
<td>Report</td>
<td>Yearly report</td>
<td>-</td>
</tr>
</tbody>
</table>

### Table 7.6 Key performance indicator supplier CT2

<table>
<thead>
<tr>
<th>KPI CT</th>
<th>Agreed</th>
<th>Measured</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response time</td>
<td>30 minutes</td>
<td>?</td>
</tr>
<tr>
<td>Time to arrive</td>
<td>PRIO BASED: 4,6,6,6</td>
<td>?</td>
</tr>
<tr>
<td>Uptime</td>
<td>95%</td>
<td>99,9%</td>
</tr>
<tr>
<td>Hours</td>
<td>8:30-17:00 Mon-Fri</td>
<td>-</td>
</tr>
<tr>
<td>Report</td>
<td>Yearly report</td>
<td>-</td>
</tr>
</tbody>
</table>

The response time is the time the supplier respond by phone. The time to arrive changes between 4 and 6 hours based on the priority of the request. The *uptime* of both CT scans is calculated with the data of unplanned corrective maintenance within the hours of the service widow. First line corrective maintenance of the KFT department is excluded. The uptime is only measured by the suppliers. The hours of the service widow are used for calculating the uptime. A yearly report is made about the functioning of the diagnostic equipment.

Service availability and service reliability are two other measurements which are not included in the service contract. *Service availability* is the uptime calculated with the data of unplanned and planned corrective maintenance performed. *Service reliability* is the uptime calculated with the data of unplanned corrective maintenance.

Both measures are presented in Table 7.7 for one of the CT’s. The red marked percentages are the availability or reliability under the 95% agreed uptime. This has no consequences for the supplier because the calculated uptime is 98,2%.

### Table 7.7 Availability en reliability measures supplier CT1

<table>
<thead>
<tr>
<th>KPI</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
<th>VIII</th>
<th>IX</th>
<th>X</th>
<th>XI</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>90,6%</td>
<td>99,4%</td>
<td>96,9%</td>
<td>100,0%</td>
<td>100,0%</td>
<td>100,0%</td>
<td>99,0%</td>
<td>56,0%</td>
<td>100,0%</td>
<td>97,0%</td>
<td>93,9%</td>
<td></td>
</tr>
<tr>
<td>Reliability</td>
<td>90,6%</td>
<td>99,4%</td>
<td>96,9%</td>
<td>100,0%</td>
<td>100,0%</td>
<td>100,0%</td>
<td>93,4%</td>
<td>100,0%</td>
<td>100,0%</td>
<td>100,0%</td>
<td>98,2%</td>
<td></td>
</tr>
</tbody>
</table>
The type of measurement done by Maasstad hospital is presented in Table 7.8. If the failures and internal hours included downtime isn’t measured by the technical department. The internal hours* are not always measured.

<table>
<thead>
<tr>
<th>Measurement Maasstad</th>
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<tbody>
<tr>
<td># failures</td>
</tr>
<tr>
<td># intern hours*</td>
</tr>
<tr>
<td># extern hours</td>
</tr>
<tr>
<td>type of problem</td>
</tr>
</tbody>
</table>

Table 7.8 Measurement by KFT department

APPENDIX J TOTAL COST OF OWNERSHIP MAASSTAD

The total cost of ownership taken into account by Maasstad hospital is presented in Table 7.9. It is shown that investments done in equipment and training are calculated. For the exploitation phase the exploitation costs are calculated by the service contract for the diagnostic equipment. This is based on documentation found at Maasstad hospital. According normal procedures the costs written in *cursive* had to be taken into account as well.

<table>
<thead>
<tr>
<th>Acquisition costs</th>
<th>Exploitation costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment</td>
<td>Service contract</td>
</tr>
<tr>
<td>Training</td>
<td>Personnel</td>
</tr>
<tr>
<td>External people</td>
<td>Overhead</td>
</tr>
<tr>
<td>Material</td>
<td>Cost of capital</td>
</tr>
</tbody>
</table>

Table 7.9 Factors in TCO Maasstad

In Figure 7.1 the TCO model is coloured by the existence of the costs in the TCO of Maasstad hospital. The acquisition or investment costs are used, however project management and construction or implementation costs were not taken into account. The maintenance costs included the service contract with RMR (revisions, modifications and retrofits), a helpdesk function and spare parts. However, no costs were found as operating costs and no downtime costs or non-performance costs are monitored. The boxes in cursive were named in the NPV cash flow analysis format which should be performed for investments. But for the purchasing of diagnostic equipment, those aspects were not found in the documentation.

Figure 7.1 Present and missing factors in TCO Maasstad
Table 7.10 visualizes a few interesting things already mentioned in the analysis. Here a short overview is provided:

- The lack of cooperation during the initial phase;
- The lack of management attention during the early stages of the project;
- No involvement of the IT department during the process;
- No involvement of the Purchasing department during the expediting and exploitation phase;
- Planning and control was not involved;
- The partial involvement of the investment committee during the initial phase.
- Other medical business units are missing in this model, no formal procedures are known. Contact about investments between medical business units is informal and based on own initiative.
APPENDIX L PERFORMANCE INDICATORS SLAZ

The performance indicators for two CT scans of Sint Lucas Andreas hospital with the supplier are presented in Table 7.11 and 7.12.

Table 7.11 Key performance indicators suppliers CT 2001

When downtime is exceeded with 1%, the service costs will be reduced by 4%. Because of the service widow used, the uptime was 98.8% in 2010, while uptime is calculated based on the service widow from 08:00-17:00u, 5 days a week, 52 weeks a year (2080 hours).

The system is ‘up’ when a readable diagnostic picture appears during normal usage. Small failures in the pictures or failures not essential for the diagnosis are not considered as downtime.

The uptime was measured 98.8% by the supplier during the service widow. However, the business unit radiology performed treatments during the weekends or evenings as well. Therefore, the uptime for the hospital was considered much lower than considered for the supplier. Sint Lucas Andreas hospital does not measure the uptime of the diagnostic equipment according to their own measurements.

Table 7.12 Key performance indicators supplier CT 2011

The time to arrive for the supplier is 4 hours after the notification of the failure by the hospital. For the new CT scan an uptime of 98% was agreed for a transfer widow of 8½ hours, 5 days a week. The service provided by the supplier is based on the functioning of the diagnostic equipment for 11 hours a day for 365 days a year.

The type of measurement done by Maasstad hospital is presented in Table 7.13. If the failures and internal hours included downtime isn’t measured by the technical
APPENDIX M  TOTAL COST OF OWNERSHIP SLAZ

The total cost of ownership taken into account by Sint Lucas Andreas hospital is presented in Table 7.14. It is shown that investments done in equipment, IT, transport, construction and training are calculated. For the exploitation phase the exploitation costs are calculated by the service contract for the diagnostic equipment and the data storage costs of the IT department.

In Figure 7.2 the TCO model is coloured by the existence of the costs in the TCO of Sint Lucas Andreas hospital. The acquisition or investment costs are used, however project management isn’t taken into account.

The maintenance costs included RMR (revisions, modifications and retrofits), a helpdesk function, spare parts, and all included in the service contract. The labour for the diagnostic equipment is lacking, while for example the costs of the MT department or IT department will fluctuate because of the effort necessary for maintaining the diagnostic equipment.

Operating costs are not specified to the diagnostic equipment, and downtime costs, or non-performance costs are lacking. The latter costs are both for the hospital as the supplier important to minimize.

<table>
<thead>
<tr>
<th>Acquisition costs</th>
<th>Exploitation costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment</td>
<td>Service contract</td>
</tr>
<tr>
<td>IT</td>
<td>IT storage</td>
</tr>
<tr>
<td>Transport</td>
<td></td>
</tr>
<tr>
<td>Construction</td>
<td></td>
</tr>
<tr>
<td>Training</td>
<td></td>
</tr>
</tbody>
</table>

Table 7.14 Factors in TCO SLAZ

Figure 7.2 Present and missing factors in TCO SLAZ
APPENDIX N  RASCI MODEL AND ROLE DESCRIPTION

Making a matrix of the purchasing process and the different disciplines within the organization which have one or more roles during those processes is a practical approach. A well-known approach to decide who has which role could be done by the RASCI-model.

- **Responsible**: The responsible person for the process or the result;
- **Accountable**: The accountable person can call to account the responsible;
- **Supportive**: The persons who produce, they help to responsible to reach the desired result;
- **Consulted**: The persons who can be consulted and can influence the result;
- **Informed**: Persons who should be informed afterwards and cannot influence the process anymore.

These roles and responsibility support the transparency in roles and responsibilities during the purchasing process.

The composition of the Decision Making Unit will be different for each situation, but with a specific buying process of capital equipment a standard can be made. According to Hughes (2005) there are five considerations to decide the roles. These roles will be described for the hospitals.

- **Market perspective**: Which impact does the purchasing process have on the markets and suppliers? Market knowledge must be present.
- **Performance perspective**: Which impact does the purchasing process have on the business goals? People whose business objectives are influenced by the investment must be informed and consulted.
- **Cultural perspective**: Which impact does the purchasing process have on the way of working of the organization now and in the future?
- **Leadership perspective**: What is necessary to overcome the tension against the purchasing process? Authority can be necessary within the DMU.
- **Competence perspective**: Can we use the necessary competence for the purchasing process? There must be decided if the available competences within the hospital are sufficient, or external experts must be involved.

These roles can be used to determine the decision making unit for the investment committee, or the purchasing team.
### Apppendix O Roles and Responsibilities

#### Maasstad

<table>
<thead>
<tr>
<th>Role</th>
<th>Medical business unit (PM)</th>
<th>Purchaser (coordinator)</th>
<th>Medical technician</th>
<th>IT</th>
<th>Planning &amp; Control</th>
<th>BoD or Manager</th>
<th>Investment committee</th>
<th>Manager KT</th>
<th>Manager Sourcing</th>
<th>Manager Purchasing and Logistics</th>
<th>Head of Purchasing</th>
<th>Experts, clinical physician</th>
<th>Implementation team</th>
<th>Stakeholders Involved (medical business units)</th>
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<td>C</td>
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</table>

Table 7.15 Roles and responsibilities Maasstad

#### Sint Lucas Andreas

<table>
<thead>
<tr>
<th>Role</th>
<th>Medical business unit (PM)</th>
<th>Purchaser (coordinator)</th>
<th>Medical technician</th>
<th>IT</th>
<th>Planning &amp; Control</th>
<th>BoD or Manager</th>
<th>Investment committee</th>
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<th>Manager Purchasing and Logistics</th>
<th>Head of Purchasing</th>
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<th>Implementation team</th>
<th>Stakeholders Involved (medical business units)</th>
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<td>Initial phase</td>
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Table 7.16 Roles and responsibilities SLAZ
APPENDIX P INVESTMENT CYCLE AND PURCHASING PROCESS MAASSTAD (IN DUTCH)

De investeringscyclus is een constant proces en helpt bij het realiseren van de doelstellingen door een beter inzicht in de te verwachten investeringen en de daarvoor benodigde middelen. De investeringscyclus loopt parallel met de begrotingscyclus omdat investeringen gevolgen hebben voor de exploitatie.

1. Strategie en afstemming

Er is een strategisch plan van het ziekenhuis opgesteld door de Directie en het Medisch Stafbureau. Gebaseerd op dit strategisch plan ontwikkelen de medische bedrijfseenheden een meerjarige strategie en doen die besproken worden met de Directie. Deze wordt afgestemd op de ziekenhuis brede strategie. Uit de afgestemde meerjarige strategie van de medische bedrijfseenheden volgen de investeringsaanvragen voor de meerjarige investeringsplanning en de jaarlijkse investeringen. De stafafdelingen stemmen het beleid af op de medische bedrijfseenheden, om deze optimaal te kunnen ondersteunen. Om bij te blijven in hun vakgebied volgen managers de marktontwikkelingen en beoordelen zij de mogelijkheden die de marktontwikkeling voor hun afdeling kan hebben. Dit geldt zowel voor medische bedrijfseenheden als stafafdelingen.

2. Meerjarig investeringsplan

Het meerjarig investeringsplan beslaat een periode van 10 jaar en toont welke bedrijfsmiddelen op welk moment vervangen moeten worden. Dit plan bewaakt de continuïteit in de bedrijfsvoering. Het plan wordt jaarlijks geactualiseerd vanuit de realisatie van het lopende jaar. Het meerjarig investeringsplan komt voort uit de gezamenlijke strategie besproken met de Directie. De levensduur van de investeringen wordt gezamenlijk bepaald door de medische bedrijfseenheid en de afdeling KFT en de investeringscommissie.

3. Jaarlijkse investeringen

Tijdens de jaarlijkse investeringen wordt de investeringsruimte voor het eerst volgend jaar toegewezen. Dit wordt afgeleid uit het meerjarig investeringsplan en overige aanvragen die managers indienen bij de investeringscommissie. Beiden wederom voortkomend uit de strategie besproken met de Directie. De investeringscommissie stelt een advies op voor de Directie met daarin prioriteitsstelling, argumentatie en consequenties van de gewenste investeringen in relatie tot het beschikbare budget en de strategie van het ziekenhuis. De Directie besluit over toewijzing of afwijzing van de investering en informeert de managers middels een directiebesluit, dat kenbaar wordt gemaakt aan het gehele ziekenhuis.

4. Inkoopproces


5. Evaluatie

**ROL INVESTERINGSCOMMISSIE**

De **Investeringscommissie** is een commissie die is ingesteld door het ziekenhuis om de aanvraag en bewaking van de voortgang van investeringen te coördineren en de investeringsmiddelen van het ziekenhuis op de juiste wijze in te zetten. De commissie toetst de aanvragen op compleetheid, de beschikbare financiële middelen en strategische relevantie t.a.v. prioriteitsstelling, standaardisatie, multidisciplinair gebruik, speerpunt relevantie, toekenning en/of reservering van budget en aanschafproces en planning.

De leden van de Investeringscommissie (met tussen haakjes de rollen) zijn:

- **Lid Directie** (voorzitter)  
  **(Strategie en Financiën)**
- **Manager Sourcing**  
  **(Inkoop en Voortgang projecten)**
- **Manager Bedrijfseenheid Zorg**  
  **(Apparatuur en Techniek)**
- **KFT / Klinisch Fysicus**  
  **(Strategie en Zorgperspectief)**
- **Medische stafbureau / Medisch specialist**  
  **(Zorgperspectief)**
- **Manager ICT**  
  **(ICT)**

**INVESTERINGEN**

**Vervangingsinvesteringen op basis van meerjarige begroting**

Jaarlijks worden de voor het komende jaar geplande investeringen (vervanging door verstrijken van de overeengekomen medische levensduur) door de afdeling KFT beoordeeld en van een advies voorzien ten behoeve van de medische bedrijfseenheden. Voor jaarlijkse investeringen dient een investeringsaanvraag ingediend te worden met business case door de bedrijfseenheid. De Directie neemt elk jaar een besluit betreffende de omvang en de inhoud van de investeringsbegroting voor het daarop volgende jaar.

**Uitbreidingsinvesteringen**

Investeringen die niet van te voren zijn gepland, bijvoorbeeld uitbreidingen of innovaties, kunnen op elk gewenst moment in het jaar worden ingediend bij de investeringscommissie. Deze investeringen moeten onderbouwd zijn met een business case en een terugverdienplan, waarmee het management van de betrokken afdeling verantwoording aflegt over de investering. Hiervoor is een innovatiebudget beschikbaar.

**Crashinvestering**

Wanneer een investeringsgoed voortijdig vervangen moet worden (dus eerder dan de geplande vervanging), is sprake van een crash investering. Wanneer bij vervanging de functionaliteit van het investeringsgoed substantieel wijzigt, de omgeving substantieel wijzigt, of de strategie is gewijzigd, moet de investering ook met een business case worden onderbouwd. In de investeringsaanvraag kan aangegeven worden dat het om een crash investering gaat. Dit moet bevestigd zijn door de afdeling KFT. Bij aflevering van het nieuwe apparaat wordt het oude apparaat van de betreffende afdeling verwijderd.

**Investeringen die wettelijk worden opgelegd**

Wanneer investeringen op basis van wetgeving gedaan moeten worden dient alsnog een investeringsaanvraag en business case gemaakt te worden.
INKOOPPROCES INVESTERINGSGOEDEREN

✓ Het inkoopteam rapporteert over de voortgang aan de projectverantwoordelijke en de aanvrager voordat een nieuw ‘blok’ begint, en minimaal 1x per maand.
✓ De investeringscommissie wordt op de hoogte gehouden van de voortgang door Sourcing.
✓ Binnen de stafafdelingen wordt de voortgang per project besproken, zodat de managers hiervan op de hoogte zijn. Het is de verantwoordelijkheid van de manager om op de hoogte te zijn van de werkzaamheden van eigen personeel binnen het inkoopteam.

1. Aanvraag investeringen
   • Een investeringsaanvraag wordt opgesteld door verschillende disciplines onder de verantwoording van de medische bedrijfseenheid. Een business case wordt bijgesloten voor aanvragen boven €50.000,–.
   • Elke medische bedrijfseenheid heeft een vaste contactpersoon per stafafdeling (Sourcing, KFT, IT en Finance & Administration) waarmee de investeringsaanvraag wordt besproken.
   • Er wordt een offerte opgevraagd door Sourcing om tot een voorlopige budgetaanvraag te komen.
   • De investeringsaanvraag moet door middel van een paraaf geaccordeerd zijn door de stafafdelingen.
   • De afdeling Finance & Administration geeft goedkeuring voor de financiële- en productie cijfers.
   • Op basis van de autorisatiematrix kan de medische bedrijfseenheid de investeringsaanvraag indienen bij de investeringscommissie, na intern overleg tussen de medisch manager, organisatorisch manager en zorgmanager.

2. Beoordeling investeringen
   • De investeringscommissie beoordeelt de investeringsaanvragen op basis van de volgende criteria:
     o Urgentie vervangingen en prioriteit
     o Standaardisatie van apparatuur
     o Multidisciplinair gebruik van de apparatuur
     o Relevante ten aanzien van speerpunten ziekenhuis
     o Projectplanning en beschikbare financiële middelen
     o Strategische relevantie
   • De Directie maakt de uiteindelijke beslissing en maakt de goedgekeurde aanvragen door middel van een besluitenlijst kenbaar binnen het ziekenhuis.

3. Formeren inkoopteam
   • KFT, Sourcing en ICT adviseren de investeringscommissie middels het investeringsaanvraag formulier per investeringsproject of een inkoopteam gewenst is op basis van de volgende criteria:
     o Projectrisico obv resultaten uit het verleden;
     o Investeringsbedrag;
     o complexiteit of omvang project;
     o impact op organisatie;
     o patiëntrisico.
   • De investeringscommissie neemt een besluit betreffende het inkoopteam en de projectverantwoordelijke en licht de aanvrager in. Een planning wordt opgesteld door Sourcing in overleg met de overige stafafdelingen en de medische bedrijfseenheid.
4. Samenstelling Inkoopteam
   • Binnen het inkoopteam zitten ten minste vertegenwoordigers vanuit:
     o Gebruiker (projectleider);
     o Sourcing;
     o KFT;
     o ICT.
   • Afhankelijk van de investeringsaanvraag wordt er een projectverantwoordelijke (Directie, (Zorg-)Manager) aangesteld waaraan het inkoopteam verantwoording aflegt. De projectverantwoordelijke wordt bepaald op basis van de volgende criteria:
     o Investeringsbedrag;
     o Complexiteit en risico’s project;
     o Impact op organisatie.
   • Alle relevante betrokkenen gedurende de totale levensduur van de medische apparatuur worden geïdentificeerd door bovenstaande personen.
   • Geïdentificeerde belanghebbende worden naar behoeft (eenmalig of permanent) geraadpleegd of ingelicht. Dit wordt vooraf kenbaar gemaakt bij de betreffende personen. Denk hierbij aan:
     o andere gebruikers;
     o ICT-projectleider;
     o Finance & Control;
     o deskundigen (straling, DSMH, Arbo, laserveriligheid, ethervervuiling);
     o overige betrokkenen (CSA, Gebouw en beheer, goederenontvangst, transport, schoonmaak, beveiliging);
     o Externe deskundigen.

5. Benoemen taken en verantwoordelijkheden
   • Er wordt een verantwoordelijkheidsmatrix voor de gehele levensduur van de medische apparatuur opgesteld voor alle relevante betrokkenen. De verantwoordelijkheden en taken kunnen verschillen per type project.

6. Opstellen Projectplan
   • Op basis van de randvoorwaarden, zoals geformuleerd door de investeringscommissie, wordt een projectplan gemaakt door het inkoopteam.
   • Het projectplan wordt voorgelegd aan de projectverantwoordelijke.
   • De investeringscommissie wordt op vastgestelde punten ingelicht over de voortgang van het project door Sourcing.
   • Na het inlichten en raadplegen van deskundigen en betrokkenen wordt in een eerste bespreking van het Inkoopteam (‘Kick-off’) een concept projectplan besproken en vastgesteld.

7. Uitvoeren risicoanalyse en implementatieplan
   • Het Inkoopteam voert een risicoanalyse uit welke een basis vormt voor het Programma van Eisen, maar ook voor de installatie, ingebruikname en inbedding in de organisatie. Risico’s en beheersbaarheid hiervan gedurende de gehele levenscyclus van het apparaat komen aan de orde.
   • Op basis van de risicoanalyse, adviseert het Inkoopteam de medische bedrijfseenheid over de noodzakelijke aantoonbare vaardigheid van medisch specialisten voor het gebruik van medische apparatuur. Dit geldt ook voor de medisch technici en andere gebruikers m.b.t. de toepassing van medische apparatuur.
8. **Vaststellen Programma van Eisen (PvE)**
- Met als doel apparatuur van verschillende aanbieders goed te kunnen beoordelen maakt het Inkoopteam een Programma van Eisen aan de hand van het aanwezige standaard format.
- Het Programma van Eisen wordt opgesteld op basis van functionele eisen gebaseerd op uitkomst en resultaatgerichte performance.
- Binnen het Programma van Eisen worden extra elementen toegevoegd als ‘risico’ en ‘waarde creatie’.
- De samenwerking tijdens het onderhoud en operatie wordt gespecificeerd.
- In overleg met KFT stelt de medisch technicus een onderhoudsstrategie vast waarin de noodzakelijke werkzaamheden en onderhoudsfrequentie op basis van het PvE, de risicoanalyse en bedrijfszekerheid zijn bepaald. Mede op basis van de offerte wordt besloten of het onderhoud in eigen beheer zal worden uitgevoerd of wordt uitbesteed.

9. **Marktverkenning**
- Potentiële leveranciers worden opgesomd (long list) door het inkoopteam.
- Op basis van kwalificatiecriteria wordt aan de leverancier een Request for Information verstuurd door Inkoop. Hieruit wordt door het Inkoopteam op basis van het RFI een objectieve selectie (short list) gemaakt.
- Er is een minimaal aantal van drie leveranciers.

10. **Offerteaanvraag**
- Op basis van het Programma van Eisen vraagt afdeling Inkoop bij geselecteerde leveranciers (shortlist) een offerte aan met het verzoek aan de leveranciers het PvE in te vullen, waardoor een objectieve vergelijking mogelijk wordt.
- Tijdens het offertestadium verlopen alle contacten tussen het Maastricht Ziekenhuis en de potentiële leveranciers via afdeling Inkoop.
- Het budget wordt bekend gemaakt ten tijde van de offerte aanvraag.
- Er wordt gebruik gemaakt van risico analyse
- Er wordt gebruik gemaakt van waarde creatie
- Er wordt zowel gebruik gemaakt van minimaal het Total Cost of Ownership principe. Aan te bevelen valt om gebruik te maken van het Total Value of Ownership principe.
- Hierin worden de realisatiefase, of implementatiefase meegenomen.

11. **Keuzematrix opstellen en beoordelen offertes en leveranciers**
- De offertes en ingevulde PvE’s worden door het Inkoopteam beoordeeld en gescord, m.b.v. een keuzematrix waarop alle eisen uit het PvE beoordeeld worden, met een bepaald waardeoordeel per eis. Op die manier kan een objectieve keuze tussen de verschillende leveranciers worden gemaakt.
- Risico analyse, added value en service interactie worden besproken met de potentiële leveranciers.
12. Proefplaatsingen en/of site-visits

- Er worden zo nodig proefplaatsingen en site-visits gedaan om een gedetailleerd inzicht te krijgen in hoeverre het apparaat aan de gestelde eisen uit de keuzematrix en het PvE voldoet en hoe het in praktijk bevat.
- Het Inkoopteam stelt een evaluatieformulier voor klinisch gebruik vast.
- KFT coördineert proefplaatsingen en/of site-visits en verzorgt de planning, tijdelijke voorzieningen, inkoopbonnen, aflevering, acceptatietest, logistiek, teruggave aan leverancier en een technische beoordeling.
- De gebruiker verzorgt, met ondersteuning van de leverancier, voorafgaand aan de proefplaatsing, een instructie voor de gebruikers.
- De ingevulde evaluatieformulieren worden door het Inkoopteam beoordeeld en meegewogen in het eindoordeel.

13. Leveranciers- en productkeuze

- Om tot een objectieve leveranciers- en productkeuze te komen wordt de prijs-kwaliteitverhouding van de producten in kaart gebracht.
- Om alle aspecten mee te laten wegen in het besluitvormingsproces worden er wegingpercentages aan de prijs (P) en de kwaliteit (Q) van het product toegekend, opgeteld komen de percentages op 100% uit.
- Bij de kwaliteit spelen meerdere aspecten een rol. Onder de kwaliteit vallen de volgende aspecten:
  - Programma van eisen
  - Proefplaatsing/Site visits
  - Productevaluatie
  - Leveranciersevaluatie
  De weging kan per project verschillen.

14. Onderhandeling

- De betrokken inkoper voert onderhandelingen met twee of meer geselecteerde leveranciers om de beste prijs/kwaliteit verhouding te vinden en betrekt daar zo nodig de overige leden van het Inkoopteam bij.

15. Eindrapportage = Investeringsadvies

- Het Inkoopteam geeft een aanbeveling voor de leveranciers- en productkeuze op basis van de ranking. Op basis van de beoordeling van klinische, technische en financiële aspecten van de apparatuur van de verschillende leveranciers wordt door het Inkoopteam een investeringsadvies opgesteld. Hierbij worden de beantwoording van het PvE, de offerte, de leverancier en de resultaten van de proef meegewogen.
- De definitieve versie van het investeringsadvies wordt voorgelegd aan de projectverantwoordelijke van het inkoopproces. De betrokken stafafdelingen geven door middel van een paraaf aan dat zij akkoord gaan. Finance & Administration checkt de financiële- en productie cijfers.
- Na akkoord wordt het investeringsadvies naar de Investeringscommissie en de Directie gestuurd door het inkoopteam. De investeringscommissie is verantwoordelijk voor het procesverloop en of dit overeenkomt met de goedgekeurde investering. Zij brengen advies uit aan de Directie.
- Een gunningsadvies wordt door het inkoopteam aan de leverancier gestuurd.

16. Investeringsbesluit

- De Directie raadpleegt zo nodig de zorgmanager, (een deel) van het Inkoopteam en/of andere betrokkenen en neemt een Investeringsbesluit.
- Het investeringsbesluit wordt kenbaar gemaakt aan de organisatie door middel van het versturen van de directiebesluiten.
17. **Contracteren**

- Het contract (dat in de offertefase is geaccordeerd) wordt definitief opgesteld en ondertekend. Hiervoor wordt modelovereenkomst (medische) apparatuur FHI-NEVI gebruikt.
- Hierin wordt ook het service contract van WIBAZ vermeld, of naar verwezen. Het service contract wordt gelijktijdig met de investeringsovereenkomst afgesloten.
- Contractperformance criteria worden in een SLA vermeld en zijn bekend bij de verantwoordelijke personen. Het beschrijven van de doelstellingen en manier van meten wordt in overleg met de leverancier bepaald.
- De SLA wordt opgesteld voor KFT, ICT en de Medische Bedrijfseenheid. Deze worden ook gebundeld opgeslagen binnen de afdeling Sourcing.
- Belangrijke criteria zijn prijzen van onderdelen, onderhoud, updates en upgrades. Daarnaast moeten de boete clausule en consequenties die hangen aan het niet presteren van leveranciers meegenomen worden en benoemd worden in een prestatiecontract of de bijlage van de modelovereenkomst (medische) apparatuur FHI-NEVI.

18. **Bestelling**

- Op basis van het investeringsbesluit en de definitieve offerte stelt afdeling Sourcing een interne bestelbon op. Indien aanwezig, wordt een (meerjarige) serviceovereenkomst of een technische training altijd mee besteld.

19. **Realisatie overige interne voorzieningen**

- De realisatie van interne voorzieningen wordt met afdeling Facilitair afgestemd.
- Ondersteunende afdelingen en leveranciers benaderen voor plannen werkzaamheden volgens reeds opgevraagde offertes
- Met de leveranciers, ondersteunende diensten en het inkoopsteam wordt een planning van levering, installatie, tijdelijke voorzieningen, training, ingebruikname enz. opgesteld.
- Zo nodig wordt met de medische zorgmanager de patiënten planning aangepast.
- De plannings worden verspreid onder betrokkenen,
- Bij grootschalige projecten (bv. vervanging van röntgenapparatuur) wordt veelal een implementatieteam ingesteld dat alle aspecten van de implementatie van de apparatuur belicht en voorbereid.

20. **Training van gebruikers**

- De medische bedrijfseenheid en de afdeling KFT plannen met de leverancier, op basis van het eerder vastgestelde opleidingsplan, de training voor gebruikers.
21. Contractmanagement
- Contractmanagement geeft aan dat de organisatie bijhoudt of de leverancier zich aan de gemaakte afspraken houdt. Zo kunnen problemen worden besproken en verbeteringen plaatsvinden voor vervolgtrajecten. De resultaten van het contractmanagement van KFT, ICT en de Medische Bedrijfseenheid worden ook gebundeld binnen de afdeling Sourcing.
- Contractmanagement bevat doelstellingen voor het Maasstad (voor meerdere afdelingen) als de leverancier.
- De frequentie van rapportage moet kort genoeg zijn om proactief te kunnen sturen op risico’s en op het verschil tussen het resultaat en de gewenste situatie.
- Verantwoordelijkheden worden ook voor interne prestaties vastgelegd.

22. Evaluatie van inkooppces
- Inkoop is verantwoordelijk voor de evaluatie van het inkooppces door het inkoopteam. Hiervoor wordt een standaard evaluatieformulier gebruikt. De evaluaties worden aangeboden aan de Investeringscommissie.

> In onderstaande Figuur zijn de verhoudingen schematisch weergegeven voor de specificatie, kwalificatie en selectiefase van het inkooppces.
APPENDIX Q  INVESTMENT CYCLE AND PURCHASING PROCESS SLAZ (IN DUTCH)

De investeringscyclus is een constant proces en helpt bij het realiseren van de doelstellingen door een beter inzicht in de te verwachten investeringen en de daarvoor benodigde middelen. De investeringscyclus loopt parallel met de begrotingscyclus omdat investeringen gevolgen hebben voor de exploitatie.

1. **Strategie en afstemming**
Er is een strategisch plan van het ziekenhuis opgesteld door de Raad van Bestuur en het Medisch Staf Bureau. Gebaseerd op dit strategisch plan ontwikkelen de medische bedrijfseenheden een meerjarige strategie en doen die besproken worden met de Raad van Bestuur. Deze wordt afgestemd op de ziekenhuis brede strategie. Uit de afgestemde meerjarige strategie van de medische bedrijfseenheden volgen de investeringsaanvragen voor de meerjarige investeringsplanning en de jaarlijkse investeringen. De stafafdelingen stemmen het beleid af op de medische bedrijfseenheden, om deze optimaal te kunnen ondersteunen. Om bij te blijven in hun vakgebied volgen managers de marktontwikkelingen en beoordelen zij de mogelijkheden die de marktontwikkeling voor hun afdeling kan hebben. Dit geldt zowel voor medische bedrijfseenheden als stafafdelingen.

2. **Meerjarig investeringsplan**
Het meerjarig investeringsplan beslaat een periode van 10 jaar en toont welke bedrijfsmiddelen op welk moment vervangen moeten worden. Dit plan bewaakt de continuïteit in de bedrijfsvoering. Het plan wordt jaarlijks geactualiseerd vanuit de realisatie van het lopende jaar. Het meerjarig investeringsplan komt voort uit de gezamenlijke strategie besproken met de Raad van Bestuur. De levensduur van de investeringen wordt gezamenlijk bepaald door de medische bedrijfseenheid, de afdeling Medische Techniek en de investeringscommissie.

3. **Jaarlijkse investeringen**
Tijdens de jaarlijkse investeringen wordt de investeringsruimte voor het eerst volgend jaar toegewezen. Dit wordt afgeleid uit het meerjarig investeringsplan en overige aanvragen die managers indienen bij de investeringscommissie. Beiden wederom voortkomend uit de strategie besproken met de Raad van Bestuur. De investeringscommissie stelt een advies op voor de Raad van Bestuur met daarin prioriteitstelling, argumentatie en consequenties van de gewenste investeringen in relatie tot het beschikbare budget en de strategie van het ziekenhuis. De Raad van Bestuur besluit over toewijzing of afwijzing van de investering en informeert de managers middels een directiebesluit, dat kenbaar wordt gemaakt aan het gehele ziekenhuis.

4. **Inkoopproces**

5. **Evaluatie**
INKOOPPROCES INVESTERINGSGOEDEREN

✓ Het inkoopteam rapporteert over de voortgang aan de projectverantwoordelijke en de aanvrager voordat een nieuw ‘blok’ begint, en minimaal 1x per maand.
✓ De investeringscommissie wordt op de hoogte gehouden van de voortgang door Inkoop.
✓ Binnen de stafafdelingen wordt de voortgang per project besproken, zodat de afdelingshoofden hiervan op de hoogte zijn. Het is de verantwoordelijkheid van de manager en afdelingshoofden om op de hoogte te zijn van de werkzaamheden van het personeel binnen het inkoopteam.

1. Aanvraag investeringen
   • Een investeringsaanvraag wordt opgesteld door verschillende disciplines onder de verantwoording van de medische bedrijfseenheid. Een business case wordt bijgesloten voor aanvragen boven €50.000,-.
   • Elke medische bedrijfseenheid heeft een vaste contactpersoon per stafafdeling (Inkoop, Medische Techniek, ICT en Planning & Control) waarmee de investeringsaanvraag wordt besproken.
   • Er wordt een offerte opgevraagd door Inkoop om tot een voorlopige budgetaanvraag te komen.
   • De investeringsaanvraag moet door middel van een paraaf geaccordeerd zijn door de stafafdelingen.
   • De afdeling Planning & Control geeft goedgekeurde investeringen voor de financiële- en productie cijfers.
   • Op basis van de autorisatiematrix kan de medische bedrijfseenheid de investeringsaanvraag indienen bij de investeringscommissie, na intern overleg tussen de medisch manager, organisatorisch manager en zorgmanager.

2. Beoordeling investeringen
   • De investeringscommissie beoordeelt de investeringsaanvragen op basis van de volgende criteria:
     - Urgentie vervangingen en prioriteit
     - Standaardisatie van apparatuur
     - Multidisciplinair gebruik van de apparatuur
     - Relevantie ten aanzien van speerpunten ziekenhuis
     - Projectplanning en beschikbare financiële middelen
     - Strategische relevantie
   • De Raad van Bestuur maakt de uiteindelijke beslissing en maakt de goedgekeurde aanvragen door middel van een besluitenlijst kenbaar binnen het ziekenhuis.

3. Formeren inkoopteam
   • Hoofden Medische Techniek, Inkoop en ICT adviseren de investeringscommissie middels het investeringsaanvraag formulier per investeringsproject of een inkoopteam gewenst is op basis van de volgende criteria:
     - Projectrisico obv resultaten uit het verleden;
     - Investeringsbedrag;
     - complexiteit of omvang project;
     - impact op organisatie;
     - patiëntrisico.
   • De investeringscommissie neemt een besluit betreffende het inkoopteam en de projectverantwoordelijke en licht de aanvrager in. Een planning wordt opgesteld door Inkoop in overleg met de overige stafafdelingen en de medische bedrijfseenheid.
4. Samenstelling Inkoopteam

- Binnen het inkoopteam zitten ten minste vertegenwoordigers vanuit:
  - Gebruiker (projectleider);
  - Inkoop;
  - Medische Techniek;
  - ICT.
- Afhankelijk van de investeringsaanvraag wordt er een projectverantwoordelijke (Raad van Bestuur, (Zorg-)Manager, Afdelingshoofd) aangesteld waaraan het inkoopteam verantwoording aflegt. De projectverantwoordelijke wordt bepaald op basis van de volgende criteria:
  - Investeringsbedrag;
  - Complexiteit en risico's project;
  - Impact op organisatie.
- Alle relevante betrokkenen gedurende de totale levensduur van de medische apparatuur worden geïdentificeerd door bovengenoemde personen.
- Geïdentificeerde belanghebbende worden naar behoeft onderling geraadpleegd of ingelicht. Dit wordt vooraf kenbaar gemaakt bij de betreffende personen. Denk hierbij aan:
  - andere gebruikers;
  - ICT-projectleider;
  - Planning & Control;
  - deskundigen (klinisch fysicus, straling, DSMH, Arbo, laserveiligheid, ethervervuiling);
  - overige betrokkenen (CSA, PAO, TO, huisvesting, onderwijsunie, goederenontvangst, transport, schoonmaak, beveiliging);
  - Externe deskundigen.

5. Benoemen taken en verantwoordelijkheden

- Er wordt een verantwoordelijkheidsmatrix voor de gehele levensduur van de medische apparatuur opgesteld voor alle relevante betrokkenen. De verantwoordelijkheden en taken kunnen verschillen per type project.

6. Opstellen Projectplan

- Op basis van de randvoorwaarden, zoals geformuleerd door de investeringscommissie, wordt een projectplan gemaakt door het inkoopteam.
- Het projectplan wordt voorgelegd aan de projectverantwoordelijke.
- De investeringscommissie wordt op vastgestelde punten ingelicht over de voortgang van het project door Inkoop.
- Na het inlichten en raadplegen van deskundigen en betrokkenen wordt in een eerste bespreking van het Inkoopteam ('Kick-off') een concept projectplan besproken en vastgesteld.

7. Uitvoeren risicoanalyse en implementatieplan

- Het Inkoopteam voert een risicoanalyse uit welke een basis vormt voor het Programma van Eisen, maar ook voor de installatie, ingebruikname en inbedding in de organisatie. Risico’s en beheersbaarheid hiervan gedurende de gehele levenscyclus van het apparaat komen aan de orde.
- Op basis van de risicoanalyse, adviseert het Inkoopteam de zorgmanager, medisch manager en organisatorisch manager over de noodzakelijke aantoonbare vaardigheid van medisch specialisten voor het gebruik van medische apparatuur. Dit geldt ook voor de medisch technici en andere gebruikers m.b.t. de toepassing van medische apparatuur.
8. **Vaststellen Programma van Eisen (PvE)**
   - Met als doel apparatuur van verschillende aanbieders goed te kunnen beoordelen maakt het Inkoopteam een Programma van Eisen (APPENDIX F) aan de hand van het aanwezige standaard format.
   - Het Programma van Eisen wordt opgesteld op basis van functionele eisen gebaseerd op uitkomst en resultaatgerichte performance.
   - Binnen het Programma van Eisen worden extra elementen toegevoegd als ‘risico’ en ‘waarde creatie’.
   - De samenwerking tijdens het onderhoud en operatie wordt gespecificeerd.
   - In overleg met het hoofd MT stelt de medisch technicus een onderhoudsstrategie vast waarin de noodzakelijke werkzaamheden en onderhoudsfrequentie op basis van het PvE, de risicoanalyse en bedrijfszekerheid zijn bepaald. Mede op basis van de offerte wordt besloten of het onderhoud in eigen beheer zal worden uitgevoerd of wordt uitbesteed.

9. **Marktverkenning**
   - Potentiële leveranciers worden opgesomd (long list) door het inkoopteam.
   - Op basis van kwalificatiecriteria wordt aan de leverancier een Request for Information verstuurd door Inkoop. Hieruit wordt door het Inkoopteam op basis van het RFI een objectieve selectie (short list) gemaakt.
   - Er is een minimaal aantal van drie leveranciers.

10. **Offerteaanvraag**
    - Op basis van het Programma van Eisen vraagt afdeling Inkoop bij geselecteerde leveranciers (shortlist) een offerte aan met het verzoek aan de leveranciers het PvE in te vullen, waardoor een objectieve vergelijking mogelijk wordt.
    - Tijdens het offertestadium verlopen alle contacten tussen het Sint Lucas Andreas Ziekenhuis en de potentiële leveranciers via afdeling Inkoop.
    - Het budget wordt bekend gemaakt ten tijde van de offerte aanvraag.
    - Er wordt gebruik gemaakt van risico analyse.
    - Er wordt gebruik gemaakt van waarde creatie.
    - Er wordt zowel gebruik gemaakt van minimaal het Total Cost of Ownership principe. Aan te bevelen valt om gebruik te maken van het Total Value of Ownership principe. Hierin worden de realisatiefase, of implementatiefase meegenomen.

11. **Keuzematrix opstellen en beoordelen offertes en leveranciers**
    - De offertes en ingevulde PvE’s worden door het Inkoopteam beoordeeld en gescoord, m.b.v. een keuzematrix waarop alle eisen uit het PvE beoordeeld worden, met een bepaald waardeoordeel per eis. Op die manier kan een objectieve keuze tussen de verschillende leveranciers worden gemaakt.
    - Risico analyse, added value en service interactie worden besproken met de potentiële leveranciers.
12. Proefplaatsingen en/of site-visits
- Er worden zo nodig proefplaatsingen en site-visits gedaan om een gedetailleerd inzicht te krijgen in hoeverre het apparaat aan de gestelde eisen uit de keuzematrix en het PvE voldoet en hoe het in praktijk bevalt.
- Het Inkoopteam stelt een evaluatieformulier voor klinisch gebruik vast.
- Medische Techniek coördineert proefplaatsingen en/of site-visits en verzorgt de planning, tijdelijke voorzieningen, inkoopbonnen, aflevering, acceptatietest, logistiek, teruggave aan leverancier en een technische beoordeling.
- De gebruiker verzorgt, met ondersteuning van de leverancier, voorafgaand aan de proefplaatsing, een instructie voor de gebruikers.
- De ingevulde evaluatieformulieren worden door het Inkoopteam beoordeeld en meegewogen in het eindoordeel.

13. Leveranciers- en productkeuze
- Om tot een objectieve leveranciers- en productkeuze te komen wordt de prijs-kwaliteitverhouding van de producten in kaart gebracht.
- Om alle aspecten mee te laten wegen in het besluitvormingsproces worden er wegingpercentages aan de prijs (P) en de kwaliteit (Q) van het product toegekend, opgeteld komen de percentages op 100% uit.
- Bij de kwaliteit spelen meerdere aspecten een rol. Onder de kwaliteit vallen de volgende aspecten:
  - Programma van eisen
  - Proefplaatsing/Site visits
  - Productevaluatie
  - Leveranciersevaluatie
  
De weging kan per project verschillen.

14. Onderhandeling
- De betrokken inkoper voert onderhandelingen met twee of meer geselecteerde leveranciers om de beste prijs/kwaliteit verhouding te vinden en betrekt daar zo nodig de overige leden van het Inkoopteam bij.

15. Eindrapportage = Investeringsadvie
- Het Inkoopteam geeft een aanbeveling voor de leveranciers- en productkeuze op basis van de ranking. Op basis van de beoordeling van klinische, technische en financiële aspecten van de apparatuur van de verschillende leveranciers wordt door het Inkoopteam een investeringsadvies opgesteld. Hierbij worden de beantwoording van het PvE, de offerte, de leverancier en de resultaten van de proef meegewogen.
- De definitieve versie van het investeringsadvies wordt voorgelegd aan de projectverantwoordelijke van het inkoopperso. De betrokken stafafdelingen geven door middel van een paraaf aan dat zij akkoord gaan. Planning & Control checkt de financiële- en productie cijfers.
- Na akkoord wordt het investeringsadvies naar de Investeringscommissie en de Raad van Bestuur gestuurd door het inkoopteam. De Investeringscommissie is verantwoordelijk voor het procesverloop en of dit overeenkomt met de goedgekeurde investering. Zij brengen advies uit aan de Raad van Bestuur.
- Een gunningsadvies wordt door het inkoopteam aan de leverancier gestuurd.

16. Investeringsbesluit
- De Raad van Bestuur raadpleegt zo nodig de bedrijfsleider, organisatorisch manager (een deel) van het Inkoopteam en/of andere betrokkenen en neemt een Investeringsbesluit.
Het investeringsbesluit wordt kenbaar gemaakt aan de organisatie door middel van het versturen van de directiebesluiten.

17. Contracteren
- Het contract (dat in de offertefase is geaccordeerd) wordt definitief opgesteld en ondertekend. Hiervoor wordt modelovereenkomst (medische) apparatuur FHI-NEVI gebruikt.
- Hierin wordt ook het service contract van WIBAZ vermeld, of naar verwezen. Het service contract wordt gelijktijdig met de investeringsovereenkomst afgesloten.
- Contractperformance criteria worden in een SLA vermeld en zijn bekend bij de verantwoordelijke personen. Het beschrijven van de doelstellingen en manier van meten wordt in overleg met de leverancier bepaald.
- De SLA wordt opgesteld voor Medische Techniek, ICT en de Medische Bedrijfseenheid. Deze worden ook gebundeld opgeslagen binnen de Inkoop afdeling.
- Belangrijke criteria zijn prijzen van onderdelen, onderhoud, updates en upgrades. Daarnaast moeten de boete clausule en consequenties die hangen aan het niet presteren van leveranciers meegenomen worden en benoemt worden in een prestatiecontract of de bijlage van de modelovereenkomst (medische) apparatuur FHI-NEVI.

18. Bestelling
- Op basis van het investeringsbesluit en de definitieve offerte stelt afdeling Medische Techniek een interne bestelbon op. Indien aanwezig, wordt een (meerjarige) serviceovereenkomst of een technische training altijd mee besteld.

19. Realisatie overige interne voorzieningen
- De realisatie van interne voorzieningen wordt met afdeling Projecten, Advies en Ondersteuning afgestemd.
- Ondersteunende afdelingen en leveranciers benaderen voor plannen werkzaamheden volgens reeds opgevraagde offertes.
- Met de leveranciers, ondersteunende diensten en het inkoopteam wordt een planning van levering, installatie, tijdelijke voorzieningen, training, ingebruikname enz. opgesteld.
- Zo nodig wordt met de organisatorisch manager de patiëntenplanning aangepast.
- De planningen worden verspreid onder betrokkenen.
- Bij grootschalige projecten (bv. vervanging van röntgenapparatuur) wordt veelal een Projectteam Bouw ingesteld dat alle aspecten van de implementatie van de apparatuur belicht en voorbereid. Naast architect, adviseur en installateur is de afdeling Medische Techniek hierin vertegenwoordigd.

20. Training van gebruikers
- In overleg met de Onderwijsunie en de leverancier kan de organisatorisch manager op basis van het eerder vastgestelde opleidingsplan de training voor gebruikers plannen en starten.
21. Contractmanagement
• Contractmanagement geeft aan dat de organisatie bijhoudt of de leverancier zich aan de gemaakte afspraken houdt. Zo kunnen problemen worden besproken en verbeteringen plaatsvinden voor vervolgbajecten. De resultaten van het contractmanagement van Medische Techniek, ICT en de Medische Bedrijfseenheid worden ook gebundeld binnen de afdeling Inkoop.
• Contractmanagement bevat doelstellingen voor het Sint Lucas Andreas Ziekenhuis (voor meerdere afdelingen) als de leverancier.
• De frequentie van rapportage moet kort genoeg zijn om proactief te kunnen sturen op risico’s en op het verschil tussen het resultaat en de gewenste situatie.
• Verantwoordelijkheden worden ook voor interne prestaties vastgelegd.

22. Evaluatie van inkoopproces
• Inkoop is verantwoordelijk voor de evaluatie van het inkoopproces door het inkoopsteam. Hiervoor wordt een standaard evaluatieformulier gebruikt. De evaluaties worden aangeboden aan de Investeringscommissie.

➢ In onderstaande Figuur zijn de verhoudingen schematisch weergegeven voor de specificatie, kwalificatie en selectiefase van het inkoopproces.