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Cost allocation in the Operating Room department: The consumer pays

Master's thesis

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Isala klinieken

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Management Summary

As a result of ageing populations and medical facilities becoming more expensive every day, the total health care expenses of western countries are increasing year after year. This is the reason for governments to take measures and gain control of the health care costs.

The government measures require hospitals to work more efficiently and effectively. Isala klinieken is a large Dutch hospital faced with this need to improve efficiency. Isala klinieken has a divisional structure, with an Operating Room & Intensive Care division providing *Operating Room* (OR) capacity to other – primary – divisions. The primary divisions pay an hourly rate for demanded OR time, and a fixed (differentiated per specialty) tariff per session. As cost allocation dictates incentives, and incentives influence decisions, the cost allocation model is a tool to promote efficient and effective medical and managerial decisions.

Isala klinieken initiated this research to evaluate the current cost allocation model, and to design alternative conceptual approaches that lead to better cost allocation and accountability that promotes cost reduction by more efficient and effective decisions.

We found that a cost allocation model should satisfy two main needs: It should give incentives that promote efficient and effective decisions, and it should be practical. We define criteria – along these two needs – to score the current cost allocation model and possible alternatives. Our criteria are *information efficiencies, evaluation of divisions, behavior congruence, communual resource pooling, effort, complexity, and infrastructural change.* The scores for 'evaluation of divisions' and 'behavior congruence' are based on financial estimates.

With the current cost allocation model, **74,9%** of OR costs are 'directly' charged to the decision maker. This means that for about 25% of the costs, someone else is responsible. As a result, **44,3%** of the costs of the OR department can not be influenced by this department. For this reason, the managers of the OR department can not be held fully responsible for budget overruns.

Our approach to find better alternatives results in two classes of solutions: solutions for the long term, and solutions for the short term. These short-term solutions should be considered as a first implementation phase, it is a step to the desirable situation.

Cost allocation models can be characterized by two important aspects: The first aspect considers the responsibilities of the various departments. For the

cost allocation model of the OR, the answer on the question 'What is the Operating Room product?' defines this first aspect. We call this the service basket. This service basket also defines which department is responsible for certain costs. The second aspect considers transfer pricing. The 'customer' (primary division) has to pay for usage of the Operating Room product. The selection of cost drivers, the method for determination of the transfer price, and autonomy issues are considered.

We formulate the alternative cost allocation models following the same order: first we define several different service baskets, then we define one or more transfer pricing systems for every service basket. This results in six alternative cost allocation models for the long term, and four possible cost allocation models for the short term.

For the long term, we recommend Isala klinieken to use a model that includes only personnel, equipment (excluding instruments), and disposables in the OR product. In this model, expensive disposables are charged to the primary division using separate cost drivers. Instruments, blood products, medication, and implants are a cost responsibility for the primary division. Furthermore, primary divisions are charged by the Sterilization department for sterilization of instruments, by the department for Pre-operative screening for screening the patient, and by the Recovery department for 'consumed' recovery time. This approach results in that **92,4%** of OR costs are directly charged to the primary division. Only **18,1%** of OR department costs can not be influenced by this department.

For the short term, we recommend Isala klinieken to use a model that includes personnel, equipment, instruments, disposables, medication, sterilization, and pre-operative screening in the OR product. Expensive disposables and medication are charged to the primary divisions using separate cost drivers. Costs for blood products and implants are a cost responsibility for the primary divisions. The primary divisions are charged by the Recovery department for 'consumed' recovery time. This approach results in that **85,5%** of the OR costs are directly charged to the decision maker. The percentage of costs of the OR department that the department can not influence decreases to **27,8%**.

Furthermore, we advise Isala klinieken to use a transfer pricing system with 'budgeted full costs' as costing alternative. This is in line with the current practice in this hospital.

Implementation of these cost allocation models will reduce perverse incentives, and will result in cost reductions. However, it is hard to quantify: probably, several actors already look at the big picture and behave according to what is good for the hospital concern. A large hospital such as Isala klinieken should, however, not rely on such coincidences; the system should promote behavior congruence.

Preface

"Students in the Financial Engineering track of the Industrial Engineering and Management Masters programme are going to work at banks or insurance companies" is a commonly heard statement. I have passed the first serious opportunity to enter this business, as my graduation project does not consider risk and return.

The credit crisis that started in summer 2007 showed the world that the models we use in this research area are even less solid than was presumed. This, in combination with my passion for people, processes, and health care in particular, and the help of Erwin Hans, resulted in a graduation project at Isala klinieken in Zwolle. A project focussed on management and human behavior.

This report covers the research that I performed in the scope of this project. I thank Reinoud Joosten and Erwin Hans, my scientific supervisors, and Bernd van den Akker and Niels van Dam, my supervisors on behalf of Isala klinieken, for the time and effort they put into this project.

I also thank Dennis Buitelaar for the time and effort he put into expressing his ideas and reading draft versions of this report. Furthermore, I thank Jessey, Ria, Annemarie, Astrid, Martine, Henry, Jeroen, Gerrit, Günter, Ingmar, Janneke, Nanda, and Elise for the wonderful time I had in our 'Personeelsflat' in the center of Zwolle. Finally, I thank everyone else who was willing to help me to complete this project.

I have marvellously enjoyed the period of my graduation project, and the period as a student in general. Apart from studying, I have spent my time with sports, organizing in boards and committees, work in the health care sector, and even more studying, this time for my law study. The little time I had left, was spent on traveling and in (not behind!) bars. I thank everyone who was part of these activities for the wonderful student life I experienced.

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Robin Meijboom

Contents

Chapter 1

Introduction

Ageing populations and increasing costs of health care products are, besides other factors, driving total health care expenses of developed countries to high proportions (in the Netherlands to 9,5% in 2004) of the Gross Domestic Product (GDP) (OECD, 2008; White & White, 1994; Asselman, 2008). Gupta (2004) expects that this will also be the trend for coming years. This both proportional and nominal increase in health care expenses is reason for governments to take measures and gain control of health care costs.

The most important measure in the Netherlands is the reform of the health care sector in 2005. Because the former financing system of the health care sector did not have enough incentives for health care providers to work efficiently and effectively, the health care market was partly liberalized.

Bringing about 30 percent of total health care costs, hospital care is by far the most expensive facility in the sector (Asselman, 2008). Before the implementation of the new financing system in 2005, hospitals were paid for medical production rather than for diseases treated. Such a system encourages increased (ineffective) output. To overcome this problem and give hospitals incentives to be efficient and effective, a system of *Diagnosis Treatment Combinations* (DTCs) is implemented. This DTC system is discussed in Section 1.1.

The introduction of this DTC system and other measures (e.g. reform of health care insurance system) have severe consequences for hospitals. More and more health care products are priced by the market. Hospitals have to transform from semi-governmental bureaucracies to efficient market parties. The importance of cost accountability increases significantly; to stay financially healthy and keep reserves at appropriate levels, hospitals have to make a small profit every year.

Isala klinieken, a Dutch hospital with 5 locations in and around Zwolle, is faced with this need for transformation. The *Operating Room* (OR) department accounts for 27 million euros of costs (budgeted 2009). However, not all costs can be influenced by this department. Several cost types are brought about by other departments (on the OR shop floor), but added to the costs of the OR department. This can result in choices that lead to local optima at the primary

division, but do not result in the best overall performance of the hospital as a whole. To overcome this problem, Isala klinieken initiated this research to evaluate and improve the current cost allocation model regarding OR costs. The hospital Isala klinieken is the subject of Section 1.2.

The problem description for this research is discussed in Section 1.3, followed by the research goals in Section 1.4. The research questions and approach of this research are considered in Section 1.5. In Section 1.6, the position of this work is discussed in a broader management perspective. The structure of this Master's thesis is presented in Section 1.7.

1.1 DTC system

The DTC system is designed to replace the 'old' output-based financing structure by running both systems parallel for several years. More and more DTCs are transferred from the 'old' system to the new one.

The introduction of the DTC system changes the financing structure of hospitals considerably. In the 'old' system, output is a significant determinant of a hospital's income, with medical and support activities as output parameters. This situation encourages ineffective production because extra production results in increased income, but might not contribute to a patient's health. The DTC system takes diseases treated as output parameter rather than production, which encourages hospitals to treat patients as efficient as possible.

Units in this system, DTCs, represent the activities needed for diagnosis and treatment of diseases, grouped according to these factors (Asselman, 2008). Most of the diagnoses and treatments fall under a formal DTC. DTCs contain not only diagnostic and therapeutic activities, but also support activities such as patient days. Although the compensation a hospital receives for a certain DTC is fixed (predefined), its exact contents depend on patient characteristics; some patients require more, fewer or different activities than the 'average' patient. The activities performed for a certain DTC can be represented in a DTC profile; it shows the average number and type of the different activities.

The DTC system was first implemented in 2005. For 20% of DTCs (2009), hospitals are paid for 'completed' DTCs rather than for activities (*Website Ministry of Health, Welfare and Sport*, 2009). The price of a DTC is partitioned into a hospital share and a specialist share. The specialist share is the product of the standard time and the hourly wage as defined by the NZa ('Nederlandse Zorgautoriteit', Dutch Health Care Authority). The hospital share depends on negotiations between hospitals and health care insurance companies, and may vary from hospital to hospital. In the end, all 'bulk' hospital care should be financed using DTCs. Only 'special care' such as *availability functions* (trauma care, etc.) will be financed otherwise.

1.2 Isala klinieken

Isala klinieken is one of the largest non-academic hospitals in the Netherlands. It provides base care, and has a large number of topclinical functions, such as thorax surgery, neuro surgery, and dialysis. Isala klinieken also provides education and training (*Website Isala klinieken*, 2009).

Isala klinieken has 5300 employees and 1000 beds, and organizes 502.000 outpatient consults and 89.000 admissions yearly (*Website Isala klinieken*, 2009). The organization structure and financial control are discussed in Sections 1.2.1 and 1.2.2, respectively.

1.2.1 Organization

Administratively, the hospital is divided in 7 divisions: 5 *primary divisions* clustering related specialties (i.e. Surgery, and Internal Medicine), and 2 *support divisions*: Medical Support Specialties (MSS), and Operating Room & Intensive Care (OR&IC). These support divisions support the primary divisions with medical products. The division MSS provides radiology products, laboratory products, pharmacy products, etc. The division OR&IC provides Intensive Care products, and Operating Room products. Furthermore, it acts as a primary division by providing anesthesia to patients outside the OR. The central department *Isala facilitair* supports all divisions with other products (space, electricity, cleaning, etc.).

The OR department is part of the division OR&IC.

1.2.2 Financial control

Every year, the hospital administration sets a financial target for the hospital. With this target in mind, the division directors negotiate about how this target is to be reached. These negotiations result in budgeted costs and budgeted revenues (production) for every division.

For their production, the primary divisions utilize their own nursing departments, outpatient clinics and other departments, but they also utilize central resources from the MSS and OR&IC division. Examples are the fairly standardized (in terms of required resources) products from the MSS division, such as lab determination of blood glucose and X-ray of hip, and the fairly complex (in the same meaning) product of the OR.

Usage of central medical resources from the MSS and OR&IC departments is charged and forms the budget for these divisions. For the division MSS, the charge is just $costs = q \times p$ with q and p being volume and price, respectively. The price of the OR product has a time component and a session component, both differentiated according to specialty, to account for the large variability of costs. Central overhead costs are distributed to the divisions based on both usage and turnover.

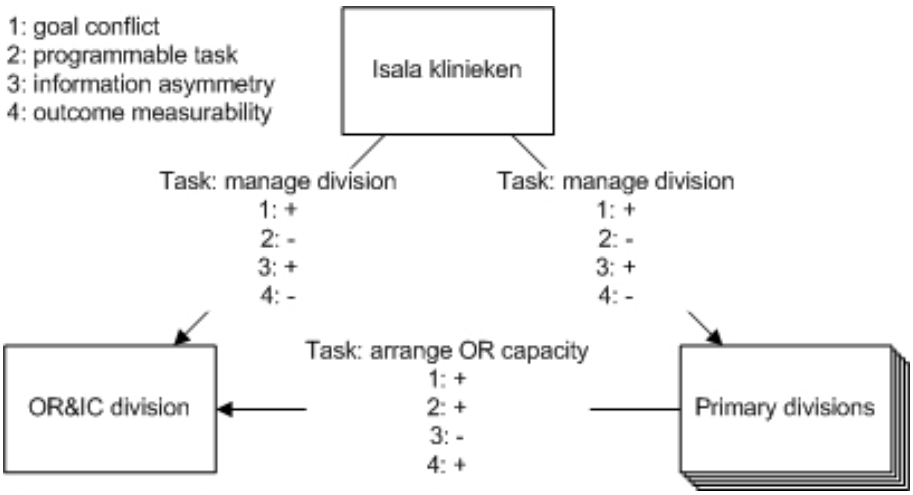

Figure 1.1: Agency problem at Isala klinieken

1.3 Problem description

Until halfway 2006, the OR department was financed by a fixed budget. Users of the ORs wanted more OR time, nicer tools, and 'golden' sutures. This has repeatedly resulted in budget overruns for the OR department. This situation was reason for a change in budgeting. Halfway 2006, a first step was made to overcome this problem; production exceeding the volumes agreed had to be paid by the user at hand. This solved at least a part of the problem.

As from January 1st 2009, the budget of the OR department is handed over to the users of the OR. With this extra budget, the users have to 'buy' the OR product (or spend it otherwise). The transfer price, based on the budgeted cost price, has a time component (hourly charge) and a material resources component (sessions), both differentiated per specialty. This measure results in better cost allocation, accountability, and managerial and medical decisions. The differentiation per specialty makes that every user pays, more or less, a fair amount. The system still does not encourage appropriate use of resources; the material resources are still 'free' (have already been paid for) on the short term, and the differentiation per specialty does not take the different types of surgeries into account.

Further analysis demonstrates that this problem is, in fact, a complex agency problem: the hospital concern (principal) can not verify whether the primary divisions (agents) behave in a way that is favorable for the hospital (for a more in-depth view on agency theory, see Section 2.1). The hospital has principal-agent relations (as principal) with both the primary divisions and the support divisions (in this case, the division OR&IC). Additionally, the primary divisions have a principal-agent relation (as principals) with the OR department (OR&IC) concerning the OR capacity. This agency structure is reflected in Figure 1.1.

Principal-agent relations are often characterized by *goal conflicts*, and *infor-*

mation asymmetry. If the agent's task is open to decisive authority (*non programmable task*, such as 'manage division X'), outcome measurement is hard, and it is never sure whether the agent has no double agenda (Eisenhardt, 1989). Because division directors can not oversee the effects of their actions for the whole hospital (they have *bounded rationality*), the organization should be arranged such that improving the financial performance of the division improves the financial performance of the whole organization.

The agency relation between the primary divisions and the OR&IC division (regarding the OR product) is characterized by a programmable task. Because a representative of the primary division is present when the service is delivered (the surgeon), there is no information asymmetry in this sense. If the OR department does not provide the service as agreed, the doctor will notify the agent. Hence, from an agency point of view, this is not a problematic relation.

The relations between the hospital management and the management of the primary- and support divisions are characterized by high informational asymmetry, non-programmable tasks, and goal conflicts (improving the performance of the division does not by definition improve the performance of the whole organization). Because the OR department can not influence all costs assigned to this department, and the primary divisions influence costs that are not theirs, outcome measurability is questionable.

In this complex situation, motivation to work inexpensive, information on resource usage, and judgement criteria (norms) are distributed in a dubious way. The concern has a stake (motivation) in behaviour of primary- and OR&IC divisions (efficiency and outcome measurability), but no information on resource usage and judgement criteria. Hence, the concern can not judge nor influence the behavior of the primary divisions. The OR&IC division has a stake (outcome measurability) and information about the primary divisions' behavior, but can not judge nor influence this behavior. The primary divisions do have these judgement criteria, but do not have information on behavior. Nor do they have motivation to work efficient; several resources are free for use. The organization Isala klinieken has sufficient information and motivation to take good decisions, but the distribution over several divisions might result in bad decisions.

Example: There are expensive staplers with cheap staples and cheap staplers with expensive staples. If the primary division has to pay the stapler and the OR department the staples, the primary division will (in case of local optimization) purchase the cheap stapler with expensive staples. This choice is not by definition optimal for the hospital concern.

As mentioned above, several measures have already been taken to overcome this agency problem. Now, the question comes in whether further measures are desirable.

1.4 Research goals

Not the whole agency problem can be solved within the scope of this research. The focus of this research is on cost allocation. As the cost allocation model

distributes information and motivation, it is an essential tool to prevent and solve agency problems.

In this thesis, we consider choices regarding cost allocation on two themes: service basket and transfer pricing. The service basket defines which services are offered by the OR department (and which are not); making the service basket smaller also makes the agency problems less significant. The transfer pricing structure, if applied well, is a method that solves agency problems.

> The objectives of this research are to evaluate the current cost allocation model, and to design alternative conceptual approaches that lead to cost reduction by better cost allocation and accountability.

Reaching this research goal contributes to solving the complex agency problem mentioned in Section 1.3, because better cost allocation and accountability result in more information and motivation for the primary divisions; local optimization results in approaching optimum for the hospital as a whole. This results in more appropriate use of resources, hence, cost reduction.

1.5 Research questions and approach

To reach the twofold research objective, we introduce two research questions with corresponding sub-questions:

1. **What is the performance of the current cost allocation model?**
   - 1.1. How are OR costs currently allocated?
     - 1.1.1. What is the cost structure of the OR product?
       - A. What activities are performed in the OR?
       - B. What cost components can be identified in the OR?
     - 1.1.2. Which of these costs are allocated to the OR department?
     - 1.1.3. How are the costs of the OR department transferred to the primary divisions?
   - 1.2. What criteria should be used to assess the cost allocation model?
     - 1.2.1. What criteria for assessment of the cost allocation model are identified in literature?
     - 1.2.2. What criteria for assessment of the cost allocation model should be added from a practical/economic point of view?
   - 1.3. What are the scores for the criteria for the current cost allocation model?

We answer Research Question 1 in Chapter 3.

2. **How can the cost allocation model be improved, considering the aforementioned criteria?**

2.1. What measures can be taken to improve the cost allocation model on the long term?
   2.1.1. Which possible service basket changes improve the score on practical criteria?
   2.1.2. What transfer pricing methods can be used to increase the scores on agency criteria, considering proposed changes in service basket?
2.2. What practical factors limit the possibility of implementing these changes?
   2.2.1. What practical limitations exist hospital-wide?
   2.2.2. What practical limitations exist in the OR department?
2.3. What measures can be taken to improve the cost allocation model on the short term?
   2.3.1. What changes (achievable on the short term) of the service basket result in increased cost accountability?
   2.3.2. What changes in transfer pricing result in increased cost accountability?

We answer Research Question 2 in Chapter 4. 'Short term', as used in this question, is used in the sense that no radical infrastructural change has to take place before the improvement can be implemented.

We answer 'situational' questions based on observations and interviews with persons involved in the OR processes and financial control. The evaluation criteria and transfer pricing methods are based on scientific literature.

1.6 Position of this work

Van Houdenhoven, Wullink, Hans, and Kazemier (2007) propose a framework for planning and control in hospitals. This framework was developed to serve as a common language to enhance communication between different stakeholders. This framework is described below. Subsequently, financial control is considered in the light of this framework.

1.6.1 Generic framework for hospital planning and control

The framework consists of four management areas being *Medical planning*, *Resource capacity planning*, *Material coordination*, and *Financial planning*. These four management areas can be decomposed in four levels of control:

Strategic level: Addresses formulation of long-term objectives and determining the investments needed to reach these objectives.

Example decision: The hospital wants to provide radiotherapy for cancer patients. 3 machines of a certain type should be purchased.

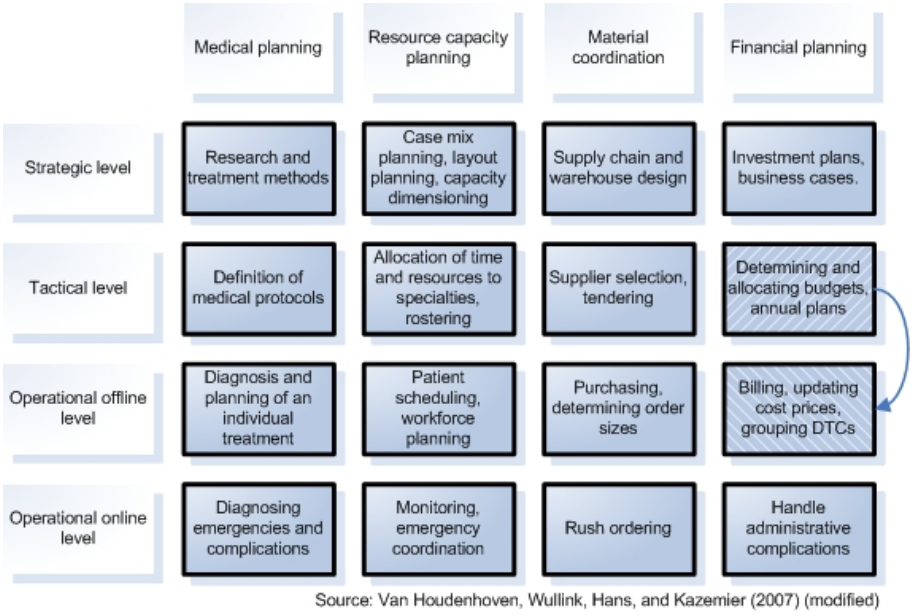

Figure 1.2: Framework for planning and control in hospitals

Tactical level: Considers the working methods to reach the objectives and formulates policy.

Example decision: For every radiotherapy machine, 3 radiotherapeutic technicians will be scheduled during operating hours.

Offline operational level: Addressess decisions that have very concrete effects and are aimed at a short-term effect exclusively.

Example decision: This week, Rachel, Joey and Chandler are scheduled in radiotherapy unit 1.

Online operational level: In hospitals, unexpected events do not come unexpectedly. They play a significant role in hospital organization. For that reason, they should be considered explicitly. On-the-fly decisions that address unplanned problems are made on the online operational level.

Example decision: Rachel is ill today. She is replaced by Phoebe.

The resulting 4×4 matrix can be filled with numerous examples, which depend on the scope. The scope can be the hospital as a whole, a division or even a single department. A typical example of the framework that addresses the entire hospital is depicted in Figure 1.2.

1.6.2 The framework and financial control

Financial control typically concerns decisions on a *tactical level*; it supports integration and differentiation of departments within organizations, and should

fit within the internal and external environments. It regards the working procedures that relate to financial subjects. It should depend on strategic decisions and result in a system that works well in the operational levels. In other words, financial control (such as transfer pricing) supports the organization to accomodate to internal and external factors.

The decisions about budgets and targets should be executed as well. Budgets and targets must be accounted for, transfer pricing must take place, suppliers have to be paid, and production has to be billed and cashed. Decisions concerning these subjects are made on the *operational level* of the financial management area.

1.7 Structure of this thesis

With the goal of this research in mind, we address several theoretical concepts in Chapter 2. We present models that we use to clarify our problem, and suggest alternative approaches to solve this problem.

In Chapter 3, we discuss several processes at Isala klinieken, and the current cost allocation method. Furthermore, we propose criteria – and use these criteria – to evaluate the current cost allocation method. This answers Research Question 1.

In Chapter 4, we suggest four cost allocation models that can be used to reach positive results on the short term, and six alternatives that can be used to gain structural improvement. We score these alternatives using the same criteria that we use to evaluate the current situation in Chapter 3. From both categories, we recommend one alternative to be considered for further investigation and implementation. This answers Research Question 2.

In Chapter 5, we recapitulate on the most important findings of this research and present recommendations.

Chapter 2

Theory

In this chapter, we elaborate on theoretical topics that support the claims that we make in subsequent chapters. In Section 1.3 we discuss the problem that is the reason for this research. In that section we use agency theory to describe and visualize this problem. A more in-depth elaboration on agency theory can be found in Section 2.1. We also use agency theory to understand criteria to evaluate the current cost allocation model, and possible alternatives.

A possible method to prevent the problem mentioned above is by reducing the service offered by the OR. In the example at the end of Section 1.3, this would mean that the primary division would have to bring in the staples itself. One method to solve the problem is *transfer pricing*. In Section 2.2 we elaborate on transfer pricing.

The possible systems for transfer pricing mentioned in Section 2.2 are useless if we do not know what system fits to which organization. In Section 2.3 we discuss several organization models and the transfer pricing models that fit these organization types.

2.1 Agency theory

In Section 1.3, we use *agency theory* to describe the current problem that the solutions mentioned in this thesis intend to (partially) solve. According to Jensen and Meckling (1976), "We define an agency relationship as a contract under which one or more persons (the principal(s)) engage another person (the agent) to perform some service on their behalf which involves delegating some decision making authority to the agent".

"Agency theory is concerned with resolving two problems that can occur in agency relationships. The first is the agency problem that arises when (a) the desires or goals of the principal and agent conflict and (b) it is difficult or expensive for the principal to verify what the agent is actually doing. The problem here is that the principal cannot verify that the agent has behaved appropriately. The second is the problem of risk sharing that arises when the

principal and agent have different attitudes toward risk. The problem here is that the principal and the agent may prefer different actions because of the different risk preferences" (Eisenhardt, 1989). It is clear that our problem, as described in Section 1.3, is one of the first category.

There are two 'areas' of agency theory: *Positivist Agency Theory* elaborates on situations in which principals and agents have conflicting goals, and describes governance systems that limit the agent's self-serving behavior. This stream of literature focuses almost exclusively on relationships between owners and managers of large public corporations (Eisenhardt, 1989). Because both the target group and subject do not match our problem, we do not consider this research area. The other stream, *principal-agent research*, is concerned with more general principal-agent relationships. This theory can be applied to every principal-agent relationship. Several problem aspects, assumptions, and variables are specified. The focus of principal-agent research is to determine the most efficient contract between the principal and the agent, given these problem aspects, assumptions, and variables.

In contrast to this 'normal use', we use agency theory to describe our problem and identify *variables* that we can change to solve this problem. The problem aspects, assumptions, and variables that are the foundation of principal-agent research, and agency theory in general, are described below.

2.1.1 Problem aspects

Eisenhardt (1989) and Vosselman (1999) mention two problem aspects in agency theory: *Moral hazard* and *Adverse selection*. The difference between these problem aspects is timing relative to the agency agreement.

Adverse selection (ex ante) refers to the situation that the agent provides wrong or incomplete information to the principal. As a result of this wrong or incomplete information, the principal contracts an inappropriate agent or contracts the appropriate agent but under bad terms. Adverse selection is a result of *information asymmetry* and *goal conflict* (see Section 2.1.2 and Section 2.1.3).

Moral hazard (ex post) means that the agent does not behave in correspondence with the interests of the principal. The reasons behind this behavior are, as with adverse selection, information asymmetry, and goal conflict.

Laffont and Martimort (2002) put it another way: They claim that the problem of incentive theory is the delegation of a task to an agent with *private information*. This information can be of two types: the agent can take an action unobserved by the principal (hidden action), or the agent has private knowledge about his cost or valuation that is ignored by the principal (hidden knowledge). They call the first type of private information 'moral hazard', and the second type of private information 'adverse selection'.

We stick to the terminology used by Eisenhardt and Vosselman, as these are the actual problem aspects. The types of private information mentioned by Laffont and Martimort are factors that can cause these problems (if present), but are not problematic by definition. Laffont and Martimort just decompose the term

'information asymmetry' into 2 types. We consider 'information asymmetry' as a variable, it is discussed in Section 2.1.3.

When using agency theory with the goal of describing a problem and identifying variables to solve the problem – rather than its normal use – we add another problem aspect: *Bounded rationality*. Simon (1957) defines the principle of bounded rationality as: "The capacity of the human mind for formulating and solving complex problems is very small compared with the size of the problems whose solution is required for objectively rational behavior in the real world – or even for a reasonable approximation to such objective rationality." Moreover, the rationality of the human mind is limited by the available information and costs of gathering information. Because decision makers can not justify the time and expense of obtaining complete information, decision makers satisfice rather than optimize (Daft, 2003).

2.1.2 Assumptions

Agency theory is based on several assumptions of human behavior, organizations, and information. Assumptions of human behavior are that they follow their *self-interest*, they have *bounded rationality*, and are *risk averse*. Assumptions about organizations are a *partial goal conflict* among its participants, that *efficiency is the effectiveness criterion*, and there is an *information asymmetry* between the principal and agent. Furthermore, information can be regarded as a *purchasable commodity*.

Self-interest does not require deeper elaboration. *Bounded rationality*, as defined in Section 2.1.1, is the main reason why organizations decentralize. Agents are usually more *risk averse* than principals, as most principals have more than one agent, but most agents have only one principal. Hence, principals spread their risk over several agents, while the individual agents are fully responsible for their specific task. Agents that bear a significant amount of risk regarding the outcome of the task take less risk (and return) than the principal would like.

Goal conflicts between principal and agent arise because they differ in risk preference, and because agents follow their self-interest when possible. In organizations, a major part of an agent's (perceived) *effectivity* is the measurable thing: *efficiency*. Because of bounded rationality of the principal, and the agent being involved in his business most, there is an *information asymmetry* between the principal and agent.

Agency theory treats information as a *purchasable commodity*. Information can be gained from *information systems*, such as a 'board of directors', budgeting, 'management by objectives', etc. All these methods cost money, both for infrastructure and people, but they are needed to monitor agents. In Section 2.1.1 we mention that we use agency theory for describing a problem and identify variables to solve the problem. The problem aspect that we introduce there – bounded rationality – can be (partially) solved by information systems, because it does only inform the principal of the agent's behavior, it can also inform the agent on what behavior is appropriate.

2.1.3 Variables

Several variables can be used to describe principal-agent relations. *Outcome measurability* refers to the opportunities to measure outcome of the actions and decisions by the agent, and not those of others. *Task programmability* refers to the level of which appropriate behavior of the agent is known in advance. *Outcome uncertainty* refers to both the uncertainty of outcome that does not result form the agent's decisions and actions but depend on the environment, and the uncertainty of the outcome of the actions and decisions of the agent. In the last case, a risk averse agent makes a different risk/reward trade-off compared to his risk neutral principal. *Information asymmetry* refers to the difference in information position between the principal and agent. The *time* variable refers to the history a principal and agent have together. A principal who knows the (potential) agent well, will not be tricked into adverse selection. Last, but not least, is the degree of *goal conflict* between principal and agent. This variable depends on the other variables, as well as measures taken to align goals.

2.2 Transfer pricing

Service from the OR department provided to a primary division is a form of internal transactions.

Internal transactions take place when one responsibility center (for example, department) delivers goods or services to another responsibility center in the same organization (Vosselman, 1999). It should be a good or service that can be clearly defined, such that it can be object of an exchange transaction (Bouma & Van Helden, 1994). A transfer price should be charged when a good or service is of value for the internal consumer and requires resources from the internal producer.

Transfer pricing has been an issue since the emergence of 'multi-unit business enterprises' (Eccles, 1985). This can be explained by the (possibly) conflicting objectives of managers. To minimize agency problems in decentralized companies and align managers' and company's interest, the method of coordinating internal transactions has to fit in the organizational context, such as structure, strategy and process (Van der Meer-Kooistra, 1993). However, there is no transfer pricing system to promotes global-optimal decisions without interfering with the autonomy of divisions (Thomas, 1980). Hence, this is a trade-off.

Although many decisions have to be made when implementing a system for transfer pricing, the discussion in this section is limited to possible choices on costing alternatives, calculation, autonomy, and cost drivers. Other decisions (described by Van der Meer-Kooistra (1993)) are not that fundamental, and can be made in a later stage.

2.2.1 Costing alternatives

In this section, we discuss the most common costing alternatives for transfer pricing. These costing alternatives are transfer prices based on *variable costs*, *variable costs plus lump sum*, *full costs*, *full costs plus markup* (administrative principles), *market price*, *negotiation* (economic principles), and *dual pricing* (hybrid).

Garrett (1992) argues that methods based on costs only (i.e. without markups for profit) do not motivate the supplying divisions very well. We do not agree with this view, as we think that the goal of cost-covering production can be as motivating as a profit target.

Thomas (1980) points out that costing alternatives based on administrative principles are carried by allocated costs, which are arbitrary; this results in arbitrary transfer prices. In 1980 this was a good argument; today, it is not. Increased use of IT has resulted in better cost allocation possibilities, which make cost allocation less arbitrary.

Variable costs

Usage of *variable costs* as transfer price results in good decisions in the departments downstream (Garrett, 1992), because the transfer price reflects the actual costs (unavoidable costs are considered as such properly). Costs resulting from investments that have already occured are neglected, as they are (mostly) not reversible. This is also true for costs that are incurred regardless of volume, such as (short term) costs for management.

A disadvantage of this costing approach is that considerable knowledge of the production process is needed, such as the distinction between variable and fixed costs and its relation to the cost drivers.

Variable costs plus lump sum

Services and goods are transferred for *variable costs*, while a *lump sum* is paid periodically to cover overhead and profit. This should result in the same quality of decisions downstream, but also provide motivation by the possibility of making profit (Garrett, 1992). It is a way to camouflage a *cost center* and make it look like a *profit center*.

As with the 'variable costs' method, a disadvantage of this costing approach is that considerable knowledge of the production process is needed to be able to use this alternative.

Full costs

Using *full costs* as transfer price sounds very fair and simple. The objective of the supplying division is to keep the division's result at 0. In the case of actual costs (Section 2.2.2), it is 0 by definition.

This method has a great disadvantage: Fixed costs for the selling division are considered variable for the buying division (Garrett, 1992). This may result in inefficient decisions (transfer price does not reflect actual costs). Another disadvantage of this method is that when standard costs are used (Section 2.2.2), the selling division's result depends on volumes demanded by buying divisions, not on performance of the division itself. Fixed costs of the selling division may not be covered if the buying divisions buy smaller volumes. This is 'unfair'.

Full costs plus profit

The *full costs plus profit* method hopes to spread profit among divisions. This profit possibility should increase the motivation of the managers of the selling division (Garrett, 1992) (as mentioned above, we do not agree).

This method is often used for tax purposes when business fall under more than one tax jurisdiction; each jurisdiction hopes to tax the profits made in its region (Feinschreiber, 2004).

Both disadvantages that are mentioned for the 'full cost' method still hold: Fixed costs are considered as variable costs, and the result of the selling divisions depend on volumes demanded by the buying division (in case of standard costs).

Market price

When a market for the intermediate product exists, the *market price* can be used as transfer price. With a market price, both parties have the opportunity to make profit (Garrett, 1992), and their contribution to the business is reflected adequately (Snoep, 2005). Profitability of the divisions is a good indicator of efficiency. Anthony and Young (2003) add to this that this price may be adjusted downward to eliminate mark-ups for credit risk and marketing costs that do not occur in internal transactions. These costs are typical for market transactions, but do not occur with internal transactions.

Garrett (1992) mentions that usage of market prices can easily lead to suboptimal decisions, because the profit component in the price can result in the buying division to make inefficient decisions. Depending on the nature of the product and the efficiency of the market, this is not necessarily a problem; both parties can trade on the market.

Negotiations

Organizations that let their divisions *negotiate* about the transfer price (also called *internal market price*) focus on both efficiency and effectivity. The negotiating parties both put forward the reasons why the transfer price should be lower or higher than it currently is. This should result in all relevant information being incorporated into the resulting transfer price (Snoep, 2005).

A disadvantage of this internal market price is that several non-relevant factors (i.e. negotiation skills, pressurization skills) become relevant. If there is only one single buyer or seller, parties have no choice in contractors. This results in negotiation skills, budgeting deadlines, and other factors becoming relevant for the transfer price (opportunism). Another disadvantage of negotiations is that considerable negotiation effort may be needed to agree on this topic. Only by coincidence will the negotiated price be the most efficient transfer price (Thomas, 1980).

Dual pricing

Dual pricing can be used to combine the advantages of one method with the advantages of another. An example often mentioned in the literature is the combination of variable cost with market price. The selling division receives market price, which results in profit opportunities (motivation) and the contribution of the division is adequately measured. The buying divisions pays variable costs instead of market price. This results in efficient decisions downstreem (see 'variable costs').

A disadvantage of the dual pricing method is that it is fairly complex; profits are counted twice and have to be cancelled on consolidation (Eccles, 1985). Additionally, it is hard to explain and defend the system to a person not familiar with financial control and transfer pricing.

2.2.2 Calculation method

When using a transfer price that is based on administrative principles, a decision has to be made whether *budgeted (standard) costs* or *actual costs* are to be used. In this context, we define the word 'budgeted costs' as a predefined price, not as a 'budget'.

Using actual cost prices is a good method if an organization wants to have actual cost price information without maintaining a double bookkeeping. The price that is allocated (after the period is closed) equals the actual costs of the intermediate good or service. This method, however, makes the internal buyer responsible for the efficiency of the internal seller (Garrett, 1992; Anthony & Young, 2003), without possibility to influence. This is not fair, and reduces outcome measurability (Section 2.1.3). It also increases outcome uncertainty (Section 2.1.3) for the buying division because the price of the goods or services is not known in advance. Furthermore, this situation does not promote efficiency via transfer pricing, because the producing division's result will be 0 anyway; the producer has no incentive to be efficient.

When budgeted costs (predefined prices) are used instead of actual costs, these problems are mostly solved; the seller can be held responsible for efficiency, and the buyer knows the price in advance. If actual cost price information is required, an additional – actual – cost price calculation of the intermediate product must be made, which can be hard and time-consuming for several organizations.

2.2.3 Autonomy

In internal transactions, autonomy of divisions can play a significant role. Autonomy can at this point be regarded in two ways: Autonomy to decide where a division obtains goods (internally or externally), and autonomy to decide which customers are served (external customers may be more profitable than internal ones). Companies can choose a policy somewhere between *full autonomy* and *mandated transactions*.

Full autonomy in purchases means that all divisions can choose their supplier for goods, either internally or externally. *Full autonomy* in sales means that all divisions can choose their customers, and can sell externally instead of internally.

In the case of *mandated transactions*, the concern level controls where purchases and sales are made.

These possibilities are extremes; it is also possible to use other – more subtle – strategies. One can prescribe mandated transactions, leaving open the possibility to sell externally if internal demand is less than capacity, or to purchase externally if internal demand exceeds capacity. It is also possible to require authorization before an external contract is signed, or to give autonomy with a requirement to notify a higher management level when contracting externally.

When an organization employs 'full autonomy', it is the purchasing division that is actually making make-or-buy decisions (Vosselman, 1999). Organizations that want to centralize decision making on this subject, especially concerning specific products, should employ one of the more subtle models.

Transaction costs on the market increase as the specificity of production resources increases, as it is harder to find an outside contractor that is capable of delivering the specific good or service that an organization needs. An organization faced with this situation will often produce the good or service itself. In such cases, organizations often use mandated transactions – or a close variant – to ensure that the benefits of this make-or-buy decision are reaped.

2.2.4 Cost drivers

Cost drivers are the units of products that divisions trade with each other, and have a certain price. These cost drivers might differ from 'market place products', because transfer pricing should promote efficient decisions; this ultimately happens when the cost structure is reflected in the price correctly. For transfer pricing, selection of cost drivers is one of the most essential decisions to make. If the costs implied by a certain product largely depend on several factors (i.e. time, expensive materials consumption), these factors can be made cost drivers to reflect the actual costs for the organization.

A mistake often made is that the transfer price (because of choosing the wrong cost drivers) does not reflect the actual cost structure of the organization. This results in inefficient decisions, because minimizing allocated (transferred) costs does not by definition minimize real costs of the organization.

Example: An IT department sells computers to other departments. This department has bargained a beneficial contract with a supplier. A high proportion of the transfer prices are actually fixed costs of the IT department. This results in 3 problems: Divisions make inefficient decisions because they look for alternatives for a new computer (which might be more expensive in use, such as the current, slow computer), or purchase a computer elsewhere, without making use of the beneficial contract. Also, as the price of fixed (mainly overhead) costs of the IT department are transferred by the number of sold computers, the IT department's coverage of fixed costs depends on the other divisions, not the IT department.

To take the risk of reduced demand away from the internal producers, Solomons (1965) proposes a pricing system with a subscription: users have to pay a subscription fee (lump sum) every period to cover fixed costs, and pay a fee for every unit purchased to cover variable costs. This way, the rules of the game are such that a division manager optimizing locally also optimizes for the organization as a whole.

Bouma (1988) and Groot (1988) suggest to use a system with a standing charge: users of an internal service can make a reservation for an amount of capacity that they plan to use. Fixed costs of the selling division are divided among reservants, on the basis of their reservation. Additionally, they pay for every unit used, with different prices for demands that are within- or exceed the reserved capacity. As mentioned above, the transfer prices must reflect the actual cost structure.

With this method, the internal suppliers have no risk of under- or over coverage of their fixed costs. The buying devisions make better decisions because only costs that are being influenced are considered, not the portion of fixed costs that is to be paid regardless of the output of the supplying division (as long as they stay within the reserved capacity). However, the system requires internal buyers to make forecasts, plans, and decisions that would otherwise not be necessary at that particular moment. Furthermore, the system promotes opportunistic behavior: the 'optimal' reserved capacity of internal buyer A depends on the size of the reservation of buyers B and C, as fixed costs are distributed over demanded capacity. Games do not contribute to the goal of the organization. This phenomenon also depends on the 'penalty' that is incurred for using non-reserved capacity. This penalty does not reflect the actual cost structure, as they should cover the fixed costs, but the fixed costs have already been paid for. This way, it discourages the internal buyers to maximize the utilization of expensive facilities.

Implementation of this system should be considered very carefully, the many disadvantages require additional measures, and the system should be monitored adequately. In most situations, it is a bad idea to implement this system.

Organizations should also be careful not to put 'all you can eat for €14,75'-products on the internal market (that is, insufficiently defined cost drivers). Primarily, the buying division can not make good decisions because they do not know what the cost-related consequences are. Secondarily, it invites people to take full advantage of the fact that it is all-inclusive; products that are perceived to be 'free' stimulate consumption (Anthony & Young, 2003).

For cost pricing, Asselman (2008) suggests to use cost drivers that have a very tight relation with the costs. Then, depending on the goal of cost pricing, several types of costs should (or should not) be incorporated in the cost prices. This criterion can be used to choose the cost driver (the internal product) for transfer pricing, too. As we have seen above, "It should be a good or service that can be clearly defined, such that it can be object of an exchange transaction".

2.3 Organization models

Eccles (1985) distinguishes four models of organizations, according to the strategies for *vertical integration* and *diversification*. Because these types of organizations differ in vertical integration and diversification strategies, different transfer pricing systems are considered appropriate. These organization models are presented graphically in Figure 2.1.

- *Collective organizations* are organizations that have low vertical integration and low differentiation. These are mostly small enterprises without a need for internal transactions. *Example: A local barber shop with several employees, managed by the owner. These organizations do not need transfer pricing.*
- *Cooperative organizations* are organizations with high vertical integration and low differentiation. They perform (relatively) many activities to provide a relatively small number of products. Contracting of goods and services externally that can be obtained internally is usually not allowed. Integral cost prices are used as transfer prices. *Example: Steel manufacturers that own ore mines. It is usually uneconomic to have the blast furnace department buy externally when the own mines have excess capacity.*
- *Competitive organizations* are highly differentiated but have low vertical integration. As the different responsibility centers are not strongly related, internal transactions do not play a significant role. Transfer prices are usually based on negotiation, but units can also choose to contract a third party. *Example: Conglomerates that provide aerospace products, power services, materials technology services, and railway services. As internal transactions are rather incidental than structural, so is transfer pricing. There is no need to employ a comprehensive and strict transfer pricing policy.*
- *Collaborative organizations* are of the most complex type. Both vertical integration and differentiation are relatively high. In this type of organization, responsibility centers should collaborate and at the same time compete for budget. Various products are purchased and sold on both internal and external markets. Units are usually not allowed to contract externally for a good or service that can be obtained internally. Transfer prices that are used are mostly based on market prices. Vosselman

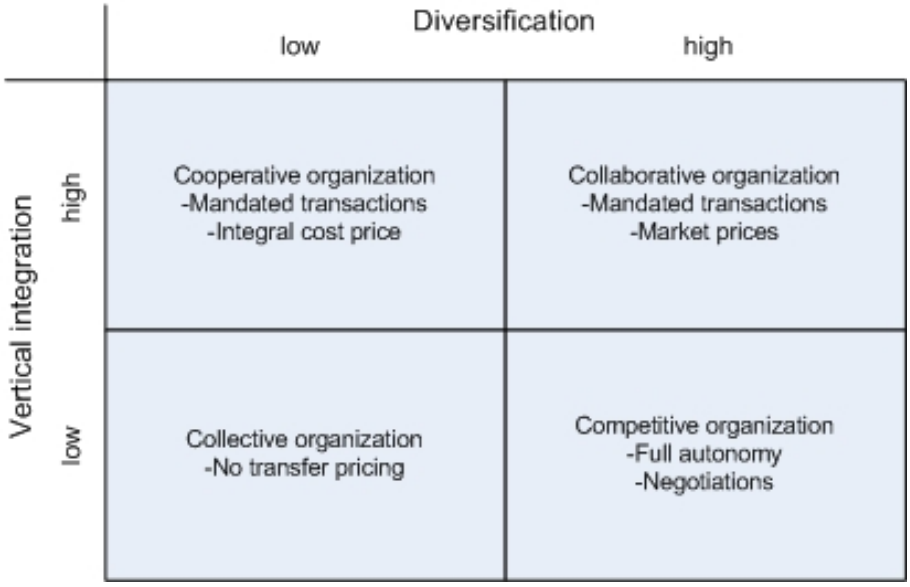

Figure 2.1: Organization models. Source: Eccles (1985).

(1999) claims that a dual pricing system is also appropriate for this organization type. *Example: Hospitals. Hospitals are highly diversified and highly vertically integrated. For all health care products, many internal services are used, such as cleaning, kitchen, intensive care, diagnostics, and operating room (while many of these products are sold externally, too). In this organization model, strategic management should restrict organizational units to buy services internally for a market price (Eccles, 1985). However, for many internal hospital services, there is no external market.*

2.4 Conclusions

In this chapter, we discuss several theoretical concepts. From the theory on principal-agent relations, we learn that Isala klinieken is facing an agency problem. Several variables that influence this problem are identified. Among them: *outcome measurability*, *information asymmetry*, and *goal conflict*. These three variables can be manipulated by changing the cost allocation model.

The agency problem can be prevented by reducing the service basket: limiting the services provided by the OR&IC division, and bringing the responsibility to the primary division. This way, no problem comes into existence. However, in many cases this is not practical. Transfer pricing can be used instead. Transfer pricing can not prevent, but solve the problem.

From transfer pricing theory we learn that several costing alternatives are possible. The choice of cost driver structure is also very important. Furthermore,

there are other choices that are to be made, such as providing the divisions with more or less autonomy.

The appropriateness of the various costing alternatives depends on the organization type. Organizations can be characterized by the amount of *diversification*, and strategy for *vertical integration*. Organizations that are highly vertically integrated and highly diversified – such as hospitals – are called *collaborative organizations*. The costing alternative that fits best to this type of organization is based on market prices. As there is no real market for Operating Room products, some creativity is needed to fill this gap.

Chapter 3

Evaluation of current cost allocation model

In this chapter we look at the current cost allocation model of Operating Room (OR) costs, and score it according to several criteria. We do this by describing the current cost structure and allocation (3.1), formulating criteria for scoring this allocation model (3.2), and scoring the current cost allocation model based on these criteria (3.3).

3.1 Current OR cost allocation model

We describe the current cost allocation model in three steps. In Section 3.1.1 we describe the activities that are performed in the OR, and costs that are brought about in the OR. In Section 3.1.2, we describe the primary allocation: The distribution of costs over departments. In Section 3.1.3, we look at secondary allocation: Transfer pricing.

3.1.1 Costs brought about in the OR

In this section, we describe the primary activities that take place in and around the OR. It should be noted that, besides these activities, more (mostly logistic) activities take place that are not mentioned here as there is no doubt to whom the costs should (primarily) be allocated: the OR department.

Activities in the OR department

In the OR department, patients follow a similar process (apart from exceptional cases). Patients scheduled for surgery arrive at the *holding* unit. In the holding unit, patients are prepared for surgery. When the OR crew is ready to receive a new patient, the patient is brought from the holding to the OR, where

the *anesthesiologist* will start anesthesiology. The surgeon performs the intervention(s), after which the patient is brought to the *recovery* unit. Patients recovered from anesthesia are sent to the nursing departments.

Costs of the OR department

On the OR shop floor, several types of costs are brought about. Costs vary from personnel, facility, equipment, instruments, disposables, blood products, medication, to implants. In this research, we investigate several cost allocation models by changing the primary and secondary allocation of these categories. Every one of these categories can be divided in sub-categories. We only do so if the nature of this cost type requires division.

- Personnel costs can be decomposed into costs for operating specialists, operating residents, anesthesiologists, anesthesiology residents, OR assistants, anesthesiology assistants, other patient-related personnel, and personnel that can not be related to patients.
- Facility costs are costs regarding the building, energy, etc.
- Equipment costs are costs for reusable tools that do not require sterilization.
- Instruments are reusable tools that do require sterilization.
- Disposables are materials that are used only once, and are disposed of after surgery.
- Blood products are products delivered by the internal blood bank, and are consumed during and after surgery.
- Medication (both anesthetic and treatment) is delivered by the pharmacy, and is consumed before, during, and after surgery.
- Implants are materials that are 'operated in' a patient during surgery.

Because the specialists are not paid by the hospital (and not included in the hospital share of DTCs), the costs for operating specialists and anesthesiologists are ignored in the remainder of this report. A cost component that is not induced in the OR, but is still organized by the OR&IC division is the pre-operative screening process. This is done at the special outpatient department for pre-operative screening. Furthermore, we separate sterilization costs from instruments, as sterilization is performed by another department and can be seen as a separate product. The same is done for recovery costs.

3.1.2 Allocation of costs brought about in the OR

Costs brought about on the OR shop floor are *primarily* allocated to the primary division (the 'customer'), to the concern, or to the OR department. Most of the cost categories are allocated to only one 'owner'. Exceptions are costs for personnel and blood.

- Personnel costs are mostly allocated to the OR department, except the costs for the operating doctors. As they 'represent' their own division and 'let' the OR, the costs are also allocated to their division.
- Facility costs are allocated to 'Isala Facilitair', a department of the concern.
- Equipment costs are allocated to the OR department.
- Costs for instruments are allocated to the OR&IC division.
- Disposables costs are allocated to the OR department.
- Costs for blood products are allocated to either the OR department or the primary division, depending on the person ordering the products. An agreement is made with the division Heart&Lungs that both divisions budget a certain amount of money for blood, and that budget overruns (on blood product costs) are equally distributed over both divisions.
- Medication costs are allocated to the OR department.
- Costs for implants are allocated to the primary division.
- Costs for the outpatient department for pre-operative screening are allocated to the OR department.
- Costs of the Sterilization department are allocated to the OR department.
- Costs of the Recovery department are allocated to the OR department.

Costs that are allocated to the OR department are part of the product 'OR' (as are cost for facility services, as we will see later). Included in the OR costs are also overhead costs of the concern, and of the OR department. Costs that are allocated directly to the primary divisions are not a (cost) responsibility for the OR department. These costs are brought about by the primary divisions – for their own account – ín the OR.

3.1.3 Transfer pricing of OR costs

Costs that are allocated to the OR department are transferred to the primary divisions in a certain way. The product 'OR' is 'sold' to the primary division. We call this *secondary* allocation. How this works is described below. The primary and secundary cost allocation is presented graphically in Figure 3.1.

Costing alternative

The transfer pricing system of the OR product uses a *full cost* method. This means that all costs, both variable and fixed, are distributed over cost drivers. If realization would be equal to budget, the financial result of the OR department would be 0: no profit and no loss.

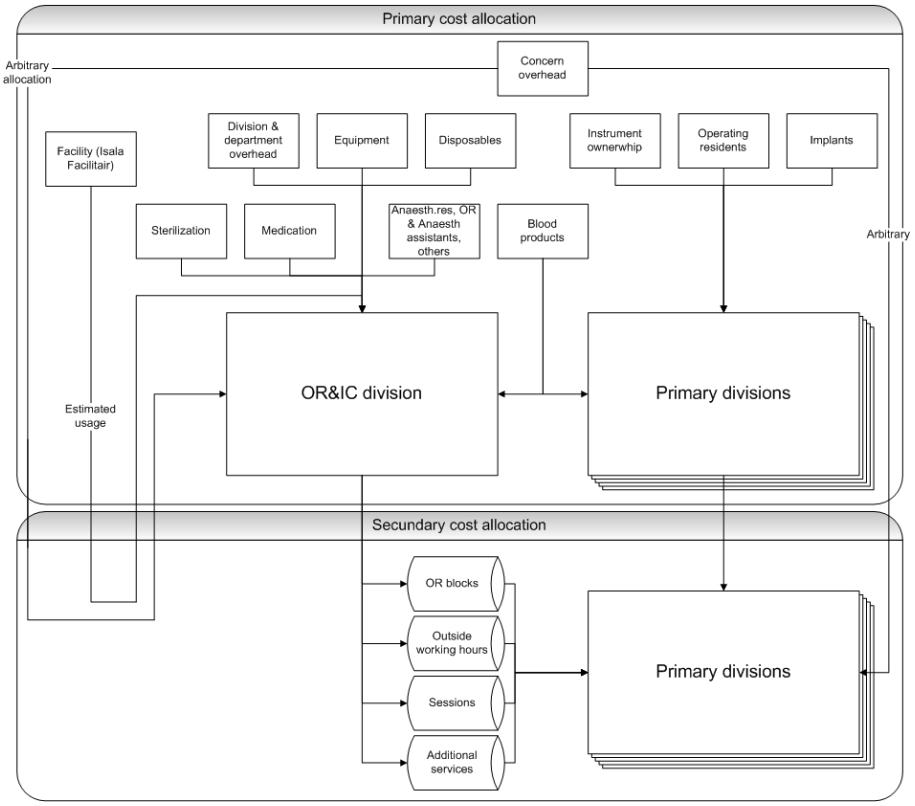

Figure 3.1: Cost structure of OR costs

Calculation method

By presenting the fact that the realization and budget of the OR department might differ (and will differ, in a realistic setting), we imply that *budgeted full costs* are transferred to the primary divisions.

Autonomy

There is no external market for OR products. It does not happen often that the hospital sources OR capacity from other hospitals. Neither does it happen often that the OR lets the OR to other hospitals. If either of these situations would occur, this would probably happen because of shutdowns of ORs at one of the hospitals, which is not a day-to-day activity. For this reason, autonomy is not an issue.

Cost drivers

For the OR product, two types of cost drivers are used: a fixed charge for time-related costs (hourly rate), and a charge for materials usage, differentiated

per specialty. These charges are based on subdivision of the budget, rough estimates, and common sense. Regular OR time is 'sold' in blocks of 4 hours. Production that falls outside these blocks (*outside working hours*) is charged with a special – strategically higher – hourly charge, depending on day and time. It is also possible to use additional services (additional anesthesia- or OR assistant). The charge for materials usage is based on the number of sessions, and also includes cost for pre-operative screening.

3.2 Criteria for assessment of cost allocation model

In this section, we propose criteria for evaluation of the current cost allocation model, and potential improvements. We use several criteria from the literature, and criteria that evaluate the practical suitibility of the allocation model.

To score the alternatives, we use a 4 or 5-point scale ranging from 1 (most unfavorable) to 4 or 5 (most favorable). Although this scoring remains somewhat arbitrary and subjective, we give an example for every possible score to clarify the scale. The score is designed such that all realistic cost allocation models can be represented and distinguished.

3.2.1 Criteria from the literature

Thomas (1980) proposes four criteria for evaluation of theoretical concepts of transfer pricing. These criteria can be used to evaluate the complete cost allocation model – not just transfer pricing – because they address outcome rather than method; they can be used to assess both primary and secondary cost allocation.

Information efficiencies: Decentralization, a prerequisite for transfer pricing, is – among other reasons – done to economize information flows. However, transfer pricing itself requires information flows that might not be necessary when no transfer pricing would take place. This criterion is used to measure the degree to which the advantage of decentralization is cancelled by the cost allocation model. *Scores: 1 - Cost allocation model cancels out decentralization advantage completely. 2 - Major information flow, concerning quantity and price. 3 - Minor information flow, concerning quantity and price. 4 - Allocation model does not cancel out information efficiencies at all, no information flow.*

Autonomy of divisions: Another major reason for decentralization is already discussed in Chapter 2: *bounded rationality*. Because division managers have a narrower area of interest than their concern counterparts, they can make better decisions (if they at least know what behavior is expected from them). As we have seen in Section 2.2.3, depending on the method used, transfer pricing can have significant effects on the autonomy of the divisions. This criterion is used to measure the degree to which the advantage of decentralization is cancelled by the method

of transfer pricing. As there is no real market for OR time (yet), autonomy is not an issue (concern management can be involved). For this reason, we do not include this criterion in our evaluation of OR costs allocation models. If these criteria are used to evaluate cost allocation for another intermediate product for which an external market exists (lab tests, for instance), this criterion should be included. *Scores: 1 - Concern management decides on (transfer) prices, suppliers, and customers. 2 - Suppliers and prices are chosen by concern management, customers are chosen by division management. 3 - Divisions have mandated buy- and sales transactions for a transfer price that is set by concern management. When demand exceeds supply or supply exceeds demand, divisions can trade externally and set their own prices. 4 - Suppliers are selected by concern management, (transfer) prices and customers are chosen by division management. 5 - No interference with autonomy of divisions. Divisions can choose their own suppliers, customers, and sales price.*

Evaluation of divisions: If divisions' financial results are used as indicators of division managers' performance, this result should reflect only the performance of this division, and not also the performance of other divisions as a result of arbitrary allocation of costs and revenues. This criterion indicates the degree to which financial figures reflect the performance of a certain division. To score on this criterion, we introduce a financial measure: Fraction not influenced costs (FNIC). This measure shows the percentage of the total costs of a responsibility center that can not be influenced by the center. *Scores: 1 - Fraction not influenced costs (FNIC) of total OR costs $>$ 30%. 2 - 30% $\geq$ FNIC $>$ 20%. 3 - 20% $\geq$ FNIC $>$ 15%. 4 - 15% $\geq$ FNIC $>$ 7,5%. 5 - FNIC $\leq$ 7,5%.*

Behavior congruence: The term *behavior congruence* is a generalization of *goal congruence*, but because goals of a concern are not always formulated – let alone, are known – the word 'behavior congruence' is used. This criterion is used to indicate whether the allocation model provides incentives that manipulates division's profit in a positive manner when behavior is shown that the concern seems to want, and vice versa. We assume here that all actors are profit maximizers. To score on this criterion, we introduce a financial measure: Allocation quality (AQ). This measure shows the percentage of costs that is allocated to the responsible responsibility center. *Scores: 1 - Allocation quality (AQ) $<$ 70%. 2 - 70% $\leq$ AQ $<$ 80%. 3 - 80% $\leq$ AQ $<$ 90%. 4 - 90% $\leq$ AQ $<$ 95%. 5 - AQ $\geq$ 95%.*

3.2.2 Practical criteria

A cost allocation model should not only give the efficient incentives and authorization to decision makers; it should also be workable. For example, a cost allocation model that requires the surgeon to take a basket with bandage with him – because the OR does not provide these – is probably not efficient. In this section, we consider several practial criteria that we use to score the current cost allocation model and possible alternatives.

Communual resource pooling: For resources that are used in the OR by more than one division (i.e. latex gloves), it is – from a logistic point of view – more efficient to organize this resource centrally, rather than having the divisions organize the resources themselves. *Scores: 1 - No communual resource pooling advantage. 2 - OR department arranges a proportion of material resources. 3 - OR department arranges the majority of material resources. 4 - OR department arranges all communual resources.*

Effort: Depending on the method used for primary and secondary allocation, more or less effort is required to operate this cost allocation model. Both effort in the primary process and in office functions are considered. *Scores: 1 - The allocation model requires many tasks to be performed by shop floor personnel for accounting purpose. 2 - The allocation model requires several tasks to be performed by shop floor personnel for accounting purpose. 3 - The allocation model does not bring about tasks for shop floor personnel, but induces a large workload for office personnel. 4 - The cost allocation model does not require effort.*

Complexity of model: Very complex cost allocation models might bring more confusion than provide information of appropriate decisions to the agents. *Scores: 1 - Both primary cost allocation and transfer pricing method are complex. 2 - Primary cost allocation method complex, transfer pricing method not complex. 3 - Primary cost allocation method not complex, transfer pricing complex. 4 - Straightforward allocation model, both cost primary allocation method and transfer pricing method not complex.*

Infrastructural change: Some cost allocation models require major infrastructural change, while other cost allocation models require only minor change. Understandibly, a cost allocation model that requires only minor infrastructural change is favorable over a cost allocation model that requires major infrastructural change. *Scores: 1 - Major infrastructural change outside OR&IC division. 2 - Major infrastructural change inside OR&IC division. 3 - Minor infrastructural change outside OR&IC division. 4 - Minor infrastructural change inside OR&IC division. 5 - No infrastructural change.*

3.3 Scoring the current OR cost allocation model

In this section, we evaluate the current cost allocation model of the Operating Room costs. We score the abovementioned criteria on a scale from 1 to 4 or 1 to 5.

For assigning scores to the criteria 'evaluation of divisions' and 'behavior congruence', we execute the allocation on paper, based on budgeted figures for 2009. As these figures are not readily available, these figures are estimates. Consumption of blood products in the OR is not registered (consumption is, but location is not). As part of blood products consumption is (randomly) allocated to the OR and part to the primary division, no good estimator is found. We use €1,5 million as an estimate, but without a solid ground. We

Percentage not influenced costs of total OR costs	44,3%
Allocation quality	74,9%

Table 3.1: Summary of financial consequences

Criterion	Score	Motivation
Criteria from literature		
Information efficiencies (1-4)	3	Little data transfer.
Evaluation of divisions (1-5)	1	Fraction not influenced costs of total costs: 44,3%.
Behavior congruence (1-5)	2	Allocation quality: 74,9%.
Practical criteria		
Comm. resource pooling (1-4)	3	OR department organizes almost all material resources.
Effort (1-4)	3	Transfer pricing does not require a lot of effort, only minor record keeping on shop floor.
Complexity of model (1-4)	2	The model is fairly complex, because several cost drivers are used, some components are split, in- and excluded.
Infrastructural change (1-5)	5	No infrastructural change is needed, the system is 'up and running'.

Table 3.2: Evaluation of current cost allocation model

only know that it is probably closer to the real figure than using €0 (no blood is consumed in the OR) or €4,4 million (all blood is consumed in the OR).

We split the costs for disposables in two categories: bulk disposables and expensive disposables. This way, we can make a distinction between these categories for transfer pricing. We give both categories 50% of the costs, which results in a boundary between the two of €19. Of course, it is possible to change the boundaries. See Appendix A for more information about disposables costs distribution.

The outcome of the allocation on paper (financial measures mentioned in Section 3.2.1) are presented in Table 3.1.

Table 3.2 presents the scores for the current cost allocation model. Figures 3.2, 3.3, 3.4, and 3.5 show all costs currently incurred in the OR, the costs that the OR department is responsible for, the costs that are currently directly allocated to the primary division (based on actual consumption/usage), and the costs that are not yet directly allocated to the primary division, respectively.

3.4 Conclusion

Table 3.2 shows that behavior congruence of the current cost allocation model is poor, and there is also a large improvement potential for evaluation of divisions. 44,3% of costs of the OR department can not be influenced by this department, while the primary divisions have incentives to increase these costs in favor of

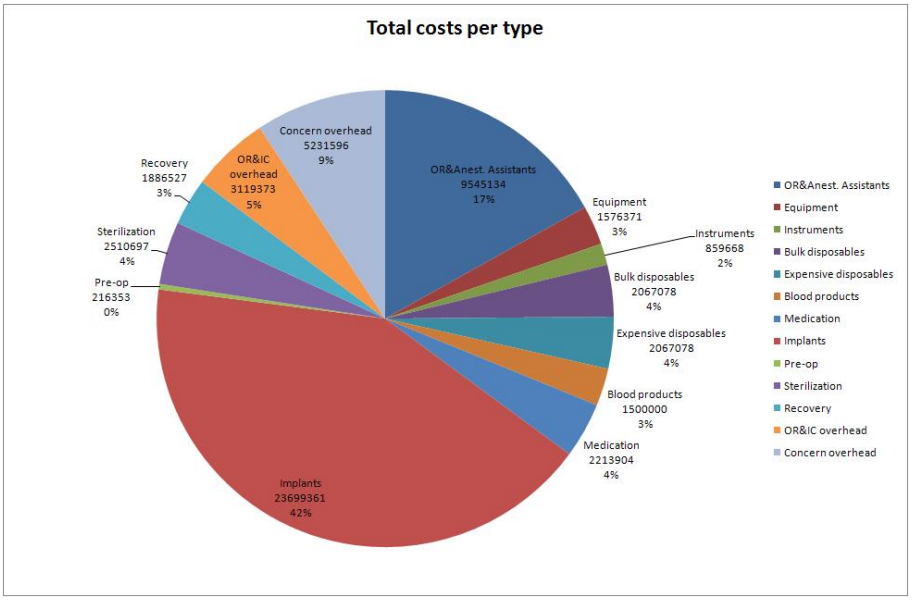

Figure 3.2: All OR costs

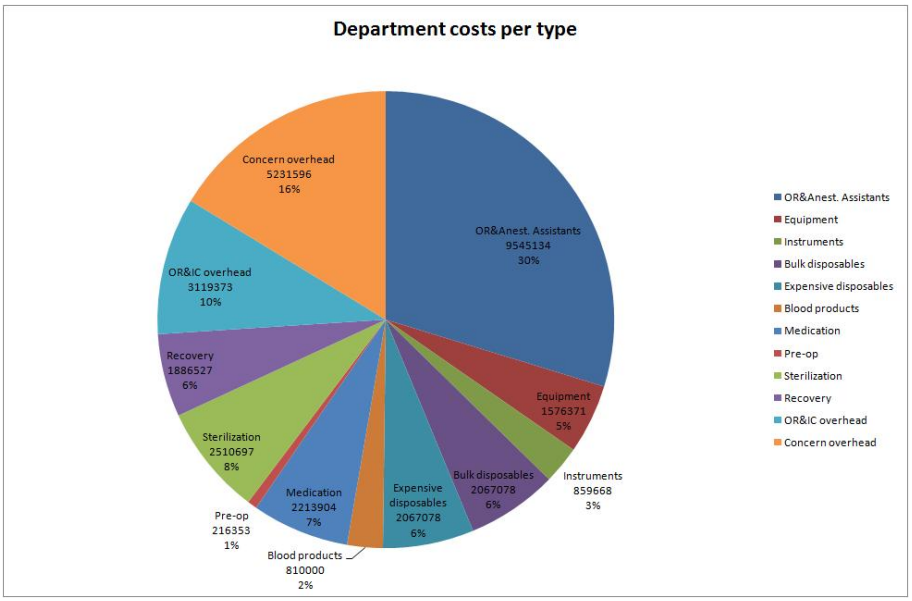

Figure 3.3: OR costs allocated to OR department in primary allocation

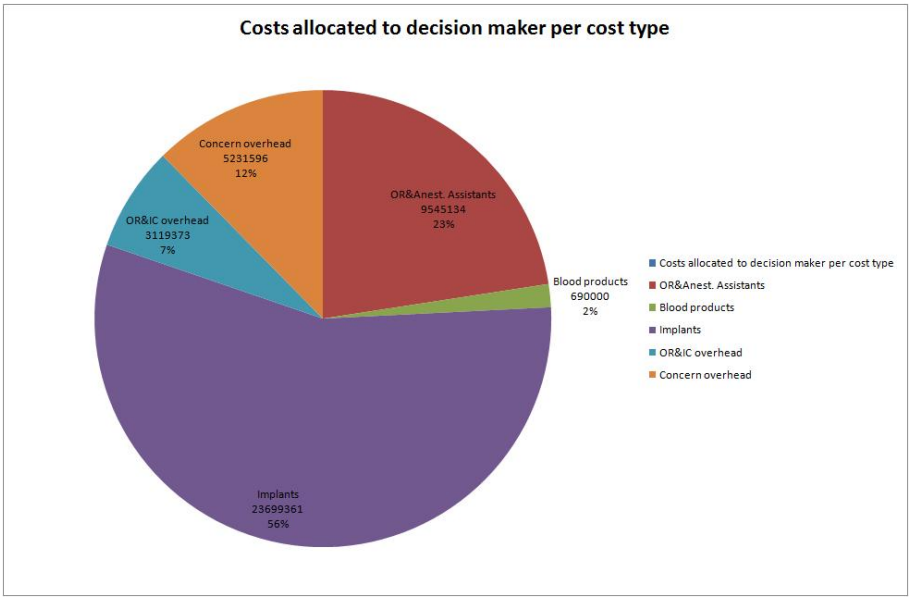

Figure 3.4: Costs allocated to primary division

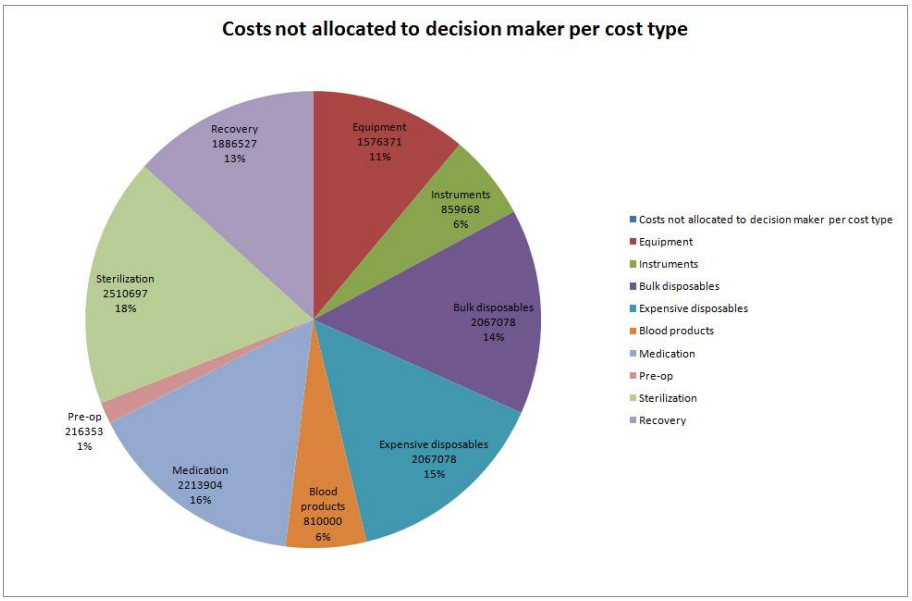

Figure 3.5: Costs not allocated to primary division

their own financial situation. Only 74,9% of the OR costs are directly allocated to the primary division.

The current cost allocation model performs moderately when considering the practical criteria. The criterion 'infrastructural change' is given a score of 5 for the obvious reason of the fact that the system is in use already. Improvement of the agency criteria ('evaluation of divisions' and 'behavior congruence') will most likely deteriorate the scores for the practical criteria.

Chapter 4

Improvements of current cost allocation model

In this chapter, we look for alternatives to improve the current cost allocation model. We distinguish between long-term and short-term improvements, because the conditions that the alternatives must satisfy differ significantly between long- and short-term. In Section 4.1 we propose alternatives for the long-term. Next, in Section 4.2 we describe the practical conditions that the current infrastructure and working methods impose on alternatives. Finally, in Section 4.3 we propose alternatives for the short-term, that satisfy these conditions. The goal of this is twofold: a vision for the future is developed, and possible measures to have results on the short term are proposed.

4.1 Measures to improve cost allocation on the long term

This section is devoted to improvement measures on the long term. In Section 4.1.1 we present alternatives for primary cost allocation. In Section 4.1.2, we present one or more alternatives for secondary cost allocation (transfer pricing) for every alternative mentioned in Section 4.1.1. In section 4.1.3, we score these alternatives, using the criteria formulated in Section 3.2.

4.1.1 Primary allocation

In this section, five alternatives for primary allocation are discussed. These alternatives are presented in Table 4.1. In this table, a plus sign means that the cost component is considered part of the OR product and should be charged by the OR to the primary division. A minus sign means that the cost component is considered not to be part of the OR product, the primary division is financially responsible for this component.

	1	2	3	4	5
Direct OR/Anesth.	+	+	+	+	+
Equipment	+	+	+	+	-
Instruments	+	+	-	-	-
Bulk disposables	+	+	+	+	-
Expensive disposables	+	+	+	+	-
Blood products	+	-	-	-	-
Medication	+	+	-	-	-
Implants	+	-	-	-	-
Pre-op	+	+	+	-	-
Sterilization	+	+	-	-	-
Recovery	+	+	+	-	-
Overhead OR	+	+	+	+	+
Overhead concern	+	+	+	+	+

Table 4.1: Primary allocation on the long term

Alternative 1 is one of the two extremes of primary allocation: All material costs made in the OR are considered part of the OR product.

Alternative 2 a close variant of the current primary allocation system: Only blood products are not at all considered to be part of the OR product (which makes the system much more transparant).

Alternative 3 strips alternative 2 by removing instruments – and instrument-related costs – from the OR product. Primary divisions are the owners of the instruments, and are charged by the Sterilization department for sterilization of their instruments. Furthermore, medication is stripped from the OR product, and is charged by the hospital farmacy directly to the primary division.

Alternative 4 strips alternative 3 by also removing costs for the pre-operative screening process and recovery from the OR product. These costs are charged by the respective departments. Recovery costs are a significant portion of Operating Room costs, and it seems that primary divisions are not always willing to take away their patients from the Recovery department as soon as possible. Charging recovery costs as a separate product with an hourly rate both increases the fairness of the cost allocation, and provides an incentive to help solve this problem.

Alternative 5 considers the OR product to be a room with personnel. Nothing more, and nothing less. Users have to take a basket with material resources with them if they want to perform a surgery.

4.1.2 Secondary allocation

For each of the alternatives mentioned in Section 4.1.1, we propose an alternative for secondary allocation. Because alternative 2 looks very favorable, and many choices are left for secondary allocation, we propose two alternatives for

secondary allocation.

Costing alternative

All alternatives in this section use a 'full costs' costing alternative (Section 2.2.1). This because it is fair and simple. The disadvantages mentioned in that section can largely be compensated by choosing good cost drivers. See Section 2.2.4 about the subscription systems.

Calculation method

We use a 'budgeted costs' method as calculation method, as it outperforms the only alternative: 'actual costs' on all important aspects: Outcome measurability increases, outcome uncertainty decreases, and the producing division is held responsible for efficiency (see Section 2.2.2).

Autonomy

When considering the Operating Room, autonomy is not an issue. There is no real market for OR capacity. We assume a system of mandated transactions. External sourcing and letting of OR capacity occurs only on incidental basis. On such occasions, concern management can decide.

Cost drivers

The aspect of transfer pricing that we put most emphasis on is the choice of cost drivers, as this is one of the most important decisions, and most debatable, too.

The alternatives for secondary allocation are presented in Table 4.2. The numbers in this table represent cost drivers. Cost drivers 1 and 2 are an hourly charge and a charge per session, respectively. It is advisable to use a standing charge system for the capacity-driven cost driver, to prevent manifestation of the disadvantages mentioned in Section 2.2.1 for the 'Full costs' system. This way, overhead is distributed among primary divisions according to intended usage of OR capacity. This system is explained in Section 2.2.4.

The other cost drivers in Table 4.2 are additional charges that depend on actual consumption. These cost drivers are presented as one cost driver per cost type, but in essence, many cost drivers are used: one for every item type, or one for every cost-homogeneous category.

The alternatives for secondary allocation mentioned in Table 4.2 all have costs for the the Recovery department charged via the hourly rate rather than the sessions tariff. It seems that there is a positive relation between time in OR time and Recovery time (see Appendix B). This makes the cost allocation more subtle and fair.

	1	2.1	2.2	3	4	5
Direct OR/Anesth.	1	1	1	1	1	1
Equipment	2	2	2	2	2	
Instruments	2	2	2			
Bulk disposables	2	2	2	2	2	
Expensive disposables	3	2	3	3	3	
Blood products	4					
Medication	5	2	4			
Implants	6					
Pre-op	2	2	2	2		
Sterilization	2	2	2			
Recovery	1	1	1	1		
Overhead OR	1	1,2	1,2	1,2	1,2	1
Overhead concern	1	1	1	1	1	1

Table 4.2: Secondary allocation on the long term

Overhead costs mentioned in Table 4.2 are distributed this way for the following reason: Concern overhead costs are costs induced by concern management, and consider mostly general and technical services, such as building, energy, etc. These costs should be charged to the OR department (and not directly to the primary divisions) because divisions that do not use the OR (much) should not be confronted with these costs. Furthermore, these costs should be charged via the hourly rate, because these costs are mostly capacity-driven.

OR overhead costs are costs for materials logistics, planning, management, etc. These costs are both capacity- and usage-driven, and hence are charged both via the hourly rate, and via the sessions tariff, distributed proportionally. Every possible allocation of overhead costs is somewhat arbitrary.

4.1.3 Scoring of alternatives

In Section 3.3, we show pie charts that present the financial consequences of the current cost allocation model. Furthermore, in that section we present the scores of the current model. Likewise, in this section, we show the results of the possible alternatives for the long term. The financial consequences of the alternatives are presented in Table 4.3. The pie charts can be found in Appendix C. The scores for the alternatives are presented in Table 4.4. The motivation for the scores can be found in Appendix D.

4.1.4 Conclusion

In Sections 4.1.1 and 4.1.2 we propose several alternative cost allocation models for costs made in the OR. We score these alternatives in Section 4.1.3.

Model 1 assumes an OR product that covers all material costs made in the OR.

Percentage not influenced costs of total OR costs

Current	1	2.1	2.2	3	4	5
44,3%	12,8%	40,9%	26,1%	17,3%	18,1%	0,0%

Allocation quality

Current	1	2.1	2.2	3	4	5
74,9%	87,2%	77,4%	85,5%	92,1%	92,4%	100,0%

Table 4.3: Summary of financial consequences

Criterion	**Current**	**1**	**2.1**	**2.2**	**3**	**4**	**5**
Criteria from literature							
Information efficiencies (1-4)	3	2	3	3	3	3	4
Evaluation of divisions (1-5)	1	4	1	2	3	3	5
Behavior congruence (1-5)	2	3	2	3	4	4	5
Practical criteria							
Communual resource pooling (1-4)	3	4	3	3	2	2	1
Effort (1-4)	3	1	3	2	2	2	4
Complexity of model (1-4)	2	3	4	3	2	2	4
Infrastructural change (1-5)	5	2	5	2	1	1	1

Table 4.4: Assessment of cost allocation model 1

This OR product is then charged via several cost drivers. This extreme 'enlargement' of the OR product results in an extremly large bookkeeping workload for shop floor personnel. At least, if the scores on agency criteria are supposed to increase, too. This is a very unfavorable alternative.

Model 2.1 is a close variant of the allocation model currently applied. The only differences are that blood products are completely (and not partly, as in the current system) taken out of the OR product, and costs for the Recovery department are charged via the hourly rate rather than per session. Model 2.1 assumes that costs for blood are charged by the internal blood bank to the primary division directly. For the long term, this is not a good alternative. For the short term, this might be an option.

Model 2.2 shows significant improvements on the scores for 'Evaluation of divisions' and 'Behavior congruence'. This due to transfer pricing of medication and expensive ($> €19$) disposables (resulting in a minor administrative workload). This alternative results in much better cost allocation, but many more improvements are possible. For the short term, this might be an option.

Model 3, considering instruments and medication as a responsibility for the primary division, results in even higher scores for these agency criteria. This does, however, result in an administrative workload for shop floor personnel. This alternative is very favorable as a long term solution.

Model 4 also takes the costs for the Recovery department and Pre-operative Screening department out of the OR product. These departments charge the primary division directly. This results in a much wanted incentive to have primary divisions take away their patients from the Recovery department as

soon as possible. This alternative is also very favorable as a long term solution.

Model 5 sees the OR product as a room with personnel, with everything else stripped off. This alternative shows 2 things: (1) a 100% score for agency criteria is possible, and (2) this requires an unpractical production environment, and is not a good idea. In other words, a model for cost alloction should be a mean, not an end!

Based on the scores and calculated financial consequences, we recommend to consider and investigate implementation of alternative 4 as a long term solution.

4.2 Practical limitations for improvements

In this section, we discuss difficulties in infrastructure and working methods that make the cost allocation a non-trivial issue. Both political- and practical issues are mentioned. In Section 4.2.1, we discuss issues that play a role outside the OR department (and requires cooperation from outside the OR department). In Section 4.2.2, we discuss issues that can be handled within the OR department. No cooperation with other divisions or units is necessary.

4.2.1 Practical limitations hospital-wide

The current hospital infrastructure supports the current cost allocation model, but does not necessarily support 'any' cost allocation model. The most important difficulty regarding infrastructure is that it is not yet possible to transfer any information from the OR application to the financial application automatically. This makes billing of the current cost drivers a tough job, it makes billing of finer cost drivers – such as material resource usage – a mission impossible. To perform billing automatically, several modifications have to be made to the OR computer application and the hospital's bookkeeping application.

Apart from infrastructural problems, there is another difficulty: A change in primary allocation means that either the OR department becomes 'owner' of a cost component that another division currently 'owns', or vice versa. In either case, the other divisions might also have a stake in this decision, and will not just accept any decision that the OR department makes unilaterally. This is a political issue.

For this reason, implementation of a cost allocation model that changes the primary allocation, or that increases the number of cost drivers, requires cooperation by persons outside the OR&IC division, and/or changes in the hospital-wide infrastructure. Both issues can require considerable implementation effort with uncertain outcome.

4.2.2 Practical limitations in the OR department

Next to the issue that the OR computer application has to be modified to communicate with the bookkeeping application and enable automatic billing (which is necessary for certain allocation models), the application should be prepared to enable registration of the cost driver being billed. In other words, if the system has to bill consumption of a certain disposable, it should be able to register disposable consumption. The program currently in use provides this functionality already, it just should be adjusted to the local environment and cost allocation model.

The short term solution that we propose must be on the line between the current allocation model ('ist') and the desirable situation ('soll'), being alternative 4 mentioned in Section 4.1.4. In other words, the solution for the short term should be in line with the solution for the long term.

4.3 Measures to improve cost allocation on the short term

This section is devoted to improvement measures on the short term. In this section, we do not neglect the conditions that are applied on the cost allocation model. For this reason, we look for primary- and secondary allocation alternatives that increase increase scores on both practical and literature criteria.

4.3.1 Primary allocation

We consider two alternatives for primary allocation for the short term. These alternatives are presented in Table 4.5. In this table, a plus sign means that the cost component is considered part of the OR product and should be charged by the OR to the primary division. A minus sign means that the cost component is considered not to be part of the OR product, the primary division is financially responsible for this component.

Alternative A is the same as alternative 2 from Table 4.1.

Alternative B is a variant of alternative A, but strips Recovery costs from the OR product. The Recovery department charges the costs to the primary division directly, based on an hourly rate.

4.3.2 Secondary allocation

For each of the alternatives mentioned in Section 4.3.1, we propose two alternatives for secondary allocation. These alternatives are based on the differences between alternative 2.1 and 2.2 in Table 4.2. In this section, we only consider the 'cost driver' part of transfer pricing. For the other transfer pricing aspects, see Section 4.1.2. The alternatives are presented in Table 4.6.

	A	B
Direct OR/Anesth.	+	+
Equipment	+	+
Instruments	+	+
Bulk disposables	+	+
Expensive disposables	+	+
Blood products	-	-
Medication	+	+
Implants	-	-
Pre-op	+	+
Sterilization	+	+
Recovery	+	-
Overhead OR	+	+
Overhead concern	+	+

Table 4.5: Primary allocation on the short term

	A.1	A.2	B.1	B.2
Direct OR/Anesth.	1	1	1	1
Equipment	2	2	2	2
Instruments	2	2	2	2
Bulk disposables	2	2	2	2
Expensive disposables	2	3	2	3
Blood products				
Medication	2	4	2	4
Implants				
Pre-op	2	2	2	2
Sterilization	2	2	2	2
Recovery	1	1		
Overhead OR	1,2	1,2	1,2	1,2
Overhead concern	1	1	1	1

Table 4.6: Secondary allocation on the short term

4.3.3 Scoring of alternatives

In this section, we present the scores for the cost allocation models that can be implemented in the short term. The financial consequences of the alternatives are presented in Table 4.7. The pie charts can be found in Appendix E. The scores are presented in Table 4.8. The motivation for these scores can be found in Appendix F.

Percentage not influenced costs of total OR costs

Current	A.1	A.2	B.1	B.2
44,3%	40,9%	26,1%	43,5%	27,8%

Allocation quality

Current	A.1	A.2	B.1	B.2
74,9%	77,4%	85,5%	77,4%	85,5%

Table 4.7: Summary of financial consequences

Criterion	**Current**	**A.1**	**A.2**	**B.1**	**B.2**
Criteria from literature					
Information efficiencies (1-4)	3	3	3	3	3
Evaluation of divisions (1-5)	1	1	2	1	2
Behavior congruence (1-5)	2	2	3	2	3
Practical criteria					
Communual resource pooling (1-4)	3	3	3	3	3
Effort (1-4)	3	3	2	3	2
Complexity of model (1-4)	2	4	3	4	3
Infrastructural change (1-5)	5	5	2	5	2

Table 4.8: Assessment of cost allocation model 1

Table 4.8 is slightly misleading. In model A.1, Recovery costs are charged via the hourly rate for the OR. As there is a positive relation between between time in the OR and Recovery time (Appendix B), this allocation can be considered 'fair'. When these costs are taken out of the OR product and charged as a separate product by the Recovery department (alternative B.1), this deteriorates the score for the criterion 'evaluation of divisions', as the denominator of this ratio decreases. Furthermore, the allocation quality does not increase (compared to alternative A.1), as the allocation of recovery costs is good already. Allocation using alternative B.1 is, however, much better. It provides an incentive for primary divisions to take the patients away from the Recovery department as soon as possible. The same holds for model A.2 and B.2.

4.3.4 Conclusion

In Sections 4.3.1 and 4.3.2 we propose several alternative cost allocation models for costs made in the OR. These are cost allocation models suitable to implement within a short period of time. We score these alternatives in Section 4.3.3.

Model A.1 is a close variant of the allocation model currently applied. The only differences are that blood products are completely taken out of the OR product, and costs for the Recovery department are charged via the hourly rate rather than per session. Model A.1 assumes that costs for blood products are charged by the internal blood bank to the primary divisions directly. This is an easy alternative, but improves performance only little.

Model A.2 is a variant of model A.1, but takes medication and expensive disposables out of the all-inclusive package. Consumption of medication and expensive disposables is registered on the OR shop floor; the systems must be adapted to make registration possible. This model improves performance considerably, it is a good choice.

Model B.1 is a close variant of model A.1, but considers recovery costs not to be a part of the OR product. As mentioned in Section 4.3.3, the performance of this model looks inferior to the performance of model A.1, but this is not the case. This alternative is also an easy one, but improves performance only little.

Model B.2 is a close variant of model A.1, but considers recovery costs not to be a part of the OR product. As mentioned in Section 4.3.3, the performance of this looks inferior to the performance of model A.2, but this is not the case. This alternative improves performance considerably, it is a very good choice for the short term.

Based on the scores and calculated financial consequences, we recommend to consider and investigate implementation of alternative B.2 as a short term solution.

Chapter 5

Conclusions and recommendations

The goal of this research is to evaluate the current cost allocation model, and to design alternative conceptual approaches that lead to better cost allocation and accountability. Here, we summarize conclusions and formulate recommendations.

5.1 Conclusions

A cost allocation model should satisfy two needs: It should generate efficient and effective decision making, and it should be practical. The criteria that measure the level of satisfaction of the first need are *information efficiencies*, *autonomy of divisions*, *evaluation of divisions*, and *behavior congruence*. The criteria that measure the level of satisfaction of the second need are *communual resource pooling*, *effort*, *complexity of model*, and *infrastructural change*. Because there is no external market for the Operating Room product, the autonomy of divisions is not an issue.

We use these criteria to score the cost allocation model that is currently in use at Isala klinieken. The model performs excellent on the criterion 'infrastructural change', as no infrastructural change is necessary. The model performs moderately on the criteria 'communual resource pooling', 'effort', and 'information efficiencies'. However, the model performs poor on the criteria 'evaluation of divisions', 'behavior congruence', and 'complexity'.

The score on the criterion 'behavior congruence' is this low because only 74,9% of the costs are charged to the primary division based on actual consumption. 25,1% is charged per session, regardless of actual consumption/usage. The result is that the OR department can not influence 44,3% of its costs. This undesirable situation is also responsible for the low score on the criterion 'evaluation of divisions'.

To improve the performance of the cost allocation model, we develop four alternative approaches to reach positive results within a short period of time. We also develop six alternative approaches to reach better cost accountability on a

structural basis. We assess these alternatives based on the same criteria. These alternatives receive higher scores on the 'evaluation of divisions' and 'behavior congruence' criteria, but some have serious drawbacks too. We propose one short-term alternative and one long-term alternative.

We recommend to enhance the cost allocation model used for allocation of OR costs in two phases:

- On the short term (phase 1), by taking blood products and recovery costs out of the OR product completely, and introducing a system for charging medication costs and costs for expensive disposables. The Recovery department must charge the primary divisions for consumed recovery time. This results in that 27,8% (currently 44,3%) of the costs of the OR department can not be influenced by this department, and 85,5% (currently 74,9%) of the OR costs are allocated to the primary division based on actual consumption/usage.
- On the long term (phase 2), we recommend to take also instrument-related costs, costs for pre-operative screening, and medication out of the OR product. Costs for medication should be charged by the hospital's pharmacy directly. The primary divisions should buy their own instruments, and should be charged by the Sterilization department for sterilization of their instruments. As with the short term alternative, the Recovery department must charge the primary divisions for consumed recovery time, and expensive disposables are charged as separate cost drivers by the OR department. This results in that 18,1% (currently 44,3%) of the costs of the OR department can not be influenced by this department, and 92,4% (currently 74,9%)of the OR costs are allocated to the primary division based on actual consumption/usage.

5.2 Recommendations

We split our recommendations into two parts: general recommendations regarding internal transactions, and recommendations regarding cost allocation in the OR.

Internal transactions

1. Coordinate internal transactions centrally. Only the concern management is responsible for establishing a system that protects concern objectives. It is unwise to leave the 'power' to create market rules to monopolist 'OR department', or any other decentralized unit. This means that the concern management has to provide the rules of the game, such as costing alternative, autonomy, and cost drivers.
2. Internal transactions regarding products for which an external market exists should take place against the budgeted full costs, but with a maximum equal to the market price. If the department is not capable of

producing more efficient than the market, outsourcing should be considered. The budgets and market prices should be verified by the Concern Control department.

3. Internal transactions regarding products for which no external market exists should take place against the budgeted full costs. The budgets should be verified by the Concern Control department.

4. Facilitate coordination of material resource flows by introducing one system for inventory control. This does not only facilitate good cost allocation, but can also result in reduction of handling costs.

OR cost allocation

5. On the short term, take blood products and recovery out of the OR product and consider these as separate products. Blood products should be provided and billed by the internal blood bank. The recovery product should be provided and billed by the Recovery department. Investigate whether more than one cost driver is necessary to reflect actual recovery costs.

6. On the short term, introduce a system to register consumption of expensive disposables and medication on patient/DTC level. Use this sytem to bill consumption of these resources. We propose a system that uses a border between 'expensive' and 'bulk' disposables based on the value of the disposable. In a real situation, this is not a workable alternative: disposables have to be marked somehow (a red dot?) to let the employee know that it is an 'expensive' disposable that has to be registered. For real use, we recommend to use categories that are recognized by shop floor personnel to make this distinction. The shop floor personnel should then be instructed to register only certain categories of disposables.

7. On the long term, take instrument-related costs out of the OR product. Primary divisions should be the owners of the instruments they use. The Sterilization department should perform sterilization of the instruments, and bill accordingly. Investigate which cost drivers reflect actual costs best. As there is an external market for sterilization services, the maximum transfer price should be the market price (Recommendation 2). When the primary divisions are the owners of the instruments, they will reconsider the contents of the instrument sets and try to make them more efficient. Sterilization of unused instruments is waste and costs them money.

8. On the long term, take the pre-operative screening out of the OR product, and have the Pre-op department perform this activity and bill accordingly.

9. On the long term, take the medication out of the OR product. Introduce a system that lets the hospital pharmacy bill consumption of medication upon registered consumption. This omits unnecessary transactions.

10. Investigate the possibilities of decomposing equipment into *generic* and *specific* equipment. Generic equipment should be owned by the OR department. Specific equipment should be owned by the primary division at hand. This results in better cost allocation and more efficient investment decisions.

11. Investigate the cost homogenety of the different methods of anesthesia. If there are significant differences between the methods of anesthesia, it might be worth while to introduce several cost drivers for these services. In this case, the costs for equipment, instruments, medication, and disposables regarding anesthesia should be primarilily allocated to the OR department, and billed according to these new cost drivers. This results in even better cost allocation.

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Appendix A

Analysis: Disposables costs distribution

Because of the diversity in disposables, prices of disposables vary significantly. Costs vary from €1860 for an expensive medical disposable to €0,003 for a paper towel.

A model for cost allocation should account for differences in price, as it may be worth while to transfer certain costs (such as the unit of €1860) to the primary division, while it is surely not worth while to transfer every single paper towel.

We collected data of all disposables delivered to the OR in the period of January 1st, 2009 until June 5th, 2009. We deleted all rows containing negative values, and/or rows that have missing values. For every transaction, a price per unit was calculated.

Table A.1 shows the number of units that fall in percentiles of 10 per cent of costs, sorted (decreasing) on price. This table is graphically presented in Figure A.1.

As these paper towels (and the like) produce a lot of noise, we deleted all units

Percentile	Units	Average price
10%	503	262,30
20%	1342	98,32
30%	2421	54,50
40%	4169	31,65
50%	6178	21,36
60%	10183	12,96
70%	21340	6,18
80%	46136	2,86
90%	82865	1,59
100%	1332489	0,10

Table A.1: Number of units per percentile of costs

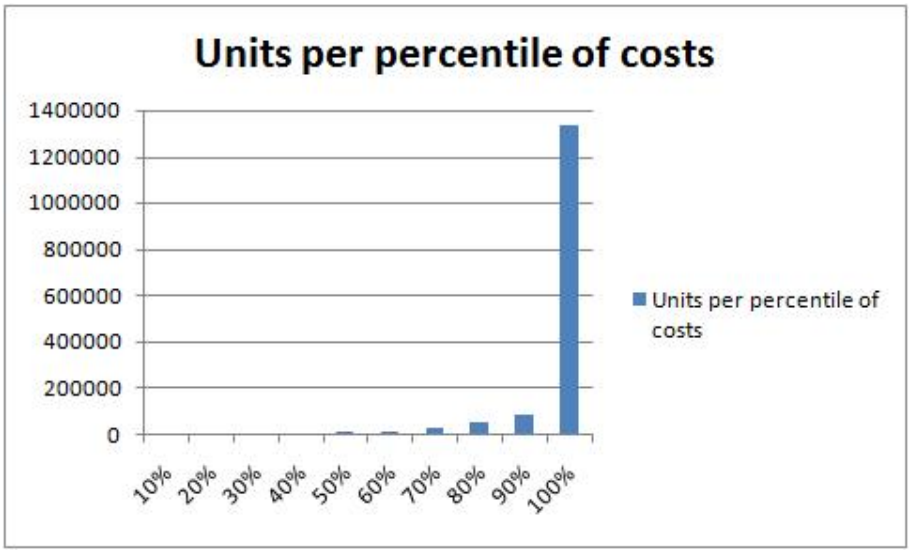


Figure A.1: Units per percentile of costs

Percentiles	Units	Costs	Costs (cumulative)
10%	48660,1	951.065	951.065
20%	97320,2	134.991	1.086.056
30%	145980,3	89.787	1.175.843
40%	194640,4	47.939	1.223.782
50%	243300,5	32.827	1.256.609
60%	291960,6	22.290	1.278.899
70%	340620,7	15.700	1.294.599
80%	389280,8	10.463	1.305.062
90%	437940,9	7.993	1.313.055
100%	486601	6.334	1.319.389

Table A.2: Costs per percentile of units

from the data with a price per unit of below €,010. Table A.2 shows the costs per percentile of number of units. This table is graphically presented in Figure A.2.

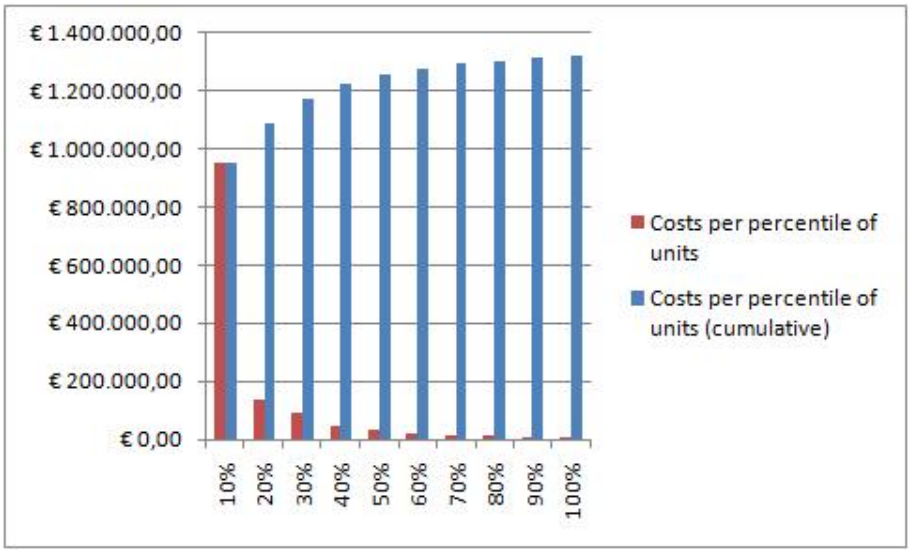


Figure A.2: Costs per percentile of units

Appendix **B**

Analysis: Relation between OR time and Recovery time

To check for correlation between OR time and Recovery time, we took data of 26077 surgeries in Isala klinieken over the period January 1, 2008 to October 22, 2008. We removed all records with missing values for the essential data. This resulted in 22812 usable records. For every record, we calculated OR time and Recovery time. We used SPSS 16.0 to calculate correlation between OR time and Recovery time. The SPSS output is presented in Table B.1.

From these data, we conclude that OR time is a better cost driver for Recovery costs than the Sessions tariff. Distributing Recovery costs over OR time can be considered 'fair'.

Correlations

		DuurInOK	DuurRecovery
DuurInOK	Pearson Correlation	1,000	,206**
	Sig. (2-tailed)		,000
	N	22812,000	22812
DuurRecovery	Pearson Correlation	,206**	1,000
	Sig. (2-tailed)	,000	
	N	22812	22812,000

**. Correlation is significant at the 0.01 level (2-tailed).

Figure B.1: SPSS output correlation between OR time and Recovery time

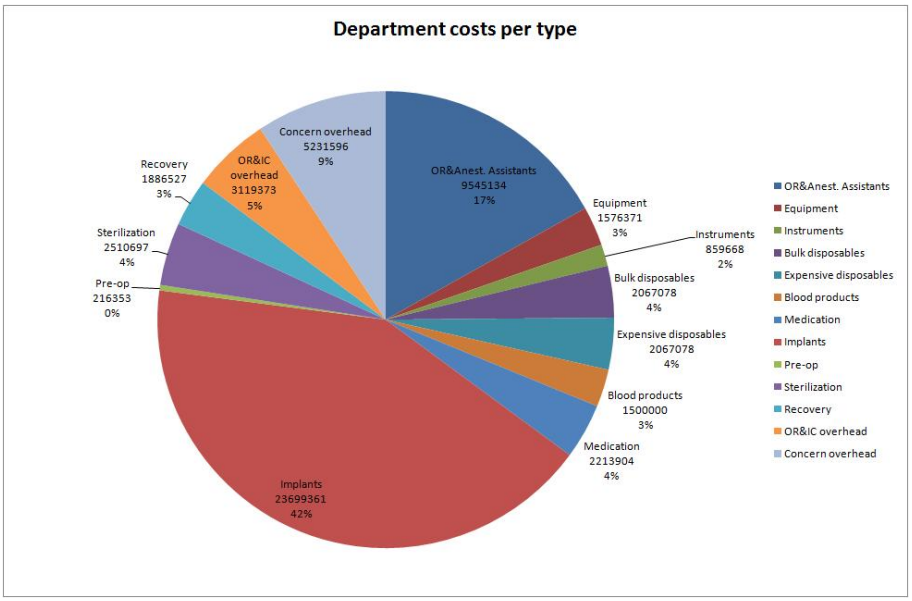
Appendix C

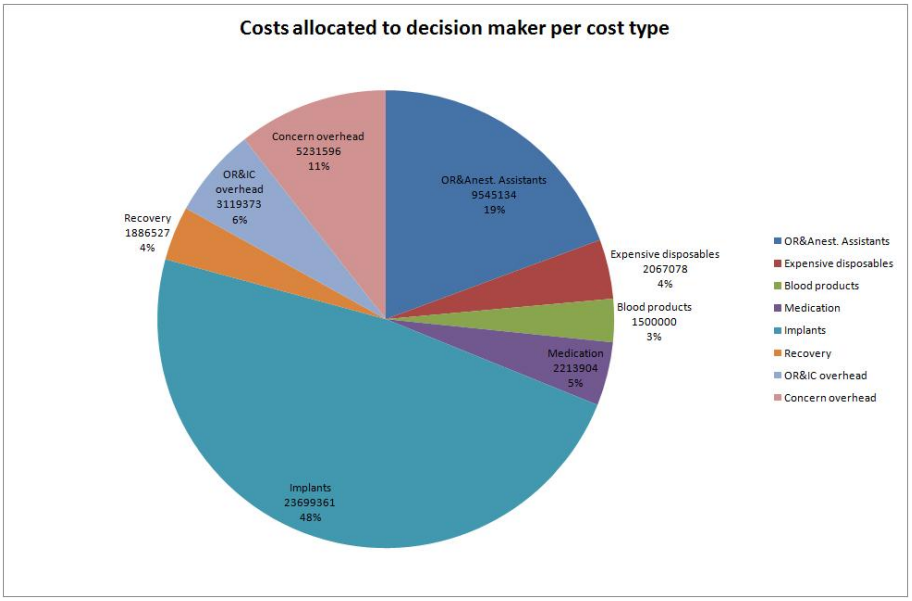
Financial consequences of alternatives for long term

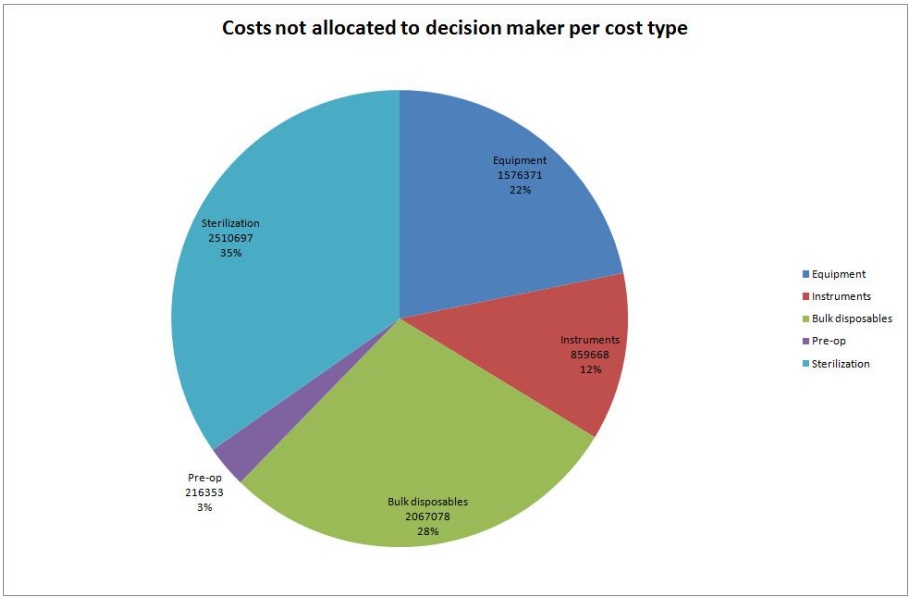
This appendix shows the financial consequences if a certain alternative is implemented. For every alternative, three charts are presented: The first chart shows all costs that are allocated to the OR department in primary allocation. The second chart shows the costs that are directly (based on actual consumption/usage) allocated to the primary division. The third chart shows the costs that are not directly (not based on actual consumption/usage) allocated to the primary division, but are charged using a tariff per sessions, for costs that are not allocated directly.

For every model, a table presents the allocation quality (total percentage of costs allocated to decision maker) and the percentage of not influenced costs of the OR division's total costs. The first one is a measure for behavior congruence, the latter one is a measure for outcome measurability.

C.1 Financial consequences of model 1

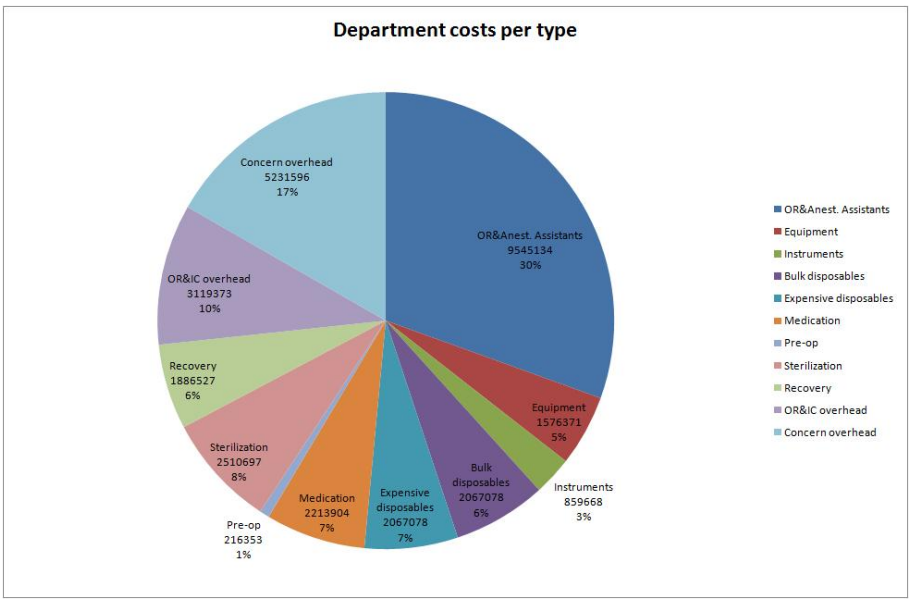


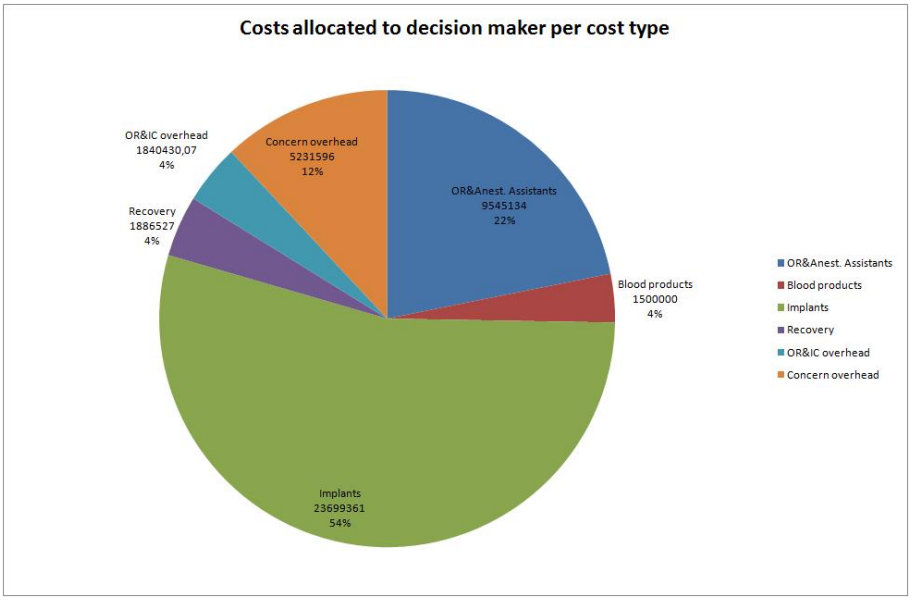


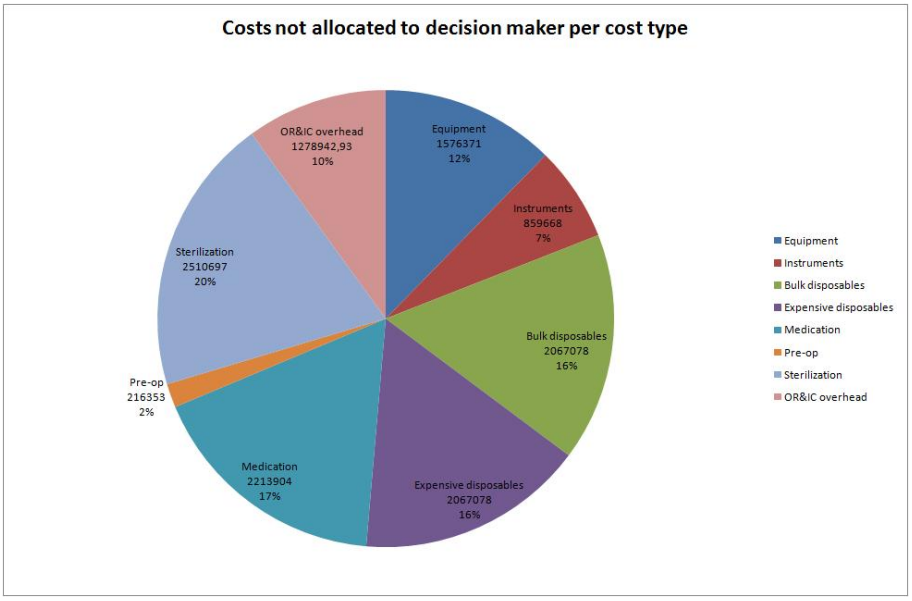


Percentage not influenced costs of total OR costs	12,8%
Allocation quality	87,2%

C.2 Financial consequences of model 2.1

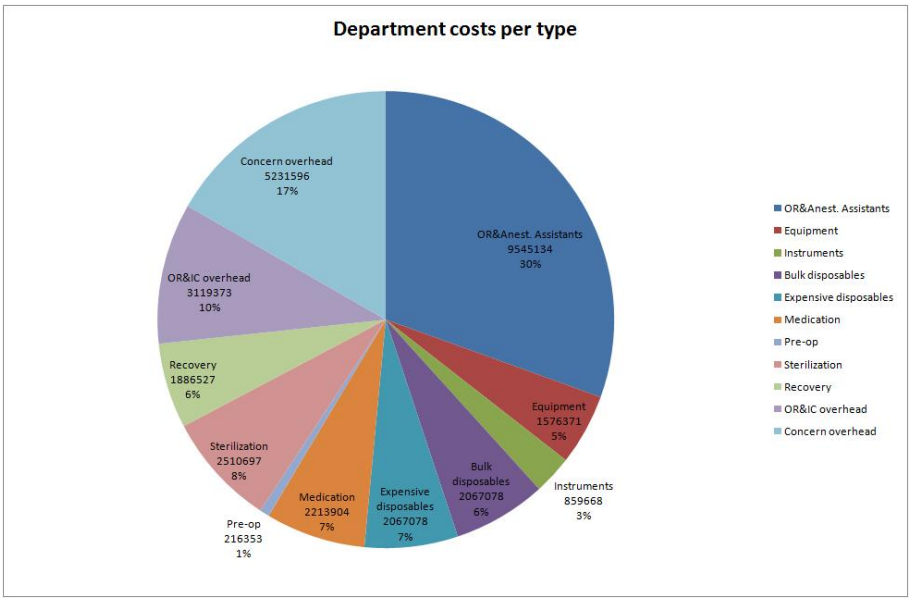


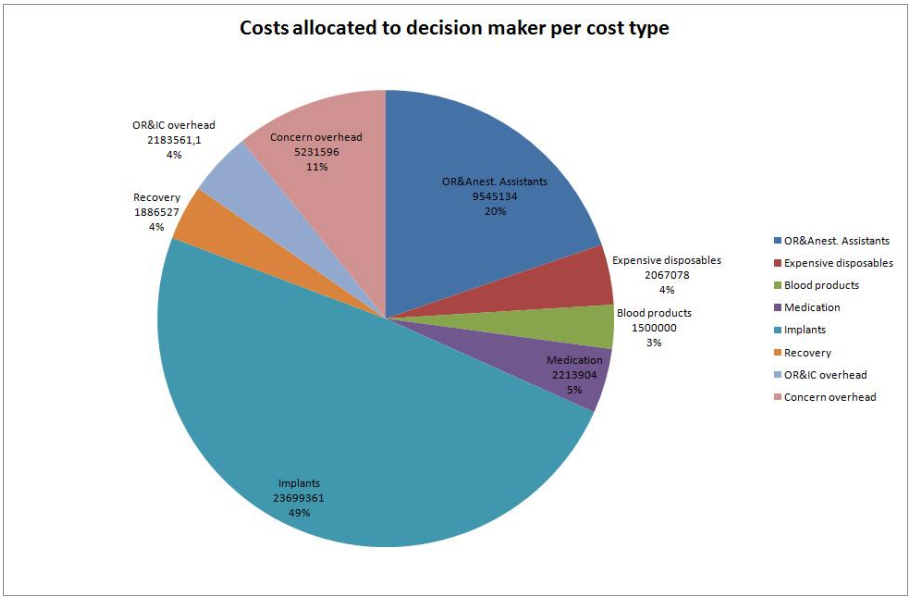


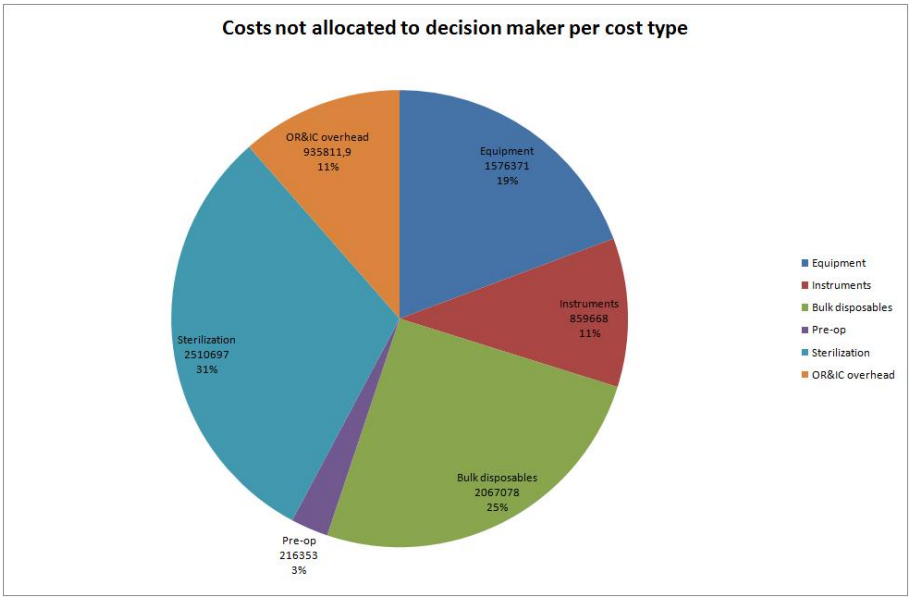


Percentage not influenced costs of total OR costs	40,9%
Allocation quality	77,4%

C.3 Financial consequences of model 2.2

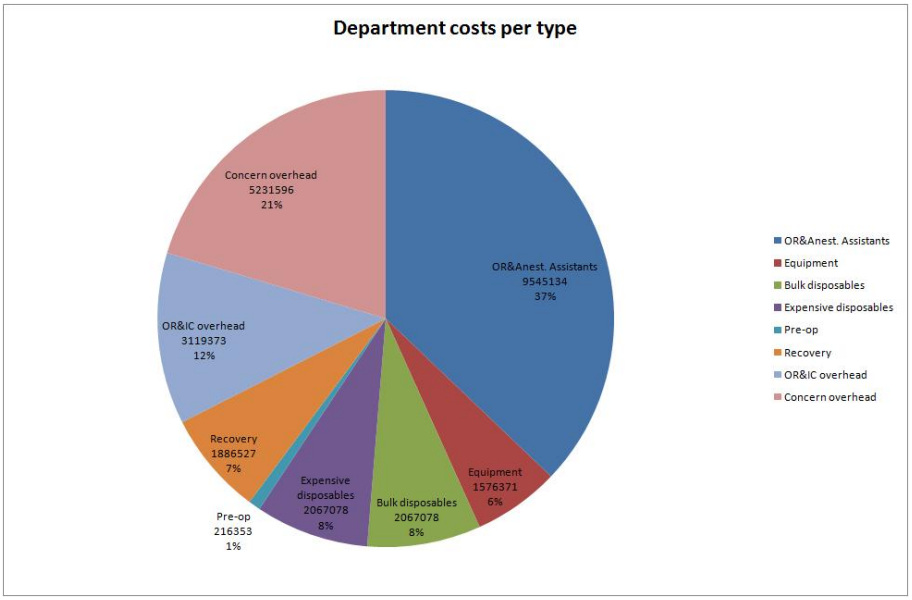


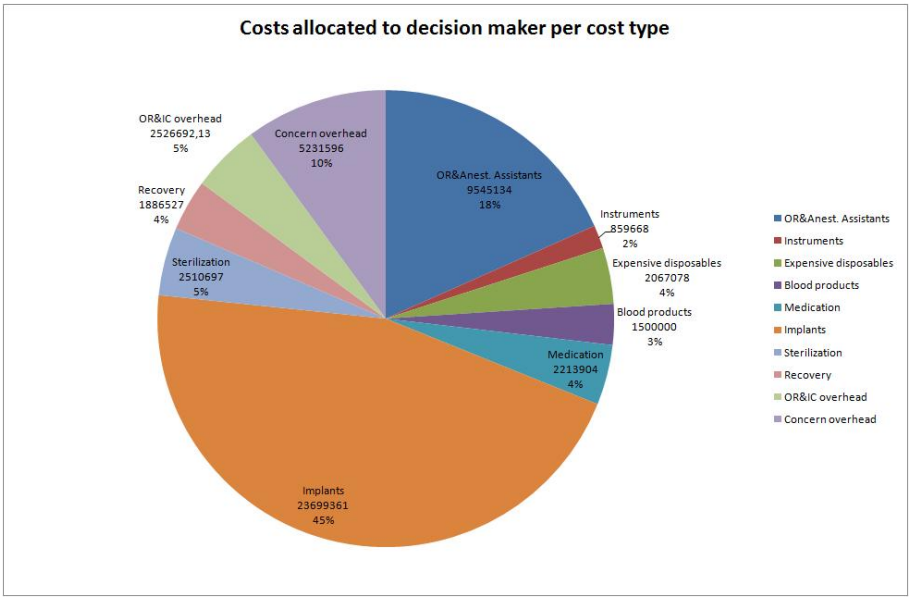


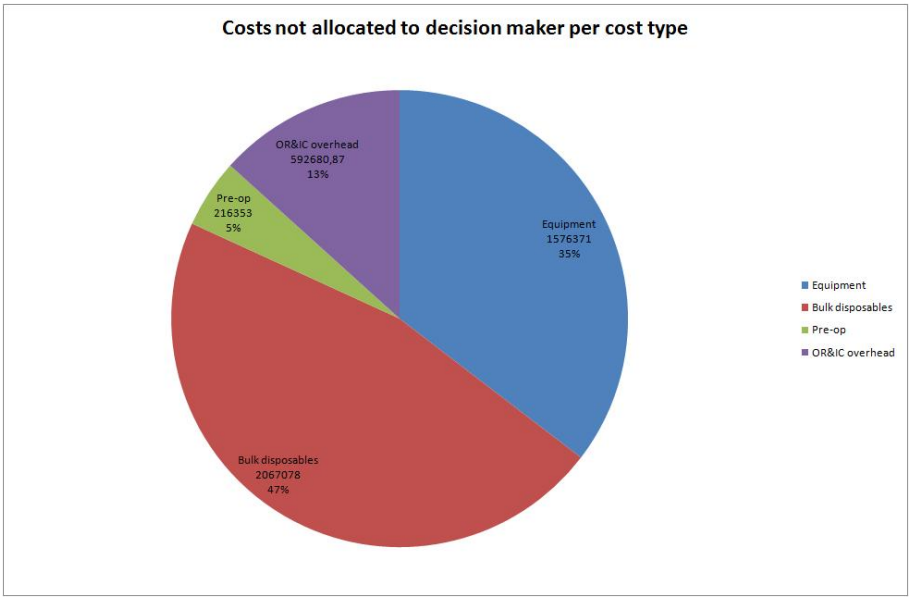


Percentage not influenced costs of total OR costs	26,1%
Allocation quality	85,5%

C.4 Financial consequences of model 3

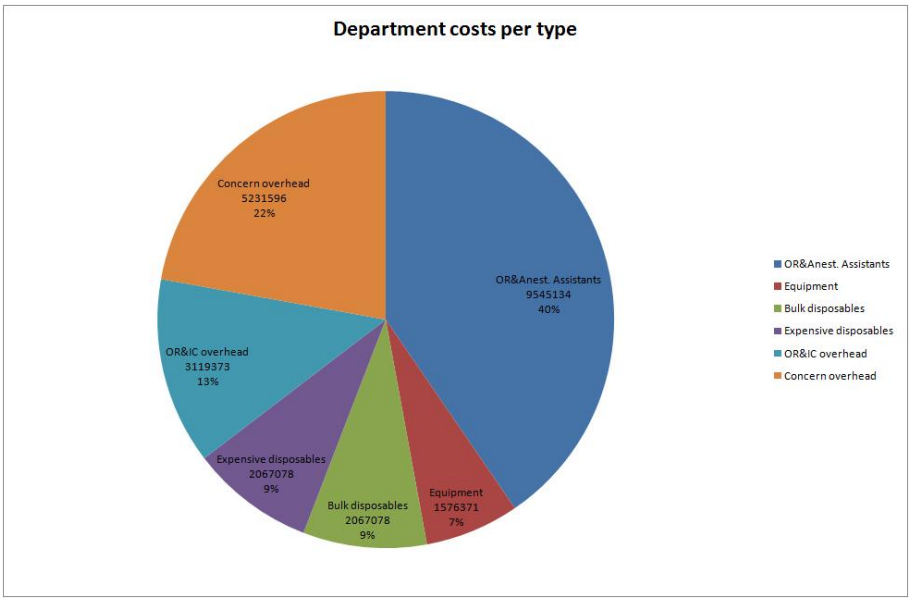


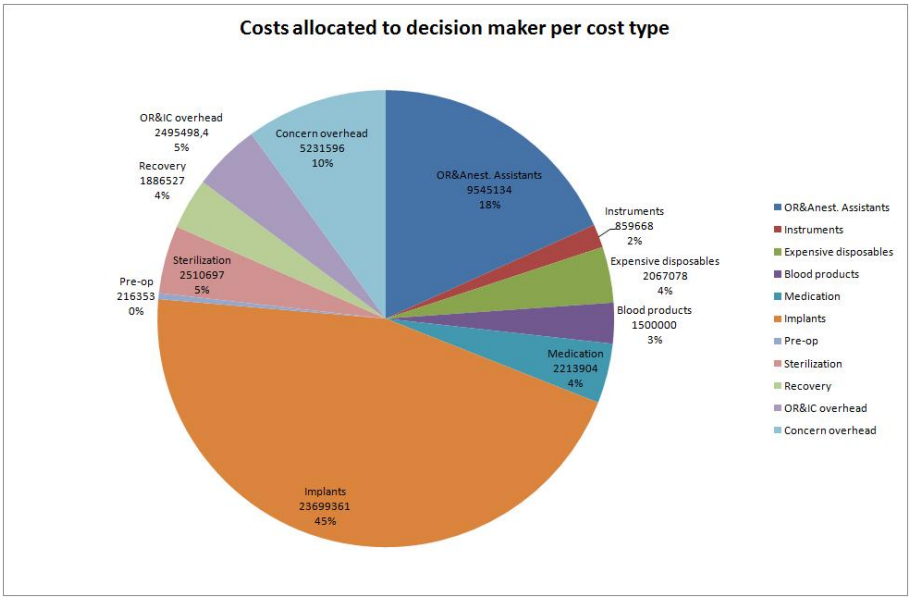


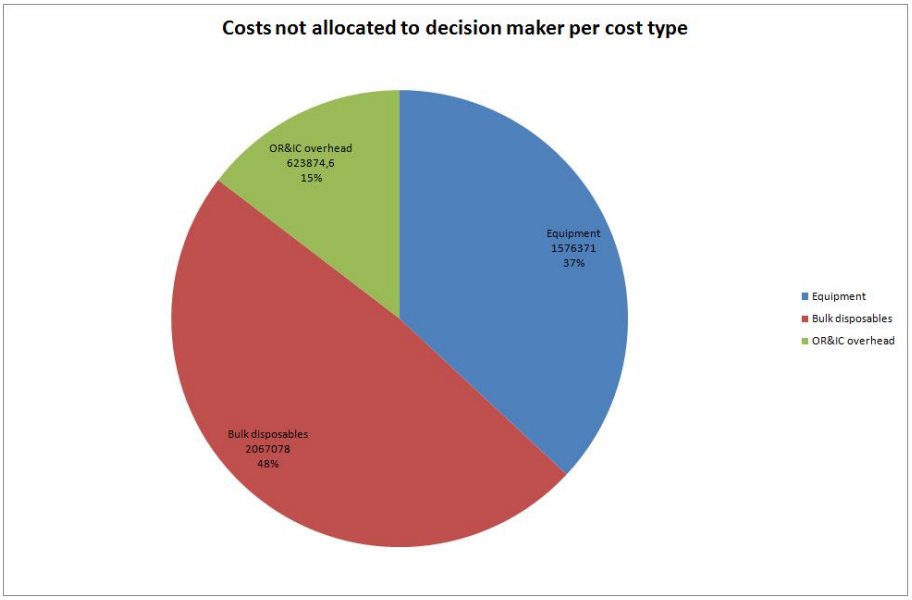


Percentage not influenced costs of total OR costs	17,3%
Allocation quality	92,1%

C.5 Financial consequences of model 4

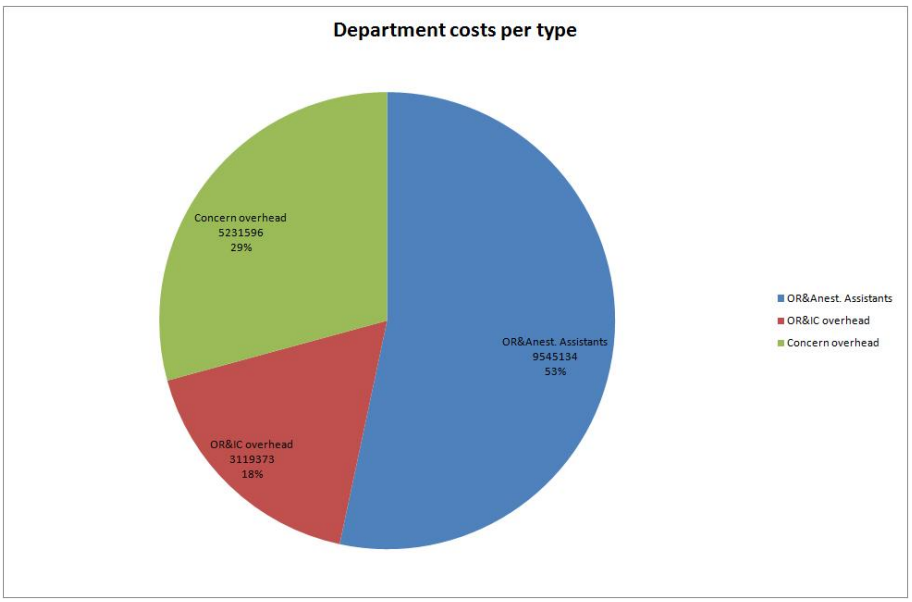


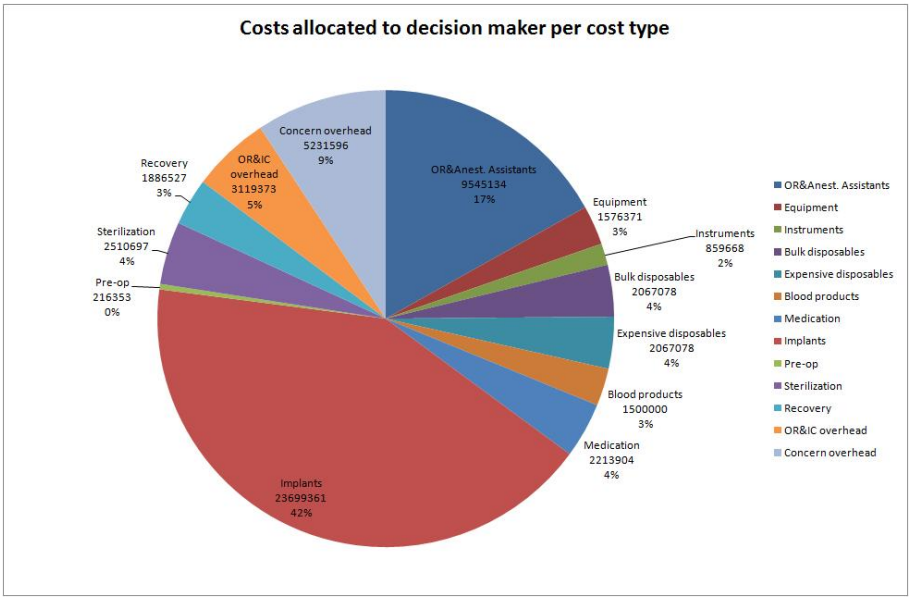




Percentage not influenced costs of total OR costs	18,1%
Allocation quality	92,4%

C.6 Financial consequences of model 5





The chart of costs not allocated to the decision maker is not included, as there are no costs not directly allocated to the decision maker.

Percentage not influenced costs of total OR costs	0%
Allocation quality	100%

Appendix D

Scores for alternatives on long term

D.1 Scores for model 1

Criterion	Score	Motivation
Criteria from literature		
Information efficiencies (1-4)	2	Extensive dat gathering and transfer.
Evaluation of divisions (1-5)	4	Fraction not influenced costs of total costs: 12,8%.
Behavior congruence (1-5)	3	Allocation quality: 87,2%
Practical criteria		
Comm. resource pooling (1-4)	4	OR department organizes almost all material resources.
Effort (1-4)	1	Transfer pricing requires a lot of effort, extensive record keeping on shop floor.
Complexity of model (1-4)	3	Straightforward, only many cost drivers are used for transfer pricing.
Infrastructural change (1-5)	2	Internal systems have to be adapted significantly, external systems only require little change.

D.2 Scores for model 2.1

Criterion	Score	Motivation
Criteria from literature		
Information efficiencies (1-4)	3	Little data transfer.
Evaluation of divisions (1-5)	1	Fraction not influenced costs of total costs: 40,9%
Behavior congruence (1-5)	2	Allocation quality: 77,4%
Practical criteria		
Comm. resource pooling (1-4)	3	OR department organizes most of the material resources.
Effort (1-4)	3	Transfer pricing does not require a lot of effort, only minor record keeping on shop floor.
Complexity of model (1-4)	4	Simple model.
Infrastructural change (1-5)	5	No infrastructural change is needed, most of the system is 'up and running'.

D.3 Scores for model 2.2

Criterion	Score	Motivation
Criteria from literature		
Information efficiencies (1-4)	3	Little data gathering and transfer.
Evaluation of divisions (1-5)	2	Fraction not influenced costs of total costs: 26,1%.
Behavior congruence (1-5)	3	Allocation quality: 85,5%.
Practical criteria		
Comm. resource pooling (1-4)	3	OR department organizes most of the material resources.
Effort (1-4)	2	Transfer pricing requires significant bookkeeping on the shop floor.
Complexity of model (1-4)	3	Primary allocation simple, but a large number of different cost drivers.
Infrastructural change (1-5)	2	Internal systems have to be adapted significantly, external systems only require little change.

D.4 Scores for model 3

Criterion	Score	Motivation
Criteria from literature		
Information efficiencies (1-4)	3	Little data gathering and transfer.
Evaluation of divisions (1-5)	3	Fraction not influenced costs of total costs: 17,3%.
Behavior congruence (1-5)	4	Allocation quality: 92,1%.
Practical criteria		
Comm. resource pooling (1-4)	2	OR department organizes several material resources.
Effort (1-4)	2	Transfer pricing does not require a lot of effort, no record keeping takes place on the OR shop floor (but a complex cost price estimation has to be made).
Complexity of model (1-4)	2	Several cost components are in- and excluded in OR product.
Infrastructural change (1-5)	1	External systems require significant change because several actions in the OR result in transactions in external systems.

D.5 Scores for model 4

Criterion	Score	Motivation
Criteria from literature		
Information efficiencies (1-4)	3	Little data gathering and transfer.
Evaluation of divisions (1-5)	3	Fraction not influenced costs of total costs: 18,1%.
Behavior congruence (1-5)	4	Allocation quality: 92,4%.
Practical criteria		
Comm. resource pooling (1-4)	2	OR department organizes several material resources.
Effort (1-4)	2	Transfer pricing does not require a lot of effort, no record keeping takes place on the OR shop floor (but a complex cost price estimation has to be made).
Complexity of model (1-4)	2	Several cost components are in- and excluded in OR product.
Infrastructural change (1-5)	1	External systems require significant change because several actions in the OR result in transactions in external systems.

D.6 Scores for model 5

Criterion	Score	Motivation
Criteria from literature		
Information efficiencies (1-4)	4	No gathering and transfer.
Evaluation of divisions (1-5)	5	Fraction not influenced costs of total costs: 0%.
Behavior congruence (1-5)	5	Allocation quality: 100%.
Practical criteria		
Comm. resource pooling (1-4)	1	OR only provides the room with personnel.
Effort (1-4)	4	Almost no bookkeeping effort.
Complexity of model (1-4)	4	Most simple model available.
Infrastructural change (1-5)	1	External systems and procedures require significant change, because divisions must organize material resources.

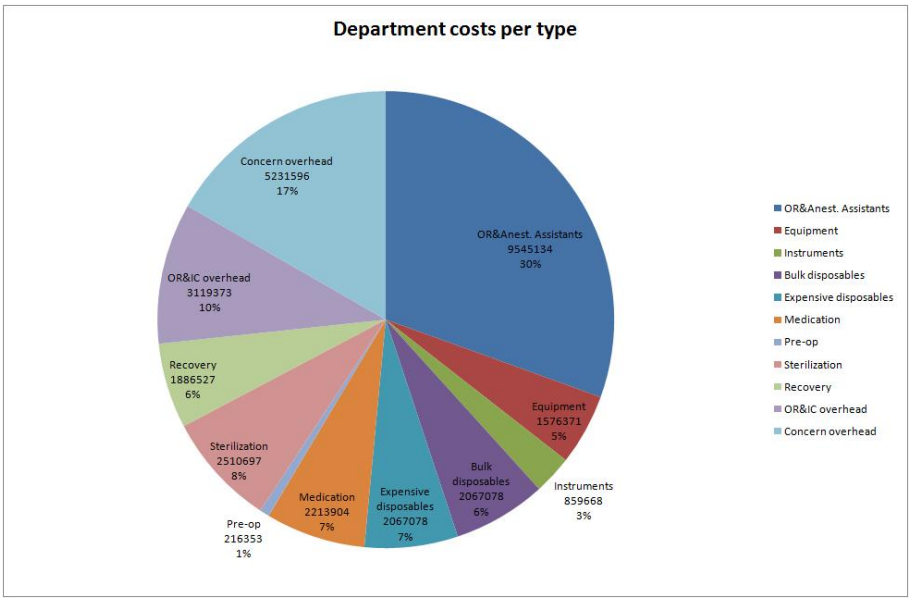
Appendix E

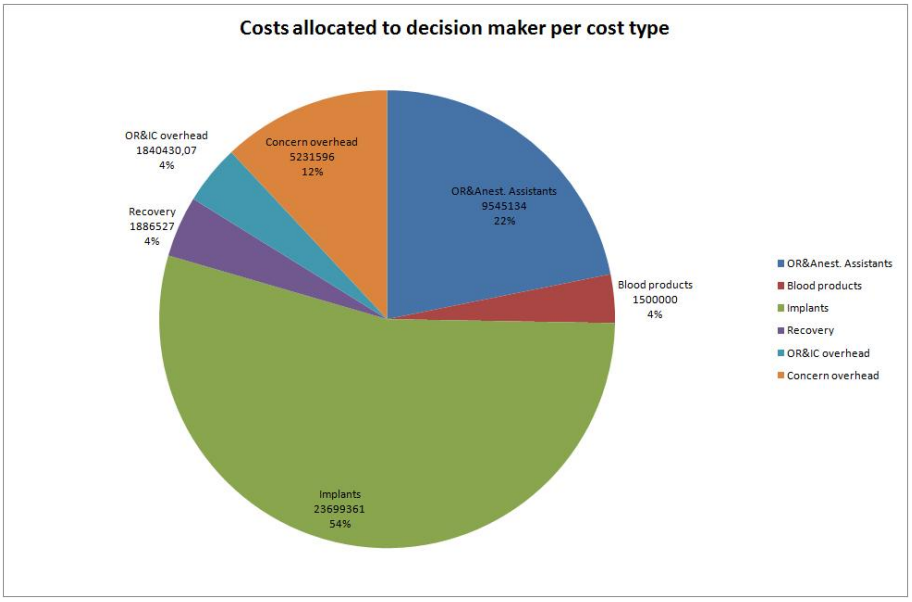
Financial consequences of alternatives for short term

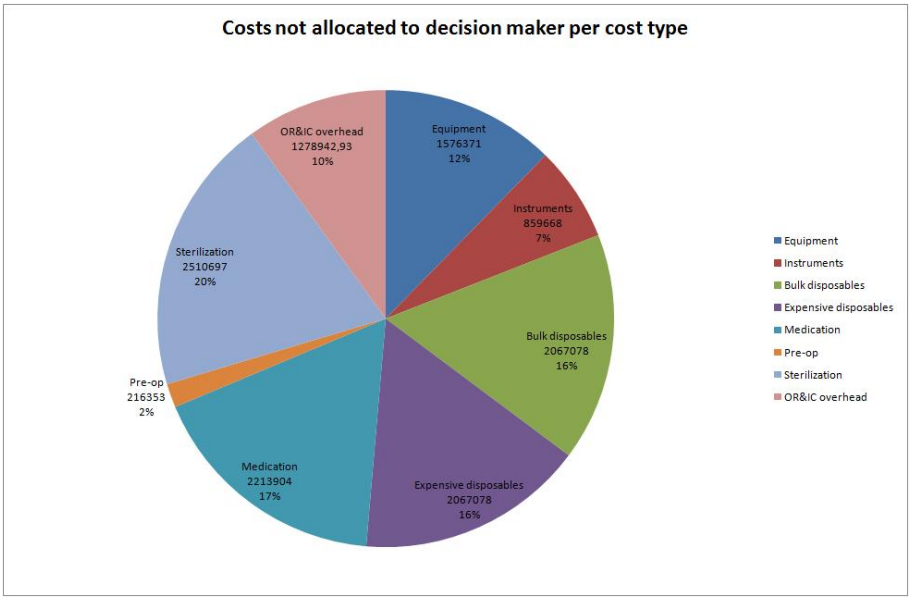
This appendix shows the financial consequences if a certain alternative is implemented. For every alternative, three charts are presented: The first chart shows all costs that are allocated to the OR department in primary allocation. The second chart shows the costs that are directly (based on actual consumption/usage) allocated to the primary division. The third chart shows the costs that are not directly (not based on actual consumption/usage) allocated to the primary division, but are charged using a tariff per sessions, for costs that are not allocated directly.

For every model, a table presents the allocation quality (total percentage of costs allocated to decision maker) and the percentage of not influenced costs of the OR division's total costs. The first one is a measure for behavior congruence, the latter one is a measure for outcome measurability.

E.1 Financial consequences of model A.1

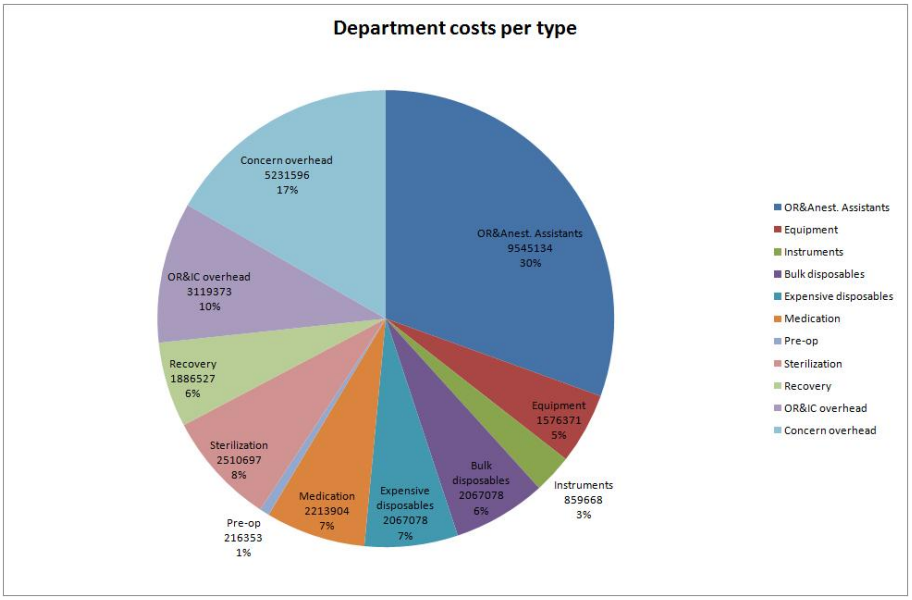


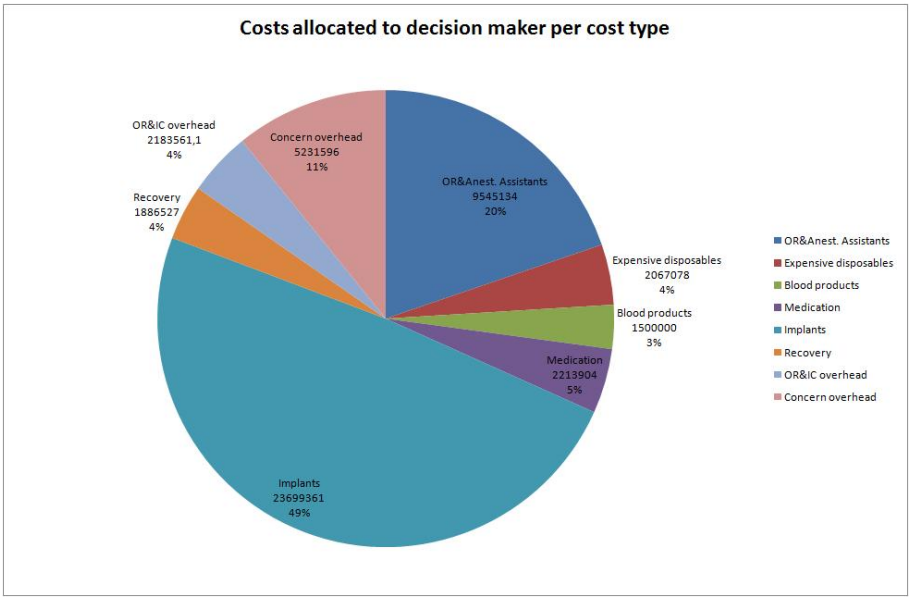


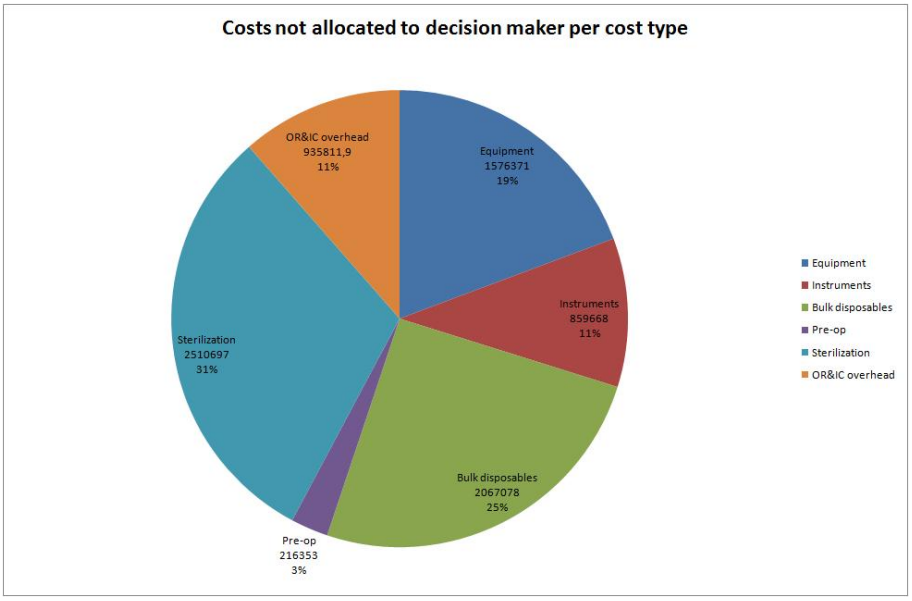


Percentage not influenced costs of total OR costs	40,9%
Allocation quality	77,4%

E.2 Financial consequences of model A.2

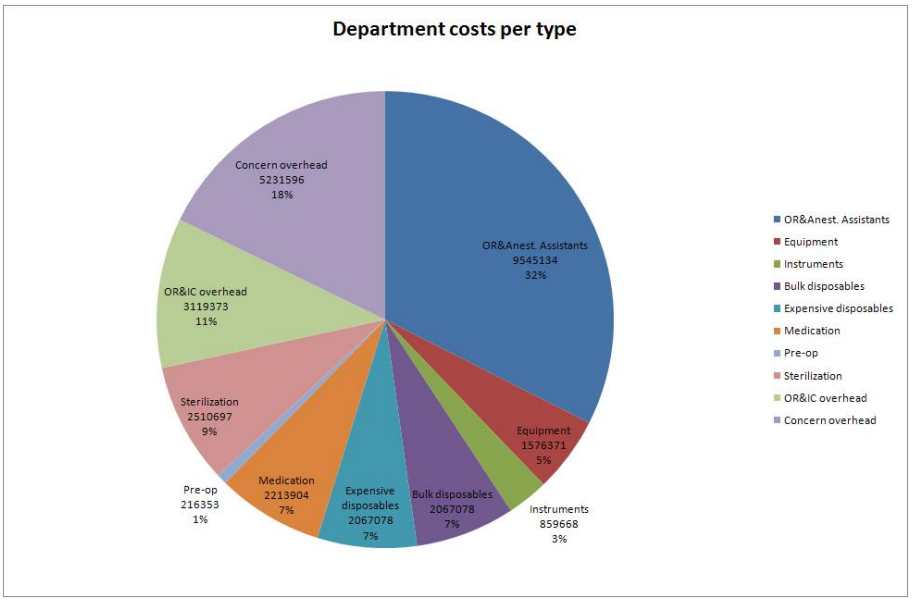


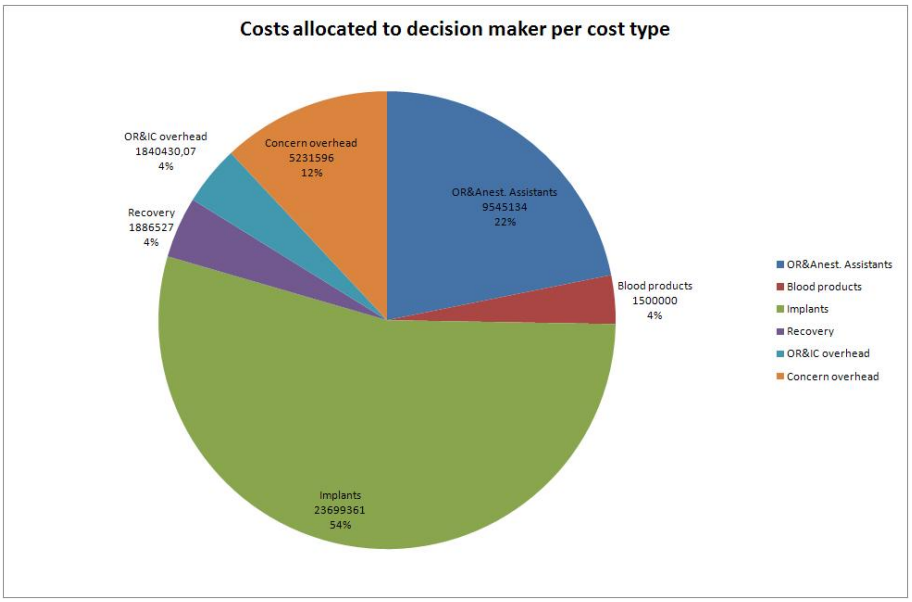


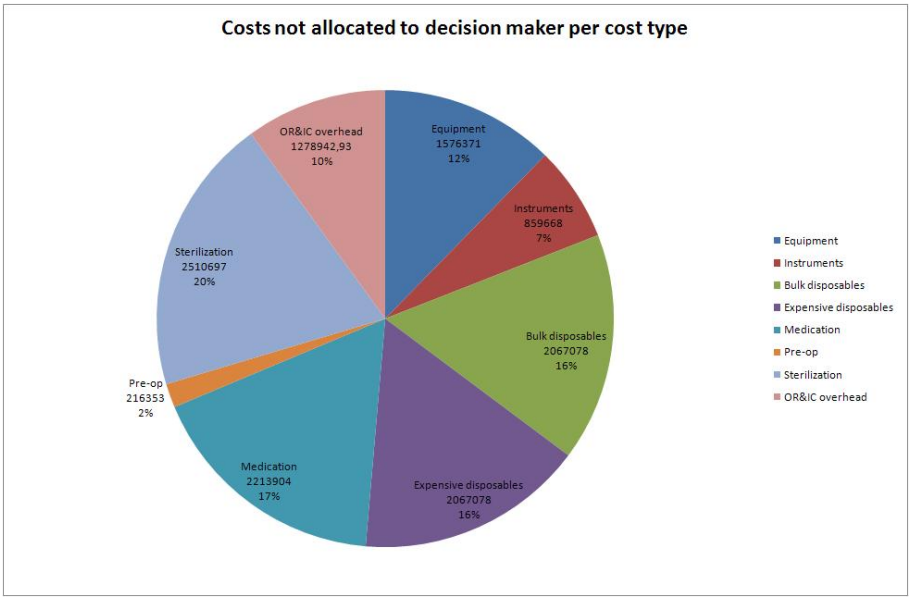


Percentage not influenced costs of total OR costs	26,1%
Allocation quality	85,5%

E.3 Financial consequences of model B.1

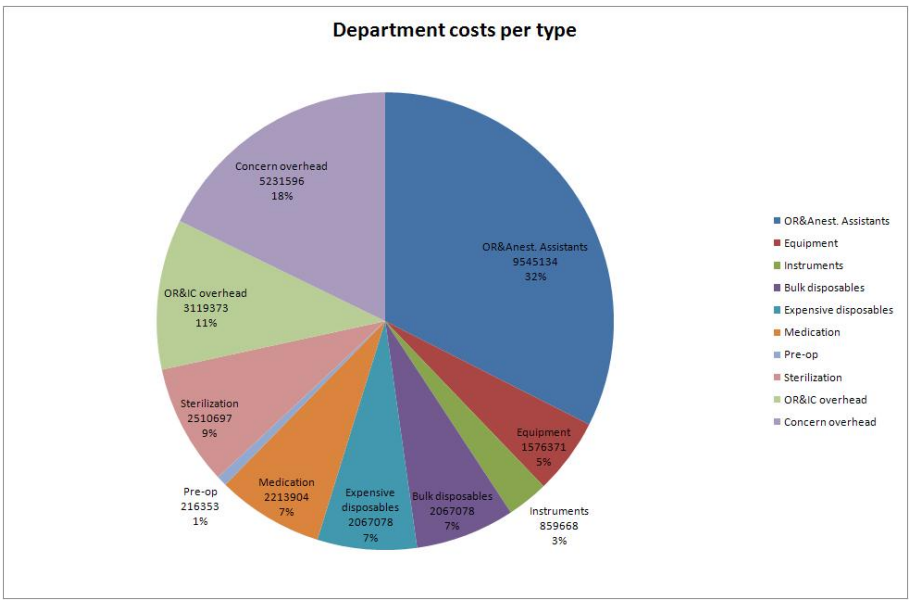


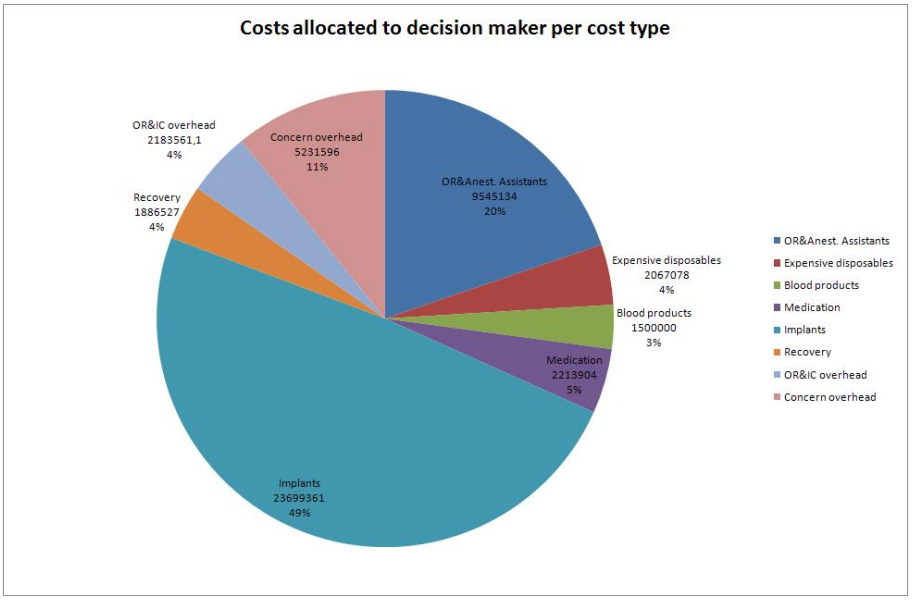


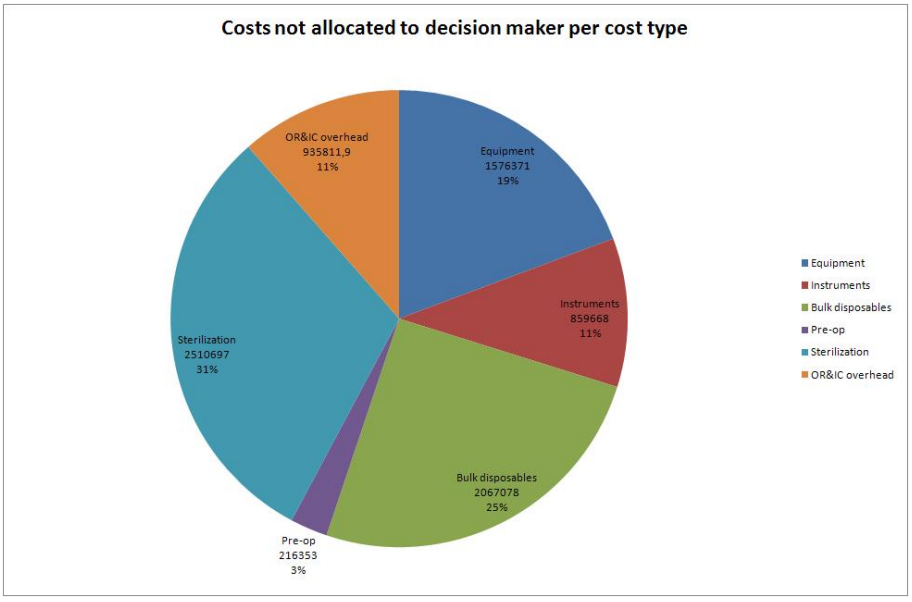


Percentage not influenced costs of total OR costs	43,5%
Allocation quality	77,4%

E.4 Financial consequences of model B.2







Percentage not influenced costs of total OR costs	27,8%
Allocation quality	85,5%

Appendix F

Scores for alternatives on short term

F.1 Scores for model A.1

Criterion	Score	Motivation
Criteria from literature		
Information efficiencies (1-4)	3	Little data transfer.
Evaluation of divisions (1-5)	1	Fraction not influenced costs of total costs: 40,9%
Behavior congruence (1-5)	2	Allocation quality: 77,4%
Practical criteria		
Comm. resource pooling (1-4)	3	OR department organizes most of the material resources.
Effort (1-4)	3	Transfer pricing does not require a lot of effort, only minor record keeping on shop floor.
Complexity of model (1-4)	4	Simple model.
Infrastructural change (1-5)	5	No infrastructural change is needed, most of the system is 'up and running'.

F.2 Scores for model A.2

Criterion	Score	Motivation
Criteria from literature		
Information efficiencies (1-4)	3	Little data gathering and transfer.
Evaluation of divisions (1-5)	2	Fraction not influenced costs of total costs: 26,1%.
Behavior congruence (1-5)	3	Allocation quality: 85,5%.
Practical criteria		
Comm. resource pooling (1-4)	3	OR department organizes most of the material resources.
Effort (1-4)	2	Transfer pricing requires significant bookkeeping on the shop floor.
Complexity of model (1-4)	3	Primary allocation simple, but a large number of different cost drivers.
Infrastructural change (1-5)	2	Internal systems have to be adapted significantly, external systems only require little change.

F.3 Scores for model B.1

Criterion	Score	Motivation
Criteria from literature		
Information efficiencies (1-4)	3	Little data transfer.
Evaluation of divisions (1-5)	1	Fraction not influenced costs of total costs: 40,9%
Behavior congruence (1-5)	2	Allocation quality: 77,4%
Practical criteria		
Comm. resource pooling (1-4)	3	OR department organizes most of the material resources.
Effort (1-4)	3	Transfer pricing does not require a lot of effort, only minor record keeping on shop floor.
Complexity of model (1-4)	4	Simple model.
Infrastructural change (1-5)	5	No infrastructural change is needed, most of the system is 'up and running'.

F.4 Scores for model B.2

Criterion	Score	Motivation
Criteria from literature		
Information efficiencies (1-4)	3	Little data gathering and transfer.
Evaluation of divisions (1-5)	2	Fraction not influenced costs of total costs: 26,1%.
Behavior congruence (1-5)	3	Allocation quality: 85,5%.
Practical criteria		
Comm. resource pooling (1-4)	3	OR department organizes most of the material resources.
Effort (1-4)	2	Transfer pricing requires significant bookkeeping on the shop floor.
Complexity of model (1-4)	3	Primary allocation simple, but a large number of different cost drivers.
Infrastructural change (1-5)	2	Internal systems have to be adapted significantly, external systems only require little change.