A model to assist the real estate investment decision making process at a large academic hospital

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Preface

During the six months that I have been working on this thesis I have learned a great deal, both about the theories used in this thesis and the functioning of the UMCG. I was glad to be able to stay at the UMCG at this period and be seated within the Finance and Control department. I would like to thank my supervisors at the UMCG R. Heida and H. Snapper and my first supervisor from the university Twente M. Wouters for the time they have spent on me and the good advice they have given me. Also I would like to thank J. Hids from the Building and Infrastructure of the UMCG for his input to improve the model further and R. Joosten my second supervisor of the university Twente for his advices to improve this thesis.
I have had a great time while doing this assignment and hopefully, you will enjoy reading this thesis just as much.

Saskia Heikens

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Management Summary

Recent changes in the healthcare system in the Netherlands have led to a situation where hospitals bear more responsibility on their investments. So it is becoming ever more important that investments are done in a smart and efficient manner. This thesis is developed to assist the investment decision making process by constructing a model for the UMCG in which different alternatives of an investment project are analysed. The first central question focuses on the method used in the model and is the following; What is the best way to analyse investment opportunities to serve as the foundation of the model and that fits with the UMCG and its surroundings?

With the use of a literature study, a comparison is made between three different methods of analysing investment opportunities, the Discounted Cash Flow (DCF), Real Options Analysis (ROA) and Direct Capitalisation (DC). The DCF method is favoured, mainly because it is accurate and easily understandable. This last argument allows the model to be used by financial and non-financial persons. The Net Present Value (NPV) of all possible different alternatives is given as output and is compared to each other to determine the best alternative. This NPV lists the total present value of all the cash flows during the lifespan of a project. The Weighted Average cost of Capital (WACC) is the weighted average between the cost of debt and cost of equity and is used to determine the discount factor. Calculating this for the UMCG resulted in a WACC of 6,07%.

The second central question focuses on the development and working of the model itself and is the following; In which way can a model be developed that assists the decision making process for real estate projects at the UMCG? By listing all the requirements of the model, the input and output parameters become clear. The input consists out of the operational income and expenses, the initial investment income or expenses and the duration of the project. The output is given by the NPV and a sensitivity analysis to see what happens if the revenues rise of fall up to 5%. An important feature of the model is its flexibility so it can be used for real estate investments for any project within the UMCG.

The model is applied to a current case where the psychiatric department for adults (UCP) and children (UCKJP) need new housing. Within this project there are three different alternatives, a completely new building, a complete renovation of the existing buildings or a combination of new building and renovation. These three alternatives are compared to each other within the model where the alternative to build a completely new building has the highest NPV and is considered the best option to proceed with. The alternative that combines renovation with building a new structure has only a slightly lower NPV and can also be considered a viable option. The complete renovation has the lowest NPV. Please note that the absolute values of the NPVs of the three alternatives contain a large degree of uncertainty, because the allocating of the Academisch Component en Rijksbijdrage (AC&R) and the overhead expenses may not be fully accurate. Any improvements that are done to make these input parameters more reliable would greatly improve the accuracy of the NPV. This lack of accuracy on the NPV is not a great problem since the main function of the model is to compare different alternatives and the uncertain input is the same for each alternative. This means that the ranking of the alternatives remains the same regardless of the height of the AC&R and overhead expenses. Another limitation is that the model can only list options that are available now, not ones that may come available in the future. This limits the number of alternatives that can be listed. Further improvements on this matter can be made by expanding the model to include option or decision trees that can list all possible options.

1 Introduction

1.1 Introduction

Changes in the healthcare sector, aimed to make the market more competitive, have had a large impact on hospitals in the Netherlands. One of the consequences is that hospitals are more responsible for their investment decisions. Currently, several hospitals are postponing their real estate investments, because they are unsure of the financial consequences. Even if a hospital does go ahead with the investment plans, the banks are often not willing to assist. In over ten cases hospitals that have a plan for a real estate investment have been turned down by the banks and have not been granted a loan.[1] Earlier this year a hospital made the news because it is near bankruptcy due to cash flow problems after a new high tech hospital was built.[2] These examples show that there is a need to focus more on the investment decision making process and to determine the consequences of these investments.

In the midst of all this, an academic hospital in the Netherlands, the Universitair Medisch Centrum Groningen (UMCG), wants to be more aware of the entire investment process. The UMCG is a rather unique hospital also because it is situated in the centre of a city. The lack of expansion room results in an even bigger need to analyse all investment alternatives in order to make smart investment with the eye on the future. For this reason, this thesis will discuss the ways in which a model is developed to assist the real estate decision making process regarding the investment opportunities at the UMCG. The goal of the thesis is therefore the following:

Develop a model by which decisions, regarding investments in the real estate at the UMCG, can be made.

The next section gives an overview of the situation at which the UMCG is currently in. The UMCG itself will also shortly be explained, followed by the changes numerous changes in the healthcare sector in the Netherlands. Also discussed in this first chapter are the problem statement and the research methods. The last section explains the further layout of this thesis.

1.2 Overview of the situation

For the last couple of years the healthcare sector in the Netherlands changed dramatically and in the next years more changes will come. The government believes more competition will lead to greater cost efficiency and shorter waiting lists. The hospitals in the Netherlands used to completely budgeted and were not subjected to any risks regarding the real estate investments.
Some investments will still be made in an area where there cannot be any competition and where hospitals will continue to work with the old budget system. In this situation there is little to lose, but also little to gain. However, there will also be investments where some competitive market functions will be introduced. These investments bear risk and can lead to losses or gains. It is this category that is most interesting for this thesis. In order to analyse these investment opportunities, it is important to understand in which situation this investment is in and how the changes will affect it. Therefore after a short introduction of the hospital for which this model was made the changes will be discussed more elaborate.

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[1] http://persblik.nl/downloads/cobouw4juni2009.pdf
[2] http://www.medicalfacts.nl/2009/05/14/orbis-medisch-en-zorgconcern-dreigt-failliet-te-gaan

UMCG

This thesis has been made at and for the Universitair Medisch Centrum Groningen, commonly known as the UMCG. It is a large academic hospital which employs over 10.000 people and has the last resort function for the entire north of the Netherlands. The UMCG is situated near the centre of the city of Groningen and does not have a lot of space to expand. It is for this reason important to build wisely and to consider all possible options before approving any projects.

1.2.1 The changes in the healthcare system

There are several different aspects of the healthcare system that are changing or have been changed in the last few years. These changes in the healthcare system lead to the shift in responsibility of the investments to the hospitals and are therefore the main motive for the development of the model. To fully understand the model and the motivations behind it, the following sections will explain the changes in the healthcare system in the Netherlands.

Diagnose-Treatment-Combination

The first major change in the healthcare sector was the introduction of the Diagnose-Treatment-Combinations (DTC). The Dutch name for this is Diagnose-Behandel-Combinaties or DBC. In the remainder of this thesis the English term is used. These can be seen as products or services a hospital offers and is the first step towards competition.

According to the government the DTC structure is still too wide and complex and needs to be further developed to be able to use it in a totally integral pricing system. Therefore the "DBC's op weg naar transparantie" (DOT) structure will (most likely) be introduced in 2010 in which the number of DTCs will be reduced and it should all become more transparent (Ministerie van Volksgezondheid, Welzijn en Sport, 2008b).

B-segment

The second step towards competition was dividing the DTCs in an A-segment and B-segment. In the A-segment all prices of the DTCs are fixed and determined by the government. Hospitals get a budget called Functiegericht Budget (FB) which includes the costs of this segment (Ministerie van Volksgezondheid, Welzijn en Sport, 2008b). The B-segment contains all DTCs that have variable prices and should be determined by negotiations between the healthcare supplier and the health insurance company. The number of DTCs in the B-segment is currently at an average of 35% of the total amount of DTCs across all hospitals (Ministerie van Volksgezondheid, Welzijn en Sport, 2008b). This percentage will continue to increase in the following years.

Whereas the capital expenses were covered by the budget up until now, as of this year, the price of B-DTCs should also cover the capital expenses. These capital expenses consist out of depreciation and interest costs. To give hospitals some time to adjust to this new situation, there is a transitional procedure. This procedure means that hospitals will get 75% of capital expenses of their B-segment included in their budget in year 1 of the investment, 50% in year 2 and 25% in year 3. After year 3 the hospital should be able to receive the income from the B-segment needed to cover the capital expenses related to this segment (Nederlandse Zorgautoriteit, 2008). The setup of the A-segment and B-segment is also depicted in Figure 1.

The Budgeting Regime

For investments there was a Budgeting Regime (bouwregime). If a hospital wanted to invest, it would need to obtain several licences issued by the government. If the project was finished according to the licence, the government would pay the capital costs. This was done in the following manner; hospitals, after receiving permission, closed out a loan from a private party and used that money to build. After that they got each year the amount of interest costs and depreciation added to their budget. This Budgeting Regime has been cancelled on 01-01-2009 (Ministerie van Volksgezondheid, Welzijn en Sport, 2008a). With the exception of the transitional system (which will be discussed in the next section) the capital expenses will no longer be covered by any budget. Because of this

removal of the capital expenses from the budget, there is also no need to obtain licences in the new Budgeting Regime (Ministerie van Volksgezondheid, Welzijn en Sport, 2008a). This means that hospitals are allowed to build without consent of the Building Regime, but will in the new situation bear all the risk on these investments.

The transitional system
The desired end situation of the government is an 'integraal prestatiebekostiging', a system in which hospitals receive income based on their turnover instead of a fixed budget. In order to get to this system, there are two possible transition systems. The first is a system with three different segments. The so-called A0-segment contains all highly specialised functions that cannot be made variable. This part will remain budget based. The A1-segment contains 'maatstafconcurrentie' in which prices are free to set, but there is a maximum price cap. Finally there will be a B-segment which is completely variable. At the beginning of this year it became clear that the 'maatstafconcurrentie' was put on hold by the government for an undetermined timeframe (Ministerie van Volksgezondheid, Welzijn en Sport, 2007). The second system is simply to keep the budget (the Functiegericht Budget or FB) as it is now and move some DTC each year from this budget to the B-segment. This means that each year the budget will decrease by the ratio that the B-segment is increasing and that the revenues of the B-segment should cover this decrease in budget (Ministerie van Volksgezondheid, Welzijn en Sport, 2007). This method appears to be favoured by the government.

1.2.2 Two types of additional funding
Besides the general changes that apply to all hospitals, there are some aspects that make the UMCG defer slightly from the above setting which results in additional sources of funding for the UMCG. First of all, the UMCG is an academic hospital. As such, it has additional functions compared to a normal hospital. For instance, it assists in the training of healthcare students and scientific research. Also, the UMCG is the largest hospital in the north of the

Netherlands and has a lot of highly specialised treatments. This gives them a last resort function, meaning that if another hospital for some reason cannot treat a patient, (s)he will be sent to the UMCG. However these patients are usually more expensive and for that reason the government will keep that part, known as the Academisch Component (AC), budgeted. This means the UMCG will always rely more on a budget than the average hospital. The AC budget is funded by the ministry of Healthcare (Volksgezondheid, Welzijn & Sport, VWS). In addition to the last resort function, the AC also supports research and development. There is also a budget issued by the Ministry of Education (Onderwijs, Cultuur & Wetenschap, OCW) called the "Rijksbijdrage", this budget is the so-called "werkplaatsfunctie". This function is described by the Ministerie van Onderwijs, Cultuur en Wetenschap (2008) in the following manner:
"Werkplaatsfunctie betreft het werk dat het academisch ziekenhuis van het Universitair Medisch Centrum doet voor het wetenschappelijk geneeskundig onderwijs en onderzoek in de faculteit geneeskunde."
Translated this means that the "werkplaatsfunctie" is the work that an academic hospital does to support scientific medical research and the research from the medical faculty. Both of these funds are normative amounts paid up-front. A specific amount is given for investments, if that amount is not used, hospitals can add it to their reserves to be used when necessary. The previously mentioned FB comes from the Ministry of Healthcare (VWS) and applies not only to academic hospitals, but is also available for regular hospitals. The two types of funding discussed above can also be seen in Figure 1, which gives an overview of the entire situation.

Decentralized Housing Academic Hospitals (DHAZ)
With the cancellation of the Budgeting Regime (bouwregime), hospitals are free to invest. However for academic hospitals there exists a 'Decentralisatie Huisvesting Academische Ziekenhuizen' (DHAZ) agreement or decentralized housing academic hospitals agreement, in which the academic hospitals and the
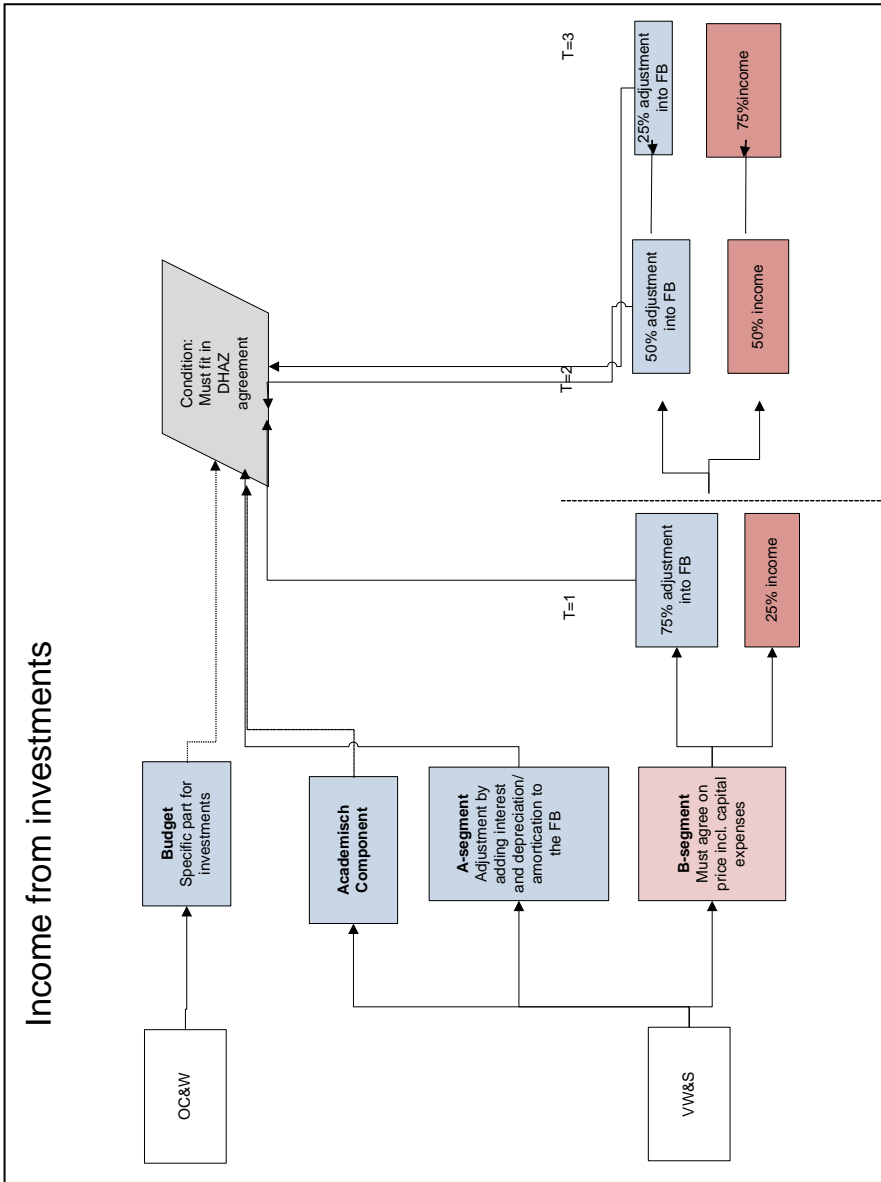
Income from investments

Figure 1: Overview of income from investments

government have set a maximum amount of investments that each academic hospital can have each year over a periods of 5 years (Ministerie van Onderwijs, Cultuur en Wetenschap, 2004). For example, if an academic hospital has agreed upon in the DHAZ covenant to invest no more than €25 million, the total investments (both new and renovated buildings) of the entire hospital can in one year be no more than €25 million. This covenant is active for five consecutive years, so the hospital can then invest up to €25 million each year until the five year period is ended and a new amount has been agreed upon. In figure 1, which is given on the previous page, there are dotted lines going towards the DHAZ, this is to indicate that the UMCG while planning new investments, must be aware of the constraints of this agreement.

All these different types of incomes related to investments are given in figure 1.

1.3 Problem Statement

The situation as was described before, with the numerous changes in the healthcare system in the Netherlands, has led to a need of the UMCG to develop a model to support them in the real estate investment decision making process. The goal of this thesis that was also given in section 1.1 The introduction is:
Develop a model by which decisions, regarding investments in the real estate at the UMCG, can be made.
In order to attain this goal, there are two central questions that need to be answered. Each central question is in turn divided into a number of sub questions. The remainder of this section will give these central and sub questions. In the following parts of this thesis these questions will be answered and the answers to these questions will also be stated in Chapter six: The conclusion.

1.3.1 Central questions

1. What is the best way to analyse investment opportunities to serve as the foundation of the model and that fits with the UMCG and its surroundings?
2. In which way can a model be developed that assists the decision making process for real estate projects at the UMCG?

1.3.2 Sub questions

1.a Which methods are there in the theory to analyse investment opportunities?
1.b In what way should the method be used?
1.c What are the general advantages and disadvantages of each method?
1.d How do the different methods fit within the UMCG and its environment?
1.e What kind of debt treatment is used within the method?
1.f How is the discount factor determined?
1.g How is the discount factor for the UMCG calculated?
2a. What are requirements and what kind of different requirements are there?
2b. What are the requirements of the model?
2c. What are the parameters of the model?
2d. What are the inputs and outputs of the model?
2e. Is the required input for the model available at the UMCG?
2f. How can the model be made flexible enough so it can be used by all departments within the UMCG?
2g. What is the outcome of the model when applied to a specific case?
2h. Does the model work as expected?
2i. Is the model understandable and easy to use?
2j. What are the limitations of the model?

The answers to these questions are key to this thesis, but the way in which these answers are found is equally important. For this reason the next section will describe the research methods that will be used to find the correct answers.

1.4 Research Methods

In order to answer the central and sub questions mentioned in previous section, there are three vital research methods, a literature study, meetings and testing.

1.4.1 Literature study

It is important to know which methods of investment decisions exist within the academic community. The literature study focuses on this aspect by comparing the different methods to each other and listing its advantages and disadvantages. Of these methods the best method that has the best fit with the UMCG and its environment is analysed in even more detail and is used in the model.

1.4.2 Meetings

During the development of this thesis several meetings with different people of different departments of the UMCG will be held, specifically with people from the Finance and Control and Building and Infrastructure departments. The goal of these meetings is slightly different during different phases of the thesis. When conduction the literature study, the different methods are discussed to see if it would be a good fit for the UMCG. Within these meetings a lot of information concerning the UMCG and the healthcare system in general can also be obtained. The second phase consists out of the development of the general model. The goals of the meetings are now to evaluate the model thus far and discuss possible improvements. The last phase is the use of the model to a real case. The goals as were listed for phase two still exist, but within these meetings the input needed for the model is also gathered and the accuracy of the data is discussed. All the meetings have a length of 30-60 minutes and total of 16 meetings were held.

1.4.3 Testing

When the model is developed and applied to a case, the future users of the model are testing it to see if the model and the manual that supports the model are understandable and usable. For this purpose an old case is used where all the needed data is already known. The output of the model is not relevant in this instance, the goal is to see if the use of the model by its future users does not lead to confusion or problems.

1.5 Layout

Chapter two covers the first part of the literature study. The main focus here is on the financial management and real estate finance theory. These two schools do not always agree with each other especially on what should and what should not be included into the methods used. This literature study will also show the different methods that are known in the theory with regard to the investment decision making process. All the advantages and disadvantages will be discussed together with the differences between the schools and their views on how these methods should be used. Chapter three continues on the literature study. The method that was chosen in chapter two is discussed in more detail and the alternatives within this method are listed. At the end of this chapter the literature study is concluded and it has become clear which method is used to analyse investment opportunities. The fourth chapter focuses on the development of the general model, using the literature study as building blocks. All aspects of the model are discussed here as well as how these aspects fit into the big picture. Chapter five discusses the model as it is applied to a specific case. Not all data concerning this case is too made public. Therefore this version, that is available to all, will generally discuss the case and the outcomes. This results in an advice to the UMCG concerning this case and also answers the question if the model can be used accordingly. Finally chapter six gives the conclusion of this thesis in which all the research questions and its answers are listed once more. Appendix A contains the glossary with a list of abbreviations used in this thesis. Appendix B is a CD with the general model and the manual of the general model. Please note that the general model and the manual are written in Dutch.

2 The available methods

2.1 Introduction

The previous chapter discussed the motivation behind the need to develop a model to support the real estate investment decision making process. It also showed which questions need to be answered in order to get a successful model. This chapter discusses the methods found in the academic world for analysing investment opportunities, the strong and weak points of all these methods and the to what degree theses methods will fit with the UMCG. At the end of this chapter there is a general answer to the first central questions. Chapter three continues with the literature study in more detail so that the first central question is completely answered at the end of that chapter. As was also mentioned in section 1.3 The problem statement, the first central questions is the following; What is the best way to analyse investment opportunities to serve as the foundation of the model and that fits with the UMCG and its surroundings?

During the literature study, six meetings occurred with the Finance and Control and the Building and Infrastructure departments to discuss the different methods and their fit to the UMCG and its environment.
In the theory the two main areas in which investment opportunities are being analysed are financial management and real estate finance. This chapter focuses on these two areas in detail, starting with the financial management theory in section 2.2, followed by the real estate finance in section 2.3. When reading the following chapters concerning the financial management and real estate finance theory, one might notice differences not just in the methods themselves, but also in the way these methods are used. Both areas use some sort of cash flow method, but they differ in what should be included in the calculations. These differences appear in the areas of debt treatment and interest expenses (Okoruwa & Cox, 1994). The sections concerning financial management and real

estate finance theory starts with explaining the way each area treats debt and then explains the methods themselves. After having discussed the real estate finance, the choice of the method to be used for the model is explained in section 2.4 Choices applicable to the UMCG. Finally section 2.5 will give the conclusion of this chapter.

2.2 Financial management theory

2.2.1 Treatment of debt

The financial management view renders interest expense as an irrelevant cash flow since any debt financing is implicitly included in to the discount rate (Brigham & Houston, 2006). In addition to excluding the interest costs, the amount of initial outlay would typically include all the costs, regardless of how much these costs may have been financed. All this is based on the rationale that the investment decision should be separated from the financing decision. If the investment appears to be attractive, it would remain attractive regardless of the way it is funded (Okoruwa & Cox, 1994). Therefore the capital structure is often seen as unimportant in the investment decision. The discount rate to be used with this system is the weighted average cost of capital for the entity as a whole to be applied to each project (Okoruwa & Cox, 1994).

2.2.2 The methods

In the financial management there are two methods that are frequently used to analyse investment opportunities, namely the discounted cash flow and real options analysis. These will be discussed and compared in this section and the best method for this situation is chosen.

Discounted Cash Flow (DCF)
The DCF method is used in valuing a project, company or asset using expected future cash flows and the time value of money. This means that money will decrease in worth over time due to inflation and interest. This time value of money is integrated into the DCF method by using a discount factor which creates a present value out of all future expected cash flows (Bierman & Smidt, 1980).

DCF	
Advantages	**Disadvantages**
- Easy to understand and calculate - Widely used - Accurate when there is low volatility	- Inflexible - Cannot deal with uncertainties - Only go, no-go decision

Table 1: Advantages and disadvantages DCF

Advantages of the DCF method are that it is easy to understand the outcome as well as the process. Also with the current software, calculations are easy and can be done in a spreadsheet. Furthermore it is a widely used method, so comparisons can be made with other companies if the data are publically known.
Disadvantages are that uncertainty arises from difficulties in determining the future forecasts and the discount factor. The method itself cannot integrate this uncertainty into the DCF calculations and the sensitivity to this uncertainty must be determined separately. This also shows that the DCF method is not a flexible one. For instance, the DCF allows you to only make a go or no-go decision (invest or not). It does not allow for the option to delay the investment or to compromise on projects.

A way to overcome some of the limitations of the DCF is to do a sensitivity analysis to identify key uncertainties, assess the probabilities for these key uncertainties and construct a decision tree (Smith & McCardle, 1999). This makes it possible to model flexibility in much the same way option trees (discussed in the next section) does.

Although it is a relative old theory and has certain drawbacks, the DCF method is still used heavily by many firms as a financial measure to base their investment decisions on.

Real Options Analysis (ROA)
Real option analysis is derived from the financial sector where an option is a right but not an obligation to buy/sell an underlying stock. This option has a certain value, since it gives you a right which in turn limits your downside risk. This idea is converted to the real world by looking at an investment decision as having different options. For example, there might be the option to delay an investment. This option will have a positive value, because in the time that you are waiting, new information might come available that increases your chance of a positive payoff. Miller and Park (2002, pp.105) explain the ROA method as following;
"The ROA method considers all future investment opportunities along the value chain, allowing a more flexible assessment of strategic projects."
The actual valuation of the option can be done by using adjusted methods of option pricing in financial markets. The first step is to form a twin security, a portfolio of stocks that is perfectly correlated with the real assets (Miller & Park, 2002) or in other words has the same risk as the investment. This is necessary because two assumptions are underlying tradability and efficient markets, meaning that there must be a market for the underlying asset. Because this is usually not the case with investments, it is necessary to make a twin security of stocks in such a way that they do have a market. The most commonly used method to price financial options is the Black-Scholes formula and its underlying assumption, that the underlying follows a Geometric Brownian Motion (GBM) is used in virtually all ROA (Miller & Park, 2002).
Another side of ROA is the use of option trees. In this tree all current and future options are listed. This is much more extensive than the DCF method where only a go or no-go decision can be made. Smith and McCardle (1999) discussed the option tree method and compared it to the DCF method when applied to the oil and gas sector. In Smith and McCardle (1999) article the option tree includes

much more options than the go, no-go option of the DCF. Examples are purchasing pre-drilling rights, possible oil price changes, or the option to postpone the investment (Smith and McCardle, 1999). Each option can result in obtaining new information on which it can become more or less favourable to go ahead with the investment. To get back to the example, the acquisition of the pre-drilling rights lead to the actual pre-drilling and the results of this pre-drilling can severely affect the expected profitability of an investment. As can be seen by the description above, the strong points of the ROA method are the weak points of the DCF method. ROA is a highly flexible method because it includes all possible options. It also uses option trees to that give insight into the probabilities of different outcomes.

The disadvantages of the 'hard core' ROA method are that there must be a twin security and that companies must be able to determine what their twin security is. It is difficult to create a portfolio that perfectly or even adequately correlates with the real project. It also assumes that the underlying follows a GBM. The option tree does not have these disadvantages, but it can easily become overwhelming. The number of options are often numerous and expand into a huge confusing tree. Furthermore the ROA method is complex, harder to understand and less known to managers in non financial sectors.

ROA	
Advantages	**Disadvantages**
- Flexible	- Complex
- Includes all options	- Difficult to understand for
- Accurate when there	non financial people
is high volatility	- Needs twin security
- Possibility to use	
option trees	

Table 2: Advantages and disadvantages ROA

DCF vs. ROA

The ROA method is not a substitute of the DCF method. It is more complementary to it, because in order to perform ROA calculations, a DCF approach should be performed first anyhow.
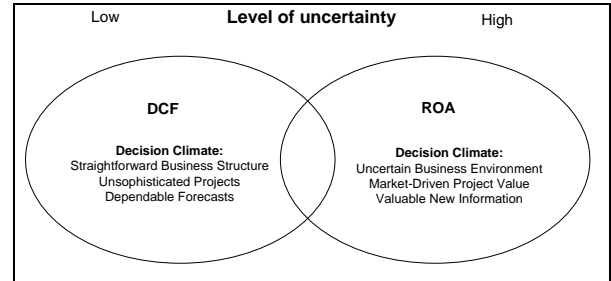
Figure 2: Comparison of the DCF and ROA method (Miller & Park, 2002)

DCF is appropriate for situations when there are low levels of uncertainty, straightforward business structure, unsophisticated projects and dependable forecasts, where ROA is appropriate when there are high levels of uncertainty, uncertain business environment, market-driven project value and valuable new information (Miller & Park, 2002). All these aspects relate to the volatility of the project. From this one could say that projects with high volatility require a ROA method and projects with low volatility can be assessed with the DCF method.

2.3 Real estate finance theory

2.3.1 Treatment of debt

The real estate finance embraces a more holistic view that incorporates financing and investment issues. Not only will the interest expense be included, but also the principal payments on the funds borrowed. As a result, the initial outlay does not include the entire purchase price, but only the amount of the actual equity invested. The analysis will thus include the depreciation write-offs, principal and loan

repayments and sometimes reserves for future maintenance (Epley, Rabianski, & Haney, 2002) (Okoruwa & Cox, 1994). The discount rate has nothing to do with the weighted average cost of capital, but will be the after-tax return required on the equity investment, also known as the capitalisation rate.

2.3.2 The method

The most commonly use method within the real estate finance is the direct capitalisation. This will be explained below.

Direct Capitalisation (DC)

DC is an income property approach which consists of several steps. The first step is to estimate rent revenues, or put more generally, (gross) operating income for the first year. Then the operating expenses for the first year are estimated. Subtracting the operating expenses from the operating income leads to the Net Operating Income (NOI) for year 1. In order to find the value of the property, the NOI must be divided by a capitalisation rate. This capitalisation rate is derived from the market by identifying several comparable properties that have been sold in the recent past and obtain both their sales price and NOI. Dividing the price for which the comparable property was sold with its NOI leads to a capitalisation rate that can be used for the subject property.

The main advantage of this method is its simplicity. It is easier to use than the ROA and even easier to use than the DCF. The difficulty of this method lies in finding the correct NOI and capitalisation rate. The direct capitalisation method and the discounted cash flow method are related. If you calculate the NOI for year one and assume that there is a constant growth over the remaining years, the discount rate of the discounted cash flow method will be approximately the capitalisation rate of the direct capitalisation method plus the growth factor. If these figures match exactly the outcome of both methods will be the same if the same assumptions are used (Bradley, 1989).

Example of direct capitalisation

The calculation of the capitalisation rate if fairly simple if a comparable building has been sold recently. For instance, if there is an apartment building containing 10 apartments where each apartment is rented for €700,- per month, the operating income is;

$$700*10 = €7.000,- per\ month\ or$$
$$Operating\ Income = 7.000*12 = €84.000,- per\ year$$

If the operating expenses are €400,- per month for each apartment, the operating expenses are calculated in the same manner as the operating income;

$$-400*10 = €-4.000,- per\ month\ or$$
$$Operating\ Expenses = -4.000*12 = €-48.000,- per\ year$$

The NOI is simply the operating income minus the operating expenses.

NOI = $NOI = 84.000 - 48.000 = €36.000,- per\ year$

If a comparable apartment building was sold recently for €800.000,-, then he capitalisation rate used for discounting the cash flows becomes according to the method presented by Epley, Rabianski & Haney (2002, pp.155);

$$Capitalisation\ rate = \frac{NOI}{Comparable\ sales\ price} = \frac{36.000}{800.000} = 4,50\%$$

The difficult aspect here is to find a comparable building that was recently sold. There is no consensus in the literature as to what a comparable building is and what would be done if there is no comparable building available.

2.3.3 Operating income

The part of the real estate sector where the focus will be on consists of companies building a structure and then renting this structure to other parties. The operating income will then consist of rent revenue. This part is irrelevant for this situation, since this aspect is not present at the UMCG. For this reason the operating income in the real estate sector will not be investigated further.

2.3.4 Operating expenses

The operating expense of investments at the UMCG, on the other hand, might be very similar to the operating expenses in the real estate sector. The following expenses are common in the real estate according to Collier, Collier & Halperin (2002, pp.103).

- Utilities
- Payroll
- Maintenance, supplies and repairs
- Replacement reserve
- Taxes
- Miscellaneous

Epley, Rabianski & Haney (2002, pp.149-150) describe mainly the same expenses, but make a distinction between variable and fixed cost.

Variable expenses
- Payroll and personnel expenses
- Management fees (expenditures due to rent collection, administration etc.)
- Utilities expenses
- Supplies and materials expenses (only those items that are used in the normal operation of the property, like light bulbs, cleaning materials, paint etc.)
- Ground care expenses (maintenance expenditures for things other than the building)

Fixed expenses
- Property taxes
- Property insurance
- Long-term ground lease
- Reserves for replacement
- Items that must be replaced every 5-10 years.

Excluded for appraisal but included for investment analysis
- Income taxes
- Debt service (principal amount plus interest payments)
- Tax depreciation
- Capital improvements or capital outlays (impact of capital improvements expenditures is seen as an increase in the income-generating potential of the property)
- Project costs

Besides the operating costs, there are also project costs, these focuses on the initial investment, whereas the operating costs only focuses on the costs after the investment. Both Collier, Collier & Halperin (2002, pp.108) and Epley, Rabianski, & Haney (2002, pp.483-486) mention that project costs fall into three categories:

- Land cost; fair market value of the raw land
- Hard cost; actual construction cost to erect the building
- Soft cost; architectural, planning, engineering, permitting, financing and marketing cost

2.4 Choices applicable to the UMCG

2.4.1 Choice of the treatment of debt

The previous two chapters started with the treatment of debt of the different areas. An advantage of the finance methodology is its simplicity. All aspects regarding debt are ignored. A disadvantage is however that the operating viability of a project may depend on the finance alternatives. The holistic view of real estate finance does take into account the viability of a project with respect to the financing alternatives. However there does not appear to be a consensus on the way the discount factor is to be calculated (Okoruwa & Cox, 1994). Furthermore, items as depreciation and reserves are included into the cash flow statement. Form a financial perspective this is contradictory, since these items are costs but not expenses and only expenses should be included into the cash flows. For these reasons the financial management view on the treatment of debt will be followed here, thus all debt services will not be included in the cash flows and the weighted average cost of capital will be used as the discount factor.

2.4.2 Choice of the method

The UMCG is currently in a situation in which they get part in their income from the government as a budget or allowance. The other part of their income comes from the revenues of the B-segment, which is the competitive part. The percentage by which the B-segment will rise is unknown as is the percentage of B-segment in the end situation.

This also gives some extra uncertainty in the expected future payoffs since the payoffs depend on the proportion B-segment/A-segment. The expected future payoffs of the A-segment are fixed and there is no uncertainty. Estimates must be made about the expected future payoffs of the B-segment. But by combining all payoffs the uncertainty is limited, because of the budget part.

In most of the projects at the UMCG the volatility is low. The hospital sector is not heavily affected by economic downfalls or trends. Most investment projects have a future payoff that can be slightly higher or slightly lower than expected, but because of the budget part and the consistent sector, there will not be a large chance of an extremely high or extremely low payoff. In there is an investment opportunity which includes a new piece a technology, for instance a new scanner, the technology might be so new that it remains to be seen if this technology becomes the standard. In this situation there is a high volatility, because of the large change of extreme outcomes.

In the majority of the projects at the UMCG there will be a low volatility and relatively low uncertainly and therefore the DCF method will equally reliable as the ROA method. The DCF method has the advantage that it is easy to understand, for both financial and non-financial people. This is an important feature, since the model will work optimal if it is used by members from all kinds of different departments. Therefore the DCF method is favoured above the ROA method although it is certainly recommended to expand this basic model. This is further addresses in the section Limitations in chapter five. As mentioned before the direct capitalisation method is related to the DCF method. It is in fact a simpler version that does not require assumptions on for each year of the projects lifespan, but

only assumptions on the first year. Because of the lack of market data necessary for calculating the capitalisation rate in the hospital sector, the direct capitalisation method itself is not usable. But if it is difficult to make assumptions on the cash flows of the following years, it might be useful to calculate the operating income and expenses and assume a growth for each following year. This will be a sort of hybrid between the direct capitalisation and DCF method. The discount rate will still be the weighted average cost of capital. The method that will be used in the model is the discounted cash flow method using the financial management treatment of debt. The following chapter will discuss this method in-depth.

2.4.3 Operational Income

At the UMCG there are three different possible income types.
- 100% Budget, no DTC structure
- DTC structure, only A-segment
- DTC structure, A-segment plus B-segment

The model must be able to recognize all three types.

2.4.4 Expenses to be recognized

In the chapter covering the real estate finance literature, a number of expenses commonly used in this sector were mentioned. Even though the treatment of debt will be based on the financial management theory, this part is still relevant. Some expenses will however not be recognized, like depreciation, debt service and taxes. Next to the operating expenses, there are the expenses of the initial investment plus the expected maintenance expenses. For the investment expenses the financing expenses are removed from the soft costs for the same reason as mentioned above. Instead of adding a maintenance reserve in the operating expenses, the actual expected maintenance investments will be added into the model.

This leads to the following list of expenses to be considered in the model:

Operating expenses

Variable expenses

- Payroll and personnel expenses
- Management fees
- Utilities expenses
- Supplies and materials expenses
- Ground care expenses

Fixed expenses

- Property insurance
- Investment expenses

Initial investment

- Land cost; fair market value of the raw land
- Hard cost; actual construction cost to erect the building
- Soft cost; architectural, planning, engineering and permitting
- Maintenance investments
- Addition investments needed to maintain the building.

2.5 Conclusion

This chapter analysed the different methods that exist to support the investment decision making process. Three methods in two different academic fields were discussed, the Discounted Cash Flow and Real Options Analysis methods from the financial management theory and the Direct Capitalisation from the real estate finance theory. In the introduction of this chapter, the first central question is listed and is;

What is the best way to analyse investment opportunities to serve as the foundation of the model and that fits with the UMCG and its surroundings?

This central question is divided into a number of sub questions. The first five of these sub questions were answered in this chapter and are listed below.

Which methods are there in the theory to analyse investment opportunities?
Three methods were discussed in this chapter, the Discounted Cash Flow (DCF), Real Option Analysis (ROA) and Direct Capitalisation (DC).

What are the general advantages and disadvantages of each method?
The DCF method is easy to use, understandable, but also lacks flexibility and cannot handle uncertainty well. The ROA method is flexible, lists all possible options and handles uncertainty well, but in turn is complex and difficult to use. The DC method is very easy in use, but is simplistic and it is difficult to determine the discount actor.

How do the different methods fit with the UMCG and its environment?
The best way to analyse investment opportunities taking into account the UMCG and its surroundings is to use the Discounted Cash Flow method, because it is understandable for non-financial people and that is important since the model will be used by both financial and non financial people. The DCF method can be further simplified by only using the operation income and expenses in year one and let the income and expenses in the following years depend on the first year as is done in the DC method.

What kind of debt treatment is used within the method?
The financial management and real estate finance theory treat debt in a different way. Financial management theory believes that the investment decision should be separated from the financing decision. The real estate finance theory includes the financing costs in the cash flow calculations as well as reserves and depreciation costs.

When using the DCF method the treatment of debt as is described by the financial management theory is used, firstly because it is a clear and straightforward method since it is not concerned with the financing decision. Secondly, the treatment of debt used by the real estate finance theory

includes aspects like depreciation and reserves, but these are not cash flows and should not be included in a cash flow calculation. Finally there is no agreement in the real estate finance theory on how the capitalisation rate should be calculated.

How is the discount factor determined?
To calculate the discount rate the Weighted Average Cost of Capital (WACC) is used. This fits with the choice to use the DCF method and the use of the treatment of debt in the financial management theory. As will be discussed in the next chapter the WACC is not a perfect way of calculating the discount factor, but it is the best option available. The next chapter will furthermore discuss the different ways the DCF methods can be used and which of these ways is most preferable for use at the UMCG.

3 The details of the DCF method

3.1 Introduction

The previous chapter listed the outcome of the first part of the literature study and discussed different methods to analyse investment opportunities. The Discounted Cash Flow (DCF) method turned out to be the best option, but this is a very broad method that can be applied in many different ways. As its logical sequel, this chapter continues with the DCF method, but gives a much more detailed view. These different aspects, like the Net Present Value (NPV), the Payback Period (PP) and the Internal Rate of Return (IRR) are discussed and compared in the next section where their strong and weak points are also discussed. A more detailed comparison is made between the NPV and the IRR and the Modified Internal Rate of Return (MIRR), the improved version of the IRR. Furthermore the Weighted Average Cost of Capital (WACC) is discussed and calculated for the UMCG. The last section of this chapter lists what kind of requirements there are in software development. This is relevant to find out what the model should be able to do which is needed to answer part of the second central question which will happen in chapter four. At the end of this chapter the first central question is completely answered.

3.2 The DCF method more in-depth

As concluded in the previous section, the DCF method is the most appropriate one to use for investment analysis at the UMCG. However the DCF method can be used in many different ways. Therefore this section will give an overview of the different aspects and will determine which ones to use in the model for the UMCG. The cash flows of the investments at the UMCG will almost always have a large cash outflow in the first year due to the building expenses and have (relatively) small cash inflows or outflows in the following years that consist out of the operational income minus the operational expenses. In certain years there may be another large cash outflow because of large maintenance and renovation expenses. The year in which this happens can vary per project and also depends on the lifespan of the project. Since the model is applicable to real estate investment opportunities, the lifespan is long with an average of about 40 years. The exact lifespan of each project can also vary.

3.2.1 Net Present Value (NPV)

The most common indicator used to determine investment probabilities is the NPV. When discounting the cash flows, the present value is calculated. Summing all present values for the investment decision leads to the NPV. The output of the NPV is an amount. Brealey, Myers, & Allen (2003) describe this in a formula in the following manner;

$$NPV = \sum_{t=0}^{N} \frac{C_t}{(1+d)^t}$$

Where
Ct = cash flow at time t
d = discount factor

If the NPV of a project is positive, its incomes are larger than its expenses and the project should be accepted. The NPV is the most reliable indicator of the DCF method as will become clear when the other options will be discussed. However it is difficult to compare NPV of projects with each other, because of different initial costs and duration. For instance a project with high initial costs might result in a nice positive NPV, but its return cannot be compared with a

project with a low initial cost and lower, but still positive, NPV.

3.2.2 Payback Period (PP)

The payback period calculates in which year the expenses are covered. This measure is mostly used in situation where the project should repay itself within the first 5-7 years. For example it was often used by IT firms which have to cope with rapidly changing technology. After a few years the new investment would then be outdated, thus it would need to have a short payback period. This does not play a role at the UMCG, investments there are made for the long run. The output of the PP is measured in years.

3.2.3 Internal Rate of Return (IRR)

The IRR calculates the rate of return that is estimated to be earned on the amount of capital invested in the project over its life (Wright, 1967). Technically it means rearranging the formula of the NPV by making the discount factor, now named the internal rate of return, the dependent variable and setting the NPV at zero as is given by Brealey, Myers, & Allen (2003);

$$NPV = \sum_{t=0}^{N} \frac{C_t}{(1+r)^t} = 0$$

Where
Ct = cash flow at time t
r = internal rate of return IRR

The output of the IRR is a percentage. The IRR is the only measure which does not have a discount factor imbedded into it. However in order to decide whether a project should be accepted, there must be a hurdle rate, a rate of return which is sufficient to cover the interest cost and risk. Usually the cost of capital is used as this hurdle rate.

An advantage of the IRR compared to the NPV is that different types of investments can now be compared, because the IRR depends on the amount of capital invested. The two methods complement each other. The IRR is an indicator of the efficiency or quality of an investment, as opposed to NPV, which indicates value or magnitude. This is the main reason the IRR is often used next to the NPV when making an investment analysis. Research has shown that CFOs almost always use IRR when making investment decisions, despite warnings from academics about weaknesses of the IRR (McKinsey, 2004). These weaknesses or drawbacks are most visible when dealing with non-normal capital projects.

Drawbacks IRR
The drawbacks of the IRR as were given by Chang & Swales (1999);
- Some projects have a number of changes of sign in cash flows, going from positive to negative and back to positive cash flows. Because the IRR is an iterative process it will result in multiple IRRs.
- Some projects have cash inflows followed by one or more outflows. This is sometimes confusing, because now the project should be accepted if the IRR is below the cost of capital.
- For mutually exclusive projects, either due to differences in scale or cash flow pattern (timing), the project with the highest IRR need not have the highest NPV. This ranking problem will be discussed more extensively in the next section.

Ranking problem
The reason for the existence of the ranking problem of the IRR compared to the NPV is not uniformly agreed upon. An article written by Keef & Roush (2001) revealed two main thoughts in the academic community on this matter.

The first reasoning is that the IRR differs in ranking from the NPV because the reinvestment rates are different. The NPV reinvest at the discount rate, while the IRR reinvests at the internal rate of return. A study has found that 71% of management accounting and finance texts follows this reasoning.

The second reasoning is that the reinvestment rate is irrelevant for the cash flow analysis, since it is not a

requirement of the IRR method that the intermediate cash flow be reinvested.

The true reason for the difference in ranking is the difference of magnitude and timing of a cash flow. These two aspects give each investment a different NPV and IRR profile. In order to have a ranking problem the two profiles must intersect at a certain point, the rate at which this happens is known as the Fisherian rate. Two different sets of cash flows intersect if there is a given discount rate at which the two different profiles have the same NPV. This discount rate is then the Fisherian rate (Keef & Roush 2001). If they do not intersect, there will not be a ranking problem and the NPV and IRR will favour the same project. If there is an intersection point, but the discount rate is larger than the Fisherian rate, there will also be no ranking problem. Only if there is an intersection point and the discount rate is smaller than the Fisherian rate, the NPV will favour another project than the IRR method (Keef & Roush 2001).

3.2.4 Modified Internal Rate of Return (MIRR)

The first two points of these drawbacks of the IRR have been addressed in the Modified Internal Rate of Return (MIRR). MIRR is defined as the discount rate which equates the PV of cash outflows for a given capital project with the PV of the "terminal value" of cash inflows from the same project. The general form of the MIRR as was given by Chang & Swales (1999) can be stated as:

$$\sum_{t=0}^{N} \frac{COF_t}{\left(1+k\right)^t} = \frac{\sum_{t=0}^{N} CIF_t * \left(1+k\right)^{n-t}}{\left(1+MIRR\right)^n}$$

Where
COFt = Cash outflow at time t
CIFt = Cash inflow at time t
k = cost of capital
MIRR = Modified internal rate of return

The output of the MIRR is just as the IRR a percentage. According to Chang & Swales (1999, pp.133) the MIRR is the improved version of the IRR;

"MIRR assumes cash flows are reinvested at the project's cost of capital, while regular IRR assumes cash flows are reinvested at the project's own IRR. Because reinvestment at the firm's cost of capital, k, generally is a better assumption, MIRR is a more effective indicator of a project's true profitability."

It has been proven by Chang & Swales (1999) that the MIRR will only give one outcome regardless of the amount of times the sign has changed. Also because the separation of the inflows from the outflows, the higher the MIRR, the better in all circumstances. As for the ranking problem, according to Chang and Swales (1999, pp. 134);

"When the required rate of return is less than the Fisher's rate of intersection, MIRR and NPV rankings will conflict with rankings provided under the IRR method"

This would imply that the MIRR will give the same ranking as the NPV and that it would solve all the limitations of the IRR. However a small example tells a different story.

Example of a ranking problem using MIRR
Assume that there is a project A and a project B, with the cash flows as mentioned below. Both have a positive NPV and an IRR above the discount rate of 10%. When comparing project A to project B, project A is the best option according to all methods. There is no ranking problem present here.

Project A

tijd (n)	0	1	2	3	4	5
Cash Flow	-100	40	40	40	40	40
Present Value	-100	36,36	33,06	30,05	27,32	24,84
NPV						51,63
IRR						28,65%
MIRR						19,55%

Project B

tijd (n)	0	1	2	3	4	5
Cash Flow	-50	15	15	15	15	15
Present Value	-50	13,64	12,40	11,27	10,25	9,31
NPV						6,86
IRR						15,24%
MIRR						8,45%

Now we add a project A+B which has the combined cash flows of project A and project B.

Project A+B

tijd (n)	0	1	2	3	4	5
Cash Flow	-150	55	55	55	55	55
Present Value	-150	50,00	45,45	41,32	37,57	34,15
NPV						58,49
IRR						24,32%
MIRR						12,89%

Comparing project A to project A+B will lead to a ranking problem. The NPV method favours project A+B, where the IRR and MIRR both favour project A. The reason for this is that the NPV of project A+B is the sum of the NPV of project A and project B, while the IRR and the MIRR of project A+B is a weighted average of the IRR or MIRR of project A and project B. The green bars in the tables highlight the best option according to the NPV, IRR and MIRR method.

Because the ranking problem still exists with the use of MIRR, it will not be used in the model. The conflicting outcomes of the NPV and MIRR will only cause confusion among the users of the model, more so since the model should be understandable to people from a non financial background. So a choice must be made between the NPV and the MIRR. The NPV is considered the superior than the MIRR method (Chang & Swales 1999), the main reason for

this is given by Clark, Hindelang, & Pritchard (1979) as being the following:

"The NPV criterion shows clearly and unambiguously the impact of projects on shareholders' wealth or the present value of the firm. However, the same is obviously not true for IRR."

Although this refers to all the drawbacks of the IRR and the MIRR does solve most of them, the main problem of the ranking remains. If one would only look at the MIRR and disregard the NPV, the wrong decision will be made. After all, the NPV shows clearly what the value is of an investment and the project with the highest value should be accepted.

The first part on how the DCF method is used in the model has become clear. The NPV is the output of the model. The next section calculates the discount factor by using the Weighted Average Cost of Capital (WACC).

3.3 Discount factor

To be able to calculate the NPV, the discount factor must be determined. If the project has the same risk profile as the company, then the Weighted Average Cost of Capital (WACC) is appropriate. Again because of the budget part, the risk profiles among different sections and investments, does not differ too much from the risk profile of the company. The WACC is commonly used by publically traded firms. Using the WACC to determine the discount factor of a non-profit organisation that does not operate in an efficient market is not optimal, but it is still the best indicator of the discount factor for the UMCG.

3.3.1 No market values

The value of debt and the value of equity that are necessary to calculate the WACC should be measured in market value (Sweeney & Warga, 1997). The market value of debt is possible to determine by correcting the long term debt

and the current interest charges with the current interest rates. However the market value of equity cannot be determined because the UMCG is a non-profit organisation that does not have stocks or any kind of marketable equity. The values of debt and equity that are used are the book values. This does not lead to problems because, in the absence of tax liabilities, the outcome of the WACC is irrelevant to the E/D ratio.

3.3.2 Weighted Average Cost of Capital (WACC)

The WACC consists out of two parts, a return demanded by debtors and a return demanded by equity holders. Because the equity holders are last in line when things go bad and do not have any collateral, they carry most of the risk and require a higher return. The weighted average of these two returns is then taken to calculate the WACC, the formula for the WACC as stated by Brealey, Myers, & Allen (2003, pp.231) is;

$$WACC = R_d * (1-t) * \frac{D}{D+E} + R_e * \frac{E}{D+E}$$

Where
Rd = cost of debt
Re= cost of equity
D= total value of debt
E = total value of equity
t = tax rate

Because the UMCG is a non-profit organisation, there are no tax liabilities. Because of the academic nature of the hospital it is likely that there will also be no tax liabilities in the future. For this reason the (1-t) will disappear in the formula.

3.3.3 Cost of debt

To calculate the WACC the cost of debt and cost of equity are needed. To start with the cost of debt (Rd), it is determined by a real risk free rate plus a credit spread. A 30 year Dutch Treasury bond is taken as the risk free rate and an average rate of 30 year European corporate bonds is taken to determine the credit spread. The duration of the

bonds should be similar to the duration of the investment. The average duration of a building in the healthcare sector is 40 years, but the 30 year Dutch government bond has the longest possible duration.

Rf	=	4,35%	30 year Dutch government bond
CS	=	1,01%	
Rd	**=**	**5,36%**	30 year corporate bond Euronext

These indicators lead to a cost of debt, Rd, of 5,36%.

3.3.4 Cost of equity

Finding the cost of equity is slightly more complicated than finding the cost of debt. The following formula, as is given by Brealey, Myers, & Allen (2003, pp.224) shows how the cost of equity can be calculated;

$$R_e = R_f + \beta_e * MRP$$

The cost of equity can only be determined if the beta of equity is known.

Beta of equity
The formula for calculating the beta of equity as is given by Myers, & Allen (2003, pp.535) is given below;

$$\beta_e = \beta_a + (\beta_a - \beta_d) * \frac{D}{E}$$

By looking at the previous formula to find the beta of equity it becomes clear that it can also not be derived directly since the beta of assets is missing. To find this beta of assets and then the beta of equity the three step procedure is used:
Step one: Construct a peer group of companies and calculate for each company its asset beta by unlevering its equity beta.
Step two: Use the average value of the unlevered betas of the peer companies to obtain an estimate of the industry asset beta.
Step three: Relever the industry asset beta to account for the particular company's debt-equity ratio.

Step one requires a peer group of companies that have the same risk profile as the company for which the WACC is being calculated. The peer group for the UMCG consists out of publically traded European hospitals and clinics. In Europe there are eleven publically traded hospitals and clinics that all operate in the healthcare sector. Preferably Dutch healthcare providers should be used to function as the peer group, because the risk profile of Dutch healthcare providers are expected to be more similar to the UMCG. None of the Dutch hospitals are publically traded companies, so it is impossible at this time to get a beta of equity of other Dutch hospitals or clinics. The beta of equity of each member of the peer group is listed below in Table 3 together with the Equity/Total assets ratio. With these two figures, the unleveraged beta of assets can be calculated for each company. The reason that the beta of equity of the peer group needs to be unlevered is that the beta of equity contains both systematic business and financial risk. The systematic business risk is the same for all companies in the industry. The financial risk is however different for each company since it depends on how leveraged (meaning how much debt compared to equity) a firm is. To be able to use the betas of the peer group, the financial risk must be removed from the beta of equity to get only the business risk and that is given by the beta of assets. The formula, given by Brealey, Myers, & Allen (2003, pp.229), with regard to the betas is;

$$\beta_a = \beta_d * \frac{D}{D+E} + \beta_e * \frac{E}{D+E}$$

When unlevering the beta, the assumption is that there is no financing risk which means that the debt beta is zero. The first part of the equation becomes zero so only the last part remains;

$$\beta_a = \beta_e * \frac{E}{D+E}$$

For example the first company in the peer group is Eifelhoehen-Klinik AG. It has a beta of equity of 0,20 and a equity/total assets ratio of 50%. The beta of assets for this company is then;

$$\beta_a = 0,20 * 0,50 = 0,10$$

This calculation is done for all companies in the peer group. The results of this are presented Table 3.

Company	Beta(equity)	E/(D+E)	Beta(assets)
Germany			
Eifelhoehen-Klinik AG	0,20	50%	0,101
MediClin AG	0,80	61%	0,488
RHOEN-KLINIKUM AG	0,91	56%	0,513
Fresenius Medical Care AG (Helios)	0,25	51%	0,129
France			
Generale de Sante (GDS) SA	0,80	36%	0,286
Greece			
Athens Medical C.S.A.	0,75	52%	0,387
Axon Holdings S.A.	1,38	20%	0,279
IASO Medical Centre	0,86	50%	0,427
HYGEIA S.A. Diagnostic & Therapeutic Center	1,01	86%	0,871
Great-Britain			
CareTech Holdings PLC	0,86	38%	0,324
Spain			
Corporacion Dermoestetica SA	0,48	86%	0,411
		Industry Beta(assets)	0,383

Table 3: Data collected from www.reuters.com

Step two consists out of taking the average of the beta of assets of all the companies in the peer group is used to determine the industry beta of assets. As is also given in Table 3, the industry beta of assets is 0,383. It is interesting to see that the betas in the peer group are much lower than the beta of the market, which is always 1,00. This indicates that the healthcare industry is less risky than the market. It is just as interesting to see that there is a large difference in the betas between the companies. As was said before, the beta of assets measures the systematic business risk which is the same for the companies in the same industry. But the large differences between the asset betas of the companies shows that the choice of the companies in the peer group in not optimal. The main reason is that some companies in the peer group, for example Fresenius Medical Care AG, offer a diversified number of services. Besides having several hospitals, this company also has large division that builds dialysis equipment and runs kidney failure centre. These companies are still included in the peer group, because the main focus of these companies is still on providing healthcare.

 Step three consists out of using the formula mentioned in the beginning of this section and using the industry beta of assets and the previously calculated beta of debt. To obtain the beta of equity of the UMCG, the beta of assets should

be relevered again to include the financial risk of the UMCG. To do this the beta of debt is needed.

Beta of debt
With the calculation of the cost of debt, the beta of debt can also be determined. The beta of debt is calculated by using the CAPM formula as is stated by Brealey, Myers, & Allen (2003, pp.224):

$$R_d - R_f = \beta_d * (R_m - R_f)$$

Where;

$$R_d - R_f = CS$$

$$R_m - R_f = MRP$$

A survey in 2006 from Price Waterhouse Coopers determined that the Market Risk Premium (MRP) for the hospital sector in the Netherlands was 4,50% (College bouw zorginstellingen, 2006). Rearranging the formula, the beta of debt can be calculated by dividing the Credit Spread (CS) by the Market Risk Premium (MRP);

$$\beta_d = \frac{CS}{MRP} = \frac{1,01}{4,50} = 0,224$$

Finally the market value of equity and debt are needed to calculate the beta of equity. As was explained before, it is impossible to obtain the market value of equity for the UMCG, so the book value is used for both the debt and equity. The book value of equity in 2007 was €91.928.000 and the book value of debt was €570.425.000. All the data needed to calculate the beta of equity is now obtained and this results in a beta of equity of;

$$\beta_e = \beta_a + (\beta_a - \beta_d) * \frac{D}{E} =$$

$$0,383 + 0,383 - 0,224 * \frac{570.425}{91.928} = 1,442$$

The last variable needed to calculate the WACC is the cost of equity, which can be calculated by the CAPM formula;

$$R_e = R_f + \beta_e * MRP = 4,35\% + 1,442 * 4,50\% = 10,84\%$$

Weighted Average Cost of Capital

Now all the data required to calculate the WACC is known. This results in the following WACC;

$$WACC = R_d * \frac{D}{D+E} + R_e * \frac{E}{D+E} =$$

$$5,36\% * \frac{570.425}{570.425 + 91.928} + 10,84\% * \frac{91.928}{570.425 + 91.928} = 6,07\%$$

The appropriate discount factor for the UMCG to use to assess investment opportunities is therefore 6,07%.
As was explained earlier, the capital structure of a firm does not influence the WACC. In fact, the only variables that influence the WACC are the risk free rate, the market risk premium and the beta of assets.

variable increase		R(d)	R(e)	WACC	
R(f)	+	+	+	+	
CS	+	+	-	=	
D/E	+	=	+	=	*
Ba (unlev)	+	=	+	+	
MRP	+	=	+	+	

* the increase in Re is neutralized by the decrease in E/V

Table 4: Effect on R(d), R(e) and WACC if one variable increases holding all other fixed

3.4 The requirements

The previous sections have given a basis for the general model. In chapter two it became clear what the output of the model should be and what kind of input is generally used in the real estate literature. To get a clear overview of these input and output and to determine the user needs, the model will be made with the use of the requirements. Requirement is a term often used in the software engineering process. The IEEE Standard Glossary of

Software Engineering Terminology (1995) defines a requirement as following:

- A condition or capability needed by a user to solve a problem or achieve an objective;
- A condition or capability that must be met or possessed by a system or system component to satisfy a contract, standard, specification, or other formally imposed document;
- A documented representation of a condition or capability as in 1 or 2.

This definition is too broad to get a clear overview of the requirements. Arendsen (2008) restricts the term condition or capability to the following four aspects:

- A need of a stakeholder
- A goal of a stakeholder
- A condition of a product
- A property of a product

Simply put the previous part says that the needs and goals of the stakeholder must be clear on the one hand, and the conditions and properties of the product (system) must be clear on the other hand. Both are requirements of a system and both are important to ensure a good working system. But these two parts are preceded by another type of requirement. The goal of the organisation is where it all begins. This leads to three types of requirements, given by Arendsen (2008);

- Business requirements; describes what an organisation wants to achieve with the system. This will have a significant overlap with the goals of the organisation with regard to the system.
- User requirements; describes the goals and tasks that users of the system must perform.
- System requirements; demands or limitations which a system will need to have in order to achieve the business and user requirements.

As can be determined by reading the definitions, the three types of requirements go from broad and general to concrete and specific. The use of these three types of

requirements will give a clear insight into the goals of the system, the needs of the users and the demands of the system. Even though the model is, from the software development point of view, a simple system, it is important to have an overview of these aspects before starting to work on the model itself. The system requirement process is far more elaborate then described here. But since this is not a complicated software development, defining the requirements as mentioned above is sufficient to keep the development of the model on track. The next chapter will list the requirements for the general model.

3.5 Conclusion

The previous chapter concluded that the DCF method is best suitable to form the basis of the model. This chapter continues to focus on the DCF method and answers the remaining sub questions of the first central question.

In what way should the method be used?
There are many different ways the DCF method can be used, the Net Present Value (NPV), Payback Period (PP) and the Internal Rate of Return (IRR) were analysed. The PP is not useful for the UMCG because of the long lifespan of its investments. The IRR, although widely used, contains several drawbacks. The IRR cannot deal with cash flows that have changing signs (positive to negative and back again), sometime the IRR gives more than one solution and in some cases the IRR prefers a different project than the NPV. An improved version, the Modified Internal Rate of Return (MIRR) was developed to overcome these drawbacks. However a simple example showed that the ranking problem, meaning that the IRR prefers a different project than the NPV, still exists with the MIRR. Since the NPV gives the correct ranking of the problems, it is better than the PP and the MIRR and will be used as the output in the model.

How is the discount factor for the UMCG calculated?
The Weighted Average Cost of Capital (WACC) was calculated for the UMCG to be at 6,07%. This calculation was done by looking at the real risk free rate and similar loans to determine the cost of debt. The cost of equity is harder to find. A peer group of similar publically traded companies is created and their beta of equity is used to compute an industry beta which applies to the UMCG. With the use of this industry beta the beta of equity and thereafter the cost of equity were calculated. Combining the cost of equity and the cost of debt and taking the weighted average leaded to the WACC for the UMCG.

This leads to the final answer to the first central question;
What is the best method for analysing investment opportunities which can be used in a model suitable for the UMCG?
Briefly stated, this is a DCF method where the NPV will be used to give insight into the value of an investment and where the WACC for the UMCG is calculated to be at 6,07%.

The last section of this chapter discussed the requirements and answers the first sub question of the second central question. This sub question is listed below.

What are requirements and what kind of different requirements are there?
The previous section of this chapter contained thee different types of requirements that the model has, namely business requirements, user requirements and system requirements. Identifying and listing the requirements that fall in these three categories leads to more insight into the structure of the model. This will be done in section 4.2 The Requirements. The following chapter uses the literature study as was given in chapters two and three to build the general model.

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4 The general model

4.1 Introduction

The general model must be able to assist the investment decision process for all possible real estate projects at the UMCG. The literature study showed that the DCF method should be used with the NPV as output by which the user can determine which project is the optimal choice.

In order to make the optimal choice all possible alternatives should be taken into account by the model.

Since different investment opportunities may have different alternatives, the model must be flexible to be able to deal with an unknown number of alternatives, where each alternative can differ in their investment expenses, size, but also in their future operational income and expenses.

As mentioned before, the goal of the model is to assist the investment decision process. It does this by giving output (NPV for each alternative) that is clear and easily understandable for both financial and non-financial people. By doing so, the model facilitates the generation of all possible alternatives that exists, because people are required to think more in that direction.

During the process of developing the general model, five meetings occurred with the Finance and Control and the Building and Infrastructure departments to discuss the progress of the model and possible improvements.

The following sections explain what input is required from the users how users should use the model and in which way the model will give an output. Before all of this is explained, the requirements of the model, using the theory that was discussed in the previous chapter, will be listed.

4.2 The requirements

As was explained in section 3.4., there are three types of requirements; business, user and system requirements. This chapter will list these requirements applicable to the general model. The model is referred to here as the system. All the requirements mentioned below are found by meetings with stakeholders and this was an iterative process. With every meeting, new and more detailed requirements became known.

4.2.1 Flexibility of the model

If the system is to be applicable for all possible building projects at the UMCG, it must be flexible to adjust to different situations and an unknown number of alternatives. Each alternative can differ from each other in their income or expense cash flows, building and/or renovation expenses and the need to demolish buildings or temporary house personnel. Each project can also differ in terms of start date, end date and lifespan. Furthermore the system must prevent the wrong use of the system in order to guarantee a valid outcome. Because of these needs it is important to mention the requirement explicitly to get a solid working model.

Business requirements
- The UMCG wants to improve their investment decisions making process for real estate projects.
- The system must be easy to use and understandable to people with and without a financial background.

User requirements

- The users must be able to insert the relevant data;
- Operational income and expenses.
- All initial investment expenses and maintenance expenses.
- Start, end of the building phase and the duration of the project.
- It should be clear to the user how and where to enter the data.
- The users must be able to insert different alternatives.
- The output of the system must be clear and easy to interpret for the user.
- The users must be able to fill in different data for different alternatives.

System requirements

- The system will show where to enter the data by means of colours.
- The system must be able to add, to a maximum of ten alternatives.
- Every time a user adds an alternative, the system must ask the user to enter the name of the alternative and make a separate sheet for that alternative.
- The system must give warning if an action is performed by the user that can result in wrong output of the model. This is important since the model is made in Excel which is prone to errors.
- Every time a user removes an alternative, the system must ask the user if the user is aware of the consequences and wants to continue.
- The system must be able to insert up to a maximum of fifteen lines into the sheet.
- The cockpit will show the NPV of all alternatives and a sensitivity analysis.
- Every time the cockpit is activated the output must be recalculated.

These requirements lead to the parameters of the model and are the following.

Parameters

The input required for the model to work is;

- The duration of the investment, n.
- Expected operational income for years $0…n$.
- Expected operational expenses for years $0…n$.
- Expected expenses due to the initial investment.
- Expected expenses due to maintenance of the buildings.
- Expected income due to the investment (for instance current buildings that can be used for other purposes due to the investment).

The output given by the model will then be;

- Net present value of the investment.
- Sensitivity analysis of the effect that income has on the NPV.

An overview of the model, its required input and produced output is given in on the next page.

Input

Model

Output

Operational cash flows

Expected Total Budget

OR

Expected DBC income

Expected A-segment income

Expected B-segment income

Expected Operational Income

Expected Operational Expenses

Investment related cash flows

Duration (n)

Expected income due to investment

Expected Expenses

Expected Initial Investment Expenses

AND

Expected Maintenance Investment Expenses

Discount Factor (WACC)

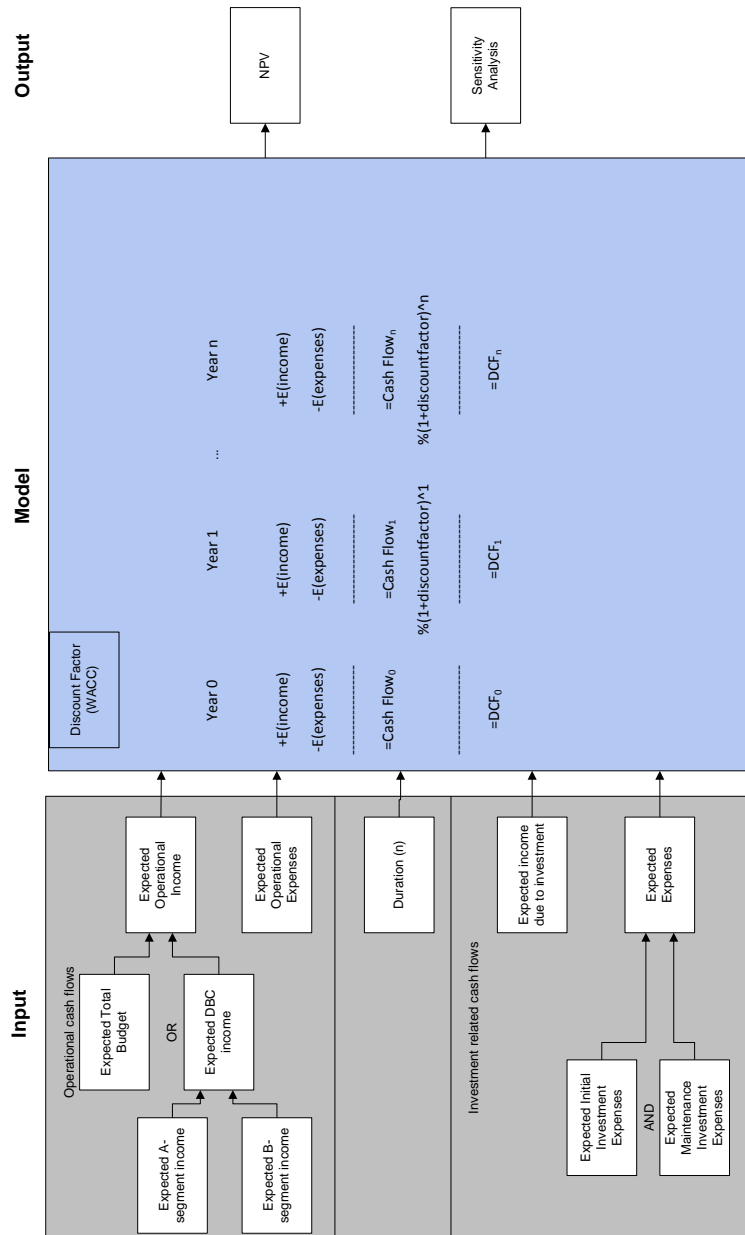| Year 0	Year 1	...	Year n
$+E(income)$	$+E(income)$		$+E(income)$
$-E(expenses)$	$-E(expenses)$		$-E(expenses)$
$= Cash\ Flow_0$	$= Cash\ Flow_1$		$= Cash\ Flow_n$
	$\%(1+discountfactor)^1$		$\%(1+discountfactor)^n$
$= DCF_0$	$= DCF_1$		$= DCF_n$

NPV

Sensitivity Analysis

Figure 3: Overview of the input and output of the model

4.3 Listing the alternatives

An important feature of the model is to compare alternatives with each other. For this to be possible the model must list all the alternatives and give the user the opportunity to enter different data for each alternative. In the model the first step is to add and name the alternatives. In the figure below, one alternative named 'test' is listed.

Figure 4: List of the alternatives and the buttons to add and remove an alternative. Hoofdalternatieven = main alternatives; alternatief toevoegen = add alternative; alternatief verwijderen = remove alternative.

If the button 'Alternatief toevoegen', meaning add alternative, is pushed, a screen pops up to ask the user to enter a name for this alternative. Each alternative gets its own sheet in which the relevant information for that alternative can be entered. Once all alternatives are listed, the data can be entered into the model.

4.4 Periodic income and expenses

During the lifespan of the project there will be cash inflows and cash outflows each year due to the fact that the department is operational. Most of the time these yearly operational cash flows are similar or tend to increase or decrease at a steady rate. For this reason and to enhance the ease of use, the model will only need the operational input of the first year it is in use again. In the standard situation the operational cash flows will be derived from

the current operational cash flows with some growth figure attached to it. This growth is set at 2.5%, the average inflation rate.

4.4.1 Operational income and expenses

The names of the operational income figures will differ per project, therefore the user must enter this into the model. Broadly there are three groups of operational income; budget, DTC and rest.[3]

Figure 5: Example of the budget category at the income side. Huidige operationele inkomsten = current operational income; Budgetinkomsten = budget income; Regel toevoegen = add line; Totaal budget = total budget; en stijgt elk jaar met = and rises each year with

Adjusting operational income and expenses
The operational expenses are standardized and will always consist out of personnel, diagnostic, material expenses and inventory. If the operational cash flows differ from the current cash flows, this can be adjusted by the user for each alternative.

Figure 6: The button by which users can adjust the operational cash flows if it differs from the current cash flows. Aanpassen operationele posten = Adjust operational cash flows

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[3] Data collected from the Building and Infrastructure Department

4.5 Non periodic income and expenses

The previous section discussed periodic income and expenses, this section will continue by covering the non periodic income and expenses. Although there are many possible alternatives, all must consist out of a combination of the following aspects.

4.5.1 Building expenses

Meetings with the people from the Building and Infrastructure department as well as external sources revealed that the expenses of building a new structure are given by a price per square meter. Combining this with the total area will give the total building expenses (College bouw zorginstellingen, 2007). For each new building there is a choice between the levels of finishing. A high finishing will result in a higher price per square meter, while a low finishing would give a lower price. The model gives the user the opportunity to make a distinction between high, normal and low finishing and enter a different price per square meter for each possibility. The level of finishing does not have any consequences for the income.[i] For that reason a luxury finishing will always result in a lower NPV than a normal finishing.

Figure 7: The insert field of the model where the user can enter the price per square meter for different degrees of finishing. Afwerking = finishing; laag = low; normaal = normal; luxe = luxury

For all alternatives that contain building a new structure, the prices of the different degree of finishing will be the same. The total building expenses are the price per square meter times the total size of the building. Within each alternative, the model also gives the opportunity for the user to enter three different sizes of the building, small, normal and large. Again, the size of the building will not

influence the income and a small size will always have a higher NPV than a current size.

Figure 8: The insert field of the model where the user can enter the size of the building for different possibilities. Oppervlakte = size; klein = small; huidig = current; groot = large

In the case of building a new structure it is possible that other structures need to be demolished first. If this is indeed the case, these expenses will be covered by the model. The demolishment of a building is about 1.5% of the rebuild value of the building. This percentage of 1.5% is obtained by looking at several previous demolishments and the rebuild value of these buildings. The 1.5% seems to be a good fit on these previous cases. The figure can be adjusted by the user at anytime though.
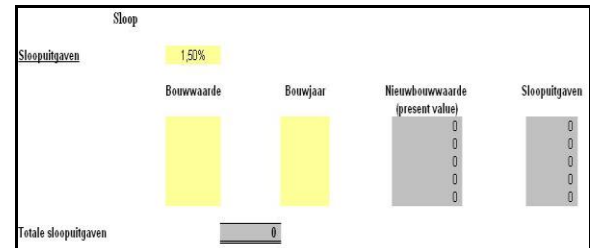
Figure 9: The expenses due to demolishment of buildings. Sloopuitgaven = demolishment expenses; bouwwaarde = value for which the building was built; bouwjaar = year in which the building was built

4.5.2 Renovation expenses

Contrary to the building expenses, the renovation expenses are not measured in a price per square meter. The department of Building and Infrastructure uses a rule of thumb that the renovation expenses are 80% of the rebuild value of the building. The rebuild value is the amount of

money that is needed to build the exact same building at this point in time and is calculated by taking the value for which the structure was built and adjusting this with the passing of time. The value for which the building can be built is increasing each year with the average inflation which is set at 2,50%. This percentage can be changed at any time.

$$RBV = V * \left(1 + 0,025\right)^{T-t}$$

Where;
RBV = Rebuild value of the building
V = Value for which the building was built
T = Current year
t = Year in which the building was built

Figure 10: The user can insert the value and the year in which the building was built in order to get the rebuild value of the building. Huidige gebouwen = current buildings; bouwwaarde = value for which the building was built; bouwjaar = year in which the building was built

It would be wrong to allocate the entire renovation of a building to one department if this department only uses a portion of the building. That is why the model will take the renovation expenses proportional to the size used by the relevant department by dividing the size of the building used by the department by the total size of the building. So the total size of the building and the size of the area relevant to the project should be determined.

The renovation expenses are then calculated in the following manner;

$$R = RBV * RP * \frac{TS}{US}$$

Where;
R = Renovation expenses
RBV = Rebuild value of the building

RP = Percentage of the rebuild value that is needed for renovation
TS = Total size of the building
US = Size of the building that is used by the relevant departments

Figure 11: Renovation expenses are calculated by using 80% of the rebuild value and using this proportional to the size used. Totale oppervlakte gebouw = total size of the building; oppervlakte betreffende renovatie = size relevant to the renovation; renovatieuitgaven = renovation expenses; nieuwbouwwaarde = rebuild value of the building

Example
For instance, it could be the case the project involves department A and that department A only uses 2.000m2 of a building that is in total 10.000m2. In this case it would be wrong to allocate the entire renovation expense to department A. If the rebuild value of that building is €5 mil, then the renovation expenses allocated to department A would be:

$$R = 5 * 80\% * \frac{2.000}{10.000} = 0,8$$

4.5.3 Other non-periodic income and expenses

(Fictitious) sell of current buildings
There is also the possibility that current buildings will become vacant due to the construction of new structures. These buildings can be used internally by other department

or can be rent or sold to external parties. Some of these events are hard to measure in currency. For instance, what is the value of a building that will be used internally by other departments? Because it is impossible to assign a direct value to this action, the model will assume that any building that has some use for the company will be sold. Even if the company has no intention of selling the property, this fictitious sell will give a decent indication of the value of the building.

Temporary housing
If a project will consist of a renovation or a demolishment to make room for a new building, there is also a need to temporarily house the employees elsewhere. The model will account for this by adding the possibility to fictitiously buy temporary housing at the start of the building/ renovation and sell that housing again when the project is finished. Since renovation can happen in phases and personnel can temporarily occupy a smaller area, there is no need to buy temporary housing for the entire size of the building. The exact size of the temporary building can be added to the model by the user and may differ per alternative. The price of the temporary housing was determined by looking at previous transactions. The resale price consists out of an educated guess.[i]

Figure 12: Temporary housing expenses. Tijdelijk onderkomen = temporary housing; Prijs tijdelijk onderkomen; price temporary housing; verkoopprijs tijdelijk onderkomen = resale price temporary housing; Benodigde oppervlakte = Needed size; Totale uitgaven = Total expenses; Totale inkomsten = Total income

4.5.4 Calculation of the building and renovation expenses

If the user has entered the relevant input into the model, the initial expenses are calculated as well as the

maintenance expenses during the lifetime of the project. Each year there needs to be some small maintenance on the buildings. On a project with a lifespan of 40 years there needs to be a large maintenance in the years 10 and 30 and after 20 years there must be a renovation.5 The value of these expenses is measured by taking a certain percentage of the rebuild value of the building. With conversations with the Building and Infrastructure department the currently used percentage were defined. Maintenance for renovation projects are higher than for new structures and the renovation at year 20 is the same size as the initial value. Both the percentage of the rebuild value of the buildings allocated for maintenance as the years in which the maintenance should take place can be adjusted by the user. After testing the usability of the model it became clear that the lifespan of a project and the years in which the maintenance and renovation take place should be a variable.

Figure 13: The calculations of the expenses related to building and maintenance. Nieuwbouwuitgven = building expenses; initiële investering = initial investment; grootonderhoud = large maintenance; jaarlijks onderhoud = yearly maintenance; renovatieuitgaven = renovation expenses

In the figure above it can be seen that the years in which maintenance or renovation takes place has a yellow background (input cell), but does already have a value. This means that the model uses maintenance and renovation in

year 10, year 20 and year 30 as starting point, but this can be changed by the user if needed.

4.6 Conclusion

This chapter focused on the development of the general model by using the results of the literature study as was given in chapters two and three. Partly answered is the second central question;
In which way can a model be developed that assists the decision making process for real estate projects at the UMCG?

The next chapter will continue with the second central question by applying a case to the model and testing if the model works as expected. The following sub questions were answered in this chapter;

What are the parameters of the model?
The input required for the model to work is;
- The duration of the investment, n.
- Expected operational income/expenses for years 0...n.
- Expected income/expenses due to the initial investment and maintenance.

The output given by the model will then be;
- Net present value of the investment.
- Sensitivity analysis of the effect that income has on the NPV.

How can the model be made flexible enough so it can be used for different real estate projects at the UMCG?
The model can compare different alternatives with each other where each alternative has its own input sheet in which the relevant data can be entered. The data consists of periodic and non-periodic data. Periodic data are the operational expenses and income that occur each year after the building is finished. Non-periodic data are the initial investment, temporary housing, demolition and maintenance expenses. The initial investment expenses are the expenses due to the building or renovation and usually

lead to a large cash outflow in the first year. During the building or renovation, the personnel needs to be situated elsewhere, this can result in placing temporary housing expenses. Sometimes buildings need to be demolished to make room for the new structures, in that case there will also be demolition expenses. Finally, during the lifespan of the project a building needs maintenance and in these years there will also be a significant cash outflow.

5 The model applied to a specific case

5.1 Introduction

Now that the general model is clear, it is important to see if it works on a real case. During this case another five meetings occurred with the Finance and Control and the Building and Infrastructure departments to gather the necessary data and discuss possible improvements.
As it happens to be, at the time the model was built, the psychiatric department of the UMCG requested new housing. Since this is a current, clear and standalone project, it is a very good case to put into the model. This project involves two parties, the 'Universitair Centrum Psychiatrie' (UCP) which is the psychiatric department for adults and the 'Universitair Centrum Kinder-, Jeugd Psychiatrie' (UCKJP) which is the psychiatric department for children and adolescents. From now on these departments will be called by the acronyms, UCP and UCKJP. The figure depicted below gives an overview of the UMCG terrain and shows where the current buildings are located. After this overview, all relevant buildings will be explained in more detail.
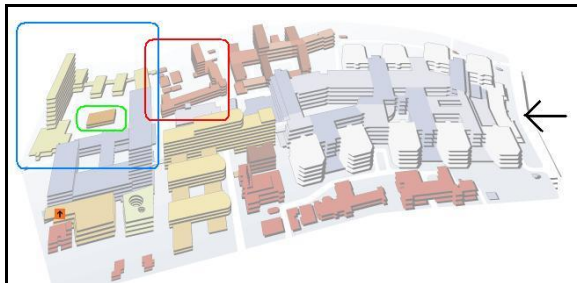

Figure 14: The UMCG terrain, the yellow building within the blue circle is the psychiatric building, the building within the green circle is the Stafbarakken and the building within the red circle is the Zusterhuis. The black arrow on the right shows the main entrance.

5.1.1 UCP

Figure 15: The psychiatric building, above the high tower and below the lower part

The UCP is a department of the UMCG and is currently housed at the end of the UMCG terrain. The building in which they are situated is simply called the psychiatric

building and has a size of 11.505m2. In Figure 14 it is the yellow building in the blue circle.

The building stems from 1970. As the name of the building implies, it is completely used for psychiatric ends. However, 400m2 of the building is used by the psychiatric faculty of the university.

For the purpose of this case, these 400m2 are subtracted from the total size, meaning that the applicable size for the building of the UCP 11.105m2 is.

5.1.2 UCKJP

The UCKJP is performed by an external party, Accare. This company has close ties with the UMCG, but is completely independent. They rent property from the UMCG. Currently the UCKJP has rent parts of three different buildings, namely the Zusterhuis, Stafbarakken and the Wenakker.

Zusterhuis
The first part of the Zusterhuis was built in 1932. This part does still exist and is shown on the left hand side of Figure 16. In 1970, the Zusterhuis was extended with a tower; this can be seen on the right hand side of figure 16. Together these two parts contain 8.733m2. Of this total size, 3.545m2 is used by the UCKJP. In Figure 14 it is the building in the red circle.

Figure 16: Above the old part of the Zusterhuis and below the tower that was build later on.

Stafbarakken
The Stafbarakken are temporary housing to be used until new housing is built for UCKJP. It consists out of an area of 858m2 and is situated next to the psychiatric building. The UCKJP uses the entire building. In Figure 14 it is the building in the green circle.

Figure 17: The Stafbarakken

The Wenakker
The Wenakker is the only building that is not situated at the UMCG terrain. It is actually located at the other end of town. Its size is 1.088m2 and it is fully used by the UCKJP. Although it is a very nice building and it is situated in a nice part of town, the distance between the UMCG terrain is difficult.

There are different ways to view this project. The UCKJP rents a total size of 5.491m2 from the UMCG. The new price per square meter to be paid by the UCKJP is not yet determined. It is reasonable to assume that the chosen alternative will play a role in the future price negotiations. Currently the UMCG makes little to no profit from renting property to the UCKJP. Assuming this remains the same, the UCKJP does not influence the NPV of the project, since the aim of the price negotiations is to get a NPV of 0. One option for calculating the alternatives is to ignore UCKJP and only look at the UCP part. This is a simple option that requires less input and is less time consuming. Another option is to include UCKJP and add an extra income for rent paid by UCKJP, where the amount of rent is such that it leads to a neutral outcome. The model can handle both options, but the choice has been made to use the second one. By including UCKJP there will be a more complete overview of the project.

Figure 18: Above, the Wenakker and belowthe location of the Wenakker given by the A at the bottom and the UMCG terrain circled in red.

5.2 The alternatives

The most important aspect of the model is that it is able to compare different alternatives. This means that the process of generating different possible alternatives is a very important one. All parties involved should get together and discuss this matter. These initial talks were already finished at the time this assignment started, so I had no influence on this process.

5.2.1 The generation of alternatives

At the very early stage of the investment decision process, a group was formed to discuss the possibilities. This group was called the steungroep and consisted out of people from the relevant departments, UCP, UCKJP and Building and Infrastructure as well as external advisors. It was this group that discussed different alternatives.

Firstly the status of the current buildings was discussed and it became clear that the quality of especially the façade of the psychiatric building is considered to be poor and renovation of this building would be very costly. Furthermore, the Stafbarakken are only temporary and cannot be used for permanent housing. The Zusterhuis is still good shape and can be of good use.[i]

Secondly the locations were discussed. Although the Wenakker is a beautiful building in a calm environment, its distance with the other buildings is difficult. Ideally all buildings should be located next to each other. Because of the interaction with other parts of the hospital, it is also important that the departments remain situated within the UMCG terrain. Recently the UMCG bought extra land at the far side of the current UMCG terrain. But because this land was already planned to be used by other projects, a new structure for UCP/UCKJP at this new terrain was not considered. The only remaining place for a new structure would therefore be the location where the psychiatric building and Stafbarakken are located at the moment.[i]

Three possible alternatives then became clear; full renovation, partly renovation and partly new building and completely new building. In the steungroep there was a preference, because of the reasons mentioned above, for the alternative completely new building. The three alternatives were not compared in an analytical manner so it is good to use the model for this purpose to determine which alternative is optimal and see if the model works accordingly.

5.2.2 The three alternatives

Renovation
This alternative consists out of a complete renovation of all the building that UCP and UCKJP occupy, namely the psychiatric building, Stafbarakken, Zusterhuis and the Wenakker. The costs of renovation are expected to be 80% of the rebuild value of the buildings.[i]

Renovation and new building
In this alternative the Zusterhuis will be renovated, while the psychiatric building and the Stafbarakken will be demolished and a new structure will be built here. The Wenakker becomes obsolete because of the new structure and will be (fictively) sold. It does not matter whether or not the Wenakker is actually sold or is used internally.

New building
A new building will be built at the place where the psychiatric building and the Stafbarakken are located at the moment, meaning that these two will be demolished. The Zusterhuis and the Wenakker will become obsolete. The Wenakker building will again be (fictively) sold. The Zusterhuis is a building situated at the UMCG terrain and is realistically unsellable. For that reason there is no taxation report. Currently UCKJP rents part of the Zusterhuis for a known price. Assumed that the Zusterhuis can be used another 20 years, its value is determined by taking 20 years of rent incomes corrected for a yearly price inflation of 2.5%.[i]

An architect made an impression of how the new building would look like. This is just an impression of one architect and it is by no means clear what the new structure would look like or if there would even be a new structure.
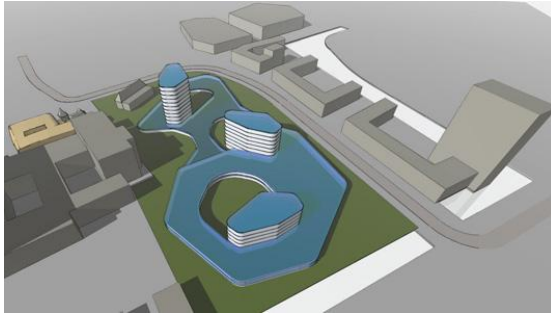
Figure 19: Would a new building for the UCP and UCKJP look like this?[4]

5.2.3 The data and assumptions

Now that the alternatives are clear, the data of all alternatives can be entered into the model. The first data that are entered into the model are the level of finishing, the building dates and the names of the existing buildings involved.

Finishing
The expenses per square meter for the sub alternatives low and luxury finishing were determined by the steungroep. The normal price per square meter was also determined by the steungroep, but this could also be calculated with the use of external sources. This calculation was done to see if the calculated price would be near the determined price by the steungroep. In order to calculate the price, the latest possible price per square meter as was set by the bouwkostennota (College bouw zorginstellingen 2007). This is a paper that was made public each year by the 'college bouw zorginstellingen' and contain the building prices per square meter for all kinds of healthcare buildings. The last paper was from 2007, since the college bouw zorginstellingen ceased to exist in 2008. However each year there was an index which showed by how much the prices would change and this index is available for 2008 and 2009.

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[4] http://www.rau.eu/site/index_php/Menu/761/pntRef/0/ pntScd/d/PSYCHIATRIE+GEBOUWEN+UMGC.html

To calculate the price per square meter, the price noted in the bouwkostennota 2007 is taken and adjusted with the indices for 2008 and 2009. The total expenses per square meter consist out of hard costs and soft costs as was discussed in the real estate finance in chapter two.

The price of 2007 is divided by the index of 2007 and then multiplied by the index of 2009.

Hard costs:
$$\frac{-1.350}{123,5}*129,9= € -1.420,-$$

Soft costs:
$$\frac{-254}{123,5}*129,9= € - 267,-$$

Together these two lead to a building expense per square meter of €-1.687,-. This price was comparable with the price that was determined by the steungroep and this price is used for the normal finishing.

Building dates
The dates at which the building/renovation would start is set to be 2010, while the building/renovating itself would take 1 year. So in 2011 the building would be finished.[i] The project has a total lifespan of 40 years, even though a new building would be depreciated in the books over a period of 50 years.

Alle hoofdalternatieven hebben een onderverdeling in de volgende **subalternatieven:**		
Afwerking (in -€ per m2		*Vul hier de kosten in van de mate van afwerking in nieuwbouw die*
Laag	1.350-	*in de verschillende subalternatieven van toepassing zijn*
Normaal	1.687-	
Luxe	2.024-	***Afwerkingskosten als negatief getal invoeren***
Bouwdata		*Vul hier de relevante bouwdata in*
Huidig jaartal	2009	
Begin bouw	2010	
Bouw afgerond	2011	
Looptijd project	40	*jaar*
Nummer	**Gebouwen of Locaties**	*Vul hier de namen van de gebouwen of locaties in die*
1	Psychiatrie	*tot aan het nieuwbouw project in gebruik zijn*
2	Zusterhuis	
3	Stafbarakken	
4	Wenacker	
5		

In conversations with the Finance and Control and the Building and Infrastructure department, it became clear that a 40 year lifespan is more realistically.

The results
The data entered in the model for each alternative is not available in the public version of this thesis. The results of this part are therefore discussed in general terms, without mentioning specific amounts. When all data is entered into the model, it turns out that the alternative to build a completely new structure has the highest NPV and is the best option. It does have the highest initial expenses, but compensates this by having two obsolete current building that can be used elsewhere and by having lower maintenance expenses. The alternative to combine renovation with building a new structure has a slightly lower NPV and is also a viable option. The last alternative to do a complete renovation of existing buildings has the lowest NPV and is not recommended. When looking at the sub alternatives, low finishing-small size results in the highest NPV. But this sub-alternative is not recommended, since patients need to feel at ease in psychiatric department. When comparing low finishing-large size and high finishing-small size, the sub alternative low finishing-large size has a considerably better NPV.

5.3 Robustness of the model

In order to test the robustness of the model itself, a number of input variables which contain a high level of uncertainty are examined. To test the robustness of the model, the input of the UCP/UCKJP project is used. There are three alternatives within his project. Building is a completely new building, where all other existing building are either demolished or sold. Renovation means that all existing buildings will be renovate and building and renovation is a combination of those two.

5.3.1 Uncertain input that changes the ranking of the alternatives

The most important uncertainties in input parameters to examine are those at which there is a different ranking of the alternatives at different inputs. If this is the case then the lines in the graphs will not be parallel to each other. In the graph below the building and renovation expenses were examined.

Building and renovation expenses
It is assumed that if the building cost will rise (fall), the renovation cost will rise (fall) with the same percentage. However these lines are not parallel to each other, because the renovation cost are lower than the building cost. More specifically, the renovation costs per square meter are 76% of the building costs per square meter. So a 2% rise in building costs is in absolute numbers more than a 2% rise in renovation costs. The result is that the building line has a steeper incline than renovation. Since renovation and building is a combination of those two, it will have an inclination that is in between building and renovation. When taking an area from €-2.024 until €-1.350, the alternative 'building' will remain the best alternative.
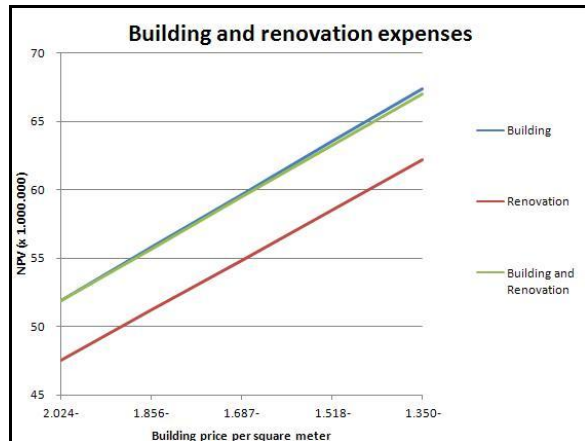
5.3.2 Uncertain input that does not change the ranking of the alternatives

There are still a few input parameters that contain uncertainty, but in contrary to the building and renovation expenses these parameters do not influence the ranking of the alternatives. To be able to choose the optimal alternative, these variables are irrelevant, since they are the same for each alternative. However, if the model is used to determine the profitability of the alternatives, uncertainty in these variables can have a significant influence. The aspect that the ranking will not change can be seen in the graph by the parallel nature of the lines.

*Academisch Component en Rijksbijdrage (AC&R)*
The AC&R is a form of revenue which is completely centralized. At this point there is no clear allocation of this fund to different projects or departments.
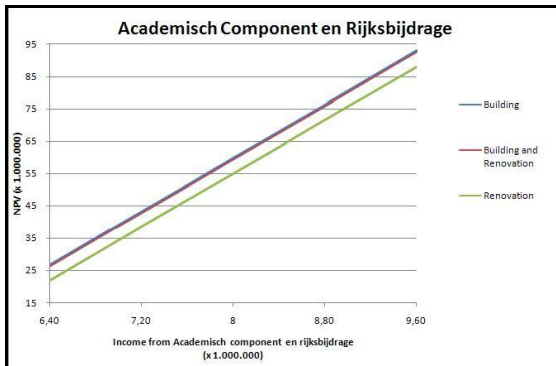

Overhead expenses
Where the AC&R is the main source of uncertainty at the revenues, the overhead is the main source of uncertainty at the expenses. It is basically the same situation; a lot of expenses are centralized, for instance utilities, financial department and the facility department. Again there is no precise allocation of these expenses to a specific project or department. Both these parameters are more or less

equally sensitive to change; the lines have the same inclination.
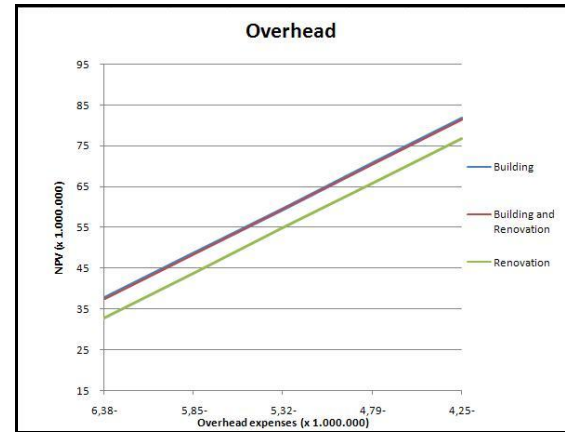
DTC revenues
Besides the uncertainty in the AC&R the UCP-UCKJP case has revealed another source of uncertainty at the revenue side. Because of the introduction of the DTC structure in 2011 in the UCP and UCKJP, it is at this point unclear how accurate the predictions of the DTC revenues are.
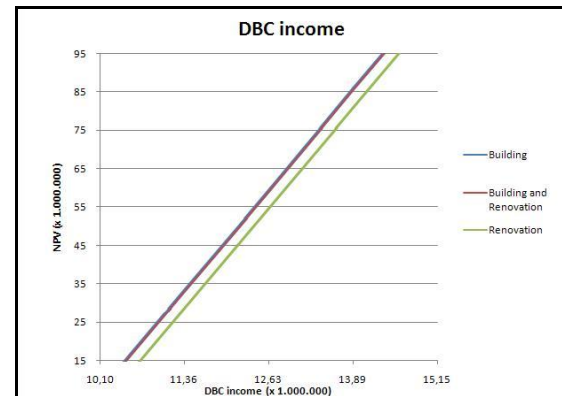
Departments which have already used the DTC structure for several years will have much better insight into these figures. As can be seen in the graph below, the NPV of each alternative is highly dependent on the prediction of the DTC revenues; the lines are much steeper than all other variables discussed. This uncertainty does not exist at the expenses side.

To be able to compare the building and renovation expenses, as was shown in the first part, with the other variables, the graph below shows the building and renovation expenses again, but now the scale is adjusted to be similar to the others. It becomes clear then that uncertainties in these expenses have considerably less influence NPV of the alternatives then the other variables.

Building and renovation expenses
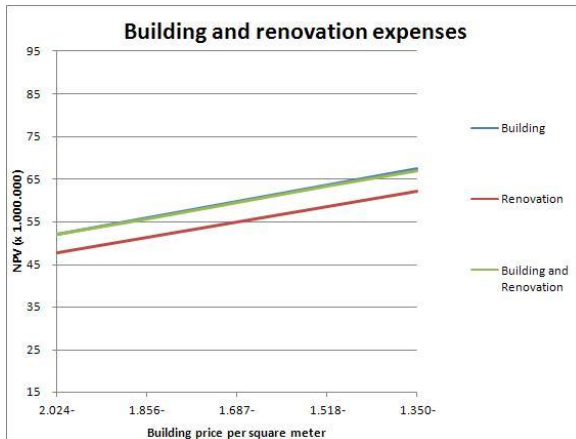
The model is robust with regard to the ranking of the alternatives. Uncertainty is only present in one variable, the building and renovation expenses. However the influence of the uncertainty is limited and in the case of the UCP-UCJKJP a change which was presented here does not result in a different ranking.

5.4 Limitations

After the general model has been applied to a specific case it becomes clear that the model works as intended, but there are some limitations. Firstly, by using the DCF method, the model cannot handle uncertainties well. This is also what the sensitivity analysis showed when testing the robustness of the model. Further development of the model to include option trees or decision trees is highly recommended. This allows for modelling flexibility, makes it easier to include uncertainties in the model and allows for more alternatives being analysed. Due to the time limitations this course was not further pursued in this thesis. Secondly, the NPV method is generally used to make go, no-go investments. In this model the NPV is also used to compare different investment alternatives. Although this is not optimal, no better solution is known at the moment. Perhaps future studies will lead to the development of a more appropriate method of comparison. Thirdly, the calculation of the discount factor is always difficult. The Weighted Average Cost of Capital (WACC) was used to determine this discount factor, but the WACC is primarily used by private companies that operate in a fairly efficient market. To obtain the cost of capital, which is needed to get the WACC, a peer group of publically traded companies was formed. European publically traded hospitals and clinics were used to form this peer group. These companies should be similar to the UMCG and to each other, but aside from being in the same sort of business, they do not have many things in common. The German healthcare system is for example different from the Dutch healthcare system. The UMCG is an academic hospital and most of the hospitals in the peer group are not. Ideally the other Dutch academic hospitals should be used to form the peer group. However, this is impossible since the data needed from the peer group, the beta of equity, is unknown for these hospitals.

The model can also be improved by taking away some of the sources of uncertainties. For instance, if the Academisch Component en Rijksbijdrage and the overhead expenses can be allocated to each department in an accurate manner, a huge part of the uncertainty that existed with the UCP/UCKJP case would be removed.

5.5 Conclusion

In this chapter the model was applied to a specific case. The psychiatric department for adults (UCP) and children (UCKJP) need new or renovated housing. There are three distinct alternatives, building a completely new structure, completely renovating the existing structure and a combination of building and renovation. The two last sub questions of the second central question are answered here and listed below.

What is the outcome of the model when applied to a specific case?
When all data is entered into the model, it turns out that the alternative to build a completely new structure is the optimal alternative with the highest NPV. It does have the highest initial expenses, but compensates this by having two obsolete current building that can be used elsewhere and by having lower maintenance expenses. Also in comparison with the renovation alternative which has the lowest NPV, the rent obtained from UCKJP is higher. The differences between the NPV of building a completely new structure and combining building and renovation are minimal. Therefore this option can still be a valid choice if it has some non financial preference. When looking at the sub alternatives, it is logically that low finishing-small size results in the highest NPV. It is however questionable if in this situation it is advisable to use this combination, since the psychiatric department needs to have a serene look so that patients feel at ease in this environment. When comparing low finishing-large size and high finishing-small size, the sub alternative low finishing-large size has a considerably better NPV.

Does the model work as expected?
The model cannot handle uncertainty very well if it is situated in the yearly revenues/expenses. Because of the long duration of the projects, a small change in these variables can have large influences on the output of the model. However, in the case of the UCP-UCKJP, all the yearly recurring variables containing uncertainty did not influence the ranking of the alternatives. Only when trying to determine the profitability of the alternatives had these variables a large influence on the outcome.
It is advisable to develop the model further to include option or decision trees to have a much more flexible model. A more accurate way to allocate the Academisch Component en Rijksbijdrage and the overhead expenses within the UMCG will further enhance the output of the model.

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6 Conclusion

6.1 Conclusion

The goal of this thesis is to develop a model by which decision regarding investments in the real estate at the UMCG can be made. The underlying reason for the development of a model is the changes in the healthcare system which makes hospitals responsible for their investments. Two central questions are listed in the beginning of the model;

1. What is the best way to analyse investment opportunities to serve as the foundation of the model and that fits with the UMCG and its surroundings?
2. In which way can a model be developed that assists the decision making process for real estate projects at the UMCG?

The three parts of this thesis were aimed at answering these questions. The first part, discussed in chapters two and three, contained the literature study and explained the situation in which the UMCG operates. This literature study answers the first central question which focuses on which method should be used in the model and made clear that there are several methods to analyse investment opportunities. The Discounted Cash Flow (DCF) and Real Option Analysis (ROA) were discussed within the financial management setting, while the Direct Capitalisation (DC) method was explained in the real estate finance setting. The DCF was the best method to be used in the model, because it is capable to give a good result while it is also easy to use and understand. Within this method different aspects were analysed and the Net Present Value (NPV) turns out to be the best possible, although not optimal, solution, because it gives the correct ranking when comparing mutually exclusive projects. The Weighted Average Cost of Capital (WACC) is used as the discount factor. The WACC of the UMCG is determined by looking

at the real risk free rate, the current interest rate of loans to get the cost of debt. The cost of equity is determined by looking at the industry beta which is determined by analysing a peer group of European healthcare providers. Combining the cost of debt and cost of equity leads to a WACC of 6,07% for the UMCG.

The second and third part discusses the development of the general model and the application of the general model to a specific case and lead to the answers needed for the second central question which questions in what way a model can be build to support the investment decision making process. The second part, given in chapter four of this thesis, contains the development of the general model, which has to be applicable to a large variety of projects. To realise this, the requirements of the model were noted. The listing of the requirements led to the needed input and output parameters. The input needed for the model is the operational income and expenses, the initial income and expenses due to the investment and the duration of the model. The output of the model is the NPV for each alternative and a sensitivity analysis to determine how volatile the output is to changes in the revenues.

The last part covers the use of the model for a specific case. The psychiatric department (UCP and UCKJP) would like new or renovated housing and the model is being used to show which of the three alternatives, a completely new building, a combination of new building and renovation and a complete renovation, is the best option. The alternative to build a complete new building has the highest NPV, with the alternative of a combination of renovation and new building followed with only a slightly lower NPV. Based only on the NPV, building a completely new structure is the best option. By testing the robustness of the model when applied to the UCP-UCKJP case, it turns out that there are

several uncertainties in the input parameters that can have a large effect on the NPV. However these uncertain inputs are at such a place that it does not affect the ranking of the alternatives, since this input is the same for all alternatives. The model is robust when it is purely used to choose the best alternative. If it is to be used to determine the profitability of a project, the uncertainty within the input should first be eliminated. The first limitation is therefore that the model is unable to deal with uncertainty. This uncertainty in the input parameters can be limited if the allocating of the Academisch Component en Rijskbijdrage and the overhead expenses are improved. Furthermore, the model is not flexible and cannot list all possible options. This can be improved if the model is further developed to include option or decision trees.

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Appendix 1 Glossary

AC   = Academisch Component
AC&R = Academisch Component en Rijksbijdrage

DCF   = Discounted Cash Flow
DOT   = DBC op weg naar transparantie: DTC on its way
        to transparency
DTC   = Diagnose Treatment Combination

FB   = Functiegericht Budget

IRR   = Internal Rate of Return

MIRR   = Modified Internal Rate of Return

NOI   = Net Operating Income
NPV   = Net Present Value

OCW = Ministerie van Onderwijs, Cultuur en
        Wetenschap: Ministry of Education, Culture and
        Science

PP   = Payback Period

ROA   = Real Option Analysis

UCKJP = Universitair Centrum Kinder en Jeugd
        Psychiatrie: psychiatric department for children
        and adolescents
UCP   = Universitair Centrum Psychiatrie: psychiatric
        department for adults
UMCG = Universitair Medisch Centrum Groningen

VWS   = Ministerie van Volksgezondheid, Welzijn en
        Sport: Ministry of Healthcare, Wellbeing and
        Sport

WACC = Weighted Average Cost of Capital

Appendix 2 CD - general model and manual

The general model is in the format of an excel file and can be found under the name:
Model investeringsbeslissingen.xls

The following manual will assist in the use of the general model. Please note that the manual is in Dutch.
It can be found in the acrobat reader file:
Handleiding model investeringsbeslissingen.pdf

The UCP-UCKJP project was applied to the model. The result of this can be found in the excel document:
UCP UCKJP.xls

To order the CD send an email to:
Ontwikkelplatform@wenckebach.umcg.nl
Please mention:
CD - general model and manual, Saskia Heikens