Costs and Benefits of Transformation from a Life Cycle Cost perspective

A LCC model for developers and investors for comparing costs and benefits of transformation with demolition and new-build
Colophon

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Preface

This report is written in the course of the third semester of the master programme of the Real Estate & Housing department of the Architecture faculty at the University of Technology of Delft. It is the first part of the graduation research, which is the final version of the research proposal. The total graduation track is divided into 5 survey points, of which this P2 is the second one. The research is being conducted at the Design and Construction Management laboratory.

This research started with my interest in the transformation of buildings. This is the task for the future, as most of Dutch real estate has already been built. The high vacancy rate in the office market poses problems, but also holds opportunities for the future. Recent developments like devaluation of office buildings and a growing demand in housing present opportunities for transformation from office buildings to housing.

This proposal consists of an introduction of the research subject, followed by a research proposal, intended method, and research organisation. The context of the research proposal is provided by a literature study on the specific subjects of this research.

Jelle de Groot // Den Haag, January 2014
Management Summary

The current vacancy level of office buildings is almost 15% of the total office supply, while a healthy office market has approximately 5% vacancy. This comes to over 7 million vacant square meters of vacant office space of the total 48 million square meters supply in the Netherlands (DTZ, 2013). Furthermore the vacancy rate keeps on increasing, inter alia due to more efficient use of floor space like the New Way of Working (NWW) and a decrease in labour force. According to research of Joëlle Lokhorst et al. (2013) the current hidden vacancy will increase the total Dutch vacancy rate to 28% in the next five years. This shows that transformation is becoming an even more important theme in the near future.

There are different intervention strategies for vacant office buildings: consolidation, renovation, transformation, and demolition & new-build. Of these strategies only transformation and demolition are ways of extracting surplus space from the office market.

Firstly there seems to be a knowledge deficiency concerning the decision whether to transform or demolish & new-build. Already research has been done on the financial feasibility (Mackay, 2008) (Muller, 2008) (Schmidt, 2012), environmental feasibility (Jansz, 2012), and functional feasibility (Schenk, 2009). These studies however all focus on providing a financial feasibility study or method of transformation, rather than comparing the different possible intervention options. A better comparison model is needed for investors and developers to decide which intervention is financially most suitable for a vacant office building.

Secondly most recent research focuses on the investment phase and initial costs of a project to measure the financial feasibility of a project. The importance of adding the operational phase to the feasibility study is not discussed in previous studies and is therefore key to this research. A shift towards a life cycle approach is noticeable with developers, who are becoming more aware that the taking into account of the operational phase is important for the investors to secure their intended return.

The research that has already been carried out falls short on these two points above; the economic comparison of the intervention options instead of just a financial feasibility study of transformation, and the focus on the entire life cycle costing and benefits of the options. This will therefore be the focus and starting point for this research.

It is unclear, which intervention strategy is financially the better option. Developers and investors don’t have a model yet for comparing the costs and benefits of transformation with demolition & new-build with a focus on the entire life cycle. The problem statement of this research is therefore as follows:

‘There is a knowledge deficiency of the costs and benefits of transformation compared to consolidation, conversion, and demolition and new-build. Developers and investors need additional knowledge on transforming a vacant office building into housing, from a LCC perspective.’

Main research question that follows from this problem statement is:

How can a LCC model be developed that compares the economic costs and benefits of transformation with demolition and new-build?

The main research question is divided into different sub-questions. The research is carried out starting with a literature study to cover all the related information of the specific subjects and the research that has already been carried out. The literature study is followed by case analyses and interviews. These are meant as cost data input for the LCC model and the factors that play an important part of the decision process of the intervention strategy. Subsequently the LCC model is built and the cost data from the case studies are applied to the model. Finally the model is tested with a pilot case, which is then submitted to an expert panel for final feedback. The research ends with conclusions and recommendations.
Reflection

During the setting up of the research design and the conducting of the literature study it became clear to me that the vacancy problem in the Netherlands is a very complex problem. The large number of actors that is involved and the rules and regulations involved with the process further complicate the problem. The research theme is very broad and a lot of research has been or is being carried out related to the theme. The extensiveness of the problem makes it important to accurately demarcate the subject.

I noticed, during the preparation of my research design, interviews, and literature study, that a shift, or at least the realisation that a shift is needed, towards a life cycle approach of real estate. In this approach the investment- and operational phase is approached as one. This requires a different approach to real estate and investments and is important to be able to help solve the vacancy problem in the Netherlands (Neprom, 2012).

Maarsen Groep as a developing investor fits well within this research. The cost data and additional information concerning the case studies, cost calculations from practice from of as well the investment phase as the operational phase, can be used from Maarsen Groep and will support this research. The selection of the cases will be depending on the availability of cost data, and will influence the choses made and results from the empirical part of the research.

During my research design the most difficult task was to get the problem statement clear and demarcated. The scope of the research and the decisions concerning the methodology and focus points of follow up research will influence the end results of the research. Many of the decisions have not been taken yet, but the possibilities have been set and the background information is analysed. This creates a good basis for the following empirical research.

The points of attention for the next steps of the research are according to me; the working out the methodology, the selection of the cases and start of the LCC model, and most important the decisions that need to be taken in relation to their influence on the end result and course of the research.
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Research Design
Part 1 | Research Design

In this section the research design of this report is explained. First an introduction to the research subject is given, which serves as background information for the research. This chapter is followed by the research proposal that describes the research problem, statement, and research questions. After that the research methodology of this research is described, including the conceptual model for this research. This part ends with the research organisation.
1 Introduction

This chapter introduces the research subject in relation to my personal motivation. It includes a personal motivation, vision and profile, study targets, definitions of the most important relevance of the research, related research, and the demarcation with the boundaries of this research.

1.1 Motivation

During my master studies I gained interest in a few different themes, which I find to be important for the future. For my final bachelor project of architecture, I did a transformation project of an old gasworks to a theatre. This project started my interest in transformation project. Since most of the real estate in the Netherlands has already been build, transformation seems to be the task for the future. It's no secret that in the Netherlands there is a big vacancy problem in office buildings (figure 1).

![Figure 1, Vastgoedmarkt (2012)](image1)

The current vacancy level of office buildings is almost 15% of the total office supply, while a healthy office market has approximately 5% vacancy. This comes to over 7 million vacant square meters of vacant office space of the total 48 million square meters supply (DTZ, 2013). Furthermore the vacancy keeps on increasing, inter alia due to more efficient use of floor space like the new way of working and a decrease in labour force. According to research of Joëlle Lokhorst et al. (2013) the current hidden vacancy will increase the total Dutch vacancy rate to 28% in the next five years. This shows that transformation is becoming even more important in the near future.

One of the biggest barriers for a financial feasible transformation project is the high book value the investors have for the vacant office buildings. However finally investors are starting to revaluate their real estate to more realistic values (figure 2), which makes transformation more interesting and more often feasible (Mackay, 2008) (Schmidt, 2012).

![Figure 2, Office Vacancy retrieved from: www.dft.nl](image2)

In 2011 the Dutch government planned a new strategy for dealing with the high office vacancy rates. Their plan resulted in three solutions for dealing with the vacancy:  
1. Redevelopment, transformation and demolition of existing office buildings  
2. Measures to ensure a good functioning of the office market now and in the future  
3. Better regional spatial planning, programming and fine-tuning  

As Sascha Jansz (2012) already indicated, the second and third options are governmental actions, but option 1 is interesting for private parties. It shows that there are multiple ways of dealing with vacant office buildings.

Because on the one hand the vacancy rate problem is getting worse and might reach 28% and on the other hand opportunities for transformation seem to be growing this subject interested me for my graduation thesis. Although already a lot of research has been done within the theme transformation, the total list of all related research and graduation research are listed in the Position Paper of the Real Estate & Housing faculty of the TU Delft (Remý, 2013). It concludes with the focus for future research, and the specific topics for which more knowledge is needed.
1.2 Vision
Building transformation and vacancy are important topics in the current Dutch office market. Still the number of vacant office buildings is increasing and the number of successful transformed offices remains limited. There is a knowledge deficiency on the strategies for vacant office buildings and a lack of long-term perspective. The vision for this research is to provide a foundation for the decision for the best intervention strategy for vacant office buildings.

The role of developers and investors in real estate is changing. A change needs to be made towards a Life Cycle approach of real estate. This demands a close collaboration between developers and investors, where each uses it’s own expertise. For choosing a strategy we need to look at the entire life cycle costs and benefits rather than just the construction costs, as most financial feasibility studies currently do. This will provide better foundation for the decision which intervention strategy is the best option. With Life Cycle Costing all the costs and benefits of the entire life cycle of the different options will be covered.

The LCC approach is necessary to compare transformation with demolition & new build, because many of the costs and benefits of a building will be in the operational phase. This research can give insight in the actual performance and costs & benefits of transformed office buildings into housing. This research will therefore show the effect of adding the investment costs and operational costs to the financial feasibility studies of the intervention strategies of vacant office buildings.

1.3 Profile
This research provides me better understanding about the way developers and investors approach the current vacancy problem in the Netherlands and the practical experience with transformation projects. This research will provide me with knowledge on the decision to transform or demolish and re-build vacant office buildings. By looking further than just the investment period of the buildings, better decisions can be made. With this research I want to expand the knowledge on the transformation process and strategies for vacant office buildings and go in depth on the modelling of the LCC of buildings.

1.4 Study targets
Aim
The aim of this research is to broaden the knowledge on transformation costs and benefits. So that this research can be used in order to help the decision making process for vacant buildings whether transformation, demolition & new-build or perhaps doing nothing is a better option. Besides broadening the knowledge, this research will focus specifically on comparing the different intervention strategies. By modelling all the costs and benefits of the investment and operation phase in the Life Cycle Cost model, the model will give an overview of the buildings life cycle of each intervention option. Finally it will be possible to compare the economic results of each option.

Objective
The objective of this research is to explore the costs and benefits of transformation from a life cycle perspective. Taking into account the operational period of transformed office buildings provides insight in the actual efficiency of transformed buildings compared to demolished and new-build.

Personal targets
- Knowledge and skills of scientific research
- Gain knowledge on the design and construction process
- Gain knowledge on the transformation process of buildings
- Gain knowledge about managing a (re)development project
- Insights in the way decisions are made concerning vacant office buildings
- Practical experience with developers and investors with transformation projects
- Gain knowledge on costs and benefits analysis
- Gain knowledge on Life Cycle Costing and cost modelling
- Gain knowledge on the Dutch real estate market
1.5 Definitions

Transformation
Transformation is commonly known as building adaption, adaptive reuse, retrofit, change of use and conversion. In the transformation position paper Hilde Remøy (2013) describes building adaptation as: “any work to a building over and above the maintenance to change its capacity, function or performance” in other words, ‘any intervention to adjust, reuse, or upgrade a building to suit new conditions or requirements”. In this research transformation will refer to a change in building function.

Structural Vacancy
Structural vacancy is the vacancy of office space, which has been vacant for three years or longer, with no perspective on future tenancy (Remøy, 2010).

LCC
Life Cycle Cost is a technique used in the building and construction industry to estimate the total cost of ownership. It is defined by the ISO 15686-5 norm as: “a methodology for the systematic economic evaluation of the life cycle costs over the period of analysis, as defined in the agreed scope”. The norm divides Life Cycle Costs into 5 categories; Construction, Maintenance, Operation, Occupancy, and End of Life. Each category is broken down into sub-categories with specific costs. By quantifying all costs throughout the building lifecycle it can assist decision making in the development and investment process (Langdon, 2006). In this research LCC will therefore refer to the costs and benefits of an asset for a specified period of time.

Figure 3, Life Cycle Cost (ISO 15686-5)

3P model
The Brundtland report of 1987 (Brundtland, 1987) gives the most commonly used definition of sustainability: “Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs”. The triple P model is most used to define sustainable development and derives from the Brundtland interpretation of sustainability. John Elkington first introduced the triple bottom line, which later was called the triple P model. The three p’s of the model stand for; People, Planet, and Profit. Where 'People' refers to the social, 'Planet' the physical, and 'Profit' the economic perspective on sustainability.

1.6 Relevance

Scientific
Firstly there seems to be a knowledge deficiency concerning the decision whether to transform or demolish & new-build. Already research has been done on the financial feasibility (Mackay, 2008) (Muller, 2008) (Schmidt, 2012), environmental feasibility (Jansz, 2012), and functional feasibility (Schenk, 2009). These studies however all focus on the financial feasibility of transformation, rather than comparing the intervention options. A better comparison model is needed for investors and developers to decide which intervention is financially most suitable for a vacant office building.

Secondly most recent research focuses on the investment phase and initial costs of a project to measure the financial feasibility of a project. The importance of adding the operational phase to the feasibility study is not discussed in previous studies and is therefore is key to this research. A
shift towards a life cycle approach is noticeable with developers, who are becoming more aware that taking into account of the operational phase is important for the investors to secure their intended return.

**The research that has already been carried out falls short on these two points above: the economic comparison of the intervention options instead of just a financial feasibility study of transformation, and the focus on the entire life cycle costing and benefits of the options. This will therefore be the focus and starting point for this research.**

**Societal**
With more than 7 million square metres of vacant office space, which is a number that is only increasing, the vacancy problem seems obvious for the society. The vacant office buildings have a negative influence on the surroundings. They negatively influence the liveability and business climate for offices, impoverishment, image of the location and social security. Besides that it’s a waste of space and capital (Agentschap-NL, 2013). When looking at the current and foreseen future growth in vacancy of office buildings, transformation or demolition and new-build will be the task for the future (Steinmaier, 2011). In order to address the vacancy problem the best intervention for vacant office buildings is important. This research focuses on a life cycle approach to the financial feasibility of different intervention options of vacant buildings. Therefore it helps to solve the societal problem that is caused by the large number of vacant office buildings.

Newspaper articles and real estate magazines show that vacant buildings are finally starting to get revaluated, making it possible for transformation to take place on a larger scale. Therefore it becomes even more important for a model to decide the right intervention, because it can help facilitate the decision whether to transform or demolish and new-build.

**Practical**
This research tries to expand the knowledge known on the decision process for vacant buildings. In practice developers and investors can make use of the results and model to make measured decisions concerning vacant office buildings and transformation projects. This research can therefore substantiate the ‘gut feeling’ on which decisions by developers are often based and support it with quantitative data. It can increase the efficiency of the decision making process and provide more and easier-available knowledge.

**1.7 Related Research**
This research is being conducted in the Design & Construction Management laboratory of the Real Estate & Housing department of the Architecture faculty of the TU Delft. Within the entire department RE&H, transformation has become the main theme.

Previous research related to my research topic is:
-Agentschap-NL (2010) conducted a research titled "Kiezen voor nieuwbouw of het verbeteren van het huidige kantoor" and is strongly related to this research. The report focuses on the ‘planet’ aspect of the 3P model and also uses a LCC approach. Different strategies for a vacant office building are plotted against each other. The final assessment model is similar to the LCC model of this research.

Agentschap-NL chose 5 different intervention strategies for vacant office buildings:
1. Consolidation
2. Minor Renovation
3. Major Renovation
4. Demolition & New-Build
5. Demolition & New-Build, after a period of vacancy

The strategies do not include a change of function, as is the case with transformation. The fifth strategy is interesting as it shows the effect of the period of vacancy, compared to the fourth strategy that omits the vacancy period. Furthermore the lifespan is chosen for 10 years for the consolidation strategy, however they assume in this strategy that the building is leased and not vacant. The remaining lifespan for the minor renovation is extended to 25 years. For the major
renovation 40 years is assumed, including an additional minor renovation after 25 years. Finally
the new-build will have a lifespan of 50 years, also with a minor renovation after 25 years.

The study is carried out by using reference buildings with different years of construction. Two
buildings were used from 1980, two from 1990, and two from 2000. The different years of
construction can show if there is a different strategy more ideal for those buildings.

The result is the environmental impact per strategy depicted as a shadow price in € per square
meter Lettable Floor Area (LFA) per year. In figure 4 the results of the research are shown. It
shows that there is definitely a relevant decision for the best intervention strategy. Interesting is
that they use the first scenario, consolidation, as comparison for the other strategies.

Since this research only focused on the ‘planet’ aspect of the strategies, their recommendation is
to carry out additional research on the ‘profit’ and ‘people’ aspects of the strategies.

-Sascha Jansz (2012) did her thesis on the effect of the Estimated Service Life on the
sustainability of vacancy strategies. This is also a LCC approach, which focuses on the
environmental aspect. My research in contrast focuses on the economical aspect.

-Mackay (2008), Muller (2008), Schmidt (2012) focused their graduation research on the
financial feasibility and building costs of transformation projects. However they all focus on the
investment period of the transformation process and omit the operation period of transformed
buildings.

-Schenk (2008) conducted his research paying attention to the functional feasibility of office
transformation. He analysed different types of offices in relation to their potential for
transformation.

1.8 Demarcation
This research needs to be conducted within a defined period of time; therefore the research will
be demarcated in order to define the limits of the research.

Limitations
-This research is limited to transformation of office buildings into housing. Different types of
offices and office building characteristics can influence the construction costs involved. Most
successful office building transformations are offices on good locations, characteristic offices,
built before 1970.

The limitation for office transformation can further be restricted on the following aspects; type of
offices, period of offices, and specific new function after the transformation. The decision for this
more detailed demarcation is not yet made and is depending on the availability of data and
information for the case studies.
Period of offices

Zuidema and Elp (2010b) divide the different periods of construction. These periods represent different typologies of office buildings and differ in vacancy rates. In figure 5 the vacancy related to the year of construction of the offices is shown in a graph. Offices can be divided into the following periods; before 1970, 1970-1980, 1980-1990, 1990-2000, 2000-2009, and new buildings. These periods represent different types of offices and different building characteristics. For office buildings mostly a lifespan of 40 years is assumed. However 80% of the vacant buildings are less than 30 years old.

Type of offices

The different periods when office buildings were built are associated with different office building characteristics. Zuidema and Elp (2010b) list these characteristics in the following elements; façade, construction, height, installations.

Specific function

The specific function of the transformed building is also a more detailed demarcation for the research. A distinction can be made for instance between; students, starters, and elderly apartments.

- Due to the structural over-supply and vacancy of office buildings renovation and consolidation are no viable options. As figure 5 shows only demolition and transformation reduce the office space and therefore contribute to solving the vacancy problem. Therefore this research will only focus on the decision between transformation and demolition and new-build (Geraedts, van der Voordt, 2005). Spite of that, the consolidation strategy will also be covered and will serve as a base case. This shows what would happen if you do nothing, since this is the option most investors choose now.

- This research is aimed at providing a model in the initiative phase of a project, where the intervention scenario needs to be chosen. This means limited information is available as input for the model and key indicators will need to be used.

- In a similar research carried out by Agentschap-Nl, the focus was on the planet aspect of the triple p model. One of the recommendations was to focus other research on the other aspects of the model. For deciding which intervention scenario is most suited, economic costs and benefits will probably be the most influential. Therefore this research will focus purely on monetary costs and benefits. This means things like monumental value etc. are not taken into account in the decision making process. Figure 6 shows the focus on the ‘Profit’ or ‘Economy’ aspect.

Figure 5, Vacancy in Relation to Construction Period (Zuidema et al., 2010b)

Figure 6, Triple bottom line for sustainable development
- This research will not focus on:
  - The influence of location aspects
  - The influence of environmental aspects
  - The influence of societal aspects

Constraints
- An important constraint is the way the options are compared. The comparison needs to be objective and the options need to be compared with the same ambition level.

- The possibility exists that adding the operational phase to the decision process to choose the most suitable intervention strategy has no significant influence at all.

- It’s possible the best strategy is to do nothing; this is not favourable for addressing the vacancy problem, but this option is usually currently most used by investors and therefore important to include in the research. It will serve as a base case for comparing the other options.
2 Research Proposal

This chapter covers the problem analysis and statement of the research, followed by the research questions and intended end result. This research will be qualitative and operational research. It is aimed at providing a new LCC model for the best feasible intervention strategy for vacant office buildings.

2.1 Problem Analysis

Market

There is a mismatch between supply and demand in the current real estate market. This mismatch is the cause for the office vacancy problem. On the one hand there is an oversupply of office space, on the other hand there is a demand for housing, especially student, starters and seniors. One of the main causes for this mismatch to occur is often described using the pig cycle of Mordecai Ezekiel (1938). This cycle shows the slow reaction of supply to the dynamic characteristics of demand. Around the turn of the century the demand for offices was high. This resulted in an increase in prices, therefore construction started for many new office buildings. When these buildings were finally completed the demand had decreased due to, among others, the economic crisis. There was a surplus of office buildings that could not be filled anymore. This over supply started to shift the Dutch office market from a growth market to a replacement market. In a replacement market new office buildings are delivered, leaving older office building behind vacant.

Supply

On the supply side the current vacancy level of office buildings of almost 15% is a serious problem for the Netherlands, which is only getting worse. This is caused not only by the economic crisis, but also due to the unrestricted new building of the past, less need in floor space as a consequence of the New Way of Working and the decline of working population (figure 8) (Schmidt, 2012). The vacancy rate is the largest in the satellite towns of the larger cities in the west of the Netherlands in the so-called ‘Randstad’ and in Amsterdam (Remøy, 2011). Amsterdam is among the worst vacancy rates with 18% of the total supply (Vastgoedmarkt, 2013). Without intervention in these vacant office buildings, most of these buildings will remain vacant (Muller, 2008).

Demand

Offices

A few trends are noticeable that have an effect on the demand for offices. First of all the number of office jobs is decreasing. The number of office jobs is an indicator for the demand in office floor space. Secondly the average floor space per employee is decreasing, among others due to the new way of working. Figure 7 shows this decline in office space per employee. The decrease in demand is the quantitative mismatch for offices.

Besides the quantitative mismatch, there is also a qualitative mismatch between demand and supply within the office market. The New Way of Working changes besides the quantitative, also the qualitative demand for offices. A different office lay-out is needed, which is different from the old offices. Further more a trend towards inner city locations is noticeable, which puts pressure on the outer city office locations.

Joëlle Lokhorst et al. (2013) describe a trend of smaller organisations with an increasing demand for flexible offices with shorter and more flexible rental contracts in buildings with multi tenants.
These organisations have neither the demand nor the means to have a new office building developed.

**Housing**

On the demand side, there is a growing need for housing. This is because not enough new houses have been built, and the consistency of the households is changing. This is because the average number of persons per household is declining. Especially the demand rises in student, starter and elderly housing. According to Primos institute, another half million dwellings must be added until 2020 (Rodenhuis, 2012, pp 9).

The relation between the vacancy problem on the supply side and the housing shortage on the demand side has often been made, transforming vacant office buildings into housing, and by doing so solving both problems at once. Demolition and transformation are ways to reduce the vacant office space. Although transformation of office buildings into housing seems to be a solution where both problems can be solved, it’s still not happening on a large scale. Among reasons given for this are; mono-functional office locations, the fictitious high book value of the assets for the investors, the inflexibility of investors to change between profiles and the complexity of the transformation projects.

**Operation phase**

In the NEPROM (2012) report ‘Aanpak Kantorenleegstand’ Nicole Maarsen from Maarsen Groep advocates for a Life-Cycle approach to the vacancy problem, where investment and operation are treated as a whole and with a close collaboration between developer and investor, each with its own expertise. The building should not become a ‘tailored suit’ for the first user, since after this user leaves also the next user will need to be able to use the building. Therefore the best building is needed that suits the location and the future needs of the users.

The often quoted ratio of 1:5:200 (Evans et al, 1998) implicates that the costs of an office building are 1 on construction costs, 5 on maintenance and building operating costs, and 200 on business operating costs. After an additional research, a different ratio of 1:0.4:12 was found. Even though these results differ a lot from each other and could not be compared, they show that most of the costs of a building are after the construction phase (Hughes et al., 2004). This means the operation phase of a building is extremely important. Instead of focussing on construction to completion, as is currently mostly done by financial feasibility studies, the operation phase should be included. As Mackay (2008) already indicated, in the short-term transformation will be a more expensive option compared to other building interventions. Therefore it seems relevant to look at the long term of a building process, including the operation period. Currently all financial feasibility studies are focussed on simply the investment period.

According to Geraedts and Van Der Voordt (2005) there is a knowledge deficiency on costs and benefits of transformation projects in the operation phase. Since then research has been carried out on this theme, but most research on the feasibility of transformation projects is limited to the investment phase disregarding the operation phase. Looking at the entire life cycle of a building is important for making the right decision between different intervention scenarios for vacant office buildings on the long run. The British Standards Institution (2008) states that LCC is a common way in the UK construction to undertake an option appraisal study in order to evaluate various solutions to a given design and construction problem. This method therefore also seems useful as a tool to evaluate the possible intervention scenarios for vacant buildings.

**Demolition & New-Build or Transformation**

It is often claimed that transformation is more sustainable and cheaper than demolition and new-build, however there is no research that compares the costs and benefits of these two interventions. One of the recommendations from research by Laurens Buenting (2012) for follow up research is the sustainability of transformation opposed to demolition and new-build. According to his research actors prefer to demolish and new-build, because it generates more income en is more sustainable.

In a research from DHV (2011) they found that the demolition & new-build from a former tax office in Utrecht was more sustainable than transformation. The research received a lot of
criticism, because DHV only looked at the energy costs rather than all the other costs involved like material costs. Also Bullen et al. (2009) state that it sometimes can be easier and cheaper to demolish and start from scratch, since new materials and new installations can lower maintenance and energy costs. These researches contradict the commonly assumed benefits of time and cost savings with transformation. Even though there was a lot of critique on the way the research of for example the DHV research was carried out, these examples show that there is no consent on which intervention method is better. The criticism on the studies shows that the decisions that are made concerning the way the research is carried out and the demarcation of the research have a large influence on the end result of the study. Besides that to whom the costs and benefits belong will greatly influence the result. Therefore in this research a position will need to be chosen in order to be able to account for the results that derive from it.

Little or no research exists that, besides stating pros and cons from the two options, weighs the actual costs and benefits. The current transformation models and tools are aimed at financial feasibility studies, but are not able to compare different intervention options. Figure 9 shows the knowledge deficiency.

Figure 9, Problem Analysis

2.2 Problem Statement
It is unclear, which intervention strategy is financially the better option. Developers and investors don't have a model yet for comparing the costs and benefits of transformation with demolition & new-build. It is therefore important to look at what the costs and benefits are and how they differ for different actors. When concluding the problem analysis above, the following problem statements results:

'There is a knowledge deficiency of the costs and benefits of transformation compared to consolidation, conversion, and demolition and new-build. Developers and investors need additional knowledge on transforming a vacant office building into housing, from a LCC perspective.'

2.3 Research Questions
The main question resulting from the problem statement is as follows:

How can a LCC model be developed that compares the economic costs and benefits of transformation with demolition and new-build?

Sub-questions:
- What are main costs with transformation projects?
- What are main benefits with transformation projects?
- How do these costs and benefits differ from new-build projects?
2.4 Final Result
This research will have two different results. The main result is a Life Cycle Costing model for deciding whether a vacant office building is more suitable for transformation or demolition and new-build, looking at costs and benefits including the initiative phase as well as the operation phase. Figure 10 shows an example of what the final result could look like.

The second result is the key indicators of a transformation process, which may influence the decision for developers and investors between transformation and demolition.

The model divides the two scenarios into the construction/investment phase and in the operation phase. For both phases a consideration can be made which option is financially the best option.

2.5 Target Group
This research will be aimed at developers and investors, which can use the LCC model to make a well thought-out decision whether to transform a vacant office building or not. The relation and relevance of the developer, investor and other actors to the research subject is further elaborated on in chapter 5.5. According to Bullen et al. (2009) a key decision that many owners and occupiers are confronted with is whether to demolish or transform a building that does not meet the needs any more. The Dutch development market is shifting towards a replacement market. Investors are finally willing to revaluate towards more realistic book values of their assets. These two trends in the Dutch market make it more then ever important for developers and investors to make the right decision about the proper intervention method for vacant office buildings.
3 Research Methodology

In the methodology of this research there will be a distinction between theoretical research and empirical research as well as a combination of quantitative and qualitative research. The theoretical research is done by literature research and conducting interviews. The goal is to distinguish the important factors that influence the decision making process and is aimed at designing the theory. In the empirical research cost data is gathered from case studies and the model is build.

Literature Study

With the literature study research on the specific topics related to my research are discussed and concluded. According to Groat & Wang (2002) a literature study can serve a number of purposes:

- Identify the research question
- Focus the topic of inquiry
- Understand the makeup of the research question
- Understand an idea’s generic roots
- Understand the current conceptual landscape

This literature research will cover the following topics that will serve the purposes of the literature study on the different topics; the Dutch Office Market, Available tools, Transformation and Demolition & New-build, LCC and model building. This study will serve as a context for the research, and as a survey of what has been research and is already known.

After the initial literature study required for the P2, additional literature study is needed on specific topics. The decisions that will need to be taken in this research for example concerning specific methods of cost calculation, building typology, type of transformation, will require in depth literature research.

This literature study will partially answer the following sub questions:

- What are main costs with transformation projects?
- What are main benefits with transformation projects?
- Do these costs and benefits differ from new-build projects?
- To whom are these costs and benefits?
- How can these costs and benefits be determined?
- Which transformation tools are currently available?
- Can these tools be used for the comparison model between transformation and demolition & new-build?

Case studies

Yin (2003) defines case study as: “A case study is an empirical inquiry that investigates a phenomenon or setting”. Case studies can be characterized by five aspects; 1) focus on cases studied in real life contexts, 2) the capacity to explain causal links, 3) the importance of theory development in the research design phase, 4) a reliance on multiple sources of evidence, with data needing to converge in a triangulating fashion, and 5) the power to generalize to theory.

Case studies can serve different purposes; they can serve an explanatory, descriptive or exploratory purpose. The purpose of choice is depending of the nature of the research question. This research will make use of case studies during two different periods and will serve different purposes. An important part of the case studies is the case selection. Choosing the right cases is can help answering the research questions.

The case studies are meant to serve as input for the construction and operation phase of the transformation scenario of the LCC model. The input is derived from gathered cost data from the cases. Besides the cost data, the key indicators that influenced the decision to choose for transformation need to be identified. The information from the case studies, together with the literature study is used to set up a list of key indicators in the transformation process and the indicators of the LCC model.
When the model is built and the data from the case studies is applied a pilot case will be used to test the LCC model. This case is calculated with the model, and should give an overview of the costs and benefits of the different intervention strategies for the building.

The case studies will partially answer the following sub questions:
- What are costs?
- What are benefits?
- To whom are these costs and benefits?
- Which tools are currently available?
- Can these tools be used for the new model?
- How is the decision currently made? (based on what information?)
- Where in the process can this decision be made?
- Which indicators or aspects influence the decision?

**Interviews**

The interviews that will be held are part of the case study. They will have a semi-open character, with questions prepared in relation to the sub-questions of the research. The semi-open character allows discussing different topics and the soft factors and indicators that are decisive when choosing the intervention strategy for a vacant building. As an addition to the cost data from the cases, the information from the interviews will help explain why decisions are made and which factors play an important part of the decision process of the specific cases. The interviews will therefore not provide quantitative data that can be used for the LCC model, but the findings can be used to explain the character of the decision process.

The interviewees will need to be actors with different perspectives to the transformation process of the same case. Appropriate interviewees would be developers, investors, owners, corporations, and users with a specific knowledge of either the investment period or the operational period.

The following interviews are being planned or have been conducted:
- Expertteam Kantoortransformaties; This team gives advice on office transformation. They specifically name giving advice in financial favourability between intervention scenarios demolition and transformation.
- NieuwHolland; As a developer NieuwHolland has a lot of experience on transformation projects and can help find the indicators which are important when comparing transformation with demolition, as well as providing information on how they have made this decision in the past.
- Maarsen Groep; Maarsen Groep is a developing investor. As a developing investor they will have knowledge and interest in as well the investment as the operation period.
- OfficeUp; is a (re)developer that has a lot of experience and specializes in office transformation.

The interviews will partially answer the following sub questions:
- What are main costs with transformation projects?
- What are main benefits with transformation projects?
- How do these costs and benefits differ from new-build projects?
- To whom are these costs and benefits?
- How can these costs and benefits be determined?
- How is the decision currently made? Based on what information? What does the decision process look like?
- Where in the process can this decision be made?
- Which indicators or aspects influence the decision?
- What is the influence of adding the operational phase in the decision making process?
- Under what circumstances is transformation financially a better option than demolition & new-build?

**Building the Model**

The results of the case studies together with key figures will be used as input for the LCC model. The results from the literature study should point out which models and tools are currently available for transformations and if they can be used to build the new model.

The most challenging part of the model is the comparison between the intervention options. Since no two identical buildings and locations exist, one of the two buildings will have to be a
fictive case. With demolition and new-build a lot of key benchmark figures exist and can for instance be found in the ‘KengetallenKompas Bouwkosten’ (Vonk et al., 2012). This option is therefore suitable to serve as a fictive case comparable to the case that is examined in the transformation option. The cost data from the transformation model are derived from the results of the case studies.

Test Case
With the pilot case the LCC model that has been built can be applied to an actual case. With the help of the new model, financially the best intervention strategy can be determined for that particular case.

Expert Meeting
To validate the model it is presented to a team of expert. This meeting is aimed at feedback on the model and the application to the test case. The expert team will consist of experts with different specializations in the different aspects of the transformation process. The model will be presented before completion; therefore it will leave room for feedback and fine-tuning the model.

3.1 Conceptual Model
Figure 11 shows the conceptual model for the research. As stated in the demarcation in chapter one, consolidation and renovation are no solution for the vacancy problem and this research only focuses on transformation and demolition & new-build. The strategy consolidation is added to the study and is used as a base case for comparison with the other strategies. Each strategy is tested for the associated the costs & benefits. These costs and benefits are based on key figures for the consolidation and demolition & new-build strategy. The case studies will serve as input for the transformation strategy. The result of the costs & benefits of these three strategies will give most cost effective option.

This research focuses on the entire life cycle as analysis period of the strategies. As the building cycle circle in figure 12 shows, the focus of the research is after the operation phase of an office building, when the decision for demolition or transformation needs to be made. Each strategy will include the costs of the investment phase, operation phase, and the revenues of the building throughout its life cycle.
4 Research Organisation

4.1 Scientific Domains
The scientific domains are:
- Transformation
- Life Cycle Costing
- Building Economics

4.2 Mentors
The mentors of my graduation research and related specialty are as follows:
1st Mentor:
Peter de Jong, LCC

2nd Mentor:
Rob Geraedts, Transformation

3rd Mentor:
Hilde Remøy, Transformation

4.3 Research Design

Figure 13 shows the research design for the graduation period. As the design shows the research started with a draft version of the research proposal for the P1. Here the problem is analysed and formulated into a problem statement with research questions.

The current phase is the P2, which mainly consists of developing a theory and serves as a context for the entire research. This is done by conducting a literature study and interviews with different actors involved with the process like developers and investors.
After the P2 the empirical research starts. The cases for the case studies need to be selected, which can best answer the research questions and support the model. Simultaneously the model building is started. The literature study is used for building the model, whereas the case studies will serve as input for the model. When the draft version of the model is finished, it will be presented to an expert team. The feedback can be used to improve and finish the final model. The research will end with conclusions and recommendations that can be drawn from the research and the results.

### 4.4 Planning

Figure 14 shows the planning for this research for the next semester, up until the final P5 presentation in July. The planning includes all important tasks and parts of the research that lead up to the 4 determining points; P2, P3, P4 and P5.

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Figure 14, Research Planning

### 4.5 Graduation Company

**Maarsen Groep**

Maarsen Groep is an independent private investment organization that develops and invests with private equity and risk. Their focus is on commercial real estate and apartments. With their knowledge on costs and benefits in the investment phase as well as the operational phase and the necessary case information they will support and fit well within my research.

[Figure 15, Maarsen Groep (retrieved from: http://www.maarsengroep.nl)]
Literature Study
Part 2 | Literature Study

In this section the literature is used to set up a theoretical framework. The following chapters discuss the Dutch office market, the available tools that support the transformation process, the costs and benefits of transformation and demolition & new-build, and Life Cycle Costing. The next chapters are an assessment of existing knowledge related to my research project. It serves a few goals; showing the context of the research project specifically for my research topic, give answers to some or parts of the sub questions, and it is used for developing the LCC model.
5 Dutch Office Market

This chapter focuses on the details of the Dutch office market related to the vacancy problem and transformation. There is a diverse supply of offices, which can be characterized in quality, location and size aspects (Djajadiningrat, 2012). A difference in quality of offices is noticed for instance with the New Way of Working (NWW), where the offices require a different layout. This is a change in office quality. With the location characteristics there is a shift towards inner cities, especially in the 'Randstad'. There is little demand for the highway locations and the monofunctional office locations outside the city. Finally the total demand for office space is less then the supply, there is a size mismatch. These examples show there is a mismatch between demand and supply in the current office market. The functioning of the office market will be described in this chapter.

5.1 Four Quadrant Model

The office market is often described using the Four Quadrant Model of DiPasquale and Wheaton (1992) and Fischer (1992) (figure 16). The model depicts an ideal situation where the supply, rental price per square meter, market sale price of office space, and construction costs are in balance. This shows how the rental price of commercial real estate is established. The four markets; users market, investors market, development market, and space market are combined into one model with a quadrant for each market. Van Gool (2007) explains the model by addressing each quadrant:

![Four Quadrant Model](source: adapted by author (Van Gool, 2007))

**First Quadrant**

The first quadrant describes the demand of the user market and shows the relationship between the stock and the rent level. The demand is the total supply of square meters of office space in use. Where an increase in demand, and a supply that remains the same results in higher rents. The angle of the line depicts the sensitivity and is a function of time.

**Second Quadrant**

The investors’ market quadrant shows the relation between the rent and price of real estate. The price of real estate is established by dividing the rental income on a return requirement. The angle of the line can be seen as the capitalisation rate. The straight line indicates that with a similar capitalization rate the price will increase proportionally with the rent level.

**Third Quadrant**

The developers market is the third quadrant shows the construction production and gives the relationship between the price and construction. The construction production will increase if the prices of real estate increase. The line doesn’t start in the origin, as there is a minimum price level for the construction costs. When demand increases new supply will be added by new buildings and renovation.
Fourth Quadrant
This is the building market, giving the relation between construction production and the stock of total supply of space. This is a function of construction and demolition. When the construction production increases, the supply will increase, which explains the inclining line.

Further more the two upper quadrants, quadrant 1 and 2, relate to the short-term dynamics of the office market. They bring the financial and real estate market in relation. The financial price and physical surface are related by the two lower quadrants. These quadrants, 3 and 4, give the long-term relations.

The simplified representation of the reality of the model makes it suitable for showing how changes in one sub market influence the other sub markets. In figure 16 the model is in balance. The model will be used in the next paragraph to explain the office market situation with the current office vacancy where the market is not in balance.

Imbalanced market
The current vacancy problem will be explained with the help of the Four Quadrant model and the adaptations made to the model by Colwell (2002). One of the adaptations made is the inclusion of vacancy as an extra variable. This makes the model more complete, but less easy to use.

When there is oversupply in the market, the model will respond to the oversupply. The oversupply results in a decrease in rental prices (First Quadrant). This decrease in rental price causes the prices to drop (Second Quadrant) and a decrease of the construction of new buildings (Third Quadrant). Subsequently the oversupply should decrease (Fourth Quadrant), as a result of the increased demand and decreased new construction. Shortly the market should have a new balance due to the decrease of rental prices and the consequential new increased demand.

However the current market is an imbalanced market, where it does not result in a new balance. The rental prices are too low, which puts pressure on the new construction of offices. Technically speaking there should even be more demolished then new being built. In the office market this shows as an increase of non-courant office buildings, while in the higher segment offices a balance does form.

In the current market the decrease of rental prices and the decrease of new construction is already visible. The following increase in demand however is not showing, on the contrary a decrease in demand is expected for the future, putting additional pressure on the rental prices and increasing the over supply. This is shown in the oversupply of offices as can be seen in figure 17, where the demand A is far less then the supply B. The only way to do something about the vacancy problem in this situation is by extractions of office space from the market. Transformation and demolition are the only two intervention options that extract office space.

In the 4Q model does not take account of the non-courant offices. According to Colwell (2002) the non-courant offices are not seen as competitive office buildings. Therefore they are left out of the model and are seen as amortized with no future perspective on tenancy. This category is the structural vacancy of the office market.
5.2 Vacancy

Vacancy in the office market is not an extraordinary occurrence. Due to the cyclic character and slow reaction of the office market, a higher vacancy rate is common in a period of declining demand. The figure below shows what these periods of over and under supply look like.

Vacancy is caused by a mismatch between demand and supply. If too much office buildings are being built or have been built, the supply exceeds the demand that causes the vacancy. This is a quantitative mismatch of space. However besides quantity, there is also a qualitative mismatch. This qualitative mismatch is reflected in preferences of office users for different location and building characteristics. The cause of vacancy can therefore be characterized by three different factors: market, location and building (Remøy, 2010).

Market

Since the second world war the commercial real estate market became an investment market. This created opportunities for real estate developers and investors to enter the office market, because a distance was formed between the owner and the occupier of office buildings. The office market is characterised by the demand and supply of office space. Office users search for office space within a specific market. Within this market the office is selected based on location and building characteristics.

Location

Vacancy is concentrated on specific locations. Higher rates of vacancy can be found in the ‘Randstad’ for example. Besides that secluded mono-functional office locations pose a real problem. These locations are secluded from any other functions and are not suited for a single building transformation. Only an area development can provide solutions for these locations.
Zuidema and Van Elp (2013) distinguish three different location types:

1. Central Locations; Offices in city centres and around central stations in the inner cities.
2. Formal Locations; Office concentration of working locations, like business parks.
3. Other Locations; Separate offices in for instance residential areas or outskirts.

Within the three types of locations, three different quality segments; A, B and C are assumed. The quality reflects the rental prices of the offices and is related to the building characteristics. In total there are therefore nine segments of offices in the market, with three quality segments for all three location segments. The current vacancy rate is the highest in the formal locations. Because the central and other locations are multifunctional locations, they offer more potential for transformation. Of course will a growth region provide more potential than a shrinking region (Zuidema et al. 2012).

Within the three types of locations, three different quality segments; A, B and C are assumed. The quality reflects the rental prices of the offices and is related to the building characteristics. In total there are therefore nine segments of offices in the market, with three quality segments for all three location segments. The current vacancy rate is the highest in the formal locations. Because the central and other locations are multifunctional locations, they offer more potential for transformation. Of course will a growth region provide more potential than a shrinking region (Zuidema et al. 2012).

![Figure 19, Segments Office Buildings (Zuidema et al., 2012)](image)

**Building**

Building characteristics have a large influence on the probability of vacancy. Different periods of construction and building elements characterise the different types of offices. Within these characteristics a difference in vacancy rate can be distinguished. The biggest problem of offices is in the office buildings built between 1975 and 1990. These buildings have specific characteristics that make them more probable to be vacant.

Because for the transformed building as well as the new-build building, the market and location aspects will be equal, only the building characteristics will be different. The focus of this research will therefore be on the building characteristics of the vacant office buildings.

**Types of Vacancy**

Different types of vacancy can be distinguished. Hulsman & Knoop (1998) name four different types:

- **Initial vacancy** is vacancy that arises at the completion of a new office building. This is approximately 1 to 2% of the total supply.
- **Friction vacancy** shows that vacancy is not necessarily negative, because it is required for movement in the office market. The friction vacancy rate is often described to be optimal at 4-5%. With the total market at 48 million square metres of office space, the friction vacancy would be approximately 2.4 million square metres of friction vacancy as opposed to the total of 7 million square metres vacant (DTZ, 2013).
- **Conjuncture vacancy** is the consequence of fluctuations in supply and demand due to conjuncture changes.
- **Structural vacancy** is the total floor space that has been vacant for at least 3 subsequent years in buildings that have been completed for at least 3 years with no future perspective in future tenancy. Approximately 60% of the vacant office buildings in the Netherlands is structurally vacant (Lokhorst et al., 2013).
Besides these types of vacancy, recent study shows there is another type of vacancy called ‘hidden vacancy’:

Hidden vacancy is a type of vacancy that is not registered and not taken into account when the current 15% vacancy rate is used. It comes on top of this vacancy rate and is all the surplus space that is leased by companies, but not needed. This space will gradually be released on the market at the expiration of existing lease contracts. The trend toward space efficiency will lead the tenants to choose less floor space that better suits their needs. When including this hidden vacancy in the vacancy rate, the rate can increase up to 24% of the supply by 2018 (Lokhorst et al., 2013).

5.3 The Origin of the Current Vacancy Problem

The origin of the current high vacancy rate will be described in this paragraph by dividing the history of the office market into 5 different phases based on research carried out by Zuidema & Elp (2010b).

Phase 0 // before 1995
After an economical setback in 1991 the vacancy problem becomes worse after a period of economic prosperity in the late 80’s. Reliable data is scarce, but researchers conclude an approximate vacancy rate of 10%. There seems to be a mismatch in demand for quality and non-suitable supply.

Phase 1 // 1995-2001
The period of high vacancy and lower demand is exchanged for a period of strong economical growth. While the government is initially reticent for developing new offices, since there was still a large vacancy rate, the demand was rising steep. This increase of demand causes an increase in the rental price of office space. This results in an enormous increase of developments and new office space. The percentage of buildings developed at risk or without a tenant is at 80%.

Phase 2 // 2002-2005
This period is characterized by the pig cycle, which is often used to describe the functioning of the office market. Still large quantities of offices are being built at risk, while the demand is decreasing due to an upcoming recession. The five year contracts of many of the less courant office buildings, which were rented out in the previous period due to supply shortage, are ended and result in a lot of extra lower quality office buildings back on the market.

Phase 3 // 2006-2008
In this period lease contracts become very valuable, meaning that investors are willing to pay high prices for offices with lease contracts. The value is stimulated by the flow of capital from investors and financiers. The high prices, the high rate of ‘incentives’, and moderate rental increase result in many owners to move to new buildings with new contracts. These new buildings are often cheaper compared to their previous building. This circumstance combined with the more efficient office layout cause in further increase of the vacancy rate. This increase has nothing to do with the pig cycle to describe a common vacancy rate in the office market cycle.

Phase 4 // 2009-2013
This is the last and current phase, is initiated by the credit crunch and the successive financial crisis. The demand from investors is lost due to the credit crunch, resulting in a decrease of value of lease contracts and prices of offices. The financial crisis deeply affects the dynamics of the office market, putting pressure on the inclination of companies to move their organisation. As a result the vacancy increases and the new build production slows dramatically. From this point on there is no prospect on a natural solution of the vacancy problem with an increased demand as in the phase 1. Therefore investors will have to take their loss and re- or devaluate their office buildings. Figure 20 below shows the phases in a graph.
Why the current vacancy problem will not solve itself
The extend of the structural vacancy problem becomes clear when the vacancy is linked to the future demand. This shows to what extend the market will be able solve the vacancy with the future demand. One of factors that have a big influence on this future demand is the future office employment. Instead of an increase in the working population, after 2020 a decrease is expected. This means no increase in demand is expected resulting from this factor.

In the research of Zuidema & Elp (2010b) with the use of 4 different long-term scenarios the scenarios for the future office market are calculated. Where even the most favourable scenario the vacancy is 5,6 million square meters. Remarkable is that with the most favourable economical scenario; the vacancy rate is the largest. This shows how the market works, with economical growth comes increased replacement demand.

5.4 Strategies for vacancy:
Four different strategies for vacancy can be distinguished: consolidation, renovation, transformation, and demolition (Remøy, 2010). Each will be discussed concisely below.

Consolidation: In this option the building is maintained in the current condition. The strategy can be to actively look for potential new users, or to wait for better times or simply sell the building for a lower price. Investors and owners of vacant office buildings mostly choose for this option. Vacancy is even preferred over lowering the rental prices due to the revaluation of the building conform the new rental prices. This revaluation is often more expensive then the on going operational costs of the vacant building. Also incentives are used to keep tenants on board or to attract tenants.

Renovation: With renovation the office building is renovated to suit other office markets, or to become a higher quality office buildings. The decision for renovation is based on a consideration between the costs of renovation and the improved revenues. Especially sustainability is driving the rent level up. However, in the current market conditions, there is a fair chance that the benefits of the renovations do not outweigh the costs. Further more this option does not solve the vacancy problem, as it doesn’t extract office floor space from the market.

Transformation: The possibilities to transform vacant offices into different functions are limited. This means offices are frequently transformed into (student) housing or educational facilities. Transformation can be expensive and disrupts the income from and the use of the building. Different practical obstacles prevent the transformation of offices to housing on a large scale.

Demolition & New-Build: Like transformation, demolition & new-build creates possibilities for the development of a new building with new functions. When a building is technically in a good condition, it’s considered a waste of resources. Also demolition & new-build is expensive and disrupts the income from and the use of the building.
The model in this research can be used to help decide which of these strategies is financially the best option when looking at the entire life cycle. As indicated earlier in this research only the options transformation and demolition & new-build will be covered. The costs & benefits of transformation and demolition & new-build are discussed in chapter 7.

5.5 Actor Analysis
In this paragraph the role of the main actors that are involved with the vacancy problem or transformation process will be discussed.

Developers
Although developers might not have been the direct cause, they have played a significant role in the origin of the current vacancy problem. The developer looks at the price for which it can buy the vacant office building and the price for which it can sell the transformed building. If the selling price, inclusive of a developer’s fee, is higher then the buying price it’s a profitable project. The model helps showing, by setting out the operation phase, which intervention option will have the highest selling price.

As the investors become more critical on their investments and want to reassure their return, it becomes more important for developers to have knowledge in order to substantiate their development plans with a solid return. Therefore also for the developers it becomes interesting to look further then just the investment phase and work together with investors.

Investors
Investors have the primary goal to receive return on their real estate by rental incomes in the operating phase or sale of their real estate. Most rental contracts are for 5 years or 2x5 years. The distinction between owners and investors is that owners posses the real estate to house their organization and investors only for the return. Three different kinds of investors can be distinguished (Gemeente Amsterdam Ontwikkelingsbedrijf, 2009):
- Institutional investors; invest direct or indirect in real estate. Examples from institutional investors are pension funds, insurance companies, and investment institutions. Direct mean the investor has the buildings in their portfolio on their own balance sheet, whereas indirect means they invest by means of a property fund.
- Private investors; choose to invest (part of) their capital in real estate. This is often just a single or part of a single building.
- Professional investors like housing associations; invest primary in (social) housing in order to house the population with affordable housing. Some housing associations also invest in commercial real estate and use the profit for their social housing goals. They can play an important part in transforming offices into housing, for example student housing (Gemeente Amsterdam Ontwikkelingsbedrijf, 2009).

Besides these investors, property funds also directly invest in real estate. The vacancy problem is mainly located in the portfolios of property funds. The problem with property funds is that they cannot simply change from investing in offices to housing. This means they would have to sell their office building to a different investor that can invest in housing. This means the property fund has to take its loss.

Investors can have different strategies for their vacant buildings:
- Actively approaching new tenants
- Waiting for better market conditions and new tenants
- Transformation to a new function (or demolition & new-build)
- Taking their loss (including depreciation and potential selling of building)

In the current market many investors don’t see the current vacancy as a real problem. The vacant buildings are most of the time part of a larger (international) portfolio. The vacant building has such a small influence on the total income, that if a certain acceptable rate of return is achieved they prefer not to revaluate or actively intervene (Zuidema, et.al., 2010b). Investors therefore choose to wait for increasing demand in office space. Even with buildings that have no view on new tenants, investors will prefer to lower the rent than to transform a building. It seems they
are only prepared to transform when it is the last real option (Gemeente Amsterdam Ontwikkelingsbedrijf, 2009).

Besides the discrepancy between demand and supply there is another problem. Currently there is also a discrepancy between the market value of an office building and the high book value. According to Brueggeman et al. (2011) there are four motivations for investing in Income Properties; the rate of return, price appreciation, diversification, and tax benefits. Before the financial crisis investors received return after collecting rents and paying operating expenses. Further more investors anticipated on the rise of prices of real estate, which meant that when selling an office building after a certain period of time it would add to an investor's return. This resulted in positive business results. Since the crisis however many of the office buildings became vacant, and therefore do not generate rental income. Besides that the prices of the real estate are decreasing instead of increasing, this also has a negative effect on an investor's fiscal year. A positive business result will already be difficult due to the crisis, which means that additional negative effects of the real estate are unwanted. Investors therefore currently often prefer to do nothing with their vacant real estate and keep their fictive high book value.

When the vacancy rate in the portfolios of investors keeps on rising however, it will have an effect on the total portfolio. There is a maximum vacancy rate, where the interest rate payments and repayment obligations can just be met. Steinmaier states that with a vacancy rate in the portfolio of 25%, which is an expected average for the Dutch office market, also investors will have trouble to maintain their Loan To Value ratio (LTV).

![Figure 21, maximum allowable vacancy rate against LTV ratio (Steinmaier, 2011)](image)

**Financers**
Financers play an important part in the construction process, as without them most developments will never get off the ground. The reluctance of the end users and the investors, which are less eager on buying rented out end products, play a role in the reluctance of financers to provide funding for developments (Steinmaier, 2011).

**Appraisers**
The vacancy problem of offices also relates to building appraisal. Appraisal is the process of determining the market value. There are different techniques for appraising buildings; most of them focus on predicted future revenues. In the current market, where the book value is often a lot higher than the actual market value, the accurate appraisal of buildings is extremely important for transformations to become financially feasible. However one of the fundamental problems of building appraisal is caused by the way appraisers are compensated for their work. Appraisers receive a percentage of the buildings they valuate. This acts as an incentive for appraisers to incline towards higher market prices (Zuidema et al., 2010b).

**Municipality**
Although indirect, the municipality has had a large influence on the vacancy problem in the Netherlands. To start with the municipality is involved with the creation of the office vacancy due to their policy that is stimulating new offices. The municipality as a landowner receives revenues with the sale of land. They therefore benefit from new office locations (Zuidema et al., 2010a).
The vacancy problem is in the first place a market problem, however this doesn’t mean the municipality shouldn’t be involved. Vacancy can entail a lot of external negative effects, like the liveability and negative appearance of the surroundings.

**Developing Investor**
As the actor analysis shows, all actors involved in the construction process directly or indirectly have an influence on the vacancy problem. Although all actors are involved in the transformation process and will have to work together, the developers and investors play the most important part in the initiation and completion of the transformation of vacant office buildings. The long-term view of the investors and the visionary view of the developers will together have to find a solution for the vacant office buildings. Therefore these actors will be the focus of this research. A developing investor has both the ownership of the building and the drive of the developer to act and do something.

**5.6 Conclusion**
The current vacancy problem is complex and related to all stakeholders in the construction process. The market will not solve it with the pig cycle, as it did in the 90’s. The only way is to extract office space of non-courant buildings from the market by demolition or transformation. The developers and investors will play an important part in the initiation of the solving of the vacancy problem. A developing investor will have the knowledge and the need to address this problem when looking further in the future. These actors are very important when looking at the costs and benefits of the options. Different costs and benefits will apply for different actors, making it important to distinguish who’s costs they are and who’s benefits.

The building characteristics will be of influence when deciding which intervention option, demolition or transformation, is most suitable. The location and market conditions will be equal for both options.
6 Available Tools

Many tools have already been developed that can be applied in the transformation process. In the graduation research of Fikse (2008) all available tools related to the transformation process at that moment were examined. Most developers are not aware and do not use these tools. In this chapter some of the relevant tools are listed with a short summary of these tools and the chapter is concluded with the potential of these tools for this research.

6.1 Tools

In this paragraph the tools that are relevant for my graduation, which Fikse (2008) analysed are summarized.

Vacancy risk meter ‘leegstandsrisicometer’
In a shrinking market, this tool allows to reflect which locations will have the highest risk of vacancy. Also on building level the buildings with the highest risk for vacancy can be determined. It does not elaborate on the costs and benefits.

Transformation potential meter ‘transformatiepotentiometer’
This tool is designed to measure the transformation potential of buildings, looking at location and building characteristics. It discusses the functional as well as the technical and financial feasibility. Also this instrument does not cover costs and benefits.

The Transformation Index ‘Herbestemmingswijzer’
Determining a suitable function is the purpose of this tool. It looks at how a building is transformable into another function. It evaluates 195 different functions, focussing on financial, technical, societal, and organizational feasibility.

ABT-Quickscan
The ABT-Quickscan is used for determining to which function the building can be transformed best. This is done by testing 96 criteria on 10 different functions. The function that requires the least amount of adjustments is seen as the best option.

Triple Jump Method
This tool is used for a quick determination in the function potential of a building after transformation. The focus is on the technical aspects of the building. After that the INKOS is used for the financial feasibility of the project. The tool is similar to the Transformation Index of Hek (2004) but it is a lot quicker in use.

TOK- Checklist
This checklist looks at the transform potential of offices to housing. It focuses on the technical aspects rather than financial aspects. However many technical difficulties will result in more costs, and will therefore indirectly influence the financial aspects.

INKOS
The INKOS instrument is aimed at giving a fast indication of the feasibility of a transformation project. Besides that it is possible to compare different variations of financial feasibility, looking at the costs and benefits of the options. The model is part of Life Cycle Costs and Benefits modelling, aiming to show the costs and benefits of the entire life cycle in the model.

6.2 Additional Tools

The additional tools below are not covered in the research of Fikse (2008), because they probably weren’t developed yet in 2008. These are therefore more up to date tools and could very well serve as a basis or starting point for the LCC model in this research.

BBN advisors Transformation Calculation Tool (2012)
This tool focuses on the investment costs and predicted revenues of a transformation. It is an easy to use tool, needs little information and makes use of key benchmark figures. This tool only
looks at the investment period, by adding the operational phase to this model it can possibly serve as a starting point for my model.

**Vastgoedmarkt Vastgoed Exploitatiwijzer (2011)**
The Exploitatiwijzer uses key benchmarking figures for the determination of the operational costs in an early stage. Data is used to bundle different prices per LFA per year for different types of buildings. These key figures can be used when adding the costs in the model.

**KengetallenKompas Bouwkosten (2012)**
The KengetallenKompas Bouwkosten is a collection of all key figures for construction costs, demolition costs, and additional costs different types of buildings. Interesting is that 3 levels are given for all costs; basic, low, and high costs. These key figures can be used as input for the fictive case of demolition & new-build.

**Research Mackay (2008)**
The building costs research of Mackay analysed the costs of different building elements, discerning the costs of the elements and finding the cost bearers of a transformation projects. Although the results of the research were not significant enough to be generic for all office buildings, is does give a good overview of which parts of an office building are high in costs.

**Research Robin Schmidt (2012)**
Robin Schmidt did the most elaborated research on financial feasibility of transformation I've come across in my literature study. It focuses on transformation costs and even a stub for comparing transformation with demolition and new-build, excluding the operation level.

**Davis Langdon (2006)**
The research of Davis Langdon Management Consulting (2006) was aimed at developing a common methodology at European level for evaluating life cycle costing. The essential components of a common LCC methodology are as follows:

- **A process model**: the intention of the model is a practical implementation of LCC representing the decision process. The necessary criteria, analysis tools and techniques are used for an effective LCC evaluation.
- **Common uses of LCC**: examples of projects at different stages of the life cycle with the different actors involved. The examples provide a means of focusing the methodology on the most likely application.
- **Data requirements and cost classification**: an important part of the methodology is the way in which the cost data can be classified to aid analysis and comparison.
- **Economic and financial analytic tools**: the methodology incorporates a number of economic, financial and other analytic tools and techniques.
- **Other analytic and evaluation tools**: i.a. sustainability assessment, risk analysis, sensitivity analysis, IT tools and other techniques are identified and integrated in the common methodology.
- **Applicability to public procurement**: the methodology incorporates various approaches of public procurement.

**Research of Craig Langston**
Craig Langston published multiple studies on the transformation potential of buildings. The focus in these researches is modelling the life cycle of buildings, in order to take property management decisions and strategic assessment of building transformation opportunities.

In his research that was published in the Habitat International, Langston et al. (2013) applied ‘Adaptive Reuse Potential’ (ARP) modelling to determine the most effective way to transform buildings in Hong Kong. The model calculates the useful life of a building as discounted physical life (figure 22). The factors physical-, economic-, functional-, technical-, social-, legal-, and political obsolescence are taken into account. The scores reflect the building’s life so far, not just the current status. The scores are expressed as percentages, where the higher the score, the higher the potential for transformation (figure 23). This provides a way of benchmarking the results of different scores.
Current research from Langston et al. (2014) the ARP model is compared with the adaptSTAR model. AdaptSTAR is a design-rating tool from Australia, made for analysing transformation projects. It helps decision makers to achieve optimum efficiency and useful life from developments. The seven categories of design criteria from the adaptSTAR model align with the seven obsolescence categories in the ARP model. This makes it possible to compare the results of both models (figure 24).

Figure 22, above: ARP results (Langston et al., 2013)  
Figure 23, left: ARP model (Langston et al., 2013)

Figure 24, the adaptSTAR Model (Langston et al., 2014)

6.3 Conclusion

The characteristics of the INKOS instrument suit the intentions of this research. It is focused on the entire life cycle and is able to able to compare the financial costs and benefits of different options. The rest of the tools are mainly focused at looking at the transformation potential or the most suitable function and are not suited to compare different options. Furthermore the cost data from the ‘Vastgoed Exploitatiewijzer’, research from Mackay, and research from Schmidt, can all possibly be used as input for in the model.

The common LCC methodology from Davis Langdon provides a sort of step-by-step plan for setting up a life cycle costing analysis. This common methodology can serve as a foundation for setting up the life cycle costing in this research.

The transformation potential modelling from Craig Langston is mainly focused on the sustainability of the life cycle of building interventions. While my research focuses on the costs, rather than the sustainability, the approach to the life cycle and the models can be useful for the monetary focus of the life cycle of building interventions.
7 Transformation or Demolition & New-build

This chapter will elaborate on all costs and benefits of transformation and demolition & new-build. The aim is to determine the key indicators of vacant buildings that can help decide in an early stage whether transformation or demolition is the best option. These are gathered from literature and interviews. The results of this chapter will serve as input for the LCC model.

7.1 Extractions from the Market

As discussed in chapter 5, from the four different strategies for vacancy only transformation and demolition & new-build are ways to extract floor space from the office market. Figure 26 shows the extraction from the office market from 2003 to 2011.

Figure 25 shows the percentage of extractions from the market by demolition and by transformation to different functions. In total demolition and transformation approximately both account for half of the extractions. Transformation of offices to housing specifically takes up 25% of the total amount of extractions. The total effect of the extractions however is still minimal. Between 1990 and 2010 only 1.8 million square meters of the office supply is extracted. This is less than 0.5% annually (NVM, 2009). This shows that the current interventions are not nearly close enough in solving the vacancy problem. Both the number of transformed and demolished office floor space will need be increased.

Professor Hans de Jonge from the TU Delft estimates that from the current office supply only 15 to 20% is eligible for transformation, besides that a part can be used for a lower segment of offices, but a large part will have to be demolished (Simons, 2012). The largest part of the vacant offices is expected to have no view on future tenancy or transformation into another function. It seems that demolition for these vacant office buildings is the only solution. Demolition and transformation will therefore both play important roles in the solving of the vacancy problem in the Netherlands.

7.2 Feasibility Studies

At the start of every new construction process a feasibility study is required. The feasibility is analysed on different aspects; Societal, Legal, Technical, Functional, and Financial (Wamelink, 2007).

Societal Feasibility

One of the important criteria with a development is whether there is social support for the development. The demand and needs determine the societal feasibility, as well as support the politics that in the end determines if a development is possible. An often-named advantage of transformation is that resistance from the neighbourhood is less likely, since the building already exists. This can favour the societal feasibility of transformation projects.

Legal Feasibility

With legal feasibility the intended development is checked if it is not in violation of any laws and regulations. The most important in the Netherlands are ‘het bestemmingsplan’ (zoning plan) and ‘het bouwbesluit’ (building act). On different levels, regional and local, many procedures are connected that result in applications for permits. These procedures and permits require a lot of
time and can eventually even result in budget and time overruns or the cancellation of a development. A difference can be seen with the legal feasibility of new-build and transformation. Acquiring permits for transformation projects is a more difficult process, because for instance for the function change of a transformation, the zoning plan has to be changed.

**Financial Feasibility**
A financial feasibility study examines whether a project is financially feasible when looking at the investment budget in relation to the potential revenues and operational costs. A development is financial feasible when the net present value of the expected revenues exceed the net present value of the costs. But the financial feasibility is more than just the financial calculations. It’s about the demand for housing or the ‘fitness for use’ and what the user is ‘willing to pay’ for it.

The risk analysis is an important part of the financial feasibility study. Risk is expressed in the study by giving a minimum and maximum limit of costs and benefits of the project. Most financial feasibility studies focus on a limited set of key figures, which in the beginning of the project is hard to be accurate since little information is known.

When establishing the financial boundaries of project key benchmarking figures are often used. The investment budget is based on key figures from previous realized projects. The problem with using key figures is that each building is unique and key figures can therefore not be generalized.

Cost modelling is a method that is better able to add project specific information in the calculations. The computer is used to simulate the entire life cycle. Also cost modelling is depending on the availability of information, however the results can be more accurate than by just using key figures.

In this research the financial feasibility is integrated in the LCC calculations. The feasibility of a project and the risks of a development are not only noticeable in the construction process, but the risks will have an affect on the owners/investors of the real estate for the remainder of the operational period. The method of determining the budget and relation with the investment costs, operational costs, and revenues are covered in chapter 8.

**Technical Feasibility**
The technical feasibility studies differ a lot between new-build and transformation projects. With new-build in the early stages of the development process not enough information is known to perform a realistic technical feasibility study. With a transformation project however the technical feasibility is one of the most important aspects. It’s essential to inspect the technical conditions of a building to reduce the risks and the associated financial consequences. In the technical condition analysis the structural condition as well as the installations are mapped. The parts that are reusable and the ones that need to be replaced are examined. This technical feasibility analysis is prior to other feasibility studies with a transformation projects. Technically it is basically always feasible to transform an office building into housing, if the interventions however become too expensive, the technical feasibility influences the financial feasibility. These are therefore closely related.

**Functional Feasibility**
If the building meets the demands and wishes of the future users is determined in the functional feasibility. It is a 2 or 3 dimensional representation of the brief. Therefore this representation depicts the dimension and position of functions, including the horizontal and vertical accessibility. In transformation projects the new brief will have to fit in the existing building, while in a new building the dimensions can be designed specifically for the brief. A transformation project needs brief that suits the existing building, or it has to be possible to adapt the building to the brief.

This research basically compares the financial feasibility of the options transformation and demolition & new-build to see which of the two has a better final result. The focus of this research is on the financial feasibility, because in practice the financial feasibility will have the largest impact on the decision between intervention options.
7.3 The Transformation Process

Before a building is build or is transformed it undergoes a certain process. The process for transformation is quite different then the construction of a new building. When the best suitable intervention strategy for a vacant building needs to be found, basically the best possible use for that building is determined. The Highest and Best Use (HBU) method is a way of determining the values of the different possibilities of intervention for structurally vacant office buildings (figure 27).

![HBU model](image)

HBU is defined by the Appraisal-Institute (2001) as the probable and legal use of undeveloped land or real estate that is physically possible and financially feasible and results in the highest value. The four aspects; legal, physical, financial feasibility and highest value are the important factors of the HBU method.

The future use is depending of the legal feasibility, which in its turn depends on the current and future zoning plan and the environmental regulations. If an intervention is not in line with the zoning plan, the municipality can sometimes make adjustments to the plan. Involvement and positive collaboration of the municipality is therefore important for transformation projects.

The physical feasibility assesses if the intervention is transformation is physically possible. Tools for this assessment are for instance the ABT quick scan and the transformation potential meter. Important with the physical feasibility is also the costs that are related to the actions that need to be carried out. The financial feasibility is therefore closely related to the physical feasibility. The final factor is to determine which of the options is the maximum financial output. The HBU method will not be used in this research, but the steps of the model do show where this research is positioned in the transformation process.

![Decision making process](image)

Figure 28 shows the process starts with demand from the market or the market potential of a vacant building. This means an intervention is needed in the current building in order to reach a better use. The market demand and vacant building are then tested if what’s legally possible. After the legal feasibility the technical, functional, and aesthetic feasibility is assessed. The next step is the financial feasibility of the possible intervention options. The addition of this research is the comparison of all intervention options on life cycle costing. The result will therefore be the best use and optimal use in relation to the Total Cost of Ownership (TCO) of the building. This results in the costs and benefits per Gross Floor Area (GFA) of the different intervention options.
7.4 Costs & Benefits

In this paragraph the frequently cited costs & benefits and advantages & disadvantages of transformation and demolition are listed. Subsequently they are linked to the actors whom bear the costs or benefits.

Transformation

Benefits:
- Old buildings are cheap to acquire (Schmidt, 2012): If costs can be saved with the acquisition of a building this will benefit the developer as their profit is the difference between the investment costs and the selling price. By lowering the acquisition costs the profit is increased or more buildings become financially feasible to transform.
- Construction cost savings (Schmidt, 2012): because the construction, foundation and other parts of the building can be reused, material costs can be saved.
- Construction time savings; because the construction, foundation and other parts of the building can be reused, the construction period can be shorter. This also influences the finance costs, if the period of financing is shorter.
- Nearby residents are used to the building in their surroundings, therefore objection against a transformation will be less likely then a new building. Besides that, transforming a vacant office building into a new function will only benefit the liveability of the neighbourhood.
- On locations where there is no more room for new buildings for instance for housing. The locations that are already built on can be used. Of course demolition & new-build shares this benefit, as also if the building is demolished the location can be used for the new function in a new building.
- An often claimed benefit is that transformation is more sustainable then demolition & new-build. The arguments used for this are that by reusing the old construction and possibly installations or façade etc. less demolition waste is produced and the depreciation of the materials is spread out over a longer period of time (Van Der Voordt, 2007).

Costs:
- Technical complexity (Van Der Voort, 2007); the transformation of an office building into housing is technically very complex. However the problem mostly is not that its technically not possible, but a modification can be so costly that the transformation is not financially feasible anymore.
- Organisational complexity; the whole transformation process is a complicated process due to inter alia the involvement and interests of all different parties involved with the process. Many of the parties don't have a lot of experience yet with transformation projects.
- Legislation; Legislation on building level can get in the way of realisation of transformation projects. A new building permit is needed that complies with the municipal building regulations, the ‘Welstandsnota’, the Monumental act, and the zoning plan. All these regulations can make the transformation financially less feasible (Zuidema et al., 2010b)
- Limited possibilities due to the lay-out (Benraad, 1994); The construction, depth and height of the building, and façade are decisive in the new building.
- Installing the new installations in an existing building is more expensive compared to in a new building, since standard sizes and fittings are less often possible compared to new buildings.
- Higher standard requirements on building climate performance and fire resistance are obligated for dwellings compared to offices. Again these higher standards also apply to the new building (Benraad, 1994). New regulations for transforming offices into housing are less strict then the regulations for new buildings.

Demolition & New-Build

Many of the demolition & new-build benefits are equal to transformation or the exact opposite.

Benefits:
- New-Build is more sustainable, because a new building can be made more energy efficient compared to a transformed building. When looking at the life cycle of an office building the energy costs will be lower.
- The costs of new buildings are easier to predict then transforming existing building. This means that new buildings will have fewer risks of unforeseen circumstances that can increase the
construction costs. Key indicators can be used in cost calculations for demolition and construction costs of new buildings, with transformation the use of key indicators is still limited among others due to the unique character of buildings. The construction period can be shorter, because the legislation and regulations are better organized for new buildings.

**Costs:**
- It seems a waste to not reuse the available foundation, construction and other elements of the building like the façade and installations. The reuse of these could save money on materials and time on the construction period.

Strikingly some of the benefits of transformation and demolition & new-build cited contradict each other. This can be explained by the facts that buildings are unique. For each building the different costs and benefits will apply, making that no generic statements concerning the costs and benefits of these can be made. Key indicators however can be linked to the costs and benefits. Making it possible to base decisions on the costs and benefits related to indicators.

### 7.5 Risk Indicators

The purpose of this paragraph is to set up a list of potential key risk indicators that can be identified in the beginning of the process. These indicators can have big consequences for the costs or benefits later in the process and can therefore be decisive for the right intervention decision. Listing and validating these indicators are used to substantiate the decision model.

These indicators basically are a way of showing which risks are involved with a transformation project. There are many definitions for risk, but they all consist of a consequence multiplied by the likelihood of that consequence. Gehner (2011) names all different definitions of risk used in literature, one commonly used is the one that will be used in this research from 'Stichting Bouw Research' (2000): "Risk = Chance of failure x consequence”.

The list of indicators mentioned above is called a risk checklist. The checklist is one of the methods to identify risk. The checklist consists of relevant risks of the list, supplemented with the project specific risks of the transformation project. It’s a simple technique giving an overview of all possible risks (Claes, 2004).

Frank Veen (2012) gathered all the known risks with project development from multiple sources in literature. A few distinctions can be made between risks. First of all there are specific and systematic risks. According to Huysmans (2011) the specific risks can be influenced, while on the contrary the systematic risks cannot be influenced due to their autonomous character. Secondly there is a difference between the risk profile of developers and investors. The developer has a different risk profile for every project; this makes it hard to categorize the risk for a developer. A developer is for instance willing to take more risk, if the return is higher (Veen, 2012). The risk profile of the investor is easier to classify. An investor has long-term data sequences of results from the past related to the type of real estate. Besides differences in risk profile, the developer and investor also have similarities of which the market risk is the most important. Both parties heavily depend on the autonomous developments in the real estate market.

Below the systematic, process specific, and project specific risks are divided in different categories.
A note to the specific risks is that the consequence of these risks is small within the operational phase. With the exception of vacancy and leasehold.

### 7.6 Success Factors

A recent research into the success factors of transformation projects by Bosma and de Ridder (2013) compared 164 successful and 81 unsuccessful transformations. A project is considered successful when a project is commercially successful, but also preservation of valuable real estate, preventing demolition. Non-successful transformation projects are mainly those that did not get off the ground. By comparing the different projects the differences are and the success and failure factors were determined.

The success factors and therefore the factors with the highest potential for success resulting from the research are as follows:

- It concerns a temporary redevelopment
- It concerns a certain specific functions (original or new) of the real estate
- Technically simple transformation
- Stimulating role by the government
- Early involvement of future users
- An appropriate book value, based on future cash flows
- The ability to utilize stimulating legislation and funding
- Small-scale projects
- A good location
- The use of unorthodox financing
- The real estate is more sustainable after transformation
- An extensive preparation

The failure factors are basically if these success factors cannot be met like: a lack of financing, legislation that cannot be met, or a lack of interest from potential buyers and users. When the decision is made between transformation and demolition & new-build certain indicators can have an influence on the decision. For instance a higher ceiling results in higher energy costs, making it purely financial a less interesting option. However the higher ceiling could result in an easier to sell or rent apartment, and therefore influence the decision. These indicators will therefore also be distinguished in the case studies.
7.7 Conclusion
Currently demolition extracts just as much floor space of the office market as transformation. Accurate feasibility studies of both options, weighing of the pros and cons, the risk and success factors, and help make the decision for the right intervention strategy for a vacant office building. If a vacant office building is cheaper to demolish and build a new building instead of transforming, only significant arguments and other benefits of transformation case specific projects can in that case cause to choose for transformation.
8 Life Cycle Costing

In this chapter the principle of Life Cycle Costing (LCC) will be explained. LCC is no new phenomenon. Already in the 70’s way of thinking behind LCC started, where the focus shifted from the investment costs to the entire life cycle. The financial feasibility calculation as discussed in chapter 7 is expanded with the operational period. With the LCC approach all costs and benefits will be weighed against each other, providing a financial feasibility analysis with a life cycle approach.

When looking at the costs and the benefits it is important to realise whose costs and whose benefits it is. With the calculation of the life cycle costs different actors are distinguished; the developer, the investor/owner, and the user/tenant. The NEN2699 (2013) divides the life cycle costs & benefits in:

- The costs & benefits of the investment (from the developers point of view)
- The costs & benefits of operating (from the investors/owners point of view)
- The costs & benefits of the accommodation (from the users point of view)

The NEN norm in the Netherlands and the British Standard International Standards Organisation (BS ISO) in the UK both give standards for various aspects of planning the service life of buildings and constructed assets. The NEN norm is a Dutch standard and the BS ISO is an international standard. Because this research focuses on the Netherlands the NEN norm will be used. The NEN2699 is the updated version of the NEN2631 Norm of 1979. Is integrates the investment and operation costs into one Norm, focusing on Life Cycle Costs. NEN2699 divides the Life Cycle Costs into Investment costs, Operational costs, and Revenues. These will be covered in this chapter.

8.1 Investment Costs

The investment budget for the acquisition is based on the expected revenues of the building. The potential revenues minus the investment costs and profit give the budget left for the investment. The investment costs includes all costs needed for the realization of the building. The investment costs can be divided into the following categories; Land costs, Construction costs, Installation costs, Additional costs, Unforeseen Costs, Taxes, and Finance Costs.

<table>
<thead>
<tr>
<th>Investment Costs (NEN 2699, 2013)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Land Costs</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Construction Costs</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Installation Costs</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Additional Costs</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Unforeseen Costs</strong></td>
</tr>
<tr>
<td><strong>Taxes</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Finance Costs</strong></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Figure 30, Investment Costs (source: edited by author (NEN2699, 2013))

Land Costs

The budget for the lands costs, as explained above, is the expected revenues minus the remaining investment costs and profit. This is the maximum amount that can be paid. The land costs can be divided in; acquisition costs, demolition and environmental costs, infrastructural facilities, and
above ground settlements. Together with the construction costs, this is the largest part of the investment costs.

In this research for both transformation and demolition, not only the land costs will have to be paid, but also the above ground settlements that in this research means the vacant office building. One of the major obstacles for the financial feasibility of the transformation projects is the acquisition cost of the office in relation to the expected revenues. If the land costs can be decreased the financial feasibility of the project is increased. The trend of revaluating the office buildings has been started, with owners and investors revaluing courant office buildings with 5 to 10% and non-courant buildings up to 50%. The lower prices in the market are now €1.000 per square meter LFA as opposed to €1.500 before the economical crisis. However only when the price drops to €500 per square meter LFA, vacant offices become feasible for transformation. Even though the reevaluating process has started, this is something that needs to happen incrementally and will therefore take some time (Oudemans, 2011).

Construction Costs
The construction costs exist of: the construction works, installations, permanent interior and facilities, terrain, and general implementation costs. There is a difference between the construction costs of transformation projects and new buildings. With transformation projects the construction costs are dependable on the building characteristics of the building that needs to be transformed and the characteristics of the new building. While with new buildings the construction costs only depends on the characteristics of the new building. Since every building is unique, the costs of transforming the old buildings cannot be generalized and is very hard to predict.

Many financial feasibility studies focus on these construction costs of the transformation project in order to predict these costs and the feasibility. Examples are the research of Mackay (2008) with a focus on the construction costs of transformation projects, and the research of Schmidt (2012) with the construction costs of building elements.

The construction costs of demolition & new-build for the reference case will be gathered from key benchmarking figures.

Installations costs
With most transformation projects, the installations are completely replaced. The new installations should therefore cost the same with new build. However the installation itself in existing buildings can be more expensive since standard dimensions might differ.

Additional Costs
Additional costs are the costs prior and during the construction needed for the construction process. This includes fees for architects, construction engineers, advisors, etc. The Additional costs are divided into: additional costs land, additional costs construction, additional costs interior, and initial costs.

Unforeseen Costs
Almost all projects include unforeseen costs. In the NEN2699 norm these are kept as one costs for the entire project. It’s interesting to see if there is a big difference with the unforeseen costs of transformation compared to demolition & new build.

Taxes
Tax and transfer tax can influence the decision for the intervention strategy for a vacant office building. Figure 31 shows that different tax rules apply for offices and housing. Extraction of commercial real estate from the market by transformation it’s not attractive in fiscal terms. Transformation to functions without VAT accounting, like housing, is therefore more costly than transformation to functions that do (Buietelaar et al., 2013). In this research the options demolition & new-build and transformation will have the same function change, and same new tax rules applied with the new function. The tax regulations will therefore be left out of the research.
**Finance Costs**

The finance costs are the interest costs that need to be paid over the loan needed for financing the construction costs. The longer and the higher the costs and loan is, the higher the interest costs will be. A difference in finance costs for the intervention strategies can have an important influence on the total costs each option.

8.2 **Operational Costs**

The operational costs are the costs during the life cycle of the building necessary for the use of the building. According to the NEN2699 norm operational costs of real estate are the recurring costs that derive from:

- The ownership of real estate
- Maintaining the real estate ready for use
- The partially or fully use of real estate

The operational costs are divided in; Accommodation, Services & Resources, ICT, External Facilities, and Facility Management of which only the first two are covered in this norm. These are costs that are related to the land and/or the real estate. The costs are registered and budgeted annually.

**Accommodation**

The accommodation costs consist of the following costs; providing accommodation, taxes, insurance, maintenance, mutations, consumption of energy/water/etc., management, and interest.
Service & Resources
The only costs of Services & Resources that will be included in the LCC calculations are the cleaning costs. These cleaning costs are directly related to the building, and are divided in interior and exterior cleaning costs.

<table>
<thead>
<tr>
<th>Operational Costs (NEN 2699, 2013)</th>
<th>Municipality</th>
<th>Developer</th>
<th>Investor</th>
<th>User</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accomodation</td>
<td>providing accommodation</td>
<td>x</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>taxes</td>
<td>x</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>insurance</td>
<td>x</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>maintenance</td>
<td>x</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>mutations</td>
<td>x</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>consumption of energy, water, etc.</td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>management</td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>interest</td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Services &amp; Resources</td>
<td>consumer services</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>risk management</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>cleaning</td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>moving costs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>document management</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>residual management</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>other services</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ICT</td>
<td>not covered in this norm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>External Facilities</td>
<td>not covered in this norm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Facility Management</td>
<td>not covered in this norm</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 32, Operational Costs (source: edited by author (NEN2699, 2013))

8.3 Revenues
As stated in chapter 8.1 the financial feasibility of a building can be increased by reducing the costs or by increasing the revenues. The revenues are determined by the market, location and building characteristics. In the graduation research of Muller (2008) he investigated the different possibilities for increasing the revenues of a transformation project. The location, possibilities for changing the floor space surface, and the possibilities for a commercial function on the ground floor, the plinth function, have the largest impact on the revenues.

The location will be equal for all the different intervention options and is not included in this research.
Relurba (2000) gathered a list of all the different ways to change the total surface of buildings, consisting of 8 different categories:

1. Thicken (opdikken)
2. Down-topping (aftoppen)
3. Excavate (uithollen)
4. Attach (aanpuisten)
5. Combining Floors (bovenkameren)
6. Topping (optoppen)
7. Adding new build (aankoppen)
8. Using the plinth (uitplinten)
Figure 33, 1. Thicken (Schmidt, 2012)

Figure 34, 2. Down-topping (Schmidt, 2012)

Figure 35, 3. Hollow (Schmidt, 2012)

Figure 36, 4. Attach (Schmidt, 2012)
Figure 37, 5. Combining Floors (Schmidt, 2012)

Figure 38, 6. Topping (Schmidt, 2012)

Figure 39, 7. Adding new build (Schmidt, 2012)

Figure 40, 8. Using the plinth (Schmidt, 2012)
NEN2699 (2013) divides the revenues in land use, construction/transformation project, and building use. The costs of all three sub-categories are divided in periodic revenues like rental income and one-off revenues like sale and transfer income.

Benefits Land Operation
The benefits of the land operation will be for the municipality and the developer. These are benefits of temporary rent of the land and the selling of the land.

Benefits Construction/Transformation Project
The developer that carries out the development will mainly receive the benefits of the construction/transformation project.

Benefits Building Operation
The benefits of the building operation are the rental income, service costs, additional services and the residual value of the building.

<table>
<thead>
<tr>
<th>Benefits/Revenues</th>
<th>Municipality</th>
<th>Developer</th>
<th>Investor</th>
<th>User</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenues Land Operation</td>
<td>periodic</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>one-off</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Revenues Construction Project</td>
<td>periodic</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>one-off</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Revenues Building Operation</td>
<td>periodic</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>one-off</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 41, Revenues (NEN2699, 2013)

8.4 Calculation Methods
Investors can use many different methods for carrying out the financial feasibility studies. Some of these methods are also used for valuating real estate. Although the investment and valuation methods look very similar, in practice there are differences. The most commonly used methods in the Netherlands are explained in by van Gool et al. (2007), and are as follows:

- Bruto-aanvangersrendementmethode (BAR method)
- Netto-aanvangersrendementmethode (NAR method)
- The X-Times–Rent method
- The Discounted Cash Flow method (DCF method), which has three different variations; the investment value method, internal rate of return (IRR method), and the unprofitable top method
- The Replacement Costs method

BAR and NAR method
The BAR and NAR method play an important role in investing in real estate. The BAR and NAR can give a first impression of the return of an investment. The BAR is used a lot more than the NAR in the Netherlands and is essentially the gross initial yield expressed in a percentage of the investment. The BAR is the Gross Initial Yield, and the BAR method essentially expresses the Gross Initial Yield in a percentage of the investment.

\[ Y_{bar} = \left( \frac{BH_1}{I} \right) \times 100\% \]
\[ Y_{nar} = \left( \frac{BH_1 - E_1}{I} \right) \times 100\% \]

Where
- \( Y_{bar} = \) Gross Initial Yield
- \( Y_{nar} = \) Net Initial Yield
- \( BH_1 = \) Gross Annual Rent in the first year of operation
- \( I = \) Total Investment
- \( E_1 = \) Total Operational Costs in the first year of operation

The disadvantage of both of these methods is that only the initial yield is calculated, which has little to do with the return from the rest of the operational period, the so-called Internal Rate of Return. Besides that it does not include aspects like vacancy, rent incentives, major maintenance, yield changes, leverage and tax matters. Therefore the BAR and NAR method are not appropriate methods for calculating the LCC.
The X-Times-Rent method
This is a simple method that basically is the opposite version of the BAR method. Investors don’t use this method a lot but brokers do due to the quick calculation. In principle the method is not different from the BAR method, because the x and the BAR are each other’s reciprocal.

\[ X = I / BH \]

DCF method
The DCF method or Net Present Value method (NPV) essentially makes the cash flows of the operational period and the selling price present. Project costs that occur at different points in the life cycle of a building can not directly be compared, because of the varying time value of money. These cash flows therefore need to be discounted back to their present value. The discounting of the cash flow gives the Present Value (PV) of the costs and benefits. The costs and benefits are converted with the discount rate, which is “the interest rate used to convert future expenditures to their present value at the base date, taking into account the investor’s time value of money” (DavisLangdon, 2006). This gives the amount of money that would need to be invested today, at an interest rate equal to the discount rate, in order to have that amount of money available in the future. The NPV is the sum of all present made costs and benefits.

\[ NPV = \sum_{t=1}^{T} \frac{C_t}{(1 + r)^t} \]

Figure 42, NPV (DavisLangdon, 2006)

Where
NPV = Net Present Value
C_t = Cost of item t
r = Discount Rate
T = Analysis period in years

The DCF method can be used to calculate:
1. De investment value of an object, this is called the Investment Value method
2. The Unprofitable Top method (Onrendabele Top method)
3. The Internal Rate of Return (IRR) of an object, or the IRR method.

1. The investment value method is used when the DCF method is used for investment analysis. It simply calculates the value the investors assigns to an object based on its own required return. Institutional investors commonly use the investment value method, because the results are easily comparable and it gives a first impression of the value of the object.

\[ IV = [CF_1 / (1+ER_p)^1] + [CF_2 / (1+ER_p)^2] + ... + [CF_n / (1+ER_p)^n] \]

Where
IV = the Investment Value
CF_n = the Cash Flow in period n
ER_p = the Expected Return of the object

2. The Unprofitable Top method is used by corporations to calculate the discounted cash flow of the unprofitable top. The method basically subtracts the total investment sum (I) from the Investment Value (IV). With social housing this subtraction results in a shortage, which is called the unprofitable top.

3. Finally the DCF method is used to determine the Internal Rate of Return (IRR) of an object. The IRR shows the return period of an investment. In contrast to the investment value, the discount rate is calculated rather than given. The IRR is mainly used by institutional investors. The advantage of the IRR over the Investment Value method is that the return period is easily calculated, besides that it is possible to include the effects of debt and tax. The IRR’s of different
options can be compares, which makes it a good method for comparing different intervention options.

A central feature of LCC is the application of Net Present Value. On purely economic grounds however the NPV makes it less attractive to spend money now, but more in the future. This is due to the fact that even with a modest discount rate the NPV reduces rapidly. This makes long-term performance unattractive to the developer.

The Replacement Costs method
Besides the methods that capitalize the rent or calculate a return, also other methods exist like the replacement costs method. The method basically calculates the price for which the building can be build or respectively rebuild. The construction price is then compared with the potential selling price. If the selling price is higher, the investment can be interesting.

The Differences between calculation methods for Developers and Investors
The developer and investor each have their own method for calculating the return on their investment.

For a long time developers used the Return On Investment (ROI) method, and for a long period of time 10% was seen as a minimum return requirement. ROI gives the ratio between return and the investment. If the investment results in loss, the ROI will be a negative figure. It's relative easy to calculate when the investment and the generated revenues are easily expressed in monetary values. The disadvantage is that the ROI is not linked to the life cycle of a project.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Omschrijving</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stichtingskosten</td>
<td>Indexering tot aan:</td>
</tr>
<tr>
<td>1</td>
<td>Grondkosten</td>
</tr>
<tr>
<td>2</td>
<td>Bouwkosten</td>
</tr>
<tr>
<td>3</td>
<td>Bijkomende kosten</td>
</tr>
<tr>
<td>4</td>
<td>Onvoorziene kosten</td>
</tr>
<tr>
<td>5</td>
<td>Algemene kosten</td>
</tr>
<tr>
<td>7</td>
<td>Reinwerkost</td>
</tr>
<tr>
<td>Opbrengsten</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Woningbouw</td>
</tr>
<tr>
<td>9</td>
<td>Commercializatie kantoor</td>
</tr>
<tr>
<td>10</td>
<td>ROI</td>
</tr>
</tbody>
</table>

Figure 43, Construction costs calculation developer (Huysmans, 2011)

Developers also started using other methods like the IRR and Weighted Average Cost of Capital (WACC). The IRR is part of the DCF calculations and therefore better in analysing future cash flows. In the acquisition phase the developer will mainly rely on key figures, form factors, and other benchmarking figures to do the calculations.

In order to calculate the internal rate of return, an investor uses the DCF method to make the future cash flows present. The method is depending on a few essential variables. The four most important cash flows from the operational period are rental income, annual operational costs, major maintenance, and the end value. The rental incomes at the start are equal to the rent in the contract. The developer will try to capitalise the rents as high as possible, when selling the building to an investor, as a higher rent will result in a more expensive building. An investor benefits from a low rent in the beginning, in order to prevent depreciation caused by lower rents in the future (Huysmans, 2011) (figure 44).
Calculation method in this research
While the BAR, NAR, and x-times-rent method are suitable for giving an in initial impression of financial feasibility, the end result is unclear since it’s only a percentage. These methods are therefore not suitable for this research.

This research will make use of the DCF method, because it enables all costs and revenues of future cash flows to be made present. Within the DCF method multiple financial parameters can be incorporated, for instance the costs of vacancy, indexation of rental prices, and inflation. The only problem with the parameters and variables in the DCF method is the large influence they have on the end result. This will need to be taken in consideration when calculating

8.5 End of Life
If at any time during the life cycle of a building the LCC analysis shows that the building is no longer economically viable, the decision will need to be taken to invest in the disposal stage. Owners will try to maximise their return. They will need to choose whether they want to dispose, retain, refurbish, or transform the building.

Important for all DCF calculations is that the end value, which is the expected sale price of the object at the end of the operation period, is determined. The end value is part of the cash flow of the last operation annum. The end value of the building can have a big influence on the outcome of the different intervention options. The consolidation option requires the least investment costs, however the end value of this option will probably be the lowest. There are several ways for determining the end value of a building:

- Building and planting method
- Value development method
- Current value method
- Exit-yield method
- Yield value method

The decision for the method of calculating will depend on the method Maarsen Groep uses. The choice of method will have an influence on the end result. All methods are predictions of the future and are therefore based on assumptions.

8.6 Sensitivity Analysis
A sensitivity analysis measures the impact on the return by changing one variable, while the other variables are kept the same. The results will show, which variables have the largest influence on the end result and are therefore the largest costs and benefits of the transformation process. The problem with the sensitivity analysis is that it doesn’t include the probability of the different outcomes. Still it is commonly used in practice due to its easy to use character (Veen, 2012).
Scenario analysis is derived from the sensitivity analysis. The method calculates three scenario’s: pessimistic, realistic, and optimistic. The bandwidth of the outcomes is wide, because the pessimistic scenario adds all negative values and respectively the optimist adds the positive values. When the decision maker is capable of estimating the probability of the different scenarios, this method is called the Expected Monetary Value (EMV) (Veen, 2012).

The Monte Carlo simulation is a technique that creates a probability distribution for the costs and benefits, this makes it possible to calculate the probability of the return of a project. Monte Carlo randomly uses parameters over a range of values from a specified frequency distribution. The advantage of the simulation is the positive and negative consequences and the dependent and independent are linked using a correlation matrix. This enables developers and investors to see what the effects of interventions are. Despite the advantages the Monte Carlo simulation is not commonly used interalia due to the complexity of the technique and the difficulties with generating reliable input data (Boussabaine et al, 2004) (Veen, 2012).

### 8.7 Lifespan

Life Cycle Costing is about determining the costs and benefits during the entire life cycle of a building. In order to be able to calculate the life cycle costs of a building, the lifespan of the building needs to be determined.

According to Van Nunen (2011) it’s important to put the lifespan of buildings in perspective. His method of ‘lifespan thinking’ focuses on the sustainability of long term strategies. As an example he approaches houses with an average lifespan of 120 years. In these 120 years interventions are needed to be able to comply with the performance requirements (figure 46).

![Figure 45](image)

**Figure 45, Strategic decision lifespan (Van Nunen, 2011)**

When deciding for the right intervention strategy, this will influence the course of the life cycle of the buildings as figure 45 shows. Interventions in buildings therefore require a life cycle approach.

Van Der Voordt (2004) divides the lifespan into the economical, technical, and functional lifespan. The reason buildings become vacant is because one of these lifespans ends.

**Economical Lifespan**

The economical lifespan is basically the period of time where the financial benefits outweigh the costs. When looking at the economical lifespan all the costs and benefits are made present. If a building is does not meet the functional needs of the users they will look for a different building, if a new tenant can not be found for the building this is also the end of the economical lifespan. The building will then have a residual value that can be positive as well as negative.
With refurbishment and transformation the economical lifespan of a building can be extended. Figure 47 below shows the course of the economical lifespan, and how investments like major maintenance and renovations can boost the revenues. When the revenues drop below the costs in the figure, the economical lifespan has ended.

![Economical Lifespan](image)

**Fig. 29: Schematisch verloop economische levensduur (Vijverberg, 2004).**

Figure 47, Schematic progress of costs and benefits (Vijverberg, 2004)

**Technical Lifespan**

The technical lifespan is the period of time where all the technical elements of a building, like the installations and the construction etc. function up to the standards and do not hinder the functional lifespan of the building. When a building deteriorates technically, this has an influence on the functional performance of the building. Investing in the building by conducting major maintenance or renovation can extend the technical lifespan.

The technical life cycle of an office building is 40 to 50 years (Zuidemal et al., 2010a). The technical lifespan of 50 years with offices outlives the current economical lifespan of around 10 years easily. The buildings are technically still meeting the demands of the users, however functionally a different building is required, or there is simply just no tenant due to the over supply which means no rental income and an end of the economical lifespan.

**Functional Lifespan**

The functional lifespan can be defined as the period of time that the building meets the demand and wishes of the user. When the building does not meet these demands anymore, the functional lifespan will end that will influence the economical lifespan. When this functional lifespan comes to an end actions are required. These are the different strategies for vacant buildings; doing nothing means there will be no tenant and no rental income, renovating can extend the functional lifespan and renew the rental income, transforming into a different function also requires an investment, or the building can be demolished ending its lifecycle for good.

Because the functional and therefore economical lifespan of office buildings is often ended long before the technical lifespan is over. This discrepancy between the different lifespans causes office buildings to be vacant, while technically they are still good enough to function as an office building. A structurally vacant that is functionally obsolete while the technical lifespan has not ended can possibly be transformed.

**8.8 Conclusion**

The NEN2699 norm categorizes all the costs and benefits for the entire life cycle of a building. It's therefore very useful as a method for this research. The DCF method is the most suitable method for calculating the future cash flows and making them present. This method will therefore be used with the NEN2699 norm. An important aspect when calculating the life cycle costs is the lifespan that is chosen for a building. The intervention strategy and lifespan influence the decisions that need to be taken. Finally the end value of the different intervention strategies will also have a large influence on the end results of the research. It's important that the decisions concerning the different methods, variables, etc. is well analysed as all these decisions will affect the course of this research and the final results.
Empirical Research
Part 3 | Empirical Research

This section covers the empirical research of the report. It’s the second part of the research that is started with end of January. In this part the interviews and case studies are discussed, followed by an elaboration on the results. These results will then serve as input for the LCC model. In one of the final chapters the LCC model is explained and tested to a test case. This section finishes with the conclusions and recommendations from the research.
9 Case Analysis
In this chapter the analysis of the case studies will be discussed.

9.1 Case Selection
As the planning in chapter 4.4 showed, the P3 period will start with the selection of cases. The case selection is very depended on the availability of cases from Maarsen Groep or within their connections. The availability of cost data and project specific information concerning the decision process will be the bottleneck for the cases. The selection criteria are among other:
- Specific period of office buildings
- Specific function change
- The availability of cost data
- The offices are non-characteristic offices (no monumental value etc.)

Examples of inspiring cases are the following five key projects below of the 'Dag van de Projectontwikkeling' on 23 may 2012. These cases show that also transformations of offices from the '60s period can be successful. The offices were out dated, but still had a good casco, oversize, freedom for choosing functions in the floor plan due to the column structure, and the ability to add another layer on top. Because of these factors, the financial feasibility studies were more favourable for transformation than demolition & new-build (Neprom, 2012). Since these financial feasibility comparisons with demolition & new-build are already available, these seem interesting cases to study and analyse the feasibility studies.

**De Studio**

![De Studio](image)

'De Studio' is a transformation project in Bos en Lommerplantsoen, Amsterdam. It was the former GAK-office and was built in the 1960’s. The building was transformed from offices to starters housing in 2011. The new building houses 330 student apartments as well as 2000 m² of commercial space. It was developed by AM and housing corporation Stadgenoot.

**Bomansplaats**

![Bomansplaats](image)
The former office ‘Bomansplaats’ in Bomansplaats Eindhoven was also built in the 60’s and transformed in 2011 to student housing. The transformation was carried out by Vissers & Roeland architecten & ingenieurs and Bouwbedrijf Hendriks Gemert b.v.. After the transformation is housed 91 apartments, 7 houses, and 20% independent units.

**Wilhelminastaete**

Figure 50, Wilhelminastaete (Neprom, 2012)

The ‘Wilhelminastaete’ building from 1979 in Diemen is the former Rabobank office. Rabo Vastgoed and Rappange & Partners transformed the building in 2007 to 43 lifecycle resistant sale apartments, 1,100 m² commercial space, and parking facilities.

**Belaastingkantoor Wageningen**

Figure 51, Belaastingkantoor Wageningen (Neprom, 2012)

The tax office in Wageningen was built in 1967. 4MAX Vastgoedontwikkelaar transformed the building in 2010-2011 to ‘t Blauwe Huys, 10 new large apartments, a penthouse, and plinth with a gym and an eye clinic.

**Coolsingel Rotterdam**

Figure 52, Coolsingel Rotterdam (Neprom, 2012)
The 20,000 m² of office space in the Coolsingel, Rotterdam, were transformed in 2012-2014 to retail, dwellings, hospitality, recreation, and offices. MAB Development, and Allies and Morrison Architects carried out the transformation.

Other interesting cases would be, where the decision for transformation, might have been different when looking back at the project. Reasons could be that costs were higher than expected in the construction and/or operating phase.

**9.2 Analysis**
In this part the cases are analysed, both quantitative on cost data and qualitative on the decisions made and aspects that influenced the process.

**9.3 Conclusions**
In this part the different cases are compared to each other and conclusions can be drawn from the analyses.

**9.4 Cost Data Input**
In this part the cost data gathered from the case analyses is transferred to useable input for the LCC model.
10 Interviews
In chapter 10 the interviews and the corresponding results and conclusions will be discussed.
11 LCC Model
In this chapter the building of the model, using of the key figures and cost data from the case studies, validating of the model, and the test case will be explained.

11.1 Explanation Model
In this part the functioning of the LCC model is explained.

11.2 Applying Data
In this part the cost data from the case studies and the key figures are applied to the model.

11.3 Test Case
In this part the model is tested with the help of a pilot case and consequently validated by the help of an expert panel.

11.4 Sensitivity Analysis/ Monte Carlo
In this part the type of sensitivity analysis or application of Monte Carlo simulation will need to be explained.

“De uitkomsten van de simulatie geven namelijk geen helder afgebakende keuzemogelijkheden, maar inzicht in de uitkomsten zodat de besluitvormer een mening kan vormen over de risico’s van het project (ook wel een prescriptieve analyse genoemd).” (Veen, 2012) This would mean the Monte Carlo simulation is not suitable as a decision model.

This would mean the Monte Carlo is suitable as a decision model:
“Ook kan de Monte Carlo simulatie de keuze tussen meerdere herontwikkelings varianten van een project vereenvoudigen doordat rendementen en risico’s naast elkaar kunnen worden gezet”(Veen, 2012)

11.5 Steps Model
In this part the steps of the LCC model are described.

Pareto 80-20 (zoals bij Schmidt, Op aanraden van Hilde)
“Pareto principe Welke methode je ook gebruikt, punten toekenning of klasse indeling van kans en gevolg, het resultaat zal waarschijnlijk zijn dat er uit bijvoorbeeld honderd geïdentificeerde risico’s een short list rollt met de belangrijkste risico’s. Het Pareto principe zegt heel eenvoudig dat van de 100 risico’s er 20 zeer belangrijk zijn. Het Pareto principe, ook wel 80-20 regel genoemd, is een economische regel die opgesteld werd door Vilfredo Pareto in 1906. Hij stelde vast dat tachtig procent van de bezittingen in Italië in handen was van twintig procent van de Italiaanse bevolking. Deze regel is door Joseph Juran veralgemeend, en hij ontdekte dat de 80-20 verhouding op heel veel aspecten toepasbaar is. De veralgemeende regel beschrijft dat tachtig procent van de uitkomsten veroorzaakt worden door twintig procent van de oorzaken. In het geval van de laatste stelling zou voor oorzaken dus ook opgetreden risico kunnen worden gelezen. Van honderd geïdentificeerde risico’s zou dit betekenen dat tachtig procent van het totale gevolg van opgetreden risico’s wordt veroorzaakt door een twintigtal risico’s. De beheersing van risico’s focust zich in eerste instantie op de risico’s met groot gevolg en grote kans van optreden. Voor de verschillende combinaties van gevolg klasse en kans klasse zijn methoden ontwikkeld om deze risico’s te beheersen, zie bijlage C.” (Huysmans, 2011)
12 Conclusion & Recommendations

The final chapter will include the conclusions from the research and results. The research ends with recommendations for Maarsen Groep and follow up research.
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Appendices

Interviews

Interview Nieuw Holland: Dennis van den Broek

Hoe wordt bij een leegstaand pand de keuze voor een bepaalde interventie optie gemaakt?
Toen ze begonnen in 2006, was er altijd wel vraag naar iets. Ze zijn begonnen met transformaties omdat nieuwbouw projecten te duur waren om in te stappen. Ze zochten gewoon een leeg pand uit en verzonnen er iets voor. Deze tijden zijn veranderd. Er moet nu specifieke vraag zijn en je moet er een huurder bij hebben als je iets gaat bouwen.

Bij Retail werkt het anders, daar vragen we aan klanten of ze geïnteresseerd zouden zijn. Bij kantoren werkt dit anders.

Welke aspecten hebben een grote invloed op die keuze?
Vooral marktvraag. De keuze is voor Nieuw Holland helemaal geen optie.

Wanneer in het proces wordt die keuze gemaakt?
-

Wordt daarbij alleen gekeken naar de investering periode?
Ja

Wat zou het nut/effect zijn van het toevoegen van de exploitatie periode?

Bij kantoren is de exploitatie periode veel belangrijker dan bij winkels. Zij merken ook de trend dat eigenaren en huurders liever een energiezuinig gebouw willen.

Heb je er als ontwikkelaar iets aan om meer inzicht te hebben in de exploitatieperiode? (ivm vaststellen rendement voor belegger, en niet alleen de eerste gebruiker)
Beleggers hebben strengere eisen vergeleken met vroeger. Als ontwikkelaar moet je aan kunnen tonen dat een gebouw goed presteert.

Zouden ontwikkelklaars of ontwikkelende beleggers iets hebben aan een model waarmee je deze opties kan vergelijken?
-

Wat zien jullie als de kosten of nadelen van transformatie?

Wat zien jullie als de baten of voordelen van transformatie?
Als het een bijzonder gebouw is. Scheelt gezelik met buren

Wat zien jullie als de kosten of nadelen van Sloop & nieuwbouw?
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Wat zien jullie als de baten of voordelen van Sloop & nieuwbouw?
Alle maten zijn in het werk na te meten.

Kunnen bestaande kantoren worden getransformeerd naar een even efficiënt gebouw als nieuwe gebouwen?
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Interview Nieuw Holland: Dennis van den Broek:

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-
Interview Maarsen Groep: Gerard Kohsie & Ton Boon

Hoe wordt bij een leegstaand pand de keuze voor een bepaalde interventie optie gemaakt? (sloop/transformatie, alleen financiële haalbaarheid?, onderbuik gevoel, etc.) Welke informatie is hiervoor nodig?

Wordt deze keuze wel genoeg onderbouwd?

Welke aspecten hebben een grote invloed op die keuze?

Wanneer in het proces wordt die keuze gemaakt?

Wordt daarbij alleen gekeken naar de investering periode?

Wat zou het nut/effect zijn van het toevogen van de exploitatie periode?

Heb je er als ontwikkelaar iets aan om meer inzicht te hebben in de exploitatieperiode? (ivm vaststellen rendement voor belegger?, en niet alleen de eerste gebruiker)

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Kunnen bestaande kantoren worden getransformeerd naar een even efficiënt gebouw als nieuwe gebouwen?
Interview Office Up: Roderik Mackay

_Hoe wordt bij een leegstaand pand de keuze voor een bepaalde interventie optie gemaakt? (sloop/transformatie, alleen financiële haalbaarheid?, onderbuik gevoel, etc.) Welke informatie is hiervoor nodig?_  
Let op 2 punten: efficiency + mate hergebruik. FSI lager dan 70/75% dan is het niet haalbaar. Er wordt altijd uitgegaan van een worst case scenario (alleen casco behouden).

Iedereen die gaat transformeren heeft deze beslissing gemaakt, zorg dat je deze informatie van cases verzameld. En omgekeerd, partijen die ervoor hebben gekozen om niet te transformeren, en waarom niet?

_Welke aspecten hebben een grote invloed op die keuze?_
- Risico van opnamen (markt vraag)
- efficiency
- mate van hergebruik
- afzetbaarheid markt (type woningen)
- initiatief fase (welke afweging maakt ontwikkelaar, kosten baten, scenario op risico)

_Opmerkingen:_

Bestaat de ontwikkelaar nog wel? Wat is de nieuwe positie van de ontwikkelaar? Dit zou bijvoorbeeld kunnen: focus op de langere termijn, mbt behartigen belangen van beleggers