INFLUENCES IN TRANSFORMATION PROJECTS

An investigation into the factors that influence the performances of a transformation process of building projects.

Mesut Yilmaz Bozkurt

Delft University of Technology
Construction Management & Engineering

21-05-2018

[Confidential version]

INFLUENCES IN TRANSFORMATION PROJECTS

An investigation into the factors that influence the performances of a transformation process of building projects.

Mesut Yilmaz Bozkurt
4245571

Master of Science Thesis
Construction Management & Engineering (CME)

Delft University of Technology
Faculty of Civil Engineering and Geoscience
Construction Management and Engineering

CREATORS

Consortium: Ballast Nedam, Strukton and Facilicom

Graduation Committee

Chairman: Prof.ir. A.Q.C. van der Horst
Faculty: Civil Engineering and Geoscience
Section: Construction Technology of Civil Engineering Structures

First supervisor: Ing. P. de Jong
Faculty: Architecture and the Built Environment
Section: Design and Construction Management

Second supervisor: Dr.ir. H.M. Jonkers
Faculty: Civil Engineering and Geoscience
Section: Materials and Environment

External supervisor: Ir. P.F. Brittijn
Function: Deputy Director Realisation
Company: Ballast Nedam Construction

External supervisor: Ir. P. Eitjes
Function: Senior Process Manager
Company: Rijksvastgoedbedrijf

PREFACE

This document is the final part of my two-year MSc degree Construction Management and Engineering at the Technical University of Delft. The research has been performed for the construction company Ballast Nedam. This document also symbolises the end of a chapter and the beginning of a new chapter in both of my professional career and personal life. The past year has been a busy year with ups and downs but despite that I can finally present my final work.

Before I continue I would like to take the opportunity to thank some people that have supported and contributed to this thesis.

First, I would like to thank my committee members Aad van der Horst, Peter de Jong and Henk Jonkers for their supervision and feedback during the process for almost a year. The meetings provided me with necessary feedback that helped me to keep moving forward with the process. Their input and guidance was essential for this research and I am deeply grateful for that.

Secondly, I would like to thank Piet Brittijn and Peter Eitjes for providing me the opportunity for conducting this research and getting valuable sources of information. I would also like to thank all the interviewees and participants providing me with all the necessary information. It was a real pleasure speaking with you all and to learn from you.

At last I would like to thank my family especially my father and mother for their support and advice during the process and my lovely wife Ceylan who supported and believed in me during this process and at last my new born son Milan who motivated me to finish my report.

Mesut Yilmaz Bozkurt

The Hague, 2018

SUMMARY

The government of the Netherlands stimulates the transformation of old office buildings. However, they don't see the difficulties that the structure of the buildings creates during construction. This influences the project performance time, money and quality of the project. To understand if a building can be transformed considerations must be made about the structure.

The goal of this research is to give insight in the factors that influence the project performance of transformation projects of office buildings, so that future transformation projects can be checked upfront it the building is appropriate to transform. To achieve this goal the following research question is made:

Which factors influence the project performances of a transformation process of office buildings and should be considered in future projects?

To provide a deeper understanding and to help answer the research question, sub questions have been made which are:

1. *What are the factors that Influence the transformation of office buildings according to the literature?*
2. *What is the transformation process of office buildings according to the literature?*
3. *What are the project performance of transformation of office buildings according to the literature?*
4. *What are the factors that influence the project performance according to the cases?*
5. *Which factors should be considered in future transformation projects of office buildings?*

To answer the research question, a qualitative research is performed wherein a theoretical analysis and an empirical analysis in the form of a case study is executed. In the theoretical analysis three main sections are described were in chapter 2.1 the two process models are elaborated and compared with each other. One model is the Transformation process model of Van der Horst (2018) which focusses on the building process from a contractors scope. The other model is the Designing an accommodation strategy framework of De Jonge, et al. (2009) which in his turn focusses on the transition process of a building from a developers scope. In section 2.2 the eloboration on the technical factors is made which have an influence on the performances of a transformation of a building project. These factors are technical quality, sustainable quality, functional quality, architectonical quality and project complexity and in the last section of the literature study the eloboration is made on the project performances pillars cost, time and quality.

In the emperical study two cases are analysed on the base of the previous literature study. The first case is De Knoop in Utrecht which was a former military office of the Ministery of Defence build in 1986. This office is transformed into a new governmental office under a DBFMO contract werein the tax department of the Netherlands is going to house. During the transformation a lot of unforseen cost were made which hit the budget of the project hard. To compare this project with another project the second case is analysed which is ASR verzekering and is also located in Utrecht and is build in 1974. The board of directors of ASR verzekering has decided to transform the building because the building was very outdated and had a high energy consumption. The building is transformed under a Engineer and Build contract. During the transformation this project had also unforseen circumstances which hit the project performances enormously. In the cross case analysis the the two projects are compared with eachother and gave a lot of clarification about the differences and simmilarities. From the result of the noncompliance analysis project De Knoop which fell under a DBFMO contract the contractor had a lot more risk to bear due to the contract. While the second case ASR verzekering fell under an Engineer an Build contract, the risk for the contractor was much less due to the fact that the contractor involved in the project after the preliminary design, hereby a part of the risk were beared by the client.

From the answer on the research question it became clear that all the transformation factors have a certain degree of influence on the project performances cost, time and quality. But one factor stood out above the rest

of the factors, this was the factor functional quality. This factor relates to the function that the new building is going to have and the installations needed for this function. The factor is far more difficult than in new building projects due to the existing construction wherein the new installations must be integrated.

On the base of these findings recommendations are given for the contractor. The first recommendation is about the preliminary investigation of the project. It is of the utmost importance that the building that is going to be transformed is pre-investigated whereby many aspects of the building become clear. On the base of the risk analysis the building can be checked about witch risks can happen in the transformation project. The most important risks are named below:

Risk No.	Risk
1.	Wrong assumptions made in the construction
2.	Settlements in the construction
3.	Bad foundation
4.	Corrosion in the construction
5.	Insufficient bearing capacity of the construction
6.	Low floor ceiling height
7.	Insufficient accessibility possibilities for the new building
8.	Insufficient Expansion possibilities for the new building

The second recommendation that is given is about the level of experience of the contractors. From the findings it became clear that project leaders are missing the experience to perform a transformation project. Therefor it is recommended that contractors invest in trainings about transformation project or hire experienced people to execute the project.

According to the findings the DBFMO contract is misunderstood in building projects and therefor this recommendation is given. The project wherein a DBFMO contract is used is approached like a traditional contract. It is a basic rule in a DBFMO process that the all the parties work integrally together. So that when the architect makes a wrong step in the structural part he should then be warned on time by the constructor.

The last recommendation that is given for the contractor is about the integration of the new installation in the existing building. Already in the tender phase the actors responsible for this must work integrally together, a misstep of the actors can have major influence for the other actor and for the performances of the project. A system engineering process is recommend that can be followed in the tender phase that shows step by step how to select and perform the integration of the new installations in the figure below this process is given. Finally, possible follow-up research could focus on conducting the research with more transformation cases, conducting a quantitative research method or minimize down the problem by focusing on just one particular part of this research would provide more accurate and certain answers.

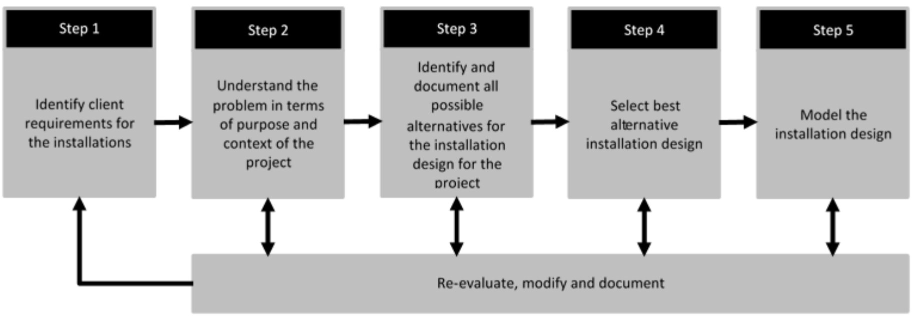


Table of contents

LIST OF FIGURES

List of tables

PART 1: INTRODUCTION

Companies which are moving from an old office to an office on a more favourable location with better facilities are leaving behind a building that is hard to rent. Instead of demolishing and building a new office on this location, there is also the option to transform the building (Van der Voordt T. , 2007). Transformation has a variation of definitions, according to Transformatieadvies (2018) transformation means change of the physical appearance. Transformation has two different ways, one is the transformation wherein the current function is preserved and the other way is the transformation wherein the function is changed into another function. The most common herein is the function of an office that is changed into houses. In the period between 2011-2015 almost 26.000 houses are realised due to transformations (Centraal bureau voor de statistiek, 2018). Some succesful transformation of buildings are shown in Figure 1.

Won the architecture price called the Berlagevlag

Positive financial endresult, with airshafts on the facade of the building

FIGURE 1: LEFT WIJNHAVENKWARTIER (LBP SIGHT, 2018) RIGHT DE STADHOUDER (FUNDA, 2018)

Despite these succesfull transformations there are still transformations which are hard to peform. In the current situation just like in the case of the construction company Ballast Nedam. This company has won the procurement of the governmental body Rijksvastgoedbedrijf in a consortium with the companies Strukton and Facilicom, wherein Ballast Nedam is responsible for the construction. The project in this case is the former military office of the Ministery of Defense De Knoop in the city of Utrecht. This building was vacant for a while till the Government decided to give a second life to the building and to transform it into a governmental office. During the transformation process of the building there were unforseeen circumstances which cost the consortium a lot of money. For Ballast Nedam it is unclear upfront what the factors are that can influence the project performances (cost, time and quality).

The proces of a transformation project has similarities with a process of a new building project. In both cases there is a initiation phase, preperationphase, designphase and executionphase. But there are also differences. A transformation project is more complex then a new building project because a existing building has specific boundary conditions wherein the transformation has to be performed. This enlarges the chance for unforseen circumstances, it makes the transformation more difficult then a new building project. In a new building project it starts all with a blank sheet of paper (Andriessen, 2007).

Managing such a project goes not wihtout managingaspects which is called the project performances in this document. The general used method for analysing construction projects comes down on the three project performance pillars of time, cost and quality. These are well known in the construction industry and are related with eachother (Burtonshaw-Gunn, 2009). The performance quality refers to the quality of the end result of the project, wherein the result is tangible. The second performance cost is always a derative of quality and time in this case. The decissions made about costs has always consequences for the other two performances. Dependent on the sort of project, costs can have a more or less important role. Time the last project performance in this document has a strong relation with cost and has an large parallel between timecontrol and costcontrol. The activities in timecontrol exists out of planning activities, monitoring and adjusting activities (Wamelink, 2010).

Factors that play a role in the transformation of a building are the following factors (Van Doorn, Heintz, & Volker, 2010):

- Technical quality
- Sustainable quality
- Functional quality
- Architectonical quality
- Project complexity

Practice shows that there are still problems when a transformation of a building is executed. Developers experience it as a surprise when the project performances are affected. They notice the factors that influence the performances to late whereby the damage has already done his work. The impact of these factors is hard to predict (Van der Voordt T. , 2007).

To improve the current situation, construction companies and developers wants to know what the factors are that can influence the project performances so that they can decide upfront if the building is appropriate to transform.

1.1 Research problem

When transformation projects of office buildings are being executed it is unclear upfront what the factors are that influence the project performances. Developers don't have a consistent answer yet to analyse if the office building is appropriate to transform. It is therefore important to consider the factors that influence the project performance before starting the project.

The problem statement for this thesis is defined as:

In transformation projects of office buildings, it is unclear upfront what the factors are that influence the project performance. Developers start a project without the consideration of factors that can influence these performances.

1.2 Research goal

The aim of this research is to give insight in the factors that influence the project performance of transformation projects of office buildings. So that possible projects can be analysed upfront to check if the office building is appropriate to transform. This is done by exploring the literature about factors that influences the transformation of office buildings, the project performances of transformations of office buildings and analyse real life cases of office buildings whereby a transformation is executed.

1.3 Research model

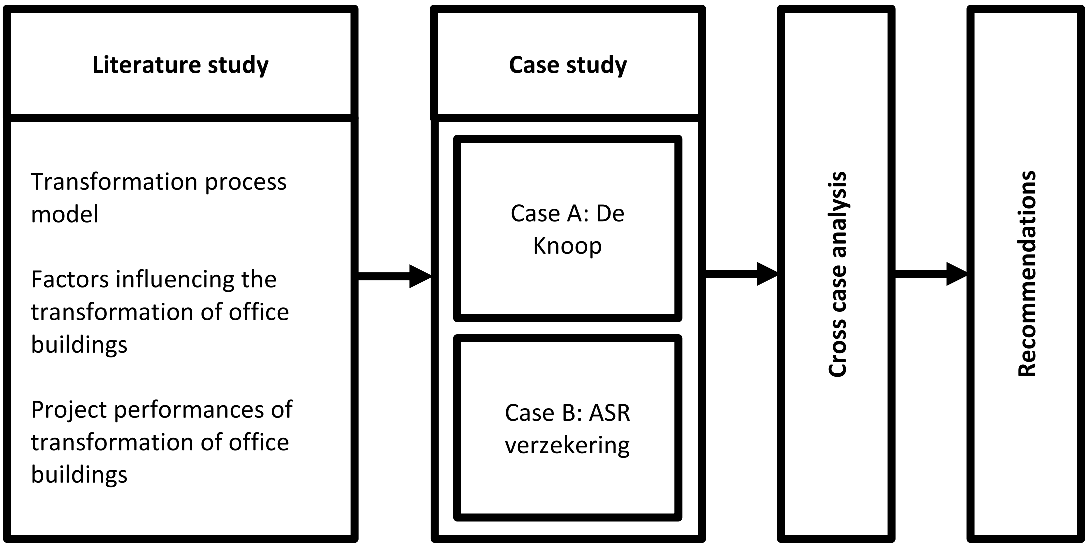


FIGURE 2: RESEARCH MODEL (OWN ILLUSTERATION)

1.4 Research question

Which factors influence the project performances of a transformation process of office buildings and should be considered in future projects?

Sub questions

1. What are the factors that Influence the transformation of office buildings according to the literature?
2. What is the transformation process of office buildings according to the literature?
3. What are the project performances of transformation of office buildings according to the literature?
4. What are the factors that influence the project performance according to the cases?
5. Which factors should be considered in future transformation projects of office buildings?

1.5 Research scope

To give an accurate answer to the research question, it is important to clearly define the scope of this research project. The focus of this research is on the factors that influence the project performance of transformation projects. It is obvious that there can be many factors that can have an influence on the project performances and there can also be many different performances. Therefore, the scope is limited to five factors that can influence the project performances of a building, which are:

- Technical quality
- Sustainable quality
- Functional quality
- Architectonical quality
- Project complexity

The project performances are limited by cost, time and quality. As stated in the research question the focus will only be on office buildings whereby a transformation is performed.

1.6 Reference

In this section the definitions of the factors are described which are named in the previous section scope and which are used in the entire document. This is done to ensure that the factors are not misunderstood.

Technical quality

Technical quality is the extent wherein the foundation, bearing construction, façade and the installations satisfy the technical demands in relations to strength, stability, sustainability and as less as possible maintenance (Van der Voordt & Van Wegen, 2000)

Sustainable quality

The factor sustainable quality can be explained on two ways. The first one stands for a long lifetime of a building which is called durability. The other one stands for a low environmental impact by developing and/or using the building and this is called sustainability (Van Doorn et al., 2010). In this document the focus is laid on the sustainability.

Functional quality

This quality factor is related to the usability of the building in practice. A building is always build on the base of the activities that must take place. For example, in an office building there must be an enough working place for the employees. In addition, every working place must have enough surface, daylight, fresh air and furniture. On the building level there must be thought of a bicycle storage, security, reception and toilets. At last the developers must take in account that the organisation can change whereby probably the building must change to (Duffy & Hannay, 1992)

Architectonical quality

Aesthetic is related to the beauty, spatial-visual quality and meaning of a building. Concepts as form, colour, texture, scale and light are on the agenda in this quality factor (Van Doorn et al., 2010).

Project complexity

In a study of Gidado and Millar in Akintoye (2000) project complexity is regarded as a factor that obstruct performance on site, including technical complexity of the task, amount of overlap and interdependencies in construction stages, project organization, site layout and unpredictability of work on site.

1.7 Research methodology

This section of the research document describes the outline of the research to provide an answer for the research question. This research started with the motivation of a former BSc research that is executed a few years ago wherein the practical side of a transformation project was executed. Now a step further a scientific research will be executed. In this section the steps are described that finally at the end give an answer to the research question:

Which factors influence the project performances of a transformation process of office buildings and should be considered in future projects?

To give an answer to this question the following steps have been conducted:

- Preliminary interviews
- Literature study
- Case study / in depth interviews
- Conclusion

PRELIMINARY INTERVIEWS

The research started with an investigation into the problems that exist during the transformation of buildings projects. When these problems were analysed preliminary interviews were held to go deeper in the problems of the certain cases. This method is chosen to get a view about how certain problems in a transformation project are rising and to understand what the effects of these problems are. These interviews are included in the appendix of this report and are also taken up as the background information of the cases. The following step is the literature study.

LITERATURE STUDY

This study is conducted to look into the existing literature about transformation projects of buildings. The literature study provides an assessment about how successful a transformation of a building project is. As a base in this study the transformation process model is used from Van der Horst (2018). This model shows how the transformation process of a building works. In the following chapter of the literature study the research will go deeper into the technical factors that can have an influence in the project performances. The last chapter in the literature study are the project performances which are the generally used method for analysing construction projects. these are performances time, cost and quality. After the literature study the case study is conducted.

CASE STUDY / IN DEPTH INTERVIEWS

The case study started with the selection of the cases. The first case was already selected which is De Knoop, this was also the one of the occasions of this research. On the base of the first case a second case is selected this became the project ASR. Both cases are executed by the contractor Ballast-Nedam division building projects. This division builds not every day project but are specialised in complex projects with special architecture, large size, hard-to-reach construction site or a construction site that is simply in use during construction. The selection criteria for these projects was that it must be a transformation of an office building with an already existing project. Due to limited time and the fact that two cases can already bring the necessary differences and similarities two cases are analysed.

The in depth interviews are executed with project leaders of the two projects and are selected on the base of their availability. The question is designed to give as deeply as possible answers about the factors that can influence the project performances. The interviewees are asked about the cause of these influences and the consequences. In the same time the noncompliance analysis is performed to go even further with the root cause problem. When the case study and the interviews was finished the conclusion is described.

1.8 CONCLUSION

This chapter describes the steps that must be taken to answer the research question. It starts with the introduction and the problem that this research faces and ends with the methodology about how this research is performed. The main aspect in this chapter is the research question wherefrom the rest of the research is based on. The result of this chapter is the methodology this section describes the steps of this research. It starts with the preliminary interviews which is followed by the literature study. The next point is the case study with the in depth interviews and at last it gives a conclusion for this research wherein the research question is answered.

PART 2: THEORETICAL ANALYSIS

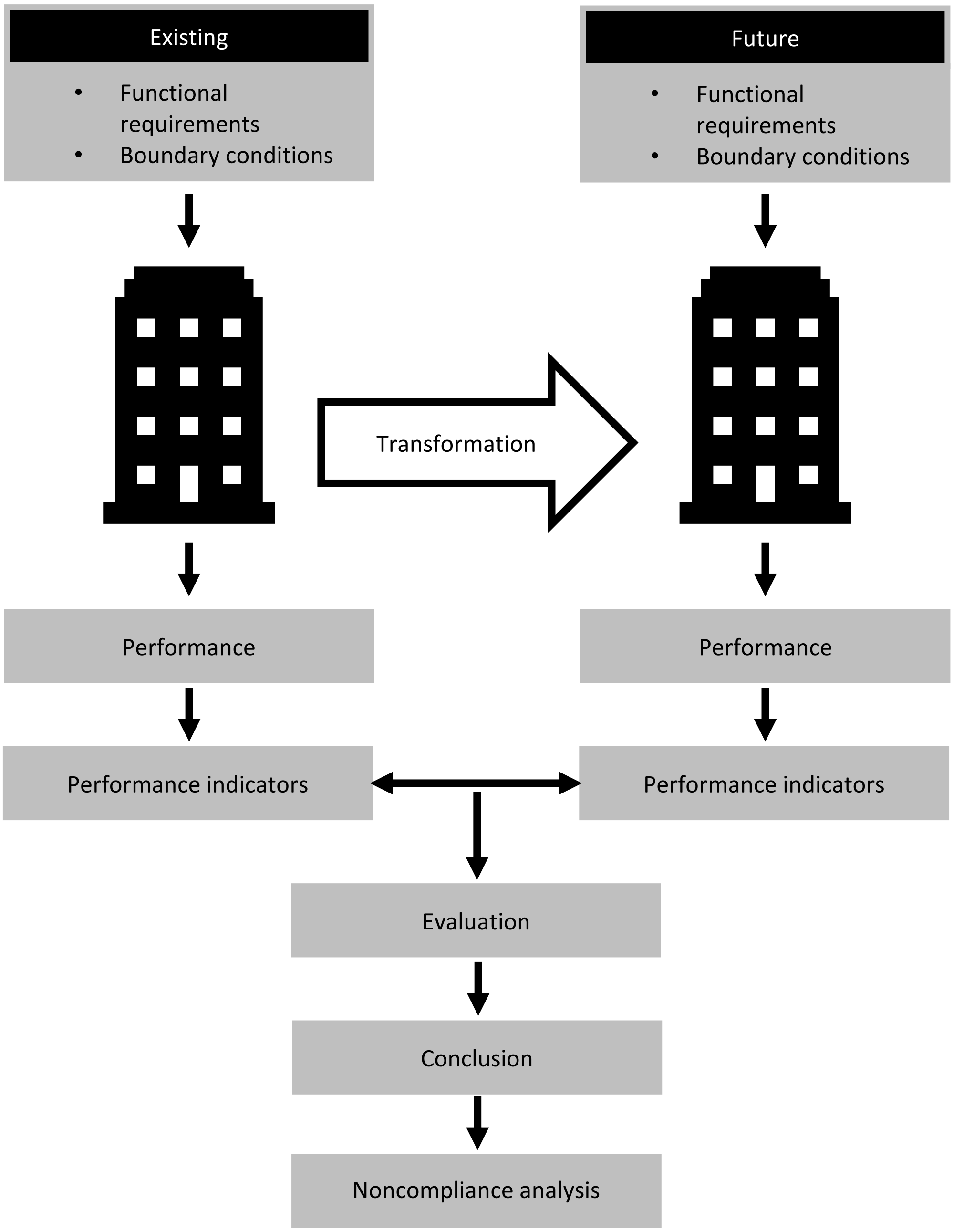
2.1 PROCESS MODEL

In this section the two different models are described and compared with each other on the aspects both models have in common.

TRANSFORMATION PROCESS MODEL

The transformation process model in Figure 3 of Van der Horst (2018) is a building process that can be used when there is an intention to develop an existing building into a building with new functions. The model describes the functional requirements and boundary conditions of the existing building and of the future building, which is the scope of the contractor. In this scope the building process must be realized. With these requirements and conditions, the transformation can be checked. The transformation focusses in this model on the technical factors. On the base of these factors the consideration can be made if the building is appropriate to transform.

FIGURE 3: TRANSFOMATION PROCESS MODEL (VAN DER HORST, 2018)



Both existing building and future building have a certain performance which relates to the project performances cost, time and quality. In turn these have a certain performance indicator which is again related to the transformation factors. These indicators show the degree of influence on the project performances. Which is then evaluated to describe how the transformation project is executed. After the evaluation a conclusion will follow about the case to summarize the complete project. At last the noncompliance analysis will follow. This analysis is a systematic approach to identify the root cause of a problem. This is executed by asking "why" and identifying the causes associated with each step towards the defined problem.

DESIGNING AN ACCOMMODATION STRATEGY (DAS) FRAMEWORK

The DAS framework (Figure 4) is based on a transition process that is iterative by nature and aims to find a match between demand and supply. It is a framework that is used by developers for different kind of real estate, at different levels and the reconciliation can be drawn up for different time checks. The framework has four reconciliation moments from which the strategy can be started (De Jonge, et al., 2009).

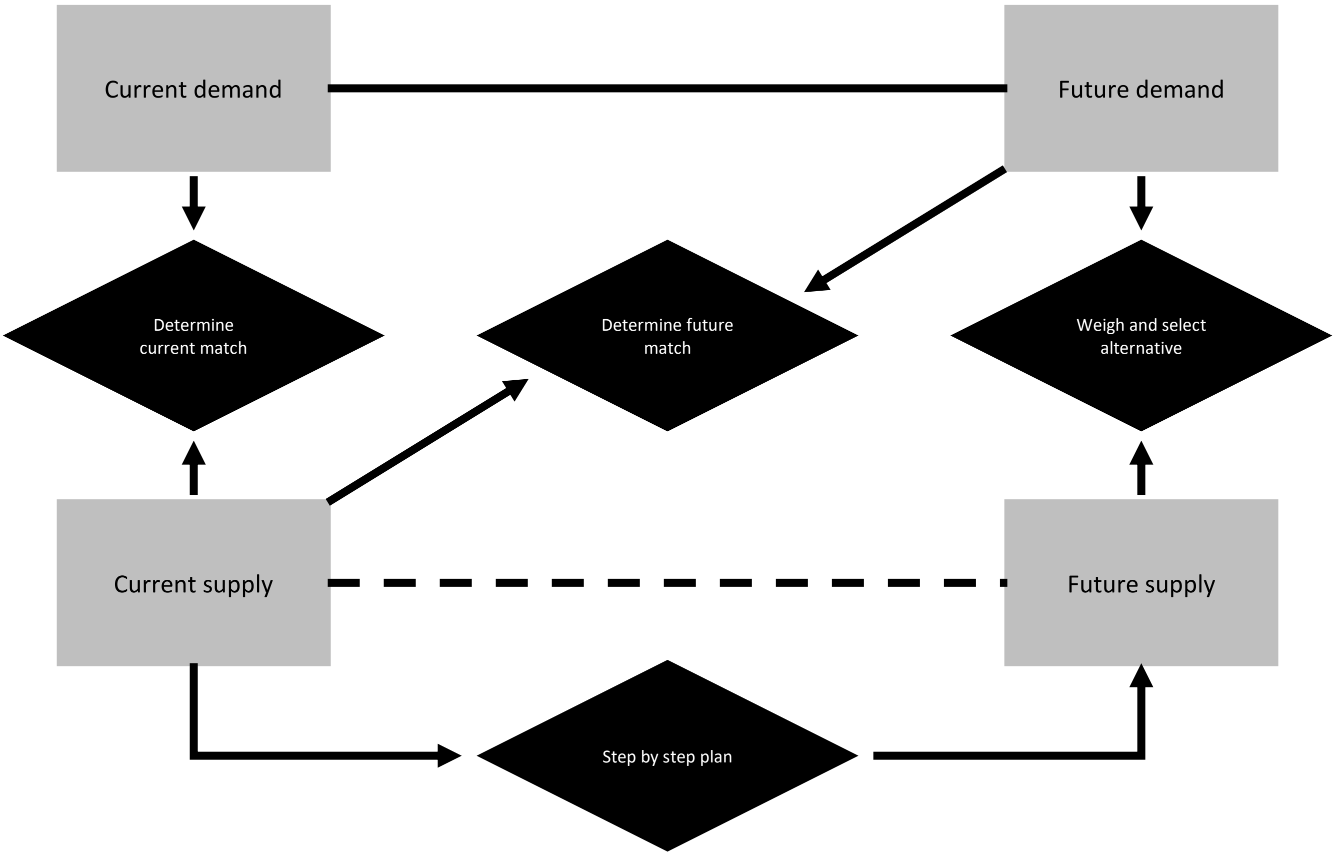


FIGURE 4: DESIGNING AN ACCOMMODATION STRATEGY (DE JONGE, ET AL., 2009)

Determine the current match between current demand and current supply

The main point in this step is to find out for all the stakeholder which problems they have and why they have these problems. The outcome of this step has a summary of all the problems that the stakeholders have related to the real estate.

Determine future match between current supply and future demand

In this step the current match and future supply is compared. Alterations in the company's ambitions and requirements for space is influenced by internal and external developments. An analysis of these alterations gives a qualitative and quantitative description of the organization future space requirements. These requirements are shown in minimum and maximum range and require a flexible solution to deal with the uncertainty in the future.

Weigh and select alternatives to bridge the mismatch

This step designs and weighs the alternatives which are designed according to the strategic assumptions. From the previous outcomes as an input the following questions are answered: what are possible solutions? and how can they be evaluated by all the stakeholders?

Transition of current supply into selected future supply

In this step the transition from the current supply into the future supply is displayed in a step by step plan on a timeline with a financial plan. The step by step plan describes the main changes to the portfolio and to the buildings.

COMPARING THE MODELS

By comparing the model Transformation process of Van der Horst (2018) by Designing an accommodation strategy of De Jonge, et al. (2009) the similarities can be seen between the models. Between these two models there are three remarkble aspect that resemble each other and are described below.

The first aspect is that both models have a existing building with future ideas. In the transformation process model this is the functional requirements and the boundary conditions of the existing building that go's thourgh a certain development to the futre building. This can be related to the current demand and future demand of the DAS framework. Here both models are checked about what the current building features are and what is expected in the new building. The next similarity in the models is of the DAS framework current supply and future supply herein a step by step plan is perfomed to perform the final result out of the strategy. This has agreements with the transformation of the transformation process model. In this part a certain feasibility is checked on the technical factors to transform the old building into a new building. The three diamonds in the middle of the DAS framework is the third aspect that determines the matches between the demand and supply in current time and in the future on the base of certain values that is important for the stakeholders like the quality and quantity of the supply. The transformation process model evaluates also the existing building and future building with each other on the base of the perfomance indicators that relates to the project peformances in cost, time and quality.

2.2 TRANSFORMATION FACTORS

This part of the theoretical analysis outlines the different factors that influence the transformation of office buildings into new offices.

TECHNICAL QUALITY

Technical quality is the extent wherein the foundation, bearing construction, façade and the installations satisfy the technical demands in relations to strength, stability, sustainability and as less as possible maintenance (Van der Voordt & Van Wegen, 2000). An important component of the technical quality is the physical quality. This is the extent wherein the building can create an attractive, safe and healthy indoor environment and preferably on a nature friendly and energy efficient way (Van Doorn et al., 2010).

Bearing construction

The construction type of a building will have a major impact on the feasibility of a transformation. Therefore, determining and understanding the form of a construction of a building is essential if a successful transformation is desired. In cases with modern buildings this is simple because the original drawings will be available at the owner or in the archives of the local authorities (Douglas, 2006).

According to (Kamerling & Kamerling, 2004) the skeleton of a building is composed out of vertical elements like columns, disks, walls and cores and elements like plates and beams. The floor and roof constructions are divided into two main groups. In the first group the bearing construction is carrying the load in one direction the other group is carrying the load in one or more directions.

The bearing construction that is carrying the load in one direction exists out of floor- and roof elements whose span is in one direction and the load is also worn out in one direction. The floor- and roof elements are supported with walls or columns and walls. For buildings that have the shape of a rectangle the following skeleton forms can be divided, see Figure 5 (Kamerling & Kamerling, 2004).

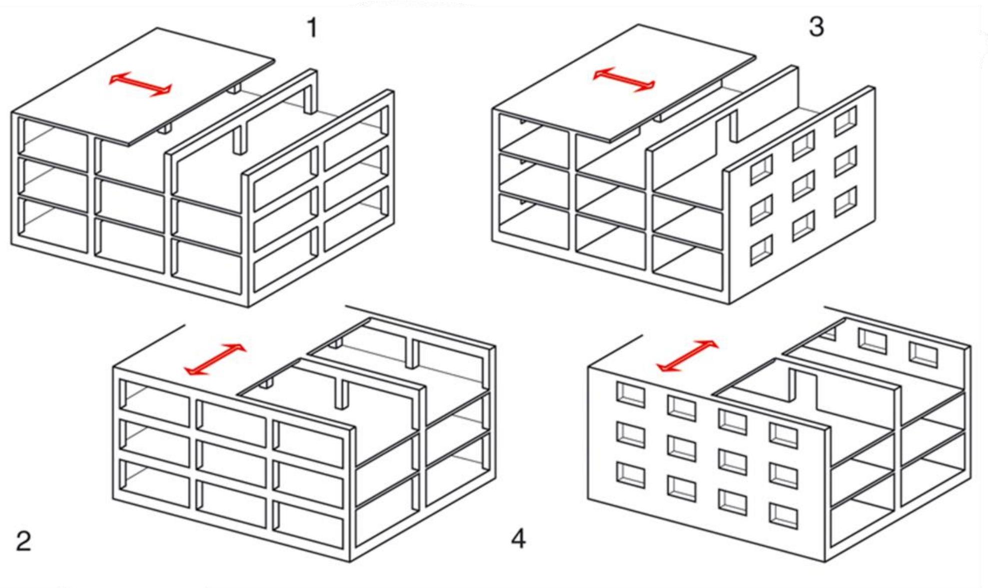


FIGURE 5: ONE DIRECTION BEARING CONSTRUCTION (KAMERLING & KAMERLING, 2004)

1. Column skeleton with cross beams
2. Column skeleton with side beams
3. Skeleton with cross walls
4. Skeleton with side walls

The second main group that is carrying the load in two or more direction exists also out of floor- and roof elements but it is supported by point shaped elements or supported by linear elements on each side. A linear supporting element exists out of columns and beams and the point shaped elements exists only out of columns. In this main group buildings that have the shape of a rectangle the following skeleton forms can be divided, see Figure 6 (Kamerling & Kamerling, 2004).

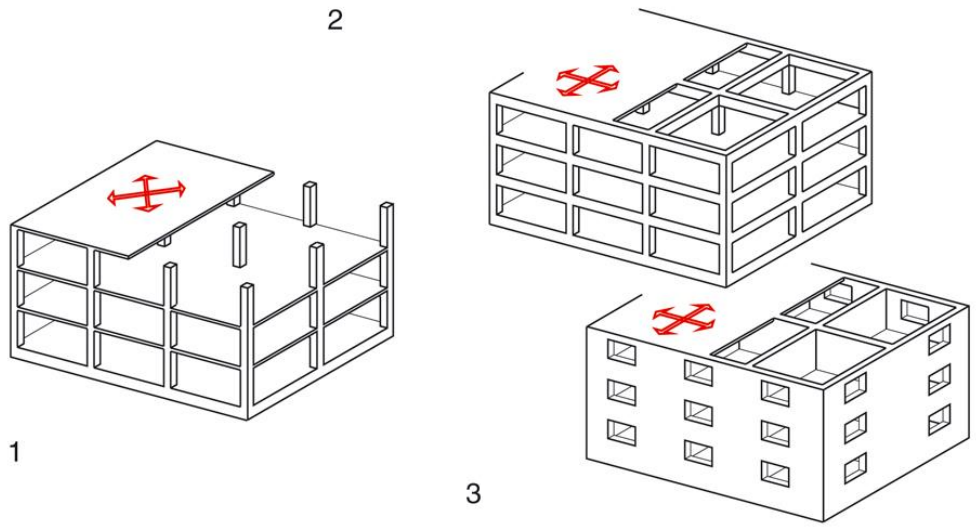


FIGURE 6: TWO DIRECTION BEARING CONSTRUCTION (KAMERLING & KAMERLING, 2004)

1. Column skeleton with point shaped supporting plates
2. Column skeleton with linear- and side beams
3. Column with linear- and side walls

The design of the bearing construction depends on the building type, in utility buildings there is large value for a flexible layout. The walls that are dividing the rooms can than not be a part of the bearing construction. The preference for a bearing construction is giving to a column skeleton, so that the layout can be changed in the future transformation projects (Kamerling & Kamerling, 2004).

The bearing construction has a primary task and belongs to the most permanent part of the building. In the same time this characteristic can make changes to the building easy or extremely hard to perform (Blok & Oudenaarden, 2007). According to Blok & Oudenaarden (2007) there are three elementary functions and characteristics of the bearing construction that has a direct influence on the transformation capacity of a building, which are: the independence of the construction, the bearing capacity and the space that the construction offers.

To judge the characteristics of the construction in more detail a simple building model (Figure 7) can be used. In this model the following building layers are divided Blok & Oudenaarden (2007):

1. Construction: columns, beams, carrying floors, foundation etc.
2. Building shell: façade, roof, separation between inside and outside
3. Installations: pipes, systems for energy, water etc.
4. Space plan: separation walls, doors, ceilings, establishment and finish
5. Access: stairs, elevators, corridors and galleries

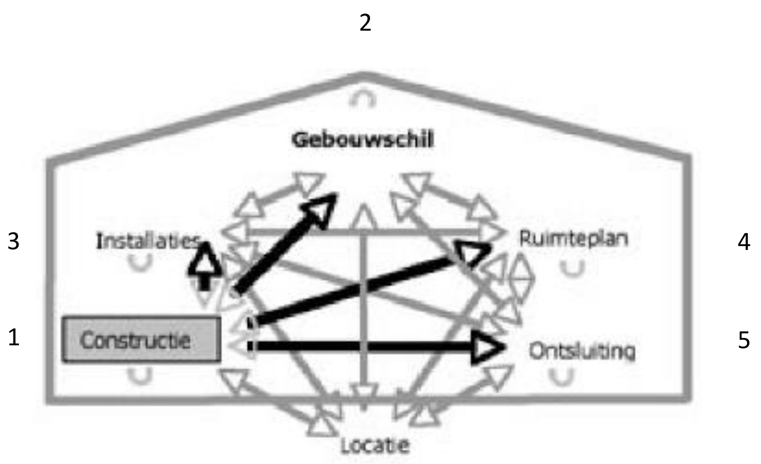


FIGURE 7: BUILDING MODEL WITH LAYERS (VAN DER VOORDT T. , 2007)

In this model the incoming arrows stand for the extend of active flexibility of the building layer. Active flexibility of the construction stands for the transformation capacity of the construction itself. The departing arrows stands for passive flexibility of the construction. This stands for the power to make changes to other building layers without changing the construction itself.

The characteristic independence relates to separation of functions of the construction with other building layers. Load carrying walls or load carrying dividing walls are combining the building layer construction and space plan and so it makes it much more complicated to make adaptions for example to the façade. The second characteristic is the bearing capacity. This characteristic determines the possibility to easy transform a building to a higher variable load. The possibilities to reposition the separation walls, changing the installations on floor or roofs, a new finishing layer of floors without removing the old one etc. depends on the bearing capacity of the construction. Space is the third characteristic. Sufficient flexible space makes it easy to make adaptions to other building layers. Enough surface is needed to change the building functions and to make a well access. Also, enough free height is needed for the functionality but also for the installations in the ceiling or under the floor. Thereby sufficient accessible vertical shaft space facilitates the possible adaptions to the installations (Blok & Oudenaarden, 2007).

Condition bearing construction

Deterioration and failure of the building construction and fabric are generally associated with one or a combination of the following three principal causes (Addleson in Douglas & Noy, 2005):

- Dampness
- Timber decay
- Cracking and subsidence

All building constructions are in some degree exposed to these major influences. The causes are few but the sources are many. This makes it hard to achieve a correct diagnosis without a thorough investigation. The process of diagnosing faults in the construction is not always simple, because of the few symptoms in the construction but with a wide range of causes and defects. In addition the precise trigger mechanism is not always apparent even if the cause is obvious. The same cause can have different mechanisms to trigger it. A bunch of these mechanisms working together can create a defect (Addleson in Douglas & Noy, 2005).

According to Massari in Douglas & Noy (2005) damp penetration is one of the most damaging failures that can occur whether the construction is old or new build. It can damage the construction by saturating it (Trotman et al. in Douglas & Noy (2005). When a construction is build there is made use of a lot of water. It is estimated that a avarage house will contain a tonne of water in the brickwork alone. Some of this water will vaporize before the house is occupied. However most of the water used in the constructional process will dryout slowly. The ground around the foundation of a construction is always damp, moisture infiltrates into the construction unless a dampproof course is provided above ground level the moisture will rise causing dampness to walls and floors.

FIGURE 8: CORROSION OF CONSTRUCTION (DE BETON GROEP N.V., 2018)

Foundations of the construction can move over time because of load applied causing downward movement known as settlement. Settlement can be tolerated by the construction if they do not exceed the allowable bearing pressure. Other possible causes of foundation movement known as subsidence caused by activity in the ground are:

- Soil erosion caused by flowing water
- Changes in ground water level
- Buildings on made up ground
- Movement associated with mining activities
- Movement due to shrinkage or swelling of clay soils (this is the most common cause of foundation movement)
- Uneven bearing capacities of differing subsoils

Foundation repairs to existing constructions of buildings are generally the most difficult and costly to effect, which is a good reason for a thorough investigations.

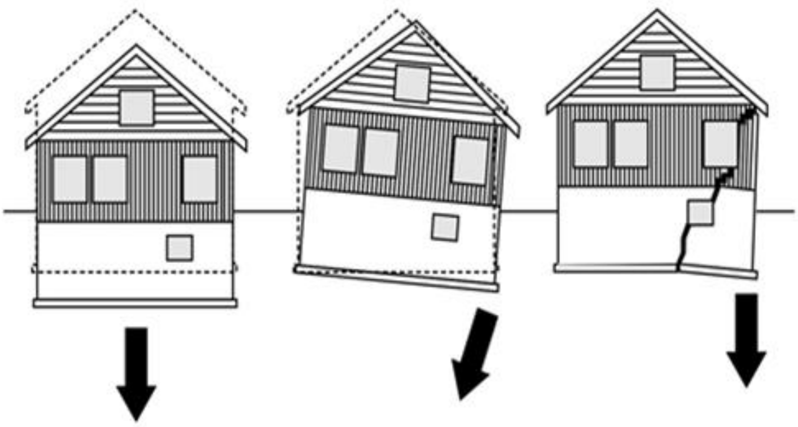


FIGURE 9: FOUNDATION SETTLEMENTS (PREETHAMBUILDERS, 2017)

Sustainable quality

The factor sustainable quality can be explained on two ways. The first one stands for a long lifetime of a building what is called durability. The other one stands for a low environmental impact by developing and/or using the building and this is called sustainability (Van Doorn et al., 2010).

With sustainable quality the focus is often laid on the technical value. It is then expressed in the form of a saving on the energy use of the CO2 emissions. Sustainability is next to the technical value also related to a spatial or esthetical value. This comes due to that clients want a sustainable image of the property next to the improvement of the energy performance of buildings. At last sustainable quality can also be coupled with the use value of a building. The health and well-being of the user is then the core of the sustainability ambition (Van Doorn et al., 2010).

Functional quality

This quality factor is related to the usability of the building in practice. A building is always build on the base of the activities that must take place. For example, in an office building there must be an enough working place for the employees. In addition, every working place must have enough surface, daylight, fresh air and furniture. On the building level there must be thought of a bicycle storage, security, reception and toilets. At last the developers must take in account that the organisation can change whereby probably the building must change to (Duffy & Hannay, 1992).

Installations

Installations have an important role in transformation projects due to the changing demands of the functionality and capacity and the large influence on the needed budget for the transformation. In transformation projects this part is larger than in new building projects. The process of adaption and new renewal of installations proceeds in various steps. A well-considered decision and evaluation of alternatives is essential to come to a good integral design. So that during the design of the building the installations, the construction of the building and the assembly of the existing situation can be taken into account (Zeiler, 2007).

According to the conceptual layout of Zeiler (2007) three kinds of installations are divided, which are central installations, installations for the distribution of warm, cold and fresh air and installations for the diffusion of warm, cold and fresh air in the certain space.

In the different installations, three possible subsystems can be divided: induce, distribution and release. Insight in these subsystem is important for the functions, mode of operation, design and structural preconditions. It gives the context without going to deep into the components of the subsystems. The following step is to determine what the needed space is to put these installations in the building. Installations from the subsystem induce are put in the technical room of the building and the subsystem release is often put in the room itself. In practice the subsystem distribution has the most far reaching consequences for the structure of the building. Warm, cold and fresh air is transported and distributed through pipes or air channels. For the horizontal transport it goes through lowered ceilings or raised floors. For the vertical transport it makes use of shafts. It is important that there is extra attention if designers make use of lowered ceilings or raised floors from the viewpoint of the construction rules in the according to the Dutch building regulations (Bouwbesluit) (Zeiler, 2007).

There are many ways to design the installation in the building, therefore it is important to make well considered decisions. In practice this goes not without problems because the costs are only a boundary condition in the initial phase of the design. Since the most important decisions are made in the start of a project, it is of great importance that the evaluation support is made on the base of scarce existing information. Such an evaluation can help to eliminate certain installation alternatives, so that it doesn't go to the next design phase wherein the integration of the building and the installations are going to be discussed. In this phase the installation decision is going to be made whereby the building alternatives are considered (Zeiler, 2007).

According to Zeiler (2007) in building transformations whereby a comparable function is demanded in relation to the installations, retaining and slightly adapting of the existing installation is possible. This is complete different with far reaching adaptions of the functionality.

In transformation projects the focus is primairy on the visiual exterior and interior. In practice often happens that the attention for technical installations is to late, while this is in these kind of projects more determinant then new building projects. For example when large adaptions are performed to give a building more windows from the architectural viewpoint it can have large consequences for the installations. In the building process there are many different parties and diciplines involved. The separate building parts and systems are developed independent of eachother, while a integral approach is necessary. In a integral approach the application of level-thinking is primary. The fysical parts of a building and the decisionmoments in the building process can be ordered in to different levels. This serves as the base for the analysis of the building and the installations (Zeiler, 2007).

Architectonical quality

Aesthetic is related to the beauty, spatial-visual quality and meaning of a building. Concepts as form, colour, texture, scale and light are on the agenda in this quality factor. Some designers believe that a building or a collection of buildings can communicate a story or message (Van Doorn et al., 2010). Therefore Johnson (1994) states that a division can be made between the extent that a building is beautiful and the message that the building brings over about the established organization in the building.

Project complexity

Construction projects are dynamic in nature due to various reasons, which are the increasing uncertainties in technology, budgets and development processes. It is also the fact that building projects are becoming much more complex and difficult to construct what leads to that project team faces unprecedented changes (Chan, Chan, & Scott, 2004). Construction projects are a unique object, accommodating different designs, sites and construction methods. All of them have different characteristics influencing how the project is initiated, designed, organized and managed and finally the outcome of the finished product (Akinsola, Harris, Ndekugri, & Potts, 1997). In a study of Gidado and Millar in Akintoye (2000) project complexity is regarded as a factor that obstruct performance on site, including technical complexity of the task, amount of overlap and interdependencies in construction stages, project organization, site layout and unpredictability of work on site. It is also considered that project complexity affects contract duration and consequently the construction costs. Overall the construction industry is considered underperformed compared to other industries (Saraf, 2015). The reason for this poor performance is the design and construction processes being particularly complex (Gidado & Wood, 2008).

Complexity is hard to define because it has many different notations. In the Collins English Dictionary in a study of Gidado & Wood (2008) complexity is defined as the state or quality of being intricate or complex, where complex is defined as made up of many interconnecting parts. In general construction projects exists out of many interconnecting parts. Its also one of the reasons why the construction process is one of the most complex and risky bussinesses undertaken (Gidado & Wood, 2008). According to Baccarini in Gidado & Wood (2008, p. 4) project complexity can be defined as “consisting of many varied interrelated parts and can be operationalised in terms of differentiation and interdependency”. He also explains that the definition can be applied on any project dimension relevant to the project management process, such as organisation, technology, environment, information, decision making and systems, it is therefore important to state clearly the type of complexity being dealt with. In a number of interviews by Gidado in Gidado & Wood (2008) he presents the views of experts in the building industry to see what they condier as a complex project. the following answers where given:

- That having a large number of different systems that need to be put together and/or that with a large number of interfaces between elements;

- When a project involves construction work on a confined site with access difficulty and requiring many trades to work in close proximity and at the same time;
- That with a great deal of intricacy which is difficult to specify clearly how to achieve a desired goal or how long it would take;
- That which requires a lot of details about how it should be executed;
- That which requires efficient coordinating, control and monitoring from start to finish;
- That which requires a logical link because a complex project usually encounters a series of revisions during construction and without interrelationships between activities it becomes very difficult to successfully update the programme in the most efficient manner.

According to these results Gidado in Gidado & Wood (2008) says that there are two perspectives of project complexity in the industry, which are:

1. The managerial perspective, which involves the planning of bringing toghether numerous parts of work to from work flow.
2. The operative and technological perspective, which involves the technical intricacies or difficulties of executing individual pieces of work.

Gidado in Gidado & Wood (2008) defines project complexity as the measure of executing a complex production process. According to Gidado in Gidado & Wood (2008) project complexity has six main components, which are:

- Organisational complexity
- Uncertainty
- Inherent complexity
- Overlap of construction elements
- Rigidity of sequence
- Number of trades

Relating to the bearing construction Flapper (2004) notes in his book that a construction project is complex when the bearing construction deviates from normal usual construction.

According to Gidado & Wood (2008) it is important to understand that one these components alone contribute to a complex project but the greatest effect is experienced in a combination of these components. It is easy to understand that when organisational complexity arises it can be manageble, however when this is coupled with uncertainty the project becomes much more complex. When performing a project in practice it is unlikely that only one of these components will encounter and therefore it is important to understand where the complexity comes from and the combinations of these components is of key importance to being able to manage and control the complexity of the project properly.

2.3 PROJECT PERFORMANCES

The generally used method for analysing construction projects settles down on the three project performance pillars of time, cost and quality. These performances are well known in the construction industry and are shown in Figure 11 in the triangle of the performances (Burtonshaw-Gunn, 2009).

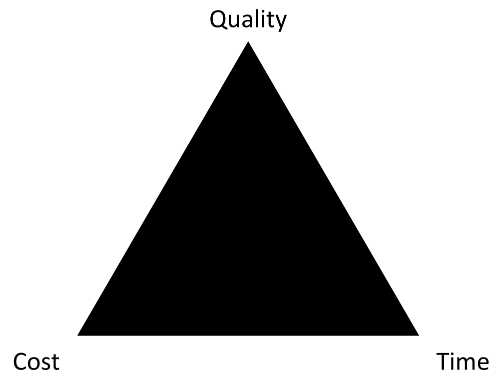


FIGURE 11: PROJECT PERFORMANCES (BURTONSHAW-GUNN, 2009)

According to the book of Burtonshaw-Gunn (2009), all of three performances have an influence on value, but the most fundamental of these performances are time and cost. In the construction industry these two are hard to separate from eachother. For example when a plannend activity in the construction process takes longer then planned this results in additional for the use of labour and material used. In contrast reducing time in the project results also to extra costs due to additional labour charges or working in shifts. The value of a construction project for the client can be described under the earlier mentioned aspects: the quality of a project, the time wherein the project is realised and the total price that the client must pay for the project (Wamelink, 2010). In Figure 10 the aspect value for the client is shown with their mutual relation between the pillars.

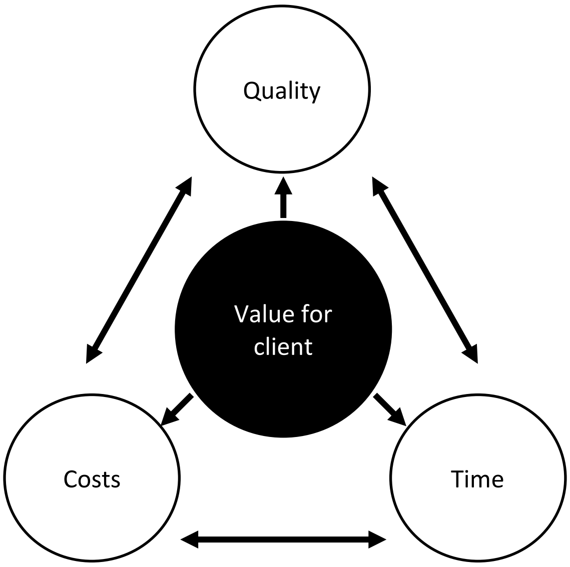


FIGURE 10: VALUE ASPECT FOR THE CLIENT (WAMELINK, 2010)

COST

In general, when it goes about costs it is all about money of the production resources to realize the product. In the construction business it is a bit different, money then means the weight on labour, material, materials, organisation and working capital. Under construction costs there are two different cost which are the direct construction costs and indirect construction cost. Under construction cost it is understood, all the costs for the architectural and installation technical terrains and buildings and under the indirect costs the following cost are settled: construction site cost, general cost and profit plus risk. The most project related cost are the construction site cost. Before executing a project, a lot of work is executed mostly in the office of the construction firm for preparation the work that must be done to construct the building, this is called general cost. As an organisation a contractor is at risk for taking a project. The client must pay also for the risk that the contractor is bearing. At last the contractor must also make profit over these cost for paying his shareholders (De Jong & Soester, 2010)

The costs of office buildings depend on three aspects:

- The organisation
- The building
- The location

These aspects have their own requirements on the building, the organisation has mainly requirements about the spatial use of the building and the technical quality level. Requirements from the building are the functionality and design whereby the legislation like the construction regulations have an important role in this. At last there are the requirements from the location which have an influence as well on the design as on the used materials (De Jong & Soester, 2010).

TIME

The parameter time in construction projects ensures that the project will finish on time. When a project delays it can cause serious problems for the client and contractor therefore time is extremely important for both client and contractor. By controlling the planning of the project regularly problems can be seen on time and adjustments can be made in the planning if that is needed. Even in the procurement phase of construction projects there can be a financial bonus if the project can be delivered earlier in time or a fine if it delays (Binnekamp, Geraedts, Van de Putte, & Vercouteren, 2010).

Controlling time

Binnekamp et al. (2010) says in his book that controlling time includes all the steering and regulating activities which are focused on the substantive activities of a construction project, to carrying out according to the in advance settled plan. The goal of time control is to determine on time the project results and the execution of the project activities according to the planning with the assigned capacities (people and production resources). Time control means the control of activities on lead time, capacity and mutual relations. Only project managers with unlimited resources don't have to comply to time control. But in normal situations there is a limitation to these aspects so project managers are forced to use the limited resources as good as possible.

Controlling activities are focused on the measurement of the actual situation of the activity that must be executed. If this is known then the signalment has occurred, the situation of the project is determined and the project can be adjusted if that is necessary (Binnekamp et al., 2010). The questions that are asked here are:

- Runs the project according to plan?
- Is the project behind on schedule?
- Is the project ahead on schedule?

According to Binnekamp et al. (2010), controlling of time what can also be called planning can be dived under three head activities which are:

- Making a planning
- Guarding the planning
- Adjusting the planning

Normally when making a planning it starts with a rough plan and becomes more detailed. The project manager will zoom continuously in and out of the planning and change the scale of it. The project cannot be executed in one large planning, it should be split up into phases wherein a partial result must be achieved. For planning the execution phase, there are also other skills required then just being a project manager. These skills are in the field of building technology, in addition there is also knowledge required about building materials, production techniques and the environmental factors for example for a location that is hard to reach (Binnekamp et al., 2010).

When the planning is made it is the intention to respect it. It is for the project managers duty that the planning is also accepted by the other members of the team, like the client, architect, advisor and contractor. All the members must accept and respect the planning as a contractual document. When this is not the case there can be fines for the member that is responsible for the delay. To guard the planning the manager makes a reporting system wherein he weekly or monthly or when this is needed reports to the team members about the progress of the project (Binnekamp et al., 2010).

Adjusting the planning has also influence on the other performances cost and quality. Adjusting only in time control means that backlogs must be caught up and that the capacities must be used differently. Only when there are no margins left it can be necessary to change the planning according to the actual situation but off course this must be prevented (Binnekamp et al., 2010).

Quality

Quality in buildings goes usually about the architectural quality, it is in relation with a characteristic or a function. Therefore, quality sticks always to a judgement about the extent of the suitability and functionality and about the extent of the quality itself. With other words: quality is determined by a judgement of the characteristics of a product (Gerritse in Van Doorn et al., 2010). According to (Van Doorn, Heintz, & Volker, 2010)quality can be dived under three concepts when a buildings quality must be jugded:

- Degree of compliance with the standard
- Suitability of the product
- Social interest

The definition of quality in quality management is the extent wherein a product satisfies the demand for the predetermined specifications. This concept of quality is not used very often where the demand is not fully clear, like ate the start of a building project. This concept is therefore used more in the execution phase then in the design phase of the project.

Quality can also be related to the goal of the object. In this concept quality is coupled to the extent of the suitability of a function or application and not to the characteristics of the product. With buildings it is difficult to judge this concept because it is excluded to make a prototype of a building. Therefore, this concept will have a speculative character during the design. This concept is also dependent on the perspective of the judgment, for example an employer can see the function of the building differently than an employee.

Quality can also be the extent wherein the building means something to the people that work or live in or in the surroundings of the building. This concept is focused on the social value of buildings and to the professional duty of architects to watch over the public heritage. Judging quality on this concept is even more speculative then the second concept about the function.

2.4 Conclusion

In this chapter the literature study is conducted and has elaborated on the factors that have an influence on the project performances of a transformation process. According to the literature study when performing a transformation project there is a certain process model that judges if the transformation of a certain building is feasible. In this model in Figure 3 there is the transformation arrow between the old building and the new building wherein the focus lays on the technical factors of the transformation. These are elaborated in chapter 2.2 wherein the main factors are elaborated. The cases will be analysed on the base of these factors and there influence on the project performances cost, time and quality which is elaborated in the last chapter.

PART 3: EMPIRICAL ANALYSIS

3.1 DATA COLLECTION AND ANALYSIS

In this part of the report an empirical analysis is conducted in the form of a case study. A case study is a research wherein the researcher tries to get a profound and integral insight in one or more-time spatial limited objects or processes (Verschuren & Doorewaard, 2015). In other words, the case study method allows investigators to retain the holistic and meaningful characteristics of real-life events such as individual life cycles, small group behaviour, organizational and managerial processes, neighbourhood change, school performance, international relations and the maturation of industries (Yin, 2009). According to (Yin, 2009) a case study is a two-part technical definition, the first part begins with: a case study is an empirical inquiry that

- Investigates a contemporary phenomenon in depth and within its real-life context, especially when
- The boundaries between phenomenon and context are not clear.

The second part is: the case study inquiry

- Copes with the technically distinctive situation in which there will be many more variables of interest than data points, and as one result
- Relies on multiple sources of evidence, with data needing to converge in a triangulating fashion, and as another result
- Benefits from the prior development of theoretical propositions to guide data collections and analysis.

To conduct a case study first you need to make a research design. The following five components are important for a research design (Yin, 2009).

1. a study's questions
2. its propositions
3. its units of analysis
4. the logic linking the data to the propositions
5. the criteria for interpreting the findings

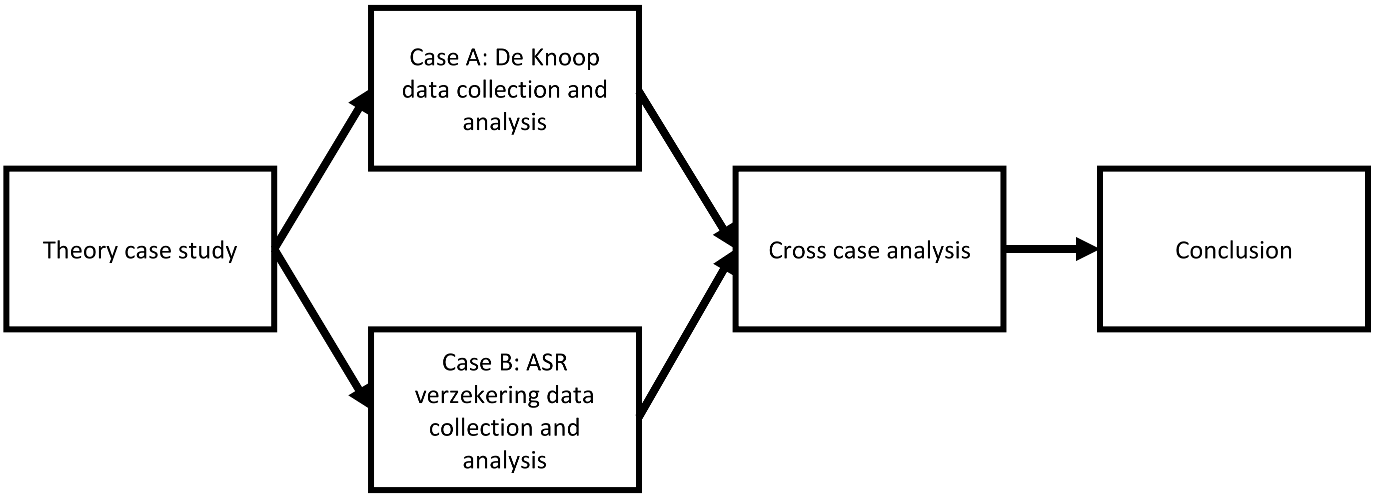


FIGURE 12: RESEARCH METHOD CASE STUDY (OWN ILLUSTRATION)

Variables	Indicators	Data collection method
Descriptive project information	Herein we introduce and describe the basic aspects of the case.	Content analysis and interview
General project information	Location	Content analysis
	Construction year	Content analysis
	Start and finish transformation	Content analysis
	Original function	Content analysis
	New function	Content analysis
	Gross floor area m^2 old building	Content analysis
	Gross floor area m^2 new building	Content analysis
	NPV million	Content analysis
	Client	Content analysis
	Developer	Content analysis
	Contract	Content analysis
	Operation phase	Content analysis
Stakeholder involvement	Stakeholders	Content analysis
	Function	Content analysis
	Involvement	Content analysis
Specific project information	Functional requirements	Content analysis and interview
	Boundary conditions	Content analysis and interview
	Technical quality	Content analysis and interview
	Sustainable quality	Content analysis and interview
	Functional quality	Content analysis and interview
	Architectonical value	Content analysis and interview
	Project complexity	Content analysis and interview

TABLE 1: DATA COLLECTION

Performance colours			
Cost	Project is delivered according to expected cost	Project costs are staying in budget despite of the extra costs	The project cost are over budget
Time	Project is delivered according to expected time	Parts of the project is delayed but the overall project is delivered on time	The overall project is delayed
Quality	Project is delivered according to demanded quality	Parts of the demanded quality is not achieved	The overall demanded quality is not achieved

TABLE 2: PERFORMANCE DEFINITIONS COLOURS

3.2 CASE A: DE KNOOP

This Case is about the governmental office De Knoop in Utrecht on the Mineurslaan 500, see Figure 13 for the exact location. This office is a former military barrack what was built in the late eighties. When it was used for a long time for military purposes it became vacant for a while, till the client directorate-general and the tax administration asked Rijksvastgoedbedrijf to develop the former military office in to a governmental office. The project was awarded on the base of EMVI criteria on June 23, 2015 to the Consortium Rcreators in a DBFMO contract for a NPV of €129 million and it is expected that the project will end in the spring of 2018. After the completion of the project it will be exploited for 20 years. In this project sustainability has always been elaborated on three key pillars: less consumption, sustainable production and healthy work. The project includes also a part demolition and a part new build. The starting point of the building is to demolish as less as possible and to reuse as much as possible. This has made changes in the floor area of the building. The gross floor area of the old building is 20.614 m², from this 3.803 m² is demolished what left 16.811 m². The part that is new is 13.375 m² what makes a total with the old building a gross floor area of 30.186 m². In Figure 14 the old and the new building is shown and in Figure 15 a sketch is shown of the old and new building.

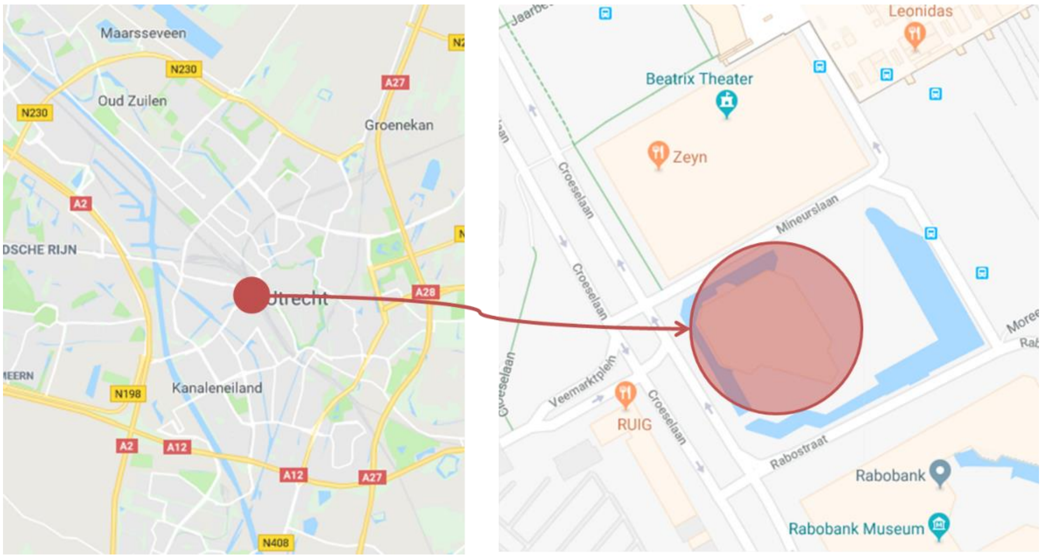


FIGURE 13: LOACTION DE KNOOP (OWN ILLUSTRATION)

FIGURE 14: LEFT OLD BUILDING (BOUWPUT UTRCEHT, 2018), RIGHT NEW BUILDING (RIJKSVASTGOEDBEDRIJF, 2018)

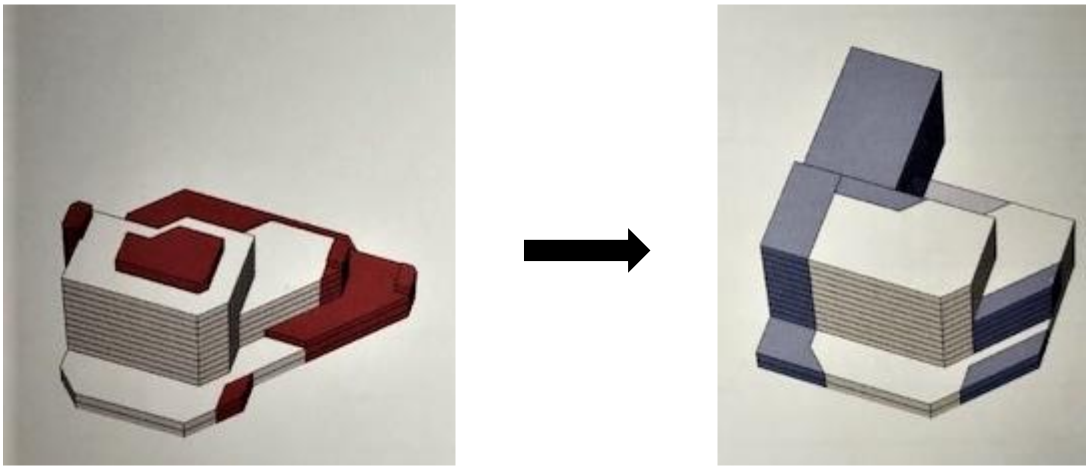


FIGURE 15: LEFT OLD BUILDING AND RIGHT NEW BUILDING (PPS RIJKSKANTOOR DE KNOOP UTRECHT, 2015)

General project information	
Location	Mineurslaan 500, Utrecht
Construction year	1986
Start / finish transformation	2016 / 2018
Original function	Military office
New function	Governmental office
GFA (m²) old function	20.614
GFA (m²) new function	30.186
NPV million	129
Developer	Consortium Rcreators
Contract	DBFMO
Operation phase	20 years

TABLE 3: GENERAL PROJECT INFORMATION DE KNOOP

Function	Company	Period of involvement
Architect	Cepezed	Design to execution
Construction company	Ballast-Nedam	Design to exploitation
Installer	Strukton	Design to exploitation
Facility	Facilicom	Design to exploitation
Construction consultant	Pieters Bouwtechniek	Design to execution
Client	Rijksvastgoedbedrijf	Whole life time

TABLE 4: STAKEHOLDER INVOLVEMENT

EXISTING BUILDING

Functional requirements

A building that is made as a military office as the headquarter of the royal army of the Netherlands. The building must house military personal wherein they can work and meet with each other and it must house facility activities.

Boundary conditions

The building should be a closed building wherein the military personal is not distracted from outside.

Future building

Functional requirements

The governmental office is intended for civil servants. The users of the governmental office are in service of the government. The first users of the building are largely from the tax authorities. During the exploitation phase the users and organisations can change. Dependent on the occupancy there is also space for other governmental users. The governmental office De Knoop offers housing and meeting facilities for various governmental departments. The building has approximately 1082 workplaces with 75 guest workplaces for random civil servants and the number of users of the building is about 1700 people. Most of the users which use the meeting centre comes from another location, this is about 4000 m² of the 6000 m² gross floor area. The activities that are taken place in the building are: Communicating, facility activities, side activities, relaxing and work activities (Rijksgebouwendienst , 2015).

Boundary conditions

The office must be transformed wherein a maximum of 25 percent is permitted for demolishment. The office forms one whole due to an integral design of the constructions, installations and the reused elements of the existing building. Architectonical resources like the spatial concept, layout, installations, finishes, daylight entry and the furniture forms one integral design a (coherent and harmonious whole) this applies both to the scale of the building, as the individual spaces and to the individual means and services in the spaces. Integrality is expressed both internally and externally, this also applies to the roof surfaces (Rijksgebouwendienst , 2015).

Transformation

Technical quality

Bearing construction

The construction of the building exists out of a concrete skeleton that is poured during the work with a floor thickness of 250mm. It is build up out of a column structure wherein the columns carry the construction, this creates flexibility in the building. The grid of this column structure has a distance of 5,28m. The stability of the building is taken care by a concrete core in the middle of the building and two walls on both sides of the building, the elevators and stairs are also located in this core. The complete building is founded on piles. The constructive floor ceiling height over the difference floors of the building has a distance of 2,85m. In the basement of the building the ceiling is a bit higher with 4,85m. The building is accessible by a main entrance and has a horizontal strip over the ground level that is connected to four vertical shafts divided over the building wherein the elevators and staircases are located.

Condition bearing construction

The condition of the bearing construction was reasonoble, there were no reasons to assume that it was not constructively justified. There was only more subsidence in the floors then known due to the formwork from that time. There were problems to get the installations in the right position because there was less space. Upfront it was unknown because the old ceiling and installations were still in the building. This cost more money and time to instal the installations.

Sustainable quality

The old building was not sustainable at al. The new building is also not of a high sustainable standard. The only thing what is made sustainable is to achieve the EPC norm, this had no further influence on the performance.

Functional quality

The current installation room of the building is on the roof, wherefrom all the installations are distributed in the building by the vertical shafts and these installations do not comply with the new requirements. The hard thing with this was is to put new installations in an existing construction wherefrom the floor height was much lower than buildings being build nowadays. More installations must be placed in a small area. For the air channels much more, drilling and cutting of the existing construction was done than expected. There is spend couple of hundred thousand euros extra for adaptions to fit the installations. But time had no influence in this.

Architectonical quality

The existing building had a cold exterior, it was built in 1989 but it looked like a building from the fifties. In that case it was an extraordinary building for that time. The problem of the new building was the design of the architect. Because the existing construction must be adapted for the new design and that was gone too far, the old construction had to be more respected. An example of this was that the architect has designed a corridor on the place where was a bearing wall, finally this wall is removed but looking back at this, it wasn't the right thing to do. The overall problems where that the architect got too much design freedom, on some points the architect was followed too much and there was a poor communication with the constructor. The costs for these adaptions where known and were taken up in the tender, but in the realisation phase there were executed more adaptions then we have expected what cost more money and time.

Project complexity

The shape of this building exists out of floors whit various number of levels. The lowest number exists out of two levels which is the strip of the building. The main part has 13 levels and between them there are another two different levels. These levels have their own vertical shafts with elevators and staircases and are positioned on an unusual way. By the positioning of these levels the building creates many facades on an unequal line what gives a unique geometric appearance. The complexity in the realisation of the new building was particularly in the details and the integration of the installations in the existing construction because the building had a low floor ceiling height.

Performance

Performance	Existing building	Future building
Cost		
Time	[Confidential information]	
Quality		

TABLE 5: PERFORMANCE

Performance indicators

	Existing building			Future building		
Performance indicator:	**Cost**	**Time**	**Quality**	**Cost**	**Time**	**Quality**
Technical quality						
Sustainable quality						
Functional quality			[Confidential information]			
Architectonical quality						
Project complexity						

TABLE 6: PERFORMANCE INDICATORS

Evaluation

Looking back at the end of this project De Knoop it finally came to a good end but for a high price due to various reasons. One of them is the given design freedom for the architect. The collaboration with the constructor was poor whereby the architect didn't respect the existing construction enough. The functional quality of the existing construction was also poor it has ensured that the adaptions that have been made was more than ever expected which resulted in more costs. Looking at the technical quality there was little space for the installations what made it difficult to install al. The new installations are installed tight together whereby the maintenance in exploitation phase will also be difficult. Focusing on the sustainability it has no special extra's only the EPC norm what was required is achieved. Overall it was a complex project whit a lot of challenges that the managers got to deal with. Considered from the contractor's perspective the goal is achieved in time, in budget despite of the additional work and the required quality is achieved.

Conclusion

In this case study of the project De Knoop in Utrecht the factors are analysed that can have an influence on the performances time, cost and quality of the project. The project De Knoop is transformed from an old military office into a new governmental office whereby a part of the existing construction is demolished and a part is new build. The analysis has shown that one of the largest impact on the project performances is the architectonical quality. The architect got to many design freedom from the consortium whereby the existing construction wasn't respected enough. This resulted in problems during the execution phase whereby more money and time is spend than expected. Installing all the installations in the building was very hard in this project. It resulted in couple of hundred and thousand euros extra in the execution phase. This factor functional quality had a large influence in costs but not in time and quality. The technical quality of the building was reasonable, but it has taken care of it that the installations was hard to install due to the low ceiling height and subsidence in the existing construction. This cost the contractor more money and time to install it. The case analysis of this project has shown that the project is delivered on time and in budget despite of the extra time and costs that the project had.

NONCOMPLIANCE ANALYSIS

[Confidential information]

3.3 CASE B: ASR

The second case in this research is the head office of the company ASR securities. It is in Utrecht on the Archimedeslaan 10 next to the highway junction between A27 and A28, see Figure 16 for the exact location. In June 2009 the board of directors of ASR has decided to bring all the company activities into one building. This decision is made to decrease the housing cost of the company and to strengthen the collaboration inside the company. After an extensive study the choice is made to transform the existing office of ASR on the Archimedeslaan. After it got awarded to the building combination Archimedes, they started in 2012 with the execution of the transformation. This happened in three phases, because there were still people of ASR working during the execution phase. In the new design of the building a part of the building is demolished and there is also a part new build in the basement what serves as a meeting centre, which gets daylight by the new atriums. In Figure 17 the old and the new building is shown and in Figure 18 a sketch is shown of the old and new building.

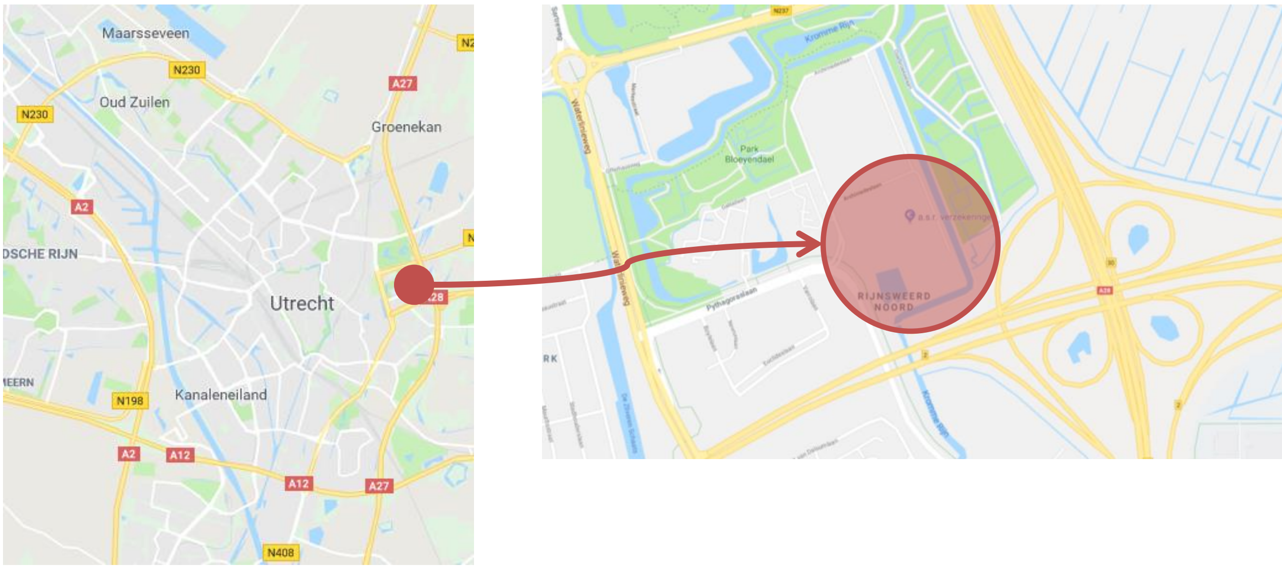


FIGURE 16: LOCATION ASR (OWN ILLUSTRATION)

FIGURE 17: LEFT OLD BUILDING, RIGHT NEW BUILDING (GOOGLE MAPS, 2018)

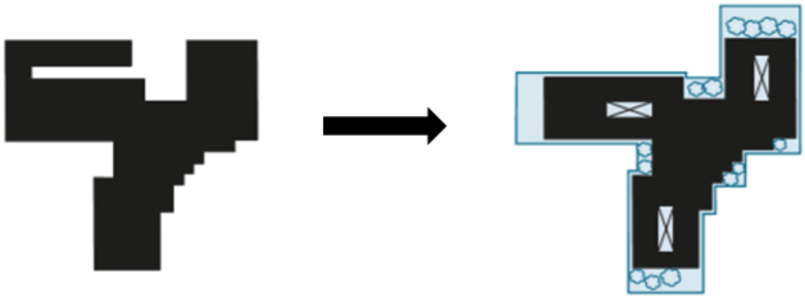


FIGURE 18: LEFT OLD BUILDING AND RIGHT NEW BUILDING (DE ARCHITECT, 2018)

General project information	
Location	Archimedeslaan 10, Utrecht
Construction year	1974
Start / finish transformation	2012 / 2015
Original function	Office
New function	Office
GFA (m²) old function	76.350
GFA (m²) new function	85.731
Contract value million	100
Developer	Building combination: Archimedes
Contract	Engineer and Build
Operation phase	n/a

TABLE 7: GENERAL PROJECT INFORMATION ASR

Function	Company	Period of involvement
Architect	Team V Architectuur	Design to execution
Construction company	Ballast-Nedam	Engineering to execution
Installer	Kuijpers	Engineering to execution
Construction consultant	Aronsohn Raadgevende Ingenieurs	Design to execution
E + W installations consultant	Deerns	Design to execution
Client	ASR verzekeringen	Whole life time

TABLE 8: STAKEHOLDER INVOLVEMENT

EXISTING BUILDING

Functional requirements

The building must house 2500 people of the company ASR securities. It must be a friendly building that fits harmoniously into the landscape. The building must have a mix of office spaces and conventional spaces which result in scenic workspaces for large groups of traditional rooms, for smaller groups and rooms for individuals (Aronsohn, 2018).

Boundary conditions

The boundary condition of the old building was that the working man spends a large part of his life in his job. So that the working conditions should be made as pleasant as possible for the employees (Aronsohn, 2018).

Future building

Functional requirements

The transformed office is for the employees of the company ASR securities. The new office has 2800 flexible workplaces where there is room for a capacity of 4000 employees. The public area has a coffee bar, brasserie, conference centre, work lounge and a restaurant where both employees and external parties are welcome. The activities that are finding place are work activities, meeting activities and facility activities. The meeting activities are finding place in the new part of the building which is in the basement.

Boundary conditions

The building will be transformed wherein the company will continue their work during the construction by the contractor. The building will follow the Breeam (Building Research Establishment's Environmental Assessment Method) method to achieve a Breeam certificate with the degree very good.

Transformation

Technical quality

Bearing construction

The main support construction exists out of a massive concrete structure that carries itself by columns and concrete floors. The columns are predominantly placed on the standard grid of 7.2 × 7.2 m². However, column distances of 14.4 - 7.2 - 14.4 m have been selected in the transverse direction of the wings. The standard column diameter here is 600 × 600 mm². The floor construction is largely 600 mm thick. To limit the load due to the own weight, large floor parts are fitted with PS-oktrons. These are weight-saving filling elements with octagonal cross-section, made of polystyrene with a closed cell structure. The constructive floor ceiling height of the construction is 4,2m. The building is accessible by a main entrance in the high tower and from there the three large strips are accessible. The stability is ensured by three main concrete cores and three secondary cores the elevators and staircases are also placed in this core. At last the whole building stands on a foundation that rest on a sand bottom.

Condition bearing construction

The condition of the bearing construction was very good, there were no further problems with the condition further in the realisation process.

Sustainable quality

The old building had a G-label on their energy card, what is the lowest concerning buildings. But for the new building many adaptions were made for the sustainability to achieve an energy label A and to get the Breeam certificate. This had no further implications on the performance because it was all known and taken up in the bidding. To save money and for the sustainability of the project the contractor decided to keep the sand-cement floor so there was only a small budget taken for this to repair the sand-cement floors if that was needed. In the realisation process they found out that the sand-cement floors were completely damaged over the years. This costs the contractor a lot of money with a factor seventy of the original budget.

Functional quality

The current state of the installations was very bad and comes from the time that the building was build. In this building the constructive floor ceiling height was very favourable for the new installation, because there was plenty of room in the height of 4,2 meter. In contrast of that the two elevators installation that must connect the floors with the basement was very hard to perform due to the foundation on sand. It made it difficult to cut a pit in the basement floor for the installation of the elevator. Finally, one of the two pits are made due to the very high costs. The effect on the performance costs was high about the factor nine of the original budget for making the two pits was issued for only one pit.

ARCHITECTONICAL VALUE

The old building did not live up to this time anymore. It consisted out of concrete gravel facades. It had very little window surface and because it had narrow window surfaces, there was almost no light in the middle of the building. There was always need for artificial light. This factor did not affect the project performances.

PROJECT COMPLEXITY

The technical side of the project was not very complex despite that the foundation of the building made it hard to perform the realisation of the design. The main complexity of this project was in the management because the building was still used by the client during the realisation. It cost a lot of time to manage this project. This factor had no further implications because the demands were known upfront.

PERFORMANCE

Performance	Existing building	Future building
Cost		
Time	[Confidential information]	
Quality		

TABLE 9: PERFORMANCE

PERFORMANCE INDICATORS

	Existing building			Future building		
Performance indicator:	**Cost**	**Time**	**Quality**	**Cost**	**Time**	**Quality**
Technical quality						
Sustainable quality						
Functional quality			[Confidential information]			
Architectonical quality						
Project complexity						

TABLE 10: PERFORMANCE INDICATORS

EVALUATION

This project transformed from a concrete block into a state of the art building wherein the latest technologies are used to make the building sustainable. For this achievement the building got a Breeam certificate. But the road to it was a different story, it had ensured that the contractor didn't make any profit from this project due to the elevators in the basement and the sand-cement floor which was completely damaged and pulverized. After and before the award was given to Ballast-Nedam and Kuijpers the client gave the possibility to do a trial demolition of a part of the building for getting to know the building. Despite of that they have not used this possibility, from which they later got enormous regret. The technical quality of the building was very good, it was a building that had the flexibility for a transformation. The functional quality to integrate the installations was favourable with a floor ceiling height of 4,2 meter, but the elevator installation in the basement caused an immense impact on the budget. The architectonical exterior of the building was very poor, after the transformation it became a transparent garden whit many atriums that was in balance with the environment. The building was not very complex but the transformation of some parts of the building made it very difficult. At the end the project is delivered on time for the demanded quality accept one of the elevators in the basement was different, but for costs the project did not yield anything.

Conclusion

In the case study about ASR the factors are analysed that can have an influence on the performances time, cost and quality of the project. This office is transformed from a concrete closed building with an energy label G to a transparent building with an A label. In the transformation process a part of the old building is demolished and to compensate the losing area a part is also build new under the ground as a meeting centre. This analyse shows further that sustainable quality and functional quality had the largest influence on the project performances. To reuse the existing sand-cement floor in terms of sustainability and for saving of money, it came out that this was the largest unforeseen cost of the project because the sand-cement floor was completely damaged and pulverized. Constructing the elevator pit was very hard to perform and a small budget was given for this compared with the actual cost. It ensured that the second elevator in the basement got another quality then demanded in the first place. The analyse showed also that a large floor ceiling height is favourable in a transformation project so that there is enough place for the integration of the new installations. At last this project was delivered in time but for a high price wherein the contractor didn't profit from the project. The quality of the new building was high only an alteration was made about the demand for the elevators.

Noncompliance analysis

[Confidential information]

3.4 Cross case analysis

In this paragraph the two cases De Knoop and ASR are analysed by a cross case analysis. They are compared with each other on the base of their indicators and performance.

Project information	Case A: De Knoop	Case B: ASR
Location	Mineurslaan 500, Utrecht	Archimedeslaan 10, Den Haag
Construction year	1986	1974
Start / finish transformation	2016 / 2018	2012 / 2015
Original function	Military office	Office
New function	Office	Office
GFA (m^2) old function	20.614	76.350
GFA (m^2) new function	30.186	85.731
Million	129 NPV	100 contract value
Client	Rijksvastgoedbedrijf	ASR verzekeringen
Developer	Consortium Rcreators	Building combination Archimedes
Contract	DBFMO	Engineering and Build
Operation phase	20 years	n/a

TABLE 11: PROJECT INFORMARTION CROSS CASE

Case A: Performance	Existing building	Future building
Cost		
Time	[Confidential information]	
Quality		

TABLE 12: PERFORMANCE CASE A

Case B: Performance	Existing building	Future building
Cost		
Time	[Confidential information]	
Quality		

TABLE 13: PERFORMANCE CASE B

Case A	Existing building			Future building		
Performance indicator:	**Cost**	**Time**	**Quality**	**Cost**	**Time**	**Quality**
Technical quality						
Sustainable quality						
Functional quality			[Confidential information]			
Architectonical quality						
Project complexity						

TABLE 14: PERFORMANCE INDICATORS CASE A

Case B	Existing building			Future building		
Performance indicator:	Cost	Time	Quality	Cost	Time	Quality
Technical quality						
Sustainable quality						
Functional quality			[Confidential information]			
Architectonical quality						
Project complexity						

TABLE 15: PERFORMANCE INDICATORS CASE B

Performance of the cases

The result shows that the largest influence is on the performance cost. This comes mainly due to unforeseen circumstances from which the contractor does not keep account with when tendering. The second influence on this is that the contractor doesn't have experience with transformation projects. The projects are approached as new building projects where form many important factors are overlooked and later in the realisation phase it shows up, but the damage is then already done. In case A the costs have remained in the budget wherefrom the contractor has also made profit from the project. In contrast of that, case B didn't make any profit of the work they have played even in this project. Oddly enough despite of these extra cost the buildings are finished according to plan, but this costs also extra because then more people or overtime is needed to catch up according to plan. The contractors would rather have more costs in the realization of the project than that they get a fine due to late delivery. The quality demanded is achieved in case A, but in case B there was a slight alteration due to the costs and risk of the elevator pit. In the original plan there were two exact the same elevator pits from which the elevator floors were on an equal level with the basement floor. But due to the amount of risks and costs from the first constructed pit they changed the plan whereby the second elevator was of another type of elevator that was constructed on a raised floor with a ramp. The performance quality is the contract of what needs to be delivered therefore it is very important that this executed according to that.

Performance indicators

Technical quality – The technical quality of the building was in both cases reasonable, only there were problems in case A due to the settlements of the floors. This has ensured that the installations in the lowered ceilings were difficult to place this cost a lot for case A.

Sustainable quality – The sustainable quality of the existing building of both case was very bad, but both cases have improved the sustainability of the buildings. In case A the EPC norm for office buildings that was demanded from the client was achieved but in case B they have gone much further they have earned the Breeam certificate for the sustainability of the transformed building. But this had a large influence in terms of costs for case B because of the sand-cement floor from which they wanted it to reuse. The floor was completely damaged and pulverized which had large impact on the budget.

Functional quality – This performance indicator was one of the main influences on costs in both cases. Case A had large problems with the integration of the new installations. This came mainly due to low floor ceiling height wherein the new installation was hard to fit in the lowered ceiling. In addition, during the engineering of the building they have worked with global sizes of the installations. When the real sizes where know this became very disappointing for the cost during the preparation- and realization phase. In case B these costs came from the new elevator pit which is made on a foundation on sand. This was problematic because there was the risk that the building would partly sink. Due to the extra work in time and the costs that that entails the contractor decided to use another type of elevator for the second elevator pit to prevent another impact on the costs.

Architectonical quality – For this indicator the two cases deviated a lot. In case A the consortium gave the architectural firm the order to design a new building from the existing building. In this order the requirement was that the existing building had to be saved by a minimum of 75 percent. The architectural firm adhered that requirement but, the new design had a large impact on the existing construction and gave a problem during the preparation phase and realisation phase. This resulted in high cost and extra time for the consortium. In case B the building was designed commissioned by the client and in this case the design of the building was much more respected. Therefore, this indicator had no further implications for case B and it gave a positive result for the outcome.

Project complexity – Both cases are not everyday buildings they both had a high tower with low plinths attached to it. In case A it was very complex to integrate the new installations in the existing building because of the low floor ceiling height. From the 2,85 meter floor ceiling height there was only 15 centimetres to integrate the installation in the lowered ceiling. In contrast case B was a far easier project due to the floor ceiling height of 4,20 meter wherein was much space for the installations and because of the building and engineering contract the design was far more developed, commissioned by the client. Case A had a DBFMO contract and had to do the design all by itself from start to end.

Noncompliance

Case A	Case B
Cause problem 1: **[Confidential information]**	Cause problem 1: [Confidential information]
Cause problem 2: **[Confidential information]**	Cause problem 2: [Confidential information]
Cause problem 3: **[Confidential information]**	

TABLE 16: NONCOMPLIANCE CROSS CASE

Common noncompliance

[Confidential information]

Not common noncompliance

[Confidential information]

The not common noncompliance causes occurred both in case A. Cause problem 2 did not occurred in case B because of the difference in the contract. Case B had an Engineer and Build contract while case A had a DBFMO contract. Due to the contract in case B the building was already investigated and designed by part of the client. The contractor involved in the project when the preliminary design was already finished by the architect and by part of the installation- and constructor advisors. For the contractor this meant that a part of the risks fell under the client supervision. In the DBFMO setting this was a different story, the contractor had to do it all by himself in a shorter time period. In the tender phase the design had to be delivered for a certain price, but for the contractor there is always the chance that they lose the tender whereby not all the invested money in the tender is earned back. Only a certain amount of money will be repaid by the client. Then for the contractor, the question remains how much it wants to invest in the tender for winning it. This is the point where the integral consideration fails. The DBFMO contract is approached like a traditional contract, this means when normally the risks are divided in the traditional contract the contractor invests also in the tender on the base of these risks. But if the same investment in the tender is also made in a DBFMO contract but then in which the entire project risk is for the contractor, then the chance that something goes wrong in a later stadium is much larger.

The reason why cause problem 3 didn't occurred in case B is also due to the contract form of case B. In case A the DBFMO contract was the guidance of the whole project while in case B it was the Engineer and Build contract. In case B the contractor involved in the project when the preliminary design was already finished by part of the client and his team. The team existing out of the architect, installation- and constructor advisors did already investigate the building and designed the new building on the base of that. The contractor in case B only had to work out the preliminary design and realize the building. Thereby a part of the risk of the project fell under the client. In case A in the DBFMO setting the contractor had to do all of the investigation by itself before even winning the tender. This is a balance between how much the contractor will invest to win the tender and how much risk it will take up in the offer. In addition, in a DBFMO setting there is the fact that all the candidates must be equally informed about the project. Thereby the investigation can be executed but to a certain limit whereby the building isn't allowed to be stripped down partially.

Mechanism

In the noncompliance of the cross case analysis the common- and not common noncompliance is analysed. Hereby it can be concluded that the problems that occurred in the not common noncompliance is due to the contract form that the contractor must deal with. In case A the misunderstanding of the integral contract DBFMO made it possible to harm the project performances. The main point was how much will the contractor invest in the tender and how much will he take up in his risk budget. While in case B the Engineer and Building contract didn't face these problems, because a part of the risk was taken up by the client.

3.5 Conclusion

In the empirical analysis, a qualitative research is carried out into the factors that influence the project performances of the two cases. From the results of the two cases it has been found out that there were differences between the two cases but also similarities.

The main factor that influenced the performances in both case A and B was the factor functional quality. This factor had to do with the demands of the installations for the functionality. Depended on the function that the building is going to have the choice can be made about what type of installation the building needs for a comfortable housing. Case A worked with global sizes of the installations in the engineering phase, when later the actual sizes were known it became hard to integrate the installations in the building, which had a large influence on the costs. This factor had also made a large cut in the budget of case B, which came due to the elevator installation in the basement. The new elevators needed an elevator pit in the basement floor which is a floor that has a foundation on sand. The floor had to be broken up to place the pit but upward water pressure could have made the building sink. This has ensured that additional measures had to be taken to prevent that the risk of sinking.

The technical quality of the building had influence on the performances only in one case which is case A. The concrete structure of the buildings in both cases was not bad only in case A there were settlement in the floor due to the formwork system that they used in that time. This made it very difficult for case A to integrate the installations which resulted in a lot of cost and more time that was spend on this. This is partly also due to the low floor ceiling height, there is already little room to install the installations and if there is a settlement, this makes it even more difficult

The new design of the building had a great effect on the existing construction of the building in case A. This came due to the architect which was not had not any restrictions for the design except the maximum of 25 percent that was allowed to demolish. This resulted in a design whereby the existing concrete structure was not respected enough. This have ensured that the factor architectonical quality had a large influence on the costs and time of the performances.

In case B the starting point was sustainability, but this went so far that it caused major damage in terms of costs for the contractor. The contractor wanted to reuse the sand-cement floor but this floor has been badly damaged over the years what the contractor did not see coming. By this the factor sustainable quality had a large influence in costs for the contractor.

In the results of noncompliance in the cross case analysis it became clear that the DBFMO contract had a large influence in the problems that the contractor faced in case A, while this was not the case in case B with an Engineer and Build contract. The link was laid between the risk taken up in the budget and the amount of investment in the tender. This appeared to exert a large influence in the later phases of the project and the performances cost, time and quality.

Part 4: Conclusion

In this part of the research the answer is given on the main research question and the sub questions. In section 4.1. the answer is given for the sub questions and the main research question. The recommendations for the company and for further research are described in section 4.2 and finally in section 4.3 the discussion with the limitations of this research is conducted.

4.1 Conclusion

This research has been focussing on the factors that can influence the project performances of a transformation process so that future transformation projects can be considered on the factors that came out of this research. Firstly, the sub questions will be answered and at last the main research question.

The main research question where this research provides an answer for is:

Which factors influence the project performances of a transformation process of office buildings and should be considered in future projects?

The first sub question is: *"What are the factors that Influence the transformation of office buildings according to the literature?".* According to the literature review there are a lot of factors that can have an influence on the transformation of office buildings. But some of these play a major role in the transformation of building projects, when these factors are not considered right it can have a large impact on the project. The factors that influence the transformation of office buildings are: technical quality, sustainable quality, functional quality, architectonical quality and project complexity. According to Geraedts & Van der Voordt (2007) the factors of the transformation potenttionmeter related to the technical side of the building are the dimensions of the bearing construction. One dimension that has a veto right herein is the floor ceiling heigt for houses that must be of at least 2,6 meters. In case A the main factors that had an influence were the technical quality and architectonical quality, in contrast of case B it was sustainable quality and functional quality that had the most influence.

The second sub question is: *"What is the transformation process of office buildings according to the literature?"*. According to the literature there are two main transformation processes. One is the transformation process model of Van der Horst (2018) in Figure 3 and the other is the Designing an accomodation strategy framework of De Jonge, et al. (2009) in Figure 4. Both have similarities with eachother while the focus is still different. The transformation process model is based on a building process with a contractor scope which is related to the performances of the project. The Designing an accommodation strategy framework is based on a transition process of building in the view of a developers scope, this again is related to the value aspects of the building. Both case studies were performed by the model of Van der Horst (2018). In case A this meant that the model is perfomed in a DBFMO contract and in case B in a Engineer and Build contract wherein the contractor shows up when the preliminary design is already finished.

The third sub question is: *"What are the project performances of transformation of office buildings according to the literature?"*. The main project performances of a transformation project are cost, time and quality. These performances are generally used in the construction industry and are well known for their use. The performances also have a certain value for the client, see Figure 19 for the interrelation with each other. These are also related to the models of Van der Horst (2018) and De Jonge, et al. (2009). The relation to the transformation process model are the main performances cost, time and quality which is analyised in the model according to the certain projects for the contractors. The Designing an accommodation strategy framework is related to the value of the client which relates to the developers scope of the framework. The Performance cost had the largest impact in case A with an orange result, while in case B the largest impact was also the performances cost but with a red result and quality with a orange result see in the tables of the cross cases analysis the overall results.

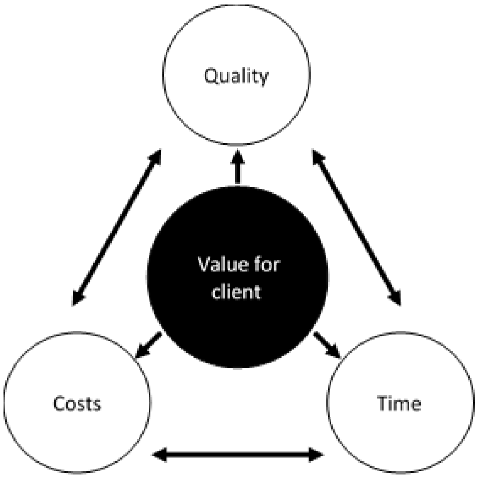


FIGURE 19: VALUE ASPECT FOR THE CLIENT (WAMELINK, 2010)

The fourth sub question is: *"What are the factors that influence the project performances according to the cases?"*. According to the cases all the factors that were named have a degree of influence on the project performances. But the main factor that jumped out and had an influence on the performance of both cases was the factor functional quality. This factor is extremely depended on the function that the building is going to have due to the demanded installation for the new function and is also strongly related to the Transformation potentiometer of Geraedts & Van der Voordt (2007). Because the veto criterium depends on the floor ceiling height of the existing construction wherein the installations are placed in the floors or the lowered ceilings. The factor architectural value had a large influence on the costs of the project of case A see Table 6 . The architect in the project had gotten a large design freedom whereby the existing construction wasn't respected by the architect. In case B the major influence on the performance was the factor sustainability see Table 10. In this case they wanted to reuse the existing sand-cement floor but after the tender it got noticed that the floor was completely damaged and could not be used. This resulted in extremely high cost for the contractor.

The last and fifth sub question is: *"Which factors should be considered in future transformation projects of office buildings?"*. According to this research, there is no one factor that is described in this research that should not be considered. But some factors play a major role in the project which could be from extreme importance for the success of the project. The factor that played a role in both cases and should be considered in each project is the factor functional quality described in chapter 2.2. In this factor the consideration must be made about which function the transformed building will house and the required installation for this function that must be integrated in the existing building. In case A this factor had a large influence on the cost due to the low ceiling height of 2,85 meters It was hard to install all the installations because of the demanded free height of 2,70 meter by the client. In case B this was not the case because the existing building had a floor ceiling height of 4,20 meter which gave the contractor enough possibilities to install the new installations.

ANSWERING THE RESEARCH QUESTION

In this research first, a literature study is performed about the existing literature of this topic in part two of the report. In the literature study two models are investigated and compared with each other on the similarities. One of that is the Transformation process model in Figure 3 of Van der Horst (2018) which is based on the building process. The other model is the Designing an accommodation strategy framework in Figure 4 of De Jonge, et al. (2009) which is based on the transition process of buildings. In the following chapter 2.2 the factors are introduced that can have an influence on the project performances of a transformation project. These factors are technical quality, sustainable quality, functional quality, architectonical quality and project complexity. In chapter 2.3 the last chapter of the literature study the project performances are described. These performances are cost, time and quality which are the performances pillars in each building project (Figure 19). The second main part of this research is the empirical study which is performed in part three of this research. In the empirical study two cases are analysed on the base of the Transformation process model of Van der Horst (2018). These cases are case A (section 3.2): De Knoop and case B (section 3.3): ASR verzekeringen. In both of the cases a transformation project is executed. which is later compared with eachother in the cross case analysis in section 3.4. This resulted in a conclusion which is described in part four of this research. In the conclusion first, the sub questions are answered to give finally an answer on the main research question described below:

Which factors influence the project performances of a transformation process of office buildings and should be considered in future projects?

It can be concluded that the factors technical quality, sustainable quality, functional quality, architectonical quality and project complexity in chapter 2.2 all can have a certain influence on the project performances of a transformation process of building projects. Some factors have a larger impact on the project performances than others, it depends on the project itself what the extent of this influence exactly is. The main factor that had an influence on the project performances of a transformation process was the factor functional quality. This factor relates to the function that the new transformed building is going to have and the new installations that this function needs. The factor is far more difficult than in new building projects, this comes due to the fact the construction already exists. Whereby the new installations must be installed in the existing construction. This is hard to perform because the dimensions of the new installations don't match with the dimensions of the old installation that is installed in the construction year of the building. In addition, the requirements for installations have become higher and older buildings have a low floor ceiling height what also give difficulties for the new installations. In new building projects the design of the construction and the design of the installation goes integrated on the same time. Whereby adaptions are easy to make because on that time the building isn't realized yet and only the drawings have to be adjusted.

This research shows that respecting the existing construction is of great importance for the success of a transformation project. The factor that belongs to this is architectural value. It came forward that in case B where the existing construction was respected with dignity that it had no further influences on the performances in contrast of case A where the existing construction was adapt extensively. This had large influences on the project performances. When a building is transformed it is the intention that the original construction is adjusted as little as possible. When too much is adjusted on the existing construction it can have drawbacks for the bearing capacity of the construction. Whereby as a result extra construction has to be placed to carry the building.

It can be concluded that contractors/developers have different degree of experience in the field of transformation projects and have different interests. This comes due to that contractors are steering on the performances of a project like in the Transformation process model of Van der Horst (2018). While developers are more concerned with the value creation like in the Designing an accommodation strategy framework of De Jonge, et al. (2009). Besides, the kind of contract between the contractor and the developer makes the transformation projects more difficult to perform. Case A was a DBFMO contract while case B was a Engineer and Build contract. Case B had far more less problems with the execution then case A because the design was much more elaborated and the building was more pre investigated by part of the developper. In case A the consortium had to do it all by it self in a shorter time period which resulted in large influences in the performances. For a successful transformation project, the factors named in this research need all to be considered explicitly in an integral manner.

4.2 Recommendations

Now the research question is answered recommendations can be given. First recommendation will be given for the company Ballast-Nedam and then recommendations are given for further research.

Recommendations Ballast-Nedam

[Confidential information]

Recommendations for further research

Conducting the case study with more cases

This will result in a more extensive and better exploration of the research. When more people are interviewed and more cases are used there will be more interaction and discussion with each other. It is also recommended to research how certain project leaders and engineers deals with this issues that can influence the transformation project.

Conducting a quantitative research method

It is recommending in a future research to do also a quantitative research on the factors that have an influence on the project performances, this could provide more insight. The quantitative method can improve the validity and reliability of this research. This can be done by conducting a survey for contractors and clients.

Minimize down the problem

Focusing on just one particular part of this research would provide more accurate and certain answers. For example, the factor functional quality had problems for the integration of the new installations in the cases. By focusing on the manner of how the contractors deal with the integration of the installation of various cases a better understanding and advise can be given about the integration.

4.3 Discussion and limitations

In this research the factors that have a certain influence on the project performances in a transformation process of building are analysed from the literature. From these factors the cases are analysed on the base of interviews and content analysis to provide an answer for this research. With this answer future developers would know which factors to consider before the start of a transformation project. Such a consideration is of great importance for the success of the project. However, the answer to this research do not provide all the factors that can have an influence in the transformation process, because of the limited literature study and the cases with the few number of interviews. But the answer to this research can help to do future research.

Furthermore, in the noncompliance analysis causes of certain problems were identified which didn't show up in the literature study. These were the inexperience of the contractors and the preliminary research concerning transformation projects. These factors had a major influence in the transformation project and resulted in high costs. When contractors get the possibility to investigate the existing building and this is not done or not done properly it can create major problems during the execution phase which can costs a lot of money, time and quality.

This research adds to existing literature about transformation of office buildings. Because previous studies didn't provide an answer about the factors that must be considered in a transformation project seen from a technical viewpoint.

However, it must be considered that this research has focused exclusively on the technical factors of a transformation project of a building which have influence only on the project performances time, cost and quality. Once focused on political, social, economic factors, the results will be possibly different.

BIBLIOGRAPHY

Akinsola, A., Harris, F., Ndekugri, I., & Potts, K. (1997). Identification and evaluation of factors influencing variations on building projects Vol.15 No.4. *International Journal of Project Management*, 263-267.

Andriessen, J. (2007). Transformatieprocessen. In T. Van der Voordt, *Transformatie van kantoorgebouwen* (pp. 322-326). Rotterdam: 010.

Aronsohn. (2018, 04 12). Retrieved from www.aronsohn.nl: http://aronsohn.nl/publication/download/duurzaam-hergebruik-betonconstructie.

Binnekamp, R., Geraedts, R., Van de Putte, H., & Vercouteren, J. (2010). Tijd. In J. Wamelink, *Inleiding bouwmanagement* (pp. 273-303). Delft: VSSD.

Blok, R., & Oudenaarden, N. (2007). Draagconstructie en gevel. In T. Van der Voordt, *Transformatie van kantoorgebouwen* (pp. 244-256). Rotterdam: 010.

Bouwput Utrceht. (2018, 04 08). Retrieved from www.bouwpututrecht.nl: http://www.bouwpututrecht.nl/2012/06/04/rgd-opleidingsvergadercentrum-knoop/

Burtonshaw-Gunn, S. (2009). *Risk and financial management in construction.* Farnham: Gower publishing .

Centraal bureau voor de statistiek. (2018, 04 02). Retrieved from www.cbs.nl: https://www.cbs.nl/nl-nl/nieuws/2016/44/26-duizend-woningen-erbij-door-transformaties-gebouwen

Chan, A., Chan, A., & Scott, D. (2004). Factors Affecting the Success of a Construction Project. *Journal of Construction Engineering and Management*, 153-155.

De architect. (2018, 04 08). Retrieved from www.dearchitect.nl: http://dearchitect.nl.s3-eu-central-1.amazonaws.com/app/uploads/2017/01/attachment-vatie-hoofdkantoor-asr_arc16.pdf

De beton groep N.V. (2018, 02 20). Retrieved from www.debetongroep.com: http://www.debetongroep.com/betonherstel.html

De Jong, P., & Soester, J. (2010). Kostenbeheersing bouw en exploitatie. In J. Wamelink, *Inleiding bouwmanagement* (pp. 323-355). Delft: VSSD.

De Jonge, H., Arkesteijn, M., Den Heijer, A., Van de Putte, H., De Vries, J., & Van der Zwart, J. (2009). *Corporate Real Estate Management Designing an Accommodation Strategy (DAS Frame).* Delft: Faculty of Architecture.

Douglas, J. (2006). *Building Adaption second edition.* Oxford: Butterworth-Heinemann.

Douglas, J., & Noy, A. (2005). *Building surveys and reports.* Oxford: Blackwell Publishing.

Duffy, F., & Hannay, P. (1992). *The changing workplace.* London: Phaidon.

Eitjes, P. (2017, 08 29). De Knoop. (M. Bozkurt, Interviewer)

Flapper, H. (2004). *Handboek voor complexe bouwprojecten.* Doetinchem: Reed Business Information.

Funda. (2018, 04 03). Retrieved from www.funda.nl: https://www.funda.nl/koop/alphen-aan-den-rijn/appartement-40574672-stadhoudersplein-67/

Geraedts, R., & Van der Voordt, T. (2007). Transformatiepotentiemeter. In T. Van der Voordt, *Transformatie van kantoorgebouwen* (pp. 382-398). Rotterdam: 010.

Gidado, K., & Wood, H. (2008). Project complexity in construction. *The international construction conference.* Brighton: University of Brighton.

Google maps. (2018, 04 08). Retrieved from www.google.nl: https://www.google.nl/maps/@52.095603,5.1542136,326a,35y,180h,39.4t/data=!3m1!1e3?hl=nl

Johnson, P. (1994). *The theory of architecture: concepts, themes and practices.* New York: Van Nostrand Reinhold.

Kamerling, J., & Kamerling, M. (2004). *Jellema 9 Utiliteitsbouw.* Zutphen: ThiemeMeulenhoff.

LBP Sight. (2018, 04 03). Retrieved from www.lbpsight.nl: https://www.lbpsight.nl/nieuws/project-wijnhavenkwartier-wint-berlagevlag

(2015). *PPS Rijkskantoor de Knoop Utrecht.* Utrecht: Consortium Rcreators.

Preethambuilders. (2017, 02 20). Retrieved from http://www.preethambuilders.com: http://www.preethambuilders.com/cracks-building-foundation-settlement/

Rijksgebouwendienst . (2015). *PPS De Knoop Contractclose.* Den Haag: Ministerie van binnenlandse en koninkrijksrelaties.

Rijksvastgoedbedrijf. (2018, 04 08). Retrieved from www.rijksvastgoedbedrijf.nl: https://www.rijksvastgoedbedrijf.nl/vastgoed/vastgoed-in-beheer/utrecht-rijkskantoor-de-knoop

Saraf, D. (2015). Study of factors affecting performance of construction project Vol.4 Nr.5. *International Journal of Science and Research*, 1339-1341.

Transformatieadvies. (2018, 04 02). Retrieved from www.transformatieadvies.nl: http://www.transformatieadvies.nl/Algemeen.htm

Van der Horst, A. (2018, 03 01). Development model. (M. Bozkurt, Interviewer)

Van der Voordt, D., & Van Wegen, H. (2000). *Architectuur en gebruikswaarde. Programmeren, ontwerpen en evalueren van gebouwen.* Bussum: Thoth.

Van der Voordt, D., & Van Wegen, H. (2005). *Architecture in use: an introduction to the programming, design and evaluation of buildings.* Oxford: Architectural Press.

Van der Voordt, T. (2007). *Transformatie van kantoorgebouwen.* Rotterdam: 010.

Van Doorn, A., Heintz, J., & Volker, L. (2010). Kwaliteit. In J. Wamelink, *Inleiding bouwmanagement* (pp. 234-272). Delft: VSSD.

Verschuren, P., & Doorewaard, J. A. (2015). *Het ontwerpen van een onderzoek (vijfde druk).* Amsterdam: Boom Lemma.

Wamelink, J. (2010). *Inleiding Bouwmanagement.* Delft: VSSD.

Yin, R. (2009). *Case study research (fourth edition).* Los Angeles: Sage Publications.

Zeiler, W. (2007). Installaties. In T. Van der Voordt, *Transformatie van kantoorgebouwen* (pp. 257-265). Rotterdam: 010.

Appendix

Interview questions

Preliminary interview questions

1. Wat is uw functie en wat was uw functie in het project?
2. Kunt u een beschrijving geven van het project?
3. Hoe ervaarde u het project?
4. Wat ging er minder goed?
5. Zijn er factoren geweest die problemen gaven met betrekking tot het behouden van de constructie?
6. Wat was de oorzaak van die factoren?
7. Wat waren de gevolgen voor de kosten?
8. Wat waren de gevolgen voor de tijd?
9. Wat waren de gevolgen voor de kwaliteit?

In depth interview question

Functionele eisen en randvoorwaarden:

1. Wat waren volgens u de belangrijkste functionele eisen en randvoorwaarden van het oude gebouw?
2. Wat waren volgens u de belangrijkste functionele eisen en randvoorwaarden van het nieuwe gebouw?

Transformatie constructie en non compliance analysis:

Technische kwaliteit

1. Wat was de huidige staat van de draagconstructie omtrent corrosie, barsten en verzakkingen?
2. Zo ja in hoeverre heeft dit problemen opgeleverd?
3. Welke invloeden heeft dit gehad op de prestaties en hoe komt dat?

Duurzame kwaliteit

4. Hoe duurzaam was het oude gebouw?
5. Heeft duurzaam maken van het nieuwe gebouw problemen gegeven?
6. Heeft dit invloed gehad op de prestaties en hoe komt dat dan?

Functionele kwaliteit

7. Wat was de huidige staat van de installaties?
8. Waren er problemen met betrekking tot de nieuwe installaties?
9. Heeft dit invloed gehad op de prestaties en hoe komt dat dan?

Architectonische waarde

10. Wat vond u van de huidige staat van het ontwerp van het gebouw?
11. Waren er problemen met betrekking tot het nieuwe ontwerp?
12. Heeft dit invloed gehad op de prestaties en hoe komt dat dan?

Project complexiteit

13. Was dit volgens u een complex project?
14. Zo ja in hoeverre heeft dit invloed gehad op de prestaties en hoe komt dat dan?

Prestaties in kosten, tijd en geld:

1. Wat waren volgens u de prestaties van het oude gebouw met betrekking tot kosten, tijd en geld?
2. Wat zijn volgens u de prestaties van het nieuwe gebouw met betrekking tot kosten, tijd en geld?

Preliminary interview Peter Eitjes

[Confidential information]

Preliminary interview Piet Brittijn

[Confidential information]

Preliminary interview Frans Bijl

[Confidential information]

In depth interview Piet Brittijn

[Confidential information]

In depth interview Frans Bijl

[Confidential information]