ACCURACY

OF THE INITIAL BUDGET OF REDEVELOPMENT PROJECTS

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ACCURACY

OF THE INITIAL BUDGET OF REDEVELOPMENT PROJECTS

THE IMPACT OF INTERNAL AND EXTERNAL FACTORS ON THE DEVELOPMENT OF THE BUDGET DURING THE REDEVELOPMENT PROCESS

Hayatım boyunca beni en iyi şekilde yetiştiren, her şeyin en iyisine layık olan annem ve babama çok teşekkür ederim

The research topic is based on my passion for redevelopment of existing buildings and my interest in the initial phase of these projects. These are originated from the experience I have with the redevelopment of a vacant building into student housing at SHS Delft, and the knowledge I acquired during my part time job at a real estate (re)development company. I experienced the complexity of the adaptation and transformation process, and the impact of missing information about the building on the process in reality. At the same time, I also perceived the deviation between the initial budget estimations and the actual costs and revenues. This made me wondering whether this was a problem which occurred sporadically, or if this was a general problem. The latter turned out to be the fact.

My master thesis led to a search for the reasons of the inaccuracy of budgets. During this search, I was invited by developers, former developers, cost advisors and others willing to participate in this research. I experienced the complexity of this research, and therefore also the complex nature of the construction industry. Each actor has her/his own perspective on the reasons for budget inaccuracies, each development process contains a unique sequence of the development activities and each developer uses her/his own method to acquire more information during the process to reduce the uncertainty.

Therefore, this research does not encourage to find systematic solutions for the problem of budget inaccuracies, but it encourages developers to perform risk analyses and building investigations in an early phase of the process for reducing the uncertainty, while maintaining the flexible attitude which is needed to react as quick as possible on changing circumstances.

Through this way, I would like to thank everyone who supported me during my search for these questions, everyone who participated in, and spread the questionnaire within their own network, and the developers who were open to share their information on such a sensitive topic. I would also like to thank my mentors Peter de Jong and Hilde Remøy, together with the two experts, who steered me towards the right direction during the entire research process.

And specifically, I would like to mention my parents and my both brothers for their endless support during my mission to become an engineer at Delft University of Technology and to become a real estate developer in the near future.

Arda Basak
Delft, January 2017

RESEARCH SUMMARY

1. INTRODUCTION

Unbalanced Dutch real estate market

Currently, the Dutch office market is still characterised by a high vacancy level: 15,0% of the total office stock is vacant (DTZ, 2016). The structural vacancy of offices became in the last decade both a financial problem for the owners, as well as a societal problem (Remøy, 2010; Remøy & van der Voordt, 2014). Overproduction, decreasing space per employee and hidden vacancy have been the drivers for the high vacancy and are slowing down the recovery, by which the lag in this period is increased.

Owners of vacant buildings can apply several strategies to cope with the vacancy of their real estate (Remøy, 2010). There are four main categories of strategies and several in-between options. The main categories are: *consolidation*, *renovation* or *upgrading (also adaptation)*, *demolishment and new construction*, and *transformation*. This research focuses on *adaption* and *renovation*, as well as on *transformation*. Seen from sustainability and market perspectives, which are characterised by high vacancy levels for offices and retail and at the same time by the urgency to meet the growing demand for housing, adaptation and transformation will remain a relevant strategy. Therefore, both adaptation and transformation need to be stimulated as much as possible.

Uncertainty in the initial phase of adaptation and transformation projects

Uncertainty in the adaptation and transformation process in relation to (a lack of) accuracy is a hurdle in dealing with the abovementioned problems. The initial phase of the real estate development process is often characterised by higher uncertainty, which often leads to inaccurate budget and risk estimations. The reduction of uncertainty through time has an important effect on project budgets; it means that budget estimates made early in the project life cycle are relatively inaccurate compared to those made later, because more information becomes available regarding the design detail and risks that might occur during the process (Winch, 2010).

Reduction of uncertainty through time has an important effect on the project budgets. Many studies have revealed that the estimated costs in the initial phase are often lower than the actual costs (Flyvbjerg, Holm, & Buhl, 2007; Bloem, 2009; de Waal, 2010; Winch, 2010). This means that estimations made in the initial phase have a high level of inaccuracy, and it also means that projects are often underestimated.

Besides missing information and other project data in the early phases of the project, there are many other factors which influence the cost development during the process, including the optimism bias, deliberate cost underestimation, manipulation of forecasts, client-related factors, but also changing market circumstances (Jackson, 2002; Flyvbjerg, Holm, & Buhl, 2007; Winch, 2010; Shapiro, Davies, & Mackmin, 2013).

Main problem to solve

The focus within this research is to investigate the *accuracy* of the estimated costs and revenues and the realised costs and revenues and to understand the *reasons* for budget inaccuracies. The establishment of the budget in the initial phase is emphasized within this research, as well as the main characteristics of the entire redevelopment process. Furthermore, the complexity of transformation projects specifically is investigated as well to understand to which extent transformation-specific risks (e.g. incorrect or incomplete documentation of the existing building) influence the inaccuracies of the costs within the redevelopment process. The main objective is to investigate which improvements can be made in the redevelopment process to increase the accuracy of budget estimations and decrease the effect of risks.

The main research question is as follows:

> *Which improvements can be made in the redevelopment process, and in particular in the establishment of the budget in the initial phase, in order to increase the accuracy of budget estimations and to diminish the probability and effect of risks?*

The findings of this research give an insight in the relation between the accuracy of the initial budget and the reasons for (in)accuracies in redevelopment projects. The target groups of this research are actors involved in the establishment of the initial budget and actors responsible for the redevelopment process (e.g. project developers, project managers and cost advisors).

2. RESEARCH METHODOLOGY

A mixed methods approach is applied in this research to increase its robustness; the combination of quantitative and qualitative research designs results in a triangulation wherein results of one method can be cross-checked by the results of the other method (Bryman, 2012). Data is collected through literature research, survey research and three case studies to answer the main research question. The literature research is used for different purposes within this research: its main purpose is to investigate the current knowledge on risks and reasons of cost and income inaccuracies in adaptation and transformation projects. Expert interviews are conducted in addition to the literature study to test and to complement the results of the literature study with knowledge from practice.

The survey, as the first part of the empirical research, is conducted to quantify and to rank the causes of cost inaccuracies in redevelopment projects. The knowledge that is generated by the survey results, gives an insight in the perceived cost generators within the redevelopment process. Furthermore, the survey gives an insight in the average accuracy of the construction costs, the revenues, the LFA and GFA, and the averagely used percentage unforeseen according to project developers, project managers, architects and cost advisors.

Three case studies are conducted to have a deeper understanding of the reasons for budget (in)accuracies. In these case studies, the difference between the initial budget and the realised costs and revenues in relation to the process is analysed by semi-structured interviews, content analysis and by the same self-completion questionnaire used in the survey. The results are cross-checked with the results of the survey and literature research to increase the validity of the research.

3. RESULTS LITERATURE STUDY

Activities within the (re)development process

The development process typically contains the following activities: *idea conception, feasibility analysis, the acquisition of an existing building, the design process, application for permits* or, in some cases, *the process to change the zoning plan, construction activities* and *the rental and/or sale of the building* (Gehner, 2008). The sequence of activities over the development phases is a part of the development strategy. The strategy also depends on the type of organisation, as well as the risk profile of the organisation.

Despite the linear models, the development process is hardly a linear process. Instead it can be best described as an iterative process in which the developer obtains more and more precise information in each iteration (Peiser and Frej, 2003). The increased amount of precise information, decreases the uncertainty within the process. This has a positive impact on the accuracy of budget estimations.

Acquisition process in redevelopment projects

The acquisition process in redevelopment projects in practice can be described by the following steps (Mensing, 2014): *initiate, select, calculate* and *bid*.

A property usually comes to developers' attention when it is suggested or tendered by (semi-)public parties, or by pro-active search of the current (market) stock or own portfolio. Due to increasing demands in the market, developers are constantly scanning the current stock to initiate a new redevelopment.

In the selection phase, potential buildings are selected following a two-step method. First, the location and the volume and shape of the existing building are analysed, followed by a second analysis on the functional, technical and juridical aspects of the building. The extent of the analysis depends on the amount of available information.

The calculations are based on simple sketches of floor plans. Cost and revenue calculations are based on the sketches and on possible scenarios, the desired quality and target group which determine the rent level and the construction costs, as well as the market risk. According to several studies, the construction costs and the percentage unforeseen are difficult to estimate in the early phases of a redevelopment project (de Vrij, 2004; Mackay, 2008; Kraag, 2015).

The last step is the actual bidding process. Depending on the risk profile of the developer, the bid can be based on the worst, base or best case scenario. A higher bid often comes with more conditions within the purchase agreement, for example with the reservation of change of zoning plan, or shared risks for the removal of asbestos. The latter often depends on the amount of available information about the existing building. Special conditions in the purchase agreement give the developer more space to investigate the building after acquisition.

Reducing uncertainty in the initial phase: getting to know the building

Adaptation and transformation of existing buildings have many advantages, but also more unexpected issues compared to new-built, and therefore a higher risk profile (Mackay, 2008; Remøy, 2010; Kraag, 2015). Before any adaptation work is undertaken, it is vital that the building being redeveloped be fully investigated to achieve a full understanding of the entire building (Douglas, 2006).

The main phases of the process of getting to know the building are as follows (Douglas, 2006, p. 66):

1. Acquisition
2. General feasibility
3. Desk top survey
4. General physical inspection
5. Specific physical inspection
6. Evaluation of options

According to Gehner (2008), process characteristics might change the order of the main phases. In some cases, general feasibility studies are performed to determine the bid for acquiring the building. Following the above-mentioned steps, increases the amount of gathered information about the building however. The sooner the building is mapped correctly, the less unforeseen interventions will occur during the design or realisation phases.

Establishment of the initial budget in redevelopment projects

According to literature, the initial budget consists of:

- construction costs,
- additional costs as a percentage of the construction costs,
- unforeseen costs as a percentage of the construction costs,
- revenues, based on market, locational and building characteristics,
- acquisition, or bid, based on the residual value,
- other costs, such as equipment costs, taxes and financing costs.

Most of the cost items are directly related to the construction costs; this emphasizes the importance of the accuracy of the construction costs. However, speed and efficiency in the development process are the determining factors for the accuracy of the initial budget, together with the missing details of the new design and the availability of enough information about the existing building. Therefore, most parties choose the use of key figures over calculations on element basis. The accuracy of the key figures which are used for determining the construction costs are argued and investigated in many studies (de Vrij, 2004; Mackay, 2008; Schmidt, 2012). Some have drawn

a conclusion that detailed models and calculations cannot be used in practice due to the limits in time and limits in budget.

As this research is focused on the budget accuracy, the budget estimating methods are used and tested in the empirical part of this research. Not only the impact of the budget estimating method on the development of the budget is considered within this research, but the impact of the entire development process. This gives a new insight on how the development strategy impacts the (in)accuracy of cost and revenue estimations and which role the use of key figures has between other reasons for budget inaccuracies.

Reducing uncertainty in the initial phase: conducting a risk analysis

Uncertainty in the initial phase can be reduced by conducting a risk analysis. According to Gehner (2006), the risk analysis consists of two sub-parts: risk identification and risk quantification. For each of these steps, several techniques and tools are available, which can be used to have more control on risks. The choice of these techniques and tools depends on factors such as actor roles, time, money or risk attitude of the developers.

According to Gehner (2006), risks are often identified by a list of already known (possible) risks: a checklist. The checklist is, according to the researcher, not suitable to use in project development, because each project is unique (especially in the case of transforming existing buildings) and the checklist is never complete. However, it is the most used method in project development, where experience with previous projects is used for new projects. This has been acknowledged by other studies and by expert interviews.

For the quantification of risks, project developers often use risk premium, or 'contingency allowance', for quantifying the risks, despite its impreciseness and subjectivity. In some cases, scenario analyses are conducted, but this is again often based on subjective input variables (Gehner, 2008; Mackay, 2008; Mensing, 2014).

Actor roles within the (re)development process

Actors have a certain impact in decreasing the uncertainty in the initial phase. Municipal organizations have a facilitating role in redevelopment projects by maintaining zoning plans, building decree and other municipal legislation. Municipalities experience structural vacancy as undesirable, redevelopment is a solution to increase the quality of life of specific areas and to stimulate interests for new developments (Remøy, 2010). Policy documents or letters of intent between the developer and the municipality can diminish the legal risks.
Investors are part of management in the real estate life cycle but rarely participate in redevelopment projects as investors have a certain distance to the market (Remøy, 2010).
Architects and cost advisors are in some cases involved in the acquisition phase and have a major role in the feasibility studies and in getting to know the building. The main task of the architect is to fit the new design in the existing structure.
Contractors still often join the project team after detailed design is completed and the permits are obtained. Therefore, it is important for contractors to have a complete building documentation to minimise the risk of unforeseen circumstances during construction. In some cases, contractors are involved in an early stage of the redevelopment process. This is considered when risk mitigation is the main focus instead of cost cutting and it heavily depends on the strategy and risk profile of the developers.

Redevelopment in inner city locations is a desired option for developers to redevelop and profit from higher revenues in inner cities. Developers may work on projects in cooperation with, or for the investor, or they develop a project of their own and sell it after completion. Developing for an investor has a benefit of reduced risks, through development and construction risks. An obstacle between investors and developers is the different view on the value of a building; developers often use the residual value to make redevelopment possible, while investors often use the market value or the book value (Remøy, 2010).

The developer's role within the (re)development process can be defined as follows (Gehner, 2008):

- The developer is responsible for the many activities of the redevelopment process due to the multidisciplinary character of real estate
- Each development project requires specialised local knowledge due to the unique characteristics of each location and, in the case of redevelopment, each building

- The development process is characterised by its long duration. Together with the cyclical character of the real estate market, it is hard to predict the construction costs or the market conditions,
- Real estate developer must deal with the long time horizon of real estate, especially in the case that a building is (re)developed for an investor or user. Changing demands from the investor or user may lead to changes in the development process.

Causes of cost inaccuracies and risks

An extensive literature study is conducted to map all factors within a (re)development process that may lead to cost inaccuracies. In total 18 studies are analysed, containing:

- studies on cost overruns in transportation infrastructure. These projects are characterised by deliberate underestimation and this aspect will be tested in redevelopment projects done by private parties;
- studies on risks and cost overruns in regular construction projects;
- In-depth analyses of cost overruns in utility buildings (n=1);
- risks in transformation projects.

All risks and causes are gathered and categorised in such a way, that the categories cover all aspects in the redevelopment process and that can be used in a survey. Expert interviews are conducted to review the findings and to complement the list with transformation-specific risks.

Availability of information during the process *E.g. general lack of information; lack of information at tender stage; lack of information at briefing*	Design development *E.g. incomplete design at tender phase; initial design lacks details*
Availability of information about the existing building *E.g. lack of information about asbestos, structure, façade, soil, installations and other building components; condition of the building unknown (measurements, foundation, roof, materialisation)*	Design brief *E.g. lack of detail or definition; client does not know what he/she wants*
Building characteristics *E.g. weak foundation; grid of building causes useless space; impossible to realise outdoor space; insufficient daylight for residential use; materials not fire resistant / rejected by fire department*	Design team performance *E.g. designer's attitude; understanding of cost/value; inadequate cost control; designer's awareness as to areas of cost risk*
Claims *E.g. aggressive or claims conscious contractors; contractors risk pressure; late information release*	Organisation *E.g. poor preparation and planning*
Contractual factors *E.g. wrong contract used; wrong allocation of risk in contract document*	Project management *E.g. management of design, site, contractors and suppliers; lack of leadership; lack of value management; communication methods; management approach*
Commercial pressure *E.g. tight bidding conditions; corner cutting clients*	Psychological factors *E.g. optimism; cognitive bias; intuition; risk attitude*
Estimations / calculations *E.g. poor cost advises; poor risk analysis; wrong estimation of unforeseen costs*	Site conditions *E.g. unforeseen site conditions, restrictions, things that basically go wrong resulting in a more expensive construction method*
Legal factors *E.g. legislation unclear; impossible to meet requirements of municipality or zoning plan*	Strategic behaviour *E.g. deliberate cost underestimation; manipulation of estimations; no release of information*
People / project team *E.g. inexperience or not qualified team; relationship between actors; stubborn client*	Time limits *E.g. unrealistic time planning for design; delays due to slow decision making; insufficient time or budget to establish realistic budget; unrealistic construction period*
Unforeseen interventions *E.g. changes in structure, facade, installations or other building components due to unforeseen situations*	External factors *E.g. changes in prices, indexes, inflation, legal factors or market trends*
Design changes *E.g. client driven design changes; design changes to maximise LFA/GFA ratio; design changes to maximise development potential*	

Table 1: Causes of budget inaccuracies, based on an extensive literature research

Causes of inaccuracies in revenues: market risk

The revenues consist of two major components: the rent level of a certain function and the gross initial yield. In the case of the sale of dwelling, the price per square meter is an important indicator for the value of the building. Parking is a form of other income. Rent levels are estimated by the initiator based on several factors (Shapiro, Davies, & Mackmin, 2013):

- market characteristics,
- locational characteristics,
- building characteristics.

Changing market situation can highly impact the revenues of a certain development. Currently (January, 2017), as the economy is recovering from the crisis, the demand in the residential market is strongly increasing, while in Amsterdam the market is even overheated. The interest rates are low for home buyers, foreign investors show their interest in the Dutch residential market and Dutch institutional investors have funds at their disposal for the investment in rental dwellings. In some specific areas in the larger cities, the demand for high quality offices are increasing. The fast-changing market circumstances impacts the momentum to develop or redevelop buildings; in some cases, quality requirements of already initiated developments change due to a decreasing market risk. This can be partially seen in deviations between expected and realised revenues.

4. EMPIRICAL RESEARCH

Survey findings

A survey has been conducted to use a larger group of experts for determining which factors in a redevelopment project have, from a statistical point of view, a high probability and a high effect on the development of the costs, and vice versa. The factors which may cause cost inaccuracies are derived from theory. Furthermore, the survey is used to gather information about the average accuracy of the construction costs, the revenues, the LFA and GFA. This survey is also used to gather data about the averagely used percentage unforeseen in the initial phase.

The sample size of the survey is 93. The group of 37 valid respondents consists of 23 project developers, 5 project managers (including 2 project managers working for a housing association), 4 cost advisors and 5 architects. All respondents are experienced with adaptation or transformation of existing buildings. The respondents' answers are categorised on type of actor and ranked on factors which have the highest perceived impact on the cost development. Remarkable differences that deviate from the average are marked in green:

Rank	n	1	2	3	4	5
Total	37	Design changes	Design development	Unforeseen interventions	Building characteristics	Missing information existing building
Developer independent	10	Design changes	Building characteristics	Missing information existing building	Design development	Unforeseen interventions
Developer delegated	3	Missing information during process	External factors	Design changes	Estimations / calculations	Unforeseen interventions
Developer contractor	6	Design changes	Building characteristics	Design brief	Unforeseen interventions	Design team performance
Developer investor	4	Unforeseen interventions	Building characteristics	Legal factors	Missing information during process	Design changes
Project manager	3	Missing information during process	Design development	Unforeseen interventions	Time limits	Design brief
PM – housing association	2	Strategic behaviour	Building characteristics	Time limits	Organisation	Estimations / calculations
Cost advisor	4	Design changes	Design development	Commercial pressure	Design brief	Design team performance
Architect	5	Missing information existing building	Building characteristics	Project management	People / project team	Design changes

Table 2: Ranking of the 5 factors which affect the cost development the most, categorised on type of actor (based on n=37 valid respondents)

Most actors agree on the two main factors for cost increases, which are:

- *client driven design changes* and,
- *transformation specific factors*.

Examples of transformation specific factors are *missing information about the building in the initial phase*, *unforeseen interventions* and *unsuitable building characteristics*. Remarkable is that the two project managers working for a housing association see *strategic behaviour*, *time pressure* and *organisational factors* as the main reasons for cost inaccuracies.

Important side note for the results based on the categorisation per actor type: the number of respondents is too small (between 2 and 10 per category) to draw reliable conclusions. However, the total survey results do give new insights on the initial budget accuracy which were not measured before, for redevelopment projects specifically. The existing theory is quantified and ranked; this clarifies what the main factors for cost inaccuracies are in redevelopment projects. This is another approach of showing how the complexity of redevelopment projects affect the budget estimations, and therefore also the financial feasibility of these type of projects.

The average perceived deviation between the initial budget and the realised costs are as follows (n=26):

- construction costs: +14%
- revenues: +9%
- unforeseen in the initial budget: 11,8% of the total construction costs.

Furthermore, the realised lettable floor area increases with +1,4% compared to the initially used LFA, and the GFA is 2,8% higher than the estimations. These results (page 72) show a large standard deviation. This emphasizes the large number of variables which determine the accuracy of the budget and the entire redevelopment process. Examples are the risk attitude of the developer, the development strategy, market related factors, and many other factors which are discussed in the theoretical framework of this report.

Case study findings

Three case studies of redevelopment projects are analysed to gain deeper understanding of how characteristics of the redevelopment process affect the development of the budget during the process. *Design changes* during the process are mentioned as the main reason for budget deviations, but design changes often originate from other factors within the process. The same applies for unforeseen situations during demolishment works and most other factors. These are investigated and emphasized in the cross-case analysis.

Cross-case analysis	*Case 1*		*Case 2*	*Case 3*
	Building 1	*Building 2*		
Deviation construction costs	+114%	+50%	-39%	-18%
Deviation construction costs / m2 GFA	+65%	+47%	-14%	-18%
Deviation rental income	+100%	+31%	-33%	+22%
Deviation LFA	+14%	+2%	-25%	0%
Deviation GFA	+29%	+3%	-28%	+11%
Unforeseen (% of cc)	10%	10%	5% initially, 3% before construction	10%
Causes of cost inaccuracy	1. Design changes 2. Design brief 3. Strategic behaviour and psychological factors 4. Availability of information about the existing building 5. Estimations / calculations 6. External factors		1. Design changes / design brief 2. Unforeseen interventions due to legal aspects 3. Unforeseen interventions due to external factors 4. Unforeseen interventions due to building characteristics and missing information 5. Estimations / calculations	1. Design changes 2. Project management 3. Time limits 4. Estimations / calculations
Main reason for design change	Market demand increases: → higher income → more floor area → higher quality		Mismatch between market characteristics and initial plan: → less floor area and costs Short preparation time → unforeseen situations	Delay in change of legislation: → long preparation phase → design optimisations → more reused materials → own coordination during construction phase

Table 3: Cross-case analysis, causes and extent of budget inaccuracy

Cross-case analysis

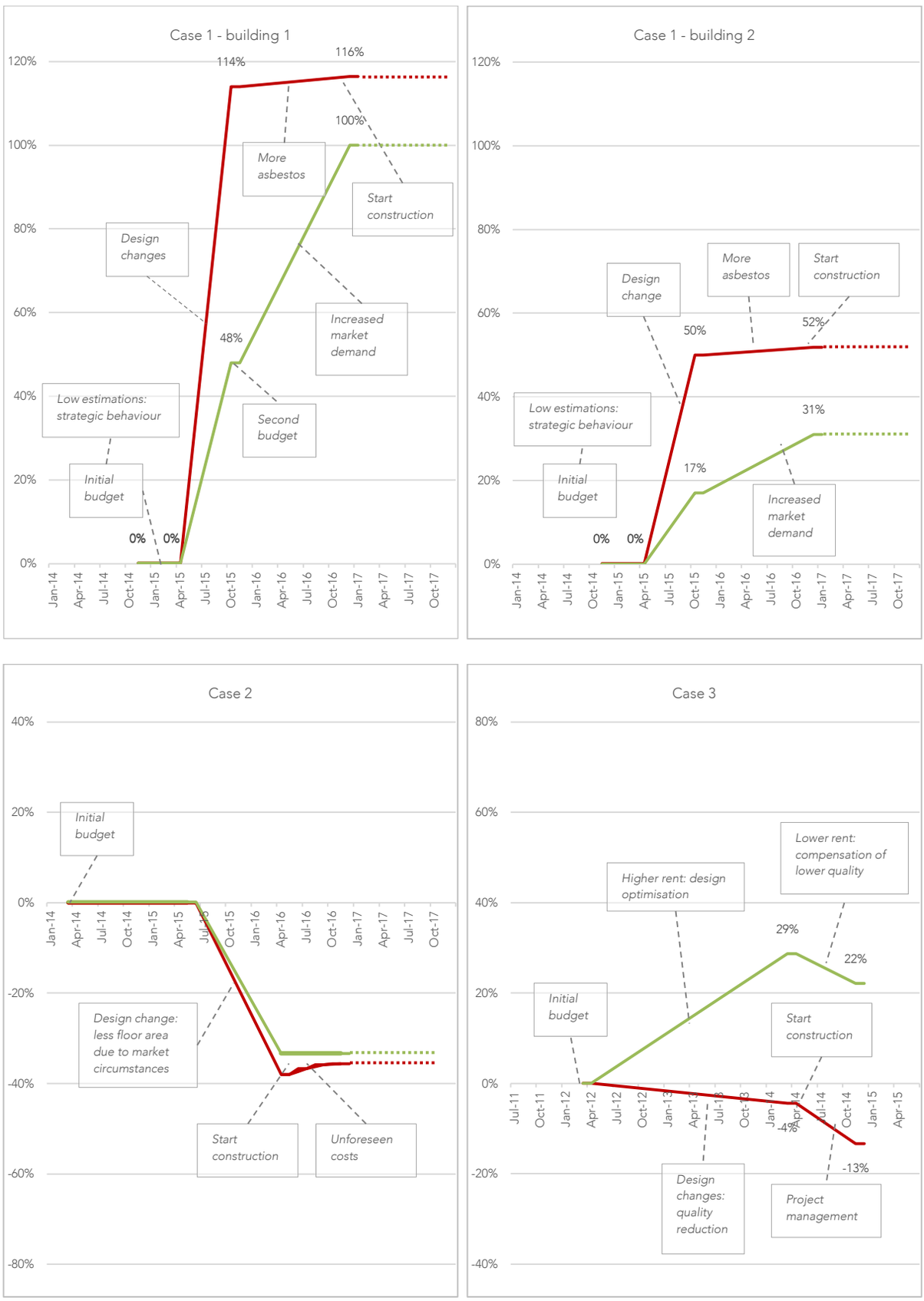

Figure 1: Cross-case analysis, classified on the development duration, key moments in the process and the main reasons for deviations in relation to the development of construction costs (red) and rental income per year (green)

5. DISCUSSION OF THE RESULTS

Public parties versus private parties: strategic misrepresentation versus design changes

The outcome of the main reason for inaccuracies in the budget are similar in all research methods (Table 25 on page 93). All three research methods reveal that *design changes as requested by the client/developer* is the main reason for cost inaccuracies in projects led by private parties.

In contrast to the abovementioned, the main reason for cost inaccuracies in *large infrastructure projects*, led by *public parties*, is *strategic misrepresentation* instead of *design changes* (Flyvbjerg, Holm, & Buhl, 2007). Even though the study of these authors is focused on different type of projects, led by different type of actors (public parties), a remarkable similarity can be found between the results of the research of Flyvbjerg et al. (2007) and the two respondents within this research working for a housing association (semi-public party). See Table 2. According to these two project managers, *strategic behaviour (i.e. deliberate cost underestimation)* is the main reason for cost inaccuracies. This indicates that projects led by public parties are more prone to strategic behaviour (e.g. deliberate cost underestimation and/or strategic misrepresentation) than projects led by private parties, irrespective of the type and size of the construction projects.

Relation between the deviation of costs, revenues, GFA and LFA in redevelopment projects

Even though the exact numbers of the survey are not fully reliable, this entire research reveals important insights in the relationship between:

- Development of costs,
- Development of revenues,
- Plan development,
- Changes caused by external and internal factors.

As it turns out, changing circumstances often directly impact the plan and budget during the process. The developer continuously keeps both the plan and the budget in balance, in order to prevent decreasing profit. This is illustrated in Figure 2.

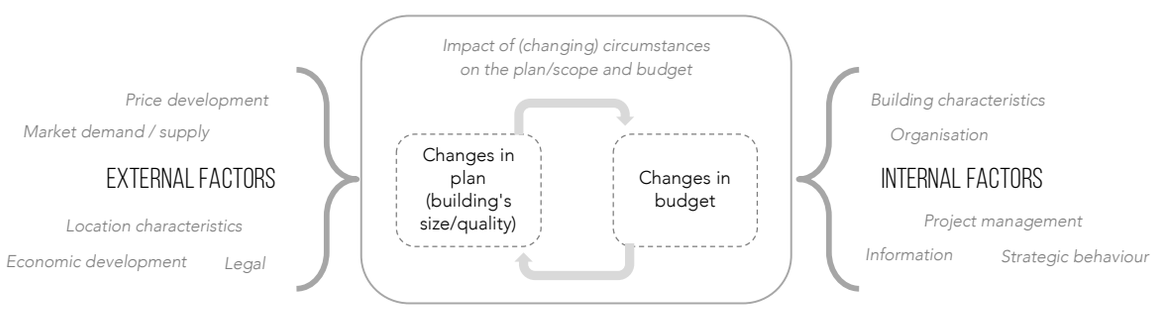

Figure 2: Balance between budget development and plan development

6. CONCLUSION

As this research consists of mixed method research with a quantitative and qualitative part, the answer on the main research question is approached through both methods, supported by the aspects derived from the literature study.

Accuracy of the initial budget

The high level of uncertainty in the initial phase leads to inaccurate project budgets in the initial phase, while at the same time the initial budget is often underestimated rather than overestimated (Flyvbjerg, Holm, & Buhl, 2007; Bloem, 2009; de Waal, 2010; Winch, 2010). This is confirmed by the survey research; the construction costs increase during the redevelopment process with 14%, suggesting that costs are averagely underestimated.

Remarkable is that the income in the initial budget is also underestimated. The percentage unforeseen is accordingly to the literature higher than new-built projects; almost 12% of the construction costs in the initial phase. These numbers can be explained by the cautious behaviour of most developers towards risks (Gehner, 2008).

The average numbers of the survey however show a high standard deviation, which affects the reliability of the results. Furthermore, the results are not based on exact calculations, but on perceived, average deviation, based on the knowledge and experience of the respondents. The high standard deviation of the survey results is confirmed by the accuracy of the budget of the three case studies. The deviations of the construction costs are: +114%, +50%, -39% and -18%, whereas the realised revenues deviate with +100%, +31%, -33% and +22% compared to the revenues in the initial budget.

Causes of budget inaccuracies

A cross-check of the survey and case study results reveal that both *design changes as requested by the client*, as well as *transformation specific factors* are the main causes of budget inaccuracies. A deeper understanding of the origination of these aspects revealed a variety of reasons for budget inaccuracies, such as design changes due to *changing market circumstances* and unexpected building characteristics, such as *problems in the structure* or a *higher quantity of asbestos*. For these causes, no pattern can be found based on the results of this research.

An answer on the research question is given below. The main research question is:

> *Which improvements can be made in the redevelopment process, and in particular in the establishment of the budget in the initial phase, in order to increase the accuracy of budget estimations and to diminish the probability and effect of risks?*

Based on the results of the case studies, the following aspects are recommended:

- Building investigations in an early phase of the project,
- Early contractor involvement, or, early removal of asbestos as a means to investigate the building (destructive research) in an early phase,
- A percentage unforeseen of at least 5% before and during construction works. Even if the building is investigated and the contractor is responsible for the risk of additional asbestos, a higher percentage unforeseen than new-built is recommended, since not all building aspects can be fully investigated.

Some factors can be influenced by the developer, while for other factors buffers need to be implemented in the initial budget. The survey results show a large standard deviation, which emphasize the large number of variables that determine the accuracy of the initial budget and the entire redevelopment process. The variety of the causes of budget accuracies corresponds with the role of the project developer within the (re)development process, which are (Gehner, 2008):

- the many activities of the redevelopment process due to the multidisciplinary character of real estate,
- the specialised local knowledge which is required due to the unique characteristics of each location and each building,
- the long duration of the process and the complexity to predict the future,
- changing demands from the investor or end-user may lead to changes in the development process.

The main solution is not to try to diminish all risks by fully investigating the building, or by establishing detailed cost calculations and designs in the initial phase, but by being flexible during the entire process and monitoring the information which become available during each iteration of the process (Gehner, 2008).

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READER'S GUIDE

This report contains four main sections:

1. Introduction and research methodology
2. Theoretical framework
3. Empirical research
4. Conclusions and recommendations

The first section consists of two chapters. In the first chapter, the problem analysis, problem statement, the main research question and the relevance of the research are described. This chapter forms the basis of the research, as this chapter describes the *WHY* aspect. The second chapter revolves around the *HOW* aspect: the conceptual framework is outlined, the sub questions are formulated and the research methods and data collection methods are described.

The second section, the theoretical framework, forms the basis for the empirical part; in the third until the sixth chapter, several aspects are investigated. This literature research is used to develop a survey and case study research, and more importantly, the acquired knowledge is used to cross-check the results of the empirical part.

Section three contains the actual data collection; in chapter 7 the results of the survey research are presented and in chapter 8 the case study research is described. In the ninth chapter, the results are discussed to determine whether these results are valid, reliable and replicable.

In the last section, the conclusions are drawn by answering the sub questions and the main research question. This chapter brings all findings from theory, survey research and case study research together, resulting in the modification of the existing theory. The recommendations for professionals and for further research are elaborated in chapter 10.

The appendix contains all other data which is generated during literature and empirical research. Due to anonymization reasons, not all personal data and interview transcripts are added to the appendix. For verification purposes, it is recommended to contact the researcher; contact information can be found on page 2.

TERMS, DEFINITIONS AND ABBREVIATIONS

Estimate:	*1. a tentative evaluation or rough calculation, as of work, quantity or size,* *2. a statement of the approximate cost of work to be done,* *3. a judgment based on one's impressions; an opinion* (Cretu, Stewart, & Berends, 2011, p. 3)
Uncertainty:	*a situation in which a number of possibilities exist and which of them has occurred, or will occur, is unknown* (Yoe, 2000)
Risk:	*'probability of event' x 'magnitude of loss or gain'* (Raftery, 1994)
Adaptation:	*any work to a building over and above maintenance to its capacity or performance (i.e. any intervention to adjust, reuse or upgrade a building to suit new conditions or requirements)* (Douglas, 2006, p. 1)*, with the preservation of its function*
Transformation:	*a major change of a building with alterations of both the building itself and the function it accommodates (Remøy, 2010)*
Budget accuracy:	*the deviation of a specific budget item between the initial budget and the realised costs and revenues*

RESEARCH BACKGROUND

1. RESEARCH BACKGROUND

The first chapter outlines the problem analysis, the problem statement which is derived from the analysis, followed by the main objectives and the research question. The last paragraph attempts to justify the societal and scientific relevance of this research, as well as the utilisation potential.
The problem analysis consists of two topics: the unbalanced Dutch real estate market and uncertainties in the development process. Both problems are reflected on the impact these have on the adaptation and transformation process.

1.1 PROBLEM ANALYSIS: THE UNBALANCED DUTCH REAL ESTATE MARKET

1.1.1 CURRENT SITUATION IN THE DUTCH OFFICE MARKET

Structural vacancy in the Dutch office market: after a peak in 2014, the vacancy in the office market has declined from 8,31 million square meters in the same year to 7,86 million in mid-2016, which is 15,0% of the total Dutch office stock (DTZ, 2014; DTZ, 2016). In the same years, the total stock has been declined from 49,6 million m2 to 49,2 million in 2016. Despite the decreasing vacancy level in the office market, the total vacancy remains both a financial problem for the owners, as well as a societal problem (Remøy, 2010; Remøy & van der Voordt, 2014). In the following paragraph the market dynamics and the drivers for the vacancy are discussed, and the forecasts on the vacancy levels.

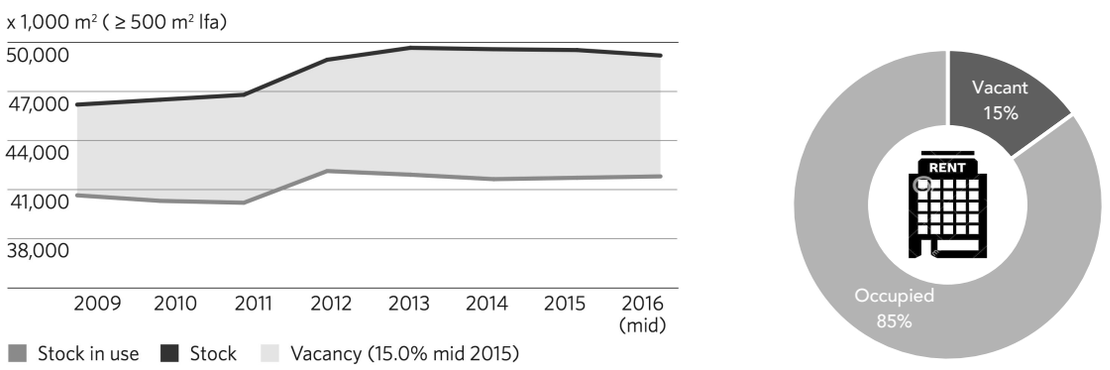


Figure 3: Stock in use versus total office stock (DTZ, 2016)

1.1.2 DRIVERS OF VACANCY AND FORECASTS ON THE MARKET

There is no significant difference between the quantitative demand and supply in a balanced real estate market. Since the production of real estate takes several years, the supply lags behind the growing demand in economic upswing, while during a recession some excess vacancy will be seen (Remøy, 2010). This phenomenon is called the *hog cycle*. In a healthy real estate market, the vacancy level will be around 5 percent. This percentage, which is called *friction vacancy*, is desired in a healthy market and it is necessary for making relocations of tenants possible.
However, the current vacancy level in the Dutch office market is substantially higher than the acceptable level of 5%, which is caused by a quantitative and qualitative mismatch between demand and supply. Overproduction, decreasing space per employee and hidden vacancy have been the drivers for the high vacancy and are slowing down the recovery, by which the lag in this period is increased. These reasons for the quantitative mismatch are elaborated below.

Overproduction

One of the main reasons for the high vacancy level in the Dutch office market is overproduction (Mackay, 2008; Remøy, 2010). Until 2008, the market was characterised as an expansion market. According to Putman (2010), developers benefit from the availability of credit before 2008. The knowledge on the demand side was not devel-

oped much due to the market circumstances: there was a supply-driven market. In the past 15 years, many office buildings have been realised in the Netherlands. Despite the stagnation of the economic growth and the growth of office jobs, the production of office buildings was continued. Municipalities stimulated the construction of offices by allowing office development and selling the land to developers. Developers developed office buildings and sold these to investors, while the take-up of offices was limited.
The real estate market has structurally changed under influence of the economic crisis; development of real estate often only starts when an end user has been contracted (Cuppen, 2011). The office market nowadays can be characterised as demand-driven. This caused less activity in the real estate markets than before the recession, which can be seen in the stabilisation of the office stock in recent years (Figure 3).

Decreasing space per employee

The new way of working is one element causing vacancy. The new way of working is a vision in which recent trends and information technology are drivers for the changing workplace environment, but also the organisation structure and culture (Bijl, 2007). This development decreased the required space per employee; from 26,6 square meter per employee in 2002 to 15 square meter per employee in 2015 (GeoPhy, 2016). A further decrease to 12 square meter per employee is expected between 2020 and 2025.

1.1.3 INVESTORS: DEVALUATED ASSETS

The value of assets which are in the portfolio of investors is mainly determined by the rental income and the gross initial yield (Shapiro, Davies, & Mackmin, 2013). The gross initial yield (*bruto aanvangsrendement*) represents the number of times a possible buyer is willing to pay. In structural oversupply, the rent level remains stable or even decreases. The real value of an asset thereby drops below the book value, resulting in yields which are below the expectations. Therefore, structural vacancy confronts many investors.

Both transformation and adaptation can be chosen by real estate owners as a strategy to cope with vacancy. Therefore, investors need to devaluate their assets, only in the case of a low or zero percent debt capital is used. These strategies are elaborated below and compared to other strategies.

1.1.4 STRATEGIES FOR COPING WITH VACANCY OF BUILDINGS

Owners of vacant buildings can apply several strategies to cope with the vacancy of their real estate (Remøy, 2010). There are four main categories of strategies and several in-between options (Table 4). The main categories are: consolidation, renovation or upgrading, demolishment and new construction, and transformation.

Owners of vacant buildings are increasingly opting for transforming their building into another function. *Consolidation* requires maintenance, while no incomes are generated. New tenancy is often time consuming and not realistic in the Dutch office market due to the high vacancy level.

As the demand for office space on specific locations in Amsterdam is currently increasing, *adaptation* of vacant office buildings for other office market segments or renovation of the property is becoming a strategy which is applied in specific situations and locations for coping with vacancy. Case 1 within this research is such an example, which is elaborated in chapter 8.

Transformation is another strategy for coping with vacancy. Compared to other interventions, transformation may be expensive and disrupt the incomes from and the use of the building (Remøy, 2010). Its future market value accommodating the new function must be higher than for offices. However, if working out successfully, transformation sustains a beneficial and durable use of the location and building, implies less income disruption than the before mentioned strategies and has higher social and financial benefits.

Next to the three before mentioned strategies for coping with vacancy, *demolishment and new construction* is a fourth intervention that 'creates possibilities for developing a new building fit to future users' needs, and is especially interesting in a declining office market' (Remøy, 2010, p. 115). In some cases, it is inevitable to demolish the existing structure due to floor heights which cannot meet the requirements for its future use. Compared to other strategies, transformation takes time, leads to a delay of income and disrupts both market and location develop-

ment. Also, in the case that the building is not yet technically obsolete, it might be a waste of resources. Reusing building components could diminish the waste stream.

Option	*Benefits*	*Drawbacks*
Consolidate	*Preserves the property* *Sustains existing use* *Ensures ongoing service and lifespan*	*Requires maintenance costs though no incomes are generated*
New tenancy – better study of the market	*Find a suitable tenant, may ensure ongoing beneficial use of the property*	*May be time-consuming to find a user for a structurally vacant building, requires maintenance, refurbishment or incentives*
Mothball	*Minimizes running costs, such as cleaning, heating and lighting*	*Costly to keep sage and secure, vulnerable to vandalism and squatting, dust and dirt accumulation, dampness in the building, no rental income*
Anti-squat	*Minimizes running costs, secures the building against squatting and vandalism*	*Exposed to wear and tear, inhabitation may influence possible tenancy negatively*
Dispose	*Realises asset/site value, reduces management and operating costs*	*Loss of potentially useful asset, price may not correspond to book value*
Demolition and new building	*New building tailored to meet users' preferences*	*Disruptive and expensive, delay of income, location characteristics cannot be influenced*
Adapt and renovate	*Enhances the physical and economic characteristics of the building, delays, deterioration and obsolescence, reduces the likelihood of redundancy, sustains the building's long term beneficial use*	*Disruptive and expensive, extended lifespan is unlikely to be as great as a new building, upgraded performance cannot wholly match that of a new building, location characteristics cannot be influenced*
Transform	*Enhances and alters the physical and economic characteristics of the building, prevents deterioration and obsolescence, sustains the building's long term beneficial use, sustains social coherence in the area*	*Disruptive and expensive, market uncertainty, location characteristics may not suit new function, building costs may be out of control, new rental function may not be the core business of the owner*

Table 4: Options for property owners to cope with structural vacancy by different types of interventions, derived from Remøy (2010), based on Douglas (2006)

This research focuses on adaption and renovation, as well as on transformation. Seen from the market perspective, which is characterised by its high vacancy level for offices and retail and at the same time by the urgency to meet the growing demand for housing, transformation needs to be stimulated as much as possible. Another reason for choosing to focus on adaptation and transformation is from sustainability perspective: since buildings use 40 percent of the global energy, 40 percent of the global resources, emit one third of the greenhouse gases, it is important to maximise the technical lifespan of the building components and to minimise the waste streams as much as possible (UNEP, 2016).
Besides developments in the market and the awareness of sustainability, there are other reasons for adapting and transforming buildings. These main influences are discussed as follows (Douglas, 2006):

Legal developments	*The Crisis and Recovery law in the Dutch planning law has changed the legal procedures to stimulate the redevelopment of existing buildings.*
Conservation	*Cultural as well as technical reasons can influence the decision to adapt a building rather than demolish and newly build the site. The architectural or historic importance of a building may be sufficient reason why it should be saved.*
Legal restraints	*Planning constraints can prohibit the demolishment of an existing building. This is the case when a building is listed as monumental. The owner may often adapt the building in its existing use or transform it to another use.*
Timing	*Redevelopment of existing buildings is often quicker than new build, depending on the extent of works and the need to change the zoning plan or not. Demolishment and new-built often takes extra time, because of the construction of the new foundation, new structure and in some cases soil decontamination.*
Available grants	*In some cases, particularly with the adaptation or transformation of monumentally listed buildings, grants may be available to help with the cost of adaptation or transformation.*

Table 5: Reasons for adapting and transforming rather than demolishing and new-built (Douglas, 2006)

Definition of transformation and adaptation within this research

Within this research, *transformation* and *adaptation* are often used terms. The first is defined as follows:

'Adaptation includes any work to a building over and above maintenance to change its capacity, function or performance (i.e. any intervention to adjust, reuse or upgrade a building to suit new conditions or requirements)' (Douglas, 2006, p. 1)

Adaptation is interpreted as the overarching term in which *transformation* is covered. Remøy (2010, p. 114) defines the latter as '*a major change of a building with alterations of both the building itself and the function it accommodates*'. Within this research, *adaptation* is used for works to a building over and above maintenance with the *preservation of its function*, while *transformation* is used in the case when its *function is being changed* (e.g. from office use to residential use).

1.1.5 TRANSFORMATION IN THE DUTCH OFFICE MARKET: VACANCY VERSUS SHORTAGE

In the upcoming years, the quantitative shortage in the Dutch residential market is expected to be four to five percent of the total housing stock (Vastgoedmarkt, 2015). The shortage on the market arises mainly by the slowdown of the production due to the financial crisis, changes in the regulations for housing associations, but also by a faster increase of the population than expected. Specifically, for the Netherlands, political insecurity around subsidies on the social housing and the mortgage market were other causes for the shortage in the housing market. Furthermore, urbanisation leads to a higher demand on the residential market of the larger cities, which makes transformation a possible solution for solving the financial problems of the property owners of vacant buildings, as well as adding extra square meters to the housing stock.

The amount of transformed buildings in the Dutch real estate market has been increasing in the past few years. According to a research of JLL (2015), 1,8 million square meter office space has been transformed between 2010 and 2015. More than 1,1 million square meter office space changed its function into residential, while a half million has been transformed into hotels (Figure 4).

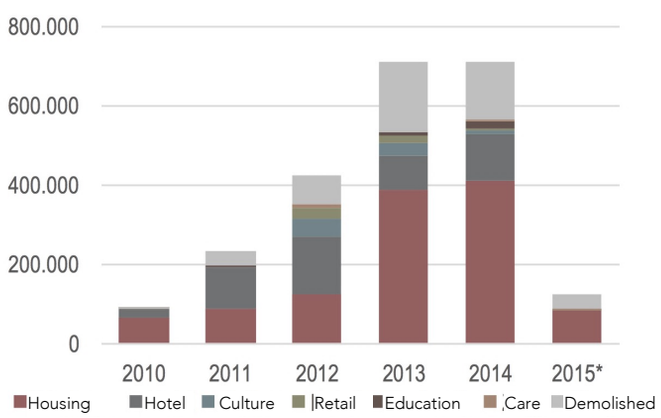


Figure 4: Yearly decline of office stock (in m2, from 2010 until Q1 2015 (JLL, 2015)

Even though not all vacant buildings are currently suitable for transformation due to legal, financial, technical, functional and cultural-historical factors (Remøy & van der Voordt, 2014), adaptation and transformation will remain the main task for the future. As the economy recovers and the demand for new built real estate increases, the preservation of the existing stock will remain a relevant issue.

Ideally, all legal, financial, technical and functional factors are considered in the early phase of a (possible) transformation project to assess the feasibility, but missing information about both the existing structure, as well as missing design details result in a large bandwidth within the calculations that are part of the feasibility study. Therefore, uncertainty in the adaptation and transformation process in relation to (a lack of) accuracy is a hurdle in dealing with the structural vacancy problem. This phenomenon is discussed in the next paragraph.

1.2 PROBLEM ANALYSIS: UNCERTAINTY IN THE INITIAL PHASE

1.2.1 INTRODUCTION: NATURE OF THE CONSTRUCTION INDUSTRY

Construction contractors have been slow in applying proper management methods in construction projects. Most project failures are attributed to the slow, sluggish and nebulous response to the changing environment. Below, explanations are given for why the construction industry has been slow in applying management procedures that have proven effective in other industries (Raftery, 1994):

- Construction projects are unique
- Construction projects involve many skills largely non-repetitive in nature
- Projects are constructed under local conditions of weather, location, transportation and labour that are beyond the contractor's control.
- Construction firms, in main, are small operations, with the management decisions being made by one or two persons (Clough & Sears, 1994)
- The future cannot be forecasted
- Construction is a high-risk business.

The abovementioned reasons are often originated by the characteristics of the real estate industry. Many books have been written about the nature of the industry, which are characterised as follows (Clough & Sears, 1994; Raftery, 1994):

- It is fragmented
- It is sensitive to economic cycles
- There are extraordinary diversity of professions, specialists and suppliers
- It is largely affected by external environments.

Another important characteristic of the construction industry, which differs from other industries, is that the manufacturing facility or plant must move to the construction site (Raftery, 1994). These characteristics often lead to complexity and uncertainty within the process.

1.2.2 INFORMATION AND UNCERTAINTY

The abovementioned characteristics of the real estate industry lead to the fundamental problem in the management of information; uncertainty (Winch, 2010). Uncertainty is defined as the lack of all the information required to take a decision at a given time. Figure 5 illustrates uncertainty as the difference between the information required for making decisions and the information available. This uncertainty has two sources:

- Complexity, or the situation where information is available, but it is too costly or time-consuming to collect and analyse;
- Predictability, or the situation where the past is not a reliable guide to the future – the future is unknowable, but experience is a valuable guide to the future in many situations. In chapter 5 these aspects are elaborated in more detail.

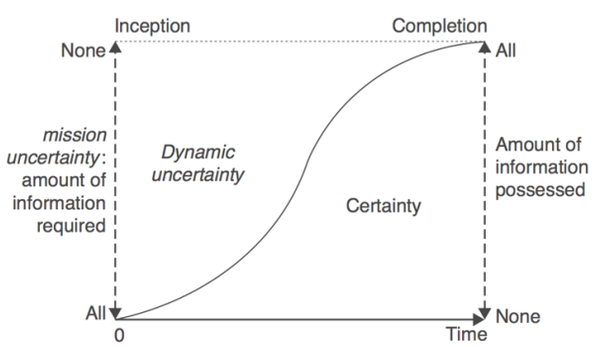


Figure 5: The project process as the dynamic reduction of uncertainty through time (Winch, 2010)

The initial phase of the real estate development process is often characterised by higher uncertainty, which often leads to inaccurate budget and risk estimations. The reduction of uncertainty through time has an important effect on project budgets; it means that budget estimates made early in the project life cycle are relatively inaccurate compared to those made later, because more information becomes available regarding the design detail and risks that might occur during the process (Winch, 2010).

Reduction of uncertainty through time has an important effect on the project budgets. Many studies have revealed that the estimated costs in the initial phase are often lower than the actual costs (Flyvbjerg, Holm, & Buhl, 2007; Bloem, 2009; de Waal, 2010; Winch, 2010). This means that estimations made in the initial phase have a high level of inaccuracy, and it also means that projects are often underestimated.

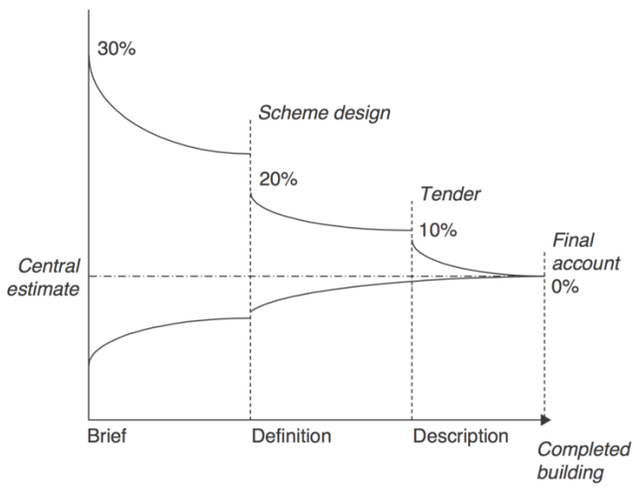


Figure 6: The changing accuracy of estimates (Winch, 2010, p. 257)

Besides missing information and other project data in the early phases of the project, there are many other factors which influence the cost development during the process, including the optimism bias, deliberate cost underestimation, manipulation of forecasts and client-related factors (Jackson, 2002; Flyvbjerg, Holm, & Buhl, 2007; Winch, 2010). These factors are analysed and presented in chapter 6.

The focus within this research is to understand the relationship between the development of the costs, as well as the revenues of projects which are done by private parties, such as project developers. Furthermore, the complexity of transformation projects specifically is investigated as well to understand to which extent transformation-specific risks influence the inaccuracies of the costs within the redevelopment process.

1.3 PROBLEM STATEMENT

The current Dutch office market shows a major oversupply of office space, while at the same time the quantitative shortage in the Dutch residential market is expected to be four to five percent of the total housing stock (Vastgoedmarkt, 2015; DTZ, 2016). A part of the vacant buildings is structurally vacant. Owners of vacant office buildings can apply different strategies for coping with their vacant buildings: consolidation, demolishment and new construction, adaptation and renovation, and transformation (Remøy, 2010).

Seen from the market perspective, which is characterised by its high vacancy level for offices and retail and at the same time by the urgency to meet the growing demand for housing, transformation needs to be stimulated as much as possible. Another reason for choosing to focus on adaptation and transformation is from sustainability perspective: since buildings use most of the global energy and resources, it is important to maximise the technical lifespan of the building components.

However, not all vacant buildings are currently suitable for transformation due to legal, financial, technical, functional and cultural-historical factors (Remøy & van der Voordt, 2014). Ideally, all factors are considered in the early phase of a (possible) transformation project to assess the feasibility, but missing information about both the exist-

ing structure, as well as missing design details result in a large bandwidth within the calculations that are part of the feasibility study. Therefore, uncertainty in the adaptation and transformation process in relation to (a lack of) accuracy is a hurdle in dealing with the structural vacancy problem.

Reduction of uncertainty through time has an important effect on the project budgets. Therefore, this research is focused on exploring the causes of cost inaccuracies in redevelopment projects specifically, as well as the impact of these factors on the development of costs. Furthermore, the relation between the development of cost and revenues are explored within this research, as well as an analysis is done for understanding the choices being made by the client and the developer during the redevelopment process. The main objective is to investigate which improvements can be made in the redevelopment process, and in particular in the initial phase, in order to increase the accuracy of estimations and decrease the amount of risks.

Insufficient information often leads to uncertainty in the initial phase and uncertainty again leads to inaccurate estimations. Besides insufficient information, many other factors influence the accuracy of cost estimations.
Redevelopment of existing projects are characterized by a higher complexity which leads to more risks. However, it is unclear what the impact of the complexity of redevelopment projects is on the accuracy of the initial budget and which factors impact the development of the budget the most. By investigating the main causes for budget inaccuracies, uncertainty in the initial phase may be reduced.

1.4 RESEARCH QUESTION

In this paragraph, the main objectives and the main research question are formulated, both derived from the problem analysis.

1.4.1 MAIN OBJECTIVES

This research is aimed at understanding how budget inaccuracies in the initial phase occur, which are partially caused by a high uncertainty due to missing information in the early phases, but also due to other factors. Therefore, the main objectives are to investigate the:

- current knowledge on risks and causes of cost inaccuracies in redevelopment projects,
- main reasons for budget inaccuracies (both costs and revenues) in redevelopment projects,
- impact of the complexity of redevelopment projects on the accuracy of the budget,
- accuracy of the initial budget in redevelopment projects,
- relation between the development of cost and revenues,
- commonly used risk analysis methods in practice,
- establishment of the initial budget in practice,
- improvements that can be made in the redevelopment process, and in particular in the initial phase, in order to increase the accuracy of estimations and to diminish the probability and effect of risks.

1.4.2 MAIN RESEARCH QUESTION

Derived from the problem analysis and the main objectives, the main research question is formulated below.

Which improvements can be made in the redevelopment process, and in particular in the establishment of the budget in the initial phase, in order to increase the accuracy of budget estimations and to diminish the probability and effect of risks?

1.5 RELEVANCE

1.5.1 SOCIETAL RELEVANCE

Towards a balanced market by stimulating transformation projects

First of all, structural vacancy is a societal problem of economic and social decay (Remøy, 2010). Especially mono-functional office areas deal with social insecurity which can be seen through vandalism and other illegal activities. Furthermore, investors have been suffering in the last decade by a missing income caused by (structural) vacancy (Remøy & van der Voordt, 2014). Investors are dealing with an increasing percentage of vacancy in their portfolio. Normally, they intend to wait for the right tenant. But the vacancy level in the Dutch office and retail market is still high compared to the acceptable level of 5% (DTZ, 2016). Forecasts show that the vacancy will remain high in the Dutch office market. Consolidation therefore will remain the strategy that results in missing income for most the office buildings, even though the market is recovering.
Adaptation and transformation of vacant office buildings is one of the possibilities to cope with vacancy, but also to partially solve the quantitative shortage of the housing market (Remøy, 2010; JLL, 2015). Especially in the inner-city areas the net present value for transformation may be higher than for consolidation, where the sale of a vacant office building may become an attractive financial option.

Sustainability

Deriving from the previous sub-paragraph, the adaptive re-use of existing buildings is a sustainable option to increase the functional and technical lifespan, while simultaneously the building materials are reused maximally and the waste streams are minimised compared to demolition and new-built. In the Netherlands, the building industry is responsible for 25% of the road traffic, 35% of the waste produced and 40% of the energy consumption and CO2 emission (Lichtenberg, 2005; UNEP, 2016). This research contributes to the stimulation redevelopment projects, by bringing new insights to the financial aspects of redevelopment projects, as currently the financial feasibility is still a hurdle in redevelopment projects.

1.5.2 SCIENTIFIC RELEVANCE

A concise literature study revealed that in practice the costs of redevelopment projects are (still) seen as one of the most important obstacles for transformations. The literature study revealed that there are studies done in the field of:

- Cost and income generators on building level of redevelopment projects,
- Cost overruns in utility buildings, infrastructure projects and building projects, both led by public and private parties,
- Risks in construction and redevelopment projects,
- Budget accuracies in transportation infrastructure.

However, an overview of causes of budget inaccuracies on process level in redevelopment projects is missing. Thereby, this research is not only focused on the accuracy of the key figures only, but all factors which may occur during a redevelopment process. These factors are gathered through literature study (in chapter 6 and appendix), and quantified and ranked in the empirical part of this research. The results of this research give a new insight on the main causes of budget inaccuracies, which can be used in practice and in literature to readjust the focus if necessary.

1.5.3 UTILISATION POTENTIAL

The complexity of adapting or transforming an existing building due to missing building information was the main reasons to start this research, combined with the experienced inaccuracy of the initial budget. As literature proves, there is a general problem of inaccurate budget estimations in the initial phase. The higher uncertainty and complexity in redevelopment projects compared to new-built projects may have an amplifying effect on the inaccuracy of the initial budget.

At the same time, real estate development projects are more complex and uncertain in areas in which the available land is becoming scarcer (Gehner, 2008). Development locations are no longer mostly greenfield areas, but also brownfield and inner-city locations. Redevelopment is taking the place of new construction. As the demand for real estate is increasing, especially in the inner-city locations of the large cities in the Netherlands, the number of parties that are willing to acquire a building for redevelopment purposes is also increasing. This is experienced by market parties, resulting in smaller margins than the situation before the economic recovery, which increases the urgency of having accurate costs and revenues. Therefore, there may be a financial problem for the parties that carry the risks, which can be the client or the project developer, and in some cases the contractor. Only by knowing the main causes for budget inaccuracies in redevelopment projects and the extent of the inaccuracy, its occurrence may be diminished.

RESEARCH METHODOLOGY

2. RESEARCH METHODOLOGY

This section discusses the research methodology. First, the conceptual model is presented, followed by the research strategy and the sub questions. This is followed by the research design and the research instruments used for data collection.

2.1 CONCEPTUAL MODEL

The conceptual model shows how the different topics of this research relate to each other. Main concepts within this research are:

- uncertainty in the initial phase of redevelopment projects
- characteristics of the redevelopment process
- accuracy of the initial budget.

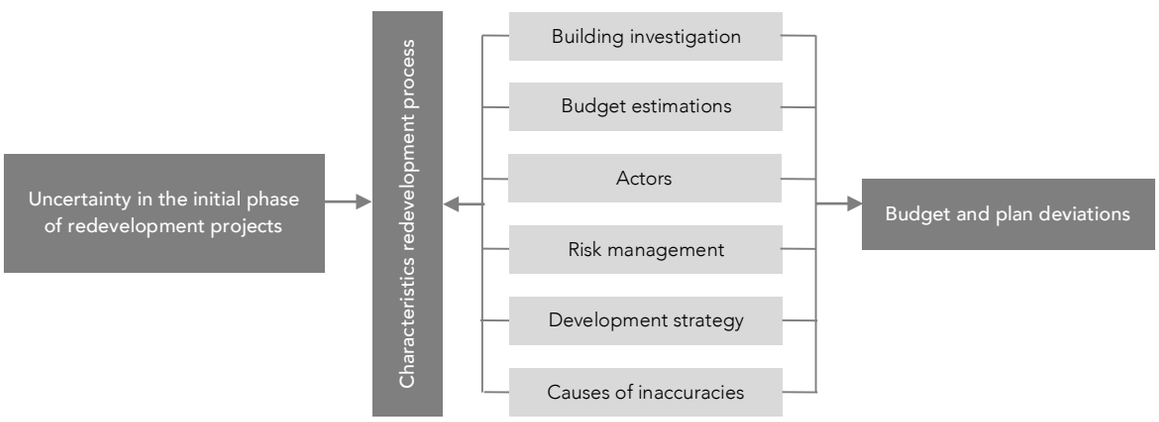


Figure 7: Conceptual model

The aim of this research is to investigate which factors within the redevelopment process are the main drivers for budget inaccuracies. The actor roles, budget estimating methods, building investigation, risk management and development strategy are considered within this research as well.

2.2 RESEARCH STRATEGY

This paragraph outlines the sub questions which are formulated for this research. For every sub question, the research strategy, research methods and the instruments for data analysis are described.

1. What is the (average) accuracy of the initial budget and percentage unforeseen in redevelopment projects?

Objective	To gain insight in the *accuracy* of the initial budget and plans
Research themes	Budget accuracy and budget estimations
Research strategy	Quantitative • Step 1: identify the establishment of the initial budget by reviewing scientific literature and by interviewing experts • Step 2: identify the extent of cost accuracies in redevelopment projects and the accuracy of the use of key figures by reviewing scientific literature and by expert • Step 3: investigate the (perceived) budget accuracy of redevelopment projects through a survey and case studies
Methods	Review of scientific literature, expert interviews, survey research and case studies
Instruments	Atlas.ti, Qualtrics and Excel

2. Which factors within the redevelopment process are the main causes for cost inaccuracies and what are the perceived probability and effect of these factors on the development of the costs?

Objective	To gain insight in the *reasons* for potential inaccuracies between the estimated budget in the initial phase and the realized costs and revenues
Research themes	Characteristics of the redevelopment process and budget accuracy
Research strategy	Qualitative and quantitative • Step 1: identify risks and causes for cost inaccuracies in the construction industry by reviewing scientific literature • Step 2: identify risks and causes for cost inaccuracies in redevelopment projects specifically, by reviewing scientific literature and by performing expert interviews • Step 3: investigate the probability and impact of the causes on the development of costs, based on general, not project-related perceptions • Step 4: investigate the probability and impact of the causes on the development of costs, based on specific cases
Methods	Review of scientific literature, survey and case studies
Instruments	Atlas.ti, Qualtrics and Excel

3. How does the development strategy in the redevelopment process, and in particular in the initial phase, affect the development of the budget?

Objective	To gain insight in the relation between choices made by the developer during the redevelopment process and the development of the budget
Research themes	Development strategy, characteristics of the redevelopment process and budget accuracy
Research strategy	Qualitative and quantitative • Step 1: investigate the role of the developer within a development process by reviewing scientific literature • Step 2: investigate the process phasing of a redevelopment project, the sequence and the development strategy • Step 3: investigate the characteristics of the process in the initial phase (steps towards acquisition) and the process to get to know the building • Step 4: investigate actor roles in the redevelopment process, budget estimating methods and risk analysis methods • Step 5: reflect abovementioned steps towards the process of a specific case • Steps 6: investigate which of the abovementioned process characteristics affect the development of the budget
Methods	Review of scientific literature and case studies
Instruments	Atlas.ti, Qualtrics and Excel

4. Which improvements can be made in the redevelopment process to increase the accuracy of the initial budget and decrease the risks?

Objective	To draw up *areas for improvement in the development process* regarding the accuracy of initial budget in redevelopment projects
Research themes	Development strategy, process characteristics and budget accuracy
Research strategy	Qualitative • Analyse cost increasing factors derived from case studies and reflect these to the development process
Methods	Review of scientific literature and case studies
Instruments	Atlas.ti, Qualtrics and Excel

2.3 RESEARCH METHOD

This paragraph outlines the research method. First, the research design is presented and elaborated, followed by the research instruments used for data collection.

2.3.1 RESEARCH DESIGN

This research consists of mixed methods, where both the cross-sectional research design and the case study design are combined. The combination of two different research designs makes quantitative and qualitative research possible, resulting in a triangulation wherein results of a research of one method can be cross-checked by the results of the other research method (Bryman, 2012). According to the literature, the disadvantage of a mixed methods research is the possibility of a missing relation between the two combined research designs. This is considered within this research by comparing and cross-checking both the results of the survey and the case studies in the conclusion of this report. The research design is presented in Figure 8.

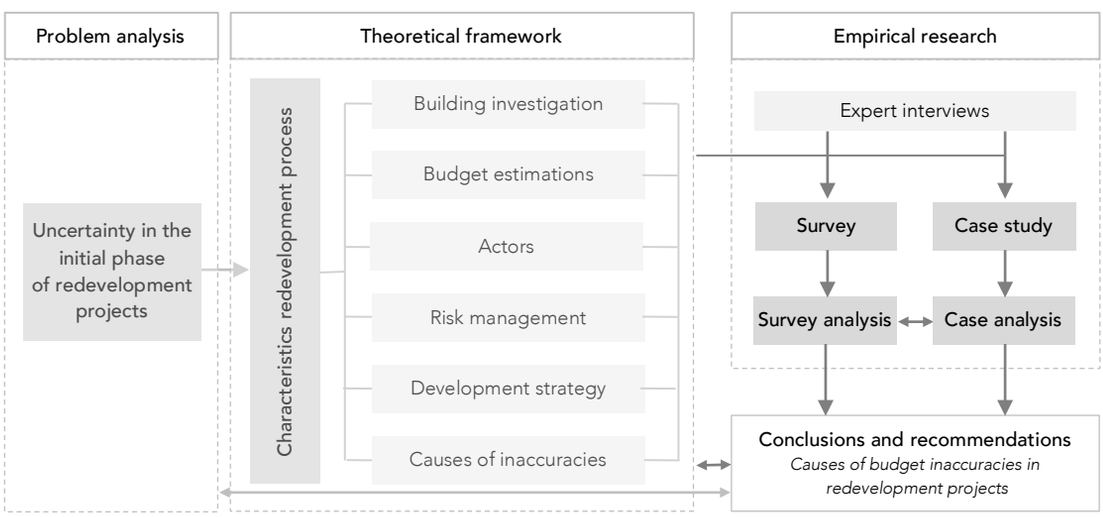


Figure 8: Research design

2.3.1 RESEARCH METHODS

Literature study

Literature study is used for different purposes within this research: the problem analysis is supported by literature to understand the origin and the extent of budget inaccuracies in the construction industry, while literature study is also used to identify the research questions. A more extensive literature research is used as a basis for the empirical part, which consists of a theoretical framework of four chapters. These chapters are according to the conceptual model, with subjects revolving around the three main themes of this research, which are: *uncertainty in the initial phase of redevelopment projects, characteristics of the redevelopment process and budget accuracy in redevelopment projects*. The following subtopics are discussed in the literature study:

- Process of building investigation to reduce uncertainty
- Process of establishment of the initial budget and methods to determine costs and revenues
- Process phasing and strategy in redevelopment projects
- Actor roles in redevelopment projects
- Risk management
- Causes of budget inaccuracies in redevelopment projects

The latter is an important part of the theoretical framework. This chapter consists of an overview of causes for cost overruns and risk-indicators within the construction industry in general, but also in adaptation and transformation projects specifically. These two topics are well-researched areas and will be used as a basis to determine the risks and reasons for budget inaccuracies in redevelopment projects. The empirical part of this research adds new reasons to the existing literature and quantifies these.

Empirical research

The empirical part of this research consists of several methods to increase the robustness of the research; expert interviews are used to test the theory, the survey is used to quantify the existing theory and the case studies are used to gain deeper understanding of the main reasons for budget inaccuracies. The results of all methods are cross-checked in the conclusion. Each step is elaborated below.

1. Expert interviews
There are many studies conducted on risk indicators and causes for cost overruns in the construction industry, but there is a lack of an overview for redevelopment projects in particular. Therefore, expert interviews are conducted to find out which risks and uncertainties in redevelopment projects often lead to budget inaccuracies. Another goal of the expert interviews is to reveal the differences in the processes of new-built projects and transformation projects. These expert interviews, together with the results from literature research, form the basis for the second step; the survey.

2. Survey
In the second part of the research, the complete list of risk indicators and causes for cost inaccuracies are spread among experts in the real estate industry, with experience in redevelopment projects. The survey can be filled in by project developers, project managers, cost advisors and architects. In this survey, the main causes for cost inaccuracies are categorised on probability, the impact on costs and the impact on revenues.

The second part of the survey contains questions about the initial budget. Project developers, project managers and cost advisors are asked for the difference between the initial and actual construction costs, revenues and the percentage unforeseen. The results of the survey are not based on specific cases, but give an insight on the perception of experts on causes for estimating inaccuracies. These results are compared with three case studies, which are conducted in the third part of the research.

An extensive comparison between survey development tools is done, in which the following survey tools are used: *SurveyMonkey, Google Forms, Survio, SurveyGizmo and Qualtrics*. The latter met all criteria and is used within this research.

3. Case studies
Both the expert interviews and the survey lead to general results, even based on the perception of several actors within the redevelopment process. Three case studies are performed for having deeper understanding of factors which lead to cost inaccuracies. The cases are selected according to criteria, which are mentioned in chapter 8.

THEORETICAL FRAMEWORK

3. REDEVELOPMENT PROCESS: THE INITIAL PHASE

This chapter outlines the different ways to phase the redevelopment process and how the sequence of the process phasing relates to the development strategy and development activities. The second and third paragraph focuses on the details of the initial phase; both the steps towards acquisition, as well as the steps of building investigation for reducing uncertainties are discussed. In the last paragraph, the actor roles within the redevelopment process are discussed.

3.1 PHASING OF THE (RE)DEVELOPMENT PROCESS

In Figure 9 the cyclical process of a building can be seen. The cyclical process consists of two parts; during the lifespan of a building, use and operation alternate with adaptations to the building (Wilkinson, Remøy, & Langston, 2014). At certain stages, the building can be technically, functionally or economically obsolete. The property owner can choose at this point between several options, as discussed in paragraph 1.1.4 (Remøy, 2010). Adapting or transforming are possible solutions to initiate a new process and to extend the lifespan of a building.

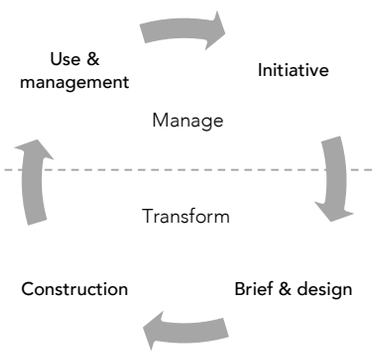


Figure 9: The life cycle of buildings

The development process is usually modelled as a series of sequential phases, such as *initiation, preparation, design, construction, completion and use* (Andriessen, 2007), *initiation, acquisition, plan development, realization, sale, exploitation* (van Tartwijk & Croon, 2005), or *initiation, feasibility, commitment, construction, management* (Gehner, 2008). The Dutch NEN-norm is more design-oriented and therefore it does not cover all development activities (NEN 2574:1993, 1993). Hence, the most important development activities need to be combined with the chosen process phasing. In this research the terms *initiation, feasibility, preparation, construction, and management* are used. It is mainly based on Gehner (2008), except from *commitment*, which is changed by a much more general term.

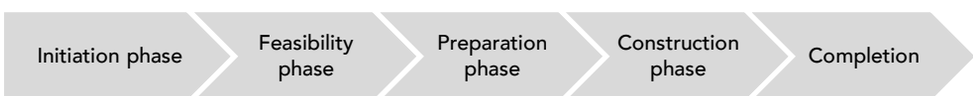


Figure 10: Process phasing used in this research, based on Gehner (2008), edited by author

The development process typically contains the following activities: idea conception, feasibility analysis, the acquisition of land or existing building, the design process, application for permits or, in some cases, the process to change the zoning plan, construction activities and the rental and/or sale of the building, see Figure 11 (Gehner, 2008). The sequence of activities over the development phases can be defined as a *development strategy*. The strategy depends on the type of organisation, as well as the risk profile of the organisation. These aspects are discussed in chapter 5.

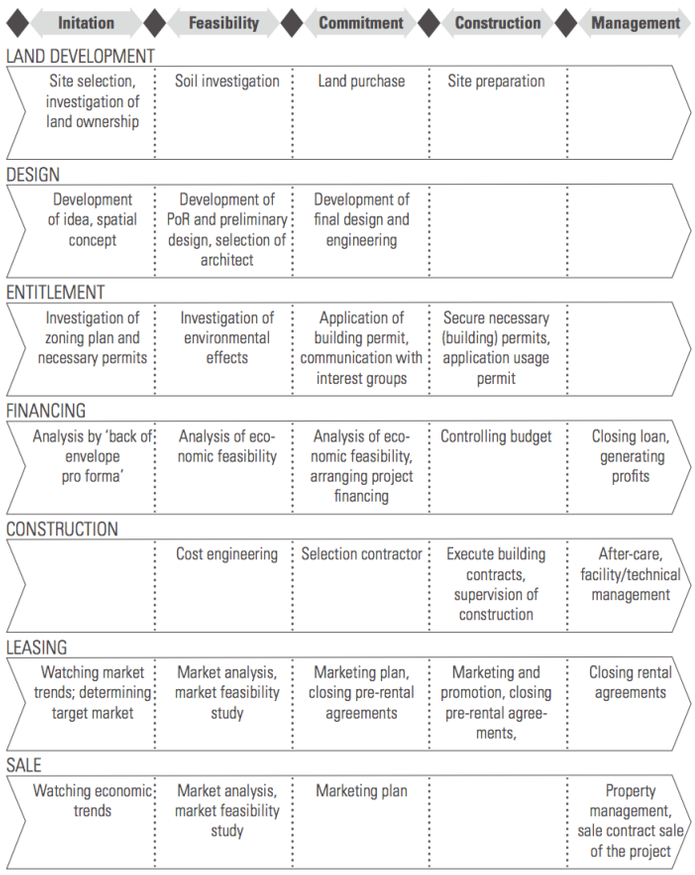


Figure 11: Activities within the framework of a real estate development process consisting of development phases and development (Gehner, 2008)

Despite the linear models, the development process is hardly a linear process. Instead it can be best described as an *iterative process in which the developer obtains more and more precise information in each iteration* (Peiser and Frej, 2003). As the uncertainty in the initial phase is higher in the initial phase due to missing information, these phases are discussed in more detail below.

Real estate (re)development processes are characterised by high investment costs in comparison to other businesses (Raftery, 1994). Often, development projects are financed by third parties; this results in higher interest payments if the process takes up more time. Therefore, speed and efficiency are in practice important factors throughout the entire (re)development process (Mensing, 2014).

3.2 FROM INITIATION TO ACQUISITION OF EXISTING BUILDINGS

The acquisition process in redevelopment projects in practice can be described by the following steps: initiate, select, calculate and bid (Mensing, 2014). These steps are derived from interviews with project developers who are experienced with redevelopment projects. The steps are confirmed within this research through expert interviews and through an analysis of the three case studies.

Figure 12: Four step plan for selection of transformation projects (Mensing, 2014)

3.2.1 INITIATION

A property usually comes to developers' attention when it is suggested or tendered by property owners who deal with vacant buildings, or who want to sell the building for strategic reasons (De Jonge, et al., 2008; Mensing, 2014). Another method to encounter a property with adaptation or transformation potential, is by pro-active search of the current (market) stock or own portfolio. Due to increasing demands in the market, developers are constantly scanning the current stock to initiate a new redevelopment.

Acquiring real estate from (semi-)public parties

Governmental, municipal, or other public or semi-public parties are often obligated by law to publicly tender the real estate, to prevent conflicts of interest between private and (semi-)public parties. Rijksvastgoedbedrijf is a governmental body which is responsible for the exploitation and the maintenance of all real estate from the Dutch government (Rijksvastgoedbedrijf, 2016). The portfolio consists of jails, court yards, airports, ministries, museums, palaces, tax offices and monuments. Due to changes in the demand or strategy, real estate of the Rijksvastgoedbedrijf may become vacant. These buildings are publicly tendered; developers can bid on real estate if the future uses match the building (Douglas, 2006), and if they meet the tender criteria set by the Rijksvastgoedbedrijf. Real estate of municipalities is tendered in the same way, often through their website and with clear tender criteria (Gemeente Amsterdam, 2016; Gemeente Rotterdam, 2016).
Semi-public parties also need permission from independent organisations. In the case of care organisations for example, a formal request from College Sanering Zorginstellingen (2016). The procedure however is not similar to the procedure which is followed by public parties; semi-public parties need to prove that no other party is interested in the sale or lease of their real estate, instead of making the real estate available for public. Hence, developers need to pro-actively approach these organisations in the case of a possible redevelopment.

Stimulation programmes and online platforms for vacant, private real estate

Pro-active approach of developers is almost always needed in the case of acquisition of real estate which is owned by a private organisation. To smoothen this process, municipal bodies initiated so-called *Kantorenloodsen* during the financial crisis of 2008 for connecting developers with owners of vacant buildings (Remøy, Pallada, Hobma, & Franzen, 2015; Gemeente Amsterdam, 2016). These municipal initiatives stimulate the amount of transformations by making the legal procedures easier, which helps developers finding vacant buildings. *Stadsloods* is a more recent initiative of the municipality of Amsterdam for linking future office tenants to vacant office buildings (Gemeente Amsterdam, 2016).

Other methods for searching for vacant and suitable properties is by using online platforms. *GeoPhy* and *Vastgoeddata* contain much of the tenancy and vacancy data of a large amount of real estate (GeoPhy, 2016; Vastgoeddata, 2016). These two platforms are also used by developers for searching matching buildings. Examples are shown in Figure 13.

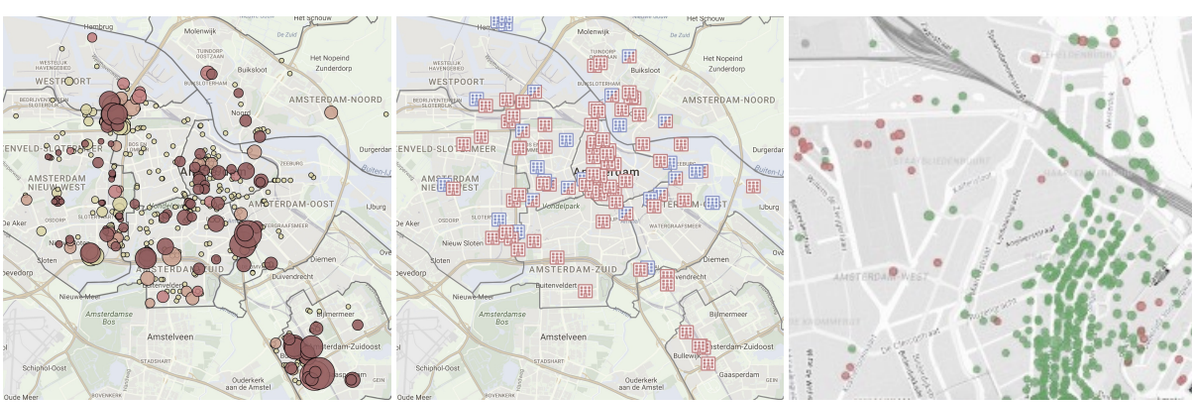


Figure 13: Map of vacant buildings in Amsterdam (left, Kantorenloods), vacant, multi-tenant buildings for the creative sector (centre, Stadsloods) and high-potential vs. no-potential vacancy (right, GeoPhy) (Gemeente Amsterdam, 2016; GeoPhy, 2016)

3.2.2 SELECTION

After initiation, a developer tests if the potential buildings match the future use (Douglas, 2006). In the selection phase, potential buildings are selected following a two-step method (Mensing, 2014). First, the location and the volume and shape of the existing building are roughly analysed, followed by a second, more in-depth analysis on the functional, technical and juridical aspects of the building. The extent of this analysis depends on the availability of information.

For the selection phase, both the practical knowledge based on expert interviews conducted by Mensing (2014) are used, as well as *De Transformatiepotentiemeter*. The latter is an instrument, developed by Geraedts & van der Voordt (2014), for determining in an efficient and systematic way if an office building can be transformed into

housing. *De Transformatiepotentiemeter* is a checklist, which consists of veto criteria and gradual criteria, for determining which characteristics of a building are good or bad for a successful transformation.

First step: volume and shape of the property and location

The first step in *De Transformatiepotentiemeter* defines veto criteria for four aspects: market, location, building and organisation (Geraedts & van der Voordt, 2014). For the selection of a potential building, the market must match the proposed function (Mensing, 2014). Market and location are judged on general assumptions of growth and demand. Each developer applies his own strategy for future function in combination with a location strategy. Besides market supply and demand, the zoning plan is analysed in the first step to know whether the zoning plan needs to be changed or not.
In second aspect of the first step, the two most important building characteristics are analysed as well: its volume and shape. Preferred volume of the building depends on the type, the strategy and the risk behaviour of the developer (Mensing, 2014). The shape of the building affects the LFA/GFA-ratio of the future use. The floor-to-floor height is an important veto criterion.
The last aspect in the first step of *De Transformatiepotentiemeter* for making a transformation successful is to find out if the owner of the building is open to the idea of selling his property.

Second step: functional, technical and juridical elements of the property

The second step in the inspection phase combines both practical knowledge, derived from Mensing (2014), with *De Transformatiepotentiemeter* (Geraedts & van der Voordt, 2014).

Functional
The functional aspects are, according to *De Transformatiepotentiemeter*, as follows:

- The location characteristics on meso and micro scale,
- The presence of amenities,
- Connectivity by car and public transport,
- Year of production of the building,
- Years of vacancy,
- Fit of new function,
- Expandability.

'All parties have confirmed the preference of projects located in residential areas with an existing structure of facilities' (Mensing, 2014). This decreases the market risk for the developer.

Another very important functional location and property characteristic is parking. A project can fail on this notion, because municipalities are often very strict on parking norms. Each municipality uses its own parking norms, which are described in the *Nota parkeernormen*. These norms depend on the function, the type of function, the size of the dwellings, but also on the location within the municipality. Inner-cities often have lower norms than areas outside the city centre. The norms are strongly related to the future function and programme of the building, and therefore also the feasibility of the transformation.

Technical
Technical aspects are the measurements of the building, the structure and its condition, the condition of other building components, the reusability of the façade and the type of concrete used in the floor for making extra vertical shafts possible (Geraedts & van der Voordt, 2014). To determine the technical aspects, enough and correct data about the building is necessary.

Juridical
The juridical aspects that are examined by developers are as follows (Geraedts & van der Voordt, 2014):

- Noise nuisance,
- Land lease or full ownership,
- Building code aspects, such as insulation for heat and noise,
- Asbestos,
- Fire safety.

According to an expert interview with a cost advisor, legislation around fire safety is partially subjective. Fire department has to verify if building components are safe enough (more than 30 or 60 minutes fire resistant). This is often based on visual inspections.

Another juridical aspect, which is not mentioned in *De Transformatiepotentiemeter* is the presence of tenants in the building. The reason for it is that this instrument is limited to buildings that are vacant or becoming vacant. In the case of adaptation and transformation of existing buildings that are partially vacant, remaining tenants can delay the project; especially, in the case of residential use (Mensing, 2014).

If the locational and building characteristics match the future use and the strategy of the developer, calculations for a bid can be established.

3.2.3 CALCULATION

The calculations are based on simple sketches of floor plans. Depending on tender criteria, the available money and time, and the organisation of the development company, a developer can choose to hire an architect for designing the initial plans or decide to sketch the floor plans within development company itself. Cost and revenue calculations are based on the sketches and on possible scenarios, the desired quality and target group which determine the rent level and the construction costs, as well as the market risk. According to several studies, the construction costs and the percentage unforeseen are difficult to estimate in the early phases of a redevelopment project due to the higher uncertainties initially (de Vrij, 2004; Mackay, 2008; Kraag, 2015; Mensing, 2014). The calculation steps are elaborated in more detail in chapter 4.2.

3.2.4 ACQUISITION

The last step is the actual bidding process. Depending on the risk profile of the developer, the bid can be based on the worst, base or best case scenario (Douglas, 2006; Gehner, 2006; Mensing, 2014). A higher bid often comes with more conditions within the purchase agreement, for example with the reservation of change of zoning plan, or shared risks for the removal of asbestos. The latter often depends on the amount of available information about the existing building. Special conditions in the purchase agreement give the developer more space to investigate the building after acquisition.

3.3 PROCESS OF GETTING TO KNOW THE BUILDING

Reduction of uncertainty in the initial phase of redevelopment projects can partially be achieved by a full investigation of the building (Douglas, 2006). The following steps must be undertaken during the redevelopment process for mapping the existing building as complete as possible. Within this research, the steps to fully investigate the building are explicitly described because information about the existing building appears to be one of the main causes of uncertainty in the initial phase. Furthermore, the activities for getting to know the building are not implemented in the general process phasing, because each development project have a different sequencing of the activities (Gehner, 2008).

Douglas (2006, p. 66) describes the main stages of the process of getting to know the building as follows:

Figure 14: Main stages for getting to know the building (Douglas, 2006)

Some stages correspond to the phases as described by Mensing (2014); the activities in the *inception* stage are similar to the activities as described in the *initial* phase on page 38, the *general* feasibility as described by Douglas (2006) contains the same activities as the first step of the *selection* phase, and *evaluation of options* and *proposals* correspond to the calculate phase as described on page 41. Other stages contain activities that are sequenced in some cases after acquisition and investigated in more detail. The stages and the activities are described below.

Desk top survey

Before the site survey is undertaken, all available documents are examined (Douglas, 2006). Typical sources of information are:

- Property documents, such as restrictive convenants,
- As built plans and drawings,
- Topographical maps of the area to indicate the date of construction,
- Geological or archaeological maps,
- *Momumentenregister*,
- Statutory notices or previously objected schemes by neighbours.

General physical inspection

In this stage, the building in relation with its surroundings are investigated. Important for inner-city redevelopments are the location and capacity of site (Douglas, 2006). A small construction site may increase the construction costs much more than expected. Other factors that must be considered are the basement and other underground services for making vertical and horizontal expansions possible.
The condition survey comprises three aspects: external inspection, internal inspection and review of the surrounding site. This is necessary to record errors in the original drawing and to record the condition of the technical aspects of the building. Type A (visual) assessments of asbestos are done in this phase.

Specific physical inspection

Structural appraisal of the building by a qualified constructor is required before adaptation or transformation. This inspection comprises the loadbearing elements of the building, such as the substructure, the structure, the type of floors, the walls and the roof structure (Douglas, 2006). Prestressed concrete floors can only be penetrated in limited points with limited sizes. On the other hand, vertical shafts are important for making residential use possible. Structural appraisal is also important to map deteriorated parts of the loadbearing elements; in case 3, one of the concrete columns was corroded, which resulted in rust in the reinforced steel. Adaptation and transformation are often done to increase the functional lifespan. A long technical lifespan of the loadbearing elements is an important aspect.
Major problems in the previous steps may require further, more detailed investigation to reduce the risk of hidden defects (Douglas, 2006). Qualified surveyors must therefore investigate, often by destructive research, the extent of the problem. Type B (destructive) assessments of asbestos are done in this phase.

The steps towards the bid and the steps for getting to know the building are done by several actors, depending on the available time and money. This is described in the next paragraph.

3.4 INVOLVED ACTORS IN THE REDEVELOPMENT PROCESS

Within the redevelopment process, several actors are involved that may affect the level of uncertainty. For the empirical research of this thesis, the variables commercial performance, building demand and function, costs and risks as described in Table 6 are most important. Other actors, such as the municipal organisations, play a key role in diminishing uncertainties in the initial phase. These actors are described below.

Profession	Variables						
	Commercial performance	Building demand and function	Costs	Risks	Operational attributes	Suitability of building	Sustainability performance
Architects	High	Medium	Medium	Medium	Low	High	Low
Property developer	High	High	High	High	Medium	Low	High
Property consultant	High	High	High	High	Medium	Low	High
Cost consultant	High	Medium	High	High	Medium	Medium	Medium
Project manager	High	Medium	High	High	Medium	Medium	Medium
Building manager	High	High	Medium	Medium	High	Medium	High
Planning Consultant	Medium	Low	Medium	Medium	Low	Low	Low
Town planner	Medium	Low	Medium	Medium	Low	Low	Low

Table 6: Influence of variables about adaptive reuse decision-making (Bullen & Love, 2010)

Municipality

Municipal organizations have a facilitating role in redevelopment projects. The main regulatory elements to the transformation process are the Spatial Planning Act (Wro) and the Squatting and Occupancy Act (Leegstandswet). The zoning plan is one of the most important mean of control of the municipality for land-use planning. As municipalities experience structural vacancy as undesirable, redevelopment is a solution to increase the quality of life of specific areas and to stimulate interests for new developments (Remøy, 2010). Often, a change in the zoning plan is needed. The process takes up to 26 weeks, which is necessary for making decision within the municipality to reject the proposed zoning plan or not. If the zoning plan is approved by the municipality, interested parties may file objections against the proposed zoning plan. In the case of objections, the town council will decide whether the objection of the interested party is grounded or not. This process can go on as long as two years, according to experienced redevelopers (Mensing, 2014).
For all construction activities, an environmental permit (Omgevingsvergunning, activiteit Bouwen) is needed. This is necessary for adaptations, as well as transformations to other functions. This means that after the zoning plan is changed, the environmental permit needs to be requested as well. Requesting the environmental permit together with the change of the zoning plan is possible to save time. The procedure for granting the permit is eight weeks. Interested parties again can file an objection against the decision of the municipality. If this is the case, all construction activities must be stopped.
Since 1 November 2014, requesting an environmental permit without changing the zoning plan has been made possible due to a change in the Environmental Licensing Decree (Besluit omgevingsrecht). This makes a temporary environmental permit for a period of 10 years possible. The reduces the process and the risks in comparison with changing the zoning plan; 8 weeks instead of 26 weeks. Therefore, this procedure is suitable for temporary transformation projects.

Investors

Investors are part of management in the real estate life cycle but rarely participate in redevelopment projects (Remøy, 2010). With the high vacancy levels in the Dutch real estate market, a part of the investors still deal with structural vacancy in their portfolio. Depending on the strategy of the investor, they can choose to consolidate or sell the building to a developer. In cases where investors were active in a redevelopment process, the investor sold the building to a developer with the intention to purchase the building back after conversion (Remøy, 2010, p. 117).

Architects and cost advisors

Architects and cost advisors are in some cases involved in the acquisition phase and have a major role in the feasibility studies and in getting to know the building. The main task of the architect is to fit the new design in the existing structure. The cost advisor establishes cost calculations, based on the initial sketches of the architect. The choice for including an architect and a cost advisor in the initial budget establishment, depends on the available time, money, the development strategy and the organisation of the development company.

Contractors

In the traditional development process, contractors often join the project team after detailed design is completed and the permits are obtained (Gehner, 2008). Therefore, it is important for contractors to have a complete building documentation to minimise the risk of unforeseen circumstances during construction. In some cases, contractors are involved in an early stage of the redevelopment process, such as in case 3 of this research on page 84. This is considered when risk mitigation is the main focus instead of cost cutting and it heavily depends on the strategy and risk profile of the developers.

Real estate developer

Real estate development is defined as the transformation of an idea for new built space into a real property (Gehner, 2008). Development moves now from greenfield to brownfield and inner-city areas. The housing market is still short in supply, but the office market is characterised by substitution, either by redevelopment or by demolition and new built space. Redevelopment in inner city locations is therefore a desired option for developers to redevelop and profit from higher revenues in inner cities (Kraag, 2015). (Delegated) developers may work on buildings together with, or for the investor, which has the benefit of reduced (market) risks. Most developers however acquire the building on own initiative and sell it after completion in a traditional process. The view on

value of a (vacant) building is still an obstacle between project developers and investors; developers often use the residual value to make redevelopment feasible, while the latter often use the market value or the book value (Remøy, 2010).

The developer's role within the (re)development process can be defined as follows (Gehner, 2008):

- The developer is responsible for the many activities of the redevelopment process due to the multidisciplinary character of real estate
- Each development project requires specialised local knowledge due to the unique characteristics of each location and, in the case of redevelopment, each building
- The development process is characterised by its long duration. Together with the cyclical character of the real estate market, it is hard to predict the construction costs or the market conditions,
- Real estate developer must deal with the long time horizon of real estate, especially in the case that a building is (re)developed for an investor or user. Changing demands from the investor or user may lead to changes in the development process.

3.5 SUMMARY

Even though the development process is usually modelled as a series of sequential phases, the process can be best described as an iterative process, in which the developer obtains more and more precise information in each iteration (Gehner, 2008). Furthermore, the development process contains development activities, such as idea conception, feasibility analysis, the acquisition of the existing building, design, permits, construction activities and the rental and/or sale of the building. The sequence of the activities depends on the development strategy and the risk profile of the developer.

The steps towards the acquisition of a building are described as follows: *initiation, selection, calculation* and *acquisition* (Douglas, 2006; Mensing, 2014). The activities within these steps are:

1. mapping the available, potential buildings in the market for adapting or transforming purposes,
2. investigating the available information about the locational, functional, technical and juridical characteristics of the building,
3. calculating the costs and revenues, based on sketch designs,
4. doing a bid, which is extracted from the worst, base or best case scenario.

A bid can be higher, but this often leads to conditions within the purchase agreement to spread or diminish specific risks categories (Gehner, 2008; Mensing, 2014). In the case of unavailable information about the building, the developer can decide to invest in additional building inspections. This may reduce the uncertainty in the initial phase.

This research focuses mainly on the project developers, project managers, cost advisors and architects; these actors may play a key role in the establishment of the initial budget. Furthermore, the involvement of contractors in an early phase of the project in relation to reduction of risks and uncertainties is discussed as well. All aspects are considered in the survey and case study research.

4. ESTABLISHMENT OF THE (INITIAL) BUDGET

This chapter outlines the classification of the budget items, followed by the establishment of the initial budget of redevelopment projects in practice. Changes in prices and rent levels may affect the initial budget; in the third paragraph the need for using indexes is described. The fourth paragraph discusses the current knowledge on the accuracy of budgets.

4.1 CLASSIFICATION OF BUDGET ITEMS

Before discussing the effect of risks and uncertainties on the development of the budget during the redevelopment process, the methods and classification of different types of costs and revenues are distinguished.

For budgeting costs and revenues in the Netherlands, standardised norms are developed by NEN, a professional, non-profit organisation (NEN 2699:2013, 2013). Investment and operating costs of properties are incorporated in NEN 2699. The investment costs are subdivided in eight types of costs. This research is limited on the construction costs, as this is in most cases the largest cost item and difficult to estimate in early phases. Unforeseen costs are investigated for understanding how developers deal with uncertainties in the initial phase. Additional costs and the total investment costs are investigated as well within this research.

Investment costs							
A. Land costs	B. Construction costs	C. Equipment costs	D. Additional costs	E. Unforeseen costs	F. Taxes	G. Financing costs	X. Exploitation costs

Table 7: Investment costs (NEN 2699:2013, 2013)

The cost items which are used within this research, are defined below:

Investment costs: *All costs needed for the realisation of the real estate*
B. Construction costs: *Costs stemming from commitments for the physical realisation of the works*
D. Additional costs: *Costs related to the preparation and accompaniment*
E. Unforeseen costs: *Addition on the estimated costs to cover future uncertainties which cannot be assigned to a specific object, sub project or a cost category*
Z. Revenues: *All revenues: rental income and/or sale*

In NEN 2699 the cost items are subdivided in 5 levels. The abovementioned cost items are level 1 items. Level 2 items of the construction costs are for example installations, site expenses and structural works. Level 2 items are not investigated within this research; the initial budget almost often contains the level 1 items only due to missing design details. Only one detailed cost item is considered within this research, if available, which is cost item D2F. This contains risk reservations and is, together with unforeseen costs, an indicator for the risk profile of the developer.

4.2 ESTABLISHING THE INITIAL BUDGET

The process between initiation and acquisition is described on page 38. One of the aspects within this process are the calculations, based on the market characteristics, locational, functional, technical and juridical aspects (Mackay, 2008; Mensing, 2014). In practice, simple sketches of floor plans are made within this process. Based on these aspects, as well as the risk profile of the developer and conditions that are sent together with the bid, the height of the bid is calculated. The method of calculating, as well as the items used in the calculations, are described in this paragraph.

4.2.1 DETERMINING THE BID: RESIDUAL APPROACH

In the initial phase, developers may decide to do a bid for a property with adaptation or transformation potential. The height of the bid, or the value from the perspective of a developer, is the residue of the total investment costs, the expected revenues in the new situation and the development costs (Shapiro, Davies, & Mackmin, 2013). This is described as the residual approach. Another method is by direct comparison with the sale of similar property which were redeveloped in a similar manner. This might be done by analysing the comparables per unit. However, this may be impracticable due to the unique nature of real estate and the development plans.
Valuations are required of different interests in different types of property for different purposes. This explains also the difference in value as calculated by owners and investors, and developers. Investors determine the value of real estate by two factors: the rent level and the level of return that an investor requires (Shapiro, Davies, & Mackmin, 2013). Due to oversupply and decrease in demand, buildings, especially offices, became (structurally) vacant. This led to a mismatch between the book values and the actual rental income of the vacant office buildings (which is argued to be 0 in the case of vacancy).
Currently, more investors accept the structural vacancy as a problem which cannot be solved in the near future (Kraag, 2015). Even though the residual value is lower than the book value, more investors choose to sell their building instead of consolidating and waiting for better times.

*Residual value = income from property - costs (acquisition price * transfer tax + transformation costs)*

Figure 15: Calculation of the residual value, based on scenarios

Below, the most important cost items, the revenues and time related factors are described for determining the bid in the initial phase.

4.2.2 CONSTRUCTION COSTS

Several studies are done in the field of construction costs in (re)development projects. De Vrij (2004), Mackay (2008), Muller (2008), Schimdt (2012), de Groot (2014) and Mulder (2015) are a few of the many researchers who contributed to the knowledge on costs and income in redevelopment projects.
Other remarkable studies in the field of construction costs are: de Jong, van Oss & Wamelink (2007), who investigated the impact of the height of the building on the construction costs per building component, as well as the impact of the height of the building on the efficiency (LFA/GFA-ratio).
These studies, as well as the *Bouwkostenkompas*, are used to support this research and to explain the reasons for possible budget inaccuracies.

There is a difference between the construction costs of transformation projects and new buildings. With transformation projects, the construction costs are influenced by the building characteristics of the building that needs to be transformed, and the design of the new building, while the construction costs of new building only depend on the design of the new building (Schmidt, 2012; de Groot, 2014; Mulder, 2015). Since every building is unique, the costs of transforming the old buildings cannot be generalized and are harder to estimate. On the other hand, the cost advisor which is interviewed during this research mentioned that construction costs can be estimated quite accurately, based on a programme of requirements in the initial phase (with a deviation of five to ten percent); construction costs deviate mostly due to changes made during the process.

There are different methods to determine the construction costs of an adaptation or transformation project. One of the methods is to use key figures, and the other method is based on element based calculations (Mackay, 2008).

Key figures and comparable projects versus element based calculations

According to experts interviewed in several studies (Mackay, 2008; de Groot, 2014; Mensing, 2014; Mulder, 2015), the most common way to estimate construction costs in transformation projects is by using comparable projects and experience. In new build projects, prices are basically established and risks can be estimated well. However, in transformation projects estimating construction costs on an element base is more difficult. Therefore, most parties stated they used comparable projects, either from knowledge within their own organisation or from available databases.

As mentioned above, most parties choose the use of key figures over calculations on element basis (Mackay, 2008; Mensing, 2014). Calculations on element basis are not always possible in early phases of a project, due to missing design detail. In this phase of the process, initiators are not sure which elements of the building will be re-used or replaced (Schmidt, 2012). Therefore, they usually work with several scenario's, including and excluding the re-use of elements like the façade, installations and elevators.
In the third case within this research however, the initiator decided to include a contractor in the initial phase, resulting in element based construction cost calculations. In the project Wilhelminastaete in Diemen, a cost advisor and an architect were also involved in the project in an early phase (Mackay, 2008). However, calculating construction costs with an accuracy of less than 10% takes much time and effort (Mackay, 2008). This can be best explained by the 80-20 rule, or the Pareto Principle; 80% of the accuracy is achieved by 20% of the effort, while the remaining 20% of the accuracy can be achieved by 80% of the effort.
Therefore, cost advisors use key figures in early phases of the project as well. According to the interviewed cost advisor, key figures are often based on their own knowledge and expertise.

Demolishment costs

The interviewed cost advisor mentioned that the calculations of the demolishment costs in an early phase deviate more from the realised demolishment costs than the estimations for the construction costs. This is mainly caused due to missing building information, but also due to the efficiency and speed which are needed within a development process.
At the same time, developers require the assistance of cost advisors for calculating the demolishment costs, but this is often done in later phases of the project (Mackay, 2008). More details about the design and the existing building are available, which increases the accuracy of the demolishment costs calculations.

Formula for construction costs

The total construction costs are in the initial budget determined as follows:

$$\textit{Construction costs} = \textit{GFA (gross floor area)} * \textit{construction costs per GFA} * (1 + \textit{\% annual increase costs})^{n}$$

In the case of a discounted cash flow model, the phasing (in %) is added to the formula. The annual increase in construction costs is described on page 49.

4.2.3 ADDITIONAL COSTS

Additional costs are the costs prior and during the construction needed for the construction process. This includes fees for architects, construction engineers, advisors, but also risk reservations and marketing costs (NEN 2699:2013, 2013).
Often, the additional costs are determined as a percentage of the construction costs (Mensing, 2014). The chosen percentage depends on the scale of the projects and its complexity. Based on practical knowledge of experts, the percentage for additional costs are between 15 to 25 percent of the construction costs. This is often higher than new built due to the higher complexity of transformation and adaptation projects (Schmidt, 2012; Mensing, 2014; de Groot, 2014).

The total additional costs are in the initial budget determined as follows:

*Additional costs = constructions costs * % (defined by the developer)*

4.2.4 UNFORESEEN COSTS

Almost all projects include unforeseen costs to cover uncertainties in the calculations. Due to the before mentioned Pareto principle, cost advisors and developers decide to calculate the construction costs as efficient and accurate as possible. In addition, unforeseen costs are added.
Based on an interview with a cost advisor, the unforeseen costs are 5 to 10 percent for redevelopment, and 3 to 5 percent for new building. According to Schmidt (2012), it is also recommended to use higher unforeseen costs in redevelopment projects.
Within this research, the literature and the results from expert interviews are tested by investigating the averagely used percentage unforeseen. This is described on page 69.

The total unforeseen costs are in the initial budget determined as follows:

*Unforeseen costs = constructions costs * % (defined by the developer)*

4.2.5 INCOME THROUGH RENT OR SALE

Income is earned through sale of the entire building during or after redevelopment, or through rental income in the case of own exploitation. In all cases, the expected exit value after redevelopment must be estimated in order to compare the investments with the revenues. The main method to determine the exit value is described below.

Determining the exit value

To determine the residual value, the costs are subtracted from the income. The income after development can be based on three scenarios (Mensing, 2014):

- Developer-investor rents out the building to tenants,
- Developer sells the building after redevelopment to another investor (office space or dwellings for rent),
- Developer sells dwellings within the building after redevelopment to individuals.

In the case of renting out by a developer/investor, the net operating income can be distinguished by the following items (Mensing, 2014):

- Potential gross income *(= lettable floor area * rent/m2)*
- Initial vacancy loss *(= potential gross income * % vacant at completion)*
- Other income *(= number of parking lots * rent per parking)*
- Operating expenses

If the building, containing floor area that will be let, is sold after development, the exit value, or the gross development value is determined by the following formula:

*Gross development value = potential gross income in first year * % gross initial yield (BAR-method)*

In some cases, the potential gross income minus operating expenses is used to determine the exit value of the building (NAR-method). In this case, the net initial yield must be used. This is often more accurate than the BAR-method. Still, the disadvantage of both the BAR and NAR-method is that only the initial yield is calculated, which has little to do with the return from the rest of the operating period, the so-called Internal Rate of Return (de Groot, 2014). Besides that, it does not include aspects like vacancy, rent incentives, major maintenance, yield changes, leverage and tax matters. Despite the inaccuracy, the BAR/NAR-method is the most used method by developers for determining the exit value of the building (Rodermond, 2011). In this research, only the expected income streams are considered to exclude external factors, such as the required IRR by the new investor.

Determining the rent level

The rent level mainly depends on the following characteristics (Muller, 2008):

- Market demand and supply on macro, meso and micro scale, now and in the near future,
- Locational characteristics,
- Building characteristics.

Real estate investors but also developers are in the business of renting space (Brueggeman & Fisher, 2010). Fluctuations in economic activity affect the variability of income produced by the property and vacancy rates. Changes in economic activity affect the demand for certain functions on certain locations. Changes in job opportunities and demographic changes also affect the demand for certain dwelling types. In financial feasibility analyses rent levels, based on demand, are estimated on which the project return is based. The risk of not achieving the desired rent or occupancy level is called the *market risk*. This is elaborated in more detail in chapter 6.

LFA/GFA-ratio and plinth functions

The financial feasibility of a building can be increased by reducing the costs or by increasing the revenues. The revenues are determined by the market, location and building characteristics, as mentioned in the previous subparagraph. According to a research of Muller (2008), the main income generators in redevelopment projects are location characteristics, changes in floor area and the addition of plinth functions.

The ratio between rentable floor area and total floor area needs extra effort in redevelopment projects. Since a new design must fit in an existing structure, which is often built for other functions, the efficiency of the building could be lower than new buildings. Therefore, developers often add extra floor area to the building. This can be achieved implementing one or more of the eight categories (Schmidt, 2012):

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

However, it is not clear if developers consider these options in the initial phase or during the process. In the case that these options are considered and implemented during the design phase, it could be a reason for deviations in the initial budget and realised costs and revenues. This is investigated in the survey and in the case studies within this research.

4.2.6 TIME ASPECT

Time management is very important in development projects. This aspect determines the speed and efficiency of the activities after acquisition, when the development process must be continued as fast as possible to diminish the financing costs.
The urgency to act depends on remaining tenants and outstanding loans (Mensing, 2014). The course of action will differ per party, but it is assumed that the preparation and application for a zoning plan revision will be filed first. Since the acquisition of the property requires an investment of equity or debt, interest will be due or missed and owners will prefer the shortest possible procedures. In the case of temporary redevelopment, where the initiator leases the building for a period of 5 or 10 years, time pressure is a less determining factor (Mulder, 2015). This affects the development process, as is described in case 3 within this research.

4.2.7 TRADE OFF-EFFECT: QUALITY, BUDGET AND TIME

Development processes are subjected to changing circumstances. Developers are able to steer during the development process with the following three aspects: *quality, time* and *money* (Bloem, 2009). Changing one of the elements during the process, means that one of other two (or both) aspects need to sacrifice. For example: if the quality needs to be increased due to changing market demand, the amount of money which is needed (the con-

struction costs), increases. The developers or client chooses during the start of the project which of the three aspects overbalances the other two aspects. Figure 16 shows this 'trade off-effect'.

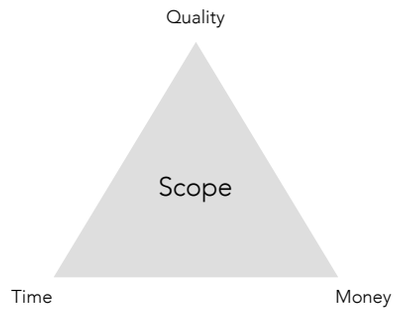


Figure 16: Building quality, construction costs and time

In the case study research, the effect of plan/scope changes on the three aspects are investigated, as well as the causes of plan and scope changes.

4.3 INDEXES

Mackay (2008) emphasizes the impact of price changes on the estimations of the constructions costs, the rent levels, land prices and more. Changes in legislation, such as the building decree, but also taxes, cause fluctuations in the estimated prices. Price increases are not every year the same. Therefore, it is necessary to use indices in the budget estimations.

4.3.1 FLUCTUATIONS IN CONSTRUCTION COSTS

There are several indices and databases which can be used to determine the construction cost development within the real estate industry:

- BDB (Bureau Documentatie Bouwwezen),
- CBS (Centraal Bureau voor de Statistiek),
- MBK.

According to Mackay (2008) and the cost advisor that is interviewed for this research, the data from BDB are used by market parties in the real estate industry. The BDB-index used to differ from the CBS-index: the latter used numbers which were based on complete construction works (output values), while BDB shows the development of wages and materials (input values) to track the cost price of the contractors. Nowadays, CBS uses both input and output values, see Figure 17. Remarkable is the development of the wages; this remains stable compared to the development of the material costs. This can be best explained by the fact that wages are less flexible; in times of crisis, contractors sometimes even lost money on the material costs according to the developer of case 1 and the interviewed cost advisor.

Figure 17: Development of the construction costs, mutation year-on-year (CBS, 2016)

According to the project developer of case 1 and the interviewed cost advisor, the development of the construction costs need to be taken into account for development projects that are initiated after 2015. The prices are forecasted to develop much faster due to the increase production in the real estate industry. The development of

house prices is an indicator for the development of construction costs, as production follows the demand and supply. In Figure 18, a comparison is made between the development of material prices and the development of house prices.

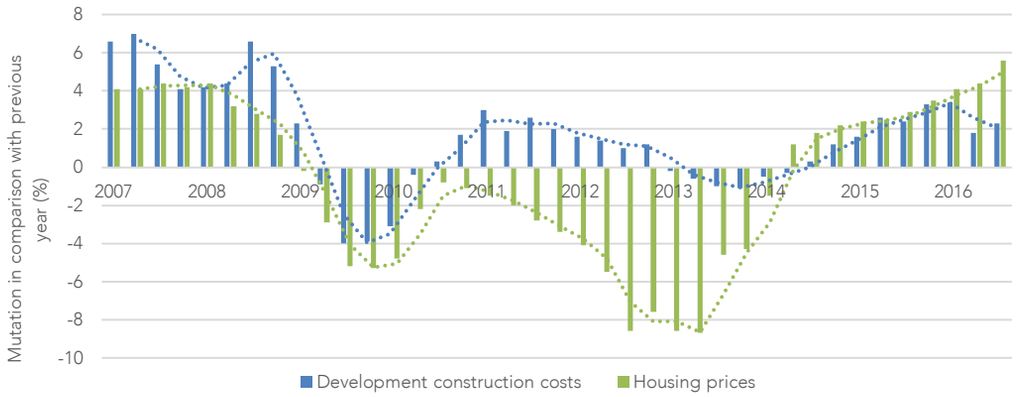


Figure 18: Development of the material costs versus development of house prices, mutation year-on-year (CBS, 2016)

A better indicator for the development of the material costs is the gross domestic product. Figure 19 shows how the development of material costs follows the development of the macroeconomic situation. As the GDP is growing after a small dip in Q4 2015, the development of the construction costs is likely to follow this growth. According to cost advisor 1 and project developer of case 1, at the end of 2017 and the beginning of 2018 a point will be reached that contractors cannot keep up with the required production. From this moment, contractors will have a better negotiation position and this will affect the development of the construction costs even more.

Figure 19: Development of the material costs versus development of house prices, mutation year-on-year (CBS, 2016)

4.3.2 FLUCTUATIONS CAUSED BY INFLATION

Inflation is the increase in the general price level of goods and services in a certain economy. Due to the long time-horizon of development processes, the price increase caused by inflation needs to be considered in the initial budgets.

Below, an overview is given of the change in inflation compared to the same quarter in the year before (CBS, 2016). Remarkable is that the inflation has been lower in the past years compared to the long-term average of almost 2%, which may have a positive impact in the expected costs. The inflation is considered as well in the explanation of possible budget deviation in the case analysis.

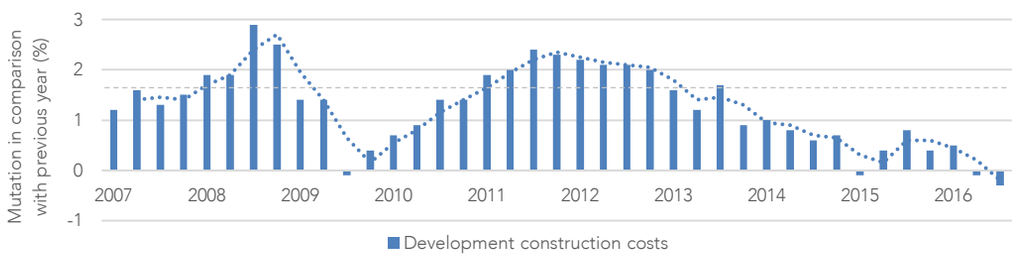


Figure 20: Development of the inflation in the Netherlands in the past ten years (CBS, 2016)

4.3.3 FLUCTUATIONS IN RENTAL INCOME

Besides the development of construction costs, the market characteristics are an important indicator for the development of the rent level and rent increase. These aspects are further elaborated in chapter 6.

4.4 ACCURACY OF COST ESTIMATIONS IN REDEVELOPMENT PROJECTS

This research is based on one of the characteristics of development projects; the relation between uncertainty and information, combined with the general lack of information in the initial phase. According to studies on the cost accuracy of construction projects, costs are often inaccurate and often underestimated in the initial phase (Jackson, 2002; Flyvbjerg, Holm, & Buhl, 2007; Bloem, 2009; Winch, 2010).
Furthermore, in studies in the field of adaptation and transformation redevelopment projects are characterised as more complex and uncertain than the development of building in greenfield locations (Douglas, 2006; Mackay, 2008; Remøy, 2010; Mensing, 2014; Kraag, 2015). Due to this complexity, costs are still seen as one of the most important obstacles for transformation and adaptation projects. Within this paragraph, the current knowledge on construction costs are explored and discussed.

Paragraph 4.2.2 shortly discussed the establishment of the initial budget and the method for calculating construction costs in this phase. In practice, key figures based on experience and knowledge are the most used method. The uniqueness of each redevelopment project is confirmed by the research of de Vrij (2004) and Mackay (2008): there is a large bandwidth in the key figures for construction costs. In the tables below, the average construction costs are shown. These are categorised on type of housing and construction year

Types	Interventions in building: low		Interventions in building: high	
	Construction costs (€)	Acquisition costs (€)	Construction costs (€)	Acquisition costs (€)
Student room	*390 à 520*	*190 à 260*	*460 à 620*	*120 à 160*
Studio	*520 à 780*	*260 à 390*	*620 à 940*	*160 à 230*
2/3-rooms, young	*650 à 870*	*320 à 440*	*780 à 1040*	*190 à 260*
4-room, young	*650 à 970*	*320 à 480*	*780 à 1160*	*190 à 290*
3-room, senior	*310 à 470*	*150 à 230*	*380 à 560*	*90 à 140*
4/5-room, senior	*420 à 970*	*210 à 480*	*510 à 1160*	*120 à 290*

Construction year	Construction costs €/m2 GFA
1969	*786*
1970	*662*
1970	*539*
1970	*591*
1971	*538*
1971	*810*
1972	*737*
1972	*668*

Table 8: Large bandwidth in key figures for construction costs, based on type of dwellings (left) (de Vrij, 2004; Geraedts & van der Voordt, 2014), or based on year of construction (right) (Mackay, 2008)

Based on these two variables, the key figures remain high. Mackay (2008) investigated during his research on 12 transformation projects, the costs per building component/cluster. Even on building element level, a high bandwidth is noticeable, with a standard deviation between 38% and 151%. The structure of the building for example, has minimum costs per m2 GFA of 11,8 and maximum costs of 215,5, with a deviation of 91% from the average construction costs for this cluster specifically.

Clusters	*n (#)*	*Minimum* *€/m2 GFA*	*Maximum* *€/m2 GFA*	*Average* *€/m2 GFA*	*SD* *€/m2 GFA*	*SD* *% of avg.*
Façade	*12*	45,1	249,9	151,6	66,3	44%
AUK	*12*	63,2	221,7	124	40,4	33%
Inner walls	*12*	48	208,5	121,9	45,3	37%
W-installations	*12*	39,7	137,4	82,2	32,4	39%
Structure	*12*	11,8	215,5	64,1	58,4	91%
E-installations	*12*	0	97	44,7	30,1	67%
Floors	*12*	0	122,5	36,9	32,1	87%
Ceilings	*12*	0	47,2	29,8	19,1	64%
Stairs	*12*	7,5	83,8	29,2	21,4	73%
Equipment	*12*	0	108,9	28,4	30,2	107%
Elevators	*12*	0	49,4	19,7	15,9	81%
Roofs	*12*	0	46,6	17,2	18,2	106%
Foundation	*12*	0	59,6	16	24,2	151%
Site	*12*	0	6,3	1,7	2,5	148%

Table 9: Cost generators, per cluster (Mackay, 2008)

Schmidt (2012) concludes, based on these numbers, that it is almost impossible to determine accurate construction costs. Instead, Schmidt (2012) emphasizes that the focus must be on controlling the amount of interventions in the building which is needed to meet the demands of the end-user, and at the same time to generate enough revenues for a positive development value. In his calculation model, the amount of input variables for calculating the construction costs are minimised by applying the Pareto principle; the most expensive clusters need the most attention, which are the façade, AUK, inner walls, installations and the structure.

Deterministic versus probabilistic approach

The abovementioned method of determining the construction costs through key figures is called the *traditional* or *deterministic* method (van der Meer, 2003). The difficulty of the traditional method is that uncertainties and risks are difficult to estimate or calculate. Therefore, cost advisors and developers apply a certain bandwidth and a risk premium, based on their knowledge and experience.
The *probabilistic* approach is a method which can be used to establish sensitivity analyses of a certain investment in relation to market prices (van der Meer, 2003). In the probabilistic method, regular uncertainties which can occur are separated from unforeseen events. This results in an overview of the bandwidth of the calculations, the probability to exceed the upper limit, and the risks which cause the highest uncertainty in the calculations. This use in practice and the complexity are further elaborated in paragraph 5.3.

All abovementioned studies increased the knowledge on cost estimations in relation with the complexity of redevelopment projects, in both literature and practice. This research does not focus on predicting key figures or cost calculation models, but instead the causes for inaccuracies during the entire redevelopment process are investigated. Which factors cause budget inaccuracies? How do the development of the costs, wrong predictions of indexes increase or decrease the costs? What is the effect of the complexity caused by the unavailability of building information in the initial phase on the cost development?

4.5 SUMMARY

According to literature, the initial budget consists of:

- construction costs,
- additional costs as a percentage of the construction costs,
- unforeseen costs as a percentage of the construction costs,
- revenues, based on market, locational and building characteristics,
- acquisition, or bid, based on the residual value,
- other costs, such as equipment costs, taxes and financing costs.

Most of the cost items are directly related to the construction costs; this emphasizes the importance of the accuracy of the construction costs. However, speed and efficiency in the development process are the determining factors for the accuracy of the initial budget, together with the missing details of the new design and the availability of enough information about the existing building. Therefore, most parties choose the use of key figures over calculations on element basis. The accuracy of the key figures which are used for determining the construction costs are argued and investigated in many studies. Some have drawn a conclusion that detailed models and calculations cannot be used in practice due to the availability of time, money and the development strategy.

As this research is focused on the budget accuracy, the budget estimating methods are used and tested in the empirical part of this research. Not only the impact of the budget estimating method on the development of the budget is considered within this research, but the impact of the entire development process. This gives a new insight on how the development strategy impacts the (in)accuracy of cost and revenue estimations and which role the use of key figures has between other reasons for budget inaccuracies.

5. RISK MANAGEMENT IN REDEVELOPMENT PROJECTS

Risk is something that people deal with in their daily lives. Often, people assess the risks on an unconscious level. This type of risk assessment and analysis is based on years of experience, instinct and intuition. In these cases, the decision making is straightforward and people often do not spend much time on analysis.
However, when risks are removed from people, they seem to take on additional complexity (Cretu, Stewart, & Berends, 2011, p. 1). Especially when considering decisions related to the development and delivery of construction projects. There is an endless amount of risks that project developers can encounter during the project. Some of these risks can be identified, while other risks lie far outside our regular expectations, which are called *outliers*. Taleb (2008) defines these type of uncertainties as *black swans*. It is impossible to predict black swan-events, but instead it is possible to build robustness to negative events that occur and to exploit positive events.

This chapter outlines definitions, as well as how risk management is applied in real estate development. In the chapter after this, the risks and causes for cost and income accuracies in literature are explored.

5.1 DEFINITIONS

Estimate

In literature, the word estimate is defined as follows (Cretu, Stewart, & Berends, 2011):

1. The act of evaluating or appraising
2. A tentative evaluation or rough calculation, as of work, quantity or size
3. A statement of the approximate cost of work to be done
4. A judgment based on one's impressions; an opinion.

Remarkable is the fourth definition of estimate, which emphasizes the subjectivity of estimations. Within this chapter, the impact of biases in budget estimations are discussed as well.

Risk and uncertainty

In most studies, risk and uncertainty are distinguished. The distinction is usually that risk have quantifiable attributes, whereas uncertainty does not. Thus, something is a risk when it is possible to make a statistical assessment of the probability of occurrence of a particular event. Risks, therefore, tended to be *insurable*.

Risk is defined as follows:

> *Risk = 'probability of event' x 'magnitude of loss or gain'.* (Raftery, 1994)

> *Risk (in relation to project development) is a predictable and stochastic modelable occasion which leads to a negative deviation of the project's return requirement.* (Gehner, 2006)

In both definitions, risk consists of a value or probability component. Events are said to be certain if the probability of their occurrence is 1 or totally uncertain if the probability of occurrence is 0. In between these extremes the uncertainty varies quite widely. Therefore, *uncertainty* is defined as *the state of not knowing* (Cretu, Stewart, & Berends, 2011). A more detailed definition of uncertainty is that it is *a situation in which a number of possibilities exist and which of them has occurred, or will occur, is unknown* (Yoe, 2000). Within this research, the word uncertainty refers to a lack of knowledge about current and future information and circumstances, as described in the problem analysis of this report (Winch, 2010).
Furthermore, risk is often associated with a negative outcome, while it represents an uncertain outcome which can be both positive – an opportunity – or negative – a threat (Cretu, Stewart, & Berends, 2011). This bias towards risks causes people to overlook opportunities. Therefore, this research does not only focus on negative risks, causing cost overruns, but also on opportunities, which can be seen in increased expected revenues.

5.2 PRINCIPLES OF RISK MANAGEMENT

In literature, risk management is defined as follows:

> *Risk management includes the processes concerned with conducting risk management planning, identification, analysis, responses, and monitoring and control on a project. The objectives of project risk management are to increase the probability and impact of positive events and decrease the probability and impact of negative events in the project* (Project Management Institute, 2008, p. 273).

> *Risk management is to recognise and to control risks and uncertainties during the execution of a project with the main aim to improve the chance for a successful process (Stichting BF, 2000).*

A more detailed process definition to identify risks is given by Eaton & Kotapski (2008):

1. Identify potential risks.
2. Assess the probability and impact of each risk.
3. Identify alternative actions that may prevent the risk from happening (avoidance), or if it does happen ameliorate the impact (reduction), or provide a strategy for dealing with the accepted consequences (acceptance).
4. Implement and monitor those actions that are cost effective and necessary to the successful delivery of the project objectives.
5. Provide feedback from experiential learning to improve the risk management of future projects and to inform the training and development of project managers.

The steps within the risk management process is described as a cyclical process by Gehner (2006), which consists the three steps shown in Figure 21.

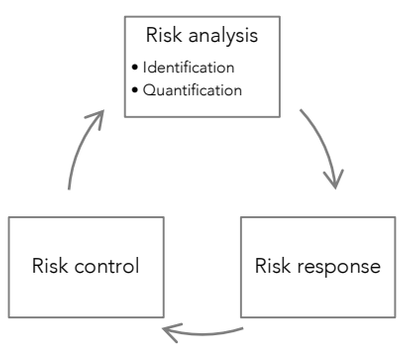


Figure 21: Risk management cycle (Gehner, 2006)

The first step of the risk management cycle is elaborated in more detail in the following paragraph, as this step often takes place in the early phases of the redevelopment process.

5.3 ANALYSIS TECHNIQUES

One of the steps of the risk management cycle, which is often the first step, is the risk analysis (Gehner, 2006). This step is subdivided in two sub-parts: *risk identification* and *risk quantification*. For each of these steps, several techniques and tools are available, which can be used to have more control on risks. The choice of these techniques and tools depends on factors such as actors, time, money or risk attitude of the developers. This chapter shows the different techniques which can be used.

5.3.1 ANALYSIS TECHNIQUES FOR RISK IDENTIFICATION

According to Gehner (2006), several tools can be used by developers to identify risks. These are discussed below.

- Checklist
- Projectomgevingskaart
- Failure Mode and Effect Analysis
- Event tree
- Risk matrix

Checklist

A checklist is a list of risks that is drawn up based on knowledge of and experience with previous projects and which can be used in the identification of risks in new projects (Gehner, 2006). The advantage of this tool is that knowledge gained by experience is documented and used in a following project, which saves time and money. Georges (2011) concludes in his research that the use of a checklist and the *projectomgevingskaart* (which is elaborated below) are the most efficient and effective two methods for identifying risks.

A checklist however is unsuitable as a risk identification technique in project development, due to a combination of the uniqueness of each project and the incompleteness of the list (Gehner, 2006). By using the checklist, the influence of the project environment on the process is not adequately considered and analysed. This increases the chance to miss a significant risk. Furthermore, the effect of the risks is not fully qualified. This technique cannot be considered a complete list, but it can be used as a reference frame.

Project environment map (projectomgevingskaart)

The project environment consists of all actors and factors that have a certain role within the development of a project (Risman.nl, 2012). A *projectomgevingskaart* shows all actors and factors within a project, the relation between the project and the project environment and the relations between the actors and factors. This tool does not lead to a list of risks, but it gives the project developer control over the project environment and a first step towards the process of risk awareness.

Failure Mode and Effect Analysis

The FMEA is a method to map all foreseen, unwanted events, by describing all functionalities in the development process (Gehner, 2006). An example of a functionality is 'removing all asbestos for €100/m2 GFA'. To each of the functionalities, words are added which describes the probability. However, this is not a structured method for having a complete list of potential risks. Therefore, the developer must use this method in a structured way, or combine it with a checklist for example.

Event tree

The event tree is a description of a sub process, where in the first node the initial event is described and which branches in several following events (Gehner, 2006). The event tree results in desired outcomes, but also in a list of risks. A developer may lose the overview with the use of the event tree; a complex project may lead to a large event tree.

Risk matrix

A risk matrix is a way to analyse the risks from different perspectives, with perspectives such as aspects, actors or both on the x-axis, and activities or budget items on the y-axis. This is a structured method for identifying risks. However, due to the large number of actors involved and activities in the redevelopment process, it may become complex method to establish a complete overview of the risks.

Identification methods in practice

According to Gehner (2006) the checklist is not suitable for using in project development, because of the uniqueness of each project (especially in the case of transforming or adapting existing buildings). Furthermore, the checklist is never complete. However, it is the most used method in the development process, where experience with previous projects is used for new projects. The choice for this technique can be best explained by the Pareto

principle, originated from the speed that is required in the development process. The use of a checklist has been acknowledged by other studies and during the interview with an experienced cost advisor.

5.3.2 ANALYSIS TECHNIQUES FOR RISK QUANTIFICATION

Risk quantification consists of three steps, namely the input of data regarding the probability and impact of the risks, the process of these data and the output of the results of the risk analysis (Gehner, 2006). The amount of available information is an important aspect for the choice of the risk quantification technique, as well as the amount of available time and money and the knowhow of the developer. Therefore, the complexity of the technique must be minimal, due to the small amount of time that is spent on risk analysis. Also, the input values that the developer has at his disposal must be multiple values for the effect and singular, often subjective probabilities.

Below an overview of risk quantification tools is given (Gehner, 2006):

- Risk premium: adding a contingency sum to the budget, which is based on previous projects and subjective observations
- Risk Adjusted Discount Rate: discounting the costs and revenues to a predefined risk premium, which is based on subjective observations
- Sensitivity/scenario analysis: defining a worst, base and best case scenario on each investment variable. The probability of each factor is missing however
- Decision analysis: allocating probability factors with a total sum of 1 to each sub event that might occur. It gives a clear overview of the side effects of an event that can occur, but it is very complex
- Monte Carlo-simulation: a stochastic analysis technique which models the project result in a probability distribution based on probability distribution functions of the investment variables.

	Complexity			Output value			
Risk analysis techniques for quantification	Easy	Average	Complex	Effect	Probability and effect	Product, probability and effect	Probability distribution
Risk premium	X			X			
Risk Adjusted Discount Rate	X			X			
Sensitivity / scenario analysis	X	X		X		X	
Decision analysis		X				X	
Monte Carlo-simulation			X				X

Figure 22: Comparison of risk analysis techniques (Gehner, 2006)

After the quantification of the risks, these can eventually be categorised based on the probability and the impact of each. The four main categories of risk are shown in Figure 23 (Raftery, 1994, p. 9). The risks which need to be considered during the redevelopment process can be found in the first quadrant. These are the risks which have the highest potential of influencing the costs and/or revenues.

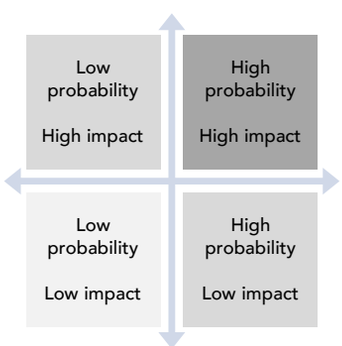


Figure 23: Categorisation of risks, based on the probability and the impact (Raftery, 1994)

Quantification tools in practice

Project developers often use risk premium, or 'contingency allowance', for quantifying the risks, despite its impreciseness and subjectivity. In some cases, sensitivity and scenario analyses are performed, but this is again based on subjective input variables. The risk analysis methods are tested in the case studies to investigate the relation between risk analysis methods and budget inaccuracies.

5.4 RISK MANAGEMENT IN THE (RE)DEVELOPMENT PROCESS

Risk management in infrastructure projects

An extensive research of Flyvbjerg et al. (2007) has shown that most transport infrastructure projects experience cost and/or schedule overruns. In this study of the 258 projects that were sampled, cost overruns were found in 9 out of 10 projects. The actual costs were on average 28 percent higher than the estimated costs. Other important findings of this study are as follows:

- Cost underestimation has not decreased in the past 70 years,
- Transportation infrastructure projects do not appear to be more prone to cost underestimation than other types of large projects.

Flyvbjerg et al. (2007) concluded that a lack of proper risk analysis, a poorly defined scope in the initial project budget and intentional underestimation due to political pressure were the main factors for cost overruns. The uniqueness of construction projects, especially in the case of redeveloping existing buildings, increases the need of proper risk analysis in the initial phase of a project.

Application of risk management in real estate development

Gehner (2008) has investigated the application of risk management techniques in the construction industry by performing literature reviews. The findings are based on five studies, with a response rate of 15 to 237 companies per study. The main findings are described below.

- According to Akintoye and MacLeod (1997), developers make the least use of Monte Carlo-simulations, the Expected Monetary Value-method and other probabilistic techniques, whereas intuition, risk premium and sensitivity analysis are mentioned as most used,
- According to Gehner, Halman and de Jonge (2006), no single respondent makes use of probabilistic techniques, whereas intuition and qualitative techniques are often used. The risk identification is not intended to be complete, but to reveal the most serious risks,

The conclusion is that quantitative risk analysis techniques are significantly less applied than qualitative techniques (Gehner, 2008), even though real estate development can be described as a risky business (Ruhl, 2015). Investment decisions are often based on assumptions of a complex, uncertain and dynamic future. The duration of a development process can take up many years. In practice, speed and efficiency in the development process are the determining factors for the choice of the risk analysis methods (Mensing, 2014).

5.5 RISK BEHAVIOUR AND PSYCHOLOGICAL ASPECTS

First of all, trying to understand risk behaviour proved to be very difficult, since it can be influenced by many factors. Still, it is an important topic for this research and especially, for the impact of initial budget estimations. This chapter describes the different types of explanatory variables of risk behaviour.

5.5.1 EXPLANATORY VARIABLES OF RISK BEHAVIOUR

Gehner (2008) describes three main categories for explaining risk behaviour:

1. Cognitive explanatory variables of risk behaviour,
2. Social explanatory variables of risk behaviour,
3. Organisational explanatory variables of risk behaviour.

Each category is described in the subparagraphs below.

5.5.2 COGNITIVE EXPLANATIONS OF RISK BEHAVIOUR

Biases and heuristics

Uncertainty results in 'relying on a limited number of heuristic principles which reduce the complex tasks of assessing probabilities and predicting values to simpler judgmental operations. In general, these heuristics are quite useful, but sometimes they lead to severe and systematic errors' (Tversky and Kahneman, 1974, in Gehner, 2008). This often leads to different perceptions of risks. Examples of biases which may occur in real estate development are overconfidence, illusion of control, belief in the law of small numbers, insensitivity to estimates of the outcome probabilities and optimism. The latter causes, according to Winch (2010, p. 260), an '*overestimation of the benefits of a project and an underestimation of the costs of a project*'. It is recommended to apply standard uplifts to the estimates of the duration of the works and the costs (Figure 24). In the first case study, the duration of the works was estimated to be 9 months, but based on calculations of the contractor, it will be at least 18 months. This is described in chapter 8.

Project type	Optimism bias %			
	Works duration		Capital expenditure	
	Upper	Lower	Upper	Lower
Standard buildings	4	1	24	2
Non-standard building	39	2	51	4
Standard civil engineering	20	1	44	3
Non-standard civil engineering	25	3	66	6

Figure 24: Recommended adjustment ranges for optimism bias (Winch, 2010, p. 210)

It is important to distinguish cost inaccuracies caused by *strategic misrepresentation* (which has *organisational* drivers) from cost inaccuracies caused by *optimism bias* (which has psychological drivers). The organisational drivers are elaborated in the next paragraph.

Escalation of commitment

Escalation of commitment is '*the continuation in a failing course of action*' (Schmidt and Calantone, 2002), caused by personal responsibility of individuals for previous actions. Another explanation of the escalation of commitment is that it is a pattern of behaviour in which an individual or group will continue to rationalize their decisions, actions, and investments when faced with increasingly negative outcomes rather than alter their course.

Entrepreneurship and problem familiarity

Studies reveal that entrepreneurs are more susceptible to cognitive biases, such as overconfidence and optimism (Busenitz and Barney, 1997; Simon et al., 2000; Forbes, 2005, in Gehner, 2008). This difference between entrepreneurs and non-entrepreneurs is mainly caused by a difference in risk perception.
The second cognitive bias is related to experience: 'when decision makers are more experienced, they may begin to focus selectively on the evidence of their past ability to overcome obstacles (March and Shapira, 1987) and, therefore, may be willing to undertake risks that less experienced individuals would avoid' (Gehner, 2008).

5.5.3 SOCIAL AND ORGANISATIONAL EXPLANATIONS OF RISK BEHAVIOUR

According to studies on risk behaviour, it may be expected that groups are less prone to extremities due to the risk behaviour of individuals. However, investigations on risk behaviour in groups reveal that individuals who are very cautious on risks, after group discussion a group become even more risk averse. The impact of individuals depends strongly on several factors, such as group size, group composition, leadership style and social norms.

5.6 SUMMARY

Even though experience may lead to cognitive biases and undertaking more risks, real estate developers use often experience for identifying risks. Risk quantification is, if conducted, often based on a subjectively determined risk premium and on scenario analyses. Both methods are imprecise methods, but the choice for these methods can be best described by the Pareto principle. The risk analysis methods are investigated during the case study research.

Risk behaviour depends on cognitive, social and organisational factors. Many individual, group and organisational factors influence the decision-making process and thus the decision outcome. These aspects are also considered in the survey and case study research, but not fully investigated due to its complexity.

6. POSSIBLE CAUSES OF BUDGET INACCURACIES

The previous chapters outlined the context of the adaptation and transformation projects, as well as the role of actors within the process. In some paragraphs, traces of possible causes for budget inaccuracies can be found. This chapter contains a complete overview of a list of possible causes of budget inaccuracies, based on an extensive literature study. The list of causes is used as the basis for the survey research.

6.1 DEFINITIONS

According to Bloem (2009), budget overruns are defined as follows:

> *'Budget overruns is used in the case of higher expenses or lower income in comparison with the estimated budget. More money is spent than initially authorised.'*

As stated in chapter 5, risks can cause both positive and negative outcomes (Cretu, Stewart, & Berends, 2011). To have a complete overview of the accuracy of the initial budget, possible cost decreases also need to be considered. Therefore, this research focuses on budget accuracy, which is defined as '*the deviation of a specific budget item between the initial budget and the realised costs and revenues'*.

6.2 CURRENT KNOWLEDGE ON COST INACCURACIES IN CONSTRUCTION PROJECTS

There are many studies done in the field of cost inaccuracies in the construction industry. One of the more remarkable studies on cost overruns is *Underestimating Costs in Public Works Projects: Error or Lie?* (Flyvbjerg, Holm, & Buhl, 2007). This research has shown that the majority of transport infrastructure projects experience cost and/or schedule overruns. In this study of the 258 projects that were sampled, cost overruns were found in 9 out of 10 projects. The actual costs were on average 28 percent higher than the estimated costs. Other important findings of this study are as follows:

- Cost underestimation has not decreased in the past 70 years,
- In 9 out of 10 transportation infrastructure projects, costs are underestimated
- Cost underestimation exists across 20 nations and 5 continents; it appears to be a global phenomenon
- Cost underestimation cannot be explained by error and seems to be best explained by strategic misrepresentation, i.e., deliberate cost underestimation
- Transportation infrastructure projects do not appear to be more prone to cost underestimation than other types of large projects.

Furthermore, this research emphasizes two important aspects: transportation infrastructure projects do not appear to be more prone to cost underestimation than large or unique building projects, and public projects do not deal more often with the same problem than projects done by private actors.

As the research of Flyvbjerg et al. is only focused on transportation infrastructure projects, an extensive study on risk indicators and reasons for cost inaccuracies is conducted. The overview of sources is presented in Table 10, and the complete list of reasons can be found in the appendix. The list contains:

- research on transportation infrastructure,
- regular construction projects,
- utility buildings (n=1 with in depth analysis of causes for cost overrun),
- risks in transformation projects,
- variation between public works and projects done by private parties.

Author(s)	Year	Title	Project types	Categories	Causes
Flyvbjerg et al.	2003	Megaprojects and Risk	Transportation infrastructure	4 categories	18
Wachs	1989	When Planners Lie with Numbers	Transportation infrastructure	-	3
Morris	1990	Cost and Time Overruns in Public Sector Project	Transportation infrastructure	-	5
Cantarelli et al.	2010	Cost overruns in Large-Scale Transportation Infrastructure Projects: Explanations and Their Theoretical Embeddedness	Transportation infrastructure	-	5
Nijkamp & Ubbels	1999	How Reliable are Estimates of Infrastructure Costs	Transportation infrastructure	-	3
Swart	2009	Kostenoverschrijding bij nieuwbouwprojecten van onderwijsinstellingen voor het primaire onderwijs	Educational buildings	-	6
Herweijer	1998	Rapport van de commissie Stadhuis	City hall	-	6
de Waal	2010	Voorzien onvoorzien	Utility projects	3 categories	9
Bloem	2009	Bouwen aan faalkostenreductie	-	-	28
Jackson	2002	Project cost overruns and risk management	-	15 categories	47
Ramanathan et al.	2012	Construction Delays Causing Risks on Time and Cost	Delays in construction projects	18 categories	18
van Notten	2013	Kosten- en tijdsoverschrijding in bouwprojecten	Construction projects	12 categories	28
Visser	2013	Postkantoor Neude Utrecht	Redevelopment	-	1
Mensing	2014	The re-development value of vacant real estate	Redevelopment	7 categories	-
de Groot	2014	Life Cycle Costs of Transformation	Redevelopment	3 categories	10
Kraag	2015	The added financial value of office conversion into housing	Redevelopment	-	6
Remoy & van der Voordt	2014	Adaptive reuse of office buildings into housing: opportunities and risks	Redevelopment	5 categories	13
Schmidt	2012	Financiele haalbaarheid van herbestemming	Redevelopment	6 categories	-

Table 10: Literature research on risks and causes of cost inaccuracies in the construction industry

6.3 CATEGORIZATION OF THE FACTORS FOR COST INACCURACIES

The main purpose for the literature research is to generate a compact list, containing the following criteria. The list must be categorised in such a way, that:

- it can be applied to redevelopment projects,
- it covers the possible causes for cost inaccuracies which can occur in the entire process,
- it can be implemented in a survey, in such a way that the time a respondent must spend remain minimal.

A research done by Jackson (2002) gives an overview of the perceived reasons for cost inaccuracies in such a way, that the reasons are categorised in 15 different items and ranked from highest to lowest impact on cost development. The complete list is shown in Table 11.

The research of Jackson (2002) however does not meet all criteria, since it does not give an overview of the causes of cost inaccuracies in redevelopment projects specifically. Therefore, a literature study has been performed in order to reveal the transformation specific risks. This list is presented in Table 12.

1. Design change	*Client driven design changes; Design variations*
2. Design development	*Incomplete design at tender; Too much generally; Initial design inadequate or lacks detail*
3. Information availability	*General lack of information; Lack of information at tender stage; Lack of information at briefing*
4. Design brief	*Lack of detail and definition, badly developed, incomplete or incorrect design; Client does not know what they want*
5. Estimating method	*Poor cost advice; Inadequate contingency allowance or assessment of risks; Base method used for calculation; Stubborn client attitude*
6. Design team performance	*Designers attitude, input, whims, understanding of cost and value; M&E estimates; Inadequate cost control; Designers awareness as to areas of cost risk and subsequent risk management*
7. Project management	*Design management; Contract and site management; Project control; Communication routes; Sub-contractor and supplier interface and management; Leadership; Lack of value management; Management approach; Decision-making*
8. Time limits	*Unrealistic design development periods; Delays by employer and client driven speed; No time to carry out realistic budgets or cost control; Unrealistic construction periods*
9. Site conditions	*Ground works; Unforeseen site conditions, constraints, restrictions, Murphy's Law; Dry rot or asbestos in refurbishments*
10. Organisation	*General poor preparation and planning; Pre tender; Inadequate surveys and investigation of existing site conditions*
11. Claims	*Aggressive or claims conscious contractors, contractors risk pressure, late information release*
12. Commercial pressures	*Fee competition; Tight bidding conditions; Confrontational approach of industry; Corner cutting clients*
13. People	*Inexperience, too optimistic, intuition, knowledge, qualifications, team, personal or practical skills; Qualifications of consultants / advisors; Qualifications of contractor*
14. Procurement route	*Wrong contract used, inappropriate allocation of risk in contract document*
15. External factors	*Changes in pricing conditions, indices, inflation, statutory factors, market trends*

Table 11: Perceived reasons causing building construction projects to finish over budget (Jackson, 2002)

Source	*Category*	*Risk*
De Waal, 2010	Time limits	*Insufficient time and budget for research*
	Unforeseen interventions in building	*Changes in structure, façade, installations, or other building components*
	Building characteristics and information availability of the existing building	*Condition of existing building unknown (measurements, state of foundation, roofs)*
De Groot, 2014	Building characteristics and information availability of the existing building	*Incorrect dimensions*
	Legal factors	*Unclear building regulations*
		Uncertainty about possibility to change zoning plan
Kraag, 2015	Site conditions	*Small construction site (impacting other factors such as construction method)*
Remoy & van der Voordt, 2014	Legal factors	*Zoning law: impossible to meet municipal requirements, zoning law or city policy*
		Building code: impossible to meet requirements, e.g. regarding the noise level and fire precautions; the municipality is unwilling to cooperate
		Historical protection: the listed status does not allow adaptations that are required to match new user needs
	Building characteristics and information availability of the existing building	*Incorrect or incomplete building structure assessment*
		Poor state of the main structure/foundation (rotten concrete or wood, corroded steel)
		Insufficient shafts available; construction allows no extra shafts being made
		Insufficient daylight for housing
		Present grid does not fit with the measurements required for new purposes, resulting in a waste of space or costly adaptations of the technical structure
		Private outdoor space is impossible

Table 12 Transformation-specific causes for cost overruns (de Waal, 2010; de Groot, 2014; Kraag, 2015; Remøy & van der Voordt, Adaptive reuse of office buildings into housing: opportunities and risks, 2014)

Two expert interviews are conducted to reveal unforeseen situations which occurred during redevelopment projects. According to the cost advisor, fire safety remains an important uncertainty (besides asbestos and all other known factors). Fire safety appeared to be one of the reasons for cost increases in case 2, which is described in chapter 8. The list of specific risks in redevelopment projects are presented in Table 13.

Source	*Category*	*Risk*
Cost advisor	Fire safety	Assessment of fire department on flame inhibiting materials is subjective
	Building characteristics	Relation between form of the building, the new design and the efficiency (LFA/GFA-ratio)
Real estate developer	External factors	Public utilities and pipelines Surroundings / neighbourhood Collaboration with the municipality Ground lease prices Economic trends Foundation remnants

Table 13: Risks in redevelopment projects, specific situations, based on expert interviews

6.4 LIST OF CAUSES OF COST INACCURACIES

The list which is used in the research of Jackson (2002) is complemented with the transformation specific risks, derived from literature, as well as from expert interviews. The new list is reviewed by both experts for their completeness. In total 21 categories are used; the causes are added as examples to prevent wrong interpretation by the respondents of the survey. The new list is presented in Table 14.

Availability of information during the process *E.g. general lack of information; lack of information at tender stage; lack of information at briefing*	Design development *E.g. incomplete design at tender phase; initial design lacks details*
Availability of information about the existing building *E.g. lack of information about asbestos, structure, façade, soil, installations and other building components; condition of the building unknown*	Design brief *E.g. lack of detail or definition; client does not know what he/she wants*
Building characteristics *E.g. weak foundation; grid of building causes useless space; impossible to realise outdoor space; insufficient daylight for residential use; materials not fire resistant / rejected by fire department*	Design team performance *E.g. designer's attitude; understanding of cost/value; inadequate cost control; designer's awareness as to areas of cost risk*
Claims *E.g. aggressive or claims conscious contractors; contractors risk pressure; late information release*	Organisation *E.g. poor preparation and planning*
Contractual factors *E.g. wrong contract used; wrong allocation of risk in contract document*	Project management *E.g. management of design, site, contractors and suppliers; lack of leadership; communication methods; management approach*
Commercial pressure *E.g. tight bidding conditions; corner cutting clients*	Psychological factors *E.g. optimism; cognitive bias; intuition; risk attitude*
Estimations / calculations *E.g. poor cost advises; poor risk analysis; wrong estimation of unforeseen costs*	Site conditions *E.g. unforeseen site conditions, restrictions, things that basically go wrong resulting in a more expensive construction method*
Legal factors *E.g. legislation unclear; impossible to meet requirements of municipality or zoning plan*	Strategic behaviour *E.g. deliberate cost underestimation; manipulation of estimations; no release of information*
People / project team *E.g. inexperience or not qualified team; relationship between actors; stubborn client*	Time limits *E.g. unrealistic time planning for design; delays due to slow decision making; insufficient time or budget to establish realistic budget; unrealistic construction period*
Unforeseen interventions *E.g. changes in structure, facade, installations or other building components due to unforeseen situations*	External factors *E.g. changes in prices, indexes, inflation, legal factors or market trends*
Design changes *E.g. client driven design changes; design changes to maximise LFA/GFA ratio; design changes to maximise development potential*	

Table 14: List of causes for cost inaccuracies, based on Jackson (2002), edited by author

All abovementioned causes for cost inaccuracies can be considered during the start of a new projects. However, this list of possible events that can occur is never finished and there is always a chance for black swan-events (Cretu, Stewart, & Berends, 2011). In the previous chapter, an overview is given of methods how to deal with risks, how to quantify these risks and how to deal with situation that cannot be predicted; the so-called black swan-events.

6.5 INACCURACIES IN REVENUES: MARKET RISK

In chapter 4.2, the establishment of the initial budget was discussed. In the fifth subparagraph of this chapter, an explanation was given on how the income level is determined in the initial budget. This mainly depends on (Muller, 2008):

- Market demand and supply on macro, meso and micro scale, now and in the near future,
- Locational characteristics,
- Building characteristics.

The market may change during the redevelopment process, which may result in a deviation between the estimated and actual income level. This is called the market (or: business) risk. Economic factors which may affect the rent level, are discussed below.

Market change as an uncertain factor during the redevelopment process

Real estate investors but also developers are in the business of renting space in properties (Brueggeman & Fisher, 2010). Fluctuations in economy affect the income which is produced by the property and affect vacancy rates. Economic factors affecting rent are demand factors, such as (Shapiro, Davies, & Mackmin, 2013):

- General level of prosperity,
- Population changes,
- Changes in character of demand (qualitative change),
- Rent as a proportion of personal income,
- Rent as a proportion of the profit margin (in the business sector for example),
- Competitive demand.

As the market consists of both a demand and a supply side, changes in the supply side may also lead to changes in the rent level. These are *the limitation of supply (price inelasticity)* and *the relation of cost to supply* (Shapiro, Davies, & Mackmin, 2013).

The risk of not achieving the desired rent or occupancy level influences the projects financial feasibility. Project developers can apply several strategies to diminish the market risk and to increase the profitability of a residential development (den Dekker & de Jong, 2009):

1. Launch an extensive promotion plan to persuade future buyers or tenants,
2. Flexibilisation of dwellings which are available for sale or rent,
3. Phase the sale of the dwellings to keep the supply limited (in the case of a large development),
4. Analyse the feedback on design and interest to match the design on the user's demand.

All abovementioned aspects are considered to explain possible deviations during the case study research.

6.6 SUMMARY

Literature research is used to determine which factors may cause cost inaccuracies. According to Jackson (2002) the main reason is changes in the design. However, this research is not focused on adaptation and transformation projects, and it is unclear how uncertainty in redevelopment projects relate to the development of costs. Therefore, the new list of categories, as presented in Table 14, is used in the survey and case study research to reveal the main causes of cost inaccuracies in redevelopment projects. For each of the 21 factors is asked for the probability and the impact on the costs. Deviations in the income is explained by changes in market, locational and building characteristics. The results are presented in the next chapters.

EMPIRICAL RESEARCH

7. SURVEY

This chapter follows on the findings of chapter 6; the causes for budget inaccuracies. In this chapter, the findings from literature are quantified to reveal the main reasons for budget inaccuracies. Furthermore, the accuracy of the initial budget is explored. This chapter gives thereby an answer on the first and second sub question of this research. First, the survey technique, sample, data collection and analysis are described. The results are elaborated in paragraph 7.4, followed by the discussion on the results and the conclusion.

7.1 TECHNIQUE

A survey is a quantitative research method (Groves, et al., 2009; Bryman, 2012), which is described as follows:

> *'A survey is a systematic method for gathering information from entities for the purposes of constructing quantitative descriptors of the attributes of the larger population of which the entities are members.'* (Groves, et al., 2009, p. 2)

The process of conducting a survey starts with literature study on the issues to be researched, followed by the formulation of research questions, which are used (in a revised form) in the survey (Bryman, 2012). The survey is used to test and to quantify the existing theory through the collection and analysis of data that has a deductive approach to the relationship between theory and research (Bryman, 2012, p. 35).

The main objective of the survey is to use a larger group of experts for determining which factors in a redevelopment project have, from a statistical point of view, a high probability and a high effect on the development of the costs, and vice versa. The factors which may cause cost inaccuracies are derived from theory (chapter 6). Furthermore, the survey is used to gather information about the average accuracy of the construction costs, the average accuracy of the revenues, but also the averagely used percentage unforeseen. The results of the survey are reflected upon the results of the case studies; possible deviations between the case study results and the survey results are explained in chapter 10.

The survey needs to (Bryman, 2012):

- Allow anonymous participation,
- Contain concisely written questions to minimize the time a respondent must spend,
- Filter the results, based on the respondent's experience and role within the redevelopment process,
- Provide an easy platform which can be used by commonly used electronic devices,
- Have a logic flow through the survey to minimise the risk for respondents quitting the survey halfway.

Based on the requirements as described above, the survey is spread as a digital self-completion questionnaire by e-mail (Bryman, 2012). This is the most appropriate method to participate anonymously with minimized fatigue, which may result in more reliable results.

7.2 SAMPLE

The sample is '*the segment of the population that is selected for investigation*' (Bryman, 2012, p. 187). The population is basically the total of unites from which the sample is to be selected. Within this research, the units consist of the following persons in the Netherlands who have experience with redevelopment projects:

- Real estate developers
- Cost advisors
- Architects
- Project managers

The selection of the sample is based on the *non-probability sampling*; the sample is not selected by using a random selection method. Instead, both the convenience sampling, as well as snowball sampling are used. In con-

venience sampling, respondents who are available to the researchers by virtue or accessibility are approached (Bryman, 2012, p. 201). In snowball sampling, '*the researcher makes initial contact with a small group of people who are relevant to the research topic and then uses these to establish contacts with others*' (Bryman, 2012, p. 202). The latter appeared to be a useful method in the real estate industry.

The sampling process was divided in two steps. In the first step, 25 experts within the researchers own network were contacted. 18 of this group filled in the questionnaire; others did not respond or did not have the expected experience with redevelopment projects. The snowball principle lead to 11 more respondents, with a total of 29 respondents in the first phase. Despite the high response rate, the process can be defined as time consuming.
In the second phase of the process, the focus was put on achieving a high response rate as possible by setting out the survey via platforms to approach a larger group of experts. Organisations which were willing to participate were the NEPROM (Association of Dutch Project Development Companies) and the NRP (National Renovation Platform).

Each organization has indicated their way of spreading the survey:

- The NEPROM spread the survey through their two weekly digital newsletters and their private LinkedIn group.
- The NRP selected a group of investors and developers which are relevant to this research. These members received a personal email.

Besides the organizations, a group of developers, project managers, cost advisors and architects were contacted through LinkedIn and e-mail, outside the researcher's network. This lead to 6 more respondents.

Type of organisation	Approached (members)	Respondents
1. Within own network	25 (personal call/mail)	18
→ *Network's network (snowball)*	?	11
2. NEPPROM newsletter	1.200 (newsletter)	8
3. NRP mailinglist	39 (personal e-mail)	
4. Outside own network	29 (personal message)	6
Total	**93 directly approached**	**43 respondents**

Table 15: Number of approached experts and members

7.3 DATA COLLECTION AND ANALYSIS

The list of cost influencing factors is determined by literature and by expert interviews (chapter 6). Below each factor, several examples are given so that the respondent can identify himself or herself with specific examples. All factors are translated to the Dutch language; both the English list, as well as the complete survey can be found in the appendix.

The establishment of the survey is done carefully: the questions are written accordingly to the literature and the expert interviews, the questions are rearranged in a logical order, a matching answering type is found in the form of sliders. Furthermore, the survey is tested by several people, including thesis supervisors H. Remøy and P. de Jong, but also the two expert interviewees. The feedback of the first group of respondents were analysed carefully. Some of the aspects of the survey did not work out well however; this is discussed at the end of this chapter.

The survey was created and tested in SurveyMonkey, Google Forms, Survio, SurveyGizmo and Qualtrics. The latter turned out to match all criteria for this survey. A link has been sent to the target group, which can be filled in on smartphones, tablets and PCs.

The survey consists of the following steps:

1. Questions about the respondent's experience,
2. Probability and effect on the cost development per factor (total of 21 factors, which are randomised in order to prevent external factors influencing the results),
3. Accuracy of estimations.

The survey consists of one main route. The characteristics of the respondent are asked in the first part of the survey, to extract respondents without experience with transformation projects or whose role within the transformation projects does not match with the criteria.

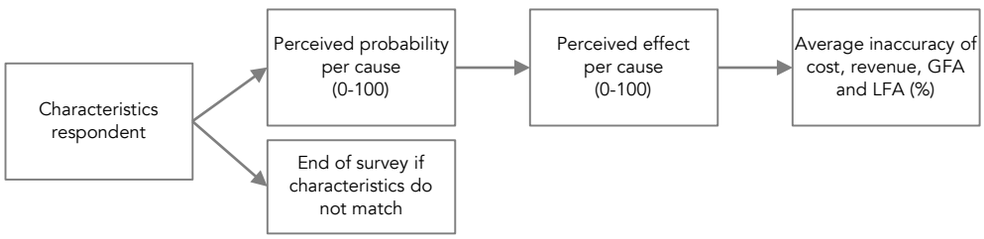


Figure 25: Steps through survey

The data is extracted from Qualtrics, and analysed in Excel for styling purposes, but also to add certain weighting factors depending on the type of respondent and his/her experience.

7.4 SURVEY RESULTS

7.4.1 CHARACTERISTICS OF THE RESPONDENTS

The sample size of this survey is 93; these are the directly approached members, by e-mail or through LinkedIn. The first question of the survey was answered by 64 members, but 21 of the members quit the survey after the first question. Most this group was an architect; apparently, they might have concluded that they do not have enough knowledge about the entire process to answer the question about the probability and the effect of factors on the budget. From the remaining 43 members, 6 more were excluded from the survey as they fell outside the scope of this research. This is the group 'other', which contains suppliers, a banker, an accountant and a financial manager who never worked for a real estate company. Hence, the total number of valid respondents is 37, which is 40% of the sample.

	Incomplete	Invalid	Valid *n*
Developer (independent)	13	11	10
Developer (delegated)	5	3	3
Developer (contractor)	8	6	6
Developer (investor)	5	4	4
Developer (owner-user)	1	0	0
Project manager	7	3	3
Project manager (housing ass.)	2	2	2
Cost advisor	6	4	4
Architect	10	5	5
Other	7	5	0
Total	*64*	*43*	*37*

Table 16: Response rate survey

To prevent that the results of unexperienced respondents are counted with the same weight as persons with more experience with redevelopment projects, the experience is used to determine the weight factor. Furthermore, cost advisors have a higher average experience with redevelopment projects. This number varies between 5 and 200, with an average of 58,75 redevelopment projects. The role of a cost advisor, as well as an architect, is different in comparison with the project developer and certain project managers, as these groups do not always have a complete overview of the entire redevelopment process. Therefore, role of the respondents is also used to determine the weight factor.
The average experience of the 37 respondents is 13,5 redevelopment projects per respondent.

Minimum	Maximum	Average	Std. deviation	Respondents *n*
1	200	13,51	32,46	37

Table 17: Average experience with redevelopment projects

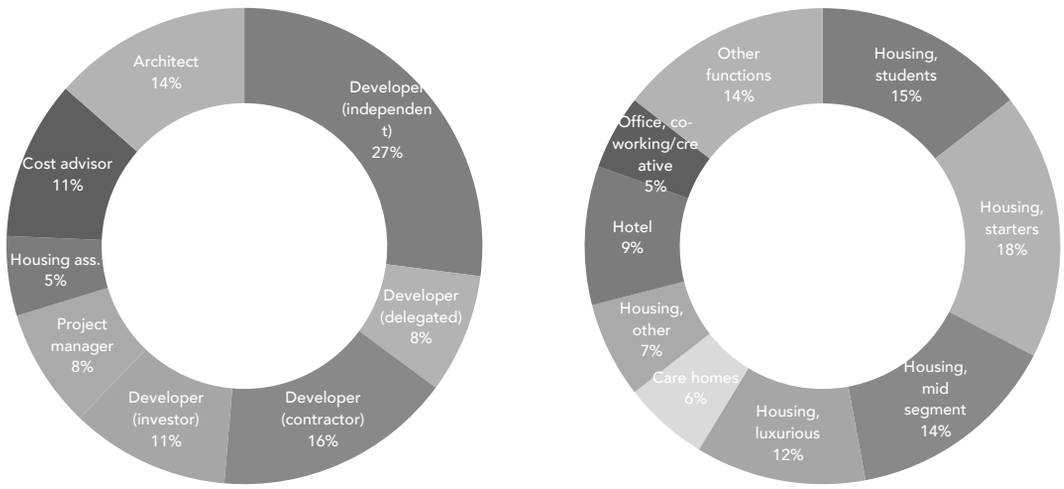
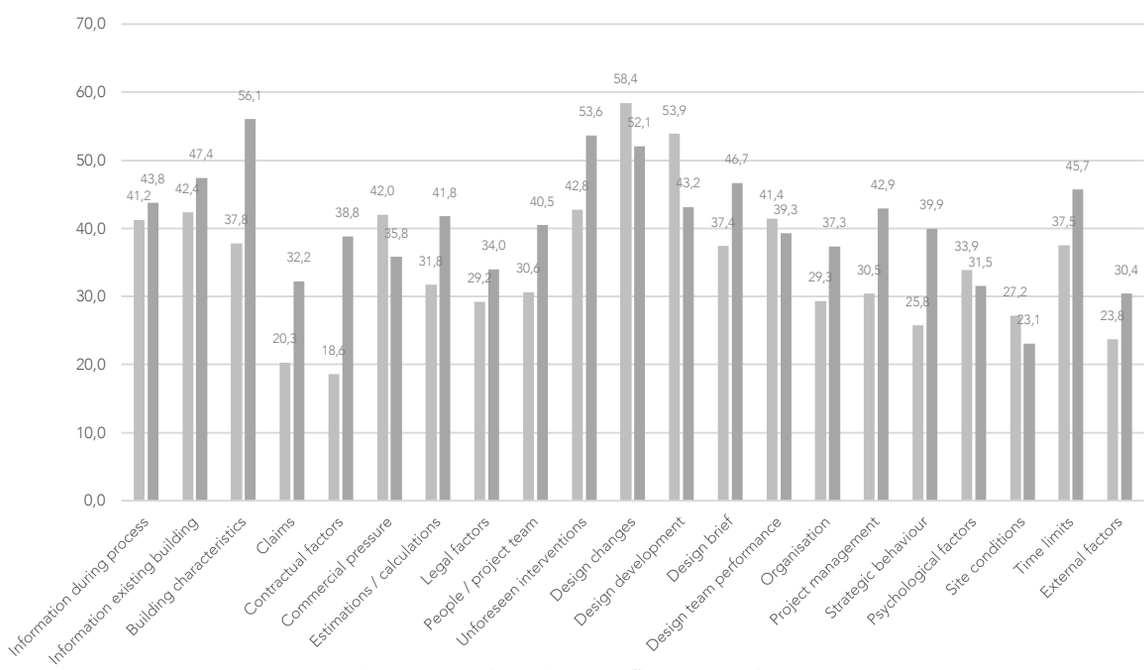


Figure 26: Respondents' role (left) and type of redevelopment projects done by the respondents (right) (n=37)

The experience of the respondents and the type of redevelopment projects are shown in Figure 26. Most of the respondents are project developers, and the experience with redevelopment is mostly transformation of a building to housing. Furthermore, two respondents work for a housing association. All other actors work in a private company. It is unclear if the project managers, architects and cost advisors have worked for a client which is a (semi-)public party.

7.4.2 MAIN CAUSES OF COST INACCURACIES IN REDEVELOPMENT PROJECTS: ALL RESPONDENTS

All respondents were asked to answer the question on the probability and the effect of cost increasing factors. Per factor, respondents could choose between 0 (no effect c.q. never) and 100 (max. effect c.q. always). The results are shown and ranked below. The full dataset can be found in the appendix.



Rank	1	2	3	4	5
Probability	Design changes	Design development	Unforeseen interventions	Missing information existing building	Commercial pressure
Effect	Building characteristics	Unforeseen interventions	Design changes	Missing information existing building	Design brief

Figure 27: Average perceived probability and effect on cost development in redevelopment projects, per factor

Figure 28 shows the results in a probability-effect matrix. The quadrant on the top right are the factors which occur most often during the redevelopment process and which have the highest effect on the costs. These factors are the main perceived cost generators during the redevelopment process according to the respondents.

Figure 28: Perceived causes of cost inaccuracies in redevelopment projects (n=37)

7.4.3 CAUSES OF INACCURACIES IN REDEVELOPMENT PROJECTS: ACTOR'S PERSPECTIVE

The respondents' answers are categorised on type of actor and ranked on factors which have the highest perceived impact on the cost development. This full list on which this table is based can be found in the appendix on page 109. Remarkable differences that deviate from the average are marked in green:

Rank	n	1	2	3	4	5
Total	37	Design changes	Design development	Unforeseen interventions	Building characteristics	Missing information existing building
Developer independent	10	Design changes	Building characteristics	Missing information existing building	Design development	Unforeseen interventions
Developer delegated	3	Missing information during process	External factors	Design changes	Estimations / calculations	Unforeseen interventions
Developer contractor	6	Design changes	Building characteristics	Design brief	Unforeseen interventions	Design team performance
Developer investor	4	Unforeseen interventions	Building characteristics	Legal factors	Missing information during process	Design changes
Project manager	3	Missing information during process	Design development	Unforeseen interventions	Time limits	Design brief
PM – housing association	2	Strategic behaviour	Building characteristics	Time limits	Organisation	Estimations / calculations
Cost advisor	4	Design changes	Design development	Commercial pressure	Design brief	Design team performance
Architect	5	Missing information existing building	Building characteristics	Project management	People / project team	Design changes

Table 18: Ranking of the 5 factors which affect the cost development the most, categorised on type of actor

Most actors agree on the two main factors for cost increases, which are *design changes as requested by the developer* and *transformation specific factors*. Examples of transformation specific factors are *missing information about the building in the initial phase*, *unforeseen interventions* and *unsuitable building characteristics*. Remarkable is that the two project managers working for a housing association see *strategic behaviour*, *time pressure* and *organisational factors* as the main reasons for cost inaccuracies. Design changes as requested by the client or developer are not seen as one of the main reasons for cost inaccuracies by architects and project managers. Important side not for this subparagraph: the number of respondents is too small to draw generalizable conclusions.

7.4.4 ACCURACY OF THE INITIAL BUDGET IN REDEVELOPMENT PROJECTS

In the last part of the survey, questions about the average increase or decrease in construction costs, revenues, LFA and GFA are asked, as well as the percentage unforeseen in the initial phase. 26 of the 37 respondents answered this question; only one member of this group calculated the deviation in exact numbers. Others answered the question, based on their knowledge and experience.

	Minimum	*Maximum*	*Average*	*Std. dev.*	*n*
Accuracy construction costs	-10 %	39 %	**14,04 %**	9,24	26
Accuracy revenues	-16 %	31 %	**9,00 %**	12,25	26
Accuracy LFA	-10 %	10 %	**1,42 %**	6,42	26
Accuracy GFA	-4 %	10 %	**3,27 %**	3,91	26
Accuracy unforeseen (% of construction costs)	0 %	25 %	**11,77 %**	6,69	26

Table 19: Accuracy of the initial budget estimations. This table shows the deviation between the initial estimations and the realised costs and revenues (based on n=26 valid respondents)

This table shows the average perceived accuracy of the initial budget in redevelopment projects. Construction costs are more than 14% higher than the estimated construction costs, but the revenues also increase during the redevelopment process with 9%. This can be best explained by the changes that are made in the design during the process; often initial plans are based on the maximum development potential in the case that the permits are not granted. A deeper reasoning for this increase might be the higher uncertainty in the initial phase, caused by missing information about the existing building, but also about the new design. The increasing costs and revenues may also be caused by the cautious attitude of the developers towards risks in redevelopment projects. The percentage unforeseen which is used in the initial budget is 11,8%; this is higher than the development of new buildings and can be explained by the redevelopment specific-risks.

The case studies in the next chapter show in more detail how the development process relates to the development of the budget in three adaptation and transformation projects.

7.5 DISCUSSION ON THE RESULTS

The most important side note on the survey results is that the number of respondents is too small to categorise the group into type of actors (e.g. architects, developers, cost advisors). In addition: the question about the accuracy of the initial budget shows a large standard deviation. This emphasizes the large number of variables which determine the accuracy of the budget and the entire redevelopment process. Examples are the risk attitude of the developer, the development strategy, market related factors, and many other factors which are discussed in the theoretical framework of this report.

However, the survey results do give new insights on the initial budget accuracy which were not measured before, for redevelopment projects specifically. The existing theory is quantified and ranked; this clarifies what the main factors for cost inaccuracies are in redevelopment projects. This is another approach of showing how the complexity of redevelopment projects affect the budget estimations, and therefore also the financial feasibility of these type of projects.

7.6 SURVEY CONCLUSION

The survey which has been conducted, with a sample size of 93, is completed by 37 valid respondents. This group consists of 23 project developers, four cost advisors, five project managers and five architects with experience in redevelopment projects. The respondents are asked to answer questions on:

- The probability and effect on costs of cost increasing factors/risks in the redevelopment process,
- The accuracy of the initial budget (construction costs, revenues, LFA, GFA)
- The averagely used percentage unforeseen in the initial budget.

The five main causes of cost inaccuracies are *1. design changes requested by the client/developer*, 2. *design development (e.g. initial design lacks details)*, 3. *unforeseen interventions in the building, 4. unsuitable building characteristics (e.g. more asbestos than expected) and 5. missing information about the existing building*. Almost all parties agree on these five main causes, except from the two project managers working for a housing association; *strategic behaviour (e.g. deliberate cost underestimation)* is the main cause for cost increases according to these two respondents.

Furthermore, the average accuracy of the estimated construction costs is 14%; this means that construction costs are often underestimated. Remarkable is the underestimation of revenues; this increases with 9%. A possible explanation is the cautious behaviour of developers towards risks. Lastly, the percentage unforeseen of almost 12% is as expected higher than new built projects. Exact reasons for these numbers differ per redevelopment project, as each development process is unique due to the location and building characteristics. The case studies in the next chapter show in more detail how the development process relates to the development of the budget in three adaptation and transformation projects.

8. CASE STUDY

Even though the survey gives a good overview of the extent of budget inaccuracies and the main reasons for the inaccuracies, the survey is not a suitable method to gain deeper understanding of the reasons for budget inaccuracies. Design changes during the process often originate from other factors within the process. The same applies for unforeseen situations during demolishment works and most other factors. In this chapter, carefully chosen cases give an answer on the third sub question by revealing *how* characteristics of the redevelopment process affect the development of the budget during the process.

8.1 TECHNIQUE

Case study research is concerned with the complexity and particular nature of the case in question (Bryman, 2012). A case study is characterised by a flexible and open-ended technique of data collection and analysis. This qualitative method focuses on a bounded subject which is representative. Within this research, the subject *budget accuracy* in redevelopment projects is investigated.
A case study is a useful design for achieving a holistic understanding of a phenomenon, whereas the survey research lacks explanation on the results. Therefore, the case study results are related to the results of the survey; both are compared to increase the robustness of the research. Possible deviations between the results of the survey, the case studies and the theory are explained in the conclusion.

The case study has a qualitative strategy which takes an inductive approach to the relationship between theory and research (Bryman, 2012). To increase the robustness of the research, multiple case studies are analysed. The main argument in favour of the multiple-case study is that it improves theory building (Bryman, 2012, p. 74). 'By comparing multiple cases, the researcher is in a better position to establish the circumstances in which a theory will or will not hold', as the evidence from multiple cases is often more compelling.

To further increase the robustness of the research, the data is not only collected through interviews, but through two more methods:

1. Semi-structured interviews
2. Content analysis (project, process and budget information)
3. Questionnaire, containing causes of cost inaccuracies derived from theory.

The questionnaire is presented after the interviewee's own explanation on the budget deviations to discuss and reveal more factors for the inaccuracy of the budget. This increases the validity and reliability of the research.

8.2 SAMPLE

In the survey, the discussion of sampling revolves around probability sampling, whereas discussions of sampling in qualitative research tend to revolve around purposive sampling (Bryman, 2012). Therefore, 'purposive sampling is a non-probability form of sampling'. Instead, the goal of purposive sampling is 'to sample cases/participants in a strategic way, so that those sampled are relevant to the research questions that are being posed'. This research focuses upon contrasting results but for predictable reasons, as all adaptation processes are unique. In this research three cases are chosen according to the case selection criteria.

The cases must meet the following criteria:

- The case should be a completed (or in progress) adaptation or transformation project in the Netherlands. In the case that the project is in progress, the construction phase must be started and demolition works must be finished,
- The case should be redeveloped by a private party,
- The case should be realised in 2012 or later,

- At least two of the three cases should have an inaccurate budget (deviation of the construction costs / m2 GFA is more than 10%),
- Sufficient information, as described in the units of analysis, should be available.

8.3 DATA COLLECTION AND ANALYSIS

According to Yin (2009), three aspects within a case study design are important: the research questions, the units of analysis and the method of linking the collected data and interpreting the results. These aspects are elaborated below.

The research questions which are relevant for the case studies are:

1. What is the (average) accuracy of the initial budget and percentage unforeseen in redevelopment projects?
2. Which factors within the redevelopment process are the main causes for cost inaccuracies and what are the perceived probability and effect of these factors on the development of the costs?
3. How does the development process, in particular in the initial phase, affect the development of the budget?

The information for answering the research questions is gathered by semi-structured interviews, content analysis and a questionnaire. The variables which are used to develop the interview protocol are presented below:

Variables	*Indicators*	*Data collection method*
Process phasing and sequence (Gehner, 2008)	Acquisition Design phase Entitlement Construction Realisation Finance, sale/lease	Interview and content analysis
Process characteristics and actor roles	Getting to know the building Establishment of the initial budget Risk distribution Causes of budget inaccuracies	Interview, questionnaire and content analysis
Budget	Construction costs Unforeseen costs Additional costs Rental income / year LFA GFA	Interview and content analysis
Risk management	Risk identification Risk quantification Risk distribution	Interview and content analysis

Table 20: List of variables

Figure 29 represents the process from theory to survey design, data collection, interpretation and conclusion.

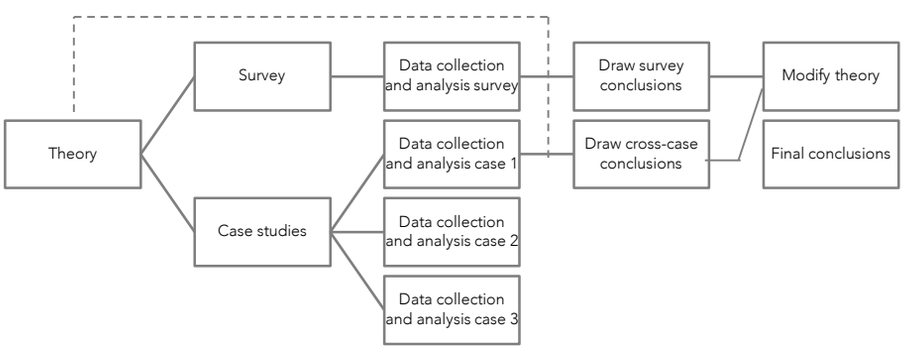


Figure 29: Case study process: data collection, linking to theory and survey

8.4 ANALYSIS OF CASE 1

PROJECT INFORMATION

Case 1 is an adaptation project in the Randstad region in the Netherlands, which was initiated by (delegated) developer X and investor Y. This project consists of two buildings, which were owned and used by company A until Q4 2014. Within this research, the two buildings are called building 1 and building 2.

Situation before transformation		
Function	*Office and showroom*	
Year of production	*1930 (building 1)*	*1960 (building2)*
Size (GFA)	*6.300 m2 (building 1)*	*14.800 m2 (building 2)*
Monumental status	*Yes, only building 2*	

(Expected) situation after transformation		
Function	*Office (multi-tenant), horeca and retail*	
Initiator	*Developer X and client Y*	
Start construction	*Q4 2016*	
Duration construction	*18 months (building 1)*	*18 months (building 2)*
Delivery	*Q1 2018 (building 1)*	*Q1 2018 (building 2)*
Size (GFA)	*10.200 m2 (building 1)*	*15.500 m2 (building 2)*
Size (LFA)	*7.200 m2 (building 1)*	*12.500 m2 (building 2)*

Table 21: Project details of case 1; before and after adaptation

PROCESS CHARACTERISTICS AND BUILDING INTERVENTIONS

Building 1 was built in the 1930s and has been used as an office building/showroom by company A. The building was completely deteriorated and needed to be adapted to increase its functional and technical lifespan. Building 2 is in a much better condition; this building is listed as a monument. This building has been used as a showroom by company A.
In contrast to building 1, building 2 only consists of a façade, a structure and a minimum amount of MEP due to its function in the past. Building 1 is a typical office building, with many inner walls and large installations. Both buildings were renovated in the 70s and therefore they contain asbestos; in this period asbestos was often used as a construction material.

Both developer X and investor Y initiated this project when the buildings were put on sale in Q3 2014. Five months later, in Q4 2014, the investor won the tender. In 2015, new architects are selected to design new plans with an increased floor area and quality. Currently (January 2017), construction works are executed until January 2018. The expected completion of both buildings is a few months later than estimated.

ESTABLISHMENT OF THE INITIAL BUDGET

In the months before the acquisition, feasibility studies were done. An architect was asked to draw a plan for both buildings, within the contours of the zoning plan. The architect delivered both a design, as well as a global programme containing GFA, LFA, parking spaces, elevators and more. Afterwards, developer X asked a cost advisor to calculate the construction costs. Based on the input of the architect and the cost advisor, developer X and investor Y established the initial budget. The residual value approach has been applied for determining the acquisition costs.

Building 1 – Costs	Estimated Initial budget	Estimated Before construction	Deviation	Realised
Construction cost *In €*	*€ 7,3 million*	*€ 15,6 million*	*+ 114%*	*N.A.*
Construction cost *In € / m2 GFA*	*€ 925 / m2*	*€ 1.530 / m2*	*+ 65%*	*N.A.*
Unforeseen cost *% of construction*	*10%*	*10%*		*N.A.*
Additional cost *In €*	*€ 0,31 million*	*€ 0,55 million*	*+ 77%*	*N.A.*
Total investment *In €*	*€ 20,7 million*	*€ 26,5 million*	*+ 28%*	*N.A.*

Building 2 – Costs	Estimated Initial budget	Estimated Before construction	Deviation	Realised
Construction cost *In €*	*€ 13,3 million*	*€ 20,0 million*	*+ 50%*	*N.A.*
Construction cost *In € / m2 GFA*	*€ 880 / m2*	*€ 1.292 / m2*	*+ 47%*	*N.A.*
Unforeseen cost *% of construction cost*	*10%*	*10%*		*N.A.*
Additional cost *In €*	*€ 0,50 million*	*€ 0,68 million*	*+ 36%*	*N.A.*
Total investment *In €*	*€ 46,4 million*	*€ 48,9 million*	*+ 5,4%*	*N.A.*

Building 1 Revenues	Estimated Initial budget	Estimated Before construction	Deviation	Realised
GFA *In m2*	*7.900 m2*	*10.200 m2*	*+ 29%*	*N.A.*
LFA *In m2*	*6.300 m2*	*7.200 m2*	*+ 14%*	*N.A.*
LFA/GFA-ratio *In %*	*80%*	*71%*		*N.A.*
Rental income / year *In € / year*	*€ 1,4 million*	*€ 2,1 million*	*+ 48%*	*€ 2,8 mil.*
Gross initial yield *Expected*	*7,0%*	*6,0%*		*6,0 %*
Total value *In €*	*€ 20,1 million*	*€ 35 million*	*+ 48%*	*€ 47 mil.*

Building 1 Revenues	Estimated Initial budget	Estimated Before construction	Deviation	Realised
GFA *In m2*	*15.100 m2*	*15.500 m2*	*+ 2,5%*	*N.A.*
LFA *In m2*	*12.300 m2*	*12.500 m2*	*+ 1,9%*	*N.A.*
LFA/GFA-ratio *In %*	*81%*	*81%*		*N.A.*
Rental income / year *In € / year*	*€ 3,2 million*	*€ 3,8 million*	*+ 17%*	*€ 4,2 mi.*
Gross initial yield *Expected*	*7,0%*	*6,0%*		*6,0 %*
Total value *In €*	*€ 45,6 million*	*€ 63,3 million*	*+ 17%*	*€ 70 mil.*

EXPLANATION OF DEVIATIONS IN BUDGET

The construction costs of building 2 were estimated at €880/m2 GFA, while the construction costs of building 1 were estimated at €925/m2 GFA. The difference is mainly caused by the addition of an extra floor and a new parking garage; the adaptation of listed buildings and complex structures is often more expensive than new buildings. Developer X mentioned that offices are often transformed for €1.000/m2 GFA by them, and new-built offices for €1.350/m2. The lower construction costs were based on the (lower) initial quality requirements.

At the start of the project, the office market was still not recovered from the financial crisis of 2008. Hence, the entire initial budget was tightly estimated. During the process, the market started to recover and both the investor as the developer changed their scope accordingly to the changing market circumstances.

Besides the construction costs, the marketing costs increased much more than expected. At a certain moment, investor Y desired to start a marketing campaign, led by a marketing company which is more expensive than expected. The extra effort which has been made for place branding, together with the increasing demand for office spaces, resulted in tenants which are willing to pay a higher rent than the expected target group.
The total sales budget was €2,5 and €5,3 million; this budget mainly consists of incentives for the tenants (in the form of 18 months rent-free). Giving incentives to attract tenants was not needed anymore.

Due to the growing demand in the market, the developer and investor decided to partially demolish building 1 and to increase the floor area of the building and to add a new parking garage. Besides the increased quality requirements (which results in a higher price per m2 GFA), the total construction costs increased as well (caused by more realised floor area than expected). The increase in LFA again pushed the revenues of the building.

At the time of writing (December 2016), the construction works have been started of both buildings. The tenant of building 1 is contracted and the rental income is 100% secured; in the initial budget, it was expected to be €1,4 million per year, but it increased with +100% to €2,8 million per year. The gross initial yield was expected to be 7,0%, but according to the developer 6,5 or 6% are achievable percentages; this has an enormous leverage on the taxation value of the buildings.

CASE CONCLUSION

The redevelopment is characterised by several factors:

- Development process during tipping point from economic recession to economic recovery, resulting in changing market demand and a changed plan during the process,
- Demolishment works and removal of asbestos in early phase, used to investigate the building,
- Redevelopment of iconic buildings in an inner city location,
- More asbestos found (in window sealant) during demolition works, which caused delays.

The (delegated) developer was asked to reflect the list of causes of cost inaccuracies on the process to reveal factors which occurred that also had an impact on the cost development. The responses are combined with the explanation on the deviation based on content analysis and presented below.

• Design changes	*Design changes, requested by the investor and the developer, are the largest cost generators within this project. The demand in the office market increased, which stimulated the revenues. Therefore, the team decided to add more floor area and to increase the quality.*
• Design brief	*Even though the developer was clear about the design brief beforehand, they had to deviate from the brief due to changing market circumstances.*
• Strategic behaviour and psychological factors	*The investor is the owner of another iconic building next to the project location. Furthermore, the buildings of the project itself are also unique and located well. Despite the aftermath of the financial crisis, both parties did their best 'to push their 'hobby' project over a point of no-return': both consciously, strategically, as well as unconsciously, caused by optimism.*
• Unforeseen situations due to missing information about the existing building	*Even though the project team mapped the building as complete as possible (3D measurement techniques, such as point-cloud, but also destructive research), extra asbestos has been found in the window sealant. The additional unforeseen costs are €100.000 and the construction period increased with 2 months.*
• Estimations / calculations	*The construction works for building 2 will take up to 18 months, instead of the 9 months that was expected. This has a certain impact on the revenues. This can be explained by optimism and cognitive biases.*
• External factors	*The price development of contractors, and thereby the construction costs as well, is increasing faster due to the increase in production within the construction industry. For this project, it has a minimal effect however.*

The following figure shows the change of scope/plan during the process through the trade off-model. In case 1, the developer decided to increase the quality (higher costs per m2 GFA) and the total floor area, which increased the costs and caused delays during the process.

Figure 30: Change in scope/plan increased the quality and total GFA, but came with higher costs and delays (schematic)

The figure below shows the relation between the development activities and the development of the budget. The improved quality, as mentioned above, is the main reason for the inaccuracy in the budget.

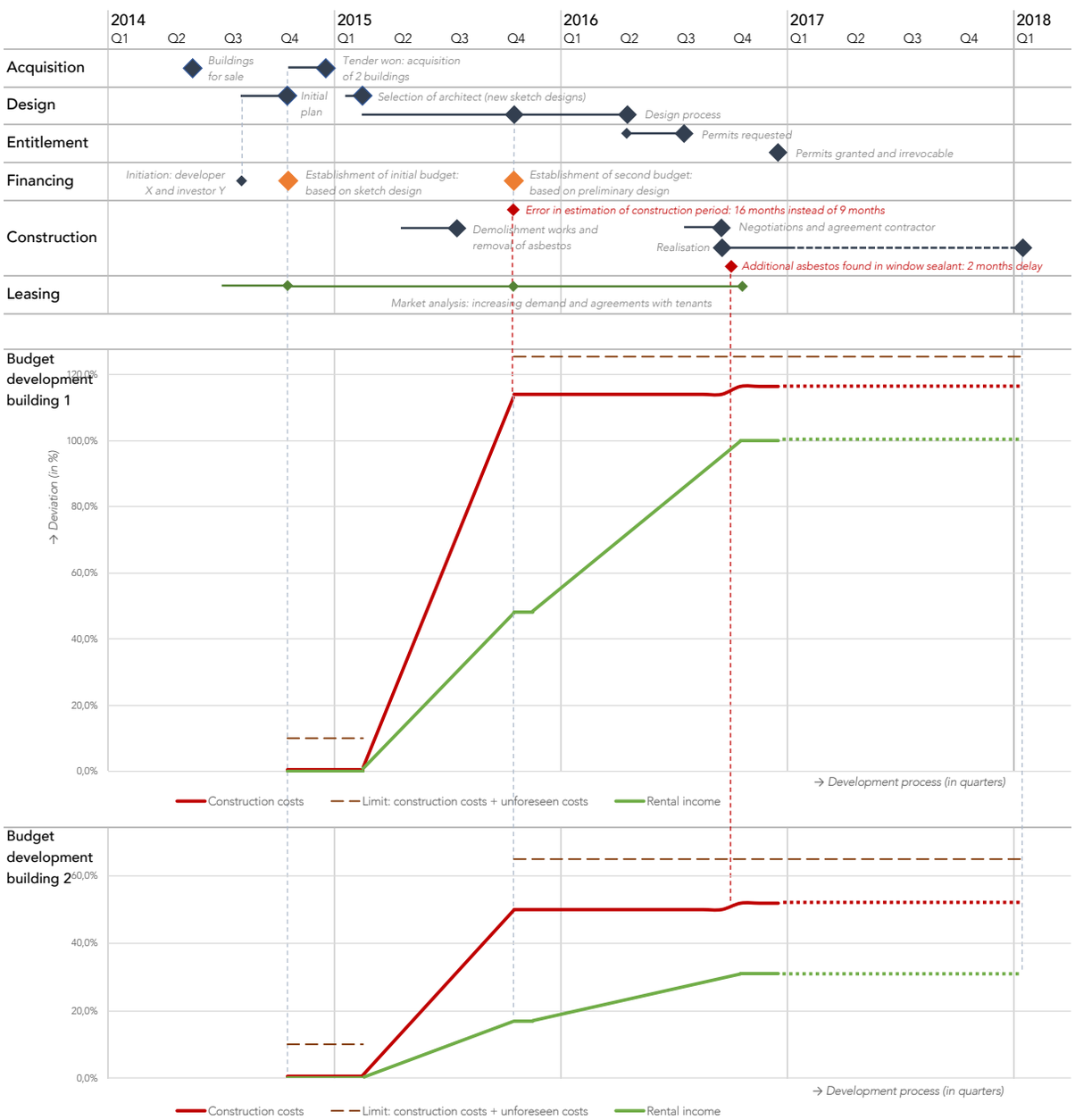


Figure 31: Timeline of the process of case 1

8.5 ANALYSIS OF CASE 2

PROJECT INFORMATION

Case 2 is a transformation project in the inner-city of one of the four largest cities in the Netherlands. The building is transformed by investor-developer Z. This project contains a high-rise building with 17 floors above a low-rise plinth. Investor-developer Z bought this building in 2008 as an investment vehicle; the building was occupied by several tenants. On the long-term, the investor-developer planned to transform the outdated building to meet the current standards.

Situation before transformation	
Function	*Office*
Year of production	*1970*
Size (GFA)	*17.300 m2*
Monumental status	*No*

(Expected) situation after transformation	
Function	*Hotel and office*
Initiator	*Investor-developer Z*
Start construction	*Q2 2016*
Duration construction	*12 months (highrise) / 13,5 months (plinth)*
Delivery	*Q3 2017*
Size (GFA)	*13.900 m2*
Size (LFA)	*12.300 m2*

Table 22: Project details of case 2; before and after adaptation

PROCESS CHARACTERISTICS AND BUILDING INTERVENTIONS

The new zoning plan for the entire area in which the building is located, was submitted in Q4 2011 and granted in Q4 2012. After the tenant left the building, the transformation of this building was started by signing the agreement with the contractor.

The building is currently (December 2016) being transformed into a hotel (floors 2 until 7) and offices in the upper floors. The low-rise part of the building will contain a lobby and shared facilities for offices. The façade of the building will be re-used, as well as the windows in the façade. New installations and inner walls will be added, and fire safety measures will be taken. The development activities are shown in Figure 34.

ESTABLISHMENT OF THE INITIAL BUDGET

The initial budget was established in Q2 2014. Initially, investor-developer Z planned to add extra floors on top of the building, since this was made possible by the new zoning plan. Even though residential use is also allowed in the zoning plan, the building is not suitable for residential use due to its proximity to the neighbour building. Therefore, investor-developer Z developed three scenarios:

1. Office use
2. Hotel use
3. Combination of office and hotel

In all three scenarios, the existing building's size would increase to 18.500 m2 GFA, resulting in estimated construction costs of 18,6 million euros. This amount is based on demolishment costs of 850.000 euros, including unforeseen costs of 10% and costs to remove the large amount of asbestos. The initial plan consists of 8.300 m2 GFA for hotel function at a cost of €950/m2 GFA, the rest of the building would be refurbished and used as an office for €600/m2 GFA. The newly built office floors on top of the building would be added at a cost of €1.250/m2 GFA. On top of the construction costs, the developer added 5% to cover all unforeseen situations

during the construction phase. All costs are based on sketch designs made by architects and calculations done by cost advisors. The rental income was expected to be 3,0 million euro per year, which is €180/m2 LFA. This is based on calculations of several brokers, determined by building, market and locational characteristics.
Below, a comparison is made between the budget based on the initial plan and the budgets in different phases of the reduced plan.

Costs	**Estimated** Initial budget	**Estimated** Before construction	**Deviation**	**Realised**
Construction cost *In €*	*€ 18,6 million*	*€ 11,5 million*	*- 38%*	*€ 11,5 million*
Construction cost *In € / m2 GFA*	*€ 1.006 / m2*	*€ 829 / m2*	*- 17,6%*	*€ 829 / m2*
Unforeseen cost *% of construction*	*5% (10% for demolishment)*	*3%*		*4% € 0,45 mil.*
Additional cost *In €*	*€ 1,87 million*	*€ 0,63 million*	*- 66%*	*N.A.*
Total investment *In €*	*N.A.*	*N.A.*		*N.A.*

Revenues	**Estimated** Initial budget	**Estimated** Before construction	**Deviation**	**Realised**
GFA *In m2*	*18.500 m2*	*13.900 m2*	*- 24,7%*	*13.900 m2*
LFA *In m2*	*16.600 m2*	*12.000 m2*	*- 28,0%*	*12.000 m2*
LFA/GFA-ratio *In %*	*90%*	*86%*		*86%*
Rental income / yr. *In € / year*	*€ 3,0 million*	*€ 2,0 million*	*- 33%*	*€ 2,0 mil.*
Gross initial yield *Expected*	*N.A.*	*N.A.*		*N.A.*
Total value *In €*	*N.A.*	*N.A.*		*N.A.*

EXPLANATION OF DEVIATIONS IN BUDGET

In Figure 34 the development of the costs over time is shown. Compared to the initial budget, the total construction costs, as well as the costs per square meter decreased. Main reason for this decline is the change of the initial plans; the floors that would initially be added on top of the building are withdrawn from the plans. The market risk for the office function is considered as high in relation with the investments that must be done for the construction of the extra floors.
Therefore, the gross floor area in the final plans decreased with almost 4.500 m2 in comparison with the initial plans. Remarkable is that the total number of square meters are even lower than the situation during acquisition. A part of the low-rise part of building 2 needed to be demolished to realise the neighbouring building in the first phase of the area.
In the current plans, the costs per square meter also decreased from 1.006 euro per m2 GFA to 829 euro; the current plan only consists of refurbishment of the existing building, while the initial plans contained newly built floors that come at a higher cost per square meter.

Unforeseen interventions during construction

Figure 34 also shows small increases in the construction costs during the realisation phase. The red line is the maximally budgeted unforeseen costs, which is reduced from 5 percent in the initial phase to 3 percent. After the investor-developer signed the agreement with the contractor in Q2 2016, several unforeseen situations occurred, in some cases resulting in extra unforeseen costs. The investor-developer is responsible for the exact specifications. The risk of additionally found asbestos is for the contractor.
Due to agreements with tenants which were made during the development of the neighbouring building, the investor-developer agreed improve the external appearance of the building. However, one of the cost items was not included in the agreement with the contractor; the improvement of the window-frames of the building. This resulted in additional works and costs of €166.000.
A second unforeseen situation is the additional investment which is needed for the fire safety of the two emergency staircases. The investor-developer assumed that the existing fire safety installations were accordingly to the regulations, but the fire department obligated a new installation to make the two staircases possible as emer-

gency exits. Instead of investing 450.000 euro in new installations, the developer decided to add enclosed compartments between the staircases and the corridor for 260.000 euro. The advantage of this solution is a lower investment, but this solution resulted in four smaller hotel rooms on every floor. These rooms did not comply with the agreement with the hotel company; renegotiations and a redesign of the four rooms were needed to prevent higher unforeseen costs.
Recently, the contractor discovered an unexpected situation in the structure in the basement. The floor of the basement is cut halfway for dilatation purposes. This may cause stability issues in the future, but additional investigation by a constructor is needed. Furthermore, more asbestos was found in a late phase, resulting in almost 170.000 euro additional costs for the developer before the agreement with the contractor was signed. The sum of other small additional costs are around 50.000 euros. Thereby, the total percentage unforeseen costs are currently 4% of the construction costs, which is one percent more than estimated. As most unforeseen situations occur during demolishment, a further increase of unforeseen costs is not expected according to the developer.

Figure 32: Unexpected situation in the structure of the basement. A junction which was constructed may cause stability issues in the future

CASE CONCLUSION

The redevelopment is characterised by several factors:

- Even though the redevelopment takes place during tipping point from economic recession to economic recovery, the market demand on this specific location did not increase as much as expected
- Contractor is responsible for building investigation and risk for additionally found asbestos
- Even though a tenant is found for only 6 of the 16 floors, the investor-developer initiated the redevelopment. Therefore, the plan is reduced to diminish market and vacancy risk.
- Overrun of the unforeseen costs due to unforeseen circumstances and low estimated unforeseen costs

The investor-developer was asked to reflect the list of causes of cost inaccuracies on the process to reveal factors which occurred that also had an impact on the cost development. The responses are combined with the explanation on the deviation based on content analysis and presented below.

• Design changes / design brief	*The difference between the initial budget and the current budget is mainly caused by a major change in the design. The extra floors on top of the building are withdrawn from the plans, resulting in lower construction costs per square meter and less floor area than initially calculated. Risks caused by design changes are mitigated by constructing a mock-up room and by requesting an official GO from the tenant.*
• Unforeseen interventions due to legal aspects	*The existing staircases were assumed to be safe and useable as emergency exits. According to the fire department however, new installations had to be purchased. The developer eventually decided to add enclosed compartments between the staircases and the corridor, which is a cheaper solution (250.000 euro). This resulted in 4 smaller hotel rooms per floor however, which had to be redesigned after renegotiations with the hotel company.*
• Unforeseen interventions due to external factors	*Agreements made in the past with the tenants in the neighbouring building about the external appearance of the building were not implemented in the agreement with the contractor. This resulted in additional, unforeseen costs of 166.000 euro.*
• Unforeseen interventions due to building characteristics and missing information	*More asbestos and unexpected situations within the structure of the building were found during the demolishment works. The removal of more asbestos resulted in additional costs for the developer, while the additional costs for repairing the structure in the basement must be paid by the contractor.*
• Estimations / calculations	*Currently, the percentage unforeseen is 4%, which is higher than the estimated three percent during negotiation with the contractor. In the initial phase, 5% was used to cover unforeseen costs. Both percentages are lower than the averagely used percentage unforeseen, resulting in overruns of the estimated unforeseen costs.*

The following figure shows the change of scope/plan during the process through the trade off-model. In case 2, the developer decided to decrease the quality (lower costs per m2 GFA) and the total floor area, which decreased the costs. The time planning remained the same.

Figure 33: Change in scope/plan decreased the quality and total GFA, but came with lower costs (schematic)

The figure below shows the relation between the development activities and the development of the budget. The reduced quality, as mentioned above, is the main reason for the inaccuracy in the budget.

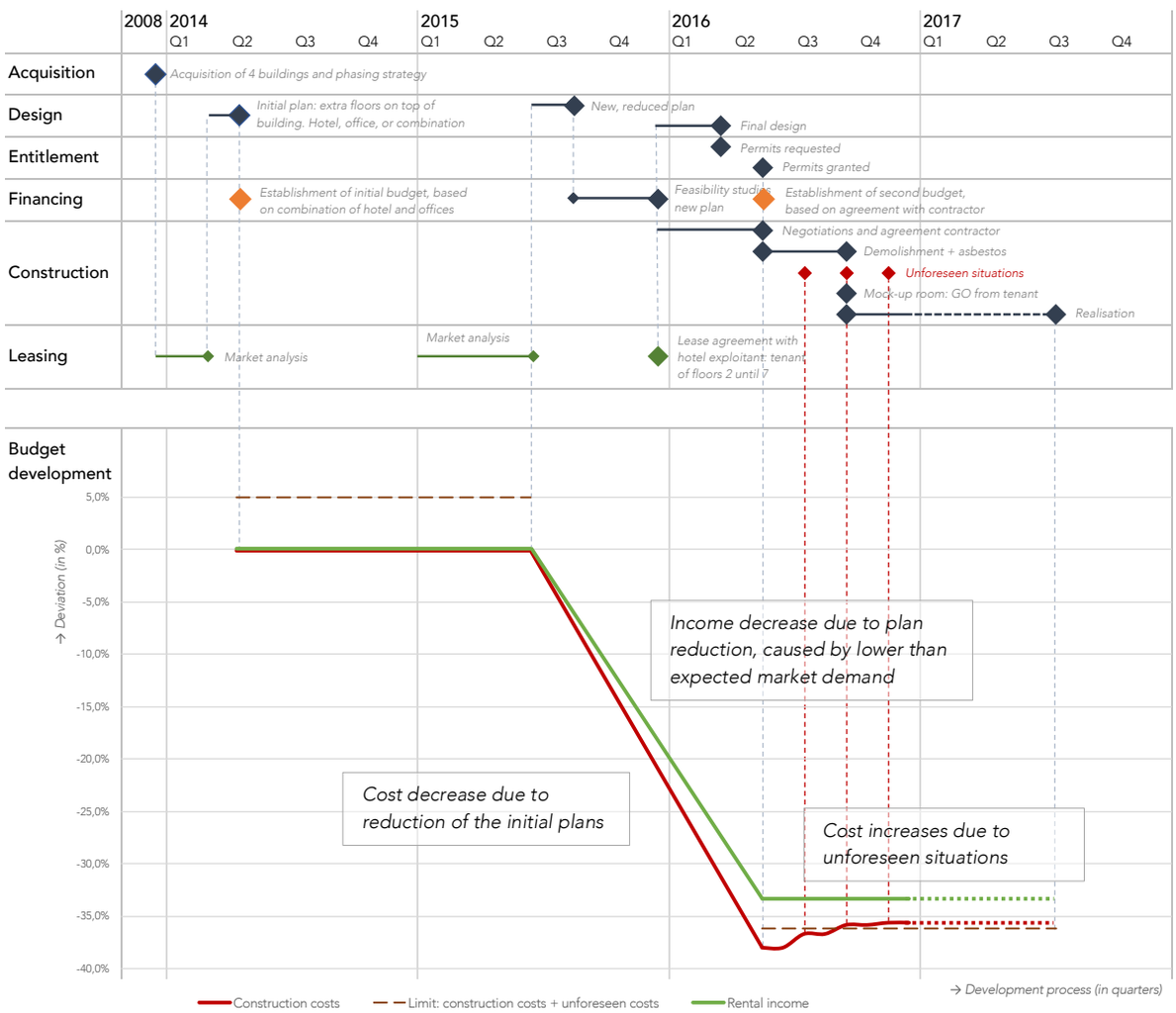


Figure 34: Process in relation with the development of the budget in case 2

8.6 ANALYSIS OF CASE 3

PROJECT INFORMATION

Case 3 is a (temporary) transformation project in Delft, the Netherlands. The building has been used as housing for nurses working in the psychiatric care centre of GGZ Delfland. The building lost its original function and became vacant for a period of eight years, until Stichting Herontwikkeling tot Studentenhuisvesting Delft (SHS Delft) initiated the transformation of the structurally vacant building into temporary student housing. This organisation, founded and led by students, has the objective to decrease vacancy and to diminish the housing shortage for students by transforming these temporarily for a period of 10 years. The first temporary transformation project of SHS Delft is presented below.

Situation before transformation	
Function	*Nurse housing*
Year of production	*1969*
Size (GFA)	*5.973 m2*
Monumental status	*No*

(Expected) situation after transformation	
Function	*Student housing (temporary)*
Initiator	*Initiator SHS Delft and investor Euroyal Invest*
Start construction	*Q3 2014*
Duration construction	*5 months*
Delivery	*Q1 2015*
Size (GFA)	*5.725 m2*
Size (LFA)	*4.533 m2*

Table 23: Project details of case 3; before and after transformation

PROCESS CHARACTERISTICS AND BUILDING INTERVENTIONS

The initial phase started in Q1 2012. In Q2 2012, the first letter of intent between SHS Delft and property owner GGZ Delfland was established. After the letter of intent, SHS Delft started the feasibility phase, combined with negotiations on the lease agreement between SHS Delft and GGZ Delfland, and finding an investor. The lease agreement was signed in Q4 2013. Important conditions in the lease agreement were:

- The contract could be withdrawn if no financing could be found or if the permits are not obtained,
- SHS Delft is responsible for the removal of asbestos,
- Lease will be paid after the permits are obtained, for a period of 10 years,
- The property needs to be vacant and empty after the period of 10 years.

For requesting the permit, SHS Delft waited until 1 November 2014 due to the change in the legislation, which made the lease for a period of ten years instead of five years possible, even though the zoning plan did not allow residential use. The student rooms were completed in January 2015.

The interventions in the building were minimal: the building was constructed for living purposes. The structure, floors, façade and windows are maintained. Most of the inner walls are reused as well. The fire department approved the building on fire safety after the fire safety installations of the building were renewed and the vertical shafts were constructed in such a way, that the vertical transition of fire would be minimised.
The elevators are renovated, the installations are completely renewed and most of the pipes and sewer system are renewed as well. Asbestos is removed on places where students can encounter the material; on other places, such as the vertical shafts, asbestos is not removed to keep the investment as low as possible.

ESTABLISHMENT OF THE INITIAL BUDGET

Unlike regular redevelopment projects, the building of GGZ Delfland was not publicly tendered, nor it was available for purchase. The strategy of SHS Delft was to convince owners of vacant real estate to temporarily lease their property and to turn costs for vacancy into an income stream.
After a quick scan, based on the first impressions of the property, the initiator decided to draw sketches of possible floor plans. Based on these plans, a contractor calculated the construction costs in March 2012. The initial budget was developed a week later. Initial sketches, a more detailed second inspection of the property and the construction costs based on the calculation of the contractor were used to establish the initial budget.
The revenues are based on the Dutch *Woonwaarderingsstelsel*: a system that assigns points, related to the size of the bedroom, the amount and size of restrooms and bathrooms, the size of the common room, etc. Even though the *Woonwaarderingsstelsel* may limit the maximal rent and therefore cause price inelasticity (Shapiro, Davies, & Mackmin, 2013), the rent level was not maximised; it was mainly determined by the market in Delft and the maximum rent a student can afford. These values are lower than the maximal possible rent.

Cost	**Estimated** Initial budget Q2 2012	**Estimated** Before construction Q1 2014	**Realised** Q1 2015	**Deviation**
Construction cost *In €*	*€ 1.155.347*	*€ 1.104.253*	*€ 951.281*	*- 17,7%*
Construction cost *In € / m2 GFA*	*€ 193 / m2 GFA*	*€ 185 / m2 GFA*	*€ 159 / m2 GFA*	*- 17,7%*
Unforeseen cost *% of construction cost*	*10%*	*10,9%*	*5,3%*	
Additional cost *In €*	*€ 128.500*	*€ 66.800*	*€ 45.922*	*- 64,2%*
Total investment *In €*	*€ 1.724.666*	*€ 1.444.833*	*€ 1.218.984*	*- 29,3%*

Revenues	**Estimated** Initial budget Q1 2012	**Estimated** Before construction Q1 2014	**Realised** Q1 2015	**Deviation**
GFA *In m2*	*5.973 m2*	*5.973 m2*	*5.973 m2*	*0%*
LFA *In m2*	*2.565 m2*	*2.890 m2*	*2.851 m2*	*+ 11%*
LFA/GFA-ratio *In %*	*43%*	*48%*	*48%*	
Rental income / year *In € / year*	*€ 352.544*	*€ 453.737*	*€ 430.286*	*+ 22%*
Gross initial yield *Expected*	*N.A.*	*N.A.*	*N.A.*	*N.A.*
Total value *In €*	*N.A.*	*N.A.*	*N.A.*	*N.A.*

EXPLANATION OF DEVIATIONS IN BUDGET

The construction costs of the project were initially, in Q2 2012, estimated at €193/m2 GFA. These costs were based on initial impressions and inspections by the contractor. The estimations of the construction costs, in Q1 2014, were decreased to €185/m2 GFA. The realised costs were €159/m2 GFA. The difference between the initially estimated construction costs and realised costs is therefore 18% lower.

The main reason for the decreased construction costs is that much more building components are maintained in its original state, such as:

- Suspending ceilings,
- Asbestos, which is only removed where students can encounter the material,
- Inner walls in the high-rise part,
- Horizontal ventilation shafts in the rooms,
- Flooring; this is transferred to the service fee and paid directly by the students,
- Functioning water pipes.

Furthermore, the plans for the multifunctional area on the ground floor, as well as the office rooms in one of the wings are renovated with a lower budget than initially desired. The construction costs are mainly reduced due to changing quality standard, combined with the desire of the investor to reduce the initial investments by maintaining as much components as possible.

Additional costs are decreased with €82.500, which is 64% lower than initially estimated. In the initial budget, this was set at €100.000 plus €28.500 for obtaining the permits. The latter decreased to €25.000, but the major difference is caused by a subsidy from the municipality of €50.000. Furthermore, financing costs decreased due to lower investment costs, and fees for other actors were lower than expected.

Hence, the total investment decreased with almost 30%. This is mainly caused by abovementioned reasons, as well a decrease of (estimated) unforeseen costs of €70.000.

At the same time, the revenues increased. This is mainly caused by:
- the amount of points that is assigned per room due to optimisations of the student houses and,
- due to measurement errors in the initial plan.

The low LFA/GFA-ratio is caused by the fact that more internal corridors are added to the building, which do not impact the rent level of the building.

CASE CONCLUSION

The redevelopment is characterised by several factors:
- Contractor involvement for establishing the initial budget
- Long preparation phase, resulting in proper inspections of the existing building and optimisations of the plan
- The development team consisted of unprofessional, low-wage initiators/developers
- No high acquisition costs in the initial phase due to the choice to lease the property
- More reuse and a decrease in desired quality during the process to minimise the investment costs.

The long preparation phase was caused by a delay in the change of the legislation that was needed. The parties could do so, because there were no financial obligations towards the property owner. This resulted in a proper analysis of the building and optimisations of the plan. In this way, the adaptation works that were needed was minimised and the reuse potential of the building increased.
Another important characteristic of this redevelopment project was the low hourly wage of the members of SHS Delft. This resulted in a highly optimised design.
The accuracy of the initial budget is also related to the early contractor involvement. The detailed cost calculations were accurate and did not change over time; a decrease in the construction cost was mainly caused by other factors during the process, such as changes in desired quality.

All members of SHS Delft were asked to reflect the list of causes of cost inaccuracies on the process to reveal factors which occurred that also had an impact on the cost development. The responses are combined with the explanation on the deviation based on content analysis and presented below.

- Design changes — *The quality in the initial plans has been reduced and optimised to the requirements of the future tenants during the development process, to minimise the investment and thereby also to diminish the risks. The building components are maintained and reused as much as possible.*
- Project management — *Sub-contractors are tendered and managed by the initiator and the investor during the realisation phase. A main contractor was therefore not needed, which reduced the costs during the realisation phase.*
- Time limits — *The long preparation phase of this case was caused by the change in legislation which was needed to make this project possible. This resulted in extra time to get to know the building, to optimise the initial plan and to reuse as much building components as possible.*

- Estimations / calculations

Some costs, such as the investment which was needed for new flooring, were initially included in the construction costs. During the process, the costs for new flooring were excluded from the construction costs and added to the service fee, paid directly by the tenants. Before the realisation phase, the rental income was maximised. Eventually, both the initiator and the investor decided that the maximised rental income did not meet the quality of the interior, combined with the market characteristics. This resulted in a decrease in the rental income in the final budget.

The following figure shows the change of scope/plan during the process through the trade off-model. In case 3, the initiators and investor decided to optimise the plan in order to decrease the costs, and increase the income. The extra time which was needed was available due to a delay in the necessary change in legislation.

Figure 35: Optimisation of the plan reduced the costs and increased the revenues. The extra time which was needed was available due to delay in the necessary change in legislation (schematic)

The figure below shows the relation between the development activities and the development of the budget. The reduced costs, as mentioned above, is the main reason for the inaccuracy in the budget.

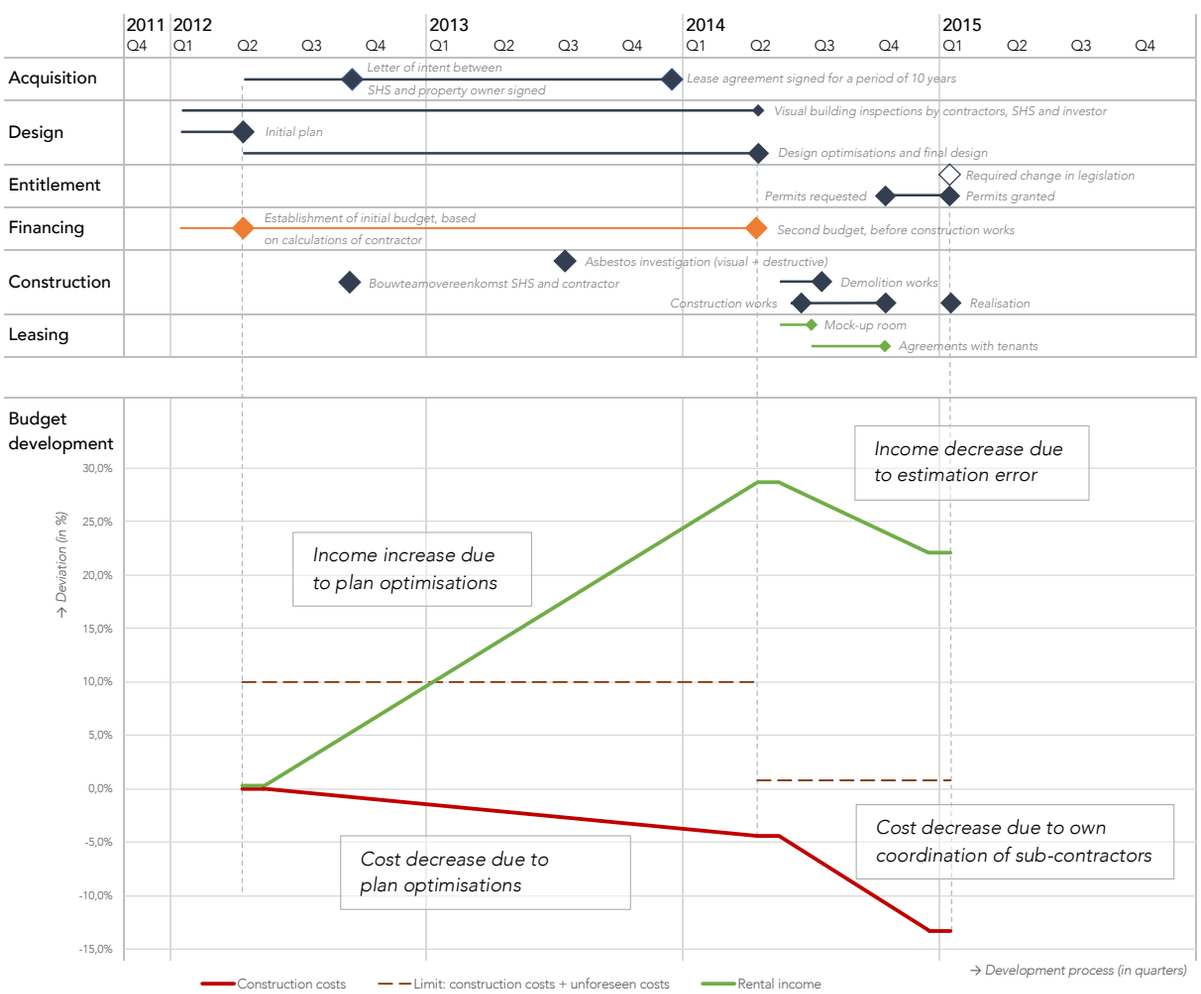


Figure 36: Process in relation with the development of the budget in case 3

8.7 CROSS-CASE ANALYSIS

This paragraph focuses on the cross-case analysis of the three cases which are analysed within this research to identify how the characteristics of the redevelopment process relate to the development of the budget during the process. The results are presented in Table 24 and Figure 37.

	Case 1	*Case 2*	*Case 3*
Old function	Office and showroom	Office	Nurse apartment
New function	Office, leisure, retail	Hotel and office	Student housing
Type and extent of adaptation	Partial demolishment and new-built of building 3	Stripped to the façade; new inner walls and installations, removal of asbestos	Maximally reused; suspended ceilings, inner walls and pipes are maintained. New installations and partial removal of asbestos
Year of acquisition	Q4 2014	Q4 2008	Q4 2013 (lease for 10 yrs.)
Initiation redevelopment	Q3 2014	Q2 2014 and Q3 2015	Q1 2012
Start construction	Q4 2016	Q2 2016	Q3 2014
(Expected) delivery	Q3 2017 Q1 2018	Q3 2017	Q1 2015
Deviation construction costs	+114% +50%	-39%	-18%
Deviation construction costs / m2 GFA	+65% +47%	-14%	-18%
Deviation rental income	+100% +31%	-33%	+22%
Deviation LFA	+14% +2%	-25%	+11%
Deviation GFA	+29% +3%	-28%	0%
Risk identification method	Experience / checklist used by developer and cost advisor	Experience / checklist used by developer and cost advisor	Experience / checklist used by contractor
Risk quantification method	Scenario analysis and risk premium (subjective)	Scenario analysis and risk premium (subjective)	Scenario analysis and risk premium (subjective)
Unforeseen (% of cc)	10% 10%	5% initially, 3% before construction	10%
Legal risks	According to zoning plan	According to zoning plan	Outside zoning plan: exemption needed to increase exploitation from 5 to 10 years
Risk distribution among actors	Extensive building investigation by developer, demolisher (mapping used materials) and architect (exact measurement)	Contractor responsible for risk of asbestos and building investigation	Early contractor involvement Extensive building investigation by initiator and contractor before establishment of initial budget
Causes of cost inaccuracy	1. Design changes 2. Design brief 3. Strategic behaviour and psychological factors 4. Availability of information about the existing building 5. Estimations / calculations 6. External factors	1. Design changes / design brief 2. Unforeseen interventions due to legal aspects 3. Unforeseen interventions due to external factors 4. Unforeseen interventions due to building characteristics and missing information 5. Estimations / calculations	1. Design changes 2. Project management 3. Time limits 4. Estimations / calculations
Main reason for design change	Market demand increases: → higher income → more floor area → higher quality	Mismatch between market characteristics and initial plan: → less floor area and costs Short preparation time → unforeseen situations	Delay in change of legislation: → long preparation phase → design optimisations → more reused materials → own coordination during construction phase

Table 24: Cross-case analysis, classified on the budget information and main process characteristics

Figure 37: Cross-case analysis, classified on the development duration, key moments in the process and the main reasons for deviations in relation to the development of construction costs (red) and rental income per year (green)

REASONS FOR INACCURACIES

Design changes as requested by the client/developer

The results show that the main reasons for cost inaccuracies are caused by design changes as requested by the developer or the client. Often, design changes are originated by other reasons. The last row in Table 24 explains what the main cause is for the design changes.
According to the developer of case 1, this is caused by the decreased market risk as the demand for unique office spaces in that specific area are increasing. Therefore, the plan changed during the process to accommodate tenants which are willing to pay higher rents. However, increasing market demand cannot be the only factor for a major increase of the construction costs per m2 GFA of 65 and 47%. The questionnaire revealed other reasons for the large deviations in the budget; optimism-bias and strategic behaviour (i.e. deliberate cost underestimation) is the first reason for the lower estimated initial costs, and secondly, errors in estimations of the duration of the construction period caused increased costs.
On the other hand, the investor-developer of case 2 changed the design, not by increasing the floor area but by decreasing it. The first tenant of the building is a hotel company, which will lease only half of the building. The other floors will remain offices; tenants are not found yet.
The investor and the initiator of case 3 optimised the design during the development process; the floor area remained the same, while the construction costs decreased. In contrast to the first two cases, the choice to change the design is not led by market changes, but by risk and investment reduction as desired by the investor. The reduced quality is compensated by a reduction of the rent level for the tenants.

Unforeseen situations, building characteristics, building information

Unforeseen situations because of missing information about the existing building occurred in case 1 and 2. In both cases, more asbestos was found than initially expected. These expectations are based on investigations by asbestos experts. Other reasons of unforeseen costs are unexpected construction methods used in the past, costs due to agreements made in the past with neighbouring tenants, and rejection of the plans by the fire department. While the additional costs in case 1 are within the reserved unforeseen costs of 10%, the latter exceeded its reservation of 3% for unforeseen costs. In both cases, these situations occurred during demolishment works.

ESTABLISHMENT OF THE INITIAL BUDGET

Construction costs and acquisition

In case 1 and 2, the construction costs were calculated by cost advisors in the initial phase, based on sketch designs of architects. These costs are mainly based on key figures and experience of cost advisors. Remarkable is that the construction costs in case 3 are calculated by a contractor, based on the initial sketches, based on a more detailed second inspection of the property. Unlike the first two cases, these calculations are based on detailed quantities instead of key figures.
All parties established several budgets containing a worst, base and best case scenario. The worst-case scenario consists of calculations, based on minimal interventions and by maintaining the existing function. The base case scenario is the most likely situation, with more adaptation works in order to increase the functional lifespan of the building, but still according to the zoning plan.

Building investigations, risk analysis and risk distribution

In all three cases past experience is used to identify risks, and scenarios analyses are developed in order to quantify risks. The three cases differ from each other when it comes to the parties which were involved in the risk analysis; in case 1 and case 3, the developers had full control over the risk analysis by investigating the building as complete as possible, whereas the investor-developer of case 2 mainly focused on distributing as much as risk as possible.
Case 2 also differs from the other two cases regarding building investigations. In case 1 and case 3, the process of getting to know the building took place in the initial phase, including complete measurement of the building and asbestos investigations, while in the situation of case 2, the investor-developer held the contractor responsible for extensive building investigations for a period of one week, during the final design phase.

8.8 CASE STUDY CONCLUSION

The initial budget of redevelopment projects is often inaccurate, according to the literature, the survey and the three randomly chosen adaptation projects in the Netherlands. All three cases revealed that the risk identification and risk quantification methods are similar. Past experience with redevelopment projects is used to determine the risks and potential reasons for cost inaccuracies. Furthermore, scenario analyses are applied in the establishment of the plans. The initial budget of two cases is based on sketch designs of architects and cost calculations done by cost advisors, based on key figures. However, in case 3, the construction costs are calculated by the contractor, which was involved in the initial phase.

The main reasons for the inaccuracy of the initial budget is mainly caused by design changes as requested by the client or developer. Design changes often arise by other factors. In two of the three cases, the market circumstances changed or did not develop as expected, resulting in changes in the quality of the design and the total floor area. In the third case, the design is optimised during the process to minimise the initial investment and risks.
The deviation in case 1 is not only caused by design changes due to increasing market circumstances. The questionnaire, which was presented during the interviews, revealed that strategic behaviour and optimism-bias were other reasons for the low initial budget. The team members were affected by the uniqueness of the buildings.
Unforeseen situations occurred in case 2 during the demolition works. Unexpected situations in the structure, agreements made in the past with tenants in the neighbouring building and a rejected fire safety plan were main causes of unforeseen costs. These are mainly originated due to missing information about the building characteristics.

A higher percentage for unforeseen costs of 10% is used in two cases. The investor-developer of case 2 reserved 5% in the initial budget and 3% in the budget which was established during the agreement with the contractor. At the moment of writing, the percentage unforeseen increased to 4%.
Adaptation and transformation projects often deal with more unforeseen situations due to the characteristics of the existing building. However, not all situations can be foreseen. Therefore, the importance of a higher percentage unforeseen, compared with detailed building investigations are key elements in the initial phase of redevelopment projects.

9. DISCUSSION OF THE RESULTS

9.1 DISCUSSION OF THE SURVEY RESEARCH

TECHNIQUE AND SAMPLE

The survey is intended as a method to rank the causes for cost inaccuracies which are derived from literature. The survey results are intended to give an insight on the relation between the different factors and relation between the different budget items, rather than revealing the exact percentage of the deviations and the percentage unforeseen. The survey namely consists of questions which are based on perceptions rather than exact data of redevelopment projects. This means that the conclusions which are drawn in the next chapter, are drawn cautiously, in order to prevent that these percentages are interpreted as exact deviations (hasty generalisation) and used for further research. For the latter, the results of the case studies can be used.

Even though the respondents could fill in the survey anonymously, all respondents are tracked and verified through the data about their current job, company, name, e-mail address and/or locational data. This increases the validity and the reliability of the survey.

For this survey, a non-probability sampling is used, respondents who are available to the researcher by virtue or accessibility are approached. The sample is therefore not representative for the entire population, which consists of 2500 companies listed as real estate development organisations (Gehner, 2008). This also means that the survey results are not generalizable for the entire population; instead, the results can only be generalized for the chosen sample (Bryman, 2012, p. 205).

ERRORS IN THE SURVEY QUESTIONS

The survey has been analysed and feedback of the test group was gathered. The survey contains some errors in some questions, but these do not have an impact on the results. In the case that results are affected, the respondents are excluded from the survey.

- The sliders are too detailed in comparison with the question. However, this has a minimal impact on the results
- Question 'current job' gives undesired results; instead the question should be reformulated to: What was your position during the redevelopment projects'. This will be added manually, since all respondents are known persons or traceable through LinkedIn.
- Question 1c can be interpreted differently depending on type of person
- Question 1d should be focused on 'main functions'
- Architects often stop without finishing the survey; apparently, the position of the architects within a redevelopment process does not match with the questions in the survey. Architects should have a different set of questions for understanding their perspective. The input of the architects however, is not key for this research, because they often do not have the full knowledge and experience on the required aspects (cost development and risks) within a development process. Therefore, some responses are marked as invalid.
- Answering the probability per item is not difficult for the respondents. The graph shows a wide range between the causes.
- Answering the effect on the cost development per item appears to be difficult for the respondents. The question is based on general perceptions, and this leads to general answers. This results in a flat graph.
- The categories 'Availability of information about the existing building' and 'building characteristics' are more or less the same type of categories. This leads to similar results (which proves while the respondents read and answer the questions carefully).

9.2 DISCUSSION OF THE CASE STUDY TECHNIQUE

The results of the case studies are not only based on (semi-structured) interviews with developers, but also on content analysis per case and a questionnaire. In this way, the robustness, (internal) validity and reliability are increased. Content analysis is conducted by analysing the budgets, by investigating market characteristics on the specific location and by investigating and analysing project and process information. Reasons for budget inaccuracies are collected through interviews and through the questionnaire; the latter appeared to be an important method to reveal more reasons for inaccuracies. Finally, the complete list of causes is reflected on the extent of the inaccuracy, but the results are also cross-checked with literature and the survey results. Deviations are explained in the conclusion and in the following paragraph.

9.3 TRIANGULATION

9.3.1 CROSS-CHECK OF THE RESULTS

Within this research, a mixed methods research is applied containing both quantitative and qualitative research for triangulation purposes. Triangulation 'is being used to refer to a process of cross-checking findings deriving from both quantitative and qualitative research' (Deacon et al. 1998), to increase the credibility and validity of the research. Therefore, this paragraph contains a comparison between the results of the literature review, the survey results and the case study results.

	Literature review	Survey results	Case 1	Case 2	Case 3
Main reasons for budget inaccuracies	Various reasons, unranked and/or not transformation-specific. *Design change* is main reason in regular projects (Jackson, 2002). In public infrastructure projects, *strategic misrepresentation* is the main reason for cost overruns (Flyvbjerg, et al., 2007)	1. Design changes 2. Design development 3. Unforeseen interventions 4. Building characteristics 5. Missing building information	• Design changes / brief • Strategic behaviour / psychological reasons • Unforeseen interventions due to missing building information • Estimations / calculations • External factors	• Design changes / brief • Unforeseen interventions due to: o Legal aspects o External factors o Missing building information • Estimations / calculations	• Design changes • Project management • Time limits • Estimations / calculations
Risk identification	Mostly used in practice: checklist of already known risks, based on experience (Gehner, 2006)	-	Checklist of already known risks, based on experience of developer and cost advisor	Checklist of already known risks, based on experience of developer and cost advisor	Checklist of already known risks, based on experience of contractor
Risk quantification	Mostly used in practice: risk premium (unforeseen) and scenario analysis (Gehner, 2006)	-	Risk premium and scenario analysis	Risk premium and scenario analysis	Risk premium and scenario analysis
Establishment of the initial budget	Key figures of cost advisor, based on initial sketch design (Mensing, 2014)	-	Key figures of cost advisor, based on initial sketch design	Key figures of cost advisor, based on initial sketch design	Exact bill of quantities, calculated by contractor, based on initial sketch design
Building investigation	Visual inspection and document analysis before acquisition, destructive research after acquisition (Douglas, 2006; Mensing, 2014)	-	According to literature. Removal of asbestos in early phase; used as a means to investigate the building	Asbestos investigation and removal in a late phase, before construction works. Late documentation of the building	Early and extensive (visual) investigation of the building throughout the entire process, by contractor, investor and initiator.
Development strategy and actor roles	Various sequence of the development activities, depending on the development strategy (Gehner, 2008)	-	Traditional process. Early involvement of sub-contractor responsible for demolishment works	Traditional process. Contractor responsible for building investigation and removal of asbestos.	Early contractor involvement

Table 25: Research triangulation, process characteristics

	Literature review	Survey results* 26 respondents with an average experience of 13,5 transformation projects / person	Case 1	Case 2	Case 3
Accuracy of construction costs	Underestimated in regular projects: +38%, n=44 (Winch, 2010) Underestimated in public infrastructure projects: +28%, SD=38,7 n=258 (Flyvbjerg et al., 2007)	Underestimated Average = +14%, SD = 9,2 Min = -10% Max = +39%	Building 1: +114% Building 2: +50%	-39%	-18%
Accuracy of revenues	No quantitative data	Underestimated Average = +9% SD = 12,3 Min = -16% Max = +31%	Building 1: +100% Building 2: +31%	-33%	+22%
Unforeseen (as % of construction costs)	Higher than new-built projects	Average = 11,8% SD = 6,7 Min = 0% Max = 25%	Building 1: 10% Building 2: 10%	5% in initial budget, 3% before construction works	10%
Accuracy of GFA	No quantitative data	Underestimated Average = +3,3% SD = 3,9 Min = -4% Max = +10%	Building 1: +29% Building 2: +3%	-28%	0%
Accuracy of LFA	No quantitative data	Underestimated Average = +1,4% SD = 6,4 Min = -10% Max = +10%	Building 1: +14% Building 2: +2%	-25%	+11%

Table 26: Research triangulation, accuracy of the initial budget

9.3.2 DISCUSSION OF THE REASONS FOR BUDGET INACCURACIES

The outcomes of the main reasons for inaccuracies in the initial budget are similar in all research methods (Table 25). All three research methods reveal that *design changes as requested by the client/developer* is the main reason for cost inaccuracies.

Public parties versus private parties

In contrast to the abovementioned, the main reason for cost inaccuracies in *large infrastructure projects*, led by *public parties*, is *strategic misrepresentation* instead of *design changes*. Even though the research of Flyvbjerg et al. (2007) is focused on different type of projects, led by different type of actors (public parties), a remarkable similarity can be found with the two respondents within this research working for a housing association (semi-public party). According to these two project managers, *strategic behaviour (i.e. deliberate cost underestimation)* is the main reason for cost inaccuracies (see Table 18 on page 71). This indicates that projects led by public parties are more prone to strategic behaviour (e.g. deliberate cost underestimation and/or strategic misrepresentation) than projects led by private parties, irrespective of the type and size of the construction projects.

Design changes: further investigated

As *design changes* often originate from other factors, a deeper investigation is done during the case study research. In two of the three cases, major changes in the design were done due to changing market characteristics (increase or decrease in market demand). In the third case, the design was changed minimally to optimise the plan (decrease of investment costs and increase of revenues).

Based on observations of the abovementioned similarities and differences, the conclusion can be drawn that in projects done by private parties, budget inaccuracies are often caused by design changes, and that the latter is followed by a change in market characteristics. Therefore, costs, revenues and quality are kept in balance with each other throughout the process. This can be seen in the development of costs and revenues, which are directly related to each other in the first two cases. The third case shows an ideal situation due to continuous design optimisations; the investment costs decreased while the revenues increased.

9.3.3 DISCUSSION OF THE ACCURACY OF THE INITIAL BUDGET

Both Flyvbjerg et al. (2007) and Winch (2010) state that costs in building projects and infrastructure projects are often underestimated, averagely increasing with 38% and 28% throughout the process (Table 26). According to the survey research, the construction costs increase with 14% averagely throughout the entire process, which is lower than the before mentioned numbers. Further research on this difference between literature and survey research is not done; therefore, the difference cannot be clarified scientifically. Below, possible reasons for the difference between the literature and the survey results are given.

The survey research has its advantages of reaching a large group with a relatively small effort. However, the disadvantage of the survey research regarding the accuracy of the budget is as follows:

- The survey results are not exact numbers of the accuracy of the initial budget, but the numbers are based on the respondents' perception of the average inaccuracy. This may lead to more optimistic numbers than the real numbers,
- The respondents might have interpreted the questions differently, even though the question was to answer the deviation of the total construction costs (instead of for example construction costs per m2 GFA or total investment costs)

Relation between the deviation of costs, revenues, GFA and LFA in redevelopment projects

Even though the exact numbers of the survey are not fully reliable, this entire research reveals important insights in the relationship between:

- Development of costs,
- Development of revenues,
- Plan development,
- Changes caused by external and internal factors.

As it turns out, changing circumstances often directly impact the plan and budget during the process. The developer continuously keeps both the plan and the budget in balance, in order to prevent decreasing profit. This is illustrated in Figure 38.

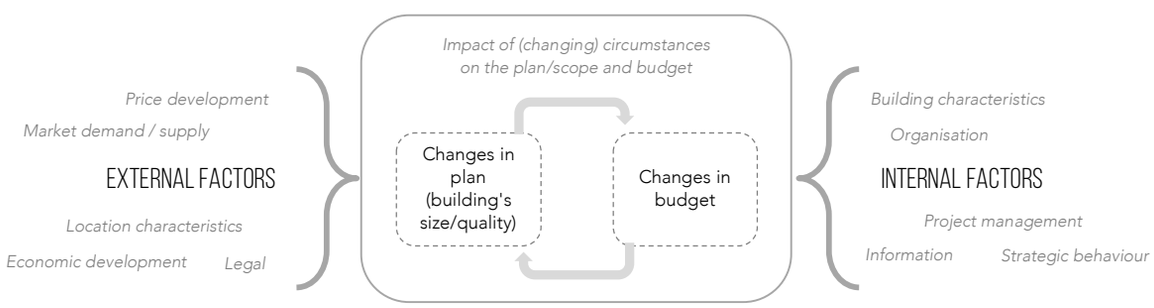


Figure 38: Balance between budget development and plan development

Figure 38 can be applied to each of the three cases. In case 1, increased market demand led to increased (estimated) revenues. To attract tenants willing to pay a higher rent, the building's quality was increased, as well as an increase in the total floor area. In case 2, the opposite occurred: the market demand was lower than expected, resulting in a reduction of the total floor area (thus, lower costs) due to a higher market risk (lower income than expected). Case 3 proves that under the same market conditions, changes in the building's quality may also impact the budget. This explains the direction of the arrows in Figure 38.

9.4 APPLICABILITY OF THE RESEARCH RESULTS

This paragraph outlines the applicability of the research results. The previous paragraphs revolve around the reliability and validity of the research results. The part of the results which can be applied by professionals and academics are presented below. Furthermore, this paragraph connects directly to the relevance of this research.

The literature review, which is based on the problem analysis and the relevance at the start of the research process, revealed that some aspects in the field of cost management are not investigated yet. Therefore, several research objectives were established to fill the scientific gap. These aspects were to investigate:

1. the main reasons for budget inaccuracies in redevelopment projects,
2. the extent of budget inaccuracies in redevelopment projects,
3. the impact of the complexity of redevelopment projects on the accuracy of the budget,
4. the relation between deviations in costs and revenues in redevelopment projects,
5. the relation between redevelopment process characteristics and the development of the budget,
6. the impact of risk analysis methods and budget estimating methods on the accuracy of the budget.

Each objective (and variable) is presented in the first column, and for each variable the applicability is presented.

	Scientific applicability	Applicability for professionals (e.g. developers)
Main reasons for budget inaccuracies	Even though the survey results are based on perceptions rather than exact analyses, the results correspond with literature and with the results of the case studies. Therefore, the ranked reasons for budget inaccuracies can be applied for further research to diminish the uncertainty in the initial phase.	Design changes, as well as (missing information about) building characteristics are the main determinants for budget inaccuracies in redevelopment projects. The results prove the complexity of transforming existing buildings and the necessary measures that need to be taken during the redevelopment process (see below).
Risk analysis methods	In each case, the same risk analysis methods are used. Therefore, it is unclear what the impact of different risk analysis methods is on the accuracy of the budget and the uncertainty in the initial phase.	In each case, the same (low complexity) risk analysis methods are used. Therefore, it is unclear what the impact of different risk analysis methods is on the accuracy of the budget.
Establishment of the initial budget	According to the literature and two cases, the use of key figures is the most used method for determining the construction costs. Except from case 3, which is based on an exact bill of quantities. The inaccuracy of the budget appears to be mainly caused by design changes, rather than the chosen calculation method of the construction costs.	The inaccuracy of the budget appears to be mainly caused by design changes, rather than the chosen calculation method of the construction costs. The use of detailed calculations in the initial phase is arguable. Throughout the process the design often changes due to changing market circumstances, which again leads to a change of the initial plans.
Building investigation	In each case, the building is investigated differently. Therefore, it is unclear what its impact is on the accuracy of the budget. Investigating the building in an early phase (as in case 1 and 3) reduces the uncertainty in an earlier stage of the process however.	Early building investigations (as in case 1 and 3) reduces the uncertainty in an earlier stage of the process. Therefore, it is advised to remove the asbestos (and thereby perform destructive research of the materials) as early as possible.
Development strategy and actor roles	Early removal of asbestos and early contractor involvement reduces uncertainty in an early phase.	Early removal of asbestos and early contractor involvement reduces uncertainty in an early phase.
Accuracy of the budget	The accuracy of construction costs in the survey research is based on perceptions rather than exact analyses. All research results however correspond with literature; costs are often underestimated. New: revenues, LFA and GFA are also underestimated. Important for further research: all results show a large standard deviation, caused by different attitudes towards risks as well as the uniqueness of each project.	Averagely, costs, revenues, LFA and GFA are underestimated in Dutch redevelopment projects, meaning that actors are cautious towards risks in the initial phase. The average numbers cannot be considered in the establishment of the initial budget (i.e. not all projects deviate with 14% and 9%), because each developer has a different attitude towards risks and each project is unique.
Unforeseen in initial phase	The average percentage unforeseen corresponds in all three research methods (around 10%) and can be applied for further research.	The cases reveal that a minimum of 5% needs to be used before construction works; averagely 11,8% is used according to the survey. The use of unforeseen costs *in the initial phase* is arguable: between the initial phase and the start of construction works, the costs (and revenues) deviate with much larger numbers due to changing market circumstances. Unforeseen costs are recommended to be used to cover unforeseen situations during construction works, rather than to cover all unforeseen situations during the process.

Table 27: Applicability of the survey results

CONCLUSION & RECOMMENDATIONS

10. CONCLUSION AND RECOMMENDATIONS

10.1 CONCLUSION

To answer the main research question, this research was compiled by four sub questions. The data was gathered through a mixed methods approach, consisting of survey and case study research and supported by literature research. The answers on the sub questions and main question are formulated in this paragraph.

Sub question 1:
What is the (average) accuracy of the initial budget and percentage unforeseen in redevelopment projects?

To start off, the initial phase is characterised by a high level of uncertainty which is originated from the nature of the construction industry (Winch, 2010). Due to missing information, it is difficult to establish accurate initial budget estimations. Furthermore, the initial budget is often underestimated, rather than overestimated (Flyvbjerg, Holm, & Buhl, 2007; Bloem, 2009; de Waal, 2010; Winch, 2010).

The literature is confirmed by the results of the survey research: the average deviation between the estimated construction costs and the realised costs is 14%, which means that costs in redevelopment projects are also often underestimated. Remarkable is that the revenues are also underestimated. According to 26 respondents, mainly projects developers, the realised revenues are 9% higher than the expected revenues. The average LFA and GFA show a small increase over time. These average numbers however show a high standard deviation, which affects the reliability of the results. Furthermore, the results are not based on exact calculations, but on perceived, average deviation, based on the knowledge and experience of the respondents.

However, the survey gives new insights on the development of the costs, revenues and the plan, as well as the averagely used percentage unforeseen. The underestimation of costs, as stated in literature, is confirmed by this survey. The increase in revenues can be explained by design optimisations (i.e. increasing the LFA/GFA ratio), as well as the cautious attitude of developers towards risks. The former can be explained by the small increase of the LFA during the redevelopment process.

The high standard deviation of the survey results is confirmed by the accuracy of the budget of the three case studies. The deviations of the construction costs are: +114%, +50%, -39% and -18%, whereas the realised revenues deviate with +100%, +31%, -33% and +22% compared to the revenues in the initial budget.

The average percentage unforeseen is 11,8% of the total construction costs according to the survey research. This is higher than the percentage unforeseen which is used in new-built projects, and therefore in line with literature. In the case studies, the initially used percentage unforeseen is lower, compared to the results of the survey; in two cases 10 percent is used, whereas in case 2 five percent is used initially. This difference between survey and case study results can be explained by:

- the small number of case studies in comparison with the survey research,
- the difference in actors and risk behaviour: cost advisors in the survey research tend to use a higher percentage unforeseen
- a low percentage used by the investor-developer of case 2, resulting in a higher sum of unforeseen costs during construction works than reserved.

Sub question 2:
Which factors within the redevelopment process are the main causes for budget inaccuracies and what are the perceived probability and effect of these factors on the development of the costs?

To answer this question, literature study is conducted to acquire knowledge on the classification and establishment of a budget in the initial phase of redevelopment project. This revealed the following information:

- most cost items are directly related to the construction costs (e.g. unforeseen costs and additional costs are a certain percentage of the construction costs),
- construction costs are determined by key figures in the initial phase, based on experience. In literature, this is argued to be unprecise and containing a large bandwidth,
- according to expert interviews, construction costs can be determined accurately based on experience and a simple sketch design. The construction costs however deviate due to changes in the design during the process,
- the calculation of the revenues is based on the rent level and the gross initial yield. These are determined by market, locational and building characteristics.
- indexes are used to determine the development of construction costs and revenues in the future.

This list contains some factors for cost and income deviations. An extensive literature research is conducted, containing 15 different sources, in order to complement the list of causes for budget inaccuracies (page 64). This list of 21 factors is used as a basis for the survey and case study research. For each factor, the probability and the effect on the development of the costs is asked.

Rank	n	1	2	3	4	5
Probability x effect	37	Design changes	Design development	Unforeseen interventions	Building characteristics	Missing information existing building
Probability	37	Design changes	Design development	Unforeseen interventions	Missing information existing building	Commercial pressure
Effect	37	Building characteristics	Unforeseen interventions	Design changes	Missing information existing building	Design brief

Table 28: Main reasons for cost inaccuracies, categorised on probability and effect per factor, based on survey results

The case study results show the same main reasons for budget inaccuracies; *design changes as requested by the developer or the client* and *unforeseen interventions* are the main reasons. A deeper understanding of the origination of these aspects revealed different reasons for budget inaccuracies, such as design changes due to *changing market circumstances* and unexpected building characteristics, such as *problems in the structure* or a *higher quantity of asbestos*. For these causes, no pattern can be found based on the results of this research.

Sub question 3:
How does the development strategy in the redevelopment process, and in particular in the initial phase, affect the development of the budget?

In each case study, the development process, development activities and sequence are analysed to answer this sub question. The following aspects are considered and related to the budget development:

- Establishment of the initial budget
- Risk analysis methods and risk distribution
- Actor roles
- Building investigation

In case 1 and 2, the construction costs were calculated by cost advisors in the initial phase, based on sketch designs of architects. These costs are mainly based on key figures and experience of cost advisors. Remarkable is that the construction costs in case 3 are calculated by a contractor, based on the initial sketches, based on a more detailed second inspection of the property. Unlike the first two cases, these calculations are based on detailed quantities instead of key figures. Therefore, these calculations are considered as accurate since these calculations represent the actual contractor's price.

All parties established several budgets containing a worst, base and best case scenario. The worst-case scenario consists of calculations, based on minimal interventions and by maintaining the existing function. The base case scenario is the most likely situation, with more adaptation works in order to increase the functional lifespan of the building, but still according to the zoning plan.

In all three cases past experience is used to identify risks, and scenarios analyses are developed in order to quantify risks. The three cases differ from each other when it comes to the parties which were involved in the risk analysis; in case 1 and case 3, the developers had full control over the risk analysis by investigating the building as

complete as possible, whereas the investor-developer of case 2 mainly focused on distributing as much as risk as possible. The additionally found asbestos in case 2 was paid by the contractor, preventing deviations in the budget of the investor-developer.

Case 2 also differs from the other two cases regarding building investigations. In case 1 and case 3, the process of getting to know the building took place in the initial phase, including complete measurement of the building and asbestos investigations, while in the situation of case 2, the investor-developer held the contractor responsible for extensive building investigations for a period of one week, during the final design phase. This lead to unforeseen discoveries in a late stadium, resulting in additional costs for the investor developer.

Main research question:
Which improvements can be made in the redevelopment process, and in particular in the establishment of the budget in the initial phase, in order to increase the accuracy of budget estimations and to diminish the probability and effect of risks?

Based on the results of the case studies, the following aspects are recommended:

- Building investigations in an early phase of the project to reduce the uncertainty in an early phase,
- Early contractor involvement, or, early removal of asbestos as a means to investigate the building (destructive research) in an early phase,
- A percentage unforeseen of at least 5% before and during construction works. Even if the building is investigated and the contractor is responsible for the risk of additional asbestos, a higher percentage unforeseen than new-built is recommended, since not all building aspects can be fully investigated.

Some factors can be influenced by the developer, while for other factors buffers need to be implemented in the initial budget. The survey results show a large standard deviation, which emphasize the large number of variables that determine the accuracy of the initial budget and the entire redevelopment process. The variety of the causes of budget accuracies corresponds with the role of the project developer within the (re)development process, which are (Gehner, 2008):

- the many activities of the redevelopment process due to the multidisciplinary character of real estate,
- the specialised local knowledge which is required due to the unique characteristics of each location and each building,
- the long duration of the process and the complexity to predict the future,
- changing demands from the investor or end-user may lead to changes in the development process.

The main solution is not to try to diminish all risks by fully investigating the building, and by establishing detailed cost calculations and designs in the initial phase, but by being flexible during the entire process and monitoring the information which become available during each iteration of the process (Gehner, 2008).

10.2 RECOMMENDATIONS

In chapter 9, the results are discussed and tested whether these are valid, reliable and applicable. The previous paragraph concludes the main causes of budget inaccuracies in redevelopment projects and how the accuracy can be improved. In both paragraphs, recommendations for developers and academics are given.
This paragraph. elaborates on the recommendations by highlighting the target groups of this research.

10.2.1 RECOMMENDATIONS FOR FURTHER RESEARCH

More case studies for more reliable results

This research consists of both quantitative and qualitative research method. The quantitative research is intended to gain insight in the accuracy of the budget of as many cases as possible. Throughout the process, the choice has been made to use a survey research to gather as much data as possible within the given time for this research. To increase the amount of respondents, the survey should be straightforward with minimised fatigue for the respondents. This is achieved by asking for the perceived accuracy of the initial budget instead of exact data. At the same time, this is the downside of this research; the survey results are not fully reliable.
Therefore, it is recommended to increase the amount of cases in further research, and to select the cases randomly instead of selecting the cases which are available.

Market characteristics, design changes and budget development

The research results reveal that the main reason for cost inaccuracies in redevelopment projects – *design changes* – are in two of the three cases originated by changing market characteristics during the redevelopment process. An interesting topic for further research is to deeply investigate the origination of design changes and/or to investigate the link between changing market supply/demand in relation to the behaviour of developers during a development process, in order to understand which impact changing market demand/supply has on the uncertainty during redevelopment projects.

Unforeseen situations during demolishment works, new technology and reuse of materials

During this research, most unforeseen situations were discovered and occurred during destructive works in the demolishment phase. Demolishment companies are more often focusing on the reuse of old building materials. To be able to do this, these companies are actively testing new techniques for measuring the buildings and for making an inventory of the used materials by using 3D measurement techniques. Especially when the price development of construction materials and the sustainability targets for the near future are considered, this may be an interesting topic. Both for reducing risks and uncertainty for the developer, as well as for reducing the cost to demolish buildings.

Increase of revenues during the process: optimisation of the LFA/GFA ratio

During the case studies and expert interviews, developers mentioned that the design is optimised during the design process. This corresponds with the survey results of this research, which show an increase in the expected income and a small increase in the initially expected LFA and GFA. These optimisations consist of maximising the LFA/GFA ratio, an important process during redevelopment projects to maximise the revenues. Some of the methods to increase the LFA/GFA ratio are: the new façade that is placed a few decimetres off its original location, the reduction of corridors and the relocation of elevators.
Within this research, no extra attention is paid on the how these optimisations exactly result in extra income and what the relation is with the extra investments that were needed.

Positive risks: opportunities

This research is biased towards negative risks, while risks can also be interpreted as positive risks (opportunities). Option-thinking and investigating the moments that developers add the most value, are interesting topics for further research.

10.2.1 RECOMMENDATIONS FOR PROFESSIONALS

Recommendations for developers

The developer of case 1 advised to remove the asbestos in the initial phase of the project, and to ask the demolisher to investigate and map all used materials in the building. If additional asbestos is found, ask the demolisher to mark these locations and re-tender for the removal of asbestos to prevent high additional costs. This is an effective way to get to know the building and thereby to reduce uncertainty in an early phase of the project.

Other recommendations which are mentioned in paragraph 9.4 and 10.1 are:

- Building investigations in an early phase of the project to reduce the uncertainty in an early phase,
- Early contractor involvement, or, early removal of asbestos as a means to investigate the building (destructive research) in an early phase,
- A percentage unforeseen of at least 5% before start of construction works,

Furthermore, the use of unforeseen costs between the initial phase and the start of the construction works is arguable; between the initial phase and the start of construction works, the costs (and revenues) deviate with much larger numbers due to changing market circumstances. Unforeseen costs are recommended to be used to cover unforeseen situations during construction works, rather than to cover all unforeseen situations during the process.

Recommendations for the investor (former property owner)

Project developers deal with a high level of uncertainty in the initial phase, partially due to missing information about the existing building. Participation in the redevelopment process may reduce the amount of uncertainty, increase the accuracy of the budget and eventually also increase the margin of the project. This can be achieved by diminishing some of the risks that otherwise the developer needs to take, such as change of the zoning plan, asbestos investigation/removal, building investigations, building passports or any other factor.

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APPENDIX

APPENDIX 1: SURVEY RESULTS: PROBABILITY AND EFFECT PER RESPONDENT

Below, the answers on the causes of cost inaccuracies are shown per respondent, including their function, experience and the weight factor per respondent. These numbers are direct input data (not edited or processed).

APPENDIX 2: SURVEY RESULTS: PROBABILITY AND EFFECT PER TYPE OF ACTOR

Below, an overview is given of the survey results, categorised on type of role. The numbers are average numbers and corrected by each respondent's experience and type of role.

Total probability

	Information during process	Information existing building	Building characteristics	Claims	Contractual factors	Commercial pressure	Estimations / calculations	Legal factors	People / project team	Unforeseen interventions	Design changes	Design development	Design brief	Design team performance	Organisation	Project management	Strategic behaviour	Psychological factors	Site conditions	Time limits	External factors
Total	43,8	47,4	56,1	32,2	38,8	35,8	41,8	34,0	40,5	53,6	52,1	43,2	46,7	39,3	37,3	42,9	39,9	31,5	23,1	45,7	30,4
Developer (independent)	35,3	45,1	63,4	13,1	35,8	35,3	31,5	28,1	35,3	47,0	46,3	35,1	44,7	33,6	40,4	42,1	20,6	30,2	15,8	47,2	25,6
Developer (delegated)	66,2	58,0	44,4	45,2	38,4	46,8	57,0	47,2	36,0	61,8	60,2	32,6	35,0	40,6	38,2	61,0	32,0	45,2	22,0	52,0	60,0
Developer (contractor)	29,8	39,1	51,8	14,1	22,4	19,3	48,2	24,5	48,8	49,5	53,3	16,1	31,4	44,3	21,4	48,3	18,8	12,6	29,1	23,7	26,2
Developer (investor)	33,4	30,7	43,0	21,3	27,6	26,3	39,4	41,8	26,5	42,8	37,1	33,9	16,9	44,8	20,3	25,4	43,4	29,9	32,2	25,4	28,4
Project manager	59,7	44,5	42,8	14,8	17,9	21,2	22,4	11,7	22,4	45,2	24,8	53,1	51,7	23,4	21,0	16,9	16,2	14,8	11,7	46,9	12,1
Project manager (housing ass.)	42,3	29,9	80,8	54,6	48,5	35,6	64,5	17,3	54,4	79,3	66,8	43,6	59,8	22,4	68,8	44,4	83,6	56,9	22,5	54,9	30,3
Cost advisor	61,7	73,4	65,3	87,1	74,4	61,9	64,8	60,7	65,9	79,1	88,3	75,0	79,0	57,4	61,6	70,0	88,3	52,1	30,7	70,3	52,6
Architect	27,5	30,4	31,9	11,1	15,7	23,4	23,2	10,3	22,5	16,6	25,4	13,9	18,7	13,7	12,1	28,7	22,1	10,1	28,3	20,2	8,6

Total, results effect on cost development

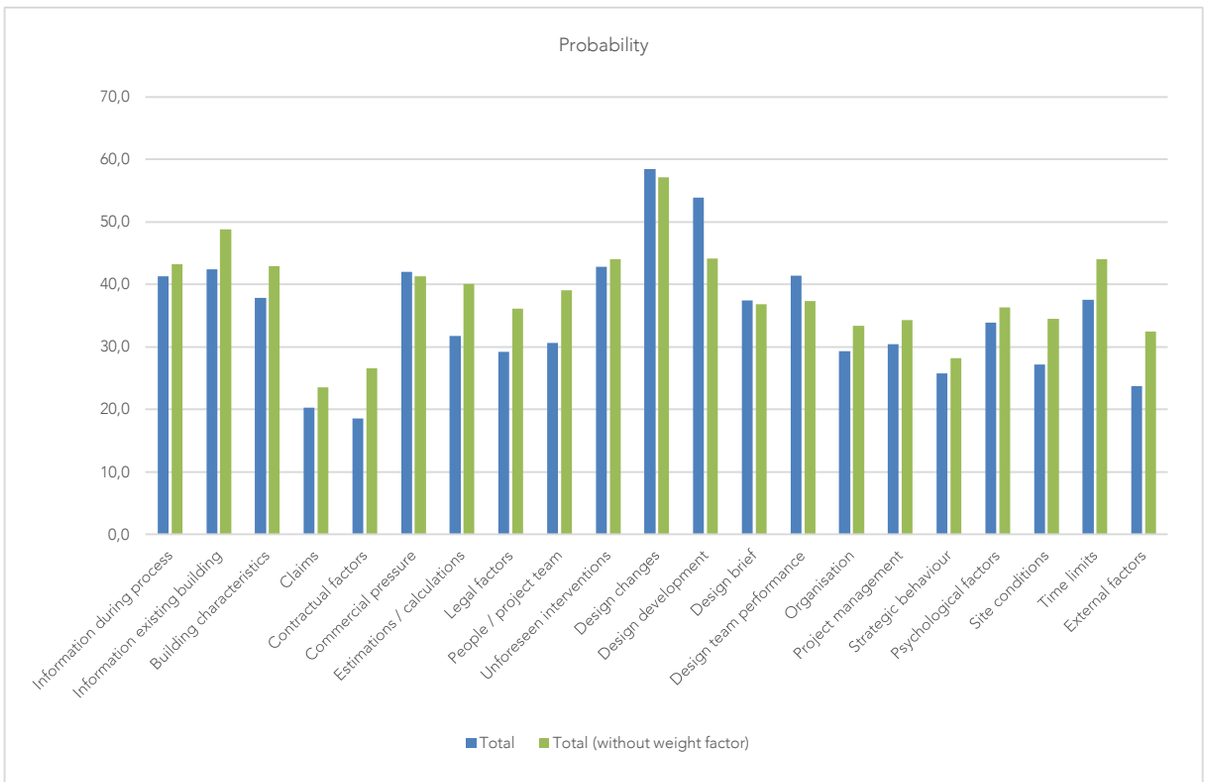
	Information during process	Information existing building	Building characteristics	Claims	Contractual factors	Commercial pressure	Estimations / calculations	Legal factors	People / project team	Unforeseen interventions	Design changes	Design development	Design brief	Design team performance	Organisation	Project management	Strategic behaviour	Psychological factors	Site conditions	Time limits	External factors
Total	1805	2010	2118	655	721	1506	1327	993	1239	2294	3043	2326	1747	1626	1094	1307	1030	1069	627	1717	723
Total (without weight factor)	1901	2463	2379	711	1102	1515	1767	1224	1728	2465	2696	1670	1619	1499	1449	1542	1036	1120	1020	1910	1047
Developer (independent)	1612	2066	3147	310	630	1260	962	1162	1539	1928	3231	1966	1572	1274	1556	1444	689	1313	497	1786	727
Developer (delegated)	4025	2680	2726	588	1659	2274	3682	3049	986	3572	3684	1376	1036	641	1841	2708	1088	2522	823	2714	3756
Developer (contractor)	848	972	1929	133	228	494	1549	380	1209	1684	3995	541	1726	1572	315	1255	200	292	502	624	465
Developer (investor)	1774	1398	2187	488	479	1271	1421	1951	537	2229	1690	1463	562	1657	499	806	1412	1095	903	915	1079
Project manager	3682	1810	944	327	488	885	568	259	904	2843	608	3168	1891	1326	515	198	531	281	643	2701	93,6
Project manager (housing ass.)	2054	2162	4673	1140	473	1193	3007	311	2073	1763	1961	1271	1890	875	3713	2374	4704	2872	374	3910	1089
Cost advisor	893	2561	730	1297	1139	3348	1496	413	519	2239	5919	5347	2857	2591	1160	1900	641	1335	195	1421	571
Architect	1526	2270	1944	507	673	1339	1573	387	1738	1193	1596	710	834	717	701	1869	468	444	1277	1331	347

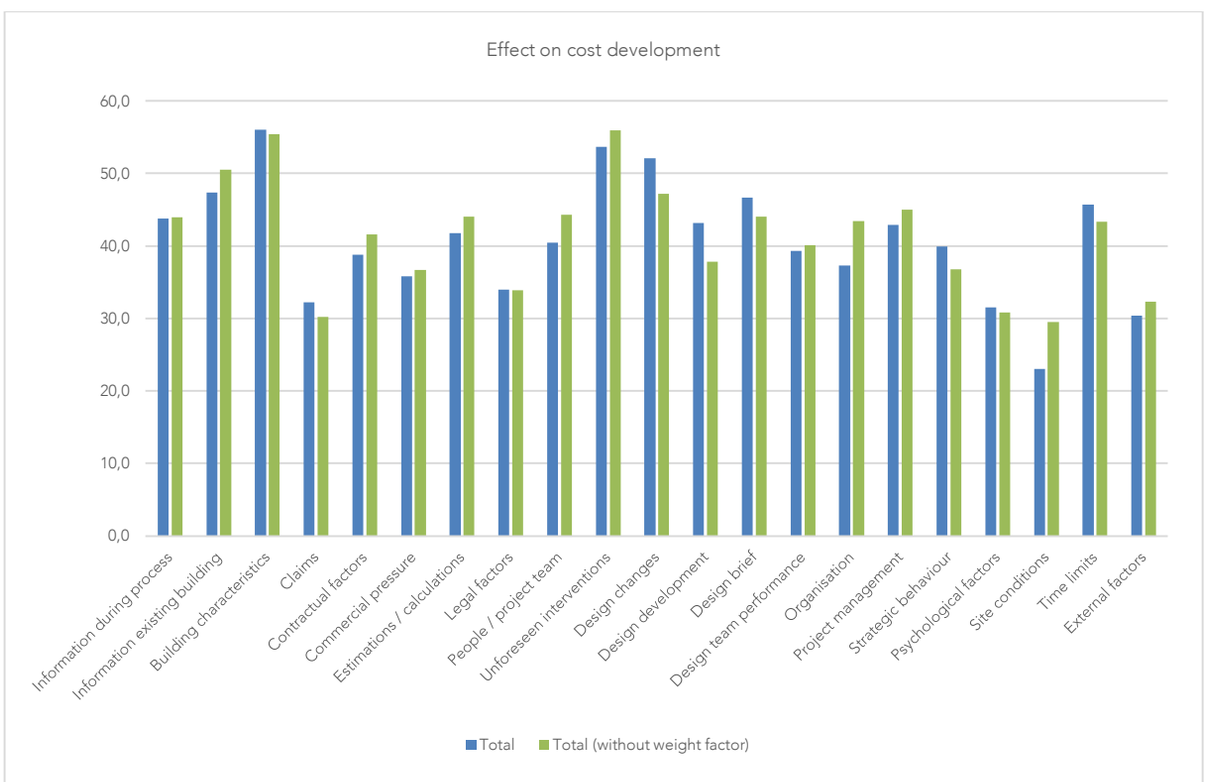
*Total, probability * effect*

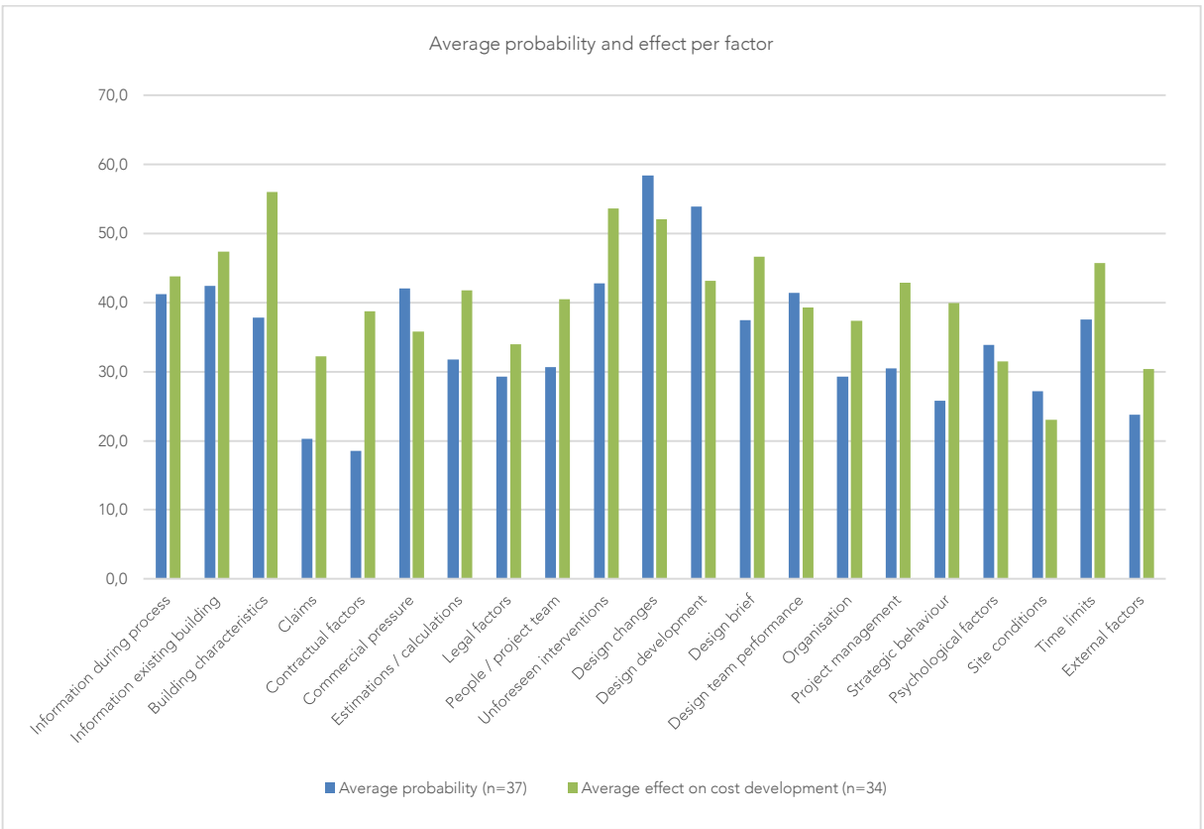
	Information during process	Information existing building	Building characteristics	Claims	Contractual factors	Commercial pressure	Estimations / calculations	Legal factors	People / project team	Unforeseen interventions	Design changes	Design development	Design brief	Design team performance	Organisation	Project management	Strategic behaviour	Psychological factors	Site conditions	Time limits	External factors
Total	1805	2010	2118	655	721	1506	1327	993	1239	2294	3043	2326	1747	1626	1094	1307	1030	1069	627	1717	723
Total (without weight factor)	1901	2463	2379	711	1102	1515	1767	1224	1728	2465	2696	1670	1619	1499	1449	1542	1036	1120	1020	1910	1047
Developer (independent)	1612	2066	3147	310	630	1260	962	1162	1539	1928	3231	1966	1572	1274	1556	1444	689	1313	497	1786	727
Developer (delegated)	4025	2680	2726	588	1659	2274	3682	3049	986	3572	3684	1376	1036	641	1841	2708	1088	2522	823	2714	3756
Developer (contractor)	848	972	1929	133	228	494	1549	380	1209	1684	3995	541	1726	1572	315	1255	200	292	502	624	465
Developer (investor)	1774	1398	2187	488	479	1271	1421	1951	537	2229	1690	1463	562	1657	499	806	1412	1095	903	915	1079
Project manager	3682	1810	944	327	488	885	568	259	904	2843	608	3168	1891	1326	515	198	531	281	643	2701	93,6
Project manager (housing ass.)	2054	2162	4673	1140	473	1193	3007	311	2073	1763	1961	1271	1890	875	3713	2374	4704	2872	374	3910	1089
Cost advisor	893	2561	730	1297	1139	3348	1496	413	519	2239	5919	5347	2857	2591	1160	1900	641	1335	195	1421	571
Architect	1526	2270	1944	507	673	1339	1573	387	1738	1193	1596	710	834	717	701	1869	468	444	1277	1331	347

APPENDIX 3: SURVEY RESULTS: PROBABILITY AND EFFECT WITH AND WITHOUT WEIGHT FACTOR

The numbers of appendix 2 are shown in the graphs below, including both the averages corrected with and without a weight factor (which are based on the experience and type of role of the respondents).






Average probability and effect per factor
70,0
60,0
50,0
40,0
30,0
20,0
10,0
0,0
Information during process
Information existing building
Building characteristics
Claims
Contractual factors
Commercial pressure
Estimations / calculations
Legal factors
People / project team
Unforeseen interventions
Design changes
Design development
Design brief
Design team performance
Organisation
Project management
Strategic behaviour
Psychological factors
Site conditions
Time limits
External factors
Average probability (n=37)
Average effect on cost development (n=34)

APPENDIX 4: SURVEY RESULTS: ACCURACY OF THE INITIAL BUDGET

In the table below, the average accuracy of the initial budget of redevelopment projects is presented. Respondent 11 calculated the exact accuracy of the initial budget. All other respondents filled in the average perceived accuracy of the initial budget of redevelopment projects.

	Type of function	Other:	Construction costs	Revenues	LFA	GFA	Unforeseen
1	Project manager		10	25	10	10	20
2	Project manager		10	10	10	5	5
3	Developer (independent)		15	10	3	3	10
4	Developer (independent)		15	20	-2	2	10
5	Cost advisor		10	-5	-10	5	10
6	Cost advisor		15	25	7	5	15
7	Developer (contractor)		10	0	-10	0	20
8	Developer (delegated)						
9	Developer (delegated)						
10	Project manager		7	3	5	5	5
11	Developer (investor)		0	0	3	0	12
12	Developer (delegated)		25	-16	-9	-4	25
13	Other	Financial manager	25	20	10	10	15
14	Developer (independent)						
15	Developer (independent)		25	-10	-10	1	0
16	Developer (investor)		25	10	10	10	10
17	Developer (independent)						
18	Developer (independent)		10	5	0	0	10
19	Cost advisor						
20	Developer (contractor)		10	10	0	0	5
21	Developer (investor)		15	25	5	2	5
22	Developer (contractor)						
23	Developer (contractor)		10	10	2	2	10
24	Developer (investor)		10	0	2	2	14
25	Architect						
26	Architect						
27	Developer (independent)		20	25	-2	0	6
28	Developer (independent)		-10	0	0	0	20
29	Cost advisor		17	24	6	5	20
30	Other	Real estate fiscalist					
31	Other	Supplier					
32	Architect						
33	Architect						
34	Project manager (housing ass.)		17	2	5	5	5
35	Architect						
36	Developer (contractor)		4	-5	-1	-1	3
37	Developer (independent)		15	31	0	-1	10
38	Project manager (housing ass.)		16	0	-7	9	16
39	Developer (independent)						
40	Developer (independent)						
41	Developer (contractor)		39	15	10	10	25
42	Other	Banker / financier					
43	Other	Supplier					

APPENDIX 5: LIST OF CATEGORIES AND CAUSES OF COST INACCURACIES, IN DUTCH

1. Beschikbaarheid van informatie gedurende het proces
   Voorbeelden:
   - *algemeen gebrek aan informatie*
   - *gebrek aan informatie tijdens aanbesteding*
   - *gebrek aan informatie tijdens opdracht*

2. Beschikbaarheid van informatie van het bestaande gebouw
   Voorbeelden:
   - *gebrek aan informatie omtrent asbest, constructie, gevel, bodem, installaties en overige gebouwcomponenten*
   - *staat van het gebouw onbekend (maatvoering, fundering, dak, materialisatie)*

3. Gebouweigenschappen
   Voorbeelden:
   - *zwakke fundering*
   - *maatvoering van constructie zorgt voor loze ruimten*
   - *onmogelijk om buitenruimten te realiseren*
   - *onvoldoende daglicht voor woonfunctie*
   - *materialen onvoldoende brandveilig / afgekeurd door brandweer*

4. Claims
   Voorbeelden:
   - *offensieve houding van aannemers, risicodruk*
   - *niet of te laat vrijgeven van informatie*

5. Contractvorming / spreiding van risico's
   Voorbeelden:
   - *verkeerde contractvorm*
   - *ongeschikte risicospreiding in contract / partijen die risico's niet kunnen dragen*

6. Financiële druk
   Voorbeelden:
   - *krappe biedingsvoorwaarden*
   - *honorarium te laag voor gewenste prestaties*
   - *opdrachtgevers die meer eisen dan in opdracht aangegeven, tegen dezelfde prijs*

7. Inschattingen / calculaties
   Voorbeelden:
   - *matig kostenadvies of matige risico-analyse*
   - *post onvoorzien verkeerd ingeschat*

8. Juridische factoren
   Voorbeelden:
   - wetgeving onduidelijk
   - onmogelijk om te voldoen aan de eisen van de gemeente of bestemmingsplan
   - onmogelijk om te voldoen aan eisen van het bouwbesluit
   - gebouw kan niet voldoen aan nieuw gebruik vanwege monumentenstatus

9. Mensen / projectteam
   Voorbeelden:
   - *onkundige of onervaren teamleden*
   - *relatie tussen actoren*
   - *eigenwijze houding opdrachtgever*

10. Onvoorziene ingrepen aan gebouw
    Voorbeelden:
    aanpassing aan constructie, gevel, installaties en/of andere gebouwcomponenten door onvoorziene situaties

11. Ontwerpaanpassingen
    Voorbeelden:
    - *aanpassingen op verzoek van de opdrachtgever*
    - *ontwerpvariaties op verzoek van opdrachtgever*
    - *aanpassing ontwerp t.b.v. maximalisatie van gbo/bvo-verhouding of maximalisatie ontwikkelpotentie*

12. Ontwerpontwikkeling
    Voorbeelden:
    - *incompleet ontwerp tijdens aanbesteding*
    - *(initieel) ontwerp mist details*

13. Ontwerpopdracht
    Voorbeelden:
    - *onduidelijke eisen voor het ontwerp*
    - *opdrachtgever weet niet wat hij wil*

14. Prestaties ontwerpteam
    Voorbeelden:
    - *'designer's attitude'*
    - *weinig kennis/bewustzijn van de architect m.b.t. kosten versus baten*
    - *slechte inschatting van bouwtechnische onderdelen (ventilatie, elektriciteit, etc.)*
    - optimistische houding van de architect m.b.t. planning

15. Organisatie
    Voorbeelden:
    - *slechte voorbereiding en planning*

16. Projectmanagement
    Voorbeelden:
    - *management van ontwerp, bouwplaats, aannemers en leveranciers*
    - *gebrek aan leiderschap, controle en toezicht*
    - *gebrek aan 'value management'*
    - *communicatiemiddelen en managementstijl*

17. Strategisch gedrag
    Voorbeelden:
    - *opzettelijk lager inschatten van kosten*
    - *manipulatie van voorspellingen / inschattingen*
    - *niet delen van informatie*

18. Psychologische factoren
    Voorbeelden:
    - optimisme (optimism bias)
    - cognitieve bias (onbewuste denkfouten)
    - voorzichtige houding m.b.t. risico's
    - intuitie

19. Terreinomstandigheden
    Voorbeelden:
    - *onvoorziene bouwplaatsomstandigheden, restricties of dingen die verkeerd gaan op de bouwplaats*
    - *krappe bouwplaats, met als gevolg duurdere bouwmethode*

20. Tijdslimieten
    Voorbeelden:
    - *onrealistische tijdsplanning voor het ontwerp*
    - *vertragingen door besluitvormingsproces bij opdrachtgever of opdrachtnemer*
    - *onvoldoende tijd en budget om realistische begroting op te stellen*
    - *onrealistische bouwtijd*

21. Externe factoren
    Voorbeelden:
    - *veranderingen in prijzen, indexen, inflatie, wettelijke factoren of markttrends*

APPENDIX 6: LITERATURE RESEARCH ON RISKS AND CAUSES OF COST INACCURACIES

SOURCE			SCOPE OF RESEARCH			RISK INDICATORS	
AUTHOR(S)	YEAR	TITLE	PROJECT TYPES	PUBLIC PRIVATE	N	CATEGORIES	CAUSES
Flyvbjerg et al.	2003	Megaprojects and Risk: An	Transportation infrastructure	Public	-	Technical	Forecasting errors including price rises, poor project design, and incomplete
							Scope changes
							Uncertainty
							Inappropriate organisational structure
							Inadequate decision-making process
							Inadequate planning process
						Economical	Lack of incentives
							Lack of resources
							Inefficient use of resources
							Dedicated funding process
							Poor financing / contract management
						Psychological	Strategic behaviour
							Optimism bias among local officials
							Cognitive bias of people
							Cautious attitudes towards risk
						Political	Deliberate cost underestimation
							Manipulation of forecasts
							Private information
Wachs	1989	When Planners Lie with Numbe	Transportation infrastructure	-	-	-	Change of scope
							Inflation
							Delays
Morris	1990		Transportation infrastructure	-	-	-	Inadequate project plan
							Bad implementation
							Inadequate funding
							Bureaucracy
							Bad coordination
Cantarelli et al.	2010	Cost overruns in Large-Scale Tr	Transportation infrastructure	-	-	-	Economic behaviour
							Strategic behaviour
							Optimism
							Organisation structure
							Relation between actors
Nijkamp & Ubbels	1999	How Reliable are Estimates of I	Transportation infrastructure	-	-	-	Price increase
							Incomplete estimations
							Scope changes
Swart	2009	Kostenoverschrijding bij nieuwl	Educational buildings	Public	10	-	Deliberate cost underestimation
							Incomplete and inadequate estimations
							Inadequate risk analysis
							Bad identification and no intervention when problems occur
							Bad project management
							Slow decision making process
Herweijer	1998	Rapport van de commissie Stac	City hall	Public	1	-	Bad organisation structure
							Formal and distant attitude of the College and the Department of Public Go
							Lack of a strong coordinator and project leader
							Optimistic attitude of the architects regarding planning
							A misused compensation method for cost management
							No notification of the budget excesses by the responsible party
de Waal	2010	Voorzien onvoorzien	Utility projects	Public	-	Realisation phase	Collaboration between architect and client
						Process	Quality of the program of requirements
							Incomplete contracts
							Insufficient time and budget for research
							Inadequate experience within project team
							Deliberate cost underestimation
							Manipulation of forecasts
							Private information
							Human factor
						Realisation phase	1 Changes in structure
						Additional works	2 Inadequate soil analysis
							3 Insufficient thorough analysis of the surrounding parcels
							4 Condition of existing building unknown (measurements, state of foundation
							5 No approval of public authorities
							6 -
							7 -
							8 -
							9
Bloem	2009	Bouwen aan faalkostenreductie	-	-	-		Changes in the process
							Changes in design
							Design not optimised or difficult to execute
							Time pressure due to tight schedule
							Staff not competent
							Incorrect dimensions
							Communication errors
							Bad site organization
							Constructions firms not competent
							Low involvement
							Wrong cost savings
							No collaboration attitude
							Bad feedback
							Experience is poorly utilized
							Expensive buy-in of materials
							Time loss due to waiting
							Re-ordering of materials
							Time loss due to discussions
							Time loss due to adjustments
							Programme of requirement is inadequate
							Inaccuracies in drawings and contract documents
							Technical realisation of the building is difficult
							Inadequate leadership skill of client/project manager
							Information transmission not at right moment
							Inadequate coordination in design phase
							Incorrect data / information
							Inadequate data / information
							Logistic shortcomings
Jackson	2002	Project cost overruns and risk n	-	-	114	Design change	Client driven design changes
							Design variations
						Design development	Incomplete design at tender
							Too much generally
							Initial design inadequate or lacks detail
						Information availability	General lack of information
							Lack of information at tender stage
							Lack of information at briefing
						Design brief	Lack of detail and definition, badly developed, incomplete or incorrect desig
							Client does not know what they want
						Estimating method	Poor cost advice
							Inadequate contingency allowance or assessment of risks
							Base method used for calculation
							Stubborn client attitude
						Design team performance	Designers attitude, input, whims, understanding of cost and value
							M&E estimates
							Inadequate cost control
							Designers awareness as to areas of cost risk and subsequent risk manageme
						Project management	Design management
							Contract and site management
							Project control
							Communication routes
							Sub contractor and supplier interface and management
							Leadership
							Lack of value management

							Management approach
							Decision-making
						Time limits	Unrealistic design development periods
							Delays by employer and client driven speed
							No time to carry out realistic budgets or cost control
							Unrealistic construction periods
						Site conditions	Ground works
							Unforeseen site conditions, constraints, restrictions, Murphy's Law (basically, t
							Dry rot or asbestos in refurbishments
						Organisation	General poor preparation and planning
							Pre tender
							Inadequate surveys and investigation of existing site conditions
						Claims	Aggressive or claims conscious contractors, contractors risk pressure, late info
						Commercial pressures	Fee competition
							Tight bidding conditions
							Confrontational approach of industry
							Corner cutting clients
						People	Inexperience, too optimistic, intuition, knowledge, qualifications, team, perso
							Qualifications of consultants / advisors
							Qualifications of contractor
						Procurement route	Wrong contract used, inappropriate allocation of risk in contract document
						External factors	Changes in pricing conditions, indices, inflation, statutory factors, market tren
Ramanathan et al.	2012	Construction Delays Causing Ri	Delays in construction projects	-	41	Delay cause:	Finance related
							Project related
							Project attributes
							Owner/client related
							Contractor related
							Consultant related
							Design related
							Coordination
							Materials
							Plant/equipments
							Labour
							Environment
							Contract
							Contractual relationship
							External
							Changes
							Scheduling and control
							Government relationship
van Notten	2013	Kosten- en tijdsoverschrijding i	Construction projects	-		Construction method	No collaboration between teams
						Design elaboration	Too much intervention of client
						Check of drawings	Inadequate soft skills
						Delays	Conflicts of interests between parties
						Site organisation	Errors in drawings
						Soft skills	Unforeseen activities during construction
						Client	Wrong construction method
						Change of staff	Additional work
						Competence of staff	Inadequate estimation of materials, delivery issues
						Planning	Incompetence of staff / parties
						Risk distribution	Calamities
						Control	More man hours than estimated
							More tasks than estimated
							Unclear budget / tasks
							Tight schedule / unrealistic schedule
							Unique project
							Busy contractors leading to delivery delays
							Late start of construction
							Wrong drawings of contractor
							Different interpretations of the scope
							Opportunism and politics
							Risk analysis inadequate
							Too many subcontractors
							Bad contract model
							Delay due to time that was needed to approve drawings
							Not enough staff
							Measurement errors
							Delay due to permit procedure
Visser	2013	Postkantoor Neude Utrecht	Redevelopment	-	1		Weak foundation
Mensing	2014	The re-development value of v	Redevelopment	-	-	Business or market risk	
						Financial risk	
						Liquidity risk	
						Inflation risk	
						Management risk	
						Legislative risk	
						Construction costs	
de Groot	2014	Life Cycle Costs of Transformat	Redevelopment	-	-	Surroundings	Regulations
						Process risks	Structure
							Processes
							Culture
							Staff
							Compliance
						Project risks	Space
							Technical
							Collaboration
							Operation
Kraag	2015	The added financial value of of	Redevelopment	-			More unexpected issues compared to new-build
							Building's location
							Financial aspects which can make a conversion project unfeasible
							The initial stage during acquisition, when intentions of the current building ow
							Changing the land use plan
							Unforeseen costs
							Organize financing
							Different actor aims and interests
Remoy & van der	2014	Adaptive reuse of office buildin	Redevelopment	-	15	Legal	Zoning law: impossible to meet municipal requirements, zoning law or city po
							Building code: impossible to meet requirements, e.g. regarding the noise lev
							Historical protection: the listed status does not allow adaptations that are req
						Financial	Development costs: slow handling of procedures (loss of income, high interes
							Vacancy: failing incomes from exploitation or sale of the apartments
							Owner not willing to sell for a reasonable price due to high book value
						Technical	Incorrect or incomplete building structure assessment
							Poor state of the main structure/foundation (rotten concrete or wood, corrode
							Insufficient shafts available; construction allows no extra shafts being made
							Insufficient daylight for housing
						Functional	Present grid does not fit with the measurements required for new purposes, r
							Private outdoor space is impossible
						Cultural-historical	Appearance of the building does not fit with the required appearance of the r
Schmidt	2012	Financiele haalbaarheid van he	Redevelopment		9	Facade	
						Structure	
						Installations	
						Walls	
						Functional	
						Other	

Masterscriptie TU Delft
Nauwkeurigheid van de inschattingen in de initiatieffase

Default Question Block

Bedankt voor het deelnemen aan mijn onderzoek op het gebied van inschattingen in de initiatieffase bij transformatieprojecten. Uw antwoord op de vragen die hierna volgen zijn van waardevolle input voor mijn masterscriptie aan de TU Delft, voor mijn toekomst als vastgoedontwikkelaar en hopelijk ook voor u als professional in de bouw.

De enquete duurt ongeveer 10 tot 15 minuten.

Toelichting onderzoek
Voor mijn scriptie onderzoek ik welke factoren binnen het transformatieproces zorgen voor kostenafwijkingen, in welke mate deze voorkomen en hoe vaak.

Bovendien zal niet alleen gekeken worden naar de oorzaken, maar ook naar de gemiddelde procentuele afwijking tussen ingeschatte en gerealiseerde kosten bij transformatieprojecten. Ook naar de afwijking in opbrengsten wordt gevraagd, aangezien bepaalde kostenverhogingen ten goede komen voor de opbrengsten.

Het uiteindelijke doel van de scriptie is om de inschattingen in de initiatieffase te verbeteren. Daarbij verdiep ik mij in de toegevoegde waarde van nieuwe meet- en analysetechnieken voor bestaande gebouwen, BIM en de toepassing van machine learning voor het bepalen van accuratere kosten en opbrengsten.

Belangrijk
De vragen kunt u beantwoorden op basis van uw ervaring met en uw waarnemingen tijdens transformatieprocessen. U hoeft dus niet de exacte data van de transformatieprojecten op te zoeken. Wel wordt dit uiteraard gewaardeerd.

Bij vragen kunt u altijd contact met mij opnemen via 0650425040 of arda_basak@me.com

Blok 2

1. Algemene informatie

1a. Ik ben momenteel werkzaam als:
Meerdere keuzes mogelijk

Projectontwikkelaar (gelieerd aan bouwbedrijf)
Projectontwikkelaar (gelieerd aan belegger)
Projectontwikkelaar (eigenaar-gebruiker, bv. Shell Real Estate)
Projectontwikkelaar (zelfstandig)
Projectontwikkelaar (gedelegeerd)
Projectmanager
Kostenadviseur
Architect
Anders:

1b. Ik heb ervaring met ... transformatieprojecten.
Voer een getal in

1c. Ik heb de transformatieprojecten uitgevoerd vanuit een:

Meerdere keuzes mogelijk

Private organisatie
Publieke organisatie (bv. Projectmanagementbureau Amsterdam)
Semi-publieke organisatie (bv. woningcorporaties)
Anders:

1d. Ik heb ervaring met de transformatie van gebouwen naar de volgende functies:

Meerdere keuzes mogelijk

Studentenwoningen
Starterswoningen
Zorgwoningen
Middensegment-woningen
Luxe appartementen
Overig, wonen
Hotel
Creatieve industrie / co-working
Overige functies (kantoor, retail, etc.)

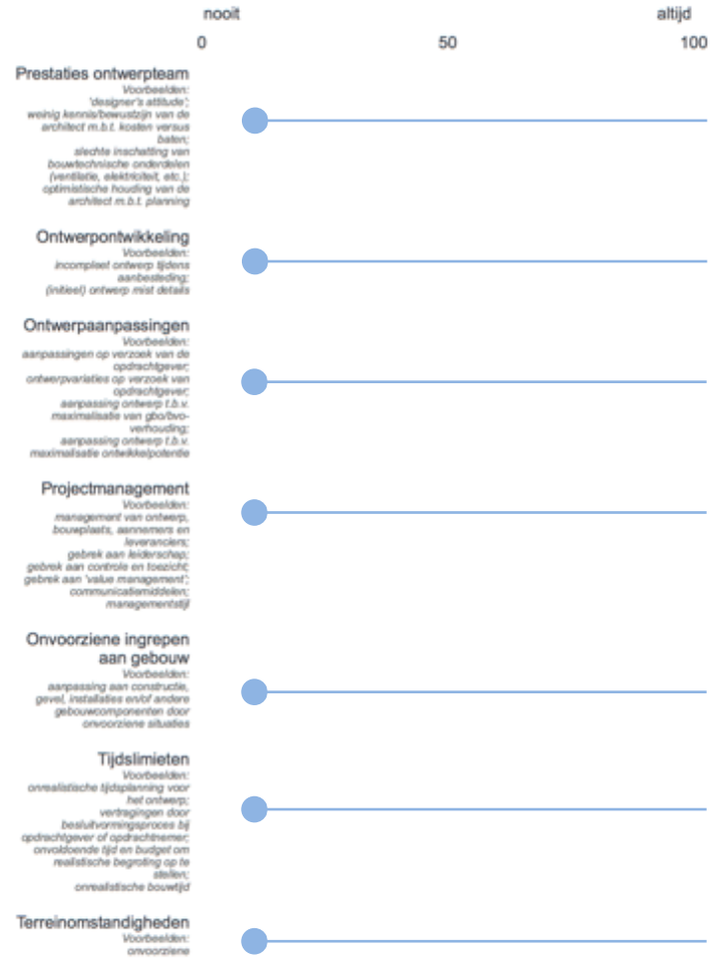
Blok 7

2. Oorzaken kostenafwijkingen bij transformatieprojecten

Het tweede deel van de enquete bestaat uit een lijst met oorzaken voor kostenafwijkingen die is gebaseerd op eerder uitgevoerde onderzoeken naar kostenoverschrijdingen. Deze lijst is gecombineerd tot 20 categorieën.

Per categorie gevraagd wat de **probabiliteit** is (hoe vaak het voorkomt gedurende het transformatieproces).

2a. Hoe vaak komen de volgende oorzaken voor kostenafwijkingen voor bij transformatieprojecten?



bouwplaatsomstandigheden, restricties of dingen die verkeerd gaan op de bouwplaats; krappe bouwplaats, met als gevolg duurdere bouwmethode

Contractvorming / spreiding van risico's
Voorbeelden: verkeerde contractvorm; ongeschikte risicospreiding in contract / partijen die risico's niet kunnen dragen

Financiële druk
Voorbeelden: krappe biedingsvoorwaarden; honorarium te laag voor gewenste prestaties; opdrachtgevers die meer eisen dan in opdracht aangegeven, tegen dezelfde prijs

Ontwerpopdracht
Voorbeelden: onduidelijke eisen voor het ontwerp; opdrachtgever weet niet wat hij wil

Mensen / projectteam
Voorbeelden: onkundige of onervaren teamleden; relatie tussen actoren; eigenwijze houding opdrachtgever

Inschattingen / calculaties
Voorbeelden: matig kostenadvies; matige risico-analyse; post onvoorzien verkeerd ingeschat

Claims
Voorbeelden: offensieve houding van aannemers, risicodruk; claims door niet of te laat vrijgeven van informatie

Gebouweigenschappen
Voorbeelden: zwakke fundering; maatvoering van constructie zorgt voor loze ruimten; onmogelijk om buitenruimten te realiseren; onvoldoende daglicht voor woonfunctie; materialen onvoldoende brandveilig / afgekeurd door brandweer

Beschikbaarheid van informatie gedurende het proces
Voorbeelden: algemeen gebrek aan voldoende informatie; gebrek aan voldoende informatie tijdens aanbesteding;

gebrek aan voldoende informatie tijdens opdrachtverstrekking

Strategisch gedrag
Voorbeelden: opzettelijk lager inschatten van kosten; manipulatie van voorspellingen / inschattingen; niet delen van informatie

Beschikbaarheid van informatie van het bestaande gebouw
Voorbeelden: gebrek aan voldoende informatie omtrent asbest, constructie, gevel, bodem, installaties en overige gebouwcomponenten; staat van het gebouw onbekend (maatvoering, fundering, dak, materialisatie)

Juridische factoren
Voorbeelden: wetgeving onduidelijk; onmogelijk om te voldoen aan de eisen van de gemeente of bestemmingsplan; onmogelijk om te voldoen aan eisen van het bouwbesluit; gebouw kan niet voldoen aan nieuw gebruik vanwege monumentenstatus

Psychologische factoren
Voorbeelden: optimisme (optimism bias); cognitieve bias (onbewuste denkfouten); voorzichtige houding m.b.t. risico's; intuïtie

Organisatie
Voorbeelden: slechte voorbereiding en planning

Externe factoren
Voorbeelden: veranderingen in prijzen, indexen, inflatie, wettelijke factoren of markttrends

Metagegevens browser

Deze vraag wordt niet aan de ontvanger getoond.
Browser: **Safari**
Version: **10.0.1**
Operating System: **Macintosh**
Screen Resolution: **1920x1080**
Flash Version: **-1**
Java Support: **1**
User Agent: **Mozilla/5.0 (Macintosh; Intel Mac OS X 10_12_1) AppleWebKit/602.2.14 (KHTML, like**

Gecko) Version/10.0.1 Safari/602.2.14

Hieronder wordt per categorie gevraagd wat het **effect** van de factoren is op de kostenafwijking.

2b. Wat is het effect van de volgende oorzaken op de kostenontwikkeling bij transformatieprojecten?

	geen effect	gering	maximaal
	0	50	100

Ontwerpopdracht
Voorbeelden:
onduidelijke eisen voor het ontwerp;
opdrachtgever weet niet wat hij wil

Tijdslimieten
Voorbeelden:
onrealistische tijdsplanning voor het ontwerp;
vertragingen door besluitvormingsproces bij opdrachtgever of opdrachtnemer;
onvoldoende tijd en budget om realistische begroting op te stellen;
onrealistische bouwtijd

Projectmanagement
Voorbeelden:
management van ontwerp, bouwplaats, aannemers en leveranciers;
gebrek aan leiderschap;
gebrek aan controle en toezicht;
gebrek aan 'value management';
communicatiemiddelen;
managementstijl

Claims
Voorbeelden:
offensieve houding van aannemers, risicodruk;
claims door niet of te laat vrijgeven van informatie

Psychologische factoren
Voorbeelden:
optimisme (optimism bias);
cognitieve bias (onbewuste denkbuten);
voorzichtige houding m.b.t. risico's;
intuïtie

Inschattingen / calculaties
Voorbeelden:
matig kostenadvies;
matige risico-analyse;
post onvoorzien verkeerd ingeschat

Financiële druk
Voorbeelden:
krappe biedingsvoorwaarden;
honorarium te laag voor gewenste prestaties;
opdrachtgevers die meer eisen dan in opdracht aangegeven, tegen dezelfde prijs

Beschikbaarheid van informatie gedurende het proces
Voorbeelden:
algemeen gebrek aan voldoende informatie;
gebrek aan voldoende informatie tijdens aanbesteding;
gebrek aan voldoende informatie tijdens opdrachtverstrekking

Strategisch gedrag
Voorbeelden:
opzettelijk lager inschatten van kosten;
manipulatie van voorspellingen / inschattingen;
niet delen van informatie

Ontwerpaanpassingen
Voorbeelden:
aanpassingen op verzoek van de opdrachtgever;
ontwerpvarianties op verzoek van opdrachtgever;
aanpassing ontwerp t.b.v. maximalisatie van gbo/bvo-verhouding;
aanpassing ontwerp t.b.v. maximalisatie ontwikkelpotentie

Prestaties ontwerpteam
Voorbeelden:
'designer's attitude';
weinig kennis/bewustzijn van de architect m.b.t. kosten versus baten;
slechte inschatting van bouwtechnische onderdelen (ventilatie, elektriciteit, etc.);
optimistische houding van de architect m.b.t. planning

Contractvorming / spreiding van risico's
Voorbeelden:
verkeerde contractvorm;
ongeschikte risicospreiding in contract / partijen die risico's niet kunnen dragen

Juridische factoren
Voorbeelden:
wetgeving onduidelijk;
onmogelijk om te voldoen aan de

bestemmingsplan;
onmogelijk om te voldoen aan eisen van het bouwbesluit;
gebouw kan niet voldoen aan nieuw gebruik vanwege monumentenstatus

Onvoorziene ingrepen aan gebouw
Voorbeelden:
aanpassing aan constructie, gevel, installaties en/of andere gebouwcomponenten door onvoorziene situaties

Terreinomstandigheden
Voorbeelden:
onvoorziene bouwplaatsomstandigheden, restricties of dingen die verkeerd gaan op de bouwplaats;
krappe bouwplaats, met als gevolg duurdere bouwmethode

Mensen / projectteam
Voorbeelden:
onkundige of onervaren teamleden;
relatie tussen actoren;
eigenwijze houding opdrachtgever

Ontwerpontwikkeling
Voorbeelden:
incompleet ontwerp tijdens aanbesteding;
(initieel) ontwerp mist details

Gebouweigenschappen
Voorbeelden:
zwakke fundering;
maatvoering van constructie zorgt voor loze ruimten;
onmogelijk om buitenruimten te realiseren;
onvoldoende daglicht voor woonfunctie;
materialen onvoldoende brandveilig / afgekeurd door brandweer

Beschikbaarheid van informatie van het bestaande gebouw
Voorbeelden:
gebrek aan voldoende informatie omtrent asbest, constructie, gevel, bodem, installaties en overige gebouwcomponenten;
staat van het gebouw onbekend (maatvoering, fundering, dak, materialisatie)

Organisatie
Voorbeelden:
slechte voorbereiding en planning

Externe factoren
Voorbeelden:
veranderingen in prijzen, indexen, inflatie, wettelijke factoren of markttrends

Blok 300

3. Gemiddelde budgetafwijking bij transformatieprojecten

In het laatste deel van de enquete wordt gevraagd naar de gemiddelde afwijking tussen de ingeschatte kosten in de initiële begroting en de gerealiseerde kosten. Veelal gaan hogere investeringskosten gepaard met hogere opbrengsten. Daarom wordt in dit onderzoek niet alleen naar de kostenontwikkeling gekeken, maar ook naar de toe- of afname van de opbrengsten.

Om de resultaten eerlijk met elkaar te kunnen vergelijken, is het belangrijk dat u de **begroting gebruikt (of in gedachten neemt) die is opgesteld in de initiatieffase**, en daarbij ook de getallen uit de **base case scenario** gebruikt.

3.1 Voor het beantwoorden van de onderstaande vragen heb ik:

de gemiddelde afwijking exact berekend.

de gemiddelde afwijking 'op gevoel' en ervaring bepaald.

de onderstaande vragen heb ik niet ingevuld, omdat ik onvoldoende kennis of ervaring heb met de ontwikkeling van kosten en opbrengsten gedurende het transformatieproces.

3.2 Hoeveel procent wijken de gerealiseerde **bouwkosten** bij transformatie over het algemeen af van de ingeschatte bouwkosten?

	-50	-25	0	25	50	75	100	125	150
Afwijking verwachte / gerealiseerde bouwkosten (%)									

3.3 Hoeveel procent wijken de gerealiseerde **opbrengsten** bij transformatie over het algemeen af van de ingeschatte opbrengsten?

-50 -25 0 25 50 75 100 125 150

Afwijking verwachte / gerealiseerde opbrengsten (%)

3.4 Hoeveel procent wijken de gerealiseerde **GBO en/of VVO** bij transformatie over het algemeen af van de ingeschatte GBO en/of VVO?

-50 -25 0 25 50 75 100 125 150

Afwijking verwachte / gerealiseerde GBO en VVO (%)

3.5 Hoeveel procent wijkt de gerealiseerde **BVO** bij transformatie over het algemeen af van de ingeschatte BVO?

-50 -25 0 25 50 75 100 125 150

Afwijking verwachte / gerealiseerde BVO (%)

3.6 Hoeveel procent is de **post onvoorzien** bij transformatie over het algemeen in de eerste begroting in de initiatieffase?

0 10 20 30 40 50

Post onvoorzien in eerste begroting (% van bouwkosten)

Blok 4

Bedankt voor het deelnemen aan de enquête! Indien u benieuwd bent naar de resultaten, dan kun u uw e-mailadres en overige gegevens hieronder achterlaten. Zodra de resultaten

verwerkt zijn, ontvangt u deze per mail.

Uw e-mailadres:

Hieronder kunt u eventueel uw overige persoonlijke gegevens invullen.

Voornaam
Tussenvoegsel
Achternaam
Bedrijf
Leeftijd

Heeft u vragen, suggesties of opmerkingen?

Uitgevoerd met Qualtrics

APPENDIX 8: CASE 1, ADDITIONAL INFORMATION

Developer X was asked to reflect the list of causes of cost inaccuracies on the process to reveal factors which occurred that also had an impact on the cost development. The results are shown below; explanation on the x-axis can be found on page 64.

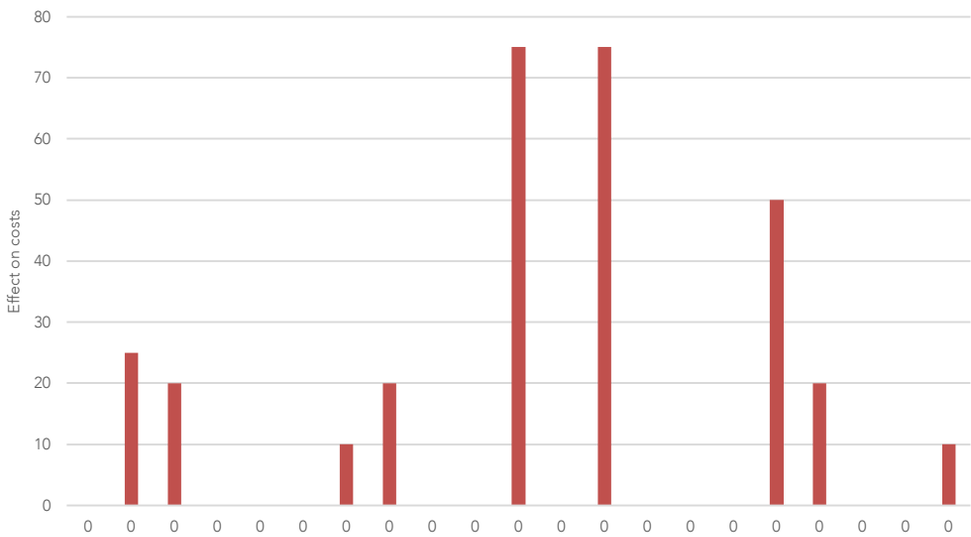


Figure 39: Effect of the causes on cost development in case 1

	Programma			Ontwerp			Uitwerking		Bouw		
	Initiatief	Haalbaar-heidsstudie	Project-definitie	Structuur-ontwerp	Voorlopig ontwerp	Definitief ontwerp	Bestek	Prijsvorming	Werkvoor-bereiding	Uitvoering	Oplevering
Beschikbaarheid informatie gedurende proces											
Beschikbaarheid informatie bestaand gebouw											
Claims											
Contractvorming / spreiding van risico's											
Financiële druk											
Gebouweigenschappen											
Inschattingen / calculaties											
Juridische factoren											
Mensen / projectteam											
Ontwerpaanpassingen											
Ontwerpontwikkeling											
Ontwerpopdracht											
Onvoorziene ingrepen aan gebouw											
Organisatie											
Strategisch gedrag											
Prestaties ontwerpteam											
Projectmanagement											
Psychologische factoren											
Terreinomstandigheden											
Tijdslimieten											
Externe factoren											

ACCURACY OF THE INITIAL BUDGET OF REDEVELOPMENT PROJECTS

ARDA BASAK
2017