Challenges to reuse of tall office buildings in the Netherlands

A Focus on the Randstad

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Msc Thesis - Management in the Built Environment

Title	Challenges in reuse of tall office buildings in the Netherlands. A focus on the Randstad
Subject	Challenges to reuse of tall office buildings

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Chair	Real Estate Management
Theme	Adaptive re-use x Economics tall buildings

Delft, The Netherlands, June 17th 2020, P5 report

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Abstract

The Randstad in The Netherlands faces on the one hand structural vacancy in office buildings and on the other hand a growing housing shortage. Reuse strategies to decrease the vacancy rate of the office market have been researched extensively both inside and outside The Netherlands. However, the challenges and opportunities for these reuse strategies specifically for tall office buildings have not been researched yet. The aim of this research is to find the difference in challenges to conversion of tall office buildings, focused on the Randstad in the Netherlands. This research will be carried out in two parts. The first part focuses on the past research, by carrying out a literature study consisting of challenges and solutions to conversion. The second part studies cases in the Randstad, comparing different cases to find the challenges to conversion of tall office buildings to housing. Concluding this research, there are not neccessarily new or other challenges in the transformation of tall buildings as opposed to the transformation of buildings that are not classified as tall. However, some challenges, especially those on technical level, can have a higher impact on the transformation of tall buildings. This report contains the problem statement and context, together with the literature study, methodology, empirical findings and conclusion.

Keywords: adaptive reuse, conversion, transformation, office buildings, structural vacancy, housing shortage, tall buildings, challenges, opportunities, solutions

Introduction

This report is written as a research progress for the Graduation Laboratory Management in the Built Environment (AR4R010) at TU Delft. This is part of the graduation within the master track Management in the Built Environment from the master Architecture, Urbanism and the Built Environment at the TU Delft.

Currently one tenth of the Dutch office market is vacant, while the demand for housing increases. Reuse strategies to decrease the vacancy rate of the office market have been researched extensively both inside and outside The Netherlands. However, the challenges and opportunities for these reuse strategies specifically for tall office buildings have not been researched yet. The aim of this research is to indicate the different challenges and possible solutions by researching the differences between the reuse of office buildings and the reuse of tall office buildings. This results in the following main research question: What are the challenges and respective solutions for the conversion of vacant tall office buildings into housing in the Netherlands? The outcomes of this research can be used as input in reuse strategy decision making and to implement during future conversions of tall office buildings to housing. The outcomes will address both the high vacancy rate in the Dutch office market and the housing shortage in the Netherlands.

Acknowledgements

I would like to thank my mentors, Hilde Remøy and Ilir Nase, for their feedback and guidance during my graduation research. I would also like to thank the delegate of the board of examiners, Teake Bouma, for his feedback on the P2 and P4 presentations.

I am also grateful for the respondents from companies and municipalities that have made time for me. Without their contribution to the research, I could not have finished this report. Thank you.

Furthermore, I would like to thank my friends and family for always being there for me. In particular I would like to thank Danny, for always lifting me up and giving me the push when I needed it.

List of terms

Adaptive reuse: give a new function to an existing building, to keep the cultural, historical, aesthetic or other value. See ‘Conversion’ and ‘Transformation’.

Conversion: transform / convert (vacant) real estate (for example: offices) to a new function (for example: dwellings). See ‘Adaptive reuse’ and ‘Transformation’.

Economic challenges / opportunities: challenges / opportunities related to the economics of a project / that can have a financial impact. For example: related to costs or financial benefits.

Frictional vacancy: when a building has been vacant for less than one year. This type of vacancy is needed for a healthy real estate market.

High-rise: buildings taller than the heights as stated per municipality. For example: in Rotterdam a building taller than 70m is considered high-rise.

Legal challenges / opportunities: challenges / opportunities related to the legal issues of a project / that can have a legal impact. For example: related to contracts, the local rules and legislations.

Long-term vacancy: when a building has been vacant for more than one year, but less than three years.

Low-rise: buildings shorter than the heights as stated per municipality. For example: in Rotterdam a building shorter than 70m is considered low-rise.

Non-tall buildings: buildings shorter than the heights as stated per municipality. For example: in Rotterdam a building shorter than 70m is considered low-rise. See ‘ Low-rise’.

Obsolete: no longer used; out of date.

Office buildings / Offices: for this research, an office building is a building that contains offices of one or more companies.

Randstad: an area in the Netherlands, consisting of the four main cities and their surroundings: Amsterdam, Utrecht, The Hague & Rotterdam.

Social challenges / opportunities: challenges / opportunities related to the social issues of a project / that can have a social impact. For example: related to the neighborhood or livability inside the building.

Stakeholders: all parties involved in the project

Structural vacancy: when a building has been vacant for over three years and there is no future prospect on a new tenant.

Tall buildings: buildings taller than the heights as stated per municipality. For example: in Rotterdam a building taller than 70m is considered high-rise. See ‘High-rise’.

Technical challenges / opportunities: challenges / opportunities related to the technical issues of a project / that can have a technical impact. For example: related to requirements or construction.

Transformation: transform / convert (vacant) real estate (for example: offices) to a new function (for example: dwellings). See ‘Adaptive reuse’ and ‘Conversion’.

Vacancy: empty or unoccupied; an empty space.

Vacancy rate: the percentage of vacant buildings

Summary

I. Introduction

Reuse strategies to decrease the vacancy rate of the office market have been researched extensively both inside and outside The Netherlands. However, the challenges and opportunities for these reuse strategies specifically for tall office buildings have not been researched yet. The aim of this research is to indicate the different challenges and possible solutions by researching the differences between the reuse of office buildings and the reuse of tall office buildings. This research the focus will be on the four big cities in the Randstad, being: Amsterdam, Utrecht, Rotterdam and The Hague. Most of the tall buildings in the Netherlands are located in Rotterdam, Amsterdam and The Hague (CTBUH, 2019; Rijksoverheid, 2013). These cities also have the highest demand for housing and therefore have the highest potential for reuse of vacant office buildings in the Netherlands.

Problem statement

"The Randstad in The Netherlands faces on the one hand structural vacancy in office buildings and on the other hand a growing housing shortage. Reuse strategies to decrease the vacancy rate of the office market have been researched extensively both inside and outside The Netherlands. However, the challenges and opportunities for these reuse strategies specifically for tall office buildings have not been researched yet."

The aim of this research is to find the challenges to conversion of tall office buildings, focused on the four big cities in the Randstad in the Netherlands, in particular Rotterdam. This results in the following main research question:

What are the challenges and respective solutions for the conversion of vacant tall office buildings into housing in the Netherlands?

Accompanied by the following sub-questions to answer the main research question:

1. What defines an office and what are the current office sub-markets in

Amsterdam, Rotterdam & The Hague?
2.What are the causes and effects of structural vacancy?
3. What are the challenges of the conversion of office buildings to housing on economical, legal, tech nical and social level?
4. What are possible solutions to cope with the challenges of conver sion of office buildings to housing?
5. What are the differences in chal

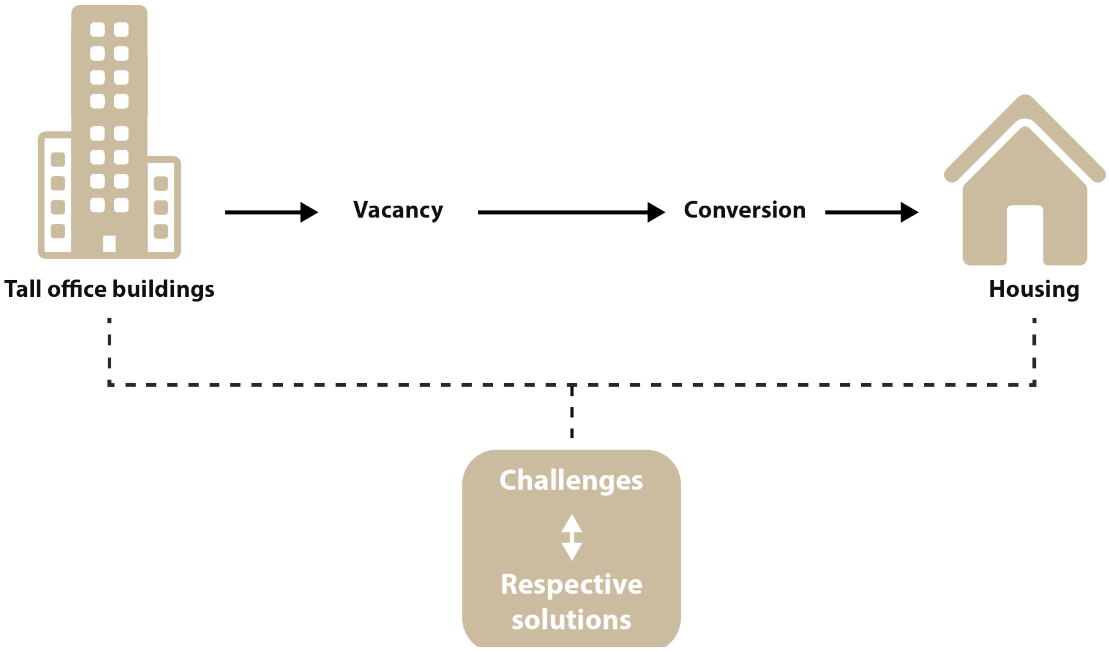


Figure I. Research framework (own ill. based on research questions)

lenges and possible solutions of the conversion of tall office buildings to housing on economical, legal, technical and social level?

The research framework is visualised in Figure I.

II. Literature study

First the causes and effects of structural vacancy have been researched. Thereafter the main stakeholders involved have been analysed, as their power and interest can affect the challenges and solutions of transformation projects. Followed by the challenges and solutions that have already been indicated and explored in literature, this will result in the theoretical framework.

The literature study has been translated into a theoretical framework, see Figure II. As can be seen, the causes and effects of structurally vacant buildings can occur in a loop. That is because structurally vacant buildings can cause other buildings in the surrounding area to become vacant as well. On the right side of the figure below the main challenges and opportunities/solutions to conversion are stated. They are categorized by: legal, economic, technical and social challenges and opportunities/solutions.

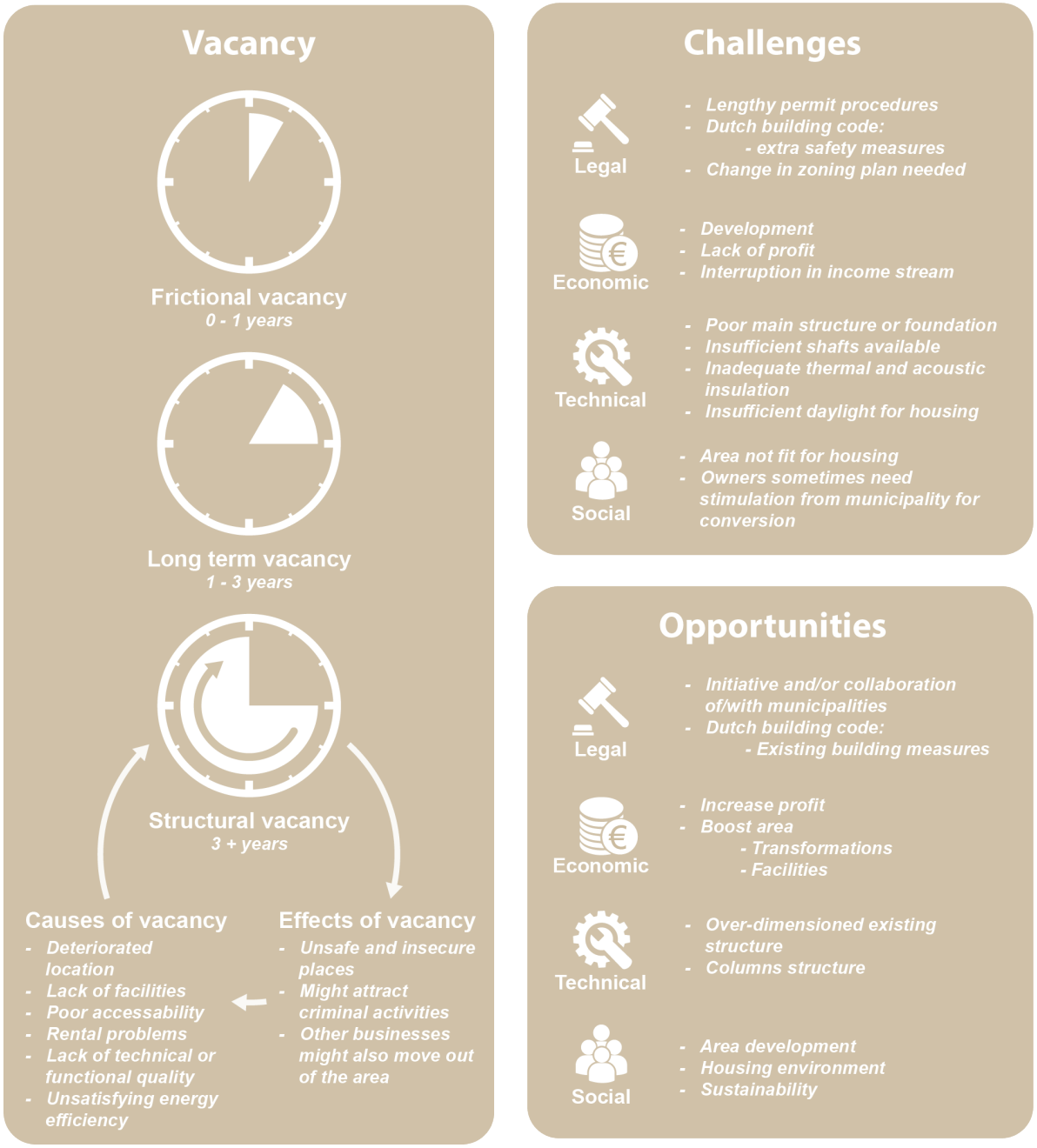


Figure II. Theoretical framework (own ill. based on literature study)

III. Methodology

The research method has been visualised in a methodological framework, see Figure III. The output of this research can be seen as a list consists of challenges to conversion that are specific for, have a higher consequence or a higher probability for transformations of tall office buildings to housing. Beside the challenges, a section with possible solutions and some examples from the case study from practice will also be included. In the following Chapter the cases will be explained and compared. Each case study will consist of an introduction and impression before and after the transformation. This is followed by the challenges, categorized in economic, legal, technical and social. Each case study will conclude with a summary and diagram. Thereafter a cross pair analysis will give insight in the main differences in challenges between the control case and case of interest within the categories.

IV. Results

The cases that have been studied are:

Pair 1: Amsterdam
- Metropoolgebouw (1964) - Zoku / We Work (2016)
- Parooltoren (1976) & Trouwgebouw (1969) - The Student Hotel Amsterdam City (2015/2016)

Pair 2: Amsterdam
- Kantoorgebouw Zaanstad / Elsevierge-bouw (1964) - DUWO Elseviergebouw (2015)
- Rembrandtparkgebouw (1973) - Ramada Apollo Amsterdam Centre / Leonardo Hotel Amsterdam Rembrandtpark (2012)

Pair 3: Rotterdam
- De Admiraliteit (1989) - De Nieuwe Admiraliteit / DNA (2016)
- Europoint complex / De Marconitorens (1975) - The Lee Towers (2019)

Pair 4: The Hague

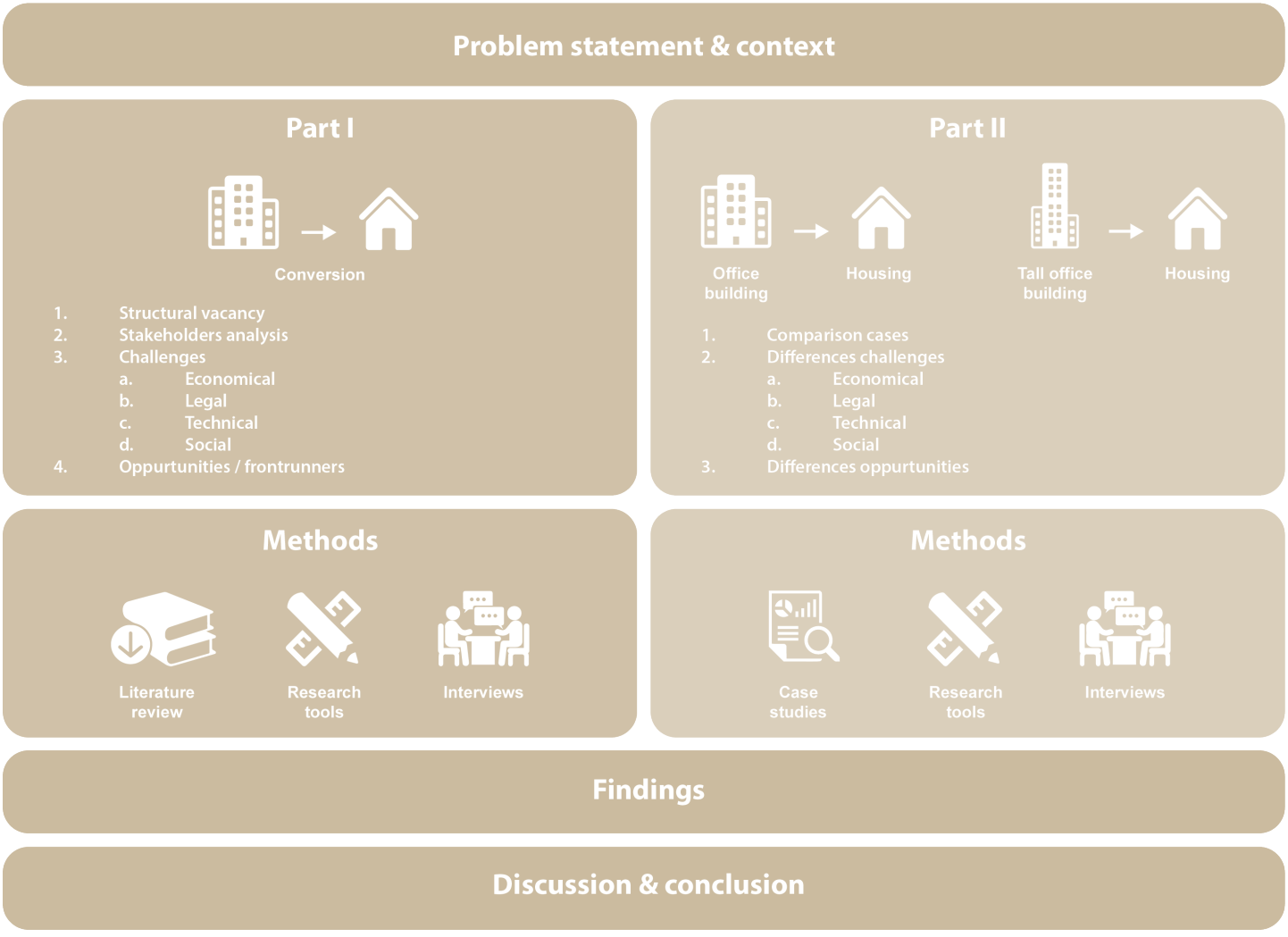


Figure III. Methodological framework (own ill.)

- Sophiestaete (1981) - De Sophie (2019)
- Ministerie van Binnenlandse Zaken (1975) - Wijnhavenkwartier (2016)

In both non-tall and tall buildings, most of the challenges occur on technical level. There are not much similarities in challenges between the non-tall cases, but there are some between the tall cases. In both the non-tall and tall cases, the majority of the challenges are either related to the existing structure or to meet/satisfy to the technical requirements.

The similarities in opportunities between the non-tall and tall cases are: lay-out and repetitions of floors.

The similarities between the control cases and cases of interest mean that those challenges and opportunities are not specific for tall buildings. However, the challenges and opportunities that in this case study are only mentioned in the tall building cases, do not necessarily only occur for tall buildings.

A comparison with the literature study, asked for an adaptation of the existing lists of challenges and opportunities.

V. Conclusion & discussion

By carrying out this research, not necessarily new or other challenges were found, but some existing possible challenges occurred more often in the tall cases than the non-tall cases. For example: fulfilling the fire safety requirements and the weight capacity of the existing structure. The technical challenges, such as the requirements of the Dutch Building Code and the fitting of the installation systems can have a bigger impact on the transformation of tall buildings. This follows from the stricter rules and regulations for high-rise and the more complicate puzzle of shafts and the amount of floors.

The literature study formed lists of possible challenges and opportunities. When comparing these outcomes to the findings from practice, it became clear that some aspects were not yet included and some were not specified enough. For example, the delay, district heating and various climate system related challenges. As well as the financial feasibility in relation to the amount of units, the collaboration between stakeholders and the optimization of the planning were found as opportunities to be added. Throughout this report, the lists of possible challenges and opportunities have been adapted to find the differences in challenges for the transformation of tall office buildings. The final adaptations within this report can be found in Figures IV & V.

Concluding this research, there are not necessarily new or other challenges in the transformation of tall buildings as opposed to the transformation of buildings that are not classified as tall. However, some challenges, especially those on technical level, can have a higher impact on the transformation of tall buildings.

List of possible challenges

	nr	Possible challenges
Economic	01	Acquirement / Purchasing costs
	02	Financial feasibility
	03	Housing market and revenues of new function
	04	Initial phase investment
	05	Unforeseen aspects causing delay
Legal	06	Dutch building decree
	07	Land ownership
	08	Ministry of Infrastructure and Water Management
	09	Monumental status
	10	Municipal building act
	11	Presence of asbestos
	12	Soil pollution
	13	Unforeseen aspects causing delay
	14	Zoning law
Technical	15	Building climate system (including heating & ventilation)
	16	Building too slender or too deep
	17	Condensation in structure
	18	Connection to district heating system
	19	Daylight < 10% of the appointed living space
	20	Inadequate pipes, ducts, etc.
	21	Incorrect technical assessment
	22	Inadequate thermal insulation
	23	Joints of brick walls in bad condition
	24	No balconies of roof terraces
	25	No basement
	26	Noise pollution
	27	Not enough elevators and staircases
	28	Poor state of main structure
	29	Poor quality of interior walls
	30	Stench pollution
	31	Sunlight
	32	Too loose fit, too high floors
	33	Type of main supporting structure
	34	Windows not operable
Social	35	In operation during construction
	36	Local opposition
	37	Need for area re-development
	38	Noise pollution

Table I. List of possible challenges (own ill. adapted from Remøy (2010) and Table 4.16)

List of possible opportunities

	nr	Possible opportunities
Ec.	01	Boost area (transformation and facilities)
	02	Financial feasibility
Legal	03	Collaboration stakeholders
	04	Dutch building code: existing building measures
	05	Municipality's initiative
Technical	06	Design consequences (lay-out, construction)
	07	Office type (corridor, center core)§
	08	Planning optimalization
	09	Sustainability
	10	Technical consequences (construction, facade)
Social	11	Area redevelopment
	12	Housing environment
	13	Sustainability

Table II. List of possible opportunities (own ill. adapted Table 4.17)

1. The research foundation

1.1. Problem description

Besides vacant buildings often being an eyesore for the city's image, they can damage the value of surrounding property and that can result in a deterioration of an area (Ordway, 2018; Remøy, 2010). According to Koppels, Remøy & Messlaki (2011) this effect of structural vacancy on the surrounding area is proved within 500m. Other negative effects of vacancy on a city are the crimes that can arise, such as: burglary, theft, vandalism and illegal housing (Vastgoedjournaal, 2017). In The Netherlands, the office market has the highest vacancy rate being 10% in 2018, followed by the retail sector with 8% in 2018 and the industrial sector with 7% in 2018 (CBS, 2018). The housing sector has the lowest vacancy rate being 2% in 2018 (CBS, 2018). An important note to these numbers is them being averages of the whole Netherlands. Some areas are scoring in both sectors largely above or below the Dutch average. The distribution of the office market can also have an influence on the vacancy rates. A research initiated by Bouwinvest and multiple companies show that over half of the office market with 57% is located inside the Randstad area (JLL, 2016; Bouwinvest, n.d.). 33% of the total office market is located in the four big cities of the Randstad (JLL, 2016; Bouwinvest, n.d.). One of the causes for the office market having the highest vacancy rate, is due to the Dutch office market being a replacement market. This means that users can choose to rent the highest quality offices at the best locations due to the surplus of space (De Ridder, 2018). The surplus of space is caused by, among other things, an economic shift and new trends in working (Buitelaar, 2017; Remøy, Koppels & Lokhorst, 2013). To decrease the vacancy rate in the Dutch real estate market, the Dutch office market is the most interesting sector to research as this is the sector with the highest level of vacancy (CBS, 2018).

Reuse strategies to decrease the vacancy rate of the office market have been researched extensively both inside and outside The Netherlands. However, the challenges and opportunities for these reuse strategies specifically for tall office buildings have not been researched yet. The aim of this research is to indicate the different challenges and possible solutions by researching the differences between the reuse of office buildings and the reuse of tall office buildings. This research the focus will be on the four big cities in the Randstad, being: Amsterdam, Utrecht, Rotterdam and The Hague. Most of the tall buildings in the Netherlands are located in Rotterdam, Amsterdam and The Hague (CTBUH, 2019; Rijksoverheid, 2013). These cities also have the highest demand for housing and therefore have the highest potential for reuse of vacant office buildings in the Netherlands.

1.1.1. Vacancy rates and trends

The term vacancy can be divided in three categories. 1. Initial or friction vacancy: building less than one year vacant. 2. Long term vacancy: building vacant between one and three years. 3. Structural vacancy: building vacant for over three years (Buitelaar, Sorel, Verwest, Van Dongen & Bregman, 2013; Keeris & Koppels, 2006). In this report the third category, structural vacancy, is researched. In 2013, 60% of the vacancy in the office market was stated being structurally vacant (Remøy, Koppels & Lokhorst, 2013).

The half yearly reports of real estate advisor Cushman & Wakefield, together with the numbers stated by CBS show that the vacancy numbers have been stable for the past two years. Medio 2018 the total vacancy rate of The Netherlands was measured at 11,6% with 5.488.000 m2 (Cushman & Wakefield, 2018). Amsterdam, The Hague and Utrecht are below the average Dutch va-

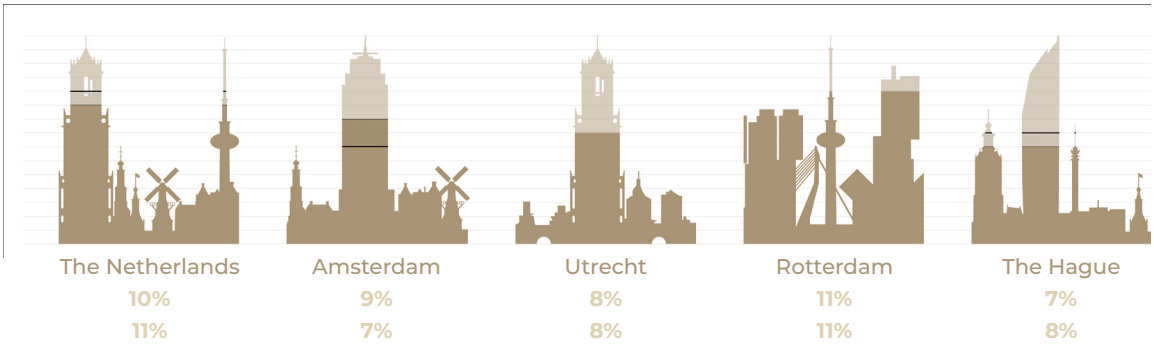


Figure 1.1. Vacancy rates (own ill. based on (CBS, 2018; Cushman & Wakefield, 2018))

cancy rate and Rotterdam is staying around the average Dutch vacancy rate (Cushman & Wakefield, 2018; CBS, 2018; JLL, 2018). Figures in the same report show a decrease of 3,7% in comparison to 2017, especially in the four big Randstad cities in The Netherlands (Cushman & Wakefield, 2018). However, as the take-up of office space has increased after the economical crisis, so did the development of new office stock (Bak, 2015; Savills Research, 2019). This has resulted in the gap between availability and take-up, being vacancy, to remain. In Figure 1.1. the vacancy rates of the Randstad and The Netherlands of 2017 and 2018 are schematically visualised.

What is interesting about these numbers, is that the vacancy level in general drops or remains stable, while in Amsterdam the vacancy level rises. The numbers by Cushman & Wakefield (2018) and CBS (2018) do not make a distinction between the different levels of vacancy and the measurements are taken at certain points in time. This is a limit for the research, as it can give a different insight than the actual current state of the structural vacancy levels. In 2015 the demand for office space decreased with 35% which meant a decline in demand for the eight year in a row, while more recent research shows that currently the office market is increasing in demand (Bak, 2015; Hoppenbrouwers, 2016; Savills Research, 2019). There still is a significant gap between demand and supply of the office market (Savills Research, 2019).

Beside these vacancy rates, for this research, the reasoning of causes and effects of obsolete buildings is more relevant.

1.1.2. Housing Shortage

After the financial crisis the demand of housing has increased significantly and this has caused the availability of housing decreasing to numbers from even before 2003 (Eg, 2018). Numbers of NVM, the Dutch Association of Real Estate Agents and Appraisers, show that the last three months of 2017 about 59.600 dwellings were available. When comparing this to the numbers by CBS, going up to 2016 (see Table 1.1) this is a enormous drop in supply (CBS, 2018). According to the numbers, the housing shortage is the biggest in the Randstad (CBS, 2018). In the Randstad the cities market prices exceed the social housing limit of €710,- per month (Signorazzi, 2018). This results in lower income households being most affected by the housing shortage.

The housing shortage has lead to the Minister of Foreign Affairs, Kajsa Ollongren, to suggest that the Netherlands needs a million new dwellings by 2030 (Jongeneel, 2018). This is called the 1 million homes challenge. Expert in the academic and practical field give a warning that the solution to this challenge should not be a repetition of the huge housing development that took place after the second world war (Jongeneel, 2018). TU Delft debates this challenge during courses and extracurricular lectures are organised to inspire and discuss about this topic. This discussion involves not only whether to build these dwellings or not, but also involves how these dwelling should be build. Some experts mention flexible and therefore adaptable dwellings, that are future proof to the demands of the coming generations (Jongeneel, 2018). Others also mention that cities in The Netherlands need to densify and that the answer lies within transformation of and new built of high rise (Jongeneel, 2018). Finally there is also

Averadge	**- 8,0 %** The Netherlands	**- 19,1 %** Amsterdam	**- 18,2 %** Utrecht	**- 11,4 %** Rotterdam	**- 9,7 %** The Netherlands
Jan 2016	130.000	2.400	1.100	3.600	2.800
Jul 2016	150.000	2.900	1.400	4.600	3.500
Jan 2015	180.000	3.700	2.300	5.900	4.300
Jul 2015	180.000	4.300	2.400	6.200	4.400
Jan 2014	200.000	5.200	2.900	7.000	5.000
Jul 2014	200.000	7.000	3.200	6.800	4.800

Table 1.1. Available dwellings (own ill. based on (CBS, 2018))

a demand for mixed-use and mixed sector buildings and areas, whereas the development of dwellings after the second world war solely focused on single-family row houses for the middle class and big apartments for the lower class (Jongeneel, 2018).

1.1.3. Adaptive reuse

In literature the four main strategies of reuse are described as: consolidation, renovation or upgrading, demolition and new-build and conversion (Remøy & Van der Voordt, 2014). The latter is also known in literature and practice as transformation or adaptive reuse. Selling is often not a solution for the vacancy problem, since the building will possibly stay vacant due to the replacement market (Remøy & Van der Voordt, 2014; De Ridder, 2018). Consolidation is the definition of maintaining the building as it is and waiting for a better time in the market (Remøy & Van der Voordt, 2014). This is not an ideal strategy, since the building will stay vacant in the waiting time. In such a case, the 'better time in the market' may never come. Renovation or upgrading may be a good solution, if the location is interesting for businesses to house their offices (Remøy & Van der Voordt, 2014). However, as mentioned there is an overall surplus in the office market and future tenants will most likely choose a building at the top of the market. There is a limited chance that buildings after renovation or upgrading, will suddenly move from the bottom of the market up to the top. Then there is the strategy of demolition and new-build (Remøy & Van der Voordt, 2014). Although this option is often quicker and financially more attractive for owners, it is not a sustainable option. As the climate is changing and resources are getting scarcer, a strategy that reuses -part of- the building is valued. Also when a building is being demolished, surrounding citizens and neighbours will have an opinion about it, either positively or negatively. The most interesting strategy is conversion: transforming a building to a new function (Remøy & Van der Voordt, 2014). Conversion, if the building and environment allows transformation, is needed, as demolition is no longer a sustainable and durable solution to vacancy (Kougea, 2019). In a report by Manewa (2012) demolition is called a waste generating strategy (Kougea, 2019). Geraedts et al. (2017) describe the trend of conversion of high-rise office buildings into housing, especially for seniors and families in large cities. In the same paper, it is named an increasing international development (Geraedts et al., 2017). With this strategy, challenges arise on economical, legal, social and technical level. However, most of these challenges have been researched in literature. In Figure 1.2. the four main reuse strategies have been visualised.

1.1.4. Tall buildings

In literature there is a broad range of definitions of tall buildings. De Jong & Wamelink (2008) describe the definition given by the Council on Tall Buildings and Urban Habitat as an appealing one: 'A tall building is not strictly defined by the number of stories or its height. The important criterion is whether or not the design, use, or operation of the building is influenced by some aspect of tallness.' (CTBUH, 2007). However, for another research called the High Rise Adaptability (HRA) the authors used a physical lower limit of 70m to describe tall buildings, due to the fact that specific regulations are applicable in the Netherlands from that height upwards (De Jong, Oss & Wamelink, 2007). As this research focuses on the Randstad, the definition of tall buildings is even more difficult as it differs per city. In Amsterdam a building is tall when it is at least 30m in height or twice the height of the buildings in their direct surroundings (Gemeente Amsterdam, 2011). In Amsterdam there is also a height limit due to the air traffic around Schiphol Airport. The Northern part of Amsterdam is limited to 80-100m, the centre of Amsterdam to 60-80m and the Southern part of Amsterdam to 40-60m. Exceptions to this rule are the buildings that have already been realised, such as the Rembrandt-tower of 135m.

Whereas in Utrecht tall buildings are only buildings and not structures (Gemeente Utrecht, 2005). This includes housing, offices and businesses, but excludes chimneys, church towers and lightning columns. For Utrecht there are then two height limits related to tall buildings. On the one hand there is a height limit of 30m, this is twice the average height in Utrecht and thus causes an effect on the view. On the other hand, tall buildings are also buildings that may be lower than 30m in height, but 1,5 times higher than the buildings in their direct surroundings. In Rotterdam there is a height limit stated of 200m, but this number can increase in the future, as the city grows and densifies (Gemeente Rotterdam, 2011). The definition of tall buildings in Rotterdam are

buildings with a minimum height of 70m (Gemeente Rotterdam, 2011). Beside the height limit, the municipality of Rotterdam has set a number of rules for the volume and slenderness of buildings. This is called the 'Rotterdamse laag' and means that the whole lower part of a building should consist of the whole plot (Gemeente Rotterdam, 2011). The upper part of the building can be maximum 50% of the plot in m2, unless the building is designed to be over 70m and the 'Rotterdamse laag' is substantial public. In The Hague the definition of tall buildings is since 2009 set at 50m, as this is the height of the Binnenhof (Gemeente Den Haag, 2017). For this research, tall buildings will be defined as buildings above 70m of height.

1.1.5. Synthesis

Reflecting on the numbers and if comparison is equal, the locations and surrounding metropolitan areas are taken into account. The numbers by Cushman & Wakefield (2018) include for all cities some surrounding cities, see Table 1.2. The vacant space at the municipal level, in percentage of stock, show that Capelle a/d IJssel and Stichtse Vecht are the most vacant municipalities for the office market in January 2018 and July 2018 (Cushman & Wakefield, 2018). The same reports show that the municipality of Rotterdam without it's metropolitan area still has a vacancy rate above the Dutch average, while the other main cities of the Randstad are below the Dutch average (Cushman & Wakefield, 2018).

Amsterdam is the only city where the va-

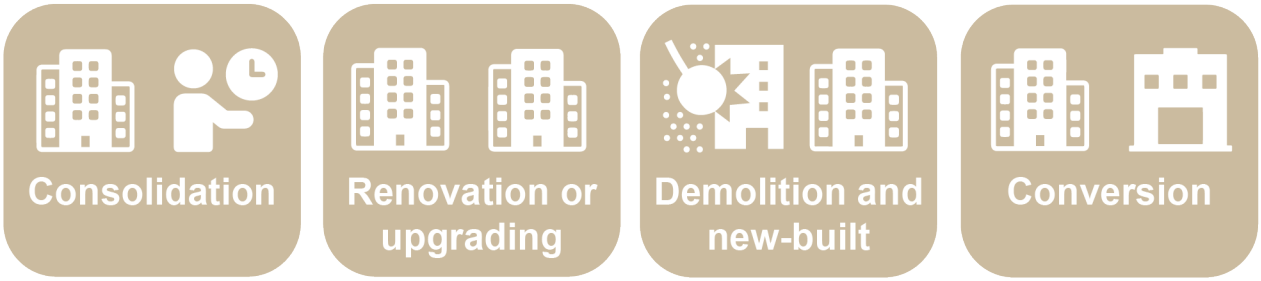


Figure 1.2. Types of reuse (own ill. based on (Remøy & Van der Voordt, 2014))

Location	Aboslute Height	Contextual height	Limit	Remarks
The Netherlands	> 70m			
Amsterdam	> 30m	2x height	80 -100m / 60 - 80m / 40 - 60m	Limits due to air traffic around Schiphol Airport, Amsterdam is within three different height limit zones.
Utrecht	>30m	1,5x height	112m	Norm: not higher than the Dom, a landmark in Utrecht
Rotterdam	> 70m		200m	Limit can increase as city grows and densifies
The Hague	> 50m			Till 2017 there was a height limit of 140m

Table 1.2. Definition of a tall building (own ill. based on the structural visions per city and the Dutch building code)

cancy level has increased. In Figures 1.3, 1.4, 1.5 & 1.6 the availability and uptake percentages are shown in comparison to the previous years. Even though availability decreases, the uptake did not increase as much as in the other cities. That can explain why the vacancy rate in Amsterdam has increased slightly. It is not mentioned how much of the vacancy rate is defined as structural vacancy. According to Keeris & Koppels (2006) it is important to make a clear distinction between different types of vacancy, as that will derive a more accurate view. In the past years, the structural vacancy has been about 60% of the total vacancy rate.

The problem statement, terms and concepts used are visualised in a conceptual model, see Figure 1.7.

In this figure the direction of the research can be found. Even though there are multiple reuse strategies, this research focuses on conversion. This has lead from the transformation need, due to structural vacancy in combination with a high demand for housing. As conversion has been researched extensively in literature, this research focuses on tall buildings in particular. Important is the comparison between the theory and practice of tall buildings and that of non-tall buildings.

Problem statement

"The Randstad in The Netherlands faces on the one hand structural vacancy in office buildings and on the other hand a growing housing shortage. Reuse strategies to decrease the vacancy rate of the office market have been researched extensively both inside and outside The Netherlands.

Amsterdam	Utrecht	Rotterdam	The Hague
Schiphol	Stichtse Vecht	Schiedam	Zoetermeer
Diemen	Houten	Capelle a/d IJssel	Rijswijk
Amstelveen	Nieuwegein	Nieuwegein	Leidschendam / Voorburg

Table 1.3. Municipalities included in the numbers (own ill. based on Cushman & Wakefield reports)

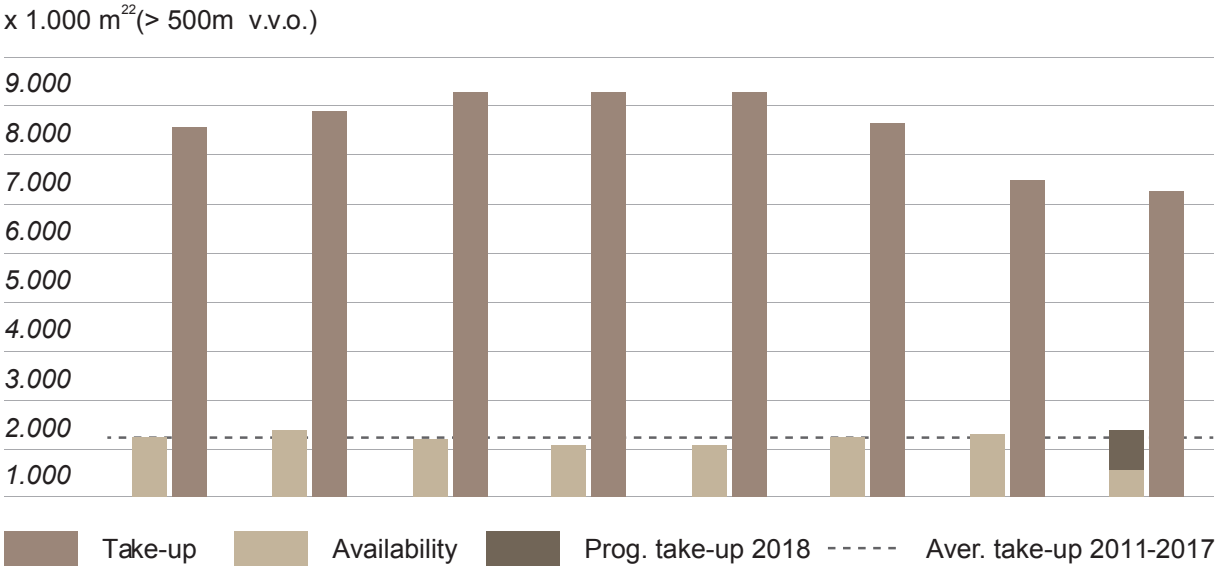


Figure 1.3. Availability and uptake office market - The Netherlands (own ill. based on Cushman & Wakefield reports)

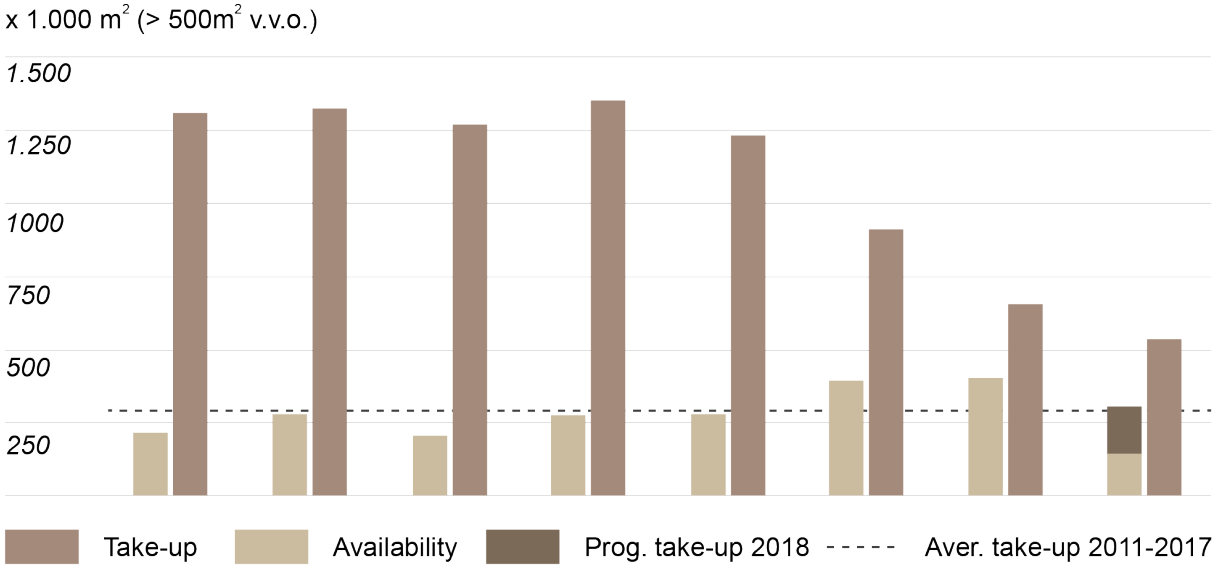


Figure 1.4. Availability and uptake office market - Amsterdam (own ill. based on Cushman & Wakefield reports)

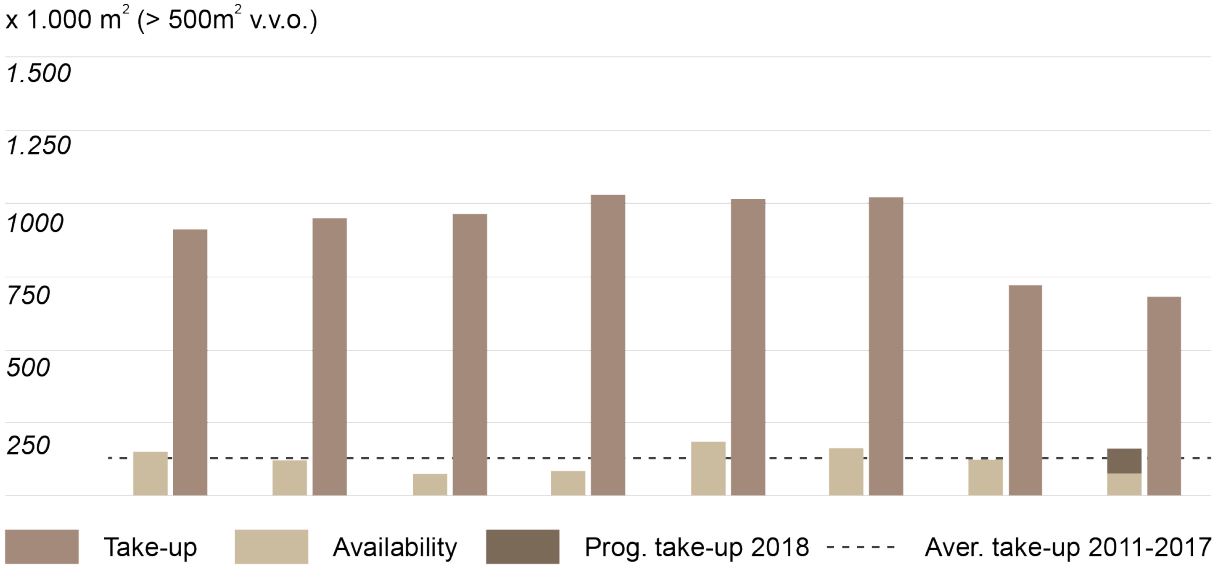


Figure 1.5. Availability and uptake office market - Rotterdam (own ill. based on Cushman & Wakefield reports)

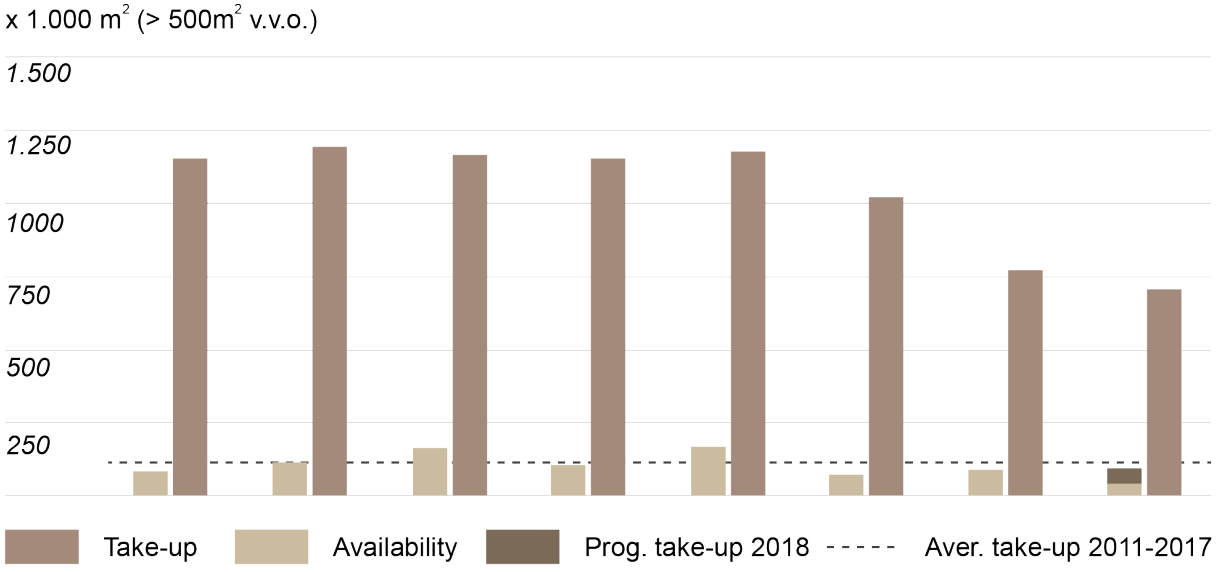


Figure 1.6. Availability and uptake office market - The Hague (own ill. based on Cushman & Wakefield reports)

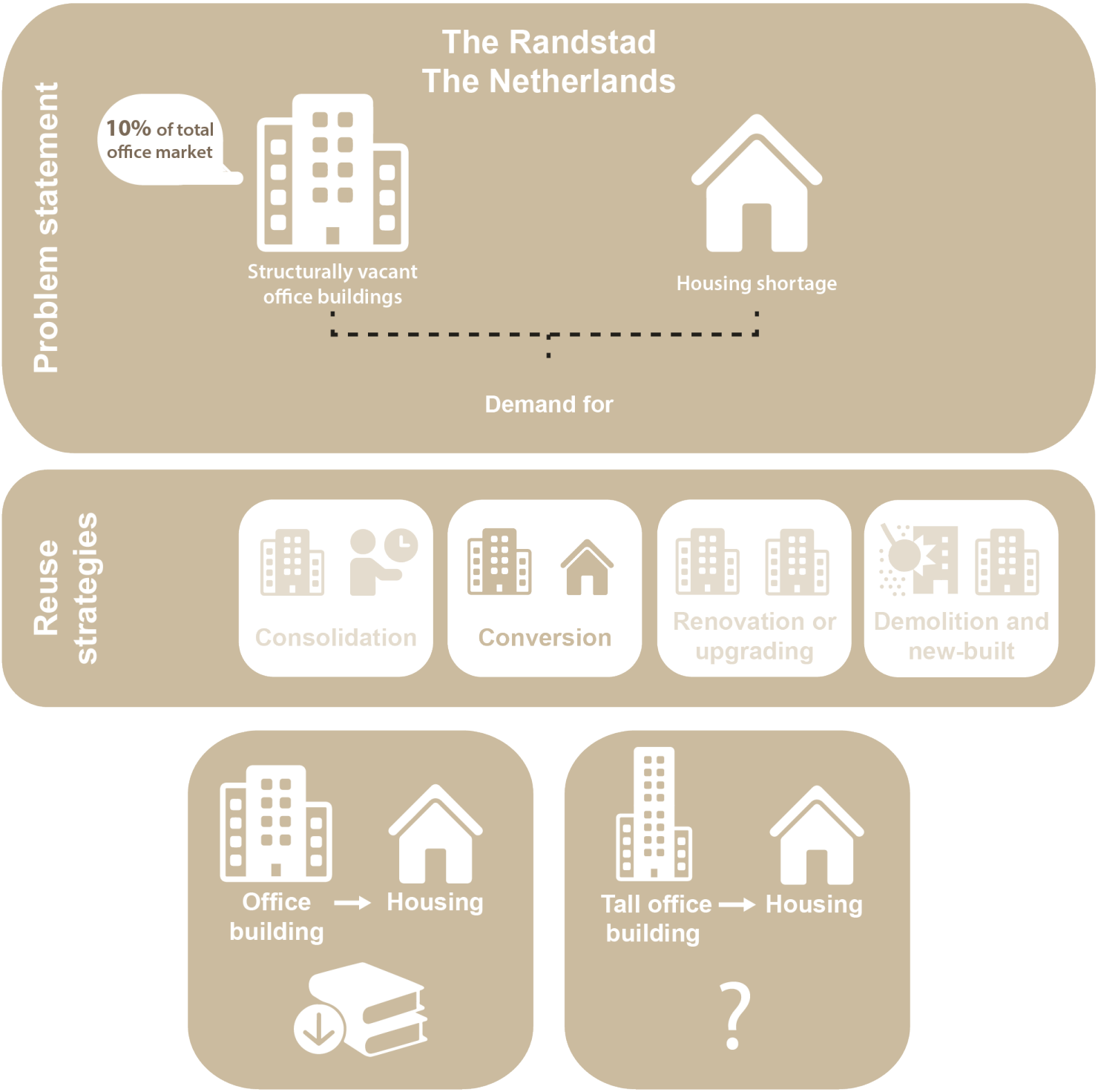


Figure 1.7. Conceptual model (own ill. based on problem statement)

However, the challenges and opportunities for these reuse strategies specifically for tall office buildings have not been researched yet."

1.1.6. Relevance

The aim of this research is to find the challenges to conversion of tall office buildings, focused on the four big cities in the Randstad in the Netherlands, in particular Rotterdam. This results in the following main research question: What are the challenges and respective solutions for the conversion of vacant tall office buildings into housing in the Netherlands? The outcomes of this research can be used as input in reuse strategy decision making and to implement during future conversions of tall office buildings to housing. The outcomes will address both the high vacancy rate in the Dutch office market and the housing shortage in the Netherlands. This is important, as currently about one tenth of the office market is vacant and the availability rate of dwellings is negative (see Fig. 1.1. & Tab. 1.1.).

Social relevance

As described above, vacancy has a negative influence on a city's image and can be ground for crimes. Transforming vacant office areas and buildings into housing can create a safer and more livable environment. By carrying out this research and possibly make it more attractive to convert vacant tall office buildings to housing can decrease the vacancy rate. Creating more housing, will also answer to the housing shortage. Especially in the Randstad the mid-income households and starters can not find a suitable and affordable dwelling. Transformation projects can be feasible options for developers and more housing availability can give these groups a better opportunity at the housing market. Vacancy can not only have a negative influence on the owner's finances, but can also affect buildings in the area (Koppels, Remøy & Messlaki, 2011)

Scientific relevance

Literature starting from 2005 (Geraedts & Van der Voordt, 2005) has been taken as a starting point for this research. This research follows up on existing research about transforming offices to housing (Remøy, 2010; Remøy & Van der Voordt, 2014; De Ridder, 2018; Bruijning, 2016). It is also based on the current state in The Netherlands, according to numbers by CBS (2018) and Cushman & Wakefield (2018). This is relevant, as such researches can be reflected upon repeatedly. This research aims to add knowledge to the existing body of knowledge by studying tall buildings in particular within the context of conversion. This direction has been chosen, because the challenges to conversion of tall offices to housing have not been researched in such a context. There is still a significant amount of vacancy in the Netherlands. The demand for housing on the other hand keeps increasing, especially in the Randstad. There is a potential for conversion within this context. It is interesting for practice and theory to know which of the tall buildings are vacant and what possible differences there are in challenges compared to buildings below 70m of height. In Chapter 3 and 4 the methodology and research output will be elaborated.

1.2. Research questions

To reach the goal of this research, determine what the challenges are to conversion of tall buildings in particular, the following research questions have been developed.

1.2.1. Main research question

What are the challenges and respective solutions for the conversion of vacant tall office buildings into housing in the Netherlands?

In this main research question there are five topics that form the base of this research. This is visualised in Figure 1.8

1.2.2. Sub-questions

To answer the main question, a set of sub-questions has been developed. For the research it is important to first explore the existing knowledge and collect that knowledge in a critical summary. The first part of this research will consist of an extensive literature review and gives insight in the current challenges and past research to conversion of office buildings. The first part will also include desk research to structural vacancy to complete the background of this research. Thereafter the perspective shifts to tall buildings. First, it will be indicated which of the tall buildings are structurally vacant and if they have a potential for conversion. These tall buildings can be used as case studies together with completed cases of conversion. Comparing different cases to find the differences between conversion of office buildings to housing and conversion of tall office buildings to housing. The boundaries of the research are within the fields of vacancy in the office market, shortage of housing and conversion of tall buildings.

1. *What defines an office and what are the current office sub-markets in Amsterdam, Rotterdam & The Hague?*
2. *What are the causes and effects of structural vacancy?*
3. *What are the challenges of the conversion of office buildings to housing on economical, legal, technical and social level?*

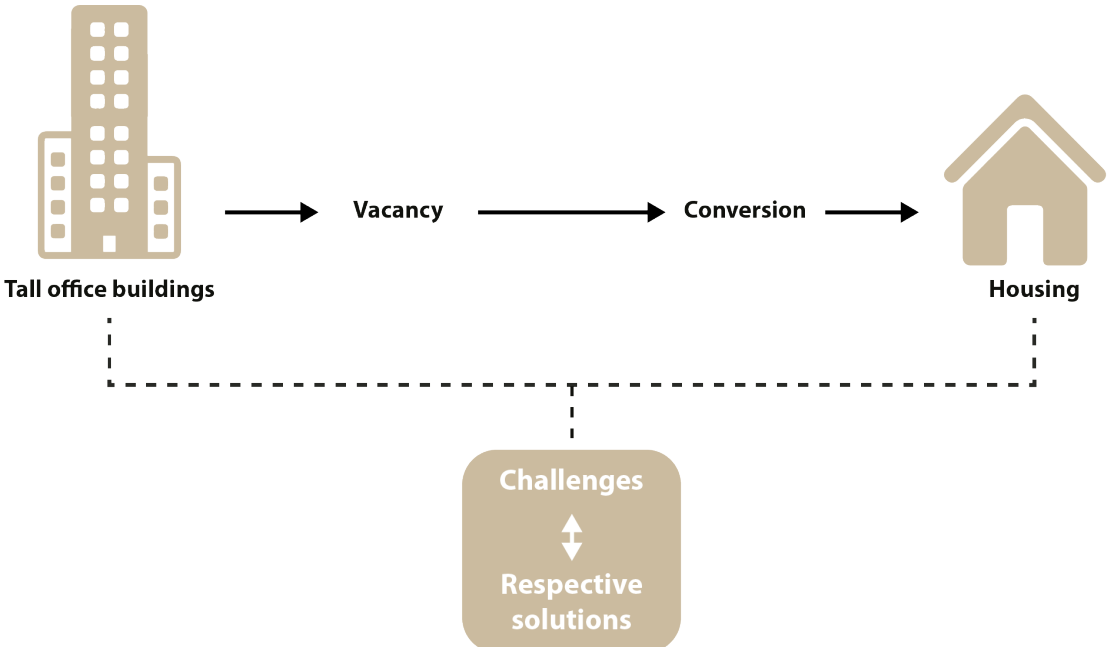


Figure 1.8. Research framework (own ill. based on research questions)

4. What are possible solutions to cope with the challenges of conversion of office buildings to housing?
5. What are the differences in challenges and possible solutions of the conversion of tall office buildings to housing on economical, legal, technical and social level?

1.3. Research output

1.3.1. Report structure

This research consists of two main parts, being:

1. Explanatory literature study to give an understanding of the stakehold ers involved, an overview of challeng es and barriers researched and an insight in opportunities from front runners.
2. Empirical research consisting of case study analyses

The report however is structured in five chapters and appendices, being:

1. The research foundation
2. Literature study
3. Methodology
4. Empirical research
5. Conclusion, discussion and reflec tion

Appendices

First, the problem statement leads to a literature study, where the context and different definitions have been explained by analysing existing literature. In the methodology chapter, both the literature study and empirical research methods are explained. The methodology chapter leads into the empirical research. The report is concluded with a conclusion, where after discussion is opened. The report ends with a reflection on both the research itself as the process. Enclosed in the report are the appendices.

1.3.2. Goals and objectives

The outcomes of this research will have a societal and scientific relevance as explained in section 1.6. The aim of this research is to find the challenges to conversion of tall office buildings and more important, explore the possible solutions. An objective to this research, is that it should be more than just a summary of what already has been researched in literature. The outcomes of this research should be fit for appliance by practice. The idea is to find out which challenges make it impossible on economic, legal, technical or social level to transform tall offices to housing at the moment. Then it is possible to find out which tall office building that are currently vacant can turn into profitable housing projects.

1.3.3. Deliverables

All of the deliverables should be documented in detail in a final report. The aim of this report is to give an overview of challenges and possibilities to the conversion of tall buildings in particular.

1.3.4. Dissemination and audiences

The outcomes of this research can be used for owners of tall vacant office buildings to help guide them in the reuse strategy decision making, by giving a clear overview of possible challenges that may arise and possible solutions to those challenges. Other interested parties could be municipalities, the governments and associations, as the outcomes may give new insights in the legal and economical challenges and opportunities. Finally, the outcomes are interested for other researchers in the same field as input or to compare findings. Other academic may be interested to carry out follow-up research, if this research indicates a demand for that. Therefore this research is meant for both theory and practice.

2. Literature study

2.1. Office buildings and environments

This chapter aims to clarify what is meant with a tall office building within the context of this research. It explains the definition of an office building, gives an overview of the different office typologies, a historical insight in the rise of tall buildings and investigates the different office environments in Amsterdam and Rotterdam.

2.1.1. Office buildings

Overall, an office is seen as a place of business. According to the Google dictionary, an office building is a building that contains the offices of one or more companies. According to the Cambridge dictionary, an office building is a large building that contains offices. For this research, an office building is a building that contains offices of one or more companies. However, this research focuses on tall office buildings with the definition of tall given in Section 1.4.

2.1.2. Classifications

In literature and relevant platforms, three main classes of office buildings are explained, being class A, B and C (Bouwinvest, n.d.; Day, 2019; Staples, 2016). This classification is mostly used by brokers and clients (Staples, 2016). Class A contains the highest-quality office spaces on the market (Day, 2019). This means high quality in location, aesthetics, amenities and technical aspects (Day, 2019). The rental rates for this class are often higher than the city's average rents (Day, 2019). An example in the Netherlands is the Zuid-As in Amsterdam. Class B buildings are considered decent in amenities and technical aspects, but do not always fulfill the location or aesthetics demands (Day, 2019). They are often located at the edge of financial districts or in the suburbs (Day, 2019). Class B buildings are mostly older than Class A buildings and can experience some deterioration, therefore the rents are average or a little higher (Day, 2019). Another source mentions that Class B buildings can also be newly built located in secondary locations or older buildings on prime locations (Staples, 2016). Class C consists of the poorest-quality structures in the least desired areas (Day, 2019). They often need major repairs or a complete renovation and the rents will be below average (Day, 2019). The classifications are visualised in Figure 2.1.

2.1.3. Typologies

Beside the classification of office buildings, there are also typologies defined of office space itself, which is more common in the Netherlands than the office classifications The typologies involves the office space itself and the different ways of working in offices. The office plans and ways of working are closely related, see Table 2.1 and Figure 2.2. In practice, combinations of the office plans and office spaces can be found. The explanations below give an overview of common situations which are available in the office market. Another typology of office buildings is the aesthetic appearance and functionality changes over time, see Table 2.2.

The office lay-out can also be divided into two kinds of typologies concerning the floor plans, according to Schenk (2009). The two types of office buildings researched are: corridor and center core. A single or double corridor building are normally horizontally orientated and a center core building is vertically orientated (Schenk, 2009). For this research, tall buildings will most likely have a center core and non-tall buildings a corridor typology. Both typologies can consist of private offices, an open plan or a combination of those (Schenk, 2009).

In the Netherlands, according to Van Meel (2000), offices tend to have a shallow floor plan. This is beneficial for the work environment, as most desks will be in proximity of a window (Van Meel, 2000). In the Netherlands the use of space per employee is higher than for example the UK, as in the UK are more mass open plans common (Van Meel, 2000).

2.1.4. Office sub-markets

Inner city office locations can be divided into different office environments. Each of these environments have their pros and cons. The top environments are normally located in environments that have a high intensity of offices, are easily accessible and offer facilities such as restaurants and shared spaces for employees. These environments are attractive for companies and therefore more expensive and scarce in availability, especially in Amsterdam (Kleve, 2019). Innovation districts are areas where offices and companies of the same expertise house. Sometimes beside offices, also

Figure 2.1. Classification of office buildings (own ill. based on Day (2019), Bouwinvest (n.d.) and Staples (2016))

Traditional Office Space	Creative Office Space	Contiguous Office Space	Coworking Space	Executive Suites
Includes often: - Reception - Boardroom - Bullpen - Private Offices Renting period: 3 - 5 years lease Company types: - Financial services - Hedge funds - Law firms	Stimulates more transperency, communication and collaboration by: - High ceilings - Large windows - Fewer walls & private offices Company types: - Start-ups - Tech companies - Creative agencies	- Multiple suites on the same floor that are combined and rented to a single tenant - Multiple suites on multiple floors rented by a single tenant	- Use of a number of desks - Shared meeting and break rooms Renting period: - Flexible lease terms Company types: - Small companie - Start-ups	- Fully serviced work space within a floor that is leased to another company - Shared conference and break room - Reception area Renting period: - Sublet with flexible terms

Table 2.1. Types of office space (own ill. based on Squarefoot (n.d.) & Van Meel, 2000)

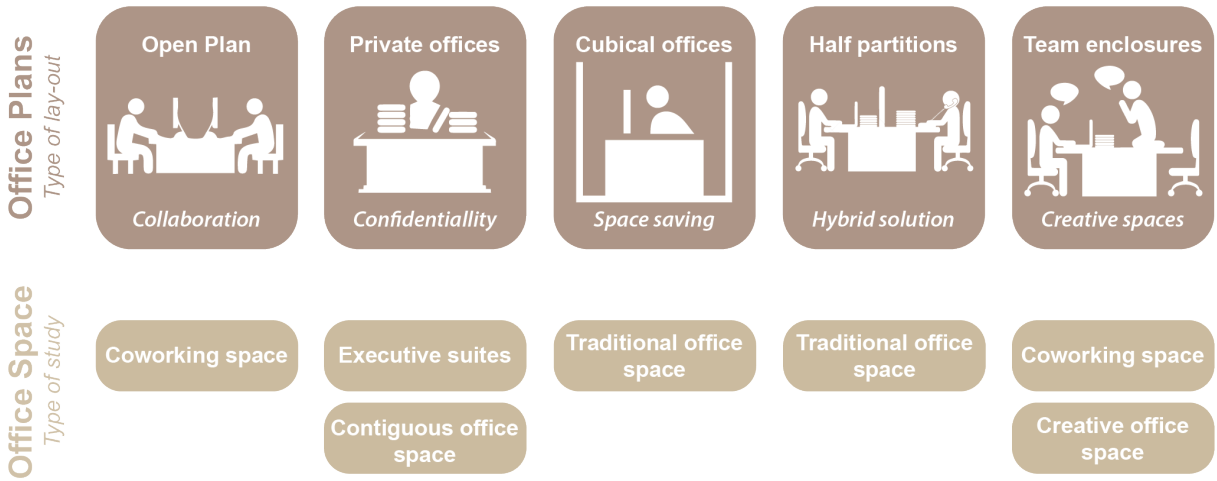


Figure 2.2. Office plans and related spaces (own ill. based on Harness (2018), Squarefoot (n.d.) & Van Meel, 2000)

educational functions are housed there. The objective for innovation districts is to stimulate knowledge transfers and accelerate start-ups (Veer, 2016). Multi-modal nodes are environments that are attractive because of their high accessibility (Van der Doelen, 2016).

2.1.5. Tall office buildings

In the Netherlands, most office buildings are considered low to medium tall in height (Rijksoverheid, 2013; Van Meel, 2000). Most of the Dutch high-rise is situated in Rotterdam, outskirts of Amsterdam and since the nineties also in other cities (Rijksoverheid, 2013; Van Meel, 2000). Tall buildings have a range of reasons for construction, including: trends, ways of working and office layout, construction, architecture and technical possibilities. A trend is the corporate identity trend of the eighties and nineties, which offices were often located in business parks (Rijksoverheid, 2013). The tallest building of the Netherlands is the Maastoren in Rotterdam with 164 meters, but at the moment of writing the Zalmhaven is under construction and will be completed in 2021 with 212 meters (CTBUH, 2019). In Table 2.4 a list of the 20 tallest buildings in the Netherlands can be found.

An explanation for the amount and location of tall buildings in the Netherlands is the Dutch urban setting (Van Meel, 2000). Most Dutch cities have a historical centre, which sometimes also is a conservation area (Van Meel; Vaughan Bowden, 1998). The Dutch urban planning also plays a role, as it is common to preserve the existing historical content of cities (Van Meel , 2000). The municipalities tend to disapprove of buildings that will limit the sight of religious, public and historical buildings (Van Meel, 2000). One of the main reasons that Rotterdam is an exception, is because most of Rotterdams historical city center was bombed during the second world war. The Netherlands is also known for participatory planning, which means that there can be an opposition from locals on projects in development (Van Meel, 2000; DEGW, 1998).

2.1.6. High-rise in the urban setting

The development of tall buildings contains more risks than low-rise buildings (Zandbelt &vandenBerg, 2008). High-rise often has an influence on the surrounding area, both visually as in terms of livability (Zandbelt &vandenBerg, 2008). In a recent Dutch Tv-show, architect Sjoerd Soeters, designer Fenna Haakma & writer Murat Isik discuss the possible pro's and con's of living in a tall building. It is discussed that high-rise residential towers are often anonymous, as each resident has its own cell (Soeters, Haakma & Isik, 2020). It is possible to meet people in the corridors or on the galleries, but it is unsure if these people are guests or residents (Soeters, Haakma & Isik, 2020). According to Soeters (2020), the human scale should be taken into account, as otherwise the relationship between buildings and people can disappear. An example is the Bijlmer, where an advantage is a lot of green in the area, but the human scale is forgotten. To also ensure a safe environment, the building or complex should include a mix of residents (Soeters, Haakma & Isik, 2020). Often, tall residential buildings consist of small units, to keep them affordable (Soeters, Haakma & Isik, 2020).

However, high-rise dwellings can be successful when situated in an center area or node, where the ground floor is already lively (Soeters, Haakma & Isik, 2020). The ground floor is the place where the building and the city come together (Zandbelt &vandenBerg, 2008). Important factors for the ground floors of - especially- high-rise are: the public space, transparency, function, parking, shadow, wind, floor height and design (Zandbelt &vandenBerg, 2008). In Table 2.5 an overview is given of pros and cons of high-rise from the perspective of different stakeholders.

In the Netherlands, the bigger cities have a vision on high-rise included in their structural visions. The cities' profiles both influence and are influenced by these visions. (Zandbelt &vandenBerg, 2008). For example in Amsterdam the historical city and restrictions from Schiphol Airport define the profile, whereas in The Hague the center contains more high-rise. In Rotterdam the river works as a center (Zandbelt &vandenBerg, 2008). The concentrations of high-rise may also differ, which can be seen in Figure 2.5. (Zandbelt &vandenBerg, 2008). In Amsterdam, Rotterdam and The Hague, the high-rise is mainly located in clusters. However, in different parts of the city, the urbanity per high-rise environment can differ. This can be seen in Figure 2.6, with Amsterdam as example (Zandbelt &vandenBerg, 2008).

On international level, the Dutch high-rise is

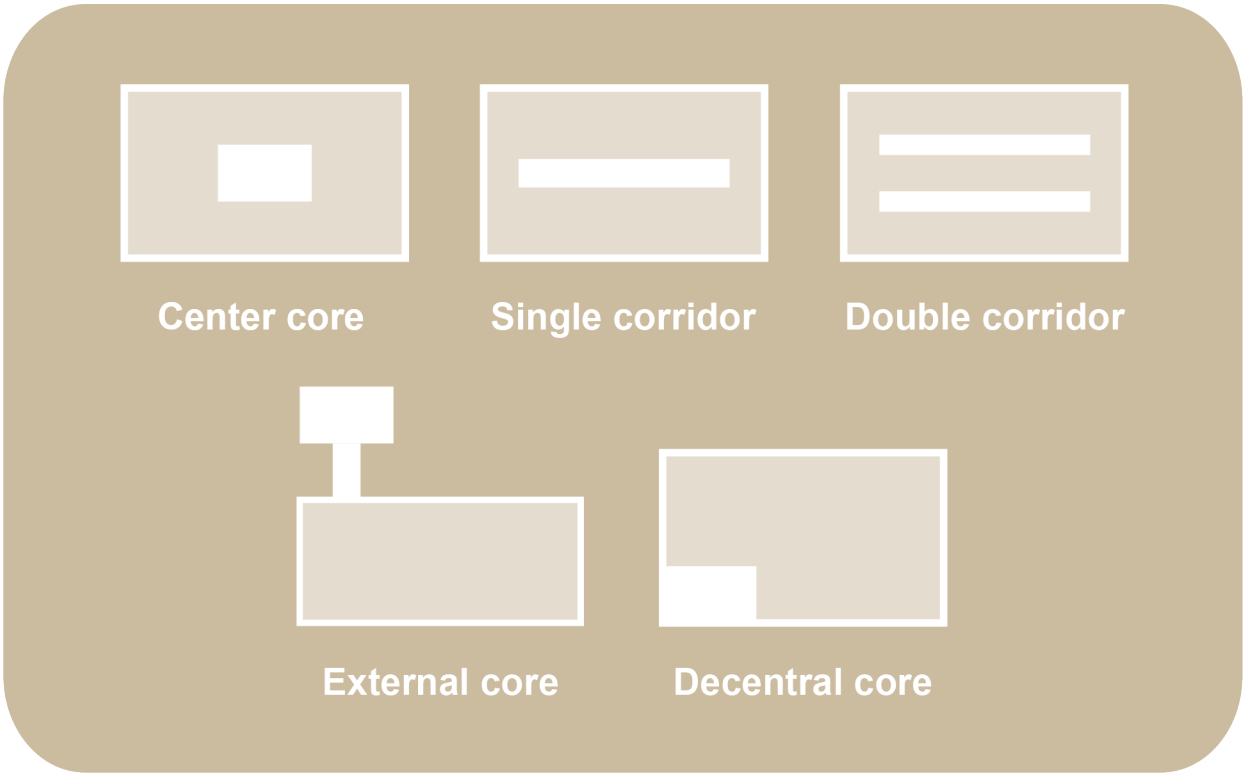


Figure 2.3. Floor plan typologies (own ill. based on Schenk (2009) & Zandbelt &vandenBerg (2008))

1850 - 1945	Witte boorden fabrieken
1945 - 1955	Representatieve werk paleizen
1955 - 1965	Glazen dozen en cellenkantoren
1965 - 1975	Kantoortuinen en grote gebaren
1975 - 1985	Humane en flexibele (verhuur)kantoren
1985 - 1995	Corporate identity en kantoorwijken
1995 - 2015	Flexibele en virtuele kantoren

Table 2.2. Aesthetic appearance of offices over time (own ill. based on Rijksoverheid, 2013))

Environment	Example Amsterdam	Example Rotterdam	Example The Hague
International top environment	Zuidas	Rotterdam Central District	International Zone
Top environment	Inner city center	Boompjes	CBD
Urban work environment (high intensity offices)	Overamstel	Marconiplein	Bezuidenhout
Urban work environment	Overhoeks	Hart van Zuid	Old Center
Innovation district	Sciencepark	EUR Campus Dijkzigt	Binckhorst
Multimodal node	Sloterdijk	Blaak	CBD

Table 2.3. Different office environments and examples in Amsterdam and Rotterdam (own table based on (Gemeente Amsterdam, 2019b; Gemeente Rotterdam, 2016))

considered mid to low-rise (Zandbelt &vandenBerg, 2008). In the '70s there was a stop in high-rise development, but nowadays especially in the bigger cities, high-rise is being developed again (Zandbelt &vandenBerg, 2008; CTBUH, 2019). The top 10 skylines worldwide and in Europe can be found in Table 2.6 for comparison withe international high-rise environment.

2.1.7. Sub-conclusion

Office buildings
Overall, an office is seen as a place of business. For this research, an office building is a building that contains offices of one or more companies.

Classifications
In literature and relevant platforms, three main classes of office buildings are explained, being class A, B and C, which is mostly used by brokers and clients. Class A contains the highest-quality office spaces on the market in both building an location. Class B buildings are considered decent in amenities and technical aspects, but do not always fulfill the location or aesthetics demands. Class C consists of the poorest-quality structures in the least desired areas. The classifications are visualised in Figure 2.1.

Typologies
Beside the classification of office buildings, there are also typologies defined of office space itself, which is more common in the Netherlands than the office classifications The typologies involves the office space itself and the different ways of working in offices. The office plans and ways of working are closely related, see Table 7.1 and Figure 7.2. In practice, combinations of the office plans and office spaces can be found. Another typology of office buildings is the aesthetic appearance and functionality changes over time, see Table 5.7. The office lay-out can also be divided into two kinds of typologies concerning the floor plans, for example a corridor and center core. In the Netherlands, offices tend to have a shallow floor plan. This is beneficial for the work environment, as most desks will be in proximity of a window.

Office sub-markets
Inner city office locations can be divided into different office environments. Each of these environments have their pros and cons. Figures 2.7. , 2.8 . and 2.9. show the office sub-markets in Amsterdam, Rotterdam and The Hague.

Tall office buildings
In the Netherlands, most office buildings are considered low to medium tall in height. Most of the Dutch high-rise is situated in Rotterdam, outskirts of Amsterdam and since the nineties also in other cities. An explanation for the amount and location of tall buildings in the Netherlands is the Dutch urban setting. Most Dutch cities have a historical center, which sometimes also is a conservation area.

High-rise in the urban setting
The development of tall buildings contains more risks than low-rise buildings and high-rise often has an influence on the surrounding area, both visually as in terms of livability. However, high-rise dwellings can be successful when situated in an center area or node, where the ground floor is already lively. In Table 2.5 an overview is given of pros and cons of high-rise from the perspective of different stakeholders. In different cities, high-rise can vary in city profile and concentration. On international level, the Dutch high-rise is considered mid to low-rise.

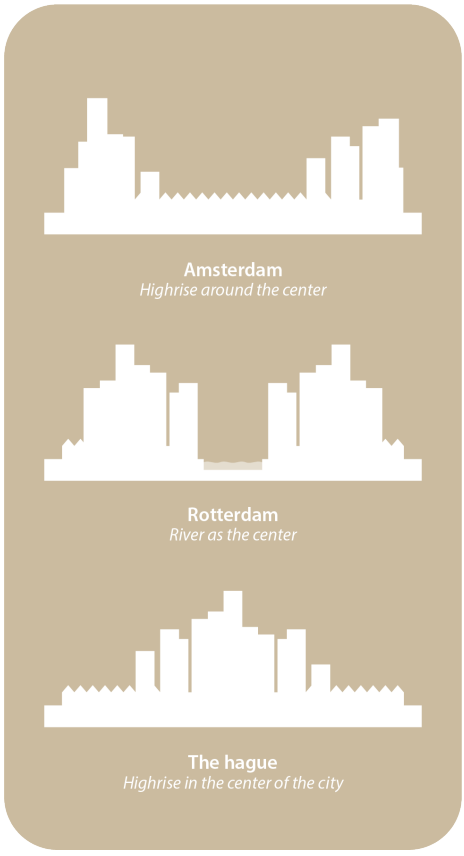


Figure 2.4. High-rise in city profiles: Amsterdam, Rotterdam & The Hague (own ill. based on municipal structural visions & Zandbelt &vandenBerg (2008))

Top 20 tallest buildings in the Netherlands		
Building	City	height
De Zalmhaven	Rotterdam	212m
Maastoren	Rotterdam	165m
New Orleans	Rotterdam	158m
Montevideo	Rotterdam	152m
Gebouw Delftse Poort 1	Rotterdam	151m
De Rotterdam	Rotterdam	151m
Cooltoren	Rotterdam	150m
Rembrandt Tower	Amsterdam	150m
Millennium Tower	Rotterdam	149m
Minis. Binnenlandse Zaken	The Hague	146m
Ministerie van Justitie	The Hague	146m
Hoftoren	The Hague	142m
New Babylon City Tower	The Hague	142m
Westpoint	Tilburg	142m
World Port Center	Rotterdam	134m
Het Strijkijzer	The Hague	132m
De Kroon	The Hague	131m
First Rotterdam	Rotterdam	128m
The Red Apple	Rotterdam	124m
Mondriaan Tower	Amsterdam	123m

Table 2.4. List of 20 tallest buildings in the Netherlands (own ill. based on CTBUH (2019))

Arguments and focus points for highrise buildings			
Stakeholders	Pros	Cons	Additional focus points
Municipality	- Adds to image - Intensive use of space - Support base for facilities - Landmark - New cityscape - Mass for public transport	- Parking problem - Overload of public trans. - Surplus of public space - Landmark - Potential lack of activities on the ground floor	- Connection to the surroundings - Highrise effect report
Developer	- Expressive image - Status - Ground-building ratio	- High foundation costs - Parking problems - Risk of market saturation - Possible local opposition - Higher chance of delays - Additional loss of taxes	- Object on the right place - Timing to current market
Investor	- Large investment - Great yield on real estate	- Risk of market saturation - High maintenance costs - sensitive to recession	- Location - Architecture - Concept - Uniqueness of highrise
User - working	- Recognizable building - Impressive view - Close to facilities - Corporate identity	- High rent - Low parking standard	- Employees have high interest in the location - Sick building sydrome
User - residential	- Central urbanity - Impressive view - Status	- Sensitive to vandalism - Expensive parking - Cheaper alternatives	- Organizing owners association - Maintenance public areas - Sick building syndrome
The city / local residents	- Support base for facilities - Metropolitan area - Viewing platforms	- Shade - Wind - Pollution of horizon - Metropolitan area	- Overload of infrastructure
Architect	- Extensive task - Prestige	- Lack of freedom - Complexity - Lack of knowledge	- Requirements municipal. - Requirements investor - Requirements developer - Requirements aesthetics committee
Contractor	- Extensive task - Prestige	- High risk - Delay of constructions	- Construction nuisance - Complex construction site

Table 2.5. Pros and cons of high-rise from the perspective of different stakeholders (own ill. based on Zandbelt &vandenBerg (2008))

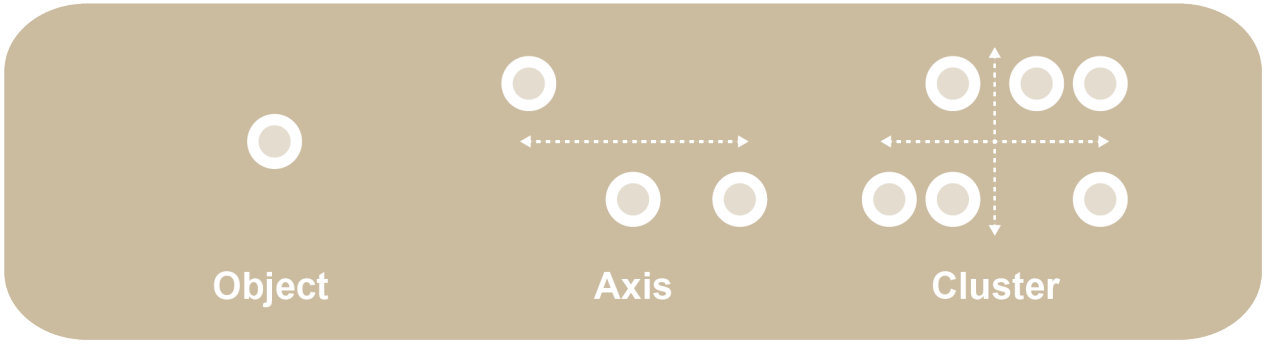


Figure 2.5. High-rise concentrations (own ill. based on andbelt &vandenBerg (2008))

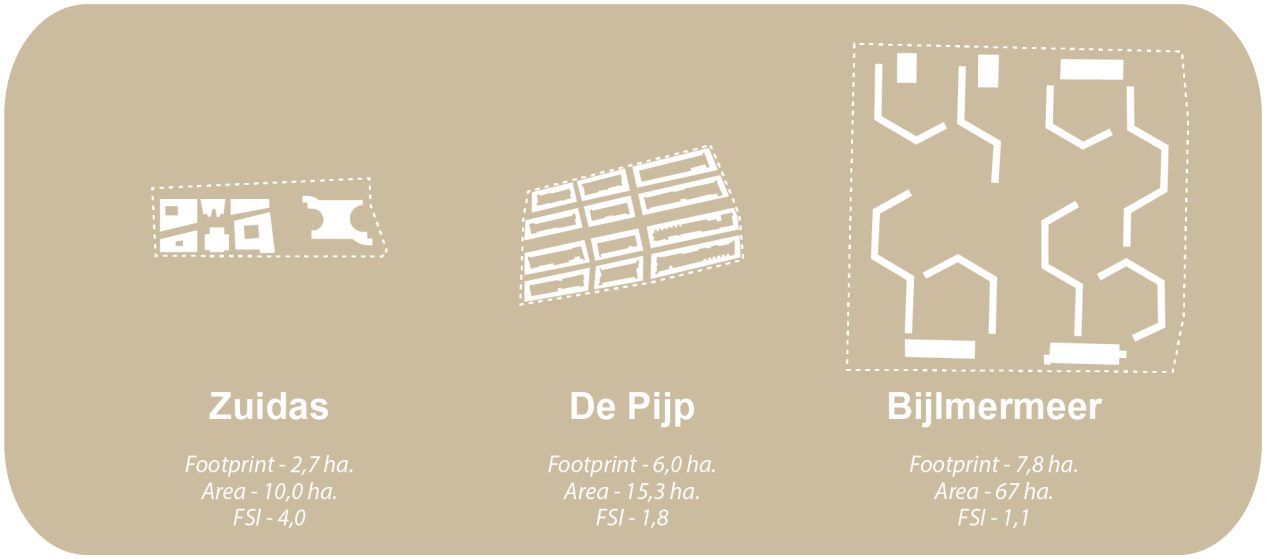


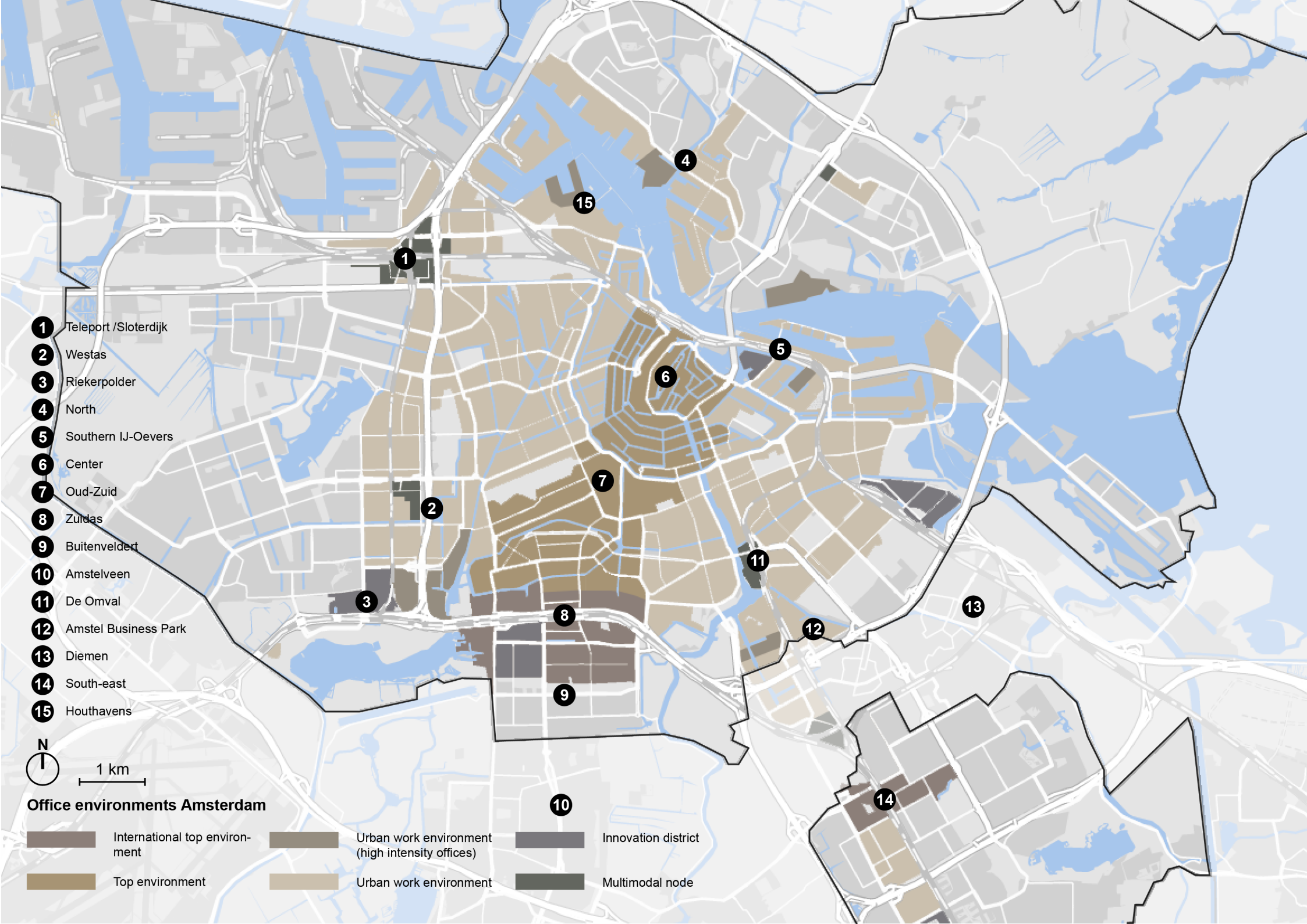
Figure 2.6. High-rise environments & urbanity (own ill. based on Zandbelt &vandenBerg (2008))

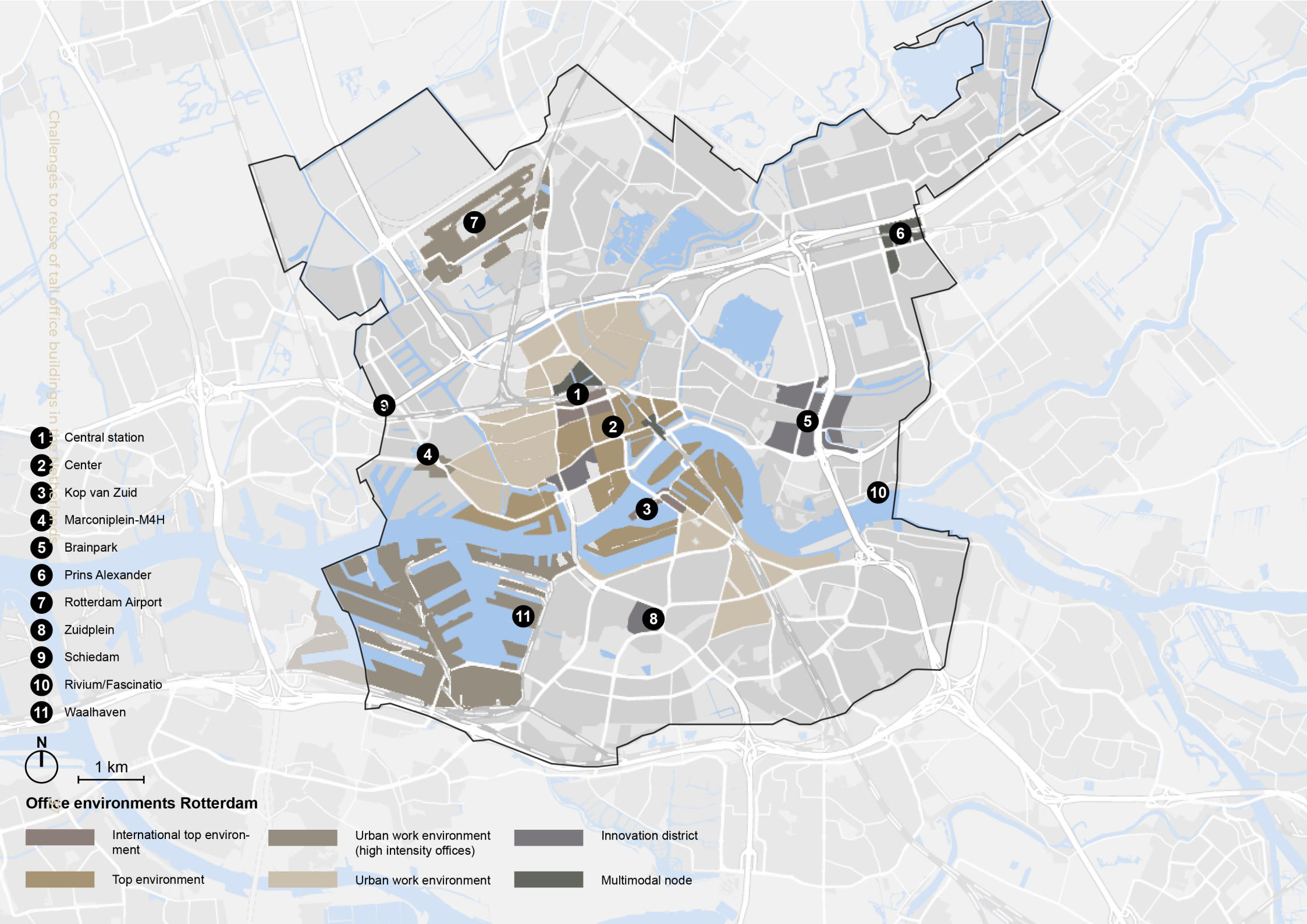
Top 10 skylines in the world	
City	Buildings > 90 m
1. Hong Kong	2.939
2. New York	849
3. Tokyo	572
4. Shanghai	549
5. Bangkok	382
6. Chicago	321
7. Singapore	296
8. Sao Paulo	281
9. Seoul	273
10. Dubai	268

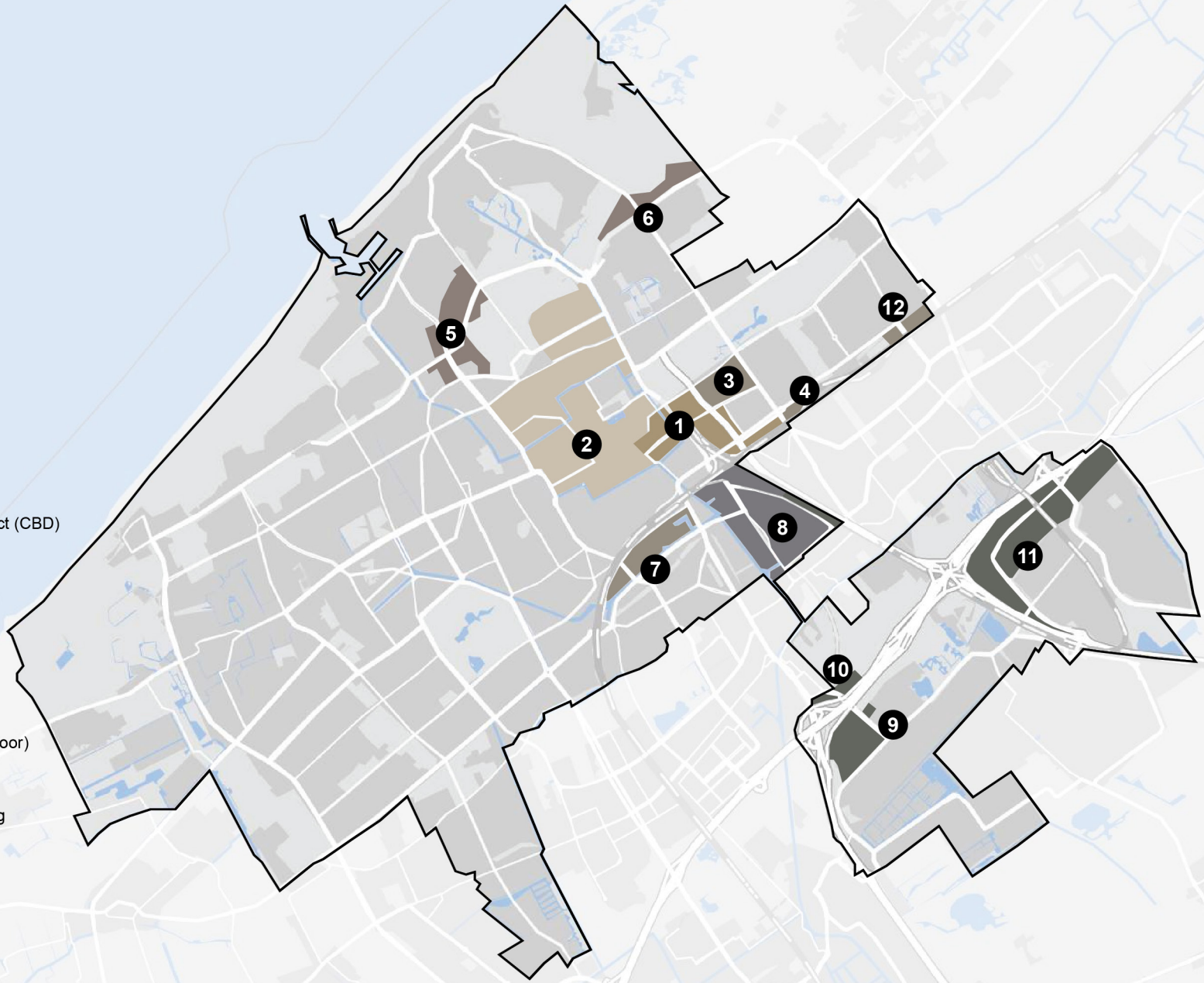
Top 10 skylines in Europe	
City	Buildings > 90 m
1. Paris	112
2. London	49
3. Frankfurt	38
4. Benidorm	35
5. Rotterdam	29
6. Brussels	22
7. Warchau	21
8. Vienna	20
9. Warsaw	17
10. Berlin	15

Table 2.6. Top 10 skylines worldwide & Europe (own ill. based on Zandbelt &vandenBerg (2008))

Figure 2.7. Office environments Amsterdam (own ill. based on Cushman & Wakefield (2018) & municipalities)
Figure 2.8. Office environments Rotterdam (own ill. based on Cushman & Wakefield (2018) & municipalities)
Figure 2.9. Office environments The Hague (own ill. based on Cushman & Wakefield (2018) & municipalities)


1 Teleport /Sloterdijk
2 Westas
3 Riekerpolder
4 North
5 Southern IJ-Oevers
6 Center
7 Oud-Zuid
8 Zuidas
9 Buitenveldert
10 Amstelveen
11 De Omval
12 Amstel Business Park
13 Diemen
14 South-east
15 Houthavens
N
1 km
Office environments Amsterdam
International top environment
Urban work environment (high intensity offices)
Innovation district
Top environment
Urban work environment
Multimodal node


1 Central station
2 Center
3 Kop van Zuid
4 Marconiplein-M4H
5 Brainpark
6 Prins Alexander
7 Rotterdam Airport
8 Zuidplein
9 Schiedam
10 Rivium/Fascinatio
11 Waalhaven
N
1 km
Office environments Rotterdam
International top environment
Top environment
Urban work environment (high intensity offices)
Urban work environment
Innovation district
Multimodal node



1 Central Business District (CBD)
2 Old-center
3 Bezuidenhout
4 Anna van Saksenlaan
5 International Zone
6 Waalsdorperweg
7 Laakhaven (Holland-spoor)
8 Binckhorst
9 Bedrijvenpark Ypenburg
10 Hoornwijck
11 Forepark
12 Schenkstrook

N

1 km

Office environments The Hague

- International top environment
- Urban work environment (high intensity offices)
- Innovation district
- Top environment
- Urban work environment
- Multimodal node

2.2. Structural vacancy

In the problem statement of this report, the vacancy rates and trends of the Netherlands are compared with those in the Randstad area. However, for this research it is also important to know why buildings are structurally vacant and what effect this has on the surrounding area. This will also give the vacancy rates more background and meaning.

2.2.1. Causes

The vacancy-risk meter, developed by Geraedts & Van der Voordt (2003) has indicated the main factors that can increase the risk of vacancy, including: deteriorated location, lack of parking space and poor accessibility (Geraedts, Van der Voordt & Remøy, 2017). Also financial decisions can have an impact on -already vacant- buildings. Private parties are often cautious when it comes to conversion or renovation of buildings, as there is uncertainty about the financial viability (Plasterk, 2009; Bruijning, 2016). Other research from Geraedts & Van der Voordt (2005) shows a table consisting of potential rental problems. In former literature, this is categorized mainly over economic, legal, technical and aesthetic level, with an interrelation of all levels. For this research, the categories legal, economic, technical and social level and are also often interrelated. This is done, because most causes and effects of vacancy have a societal impact (De Jong, 2009; Koppels et al., 2011; Remøy, 2010). When it is hard to find a new tenant, owners can lower their rent to make it financially more attractive for future tenants. However, a lower rent can at a certain point make the operation of the building more expensive than the operation of an empty building without revenues (Bruijning, 2016, p. 29). Especially office buildings constructed between 1960 and 1980 are sensitive to vacancy, as these buildings often lack in technical quality, functional quality, energy ambitions and esthetic identity (Geraedts & Van der Voordt, 2005). As this source comes from 2005 and this report is written in 2019, the construction years may have changed. Currently structural vacant tall buildings in Rotterdam for example are constructed mainly in the seventies to the zeros, as can be seen in Appendix 4. Other causes for vacancy in the Netherlands are for example the new ways of working, called: Het Nieuwe Werken (HNW). This way of working stands for more collaborating, combining work with leisure and work with flex places and in different locations (Berlee, 2012). HNW requires overall less square meters in office space. This is also an example of a building becoming obsolete, as the behavioural aspects are not fit anymore due to a change in use (Thomsen & Van der Flier, 2011). Beside behavioural aspects, a building can also become obsolete due to the physical aspects. This can be caused by poor design or maintenance (Thomsen & Van der Flier, 2011).. Obsolescence can result in vacancy or a need for either demolishment or transformation (Thomsen & Van der Flier, 2011).

2.2.2. Effects

In a graduation report by Bruijning (2016) it is stated that structural vacancy is a significant problem for the quality of the urban area. One of the consequences of vacant areas, is that places will be avoided as they seem unsafe and insecure (De Jong, 2009; Bruijning, 2016). Furthermore, areas consisting of multiple vacant buildings often attract criminal activity such as vandalism, burglaries or illegal housing (Remøy & Van der Voordt, 2007). The effect is that citizens will make less use of the public space as a social space. In Adams & Tiesdell (2010) it is concluded that people are necessary in urban areas for a place to be successful, therefore it is important that areas feel safe. Another negative effect of structural vacancy, is that other businesses tend to move out of the area as well (De Jong, 2012). As may got clarified, is that all these effects are inter-related to one another.

2.2.3. Strategies in practice

In Amsterdam, Rotterdam and The Hague the municipalities are highly present and stimulate transformations to deal with both the vacancy of offices, the housing shortage and high-rise. This section explains the municipalities' main learning points from previous transformations and main focus points for future transformations. As well as their vision on high-rise in their cities.

Amsterdam

In Amsterdam some areas the municipality even plans to create more office space, for example in: Zuidas, Arenapoort, Sloterdijk Centrum, Amstelstation, Amstel III & Noord (Gemeente Amsterdam, 2019c; interviewee 3). The scenario for 2019-2026 is the development of 1,4 million m2 offices and the with-

drawal of 350.000 m2, the lather possible with transformation (Gemeente Amsterdam, 2019c). The concentration of transformation projects can be found in Sloterdijk Centrum and Arenapoort (Gemeente Amsterdam, 2019c). The highest concentration of structurally vacant office building can be found in Zuidoost, Noord and Nieuw-West (Gemeente Amsterdam, 2019c; interviewee 3).

The demand for dwellings is extremely high, especially on mid and social level dwellings. To make sure that these are developed, the 40-40-20-rule is active. This means that for each development, 40% social housing, 40% mid level and 20% high segment need to be realised. This rule also creates a mix.

Amsterdam's vision on high-rise is strongly influenced by the restrictions of Schiphol Airport (interviewee 3).

Rotterdam
Rotterdam had 20% vacancy in office buildings, which was the reason the transformation of office buildings was a priority (interviewee 7). The focus was mainly on the transformation of deteriorating office building (interviewee 7). The hospitality sector has boosted transformation (interviewee 7).

As there is currently a high amount of smaller dwellings, the focus lays on creating dwellings bigger as 50m2 (interviewee 7).

Rotterdam's vision on high-rise is a decrease in height towards the river Maas and some specific and compact clusters in parts of the city (Zandbelt &vandenBerg, 2008). The clusters are: Weena, Wijnhavengebied, Wilhelminapier and Parkstad (Zandbelt & vandenBerg, 2008; CBTUH, 2019).

The Hague
From 2010 the need for transformation was high, to decrease the vacancy in The Hague (interviewee 8). The goal was to transform 75.000 m2 per year, which was easily achieved each year (interviewee 8). However, nowadays the demand for offices has risen as well and therefore each transformation development will be more critically analysed (interviewee 8). The vision is to even develop more offices in the future (interviewee 8).

2.2.4. Sub-conclusion

Causes
In former literature, the causes for vacancy are categorized mainly over economic, legal, technical and aesthetic level, with an interrelation of all levels. For this research, the categories legal, economic, technical and social level and are also often interrelated. This is done, because most causes and effects of vacancy have a societal impact. The main causes for structural vacancy are: deteriorated location, lack of facilities, poor accessibility, rental problems, lack of technical or functional quality and an unsatisfying energy efficiency.

Effects
Structural vacancy is a significant problem for the quality of the urban area. The main effects of structural vacancy are: places will be avoided as they seem unsafe and insecure, areas consisting of multiple vacant buildings often attract criminal activity such as vandalism, burglaries or illegal housing and other businesses tend to move out of the area as well. As may got clarified, is that all these effects are inter-related to one another.

Strategies in practice
In Amsterdam, Rotterdam and The Hague the municipalities are highly present and stimulate transformations to deal with both the vacancy of offices, the housing shortage and high-rise.

In Amsterdam some areas the municipality even plans to create more office space. Meanwhile the demand for dwellings remains extremely high, especially on mid and social level dwellings. Amsterdam's vision on high-rise is strongly influenced by the restrictions of Schiphol Airport.

In Rotterdam, the focus was mainly on the transformation of deteriorating office building. The hospitality sector has boosted transformation. As there is currently a high amount of smaller dwellings, the focus lays on creating bigger dwellings. Rotterdam's vision on high-rise is a decrease in height towards the river Maas and some specific and compact clusters in parts of the city.

In The Hague the demand for offices has risen as well and therefore each transformation development will be more critically analysed. The vision is to even develop more offices in the future.

2.3. Conversion

In this research, the adaptive reuse strategy conversion is one of the main focus points. This chapter aims to explain the terminology, challenges and solutions to conversion.

2.3.1. Terminology

In literature, the terminology regarding this research can be quite confusing. According to Campbell (1996): "Adaptive reuse is the term used to refer to the conversion of an existing property to accommodate the requirements of a new tenant". Conversion means the transformation of a building to a new function (Remøy & Van der Voordt, 2014). Bullen & Love (2010) describe adaptive reuse as a process to improve the financial, environmental and social performance of a building (Langston et al., 2007; Bullen, 2007). In other words, a process that changes a disused or ineffective building into a building that can be used for a different purpose (Department of Environment and Heritage, 2004). In this context, that means the conversion of offices to housing. In this research the term transformation is also used, with the same meaning as conversion.

2.3.2. Challenges

The challenges of conversion in general have been widely investigated in literature. A checklist consisting of potential risks has been set up by De Vrij (2004) and has been revised with the use of a cross-case analysis by Remøy & Van der Voordt (2007). The initial checklist consisted of a distinction between location and market challenges and building challenges (De Vrij, 2004). The revised checklist resulted in defined risks and are based on market, location and building challenges taken as a whole. The risks can occur on legal, financial, technical and functional/architectonic level (Remøy & Van der Voordt, 2007). For this research, the decision has been made to merge the functional/architectonic level with technical level and add social level. This has been done, because another function adds another dimension of living into the area and that can have its own challenges.

Economic level

The main challenge to all developments is often the profit, or lack of. Location plays a big role in the potential value of the current building and after conversion or renovation. This is mentioned in Geraedts et al. (2017), the surrounding area of a building can make the location itself being attractive or not. Structurally vacant offices always cost money, as there is an interruption of income streams (Geraedts et al., 2017; Remøy & Van der Voordt, 2007). Even if temporary tenants are found and selected for the building, the temporary rents are often reduced to make renting the place more attractive (Geraedts et al., 2017). If renovation or conversion is needed, costly improvements are necessary to bring the building to the current quality standards (Geraedts et al., 2017). Another financial challenge is that conversion and its development are cost and time consuming, due to possible asbestos (Remøy & Van der Voordt, 2007).

Legal level

Changing the use of the building requires a change in zoning and/or land-use plan. Lengthy permit procedures are common for building projects. A change to dwellings in the land-use plan is by most municipalities normally granted, as dwellings improve the area (Schenk, 2009).

In the Netherlands on building law there is the Dutch Building Code. The main aspects that are affected by conversions are: (fire) safety, health and environment and usage (Schenk, 2009). High-rise are buildings with a residential area above 70m (Bouwbesluit, 2012). There are no specific restrictions for buildings over 70m in terms of fire safety, but local government has to guide high rise (re-)development and provide advice and checks for necessary safety restrictions (Bouwbesluit, 2012; Van Oss, 2007). Other restrictions in relation to the height and fire safety are: at least two fire lifts -to be used by the fire brigade-, above 100m a sprinkler installation is mandatory and above 13m the construction should be 120 minutes fire safe (Bouwbesluit, 2012; Van Oss, 2007). In relation to these restrictions it is studied that the fire-precautions and noise-level prescriptions of the Dutch Building Code are sometimes impossible to meet (Remøy & Van der Voordt, 2007). However, conversion projects are not seen as newly built, but existing built, and therefore less strict rules can apply (Bouwbesluit, 2012).

In and around Amsterdam there is also the Luchthavenindelingsbesluit, which is a document that states per area what the height restrictions are concerning the air-

plane routes (Luchthavenindelingsbesluit Schiphol, 2002).

Technical level
Geraedts et al. (2004) mentions that building factors play a significant role in the challenges to conversion. In the Dutch Building Code there are different functional and technical requirement for offices and residential areas (Bouwbesluit, 2012). This can cause the building structure of a conversion project being incorrect or incomplete in terms of: insufficient thermal and acoustic insulation in the facades, insufficient daylight for housing, inadequate acoustic insulation of the floors and an insufficient amount of shafts available (Remøy & Van der Voordt, 2007; Wilkinson & Remøy, 2017). The main structure and/or foundation of the building can be inadequate or poor, contain thin floor not suitable for insulation and no possibility for extra shafts (Remøy & Van der Voordt, 2007; Wilkinson & Remøy, 2017). For a residential area there are also other parking norms stated as for office areas (Schenk, 2009). Municipalities state these norms themselves and make a division between inner city locations and city border locations. In the graduation report by Schenk (2009) he explains three possible scenarios regarding cars. In 2016 CBS measured the Dutch average being 0,9 cars per household, Amsterdam 0,4 and Rotterdam 0,6. This means the car usage has decreased since the report by Schenk in 2009. When it comes to tall buildings, the Dutch Building Code contains extra requirements based on building height, which can be found in Figure 2.10. Zandbelt &vandenBerg, 2008).

Social level
Place, environment and atmosphere are important aspects which make a location livable (Adams & Tiesdell, 2012). Often vacant office buildings are situated in business parks: large scale developments outside of the city (Baird, 2019). These areas are mono-functional and considered not fit for housing (Geraedts et al., 2017). This has to do with the lack of needed functions for dwellings, such as supermarkets and schools (Schenk, 2009). In his report, Schenk (2009) mentions a function mixed area as a veto criterion: no function mixed area, no single building transformation. This causes the challenge that the whole area needs to be transformed when structurally vacant office buildings are located in business parks (Geraedts et al., 2017; Avidar et al., 2007; Smit, 2007; Koppels et al., 2011). However, border areas of business parks are interesting for conversion, as these locations can be more easily attached to the surrounding neighbourhoods (Schenk, 2009). As mentioned, buildings that are structurally vacant can deteriorate the whole surrounding area in terms of atmosphere. A challenge is that owners sometimes choose consolidation to trigger the municipality to receive stimulation. Even though conversion in business parks and outskirts of cities are not that common, conversion from offices to housing in city centers are considered a valued enlargement to the current stock (Geraedts et al., 2017). The social level a challenge that occurs is also the mobility changes over the past few years (Savills Research, 2019).

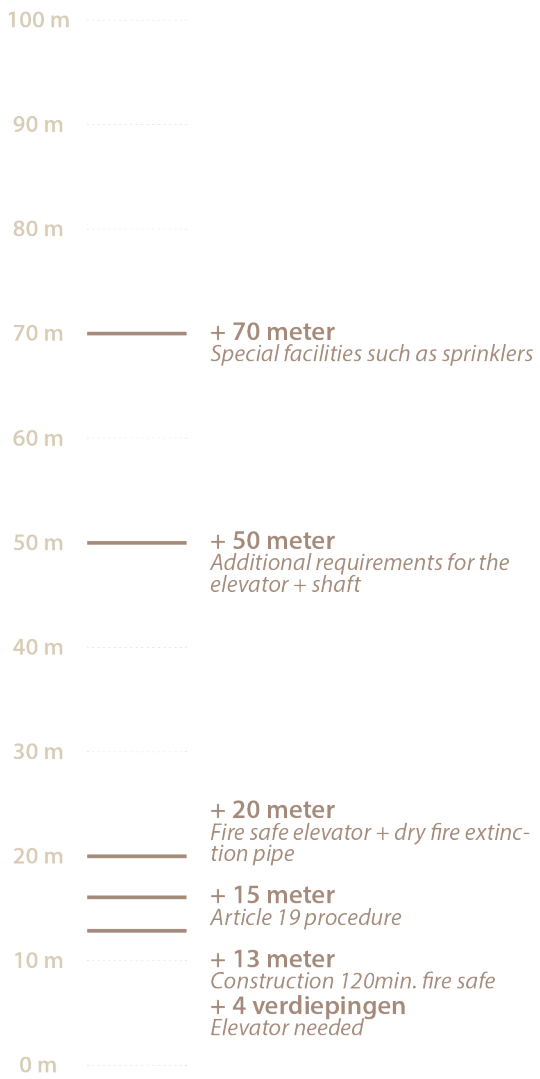


Figure 2.10. Requirements based on building height (own ill. based on Zandbelt &vandenBerg (2008))

A trend is the commuting by train getting more popular than the car in combination with the commuters maximum distance is increasing (Savills Research, 2019).

On building level a social challenge is the difference in living in high rise buildings as opposite to non tall buildings. Jane Jacobs (1961) describes this as a negative influence on the urban image, as high rise tends to have empty corridors opposite to a high livability in streets on ground level. Gentrification, with its positive and negative effects on the environment, also has an influence on social level. In a report by Nanninga (2017) it is mentioned that former office locations that are being transformed often have a positive effect on the environment. This is an effect on social level, as the livability rises in such areas.

In the research 'Out of Office' by Remøy (2010), an overview is given of possible risks for transformation projects. This can be seen in Table 2.7.

2.3.3. Stakeholder analysis

A general stakeholder analysis has been carried out by first collecting data from literature. Followed by analysing completed conversion projects and finding out the main stakeholders involved. This section of the literature study is needed to form a background and know which stakeholders have an influence and interest.

Stakeholders involved

To indicate who are the stakeholders involved in conversion projects, it is important to know what the definition is of a stakeholder. In literature this is and has been a vague definition, as each person has a different perspective. The definition by Jepsen (2008) fits a building project, as it includes for example the neighbours: 'a person or a group of persons, who are influenced by or able to influence the project' (Freeman, 1984; Andersen, 2005). The neighbours are stakeholders that can be affected, but may not have a direct power. This is an opposite definition as given by Bryson (2004). Geraedts et al. (2004) mentions initially two main parties involved in conversion projects, being: building owners and professional advisors. This includes: pension funds, investors, insurance companies, real estate managers, facility managers, project developers and architect. These stakeholders are always in some way involved in construction projects.

Power and interest

A hypothesis from practice is: business as usual, but over the different stages of the construction project, the involvement shifts and differs from other construction projects. However, all construction projects have some project specific aspects in relation to the stakeholders involved.

2.3.4. Opportunities

According to Schenk (2009) a huge opportunity to conversion of tall buildings is the view that comes with high-rise dwellings. The view can give dwellings a higher quality and taller buildings have an easier to convert building type compared to horizontal oriented buildings (Schenk, 2009). In a paper by Wilkinson & Remøy (2017), physical building characteristics that positively affect the adaptive reuse potential are discussed. Tall buildings are more common to have most of these aspects, such as: columns, an over dimensioned structure and an excess number of elevators.

2.3.5. Sub-conclusion

Terminology

In this context, adaptive reuse means the conversion of offices to housing. In this research the term transformation is also used, with the same meaning as conversion.

Challenges

In the research 'Out of Office' by Remøy (2010), an overview is given of possible risks for transformation projects. This can be seen in Figure 2.x. In this research, the challenges are categorized on: economic, legal, technical and social level.

Stakeholder analysis

These stakeholders are always in some way involved in construction projects: pension funds, investors, insurance companies, real estate managers, facility managers, project developers and architects. The neighbours are stakeholders that can be affected, but may not have a direct power.

Opportunities

A huge opportunity to conversion of tall buildings is the view that comes with high-rise dwellings. Physical building characteristics can also positively affect the adaptive reuse potential.

	Location and Market aspects
Legal	- Zoning law - Land ownership - Soil pollution
Financial	- Purchasing costs of vacant office buildings - Housing market and revenues of the new function
Technical	- Stench pollution - Noise pollution
Functional / Architectonic	- Bad reputation, unsafe area - Amount of parking places - Amount of facilities in the area - Accessability by public transport - Sustainability

	Building aspects
Legal	- Presence of asbestus - Monumental status - Dutch building decree, including fire regulation - Municipal building act
Financial	- Acquirement / purchasing costs - Initial phase investments - Financial feasibility
Technical	- Incorrect technical assessment - Inadequate pipes, ducts, electricity system and water supply - Inadequate acoustic insulation of the floors - Inadequate thermal insulation of facade, openings and roof - Damp / condensation in structure - Joints of brick walls in poor condition - Daylight < 10% of the appointed living-space - Sunlight; building is poorly situated - Inadequate / poor state of main structure or foundation
Functional / Architectonic	- Incorrect assessment of functionalpossibilities - Low recognisability of the building and its entrance - Building too slender or too deep - Too loose fit, too high floors - No basement - Windows not operable - Few or poor quality of interior walls, few points for attaching interior walls to the facade - No balconies or roof terraces - Not enough elevators and staircases

Table 2.7. List of possible risks in transformation projects (own ill. based on Remøy (2010))

2.4. Theoretical famework

First the causes and effects of structural vacancy have been researched. Thereafter the main stakeholders involved have been analysed, as their power and interest can affect the challenges and solutions of transformation projects. Followed by the challenges and solutions that have already been indicated and explored in literature, this will result in the theoretical framework.

The literature study has been translated into a theoretical framework, see Figure 2.11. As can be seen, the causes and effects of structurally vacant buildings can occur in a loop. That is because structurally vacant buildings can cause other buildings in the surrounding area to become vacant as well. On the right side of the figure below the main challenges and opportunities/solutions to conversion are stated. They are categorised by: legal, economic, technical and social challenges and opportunities/solutions.

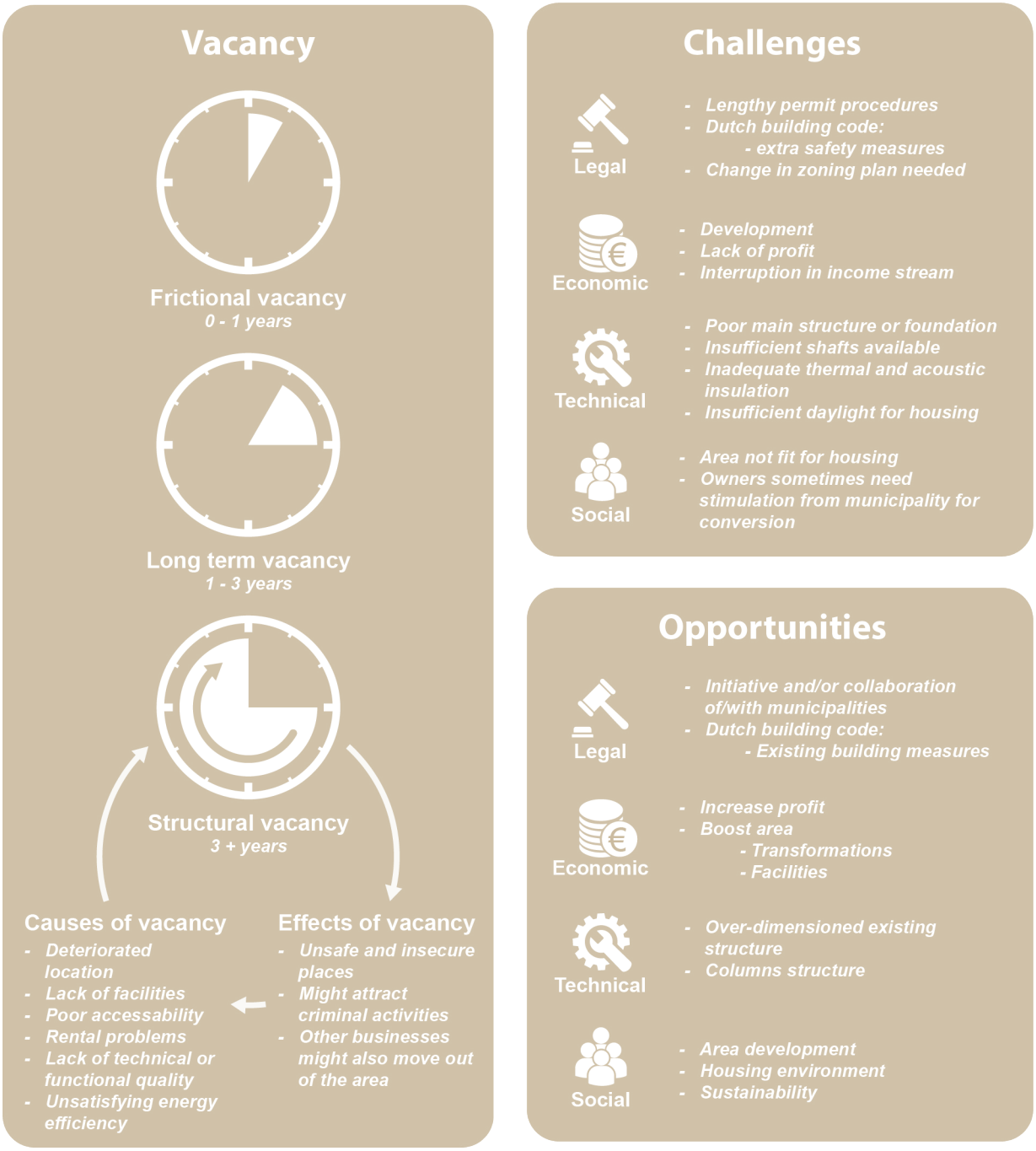


Figure 2.11. Theoretical framework (own ill. based on literature study)

2.4.1. Overview challenges

The literature and list of possible risk by Remøy (2010) have been adapted into a list of possible challenges in transformation projects. The risks were categorized on legal, financial, technical and functional/architectonic level (Remøy & Van der Voordt, 2007). For this research, the decision has been made to merge the functional/architectonic level with technical level and add social level. This has been done, because another function adds another dimension of living into the area and that can have its own challenges. An overview of possible challenges can be found in Table 2.8.

The challenges that may occur on economic level are related to the project's finances and the challenges that have an influence on the finance, such as: the financial feasibility.

On legal level, the challenges are related to the rules and regulations of construction and the context of the project's location. In the Netherlands each city has its own vision about the built environment and overall there are the Dutch Building Code requirements. Unforeseen aspects, like soil pollution and asbestos, can beside legally in terms of safety also form a financial challenge.

The technical challenges that can occur are mainly related to the Dutch Building Code requirements and the dimensions, lay-out, floor height and the state/quality of the existing structure.

The challenges that can occur on social level are related to the area and the effect of the transformation project. The decision to transform can be based on the amount of existing facilities or the project can ask for certain facilities to be realised.

2.4.2. Overview opportunities

For the opportunities, the same level has been chosen to categorize them. The term opportunities is used in stead of solutions, as some aspects can benefit and facilitate transformation projects, but are not directly solutions to an existing challenge.

On economic level, it is stated that a whole area can be boosted by a transformation project. The other way around, sometimes an area redevelopment is needed to create the necessary facilities like shops and public transport access which are needed for dwellings.

An opportunity in legal level can be the collaboration and initiative from the municipality.

It is mentioned that a technical challenge can be the dimensions, lay-out, floor height and the state/quality of the existing structure. However, the existing building can also be an opportunity, if the lay-out and dimensions for example are fit for transformation to dwellings.

Area redevelopment can be an accelerator for transformation projects. The housing market in a city or country also plays a role, as this can make transformation projects attractive for developers and investors. Ever changing sustainability requirements can also be an opportunity to renovate or transform a building.

An overview of possible opportunities can be found in Table 2.9.

	List of possible challenges in transformation projects
Economic	- Acquirement / purchasing costs - Financial feasibility - Housing market and revenues of new function - Initial phase investments
Legal	- Dutch building decree - Land ownership - Monumental status Municipal building act - Presence of asbestos - Soil pollution - Zoning law
Technical	- Building too slender, too high floors - Condensation in structure - Daylight < 10% of the appointed living space - Inadequate acoustic insulations - Inadequate pipes, ducts, electricity system and water supply - Inadequate technical assessment - Inadequate thermal insulations - Joints of brick walls in bad condition - No balconies or roof terraces - No basement - Noise pollution - Not enough elevators and staircases - Poor state of main structure - Poor quality of interior walls, few points for attaching interior walls to the facade - Stench pollution - Sunlight - Too loose fit, too high floors - Windows not operable
Social	- Accessability by public transport - Amount of facilities - Amount of parking spaces - Bad reputation, unsafe area - Low recognisability of the building and entrance - Routing of the area

Table 2.8. Overview possible challenges (own table based on literature study & adaptation of Remøy (2010))

Level	Opportunities
Economic	- Boost area (transformations and facilities)
Legal	- Municipality's iniative - Dutch Building Code: existing building measures
Technical	- Office type (corridor, center core) - Design consequences (lay-out, construction) - Technical consequences (construction, facade) - Sustainability
Social	- Area redevelopment - Housing environment - Sustainability

Table 2.9. Overview possible opportunities (own table based on literature study)

3. Methodology

The research method will explain the process from the problem statement to the research output. This is needed to manage, organize and provide insight into the research that needs to be done, in order to answer the research questions. The first section explains the research method between the problem statement and literature study. Thereafter the next section will cover the empirical research method. The methodological framework is giving the complete overview of the research process, see Figure 3.3.

3.1. Literature study

3.1.1. Type of study

This research consists of two main parts:
1. Explanatory literature study to give an understanding of the stakeholders involved, an overview of challenges and barriers researched and an insight in opportunities from front runners.
2. Empirical research

The empirical part will be explained in Chapter 3. Both parts are classified as qualitative research, as the main outcomes are described in words. Numbers are used to back-up facts about the real estate sector for example vacancy, rents and heights.

3.1.2. Methods

For understanding of the sub-markets and definitions of the office real estate market, literature will be researched. Thereafter the main barriers of office transformations to dwellings will be researched with the use of existing literature in this context. The outcomes will be categorised on economic, legal, technical and social level. The problem statement from Chapter 1 has introduced the topic and determined the problem statement. However, this literature review has not set all boundaries and terminologies for this research.

The literature study will consist of four sections:
1. Office buildings and environments
2. Structural vacancy
3. Conversion
4. Summary

Each of these sections will provide the reader with the necessary information with the use of literature. This part of the research will focus more on the Randstad area, as the literature study forms a bridge to the empirical research.

3.1.3. Data collection

By searching the TU Delft repository, theses from former students within the field of Real Estate Management have been analysed. A more general search of relevant literature has been found by consulting the TU Delft and other universities repositories and Google Scholar. In the found literature, useful references have been used to research more in depth. This is also known as the snowball method, where one source can lead to multiple more sources. Studying existing literature is essential for doing research, as stated by Bryman (2016), for developing a background and justification for the research. In the early stages of the research proposal, interactions with practice have been held to confirm or invalidate the gap in literature and can give input and guidance for the research and problem statement.

3.1.4. Data analysis and plan

The collection of the data and the analysis of the data will happen in two parts, as can be seen in Figure 3.3. The literature study of part one will form the theoretical framework.

3.1.5. Ethical considerations

All data collected will be handled with great care and all sources will be credited according to the APA reference system. The interview ethical considerations are described in section 3.5.

3.2. Empirical research

3.2.1. Type of study

The empirical research consists of case studies. Analyses of completed cases of non-tall buildings in comparison to tall office buildings that have a potential for adaptive reuse or are successfully converted according to practice. Opportunities for the future will be explored using theory and the outcomes from practice.

3.2.2. Methods

The literature study will be the input for an extensive case study from practice. As cases from The Randstad, a non-tall building that has been transformed will be analysed and compared to a tall building that has been converted or with a potential for conversion. The non-tall building will be the control case and the tall building will act as the case

of interest. To validate the case study, sampling criteria have been set. The outcomes of the literature study such as office locations and lay-outs will be part of the comparison points between cases. The outcomes will be categorised on economical, legal, technical and social level as well, to make comparison between theory and practice doable.

3.2.3. Data collection

The data will be collected by carrying out case studies. Part of the data will be researched from researching stakeholder's websites and information from journals, articles and newspapers. This data will probably contain general information, thus the majority of the data needs to be generated by interviews.

Case study pairs

The research field of the case study is the Randstad in the Netherlands. The case study will consist of four pairs of cases, one tall and one non-tall, which will be analysed per case and compared within the pairs. After completing the case studies, a cross case analysis will be carried out in order to get valid results. The cases need to be comparable by location, main supporting structure and new function. This is visualised in Figure 3.1.

Sampling method

To get a valid outcome of the research, a sampling method has been set up. It is a set of criteria to verify that all cases are in some way similar and/or comparable within the context of this research. This is important, because otherwise the cases can be too different from one another and the main difference for this research should be the height. As stated in the problem statement, the context of this research is the Randstad. For that reason, cases situated within the Randstad will be used. As hotel units are in some way comparable to housing units, hotels are accepted as well. They are comparable especially to student housing, as they both consist of smaller units. It is also common for student housing and hotels to have shared functions included in the building, such as work/meet places and facilities as a restaurant or laundry service. Nowadays, some hotels are also designed to stay for a longer period, for example 3 to 9 months. The rooms then should more or less be of the same quality as a dwelling unit. However, the previous function should have been offices. Cases within one pair should be situated in the same type of location and environment, as the area can have an influence on for example the social challenges. The office sub-markets can have influenced the vacancy of a project or the challenges that occurred. The cases should have the same main supportive structure, as this can influence the technical challenges. Preferable cases that have been built and/or transformed in the same time or decade, as this can influence the technical, economic and legal challenges. Each period of time has its own aspects and trends in building architecture and materials. Cases that have been structurally vacant are preferred, as this can have an influence on the social challenges. However, in some cases, structural vacancy could have affected only part of the building. Other cases could still give a good overview of challenges, even tough the buildings have not been structurally vacant or vacant at all. Therefore structural vacancy is not a criteria.

Criteria to the pairs of cases are;

1. cases inside the Randstad area;
2. situated in the same type of office sub-market;
3. the same main supportive structure;
4. changed from offices to the functions: housing, hotel or a mixed-use that includes either.

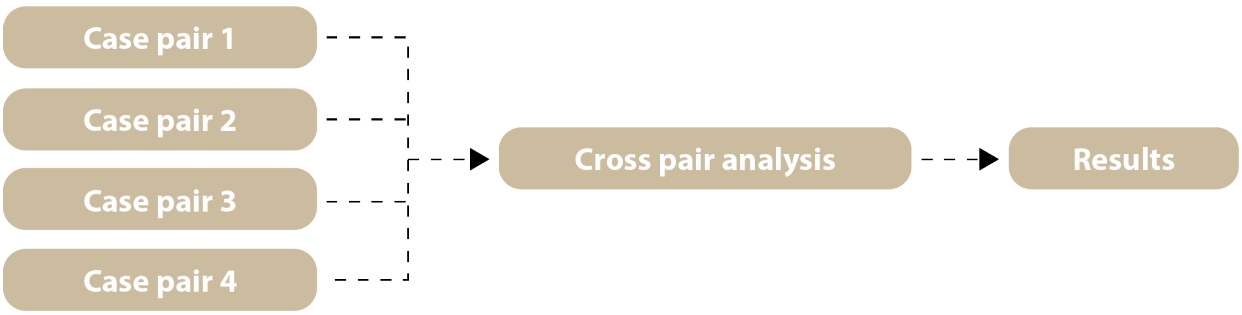


Figure 3.1. Case study pairs (own ill.)

Preferred cases:
1. that have been built and transformed in the same time (or same decade);
2. that have been structurally vacant.

Interviews and respondents
Interviews will be semi-structured interviews with experts and/or stakeholders that have completed a transformation project that is suitable as case or have done research in this context. With the use of the outcomes of these interviews, the findings from the literature review and case study will be validated and possibly even give new insights. The outcomes of the case studies will be collected and reported, for each city in the same way, to make comparisons doable.

Participants for the interactions and interviews are found by researching the stakeholders involved in conversion projects and by asking respondents for recommendations for other cases, companies and participants. This has been an useful tip, gained during one of the interactions with practice. A in-depth interview or semi-structured interview method will be used, which both are open forms of interviewing where the researcher has developed an interview protocol with guiding questions. The interview itself is more of a - guided - conversation than that it is a strict answering of questions. The themes that define the interview protocol are: background information, project information, stakeholders involved, challenges on legal, economic, technical and social level and -possible- solutions. The first two themes are important to get to know the participants background and the project its context from the respondents point of view. The complete interview protocols will be added in the appendix of the final report. The interview protocol includes also a very important question, that of permission of audio recording. This is important for collecting the data from the interview, without interrupting the interview itself by writing. If audio recording is not permitted, more specific minutes will be made. When developing the interview protocols, the methods described by Yazan (2015) will be taken into account. The case fits the description by the Yin method: Case is “a contemporary phenomenon within its real life context, especially when the boundaries between a phenomenon and context are not clear and the researcher has little control over the phenomenon and context” (Yazan, 2015). Not included in the protocol, but will taken into account during the interviews are probing techniques, as described by Moerman (2010). The used techniques are: nodding, humming, requests for elaboration, requests for specification by example and by contrast, follow-up questions, requests for experiences and paraphrasing after closing each of the -sub- questions.

Different stakeholders of a project have a different perspective on the project. To have a more complete overview of the cases, interviews have to be carried out with the different stakeholders. With regard to the different types of challenges that can occur during transformation projects the stakeholders to interview have been chosen.

The experts:
1. the municipality: the transformation team or advisor
2. the developer: the project manager
3. the contractor: the project manager, head of construction or head of preparation
4. the architect

The challenges and experts:
1. legal: municipality, developer and contractor
2. economic: municipality, developer and contractor
3. technical: contractor and architect
4. social: municipality, developer and architect

All stakeholders will be asked about all levels of challenges and solutions, but the different expertises have to be taken into account when conducting the interviews. The different perspectives will be compared and analysed. This is visualised in Figure 3.2. The interview protocol can be found in Appendix 5.

3.2.4. Data analysis and plan

As described in section 1.3, the collection of the data and the analysis of the data will happen in two parts. The literature study of part one will formed the theoretical framework. The second part of the research are the case studies, which will use semi-structured interviews. The outcomes of the case studies will be translated into the findings section and to discuss the outcomes from the literature study.

3.2.5. Case study analyses

According to Yin (1994) it is important for a study to contain criteria to stay within reasonable limits.

The cases will be analysis in depth and according to the criteria compared:
1. Location analysis
2. Historical analysis of building status (vacant/occupied)
3. Structurally vacancy period and reasoning
4. Stakeholders involved during the project
5. Construction method
6. Former office typologies
7. New function
8. Challenges (legal, economic, technical, social)
9. Solutions used

A location analysis has been carried out in the literature study, but for each case individually it is important to check the rental prices for offices. This is important, as that could be an indication why the office has been vacant in the first place. A historical analysis of each case will result in a timeline, giving insight in the vacancy and occupancy of each building. There could be different reasons why some of the cases will have a longer vacancy period and others perhaps will not even have been structurally vacant. In the introduction, the vacancy period, stakeholders involved and construction method and former office typologies and the new function will be mentioned. The challenges of each case will be explained with the information gathered during interviews and will be categorised in legal, economic, technical and social challenges. There is a probability that some challenges will fit more than one category. For example: a technical challenge can have an influence on the finances. The solutions used will be explained in a opportunities section.

3.2.6. Ethical considerations

All data collected will be handled according to the respondents privacy and all sources will be credited according to the APA reference system. For the interviews all respondents will be explained that the information will be handled confidentially and will only be used with consent and solely for this research. The interview protocols will include also a very important question, that of permission of audio recording. Beside being important for properly collecting the data from the interview, permission is needed to be able to implement the data in the final report. The respondents will be mentioned in the final report anonymously and company names will only be mentioned if consent is given upfront. For privacy reasons, in the final report the list of contacts and transcriptions of the interview are not included.

3.2.7. Hypothesis

For this research it is thought that the differences in height can cause differences in the type of challenges and impact of existing challenges. This is related mainly to

Figure 3.2. Case study method (own ill.)

the stricter rules for tall building according to the Dutch Building Code and therefore an expected higher financial and legal impacts.

3.3. Summary

The research method has been visualised in a methodological framework, see Figure 3.3. The output of this research will consist of a list consists of challenges to conversion that are specific for, have a higher consequence or a higher probability for transformations of tall office buildings to housing. Beside the challenges, a section with possible solutions and some examples from the case study from practice will also be included. In the following Chapter the cases will be explained and compared. Each case study will consist of an introduction and impression before and after the transformation. This is followed by the challenges, categorised in economic, legal, technical and social. Each case study will conclude with a summary and diagram. Thereafter a cross pair analysis will give insight in the main differences in challenges between the control case and case of interest within the categories.

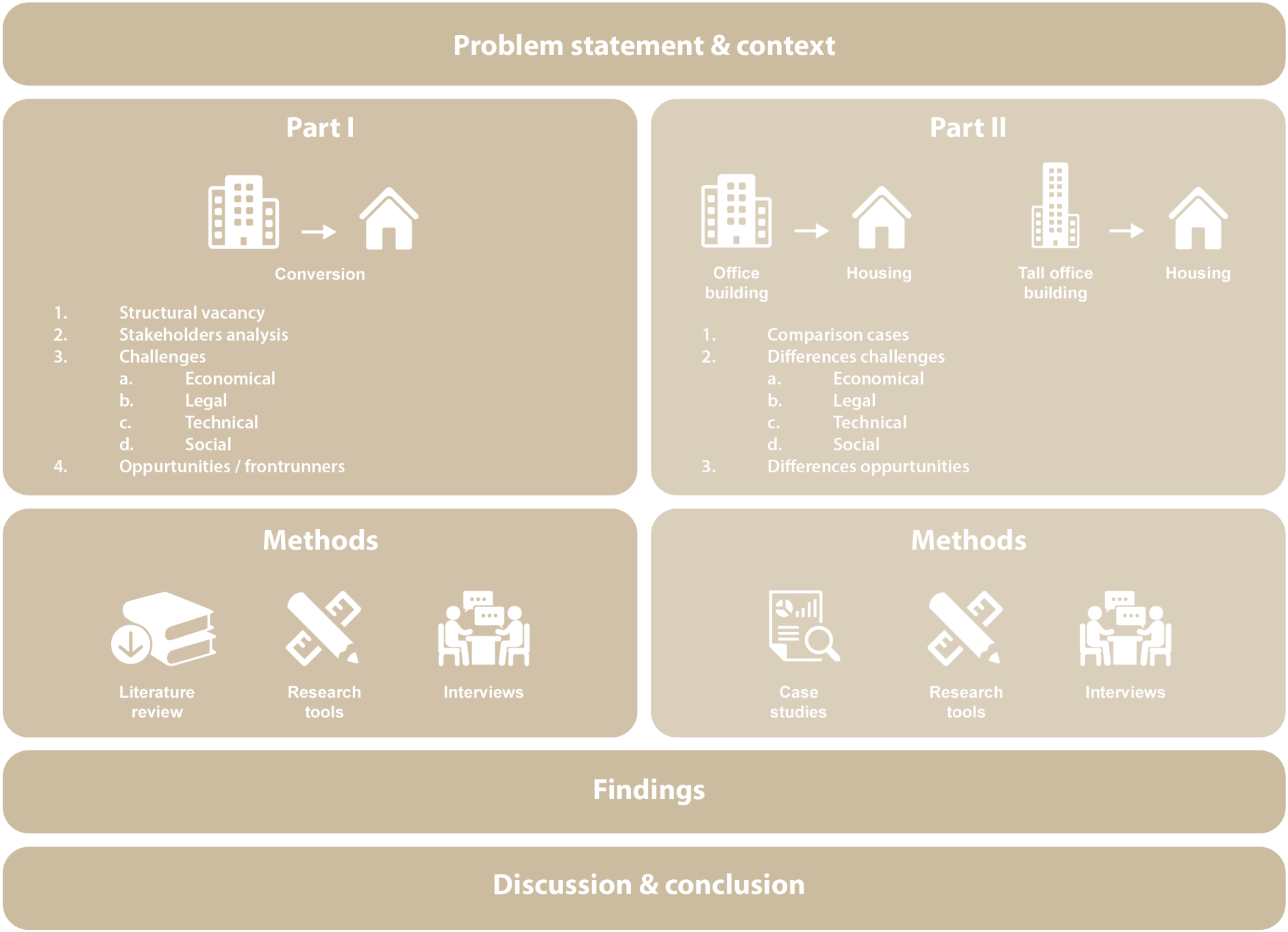


Figure 3.3. Methodological framework (own ill.)

4. Empirical research

4.1. Case study overview

As described in Chapter 11, cases of pairs have been formed and studied. The case pairs are nearly similar in location, former and new function and main construction. However, the vacancy level and construction years differ. The main data for each pair is shown in Table 4.1.

4.1.1. Timeline cases

To give an overview of the construction years, vacancy period and transformation period, a timeline is shown in Figure 4.1. Standing out are the vacancy years of Case pair 1. The Metropool gebouw has not been vacant as it was known when the last user would leave and transformation plans started before the last tenant moved out (Greenroofs, n.d.). The Parooltoren & Trouwgebouw have been vacant since 2004, but some parts of the building have been (temporarily) occupied by pop-ups and artists (Nanninga, 2017).

4.1.2. Case analyses

For each of the case pairs a basic map is provided to give insight in the location of the projects. A fact sheet will give an overview of the main comparable aspects of each case, followed by a short project description. Each of the challenges and opportunities and/or solutions for each case will be studied per category. The data input comes from interviews, project profiles from the stakeholders involved, newspapers, projects drawings and project analyses.

In section 4.10 the cases will also be discussed, to answer certain questions that have arised during the case studies. The choices for the cases per pair will also be questioned and discussed in that section.

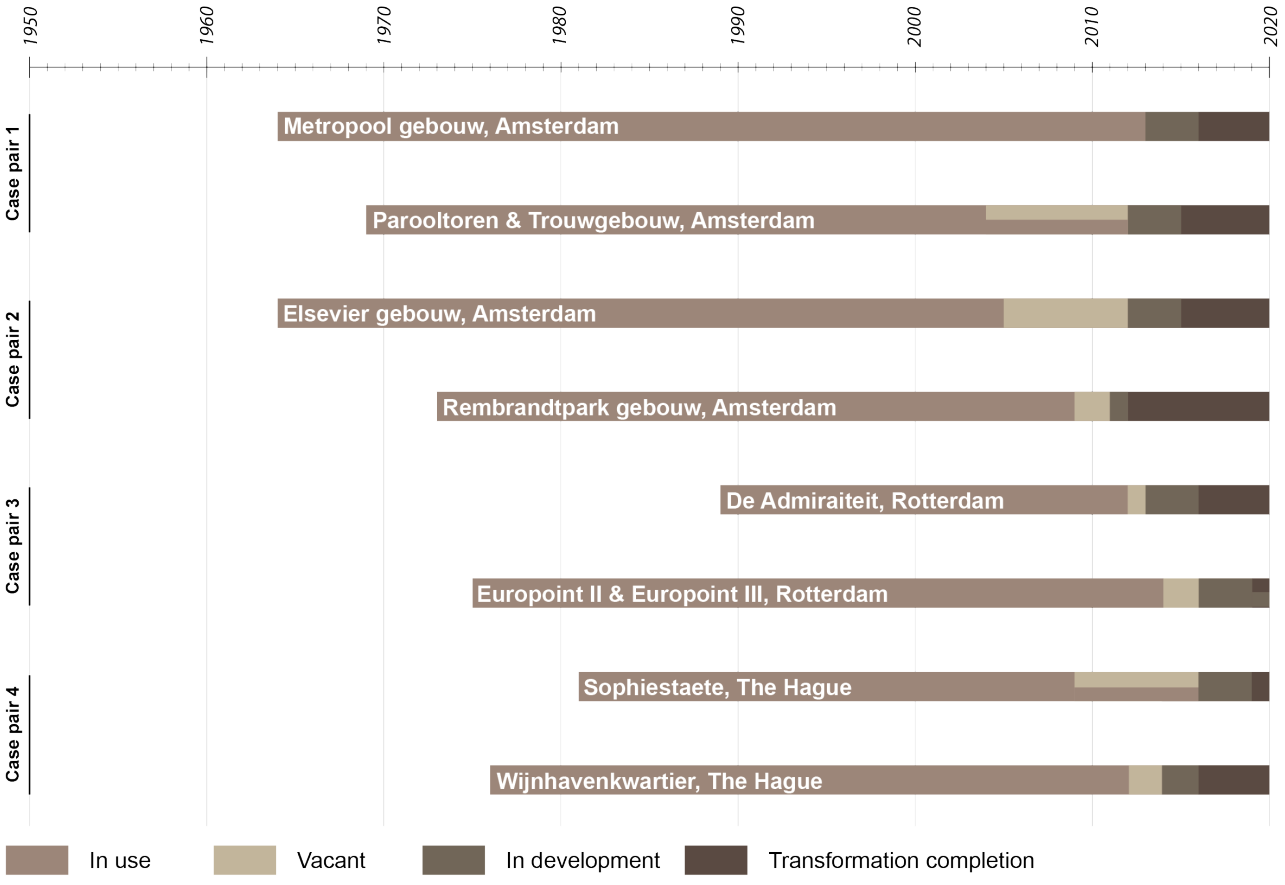


Figure 4.1. Timeline cases (own ill. based on case study data)

	Case study pair 1		Case study pair 2		Case study pair 3		Case study pair 4	
Original building name	Metropool gebouw (1964)	Parooltoren (1976) & Trouwgebouw (1969)	Kantoorgebouw Zaanstad / Elsevier gebouw (1964)	Rembrandtpark gebouw (1973)	De Admiraliteit (1989)	Europoint II & III (Marconitorens) (1969)	Sophiestaete 120-130 (1981)	Ministerie Binnenlandse Zaken (1973)
Vacancy	<1 year	<1 year / 7 years	9 year	<1 year / 2 years	1 year	3 years		2 years
Location	11. De Omval	11. De Omval	1. Teleport / Sloterdijk	1. Teleport / Sloterdijk / 2. Westas	2. Center	4. Marconiplein / M4H	11. Bezuidenhout / Beatrixkwartier	1. CBD / Nieuw Centrum
Address	Weesperstraat 61-105, Amsterdam	Wibautstraat 129, Amsterdam	Krelis Louwenstraat, Amsterdam	Staalmeesterslaan 410, Amsterdam	Admiraliteitskade 40-60, Rotterdam	Galvanistraat 15, Rotterdam	Koningin Sophiestraat 120-130, Den Haag	Turfhaven, Den Haag
Aver. office rent locat. (m2/year)	11. €250-400	11. €250-400	1. €100-210	1. €100-210 / 2. €95-195	2. €120-225	4. €100-125	11. €135-210	1. €145-195
Cur. office rent Street (m2/year)	Weesperstraat 61: €350 / Weesperstraat 105A: €250	James Wattstraat 100: €275	Bos en Lommerplein 303: €170	Delflandlaan 4: €185	Admiraliteitskade 62-73 : €175	Marconistraat 2: €110	Wilhelmina van Pruisenweg 104: €165	Fluwelen Burgwal 56: €180
Transformed building	Zoku / WeWork (2016)	The Student Hotel Amsterdam City (2015)	DUWO Elsevier (2015)	Ramada Apollo Amsterdam Centre (2012)	De Nieuwe Admiraliteit (2016)	The Lee Towers (in development)	De Sophie (2019)	Wijnhavenkwartier (2016)
New function	Mixed-use	Mixed-use	Housing	Housing	Housing	Mixed-use	Housing	Mixed-use
Main construction	Concrete columns, beams and thin floors	Concrete	Concrete columns and floors	Concrete	Concrete columns and wide slab floors	Concrete	Concrete	Concrete
Height	36m	55m & 29m	47m	55m & 29m	50m	95m	26m	80m
Developer	Breevast	Boelens de Gruyter / The Student Hotel	Rochdale Projectontwikkeling	Boelens de Gruyter / The Student Hotel	ABB Ontwikkeling B.V. / U Vastgoed / City Pads	Foolen en Reijs / City Pads	Local	Heijmans Vastgoed B.V.
Contractor	Kondor Wessels Amsterdam	Heijmans Amersfoort	Bouwbedrijf M.J. De Nijs en Zonen	BAM Utiliteitsbouw	ABB Bouwgroep	Konder Wessels Amsterdam	Trebbe	Heijmans Woningbouw B.V.
Architect	Mulderblauw Architecten	Penta Architecten Harlingen	Knevel Architecten	ZZDP Architecten	Klunder Architecten	DierenDirrix	Atelier Pro	Geurst & Schulze Architecten

Table 4.1. Overview cases (own ill. based on case study data)

Case pair 1

Metropoolgebouw (1964)
Zoku / We Work (2016)

Figure 4.2. Metropoolgebouw (Arcam, n.d.)

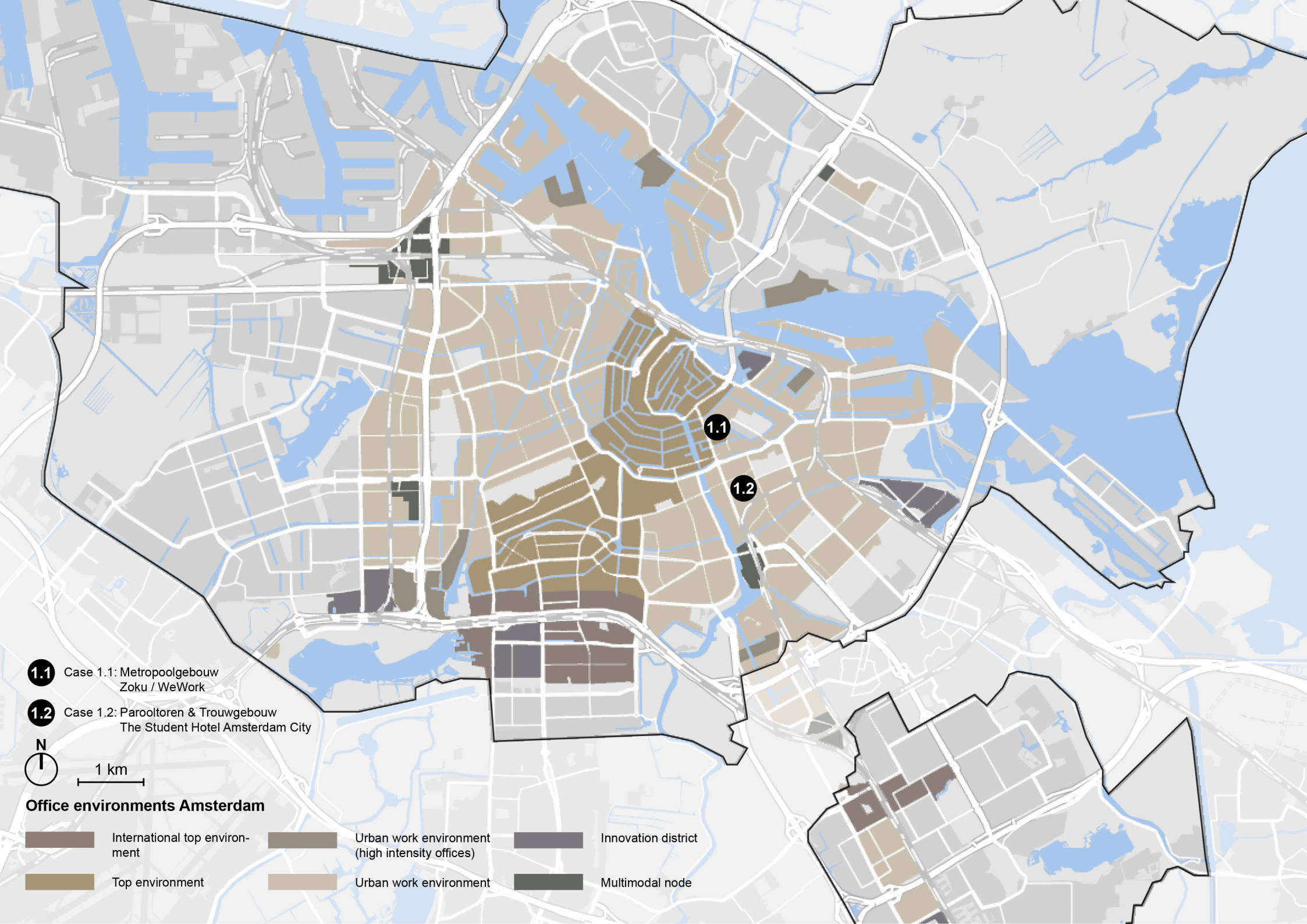
Figure 4.3. Zoku / Wework (Zoku, 2020)

Parooltoren (1976) & Trouwgebouw (1969)
The Student Hotel Amsterdam City (2015/2016)

Figure 4.4. Parooltoren & Trouwgebouw (Parool, 2014.)

Figure 4.5. he Student Hotel Amsterdam City (Agoda, n.d.)

Figure 4.6. Overview locations case pair 1 (own ill.)


1.1
1.2
1.1 Case 1.1: Metropoolgebouw
Zoku / WeWork
1.2 Case 1.2: Parooltoren & Trouwgebouw
The Student Hotel Amsterdam City
N
1 km
Office environments Amsterdam
International top environment
Urban work environment (high intensity offices)
Innovation district
Top environment
Urban work environment
Multimodal node

4.2. Metropoolgebouw (1964) - Zoku / We Work (2016)

4.2.1. Introduction
The Metropoolgebouw located at the Wibautstraat in Amsterdam has been built in 1964 as an office building (Greenroofs, n.d.). Its previous users have been a furniture showroom and shop mix of offices, institutions and retail businesses (Greenroofs, n.d.). The last user announced in 2011 to leave the building in 2013 and Breevast initiated the transformation (Greenroofs, n.d.). Hans Meyer and Marcs Jongerius designed the Zoku concept: a short stay hotel concept for tourists and expats (Greenroofs, n.d.). The rooms are complete studios spread over seven levels, a roof terrace and 16.000 m2 (Greenroofs, n.d.; (Konder Wessels Amsterdam, n.d.; Mulderblauw, n.d.). The building now also houses public areas, a greenhouse on the roof and flex office spaces from We Work on the ground level (Greenroofs, n.d.; Mulderblauw, n.d.). The whole concrete structure has been reused in the transformation project (Konder Wessels Amsterdam, n.d.).

4.2.2. Economic
For this case, there was no mention of major financial challenges. However, the fact that there were two end-users could have had an impact.

4.2.3. Legal
For this case, there was no mention of major legal challenges. However, the fact that there were two end-users could have had an impact.

4.2.4. Technical
Most of the transformation works were focused in the interior of the building, but on the sixth floor the facade and window frames needed to be replaced (Kondorwessels Amsterdam, n.d.). The installation of a completely new climate system was required (Dames 2, n.d.). The amount of units put a challenge to the wiring of the installation systems (Ooijevaar, n.d.). The existing four elevators needed to be renovated and increased in height (Dames2, n.d.).

The transformation project was rewarded with a Green Key Gold certification for sustainability (Techniplan Adviseurs, n.d.). This could have been a challenge, as existing buildings constructed before 1974 have in average a energy label G (Vastgoedmarkt, 2018).

4.2.5. Social
The shops at the ground floor were in operation during the construction, this could also have been a logistic challenge (Dames 2, n.d.).

4.2.6. Opportunities
The use of lean planning in combination with early collaboration between all parties have led to an extremely short construction time (Ooijevaar, n.d.). As existing drawings can have differentiations in measurements, the whole building was 3D scanned (Ooijevaar, n.d.).

4.2.7. Summary
For this case it was unfortunately not possible, yet, to organise an interview with at least one of the involved parties.

For this case there was no mention of any major financial or legal challenges. The main technical challenges were: deterioration of the existing materials, integration of the installations and climate systems, an unsatisfying existing elevator capacity, sustainability requirements and logistics on site during construction. The latter is also in relation with the social challenge, as shops remained in operation on the ground floor during construction.

The main opportunities for this case have been: the use of a lean planning method, a collaborative process within the building team from initiative phase till final completion and a 3D scan of the building to check the measurements on the drawings.

An overview of challenges and opportunities can be found in Table 4.2. An example of the old and new floor plans, together with an impression of the project can be found on the next pages in Figures 4.7 and 4.8.

4.2.8. Main lessons learned
The main lessons that can be derived from this case occur around the fact that the floor height and lay-out of the building was not suited for the required new installations and sustainability requirements. On top of that, the present materials have been deteriorating, which forced them to replace lots of the existing elements. Another main lesson

learned is that the building could stay partially functioning while under construction, which caused certain challenges during the construction process but also could ensure minimal financial consequences for the local commercial facilities.

This case shows that with the use of a lean planning method, precious time can be saved, which also indirectly lead to a cost reduction. A 3D scan corrects the existing drawings and measurements, to ensure that materials and elements will fit. Naturally, a collaborative process is needed within the building team to ensure that the different processes are aligned and each stakeholder knows the process.

Challenges				Opportunities
Economic	**Legal**	**Technical**	**Social**	
No mention of economic challenges for this case	*No mention of legal challenges for this case*	- Deteriorating existing materials - Climate system - Elevator capacity - Sustainability requirements - Construction logistics - Integrating installation grid	- In operation during construction	- Lean planning - Collaborative process - 3D-scan building

Table 4.2 Overview case challenges and opportunities (own ill. based on case study data)

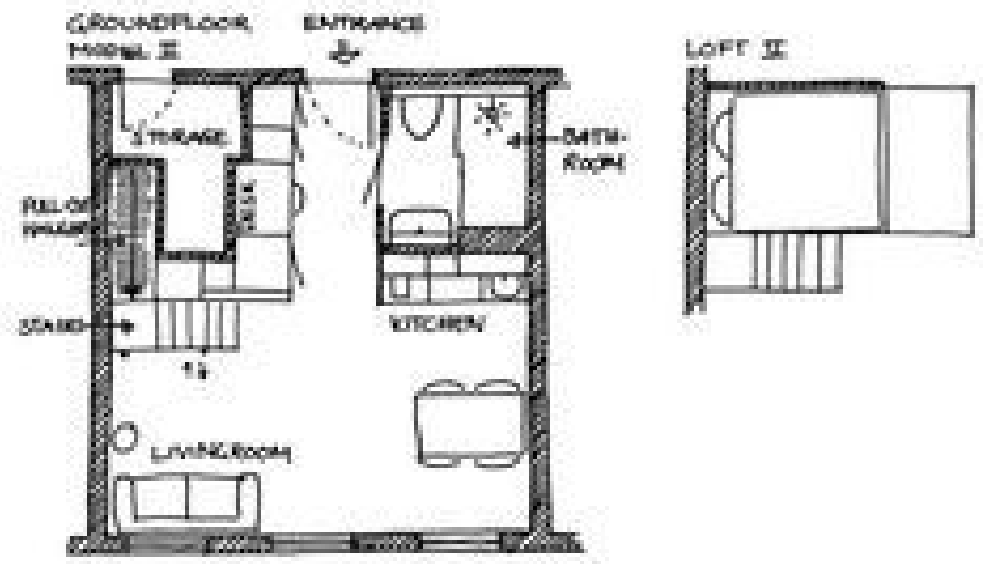


Figure 4.7. Floor plans before and after transformation (NRP Gulden Feniks; Pinterest)

Figure 4.8. Impression transformation (Zoku)

4.3. Parooltoren (1976) & Trouwgebouw (1969) - The Student Hotel Amsterdam City (2015/2016)

4.3.1. Introduction

The Parooltoren - constructed in 1976- & Trouwgebouw - constructed in 1969- have been a well known printing and office location in Amsterdam by the publishers of the same name, see Fig. 4.4. (Stedenbouw, 2015). The publishers left the building mostly vacant, apart from some areas temporarily occupied by artists and a restaurant (Nanninga, 2017). In 2012 developer Boelens de Gruyter bought the buildings from Stadgenoot (Boelens de Gruyter, n.d.; Stedenbouw, 2019). Together with The Student Hotel they transformed the building from offices to, in total, 573 student- and hotel units, increasing the initial floor space from 25.700 m2 to 28.800 m2 together with 4.000 m2 in commercial space, see Fig. 4.5. (Boelens de Gruyter, n.d.; Heijmans, n.d.; Stedenbouw, 2015). This project has acted as an accelerator for the whole area redevelopment (Stedenbouw, 2015). Main aim was to keep the original appearance of the building, which has been accomplished (Stedenbouw, 2015). With the use of prefab bathrooms the construction time decreased and it was more feasible to built in the inner city (Stedenbouw, 2015).

4.3.2. Economic

For this case, there was no mention of major financial challenges. However, the time which it was constructed in, just after the financial crisis, could have had an impact.

4.3.3. Legal

The existing building was an order 2 monument. This meat that it was either possible to demolish and rebuild, or if the building is transformed, it has certain aesthetic criteria (interviewee 2).

4.3.4. Technical

The acoustic requirements caused a challenge, as the former office construction had thin floors (interviewee 2). As the facade consisted of non-insulated concrete elements, this caused a thermal insulation problem (interviewee 2). To ensure the fire safety, the use of screens were needed (interviewee 2). In case of emergency these screens will fall from the ceiling and create smaller fire compartments within the building, which is required for dwellings.

The constructions logistics were a challenge, especially in the high-rise part. The use of prefab elements and bathroom units has mitigated this challenge (interviewee The urban planning in relation to the supply logistics and parking spaces was also a challenge, as the construction site was limited in the inner city location (interviewee 2).

The design choices were a cause for more technical difficulties, such as the fitting of the steel structure on top of the low-rise part (interviewee 2).

4.3.5. Social

For years the Wibautstraat was the most boring street in the inner city of Amsterdam (interviewee 2). Because of the whole area re-development, the transformation project was a success. It was possible to buy the building, partly due to the financial crisis (interviewee 2)

4.3.6. Opportunities

The column structure of the existing buildings were well fitted for the student- and hotel units (interviewee 2). Design wise, the high-rise part was more fitted for re-design to student- and hotel units due to the lay-out and orientation (interviewee 2). The good and early collaboration of the developer, contractor and architect has benefited the project (interviewee 2). The architect, contractor and developer hosted two intensive days, where all details and drawings were discussed one-by-one. This has helped all parties to understand the transformation project (interviewee 2).

4.3.7. Summary

For this case there was no mention of any major financial challenges. The legal challenge was the monumental status, which asked for specific requirements. The main technical challenges were: to meet the acoustic requirements, thermal insulation, fire safety measures and several design choices, which asked for specific requirements. The social challenge was the need for a whole area re-development, in order for the project to be successful.

The main opportunities for this case have been: the existing column structure and lay-out, the building orientation and a col-

laborative process within the building team from the initiative phase upon final completion.

An overview of challenges and opportunities can be found in Table 4.3. An example of the old and new floor plans, together with an impression of the project can be found on the next pages in Figures 4.9 and 4.10.

4.3.8. Main lessons learned

The main lessons that can be derived from this case on technical level are the challenges to achieve the requirements set by the Dutch Building Code. In this case, the logistics on site were a problem, as the building was situated in an inner city location. Furthermore, it can be learned that the existing building lay-out, dimensions and orientation can be an opportunity when it is fit for transformation.

Challenges				Opportunities
Economic	**Legal**	**Technical**	**Social**	
No mention of economic challenges for this case	- Monumental status	- Acoustic requirements - Thermal insulation - Fire safety - Construction logistics - Design choices	- Need for area re-development	- Column structure - Lay-out - Building orientation - Collaborative process

Table 4.3. Overview case challenges and opportunities (own ill. based on case study data)

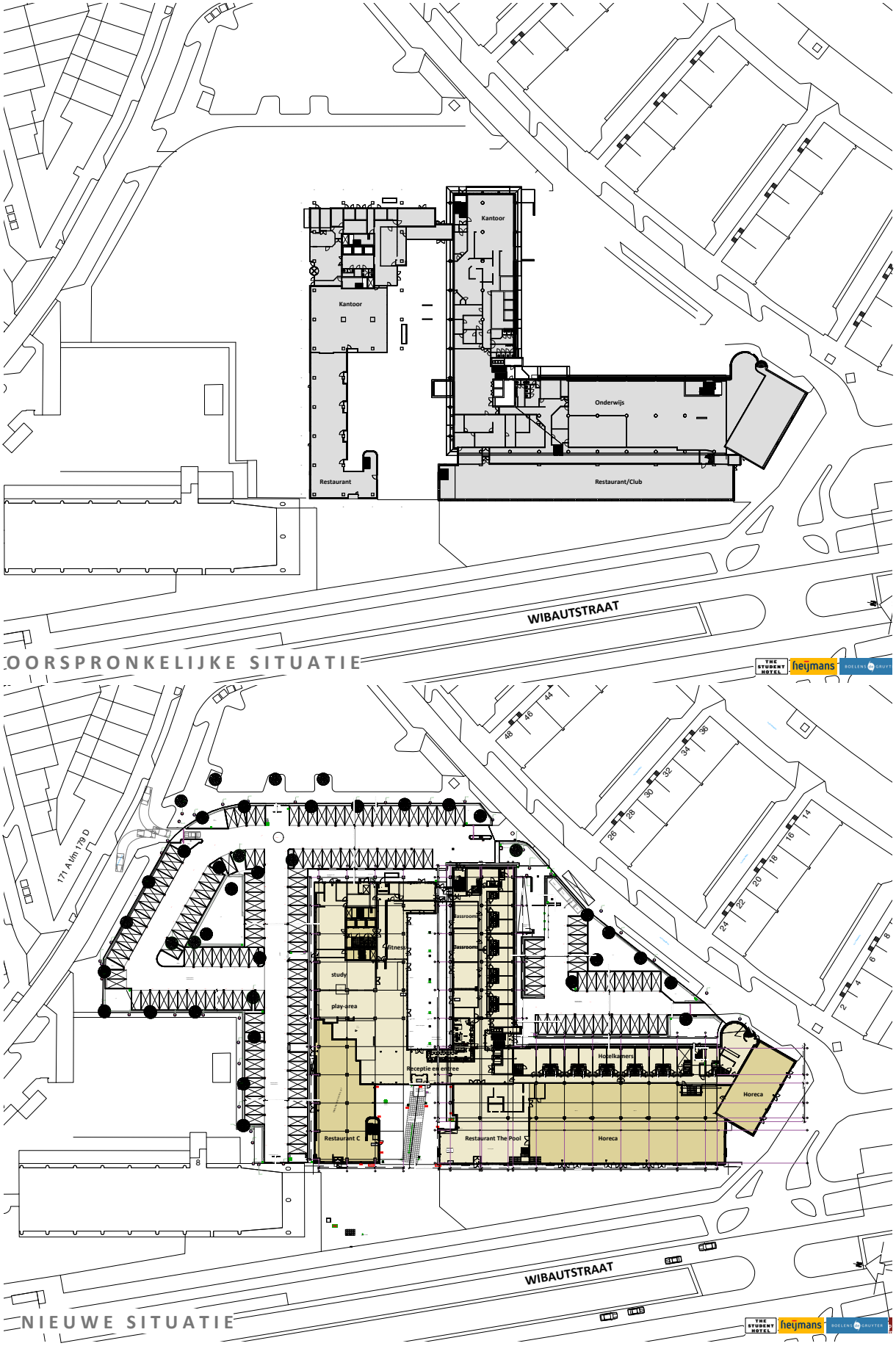


Figure 4.9. Floor plans before and after transformation (Penta Architecten, n.d.; NRP Gulden Feniks)

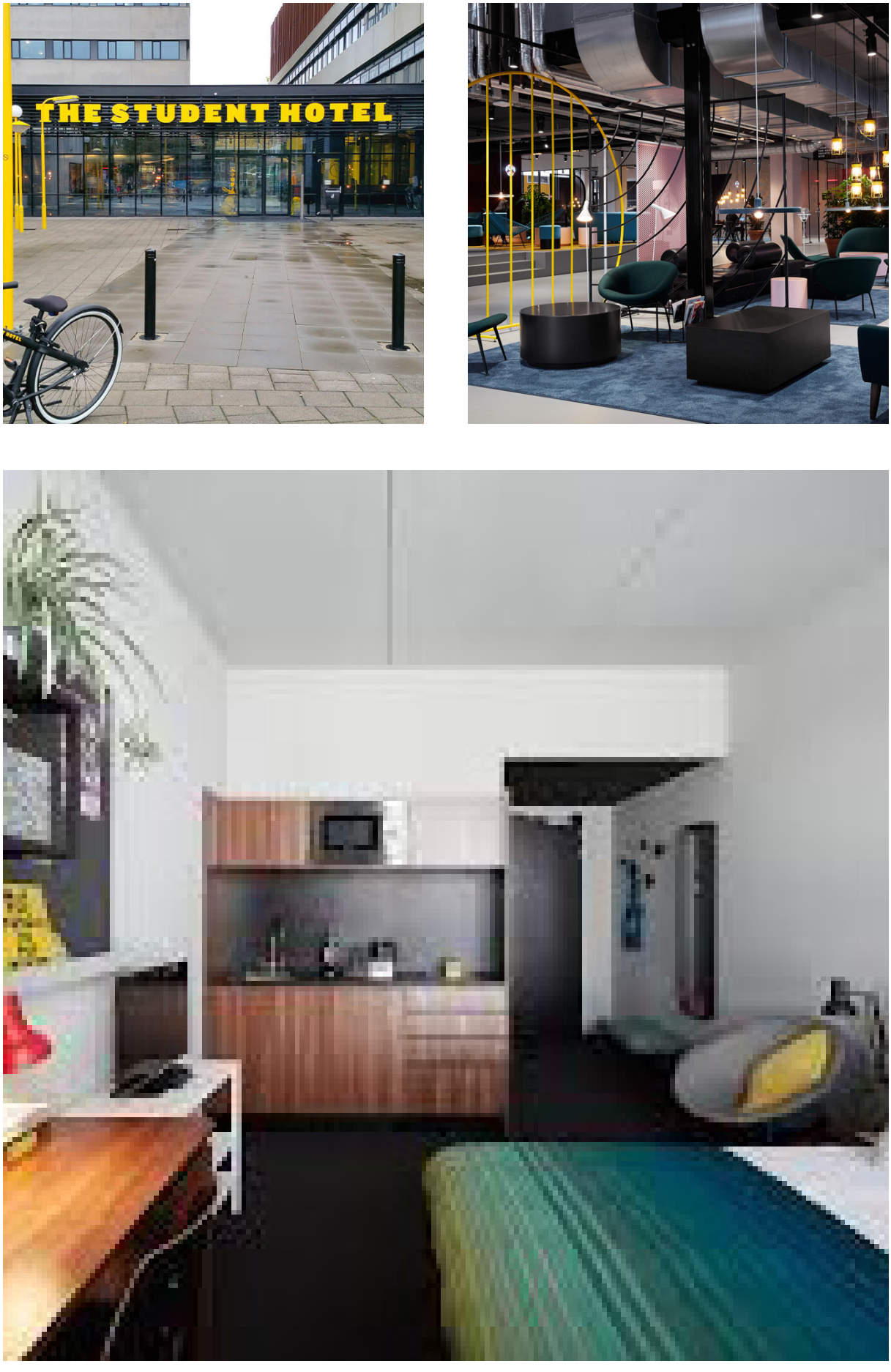


Figure 4.10. Impression transformation (The Student Hotel)

Case pair 2

Kantoorgebouw Zaanstad / Elseviergebouw (1964)
DUWO Elseviergebouw (2015)

Figure 4.11. Kantoorgebouw Zaanstad / Elsevier (T Gooi, n.d.)

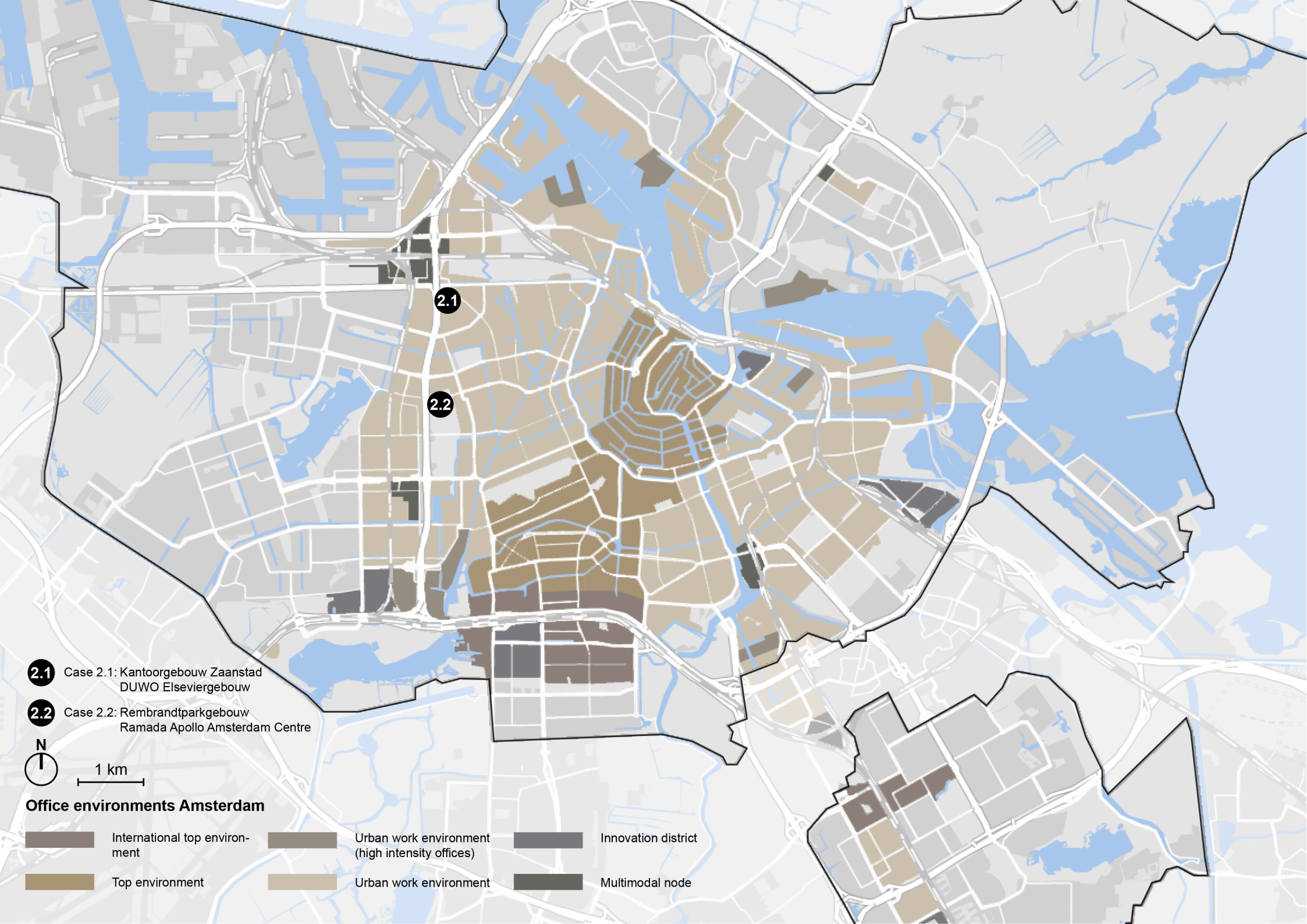
Figure 4.12. Iseviergebouw (Dudok, n.d.)

Rembrandtparkgebouw (1973)
Ramada Apollo Amsterdam Centre / Leonardo Hotel Amsterdam Rembrandtpark (2012)

Figure 4.13. Rembrandtparkgebouw (Peak Development, n.d.)

Figure 4.14. Ramada Apollo Amsterdam Centre (Agoda, n.d.)

Figure 4.15. Overview locations case pair 2 (own ill.)


2.1
2.2
2.1 Case 2.1: Kantoorgebouw Zaanstad
DUWO Elseviergebouw
2.2 Case 2.2: Rembrandtparkgebouw
Ramada Apollo Amsterdam Centre
N
1 km
Office environments Amsterdam
International top environment
Urban work environment (high intensity offices)
Innovation district
Top environment
Urban work environment
Multimodal node

4.4. Kantoorgebouw Zaanstad / Elseviergebouw (1964) - DUWO Elseviergebouw (2015)

4.4.1. Introduction

In 1964 the 12.000 m2 office building Zaanstad was built, but is mostly known as the Elseviergebouw as the building has been the Elsevier's headquarters (Dudok, n.d.; BouwWereld, 2015; Knevel Architecten, n.d.). In 2012 student housing association DUWO in collaboration with Rochdale gave Knevel Architecten the task to redesign the former vacant office building to student housing (Dudok, n.d.; BouwWereld, 2015). In total 245 units have been created, together with a laundry area and a hotel on the ground floor and build by Bouwbedrijf M. J. de Nijs en zonen (Knevel Architecten, n.d.). According to both Dudok (n.d.) - the original architect - and Knevel Architecten (n.d.), this transformation has led to a safer and more lively environment. A major challenge was the noise pollution from the highway, but this has been solved by using a double facade (Dudok, n.d.; Knevel Architecten, n.d.).

4.4.2. Economic

The budget has led to some choices to minimize the costs. For example: the facade was cleaned and not completely renewed (interviewee 1). A big cost has been the removal of the asbestos during the demolishing of the interior (interviewee 1).

4.4.3. Legal

The building was a municipal monument, originally designed by architect Dudok. This meant that the transformation needed to keep the original aesthetic appearance (interviewee 1).It also asked for more background research to find the right materials, which also resulted in higher costs (interviewee 1). More contracts and guarantees were needed due to the different materials (interviewee 1). The use of district heating is common in Amsterdam and for most projects it is easy to connect to the existing network. However, for this project it was a challenge, as a new route needed to be placed under an existing highway. This asked for the approval of the Rijkswaterstaat, the Dutch government for Public Works and Water Management (interviewee 9).

4.4.4. Technical

All window frames and facades on the short sides of the building needed to be replaced (interviewee 1). Different parties supplied materials for those facades and therefore more contracts and guarantees than usual were needed (interviewee 1). During the demolition of the interior, the contractor discovered some rotten columns and beams. Steel supporting structures were needed, which were not expected (interviewee 1).

4.4.5. Social

During construction, local residents have complained, but no more than during usual construction works (interviewee 1). However, upfront there was a social challenge, as the majority of the neighbourhood was against student housing. They feared for nuisance and pressure on the calm neighbourhood (interviewee 9).

4.4.6. Opportunities

The construction of the building remained, which has both a financial and time benefit as opposed to demolishing and rebuilt (interviewee 1). Usually a contractor keeps in mind the days that construction will delay due to the weather conditions, but because part of the facades and the main construction remained this was not necessary. This also resulted in less noise pollution for the neighbourhood (interviewee 1). The form of the building, smaller sides and horizontally orientated, was good transformable to dwellings (interviewee 1). The staircases and elevators were also fit for fire safety. The building was also suitable for lean planning, as the units were mostly identical. Only one floor needed to be thought out and this was copied to the other floors, which also resulted in time and cost reductions (interviewee 1). The social challenge was mainly mitigated by keeping the neighbours updated with information events, presentations and leaflets (interviewee 9). The inner building lay-out has been reversed, by keeping the original entrance at the highway side for the hostel and the entrance for students on the neighbourhood's site. The has transformed that area from dull and unsafe to lively and safer, especially in the evening and at night (interviewee 9). The supermarkets and other facilities in the area also benefited from the transformation (interviewee 9).

4.4.7. Summary

The financial challenges followed from several design choices, which asked for specific

requirements and the remediation of asbestos. The legal challenge were: the monumental status and design choices, which asked for specific requirements. The main technical challenges were: deterioration of the existing structure and the integration to the district heating network. The social challenge was the local opposition during the development of the project.

The main opportunities for this case have been: the existing lay-out, building dimensions and orientation, the reuse of several materials and elements, the existing elevator and escape route capacities, the repetition of floors, keeping the locals informed and creating a benefit for the urban setting.

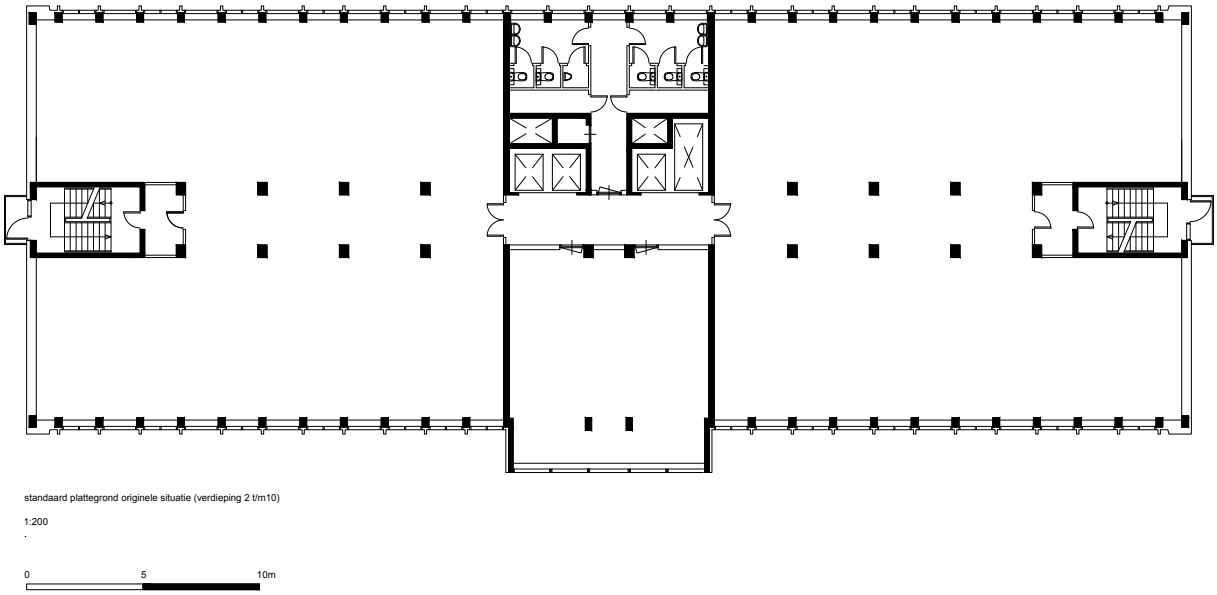
An overview of challenges and opportunities can be found in Table 4.4. An example of the old and new floor plans, together with an impression of the project can be found on the next pages in Figures 4.16 and 4.17.

4.4.8. Main lessons learned

From this case we can learn that the financial challenges often are technical or legal challenges as well. For example the asbestos and design choices can be a legal or technical challenge. Furthermore, it can be learned that the existing building lay-out, dimensions and orientation can be an opportunity when it is fit for transformation. This is interesting, as more cases had this advantage.

Challenges				Opportunities
Economic	**Legal**	**Technical**	**Social**	
- Design choices - Asbestos	- Monumental status - Design choices - District heating	- District heating - Deteriorating existing structure	- Local opposition	- Reuse existing materials - Building orientation - Lay-out - Dimensions - Elevator & escape route capacity - Lean planning - Repetition of floors - Informed locals - Urban setting benefit

Table 4.4. Overview case challenges and opportunities (own ill. based on case study data)



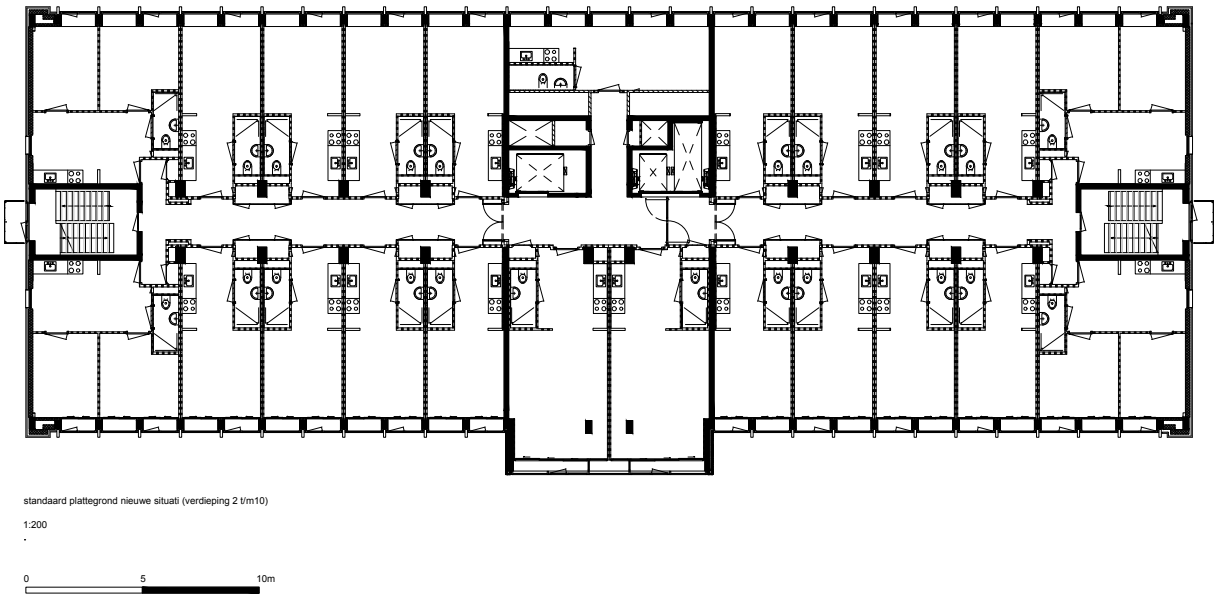


Figure 4.16. Floor plans before and after transformation (NRP Gulden Feniks)

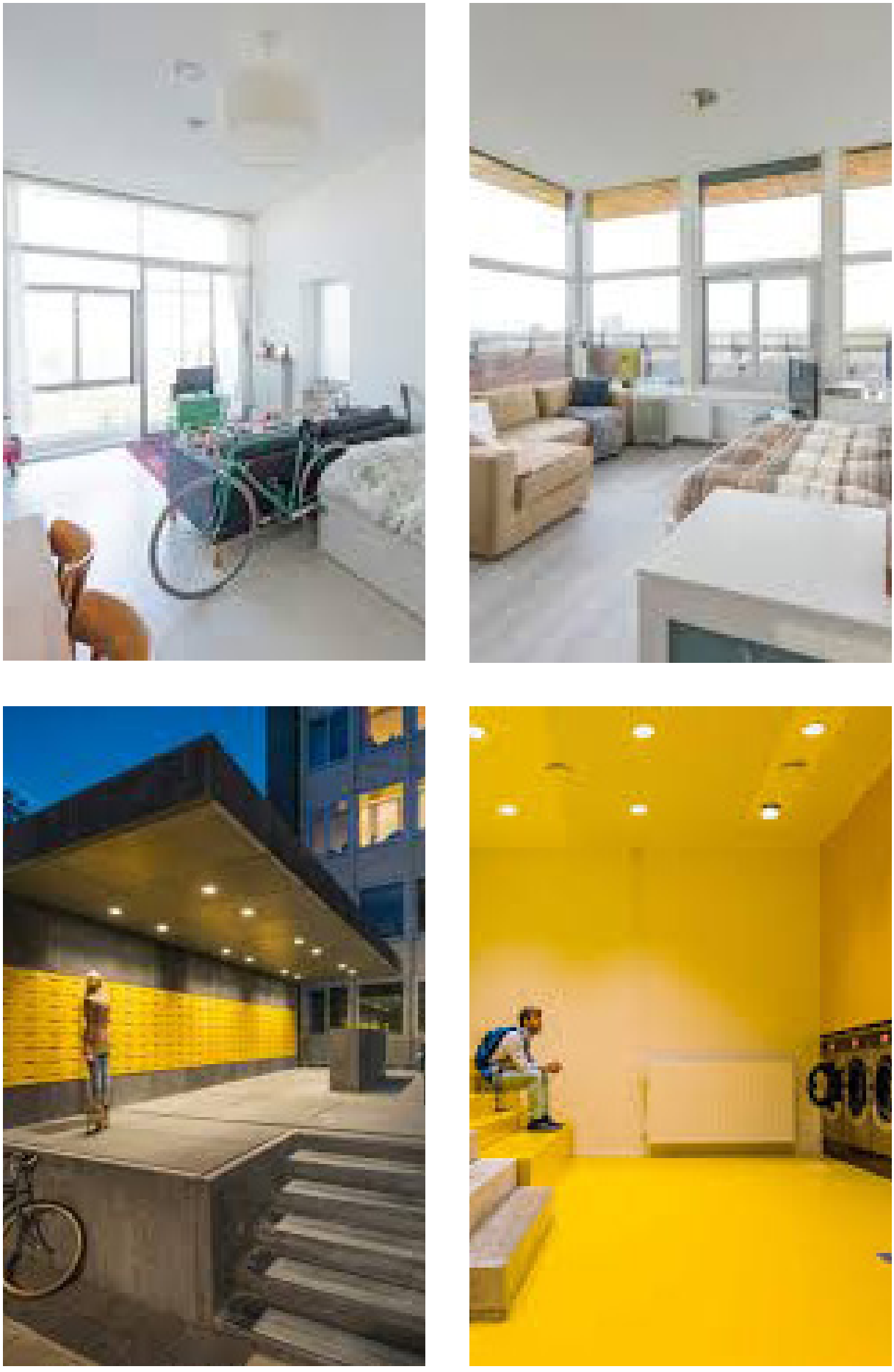


Figure 4.17. Impression transformation (De Nijs; Architectenweb; Dudok)

4.5. Rembrandtparkgebouw (1973) - Ramada Apollo Amsterdam Centre / Leonardo Hotel Amsterdam Rembrandtpark (2012)

4.5.1. Introduction

This building located close to the main highway of Amsterdam and the Rembrandtpark has been a landmark since its construction in 1973 (Het Parool, 2010; BAM, n.d.). The building consists of 33.000 m2 spread over 19 floors and a lower part spread over two floors (Het Parool, 2010). During the years, multiple companies such as ABN Amro, GAK, Pink Roccade and Getronics have housed their offices in the building, but preferred a modern appearance as the Rembrandtparkgebouw was typically from the '70s (Het Parool, 2010). In 2009 the last renter mentioned to leave the building in two years and n 2010 it was known that the building would be transformed by Peak Development from offices to a hotel with student housing and educational facilities (Het Parool, 2010; BAM, n.d.; Peak Development, n.d.). Designed by ZZDP Architecten and constructed by BAM Utiliteitsbouw, the transformation has had a positive influence on the neighbourhood in safety and livability and decreased vacancy in the area (BAM, n.d.; Peak Development, n.d.).

4.5.2. Economic

For this case, there was no mention of major financial challenges. However, it was transformed during the financial crisis, which could have had an impact.

4.5.3. Legal

For this case, there was no mention of major legal challenges. However, the procedures of changing the land-use plan could have had an impact.

4.5.4. Technical

In this case, the facade was the main supporting structure of the construction of the building (De Architect, 2013). Therefore, the facade was not completely replaced, but intensively cleaned and renovated where necessary (Herbestemming, n.d.).

To satisfy the daylight requirements, a glass roof structure needed to be integrated in the building (Herbestemming, n.d.).

This transformation project was also rewarded with a Green Key Gold certification for sustainability (Herbestemming, n.d.). This could have been a challenge, as existing buildings constructed before 1974 have in average a energy label G (Vastgoedmarkt, 2018).

The location of the building played a significant role in the project. As the building was located near the highway, it suffered from noise pollution (BouwWereld, 2012). A noise canceling screen close to the source was needed, together with improved sound insulation in the facades and windows (BouwWereld, 2012).

To comply with the fire safety requirements, the amount of floors had to be taken into account and were a critical point (BouwWereld, 2012). The function change also required an increased amount of fire compartments within the building (BouwWereld, 2012).

4.5.5. Social

For this case, there was no mention of major social challenges. However, the neighbourhood was considered as an unsafe place. Therefore, that could have led to a social challenge.

4.5.6. Opportunities

As mentioned above, the facade was the main supporting structure. This had also a n advantage, as it gave freedom to the lay-out of the floor plan of the new function (De Architect, 2013). The existing lay-out and center core structure also supported this freedom (Herbestmming, n.d.; BouwWereld, 2012). To safe time during construction, prefab bathrooms were used (Herbestmming, n.d.).

The transformation project has had a positive influence on the whole area, as there used to be a lack of social control (Herbestmming, n.d.). The livability and safety has been improved (Herbestmming, n.d.). The interaction on ground level has improved, together with the physical and mental accessibility of the building (Herbestmming, n.d.). The latter has been done by creating a transparent glass entrance and a different type of glass in the facade (Herbestmming, n.d.).

4.5.7. Summary

For this case it was unfortunately not possible, yet, to organise an interview with at least one of the involved parties.

For this case there was no mention of any major financial, legal and social challenges. The technical challenges were: the facade as the main supporting structure, to meet the daylight and sustainability requirements and the fire safety and noise pollution measures.

The main opportunities for this case have been: the existing lay-out, the facade as the main supporting structure, the use of prefab elements and improvement of the social interaction, livability and safety.

An overview of challenges and opportunities can be found in Table 4.5. An example of the old and new floor plans, together with an impression of the project can be found on the next pages in Figures 4.18 and 4.19.

4.5.8. Main lessons learned

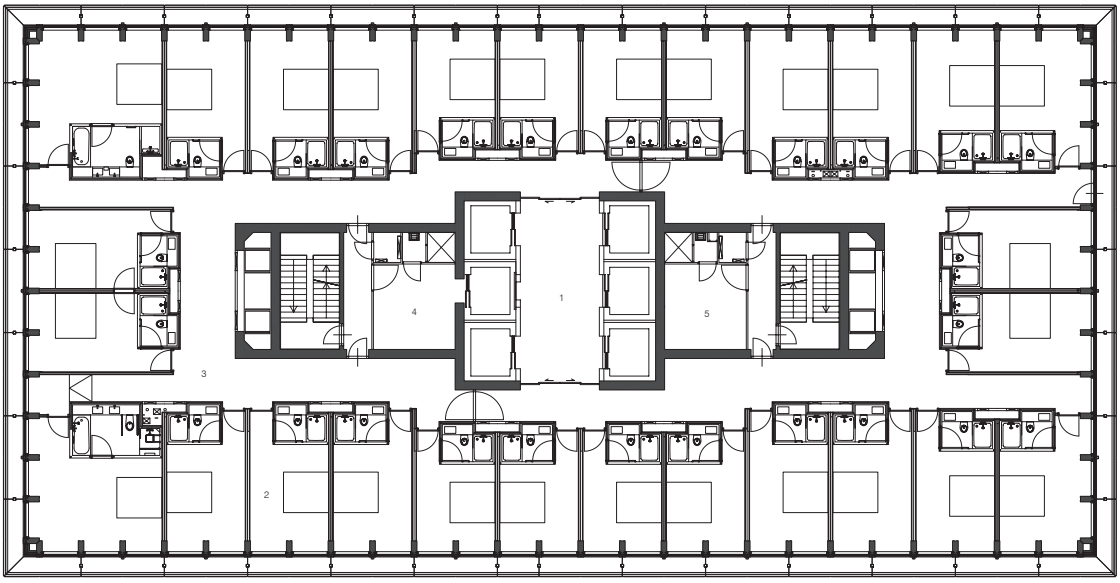
From this case, a learning point is the influence of the existing main supportive structure on both design and technical choices.

This case is also an example on the influence of transformation projects on social level on the area and urban setting.

Challenges				Opportunities
Economic	**Legal**	**Technical**	**Social**	
No mention of economic challenges for this case	*No mention of legal challenges for this case*	- Facade as supporting structure - Daylight requirements - Sustainability requirements - Noise pollution - Fire safety	*No mention of social challenges for this case*	- Improvement social interaction - Improvement of accessability - Prefab elements - Lay-out - Improvement livability - Improvement safety - Facade as supporting structure

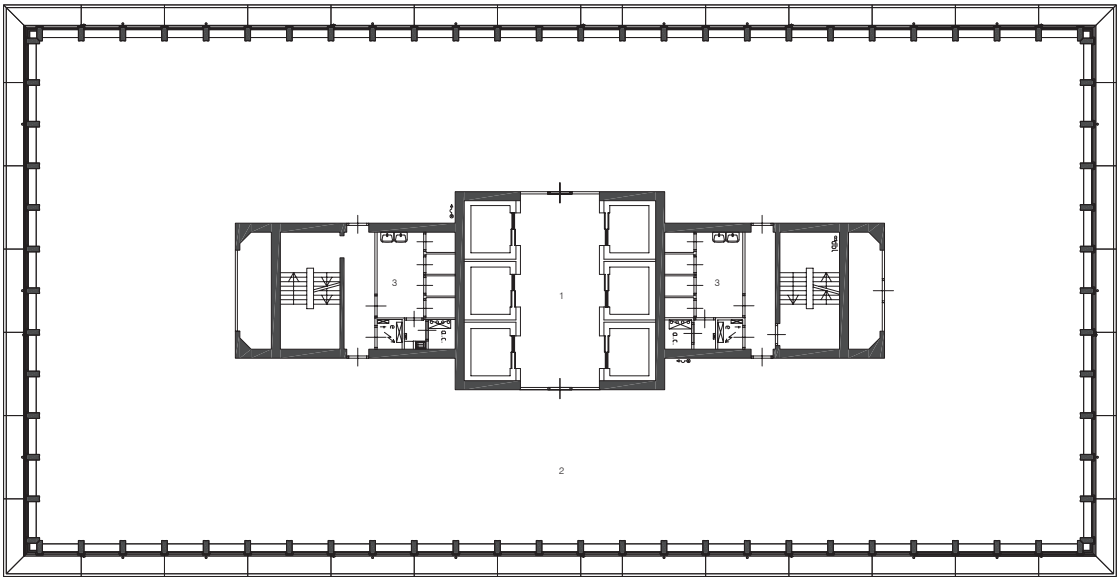
Table 4.5. Overview case challenges and opportunities (own ill. based on case study data)

Rembrandtparkgebouw hoogbouw: Ramada Hotel
plattegrond standaard verdieping
schaal 1:200



1 lifthal
2 hotelkamers
3 gangzone
4 linnenkamer
5 opslag

Rembrandtparkgebouw hoogbouw: oude situatie
plattegrond standaard verdieping
schaal 1:200



1 lifthal
2 kantoren
3 toiletten

Figure 4.18. Floor plans before and after transformation (NRP Gulden Feniks)

Figure 4.19. Impression transformation (Booking.com; VVV)

Case pair 3

De Admiraliteit (1989)
De Nieuwe Admiraliteit / DNA (2016)

Figure 4.20. De Admiraliteit (Prenger, n.d.)

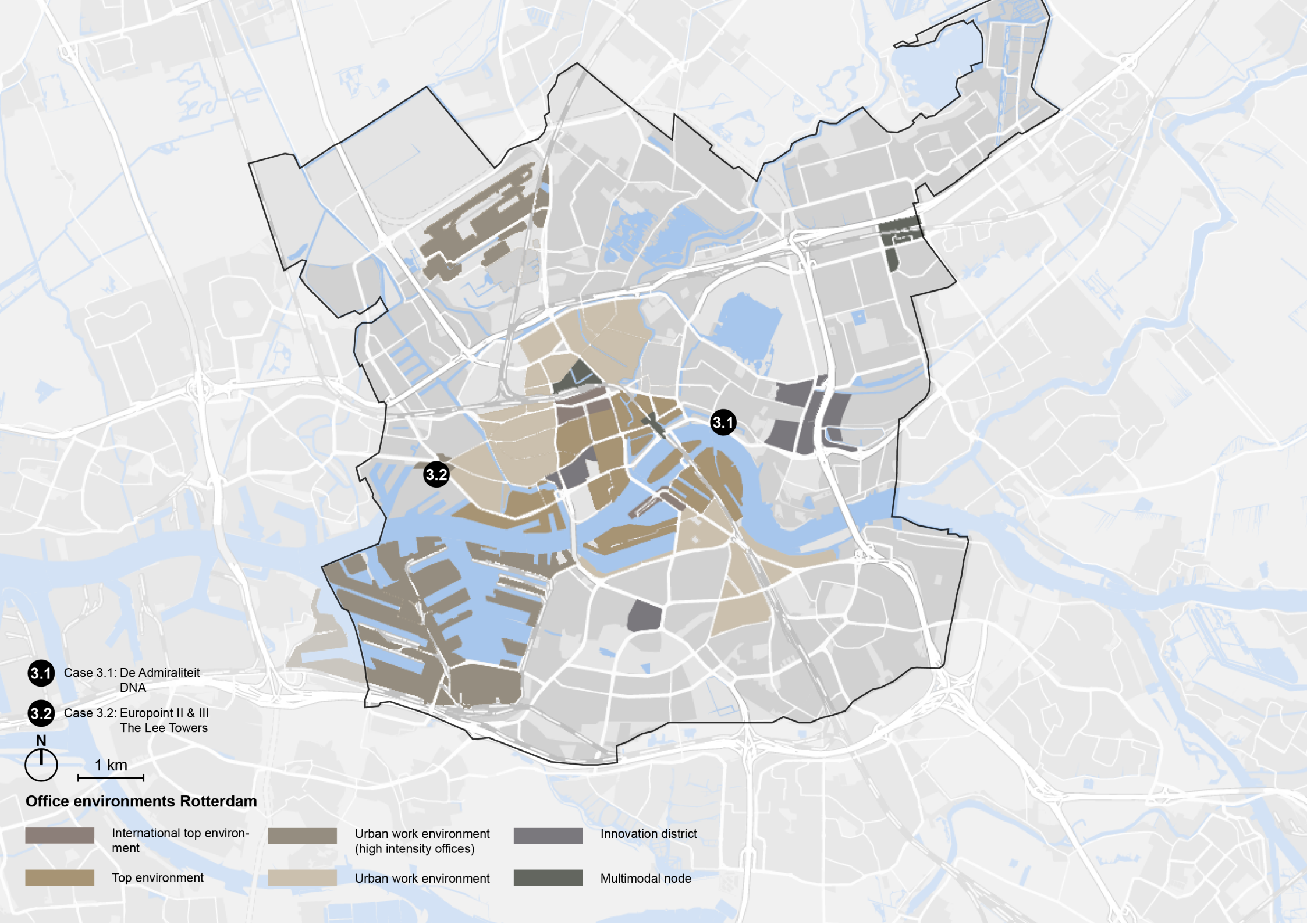
Figure 4.21. De Nieuwe Admiraliteit / DNA (Van Helleman, n.d.)

Europoint complex / De Marconitorens (1975)
The Lee Towers (2019)

Figure 4.22. Europointcomplex / Marconitorens (Versbeton, 2019)

Figure 4.23. The Lee Towrs (Holland2Stay, n.d.)

Figure 4.24. Overview locations case pair 2 (own ill.)


3.1
3.2
3.1 Case 3.1: De Admiraliteit DNA
3.2 Case 3.2: Europoint II & III The Lee Towers
N
1 km
Office environments Rotterdam
International top environment
Top environment
Urban work environment (high intensity offices)
Urban work environment
Innovation district
Multimodal node

4.6. De Admiraliteit (1989) - De Nieuwe Admiraliteit / DNA (2016)

4.6.1. Introduction

Built between 1985 and 1989 in three phases with as top renters Centerparcs and Deloitte (Klunder Architecten, 2013). The building had been structurally vacant due to being outdated and having a mono-function (Klunder Architecten, 2013). In 2013 the complex has been bought by U Vastgoed / City Pads and ABB for transformation and transformed from mono-functional office complex to urban mixed-use building, one of the main goals of the projects (Klunder Architecten, 2013). The re-design comes from Klunder Architecten and the construction works have been carried out by ABB Bouwgroep (BOAG, 2017). 578 units, a gym, a laundry and young professional spaces have been created in the former office over 35.000 m2 (BOAG, 2017).The facade and structure has been reused, but upgraded with a modern appearance and durability (Klunder Architecten, 2013; BOAG, 2017). With the amount of units came the possibility for mass production of elements to decrease the construction time (De Architect, 2017).

4.6.2. Economic

For this case, there was no mention of major financial challenges. The construction materials did rise during the building period, but this could be compensated with the rise in revenues (interviewee 5).

4.6.3. Legal

For this case, there was no mention of major legal challenges. However, the procedures of changing the land-use plan could have had an impact.

4.6.4. Technical

Asbestos had been found, but this was expected and calculated beforehand (interviewee 5). The crane during construction needed to be placed on a parking area with an extra construction, but overall the construction site was not a challenge for this case (interviewee 5).

In terms of fire safety, the re-design of the building met the requirements from the Dutch Building Code, but due to the amount of units the fire brigade of Rotterdam had extra requirements (interviewee 5). The main critical points were the thickness of walls and the amount and specifications of escape routes throughout the building (interviewee 5).

sound insulation / noise pollution

4.6.5. Social

For this case, there was no mention of major social challenges. The neighbourhood had been well informed during the project, which might have helped (interviewee 5).

4.6.6. Opportunities

The existing structure was well fit for transformation to dwellings, for example: the center core lay-out in relation to the daylight requirements, the amount of units in relation to the repetitive floors and the construction itself (interviewee 5; interviewee 6). The amount of parking spaces can often be a challenge for transformation projects (interviewee 5). In this case, the existing building contained an underground parking garage in the basement, which made it easy to meet the parking norm of the municipality (interviewee 5).

It was a challenge to transform the building within nine to twelve months, but this has been done due to several opportunities for time reductions. Due to the collaboration with the municipality, it was possible to get a reduction on the procedure for changing the land-use plan (interviewee 5). The use of a mock-up on site has also led to time reductions, as it could be thoroughly tested and improved (interviewee 5). The mock-up, in relation to the repetitiveness of the floors and visible '3-parts' of the building. The financial crisis also had some benefit in terms of time, as companies could still act quickly as there was still human and materials capacity (interviewee 5). The production speed was also boosted by using a lean planning method and organizing daily meetings on site (interviewee 5).

4.6.7. Summary

For this case there was no mention of any major legal and social challenges.

The financial challenge was to cope with the rise in costs for the materials and human resources. The technical challenges were: the remediation of the found asbestos, the logistics on site during construction and to

meet the fire safety measures and sound insulation requirements.

The main opportunities for this case have been: the existing lay-out and amount of parking spaces, the repetition of floors, the amount of units, the use of an on site mock-up and lean planning method and the collaboration with the municipality throughout the entire development.

An overview of challenges and opportunities can be found in Table 4.6. An example of the old and new floor plans, together with an impression of the project can be found on the next pages in Figures 4.25 and 4.26.

4.6.8. Main lessons learned

A lesson that can be derived from this case is the importance of the construction logistics. Another point is the use of an on site mock-up and lean planning, which both are planning optimization tools.

Challenges				Opportunities
Economic	**Legal**	**Technical**	**Social**	
- Rise in costs materials & human resources	*No mention of legal challenges for this case*	- Asbestos - Construction logistics - Fire safety - Sound insulation	*No mention of social challenges for this case*	- Lay-out - Repetition of floors - Amount of units - Existing & sufficient amount of parking spaces - Collaboration with municipality - On site mock-up - Lean planning

Table 4.6. Overview case challenges and opportunities (own ill. based on case study data)

Figure 4.25. Floor plans before and after transformation (NRP Gulden Feniks)

Figure 4.26. Impression transformation (Metaglas; ABB Bouwgroep; Rotterdam Architectuur Prijs)

4.7. Europoint complex / De Marconitorens (1975) - The Lee Towers (2019)

4.7.1. Introduction

Built in the '70s the Europoint complex consisted of three high-rise towers and one smaller building (Ondernemen010, n.d.; diederendirrix, n.d.). After the municipality moved out, the towers have been structurally vacant (Ondernemen010, n.d.; diederendirrix, n.d.). Two of the three former towers of the Europoint complex have been transformed by TB3 and Foolen en Reijs from offices to 883 apartments, each tower measuring about 40.000 m2 (Architectenweb, 2019; Ondernemen010, n.d.; diederendirrix, n.d.). The other towers has previously been transformed from offices to education and offices, now known as the Rotterdam Science Tower (Architectenweb, 2019). The design comes from diederendirrix architecten and the main challenge was to keep the former appearance of the complex, by reusing the windows and part of the facades (Architectenweb, 2019; diederendirrix, n.d.). The ground floor includes also a gym, cinema, meeting points, work spaces and restaurants; making the building multifunctional (Architectenweb, 2019; diederendirrix, n.d.). This transformation has been part of the wider M4H area redevelopment (Architectenweb, 2019; Ondernemen010, n.d.; diederendirrix, n.d.).

4.7.2. Economic

For this case, there was no mention of major financial challenges. The size, and therefore risks, could have had an impact on the financial feasibility of the project.

4.7.3. Legal

For this case, there was no mention of major legal challenges. the procedures of changing the land-use plan could have had an impact.

4.7.4. Technical

The existing window frames were not perfectly mounted, which resulted in only partly reuse of them (interviewee 4). To keep the aesthetics of the original design, which was one of the main requirements, a special frame needed to be created for this project (interviewee 4).

Another technical challenge was the integration of the installation grid (interviewee 6). The mechanical ventilation system was the only option, as the outdoor vents could not be visible for the aesthetic requirements. More room was needed for this type of ventilation system, which needed precise fitting in the installation grid (interviewee 4). This had also an effect on the heating installation of the dwellings. The original offices were heated with a block heating system, but the dwellings required a pipe system per dwelling (interviewee 4). Ideally all the shafts containing the pipes would be in one direct place on each floor. This high-rise required two different kind of shafts, divided in a set below floor level 10 and above floor level 10. This was a puzzle, together with the fuse boxes per dwelling (interviewee 4).

The weight capacity of the existing structure was a critical point in the project. The whole building needed to be recalculated to ensure safety (interviewee 4).

A downside to the existing fire safety sprinkler installation was the connection in the whole building. During the final stages of construction when part of the building was already completed, this caused a smoke-alarm on the first floor to set the sprinkler installation in motion for the whole building (interviewee 4).

4.7.5. Social

The existing companies and factories in the area faced acoustic challenges when the land-use plan was changed from offices to dwellings, because of the noise pollution. The building permit was already granted and this could have been a problem. The municipality stimulated a good collaboration and communication within the area (interviewee 4). The acoustic challenge has mainly been solved within the facades, but for some of the surrounding buildings and factories the source acoustic insulation needed to be improved (interviewee 4).

4.7.6. Opportunities

By creating a prototype of one unit in the main construction itself, it could be tested and improved before transforming the rest of the buildings (interviewee 4). The constructor that originally worked on the project, was also part of the transformation team (interviewee 4).

Due to the height of the buildings, the design of one floor could be copied to the other floors of the building (interviewee 4). The lay-out and dimensions of the existing structure were also fit for the dwellings units (interviewee 4). The capacity of elevators in high-rise can be a challenge, but in this building the capacity was fit to the requirements (interviewee 4).

As mentioned in 4.6.4. the sprinkler installation caused a downside, however a plus side was that it was already used in the previous function. For dwellings above 70m height a sprinkler installation is required, but it was needed to separate and renew the system per dwelling (interviewee 4).

As mentioned, the municipality functioned as a collaborator and communicator within the area. This has benefited the project and area re-development as a whole (interviewee 4).

4.7.7. Summary

For this case there was no mention of any major financial and legal challenges.

The technical challenges were: the deterioration of the existing materials and weight capacity, to meet the fire safety measures, the integration of the installation grid including the heating and ventilation system and shafts and the design choices which asked for specific requirements. The social challenge was handling the noise pollution coming from the surrounding area.

The main opportunities for this case have been: the existing lay-out and dimensions, the repetition of floors, the use of an on site mock-up, the reuse of the existing fire safety installation, the capacity of the existing elevators and escape routes and the collaboration with the municipality and building team throughout the entire development.

An overview of challenges and opportunities can be found in Table 4.7. An example of the old and new floor plans, together with an impression of the project can be found on the next pages in Figures 4.27 and 4.28.

4.7.8. Main lessons learned

A lesson that can be derived from this case is the relation between shaft, installation systems and the existing structure. The ceiling height and weight capacity can limit the amount of shafts and space for installation in the floor and/or ceiling.

Economic	**Legal**	**Technical**	**Social**	
No mention of economic challenges for this case	*No mention of legal challenges for this case*	- Design choices - Deteriorating existing materials - Integrating installation grid - Ventilation system - Heating system - Shafts - Weight capacity - Fire safety	- Noise pollution	- Lay-out - Dimensions - Collaboration with municipality - Collaborative process - On site mock-up - Repetition of floors - Existing fire safety installation - Elevator & escape route capacity

Table 4.7. Overview case challenges and opportunities (own ill. based on case study data)

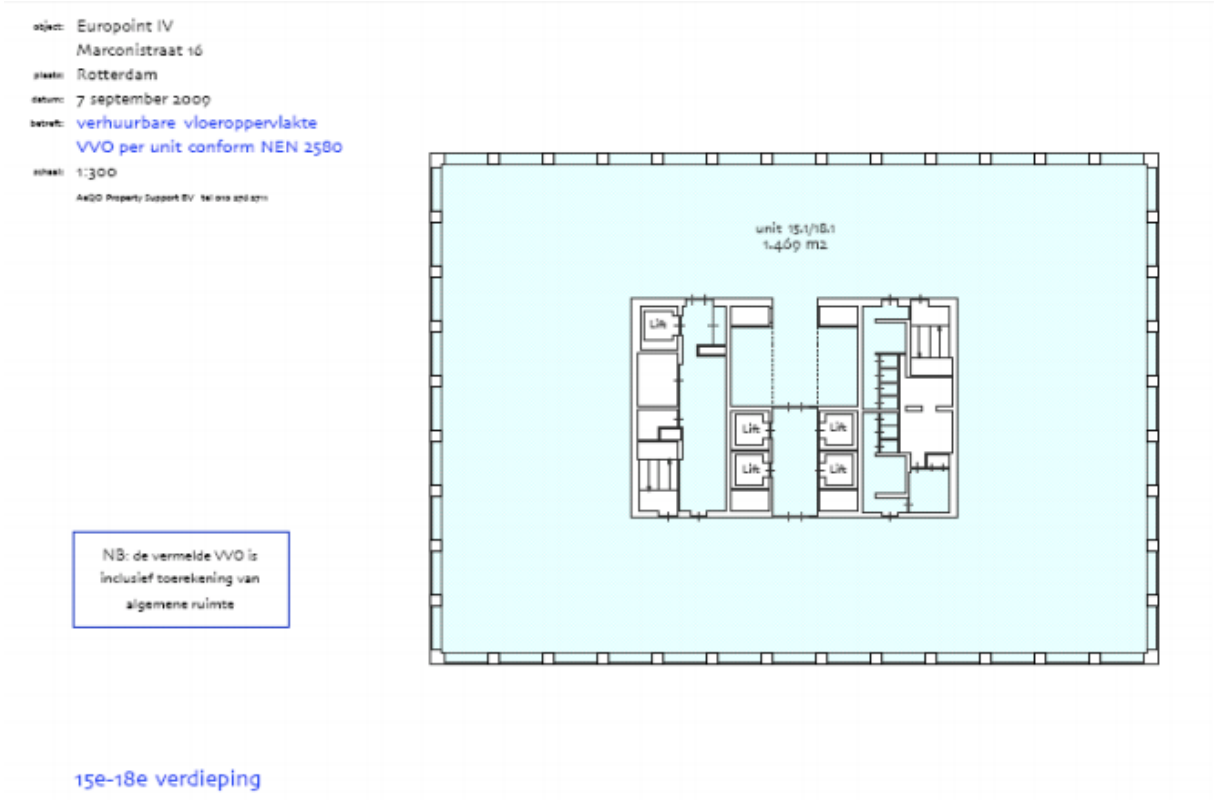


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Figure 4.27. Floor plans before and after transformation (JLL; diederendirrix)

Figure 4.28. Impression transformation (Architectenweb, Wonen in Rotterdam)

Case pair 4

Sophiestaete (1981)
De Sophie (2019)

Figure 4.29. Sophiestaete (Atelier Pro, 2019)

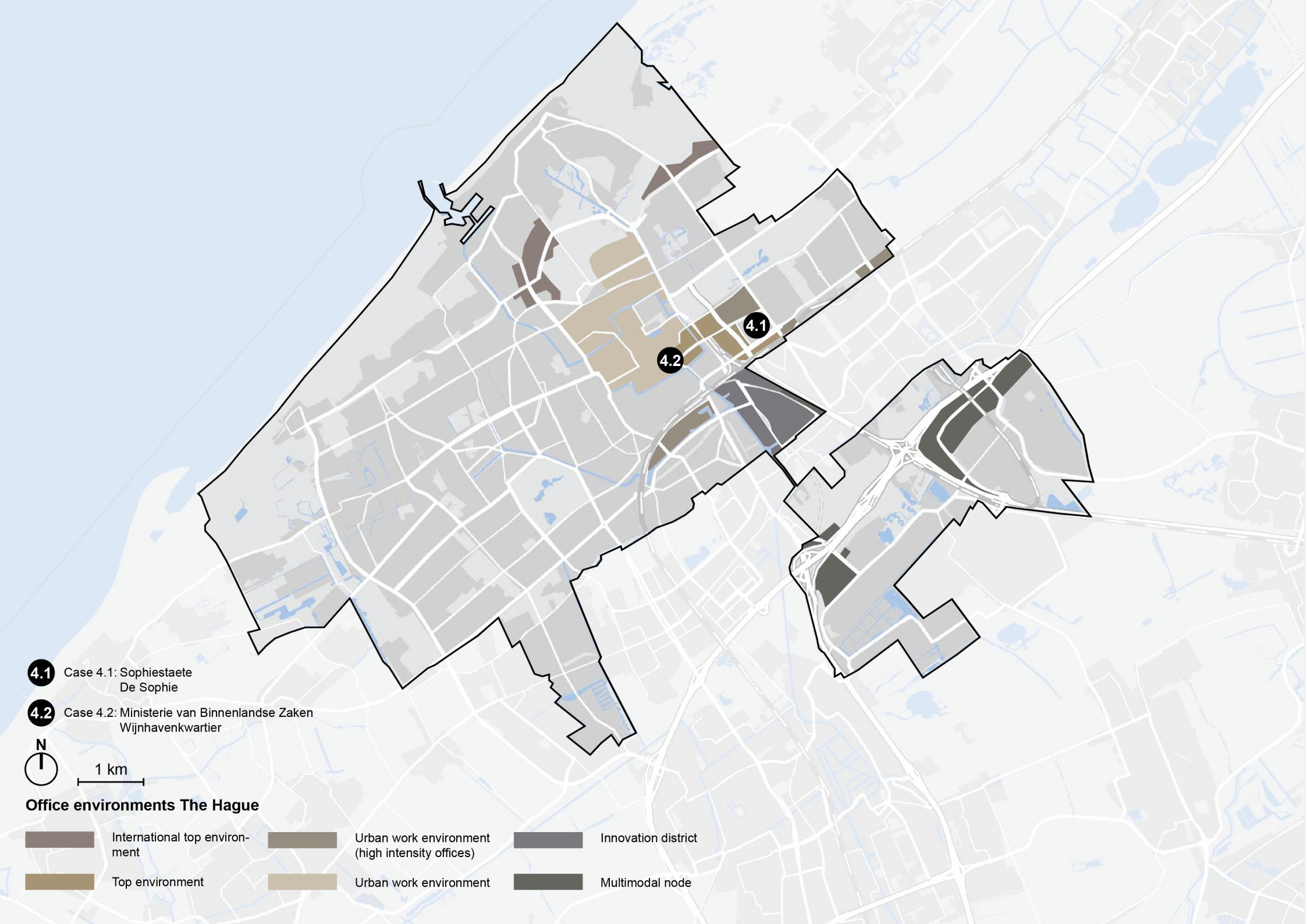
Figure 4.30. De Sophie (BplusM, n.d.)

Ministerie van Binnenlandse Zaken (1975)
Wijnhavenkwartier (2016)

Figure 4.31. Wikiwand (n.d.)

Figure 4.32. Wijnhavenkwartier (NRP Gulden Feniks, 2017))

Figure 4.33. Overview locations case pair 2 (own ill.)


4.1
4.2
4.1 Case 4.1: Sophiestaete
De Sophie
4.2 Case 4.2: Ministerie van Binnenlandse Zaken
Wijnhavenkwartier
N
1 km
Office environments The Hague
International top environment
Urban work environment (high intensity offices)
Innovation district
Top environment
Urban work environment
Multimodal node

4.8. Sophiestaete (1981) - De Sophie (2019)

4.8.1. Introduction
The office building originally built in 1981 consisted of approximately 7.000 m2 spread over six floors and included a underground parking (BplusM, n.d.). The buildings had been used by Meavita, a caring institution, from 2006 till their bankruptcy in 2015 (Hanzevast Capital, 2006; Vastgoedmarkt, 2015). Between 2015 and 2017 the building had been partially in use by some care facilities and the municipality to reduce vacancy (Vastgoedmarkt, 2015). According to Trebbe (2019), the building had been vacant for a few years and reuse was a sustainable and resilient choice as opposed to demolition and new built. Simultaneously the demand for dwellings in the Bezuidenhout district grew and the neighbourhood was in need of a higher livability (Trebbe, 2017). In 2016 Local Investments and Trebbe Wonen as Villa Sophie BV initiated redevelopment with a design by Atelier Pro and in 2018 Trebbe West started construction (BplusM, n.d., Trebbe, 2019). The transformation was completed in March 2019 with 67 apartments and 63 underground parking spaces (BplusM, n.d.; Trebbe, 2017; Trebbe, 2019). From a sustainability point of view the facade is mostly reused to limit construction waste and the building is now energy neutral (BplusM, n.d.; Trebbe, 2019).

4.8.2. Economic
The overall project budget limited the design freedom a bit, but there were no big financial challenges (interviewee 10).

4.8.3. Legal
The first design for the project was declined by the aesthetics committee of the municipality [welstand], which is needed to get a building permit and change of the land-use plan. Therefore, the whole project needed to be re-designed by the architect (interviewee 10).

4.8.4. Technical
The existing construction was fit for an extra floor on top, but the existing facade would have been to heavy. Therefore, a lightweight facade was designed for this extra floor (interviewee 10). The balconies were also too heavy for the existing construction and independent smaller constructions were designed to support the balconies (interviewee 10). A challenge that is known for transformation projects are the acoustic requirements (interviewee 10). The reason for this is the use of bigger floor spans in offices (interviewee 10). In this case, the acoustic challenge has been solved by using a floor heating system, to separate the floor by adding an additional layer (interviewee 10).

4.8.5. Social
On one side, the existing building is attached to another building. The home-owners of that building were not content with the construction works and possible parking problems and filed complaints during the design phase (interviewee 10). After negotiations and a compensation for nuisance and damages [planschadevergoeding], the contractor had permission to start the works {interviewee 10). This cost not only financially, but also in time (interviewee 10).

4.8.6. Opportunities
In this case, the acoustic challenge has been solved by using a floor heating system, to separate the floor by adding an additional layer (interviewee 10).

The social challenges might have been mitigated by informing the neighbours in an even earlier stage, to prevent complaints.

4.8.7. Summary
For this case there was no mention of any major financial challenges.

The legal challenge was to satisfy the aesthetics committee with the architectural design to be granted the building permit. The technical challenges were: the existing weight capacity and to meet the acoustic requirements. The social challenge was handling the local opposition.

The main opportunity for this case was the use of a floor heating system to tackle the sound insulation challenge.

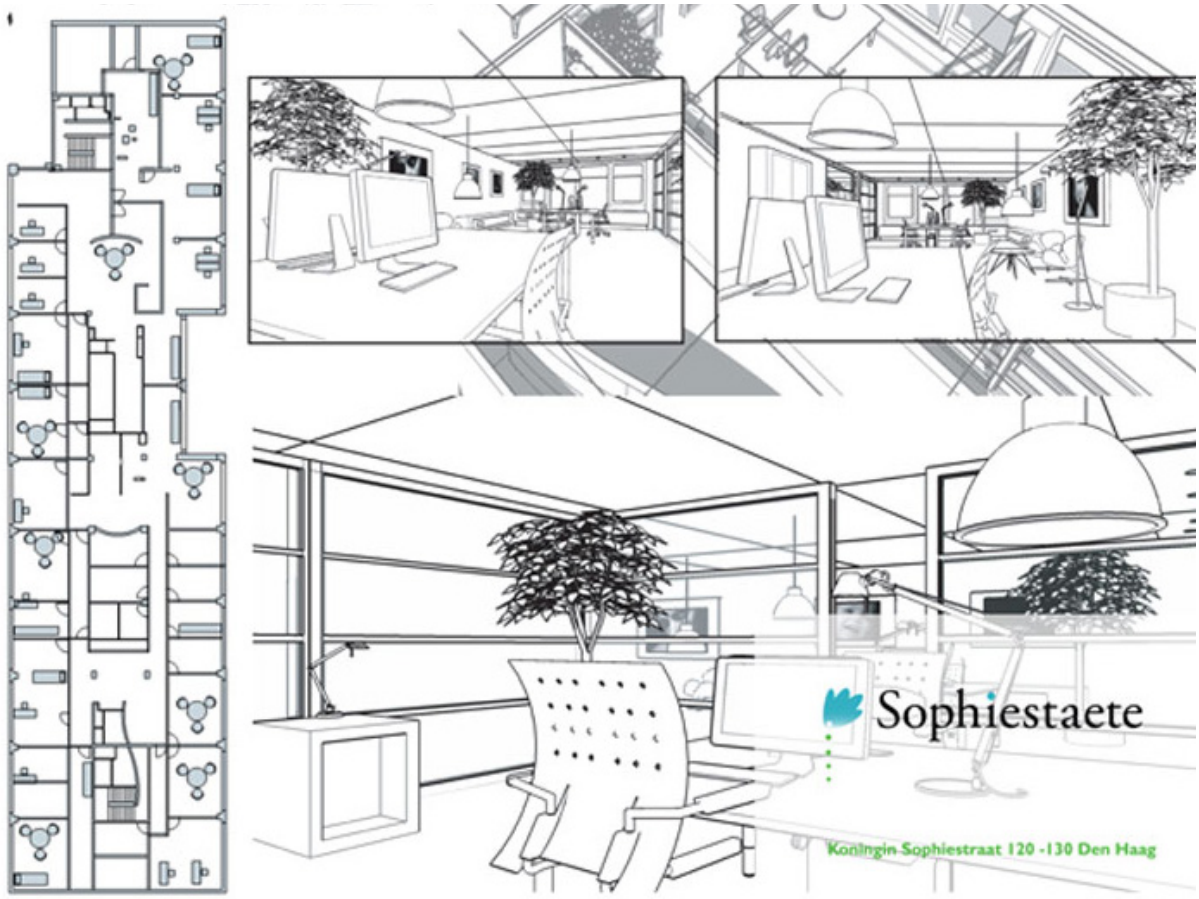
An overview of challenges and opportunities can be found in Table 4.8. An example of the old and new floor plans, together with an impression of the project can be found on the next pages in Figures 4.34 and 4.35.

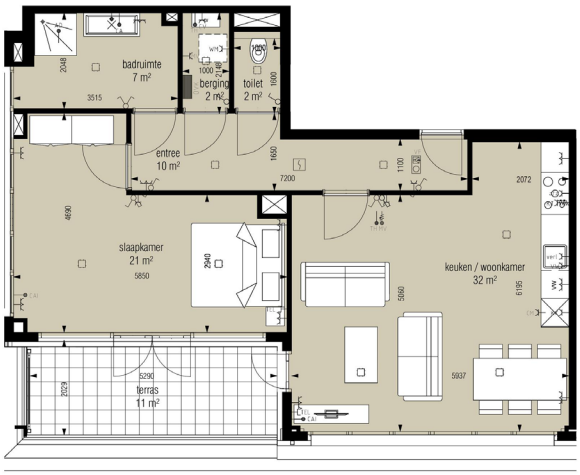
4.8.8. Main lessons learned
From this case it can be learned that the approval of the local aesthetics committee is of such an importance, that it can mean a project has to be re-designed if it is not ap-

proved. Informing the local aesthetics committee upfront can possibly help with this.

Challenges				Opportunities
Economic	**Legal**	**Technical**	**Social**	
No mention of economic challenges for this case	- Building permit & aestherits committee	- Weight capacity - Acoustic requirements	- Local opposition	- Floor heating system

Table 4.8. Overview case challenges and opportunities (own ill. based on case study data)





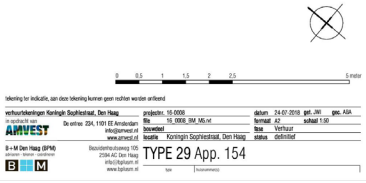


Figure 4.34. Floor plans before and after transformation (MVGM; IkWilHuren.nl; Building Concept)

Figure 4.35. Impression transformation (MVGM; Ikwilhuren.nl)

4.9. Ministerie van Binnenlandse Zaken (1975) - Wijnhavenkwartier (2016)

4.9.1. Introduction

From 1975 till 2012 the building had been in use by the Dutch Ministry of Internal Affairs. The ministry moved to the newly built ministry building and left the former building vacant till redevelopment started in 2014 (Heijmans, 2016). At the time one of the biggest transformation projects in the Netherlands, the building was converted from offices to 162 apartments, 8 penthouses, a university and offices and commercial space including restaurants (Heijmans, 2016; Syntrus, n.d.; Geurst & Schulze, 2016). This has been done by a collaboration between Heijmans, Syntrus Achmea Real Estate & Finance, the municipality of The Hague and the University of Leiden (Heijmans, 2016). The concrete structure of the building is reused (Heijmans, 2016). Previously the neighbourhood had a gloomy and unsafe appearance, but the transformation of the project uplifted the whole area (Heijmans, 2016; Geurst & Schulze, 2016).

4.9.2. Economic

The financial challenges for this case are related mainly to the delay, which was an effect of the fire (interviewee C).

4.9.3. Legal

Some setbacks, as will be explained below, have caused for delay. The tenants and other parties involved were obliged to an compensation for the postponement of the completion deadline (interviewee C).

4.9.4. Technical

The logistics on the construction site and also the supply logistics were a challenge, because the construction site was inner city and not much bigger than the building itself (interviewee C). The use of prefabricated facade elements has mitigated this challenge (interviewee C). Due to the weight limits of the existing construction, the composition of the facade components had been chosen (interviewee C). The construction was also not fit for huge installations, as the height was only 2.96m, where 3.60m was preferred (interviewee C). This caused a challenge for the fitting of the climate system and its installation (interviewee C). Not all floors could be elevated or adjusted, as that would have had consequences for the window frames and the weight limits of the construction (interviewee C). This difference in floor height is visible in the stairs as well (interviewee C).

A downside to transformation projects is the possibility that existing drawings and measurements are not correct to reality. In this case, the preparation works already took off while the building was being stripped and re-measured. Some elements, such as the balconies, did not fit perfectly in the existing construction (interviewee C). For example: the floors were hanging on a Jack-Block system, which sloped towards the edges (interviewee A). The size deviations also caused a problem for the supply of the products, as a lot of different sizes needed to be ordered and still a lot of adjustments needed to be made on site (interviewee C). A higher tolerance on measurements should be taken into account with transformation projects as opposed to new building projects (interviewee A).

Another challenge related to the existing structure, was the fitting of installations on the roof (interviewee A). Due to both the weight limit of the existing structure as the preference for a hidden installation aesthetically (interviewee A).

A huge pressure on the planning was the discovery of asbestos, even though an investigation had taken place before construction started. The asbestos in combination with a fire during construction has caused about 3-4 months delay (interviewee C). The planning was precise, as for example the parking spaces needed to be finished before the dwellings (interviewee C). The university also had its own subcontractors, which made the strict planning even more tense (interviewee C).

4.9.5. Social

For this case, there was no mention of major social challenges. However, the inclusion of an university in the project could have had an impact on the social challenges.

4.9.6. Opportunities

On social level, the use of a surroundings manager has played a significant role. This person has kept the neighbourhood updated and dealt with complains carefully (interviewee C). Beside the use of a surroundings manager, the facades of the surrounding residential tower was cleaned and a roof

performance was arranged for nearby residents to 'make up' for the nuisance during construction (interviewee C).

By using strict logistics schemes and traffic leaders both in- and outside the building, the accessibility of the city was safeguarded (interviewee C).

For the weight limits of the facade, different mock-ups were made of the balconies. These mock-ups have been tested and investigated by the architect, developer and contractor (interviewee B).

The high-rise part of the building had the advantage of repetitions of the floors. One floor had to be designed and was then copied to the other floors. This saved time, as well as mitigated challenges (interviewee B).

4.9.7. Summary

For this case there was no mention of any major social challenges.

The financial and legal challenges followed from the delay, which was a consequent of the fire during construction. The technical challenges were: remediation of the found asbestos, the existing weight capacity, , the integration of the installations in floor and ceiling height and on the roof, the logistics on site during construction and the lack of accuracy of the existing drawings.

The main opportunities for this case have been: the repetition of floors, the use of an on site mock-up, having a surroundings manager and working with schemes to manage the on site logistics.

An overview of challenges and opportunities can be found in Table 4.9. An example of the old and new floor plans, together with an impression of the project can be found on the next pages in Figures 4.36 and 437.

4.9.8. Main lessons learned

From this case it can be learned that unforeseen aspects can have a huge influence on the financial feasibility and legal procedures. The example in this case is the fire, which caused a delay; and the delay mainly caused the financial and legal challenges. A learning point and example is also the use of planning tools, such as logistic schemes and a surroundings manager. These tools have been a time and therefore cost reduction on the construction site.

Challenges				Opportunities
Economic	**Legal**	**Technical**	**Social**	
- Delay as effect of fire	- Delay as effect of fire	- Weight capacity - Construction logistics - Installations & floor/ceiling height - Non-accurate existing drawings - Asbestos - Roof installations	*No mention of lsocial challenges for this case*	- Surroundings manager - Logistics schemes - On site mock-up - Repetition of floors

Table 4.9. Overview case challenges and opportunities (own ill. based on case study data)

Figure 4.36. Floor plans before and after transformation (NRP Gulden Feniks)

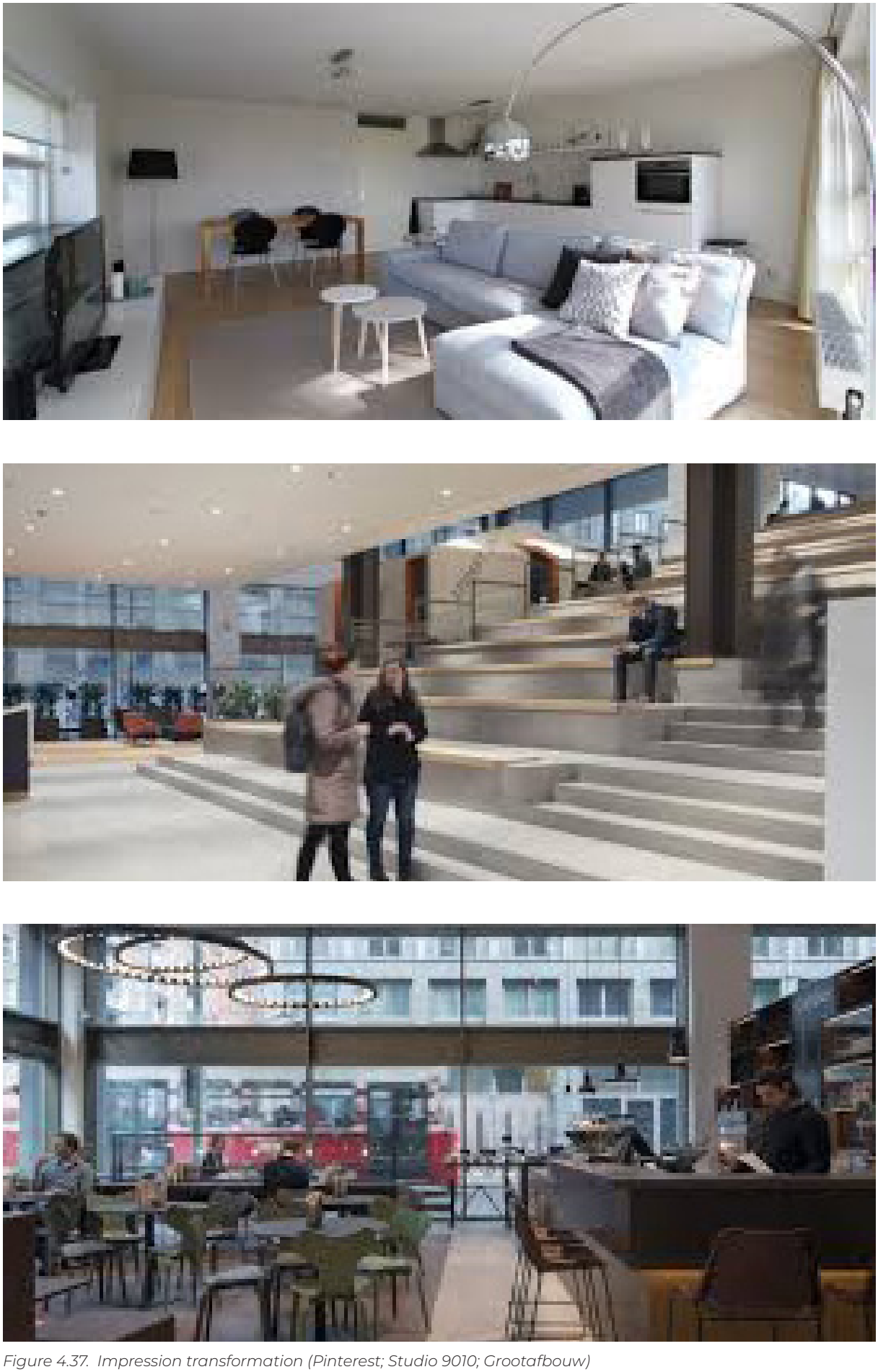


Figure 4.37. Impression transformation (Pinterest; Studio 9010; Grootafbouw)

4.10. Results

In this section the pairs and cases will be discussed and the outcomes from the case studies will be compared per pair. Thereafter the outcomes will also be analyse cross-pair. The results are concluded with an overview of non-tall cases and tall cases. The overviews show the difference in challenges and opportunities between the transformation of non-tall and tall office buildings.

4.10.1. Pair 1: Metropoolgebouw + Parooltoren & Trouwgebouw

The differences of the cases are:

Height
According to the Dutch definition of high-rise (70m), both building are not classified as tall. However, according to the Amsterdam's definition of high-rise (30m) they are both considered tall. The buildings differ in height by 19m. The cases are still comparable, as the Parooltoren is above the 50m, which has an extra requirements for elevator shafts in the Dutch Building Code and the Metropoolgebouw is not.

Size
The cases differ in size by 12.800m2.

Original construction period
The Metropoolgebouw and Trouwgebouw are constructed in the same era (5 year difference), as the Parooltoren was constructed in the '70s (12 & 7 year difference).

Transformation period
Case 1.2 was completed 1 year later as case 1. 1

Both the non-tall and tall case dealt with the challenge of the construction logistics on site. The challenges for specifically the tall case are the extra fire safety measures. Both cases benefited from a collaborative building process.

4.10.2. Pair 2: Kantoorgebouw Zaanstad/ Eleviergebouw + Rembrandtparkgebouw

The differences of the cases are:

Height
According to the Dutch definition of high-rise (70m), both building are not classified as tall. However, according to the Amsterdam's definition of high-rise (30m) they are both considered tall. The buildings differ in height by 8m, which are about 3 floors. Even though the cases have been interesting to research, the lack of difference in height has made them less comparable.

Size
The cases differ in size by 20.000m2

Original construction period
Case 2.2 was completed 9 years later as case 2.1. They were built in a different era , with possible different building characteristics.

Transformation period
Case 2.1 was completed 3 year later as case 2.2.

There are no major similarities in challenges mentioned between the non-tall and tall case in this pair. The challenges for specifically the tall case are the extra fire safety measures. Both urban settings of the cases benefited from the transformation project. In both cases the existing building was fit for conversion to dwellings in terms of existing lay-out and dimensions.

4.10.3. Pair 3: De Admiraliteit + Europoint II & III / Marconitorens

The differences of the cases are:

Height
According to both the Dutch and Rotterdam's definition of high-rise (70m), case 3.1 is considered non-tall and case 3.2. is considered tall. The buildings differ in height by 45m, which are about 15 floors. Therefore, the cases differ to make them comparable.

Size
The cases differ in size by 5.000m2, or 45.000m2 if both towers of case 3.2 are taken into account.

Sub-market
The cases are located in different office sub-markets. As the office rental rates have a higher differentiation, the cases are less comparable.

Original construction period
Case 3.1 was completed 14 years later as case 3.2. They were built in a different era , with possible different building characteristics.

Transformation period
Case 3.2 was completed 3 years later as case 3.1.

Both the non-tall and tall case dealt with the challenge of the fire safety measures. The challenges for specifically the tall case are the the integration of the installation systems. Both cases benefited from a collaborative building process and the use of an on site mock-up. In both cases the existing building was fit for conversion to dwellings in terms of existing lay-out and dimensions.

4.10.4. Pair 4: Sophiestaete + Ministerie van Binnenlandse Zaken

The differences of the cases are:

Height
According to both the Dutch (70m) and The Hague's definition of high-rise (50m), case 4.1 is considered non-tall and case 4.2. is considered tall. The buildings differ in height by 54m, which are about 18 floors. Therefore, the cases differ to make them comparable.

Size
The cases differ in size by 43.000m2

Sub market
The cases are located in different office sub-markets. However, as the office rental rates did not differ much, the cases are comparable.

Original construction period
Case 4.1 was completed 6 years later as case 4.2. They were built in a different era , with possible different building characteristics.

Transformation period
Case 4.1 was completed 3 years later as case 4.2.

Both the non-tall and tall case dealt with the challenge of the weight capacity of the existing structure of the building. The challenges for specifically the tall case are related to the integration of the installation systems. The opportunities for specifically the tall case is the repetition of floors in combination with the amount of total floors.

4.10.5. Cross-pair analysis

Table 4.10 gives an overview of challenges that occur in the non-tall, control cases. Most of the challenges occur on technical level (14), followed by legal (5), financial (4) and social (3) challenges. With the exception of construction logistics and local opposition, there are no major similarities in challenges found between the cases. The majority of the challenges are either related to the existing structure or to meet/satisfy to the technical requirements.

Table 4.11. gives an overview of challenges that occur in the tall, cases of interest. Most of the challenges occur on technical level (24), followed by legal and social (2) and financial (1) challenges. The most common challenges that occur in multiple cases are on technical level and are: fire safety (3), construction logistics and weight capacity (2). Just as the non-tall buildings, the majority of the challenges are either related to the existing structure or to meet/satisfy to the technical requirements.

Table 4.12. gives an overview of opportunities for the non-tall, control cases. The most common opportunities that occur in multiple cases are: lean planning (3), lay-out and repetition of floors (2).

Table 4.13. gives an overview of opportunities for the tall, cases of interest. The most common challenges that occur in multiple cases are: lay-out (3), on site mock-ups, repetition of floors and surroundings manager (2).

Table 4.14. gives an overview of challenges of both the tall and non-tall buildings, together with the amount of cases the challenge were mentioned. The similarities between the control cases and cases of interest mean that those challenges are not specific for tall buildings. The similar challenges are: monumental status (2), acoustic requirements (2), asbestos (2), construction logistics (4), deteriorating existing materials (2), fire safety (4), integrating installation grid (2), sustainability requirements (2) and weight capacity (3). However, the challenges that in this case study are only mentioned in the tall building cases, do not necessarily only occur for tall buildings.

Table 4.15. gives an overview of opportunities of both the tall and non-tall buildings, together with the amount of cases the opportunities were mentioned. The similarities between the control cases and cases of interest mean that those opportunities are not specific for tall buildings. The similar challenges are: 3D-scan building (2),

amount of units (2), building orientation (2), collaboration with municipality (2), collaborative process (3), column structure (2), dimensions of the building (2), elevator & escape route capacity (2), lay-out (5), on site mock-up (3), repetition of floors (4) and the urban setting benefit (2). However, the opportunities that in this case study are only mentioned in the tall building cases, do not necessarily only occur for tall buildings.

4.10.6. Main lessons learned from case studies

In both non-tall and tall buildings, most of the challenges occur on technical level. There are not much similarities in challenges between the non-tall cases, but there are some between the tall cases. In both the non-tall and tall cases, the majority of the challenges are either related to the existing structure or to meet/satisfy to the technical requirements.

The similarities in opportunities between the non-tall and tall cases are: lay-out and repetitions of floors.

The similarities between the control cases and cases of interest mean that those challenges and opportunities are not specific for tall buildings. However, the challenges and opportunities that in this case study are only mentioned in the tall building cases, do not necessarily only occur for tall buildings.

In the next chapter these results will be discussed, as some outcomes may not all be valid and need explanation and reasoning.

4.10.7. Comparison with literature study

For the comparison between theory and practice, the literature study has been compared to the findings from the case studies. The different lists of challenges and opportunities have been compared, too find the similarities and more importantly the differences. For each overview, the findings from literature can be found vertically on the left and the findings from the case studies can be found horizontally on the top. For each challenge or opportunity, the similarities have been marked with a letter.

Explanation letter marks in overviews:

C = Mentioned in the control cases
I = Mentioned in the cases of interest
B = Mentioned in both type of cases
X = Not mentioned, but could have been a similarity

If there is not a mark for a specific challenge, that means that this challenge does not fit perfectly within an existing challenge. Therefore, the list of challenges will need to be adapted.

In Table 4.16. an overview of the comparison between the literature study and findings from the case studies in relation to the possible challenges can be found.
Overall, it can be seen that most of the technical challenges are related to the requirements of the Dutch Building Code/decree (E). It can also be seen that the need for area re-development (38) has an influence or can be influenced by facilities (AE) and accessibility (AD).

The delay (2) on economic level has an influence on the financial feasibility. The delay however is not a direct challenge, but can be caused by unforeseen aspects. In the case study this was a fire, which could not have been predicted upfront. In the case studies, delay (8) could also be a legal challenge. If a final completion deadline is delayed, normally the contractor has to pay a fee per day to the client. A similarity is also the possibility that the legal procedures can cause a delay.

The connection of the district heating in the case study was related to the Ministry of Infrastructure and Water Management. This was a legal challenge and therefore this ministry should be included in possible legal challenges.

In the case studies, different installation systems have been mentioned as a challenge. By checking the literature with the case studies, it has been concluded that some of these could be merged. The challenges: climate system (15), heating system (24) and ventilation system (34) can be merged into climate system only. As heating en ventilating is part of controlling the climate in a building.

In one of the case studies, a challenge was the facade being part of the main supporting structure (22) of the building. This could not directly be linked to a poor state of the main structure (X), as this was not the case. The type of main supporting structure can be a challenge on its own and should therefore be included in the list of possible challenges.

In Table 4.17. an overview of the comparison between the literature study and findings from the case studies in relation to the possible opportunities can be found.

Immediately visible is the lack of categories in the outcomes from practice. This has happened, as the opportunities and mentioned solutions were not always directly linked to a challenge. To clarify and improve the opportunities overview, the categorization should be applied.

In the case studies, the amount of units (2) were a opportunity to achieve a higher financial feasibility. The financial feasibility is not only a possible challenge, but also a possible opportunity and should therefore be included in the list.

The collaboration with the municipality (4) has been an advantage in the case studies and can be related to the municipality's initiative (B), but this is not a given. Overall in the case studies, a collaborative process (5) has been mentioned as an opportunity in transformation projects. As is it mentioned in the case studies and clearly was an important aspect, it should be included in the list of possible opportunities.

In some cases, different tools have been mentioned to improve the planning in time and therefore, also cost. Examples are: lean planning (19), logistics scheme (20), an on site mock-up (21) and the use of prefab elements (22). These can be merged into: planning optimization.

Challenges during the transformation of office buildings						
	nr.	Challenge	1.1	2.1	3.1	4.1
Economic	01	Asbestos		X		
	02	Delay (as effect of fire)				
	03	Design choices		X		
	04	Rise in costs materials			X	
	05	Rise in costs human resources			X	
Legal	06	Aesthetics committee				X
	07	Building permit				X
	08	Delay (as effect of fire)				
	09	Design choices		X		
	10	District heating		X		
	11	Monumental status		X		
Technical	12	Acoustic requirements				X
	13	Asbestos			X	
	14	Construction logistics	X		X	
	15	Climate system	X			
	16	Daylight requirements				
	17	Design choices				
	18	Deteriorating existing materials	X			
	19	Deteriorating existing structure		X		
	20	District heating		X		
	21	Elevator capacity	X			
	22	Facade as supporting structure				
	23	Fire safety			X	
	24	Heating system				
	25	Installations & floor/ceiling height				
	26	Integrating installation grid	X			
	27	Noise pollution				
	28	Non-accurate existing drawings				
	29	Roof installations				
	30	Shafts				
	31	Sound insulation			X	
	32	Sustainability requirements	X			
	33	Thermal insulation				
	34	Ventilation system				
	35	Weight capacity				X
Social	36	In operation during construction	X			
	37	Local opposition		X		X
	38	Need for area re-development				
	39	Noise pollution				

Table 4.10. Overview challenges control cases - non-tall (own ill. based on case studies)

In this table, the challenges from all non-tall cases are visualised.

Challenges during the transformation of tall office buildings						
	nr.	Challenge	1.2	2.2	3.2	4.2
Economic	01	Asbestos				
	02	Delay				X
	03	Design choices				
	04	Rise in costs materials				
	05	Rise in costs human resources				
Legal	06	Aesthetics committee				
	07	Building permit				
	08	Delay				X
	09	Design choices				
	10	District heating				
	11	Monumental status	X			
Technical	12	Acoustic requirements	X			
	13	Asbestos				X
	14	Construction logistics	X			X
	15	Climate system				
	16	Daylight requirements		X		
	17	Design choices	X		X	
	18	Deteriorating existing materials			X	
	19	Deteriorating existing structure				
	20	District heating				
	21	Elevator capacity				
	22	Facade as supporting structure		X		
	23	Fire safety	X	X	X	
	24	Heating system			X	
	25	Installations & floor/ceiling height				X
	26	Integrating installation grid			X	
	27	Noise pollution		X		
	28	Non-accurate existing drawings				X
	29	Roof installations				X
	30	Shafts			X	
	31	Sound insulation				
	32	Sustainability requirements		X		
	33	Thermal insulation	X			
	34	Ventilation system			X	
	35	Weight capacity			X	X
Social	36	In operation during construction				
	37	Local opposition				
	38	Need for area re-development	X			
	39	Noise pollution			X	

Table 4.11 Overview challenges cases of interest - tall (own ill. based on case studies)

In this table, the challenges from all tall cases are visualised.

Opportunities during the transformation of office buildings					
nr.	Opportunities	1.1	2.1	3.1	4.1
01	3D-scan building	X			
02	Amount of units			X	
03	Building orientation		X		
04	Collaboration with municipality			X	
05	Collaborative process	X			
06	Column structure			X	
07	Dimensions of the building		X		
08	Elevator & escape route capacity		X		
09	Existing fire safety installation				
10	Existing & sufficient amount of parking			X	
11	Facade as supporting structure				
12	Floor heating system				X
13	Improvement of social interaction				
14	Improvement of accessability				
15	Improvement of livability				
16	Improvement of safety				
17	Informed locals		X		
18	Lay-out		X	X	
19	Lean planning	X	X	X	
20	Logistics scheme				
21	On site mock-up			X	
22	Prefab elements				
23	Repetition of floors		X	X	
24	Reuse existing materials		X		
25	Surroundings manager				
26	Urban setting benefit		X		

Table 4.12. Overview opportunities control cases - non-tall (own ill. based on case studies)

Opportunities during the transformation of tall office buildings					
nr.	Opportunities	1.2	2.2	3.2	4.2
01	3D-scan building			X	
02	Amount of units			X	
03	Building orientation	X			
04	Collaboration with municipality			X	
05	Collaborative process	X		X	
06	Column structure	X			
07	Dimensions of the building			X	
08	Elevator & escape route capacity			X	
09	Existing fire safety installation			X	
10	Existing & sufficient amount of parking				
11	Facade as supporting structure		X		
12	Floor heating system				
13	Improvement of social interaction		X		
14	Improvement of accessability		X		
15	Improvement of livability		X		
16	Improvement of safety		X		
17	Informed locals				
18	Lay-out	X	X	X	
19	Lean planning				
20	Logistics scheme				X
21	On site mock-up			X	X
22	Prefab elements		X		
23	Repetition of floors			X	X
24	Reuse existing materials				
25	Surroundings manager			X	X
26	Urban setting benefit			X	

Table 4.13. Overview opportunities cases of interest - tall (own ill. based on case studies)

Challenges during the transformation of office buildings				
	nr.	Challenge	Control case	Case of interest
Economic	01	Asbestos	1	
	02	Delay (as effect of fire)		1
	03	Design choices	1	
	04	Rise in costs materials	1	
	05	Rise in costs human resources	1	
Legal	06	Aesthetics committee	1	
	07	Building permit	1	
	08	Delay (as effect of fire)		1
	09	Design choices	1	
	10	District heating	1	
	11	Monumental status	1	1
Technical	12	Acoustic requirements	1	1
	13	Asbestos	1	1
	14	Construction logistics	2	2
	15	Climate system	1	
	16	Daylight requirements		1
	17	Design choices		2
	18	Deteriorating existing materials	1	1
	19	Deteriorating existing structure	1	
	20	District heating	1	
	21	Elevator capacity	1	
	22	Facade as supporting structure		1
	23	Fire safety	1	3
	24	Heating system		1
	25	Installations & floor/ceiling height		1
	26	Integrating installation grid	1	1
	27	Noise pollution		1
	28	Non-accurate existing drawings		1
	29	Roof installations		1
	30	Shafts		1
	31	Sound insulation	1	
	32	Sustainability requirements	1	1
	33	Thermal insulation		1
	34	Ventilation system	1	
	35	Weight capacity	1	2
Social	36	In operation during construction	1	
	37	Local opposition	2	
	38	Need for area re-development		1
	39	Noise pollution		1

Table 4.14. Overview challenges comparison (own ill. based on case studies)

In this table, the amount of challenges from all cases are visualised.

Opportunities during the transformation of tall office buildings			
nr.	Opportunities	Control case	Case of interest
01	3D-scan building	1	1
02	Amount of units	1	1
03	Building orientation	1	1
04	Collaboration with municipality	1	1
05	Collaborative process	1	2
06	Column structure	1	1
07	Dimensions of the building	1	1
08	Elevator & escape route capacity	1	1
09	Existing fire safety installation		1
10	Existing & sufficient amount of parking	1	
11	Facade as supporting structure		1
12	Floor heating system	1	
13	Improvement of social interaction		1
14	Improvement of accessability		1
15	Improvement of livability		1
16	Improvement of safety		1
17	Informed locals	1	
18	Lay-out	2	3
19	Lean planning	3	
20	Logistics scheme		1
21	On site mock-up	1	2
22	Prefab elements		1
23	Repetition of floors	2	2
24	Reuse existing materials	1	
25	Surroundings manager		2
26	Urban setting benefit	1	1

Table 4.15. Overview opportunities comparison (own ill. based on case studies)

In this table, the amount of opportunities of all cases are visualised.

nr.	Possible risks	Challenges: Asbestos	Delay	Design choices	Rise in costs materials	Rise in costs human resources	Aesthetics committee	Building permit	Delay	Design choices	District heating	Monumental status	Acoustic requirements	Asbestos	Construction logistics	Climate system	Daylight requirements	Design choices	Deteriorating existing materials	Deteriorating existing structure	District heating	Elevator capacity	Facade as supporting structure	Fire safety	Heating system	Installations & floor/ceiling height	Integrating installation grid	Noise pollution	Non-accurate existing drawings	Roof installations	Shafts	Sound insulation	Sustainability requirements	Thermal insulation	Ventilation system	Weight capacity	In operation during construction	Local opposition	Need for area re-development	Noise pollution
	nr.	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
A	Acquirement / Purchasing costs																																							
B	Financial feasibility	C	I	C	C	C			X	X				X				X																							
C	Housing market and revenues of new function																																							
D	Initial phase investments																																							
E	Dutch building decree							C				X	X			X	X					X		X	X			X				X	X	X	X	X				X
F	Land ownership								X																															
G	Monumental status							C	X			B																												
H	Municipal building act						C	C	X		C																													
I	Presence of asbestos	X							X					X																										
J	Soil pollution								X																															
K	Zoning law						C	C	X		C																													
L	Building too slender or too deep			X						X																		X											
M	Condensation in structure																	X																						
N	Daylight < 10% of the appointed living space																I																							
O	Inadequate acoustic insulations												B																			C								
P	Inadequate pipes, ducts, etc.															C														X		X								
Q	Incorrect technical assessment																																							
R	Inadequate thermal insulation																																X	I						
S	Joints of brick walls in bad condition																																							
T	No balconies or roof terraces																																							
U	No basement																																							
V	Noise pollution																											I												X
W	Not enough elevators and staircases																				C		B																	
X	Poor state of main structure																		C												T									
Y	Poor quality of interior walls																	B					X																	
Z	Stench pollution																																							
AA	Sunlight																I																							
AB	Too loose fit, too high floors			X						X																		X											
AC	Windows not operable																	B																						
AD	Accessability by public transport																																						X	
AE	Amount of facilities																																						I	
AF	Amount of parking spaces																																					C		
AG	Bad reputation, unsafe area																																						I	
AH	Low recognisability of the building and entrance																																							
AI	Routing of the area														X																						C			

Table 4.16 Comparison literature study and findings from case studies (own ill. based on literature study & case studies)

In this table, the challenges from literature are compared to the findings from the case studies.

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Opportunities cases	nr.	Possible opportunities	nr.	A	B	C	D	E	F	G	H	I	J
3D-scan building	01	Boost area (transformation and facilities)	A			B		X	X				
Amount of units	02	Municipality's initiative	B			B		B	B				
Building orientation	03	Dutch Building Code: existing building measures	C		B								
Collaboration with municipality	04	Office type (corridor, center core)	D		B			B	B	C	I	I	I
Collaborative process	05	Design consequences (lay-out, construction)	E		B	I		I	I		I	B	
Column structure	06	Technical consequences (construction, facade)	F		B	C		C	C		X		
Dimensions of the building	07	Sustainability	G		B	I		I	I		I	I	
Elevator & escape route capacity	08	Area redevelopment	H		B	I		I	I		I	I	
Existing fire safety installation	09	Housing environment	I		B	I		I	I		I	I	
Existing & sufficient amount of parking	10	Sustainability	J		B	I		I	I		I	I	
Facade as supporting structure	11					I							
Floor heating system	12									C			
Improvement of social interaction	13			I							I	I	I
Improvement of accessability	14			I							I	I	I
Improvement of livability	15			I							I	I	I
Improvement of safety	16			I							I	I	I
Informed locals	17										I	C	
Lay-out	18							B					
Lean planning	19												
Logistics scheme	20												
On site mock-up	21					X		X	X				
Prefab elements	22							I	I				
Repetition of floors	23							B	B				
Reuse existing materials	24							C	C				
Surroundings manager	25										I	I	
Urban setting benefit	26			B							B	B	B

Table 4.17. Comparison literature study and findings from case studies (own ill. based on literature study & case studies)

In this table, the opportunities from literature are compared to the findings from the case studies.

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5. Conclusion & discussion

5.1. Conclusion

In this section the main research question is answered, based on the research that has been carried out. The conclusions of the sub-questions can be found in Chapter 2 and 4.

The first four sub-questions are answered by the literature study, Chapter 2:

1. What defines an office and what are the current office sub-markets in Amsterdam, Rotterdam & The Hague?
2.What are the causes and effects of structural vacancy?
3. What are the challenges of the conversion of office buildings to housing on economical, legal, tech nical and social level?
4. What are possible solutions to cope with the challenges of conver sion of office buildings to housing?

The fifth sub-question is answered by the empirical research, the case studies, Chapter 4:

5. What are the differences in chal lenges and possible solutions of the conversion of tall office buildings to housing on economical, legal, technical and social level?

As stated in the problem description, the Randstad in The Netherlands faces on the one hand structural vacancy in office buildings and on the other hand a growing housing shortage. Reuse strategies to decrease the vacancy rate of the office market have been researched extensively both inside and outside The Netherlands. However, the challenges and opportunities for these reuse strategies specifically for tall office buildings had not been researched yet. The aim of this research was to find the challenges to conversion of tall office buildings, focused on the four big cities in the Randstad in the Netherlands, in particular Rotterdam. This resulted in the following main research question:

What are the challenges and respective solutions for the conversion of vacant tall office buildings into housing in the Netherlands?

What can be seen from the main research question, is the usage of terms throughout the research which ask for some clarification. The 'respective solutions' have, by the research, been changed and integrated into 'opportunities'. This has been done, as the found opportunities and mentioned solutions were not always directly linked to a challenge. Some of the aspects are also not to be labeled as a solution -to a challenge-, but can have a positive influence on the transformation of tall office buildings to dwellings.

By carrying out this research, not necessarily new or other challenges were found, but some existing possible challenges occurred more often in the tall cases than the non-tall cases. For example: fulfilling the fire safety requirements and the weight capacity of the existing structure. The technical challenges, such as the requirements of the Dutch Building Code and the fitting of the installation systems can have a bigger impact on the transformation of tall buildings. This follows from the stricter rules and regulations for high-rise and the more complicate puzzle of shafts and the amount of floors.

The literature study formed lists of possible challenges and opportunities. When comparing these outcomes to the findings from practice, it became clear that some aspects were not yet included and some were not specified enough. For example, the delay, district heating and various climate system related challenges. As well as the financial feasibility in relation to the amount of units, the collaboration between stakeholders and the optimization of the planning were found as opportunities to be added. Throughout this report, the lists of possible challenges and opportunities have been adapted to find the differences in challenges for the transformation of tall office buildings. The final adaptations within this report can be found in Figures 5.1 and 5.2.

Concluding this research, there are not necessarily new or other challenges in the transformation of tall buildings as opposed to the transformation of buildings that are not classified as tall. However, some challenges, especially those on technical level, can have a higher impact on the transfor-

List of possible challenges

	nr	Possible challenges
Economic	01	Acquirement / Purchasing costs
	02	Financial feasibility
	03	Housing market and revenues of new function
	04	Initial phase investment
	05	Unforeseen aspects causing delay
Legal	06	Dutch building decree
	07	Land ownership
	08	Ministry of Infrastructure and Water Management
	09	Monumental status
	10	Municipal building act
	11	Presence of asbestos
	12	Soil pollution
	13	Unforeseen aspects causing delay
	14	Zoning law
Technical	15	Building climate system (including heating & ventilation)
	16	Building too slender or too deep
	17	Condensation in structure
	18	Connection to district heating system
	19	Daylight < 10% of the appointed living space
	20	Inadequate pipes, ducts, etc.
	21	Incorrect technical assessment
	22	Inadequate thermal insulation
	23	Joints of brick walls in bad condition
	24	No balconies of roof terraces
	25	No basement
	26	Noise pollution
	27	Not enough elevators and staircases
	28	Poor state of main structure
	29	Poor quality of interior walls
	30	Stench pollution
	31	Sunlight
	32	Too loose fit, too high floors
	33	Type of main supporting structure
	34	Windows not operable
Social	35	In operation during construction
	36	Local opposition
	37	Need for area re-development
	38	Noise pollution

Table 5.1. List of possible challenges (own ill. adapted from Remøy (2010) and Table 4.16)

mation of tall buildings.

List of possible opportunities		
	nr	Possible opportunities
Ec.	01	Boost area (transformation and facilities)
	02	Financial feasibility
Legal	03	Collaboration stakeholders
	04	Dutch building code: existing building measures
	05	Municipality's initiative
Technical	06	Design consequences (lay-out, construction)
	07	Office type (corridor, center core)§
	08	Planning optimalization
	09	Sustainability
	10	Technical consequences (construction, facade)
Social	11	Area redevelopment
	12	Housing environment
	13	Sustainability

Table 5.2. List of possible challenges (own ill. adapted Figure 4.17)

5.2. Discussion

In this section the outcomes of the research are discussed.

Possible scenarios
For companies, working remotely can be an investment not everyone is willing to take. Due to COVID-19, everyone was forced to work from home. It could be the case that some companies value working from home, now that their employers have experienced it. Therefore, it is a possible scenario that there will be a higher office vacancy rate in the future. Another scenario could be that companies rather have their employees work together again in one building, floor or room. In that case, there is a possibility that offices need to expand due to the 1,5m-distance rule, which is currently active in the Netherlands.

Vacancy and building height in the Netherlands
During this research it was found that in the Netherlands, even though there is still a significant amount of vacancy, the office market is also in demand in the top office environments of the main cities. Therefore this research could have been more useful if it focused on a broader area. It might also be interesting to look into the reason of the vacancy per case. It could be the case that the location was not interesting anymore for future tenants, but it could also be the case that the building was deteriorated and therefore obsolete. In the Netherlands it was also discovered that not a lot of vacant office buildings were high-rise and/or considered tall. This research used the definition of tall for each city, while comparing the cases cross-pair could be useful if all definitions of tall were the same, for example the 70m definition of the Dutch Building Code.

Interview data
As a consequence of COVID-19, some planned interviews could not take place, as companies had their priorities, understandably, elsewhere. Some interviews have taken place over the phone, instead of a meeting. In total, 10 interviews have been carried out (interviewees 1-10) and 3 interviews have been used from a previous course (interviewees A-C, Re-design course at the TU Delft).

Similarities and differences between cases
Some of the case pairs had different aspects on which they differed. To make the outcomes of the case studies more valid, cases should be found -if they are existing- that have the height criteria as only difference. The amount of cases researched could also be increased, to improve the quality of the research output.

If other cases would have been studied, the outcomes might vary. This can be linked to several criteria, for example: location. If cases are researched worldwide or for one city in particular, the height definitions and ways of working and living might vary. Therefore, transformation in other locations or on another scale can have different outcomes than the research presented in this report.

5.3. Recommendations

In this section, recommendations for further research are given.

Recommendations for research
In the previous section, possible scenarios are discussed. Both possible scenarios need follow-up research in the field of office transformations and renovations.

If this researched is followed up, it is recommendable outside the Netherlands, in a city or country that has a significant amount of tall, vacant, office buildings and are in need of more dwellings. It is recommended to hereby also focus on a broader area.

To possibly develop more valid outcomes, it is recommended to increase the amount of cases researched and optimize the criteria.

Recommendations for practice
For practice it can be recommended to use the outcomes of this research as input for future transformation projects from former offices to housing. It can be learned that most challenges occur on technical level and are inter-related with each other.

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Interview data

For privacy reasons, the names and companies of respondents are excluded from this report

Interviewee 1-11 (own interview data)
Interviewee A-C (interview & data from course Re-design - TU Delft)

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I. Tall buildings list Rotterdam

Building name	Height (m)	Floors (#)	Completion year	Use	Availability (2016)		Legend availability
Maastoren	164,8	44	2010	Office	0-10%		0-10%
Gebouw Delftse Poort 1	151,4	41	1991	Office	50-60%		10-20%
World Port Center	133,6	38	2001	Office	0-10%		20-30%
First Rotterdam	128,2	32	2015	Office	0-10%		30-40%
Fortis Bank Blaak	106,9	28	1996	Office	60-70%		40-50%
Toren op Zuid	96,5	23	2000	Office	30-40%		50-60%
Robeco	95,3	21	1991	Office	70-100%		60-70%
Hofpoort	95,0	27	1976	Office	40-50%		70-100%
Hoge Erasmus	93,0	28	2001	Office/Residential			
Gebouw Delftse Poort 2	93,0	25	1991	Office	50-60%		
Europoint II	93,0	22	1975	Office	70-100%		
Europoint III	93,0	22	1975	Office	70-100%		
Europoint IV	93,0	22	1978	Office			
World Trade Center	93,0	25	1986	Office	50-60%		
Wilhelminatoren	90,4	22	1997	Office	20-30%		
ABN Amro	89,0	23	1993	Office	0-10%		
Willemswerf	87,7	24	1988	Office	30-40%		
Gebouw De Maas	75,6	22	1988	Office	0-10%		
Ernst & Young	75,1	21	2005	Office	0-10%		
T-Gebouw Erasmus Universiteit	75,0	20	2005	Office	0-10%		
Coolse Poort	74,2	21	1980	Office	10-20%		
UWV	72,3	19	2008	Office	0-10%		
Splinter	<70	<20	2002	Office			
PriceWaterhouseCoopers	<70	<20	2005	Office			
Blaak 333	<70	<20	1962	Office			
UPC	<70	<20	1991	Office			
Weenapoint	<70	<20	1970	Office			
Stad Rotterdam Verzekeringen	<70	<20	1990	Office			
Vopak	<70	<20	1960	Office			
Wilhelminahof	<70	<20	1997	Office			
Adriaan Volkerhuis	<70	<20	1973	Office			
Witte Huis	<70	<20	1898	Office			

II. Interview protocol

Email

Beste {NAME},

Momenteel zit ik in het afstudeerjaar van mijn master Management in the Built Environment aan de TU Delft.
Mijn onderzoek focust zich op transformaties van (hoogbouw) kantoren tot woningen.
Voor dit onderzoek is het van belang om naast een literatuuronderzoek ook kennis uit de praktijk te vergaren door middel van case studies en interviews met experts.

Het doel van het onderzoek is om de verschillende uitdagingen en mogelijke oplossingen te vinden tussen transformaties van kantoorgebouwen ten opzichte van hoogbouw kantoorgebouwen naar woningen.
De hoofdvraag van dit onderzoek is: What are respective solutions to challenges for the conversion of vacant tall office buildings into housing in the Netherlands? (Wat zijn respectieve oplossingen voor uitdagingen voor de transformatie van leegstaande hoge kantoorgebouwen naar woningen in Nederland?)

Graag zou ik met u als {FUNCTION} hierover in gesprek willen gaan.
{CASE SPECIFIC}
Het interview zal ongeveer een uur duren en de informatie zal anoniem verwerkt worden.
Als u hiervoor open staat hoor ik graag welke datum en tijd u schikt.
Uiterlijk twee werkdagen van tevoren zal ik u de interviewvragen en het onderzoeksvoorstel versturen ter informatie.

Ik hoor graag van u.

Met vriendelijke groet,
Lisanne Alexandre
L.M.Alexandre@student.tudelft.nl
+31 6 345 458 68

5.4.1. List of contacts

Not included in this document due to privacy reasons.

Interview protocol (Dutch)

As respondents will most likely be Dutch, the interview protocol is written in Dutch.

Datum	0 maand 2019
Tijd	00:00 - 00:00
Locatie	Bedrijf
	Adres
Respondent	Naam - Functie
Interviewer	Lisanne Alexandre - Student TU Delft

Beste {NAME}

Hartelijk bedankt dat u de tijd neemt voor dit interview.

Het onderzoek focust zich op transformaties van (hoogbouw) kantoren tot woningen. Het doel van het onderzoek is om de verschillende uitdagingen en mogelijke oplossingen te vinden tussen transformaties van kantoorgebouwen ten opzichte van hoogbouw kantoorgebouwen naar woningen. De hoofdvraag van dit onderzoek is: What are respective solutions to challenges for the conversion of vacant tall office buildings into housing in the Netherlands? (Wat zijn respectieve oplossingen voor uitdagingen voor de transformatie van leegstaande hoge kantoorgebouwen naar woningen in Nederland?)

Het eerste deel van het interview bestaat uit een aantal algemene vragen om uw achtergrond en perspectief te begrijpen. Het tweede deel van het onderzoek zal ingaan op de uitdagingen en oplossingen op legaal, financieel, (bouw)technisch en sociaal vlak vanuit uw expertise.

Om het transcriberen van het interview efficiënter te maken wil uw toestemming vragen om het interview op te nemen. In verband met de privacy, zullen alleen mijn mentoren en ik toegang hebben tot deze transcriptie en het audiobestand zal direct na transcriptie verwijderd worden. De informatie die gedeeld wordt tijdens het interview zal met zorg behandeld en anoniem in het rapport verwerkt worden. Deelname aan het interview is vrijwillig en u mag op elk moment het interview stoppen.

Heeft u nog vragen voor de start van het interview starten?

Na start audio:
Mag het interview worden opgenomen?

Algemene vragen

1. Professionele achtergrond

1.1. Sinds wanneer bent u werkzaam binnen dit bedrijf met deze functie?
1.2. Heeft u andere functies gehad binnen dit bedrijf of vorige werkgevers?

2. Project informatie

2.1. Kunt u een korte introductie geven over het project?
2.2. Wat was precies uw rol binnen het project en wat hield dit in?
2.3. Bij welke fasen binnen het project was u betrokken?

Vragen gemeente

3. Gemeentelijke visie

3.1. Kunt u kort beschrijven wat de gemeentelijke visie is met betrekking tot kantoor transformaties?
3.2. Is deze visie sterk veranderd de afgelopen jaren? Wat heeft er voor gezorgd dat deze wel of niet is veranderd?

4. Gemeentelijke rol

4.1. In welke mate speelt de gemeente een rol binnen kantoortransformaties?

4.2. Wat zijn tools van de gemeente die ingezet kunnen worden tijdens het transfor matieproces?

5. Uitdagingen

5.1. Kunt u voorbeelden noemen van wettelijke uitdagingen en hoe gaat de gemeen te hiermee om?
(bijvoorbeeld: omgevingsvergunningen)
5.2. Kunt u voorbeelden noemen van financiële uitdagingen en hoe gaat de gemeen te hiermee om?
(bijvoorbeeld: subsidies)
5.3. Kunt u voorbeelden noemen van (bouw)technische uitdagingen en hoe gaat de gemeente hiermee om?
(niet direct een uitdaging voor de gemeente, maar wellicht kunt u wel voorbeelden noemen uit de praktijk)
5.4. Kunt u voorbeelden noemen van sociale uitdagingen en hoe gaat de gemeen te hiermee om?
(bijvoorbeeld: woonomgeving, gentrification, faciliteiten)

6. Case studie

6.1. Wat zijn volgens u binnen uw gemeente geslaagde kantoortransformaties gewe est? Waar zit het succes in?
6.2. Heeft u verder nog vragen, opmerkingen of tips met betrekking tot het onder zoek?

Vragen ontwikkelaar / architect / bouwbedrijf

3. Project team

3.1. Welke stakeholders maakten deel uit van het project team?
3.2. Van wat voor soort team of contractueel verband was er sprake?
3.3. Heeft deze vorm van een team verband gezorgd voor bepaalde uitdagingen en/of oplossingen?

4. Uitdagingen

4.1. Kunt u voorbeelden noemen van wettelijke uitdagingen? In welke fase van het project kwamen deze uitdagingen voor? Hoe is er omgegaan met wettelijke uit dagingen?
(bijvoorbeeld: Bouwbesluit, omgevingsvergunning)
4.2. Kunt u voorbeelden noemen van financiële uitdagingen? In welke fase van het project kwamen deze uitdagingen voor? Hoe is er omgegaan met financiële uit dagingen?
(bijvoorbeeld: vertragingen, onvoorziene kosten en oorzaken)
4.3. Kunt u voorbeelden noemen van (bouw)technische uitdagingen? In welke fase van het project kwamen deze uitdagingen voor? Hoe is er omgegaan met (bouw) technische uitdagingen?
(bijvoorbeeld: constructief, daglicht, verdiepingshoogtes, grid, gevel)
4.4. Kunt u voorbeelden noemen van sociale uitdagingen? In welke fase van het proj ect kwamen deze uitdagingen voor? Hoe is er omgegaan met sociale uitdagingen?
(bijvoorbeeld: transformatie en de buurt)

5. Hoogbouw

5.1. Merkt u verschil in uitdagingen tussen specifiek hoogbouw transformaties en niet hoogbouw transformaties? Waarom wel of niet?
Zo ja, welke uitdagingen zijn dit en op welk aspect?

6. Case studie

6.1. Welke casus lijkt u nog meer interessant voor dit onderzoek? Waarom?
6.2. Wat zijn volgens u geslaagde kantoortransformaties? Waar zit het succes in?
6.3. Heeft u verder nog vragen, opmerkingen of tips met betrekking tot het onder zoek?

Challenges to reuse of tall office buildings in the Nether-lands

A focus on the Randstad