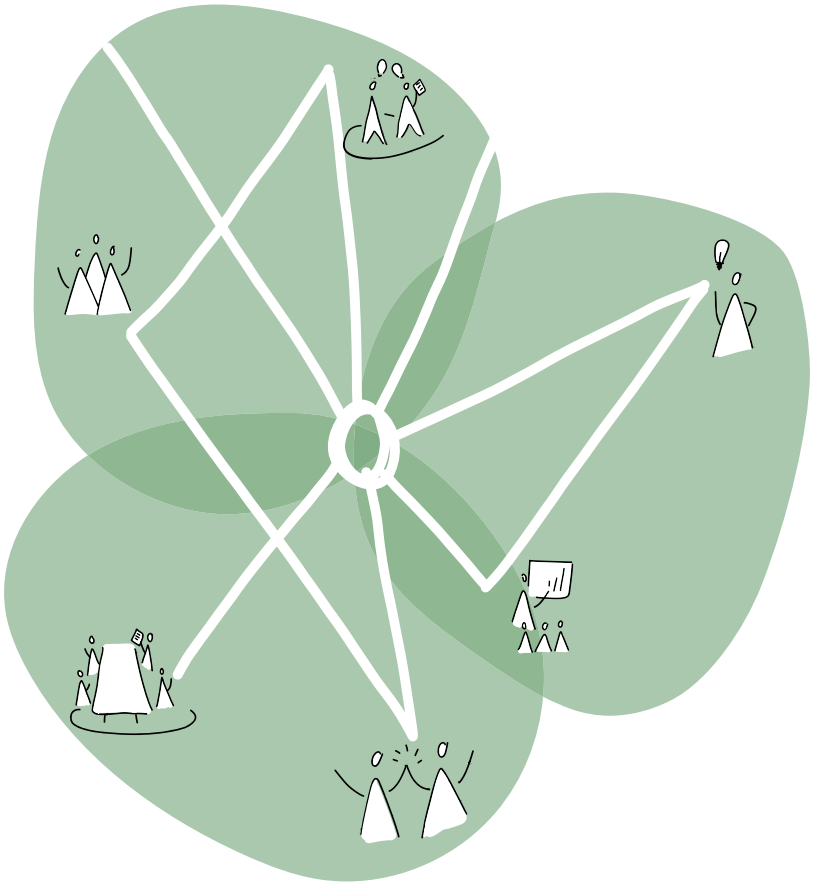
The implementation of adaptability as a tool for future proof buildings in the Netherlands



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Colophon

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Preface

In 2021, I moved to Delft. After living in Enschede for five and a half years and studying at the University of Applied Science, I was ready for a new challenge. During my architecture bachelor I missed focus on the processes that made it possible to develop the buildings I studied. Because of this, I started the master Management in the Built Environment. This master made me realize that studying and learning new things every day is very valuable and quite amazing.

During one of the lectures of the master, a professors mentioned that we have to be future proof. However, we don't know what the future will hold. In the past few years, we have learned that the future as we might have predicted it, can be totally different than reality. So, how can we be future-proof? Buildings as we are developing them right now are mono-functional, responding to the demands at that particular moment. So, being future-proof is actually being able to react to changes, being adaptable. By focusing on adaptable buildings, we can create a resilient built environment, simultaneously reducing construction carbon emissions and fostering sustainable urban development.

This research is a contribution to the understanding of developing adaptable buildings. As the physical aspects of adaptability are clear to most real estate practitioners, studying the roles and influence of the stakeholders involved, can positively influence the development of adaptable buildings. This thesis aims to give clarity and guidance to stakeholders in developing more adaptable buildings. It also aims to inspire and motivate people in their responsibility for developing a sustainable built environment.

I would like to thank my supervisors, Hilde Remøy and Peter de Jong, for your guidance during the writing of this graduation thesis. Your critical questions and feedback encouraged me to keep looking at my research with a critical eye and motivated me to push the research further. Next to that, I would like to thank my colleagues at Dev_ real estate, and in particular my supervisor Bart Rodenburg, for the guidance in the past year. You were always willing to discuss my subject and ensured that I always thought critically about my own statements.

Lastly, I would like to thank the interviewees and experts for participating in the research and willingness to share their opinions and view on the research. Your input played a large role in the outcomes of the research and was not possible without you.

Enjoy reading this research!

Esra van der Weijden
Delft, January 2024

Abstract

We have to change. We have to take a second look at our daily patterns. The construction sector is responsible for 36% of the world's final energy use and 39% of energy and process-related carbon dioxide emission (IEA, 2019). 30% of this emission is due to building construction. Therefore, it is important to start to limit the carbon emission from construction processes. An efficient and sustainable way to limit the emissions is to develop buildings that are adaptable to any function or user, with the least effort and minor transformations to the building. Additionally, according to Manewa et al. (2016) buildings are continuously confronted with internal and external environmental changes to which they must respond. Those changes happen unpredictably and with many uncertainties. Buildings that are not able to react to those changes will be prematurely obsoleted, require extensive transformations, or need to be demolished, neither of which will result in a built environment that is sustainable (Manewa et al., 2016). Therefore, by not being able to adapt to the changing society and future demands, we are not building to last.

Even though several strategies have been developed and research has been conducted on the concept of adaptability, the transition from knowledge to implementation seems out of reach. Those studies mainly focus on the implementation of adaptability on the building level and not on the building as a "life cycle process". Only a number of books and studies also examine the cooperation of the various parties in developing the proposed strategies. From this problem statement, the following research question is formulated: *"What are the criteria for developing an adaptable building, and how can clients influence the implementation of these criteria in development projects?"*. To answer this question, a literature review is conducted from which a list of adaptability criteria is developed. Additionally, the criteria are compared to existing Dutch cases through a case study with a cross-case analysis, and the roles and influences of parties involved in the development of adaptable buildings are established through interviews. The findings from the empirical research are used to develop an action plan which is validated by an expert panel. The action plan can be used by clients or other stakeholders as a guideline for developing adaptable buildings in the Netherlands. It can also be used to motivate and inspire other stakeholders or to start the discussion about the concept.

Keywords – adaptability, future-proof, adaptability criteria, action plan, stakeholders, roles and influences

Executive summary

Introduction

In an ever-changing world, the resilience of our building stock is crucial in responding to evolving societal needs and environmental challenges (Cobouw & VBI, 2021; Ganzlebem & Marnane, 2019; United Nations Environment Programme, 2018). Currently, buildings are mono-functional, designed to meet immediate societal demands but not equipped to adapt through their lifespan, increasing the risk of vacancy or demolition (Blakstad, 2001; Slob & Mohammadi, 2010). Stewart Brand (1995) highlights in his book that buildings are static objects in a dynamic world, often unable to adapt to changing demands, technologies, economies, and societal shifts. He points out that buildings are predictions, yet the ones designed to adapt are the ones that endure (Brand, 1995).

Today's emphasis on sustainability brings into focus the construction sector's contribution to carbon emissions, accounting for almost 40% of the total (IEA, 2019). 30% of this emission is due to building construction. Currently, sustainable practices focus on raw materials, energy consumption, CO2 emissions, and circularity (Batbileg et al., 2018; PWC & Institute, 2018). Adaptability emerges as a solution, addressing the current inability of buildings to undergo functional transformations without extensive alterations. Peter Graham (2009) once said *"A sustainable building is not one that must last forever, but one that can easily adapt to change."* (Graham, 2009). This perspective underscores the importance of designing buildings with future value in mind (Askar et al., 2021).

However, current studies mainly focus on the physical criteria of adaptable buildings. In order to make a transition, the cooperation of the stakeholders involved in developing adaptability must be considered. Clients, involved in the development process, are experiencing many risks and uncertainties. It is therefore necessary to create certainties and find out how people should co-operate. To address this problem, this thesis aims to give clarity and guidance to stakeholders involved in the development of adaptable buildings.

To address the problem statement, the following research questions is answered in this research:

"What are the criteria for developing an adaptable building, and how can clients influence the implementation of these criteria in development projects?"

To get a better understanding of the main themes and to support the main research question, the following sub-questions have been used:

1. How can adaptability in buildings be described?
2. What are existing adaptability strategies?
3. How can existing adaptability strategies be combined into adaptability criteria?
4. How do the adaptability criteria compare to cases in practice?
5. What are the roles of the stakeholders involved in the development of adaptable buildings?
6. How can clients influence the implementation of adaptability in new buildings?

Research methods

In the figure below, the research model is shown. To create an overview on how the main research question have been answered by means of the sub-questions the research is divided into three sections.

Desk research

To get an understanding of the concept of adaptability with its different underlying aspects, and existing adaptability strategies a literature review is conducted. This background information is then combined into the overall adaptability criteria that form the foundation of the research. The desk research is used to collect the right information for further phases, because introducing a new concept in the field of adaptability requires a proper understanding of the concept and what is already studied and developed (Cooper et al., 1998). The desk research addresses the first three sub-questions. In the overall research focus lies on adaptability strategies for new buildings within a Dutch context. For the literature review this focus is broader in order to collect all important data for developing the preliminary list of criteria and selecting the most important elements.

Empirical research

To improve and test the preliminary list of criteria and to get an understanding of the stakeholders involved in the development of adaptability in buildings, a multiple case study is conducted. The advantage of a multiple case study is that it allows the researcher to analyze both inside the cases and across the cases. Another advantage of using a multiple case study is that it improves the validity of the data (Gustafsson, 2017).

For the research three cases are studied. Studying three cases makes it possible to go deeply into the content of the cases, but they can still be compared with each other through cross-case analysis in order to find similarities and differences, which improves the reliability of the results (Groat & Wang, 2013; Gustafsson, 2017). The empirical research consists of a multiple-case study with a cross-case analysis and semi-structured interviews. The case study focuses on buildings that have been transformed from one function to another, within the Dutch context to establish ‘‘lessons learned’’.

Synthesis

All findings from the research on the adaptability criteria, the roles and influences of stakeholders, the barriers they experience and the opportunities they see are combined into an action plan for clients. The goal of the action plan is to function as a guideline for clients to develop adaptable buildings in the Netherlands by overcoming different barriers, creating clarity about the direct and indirect influence a client has on the process.

For validation of the research outcomes an expert panel is used. An expert panel is a qualitative interview where focus lies on a subject within the expertise of the experts (Döringer, 2021). The expert panel consists of three clients working in the built environment. Every expert reacts to statements given by the researcher and the developed action plan. The expert panel is used to get feedback on the action plan and the findings from the case study.

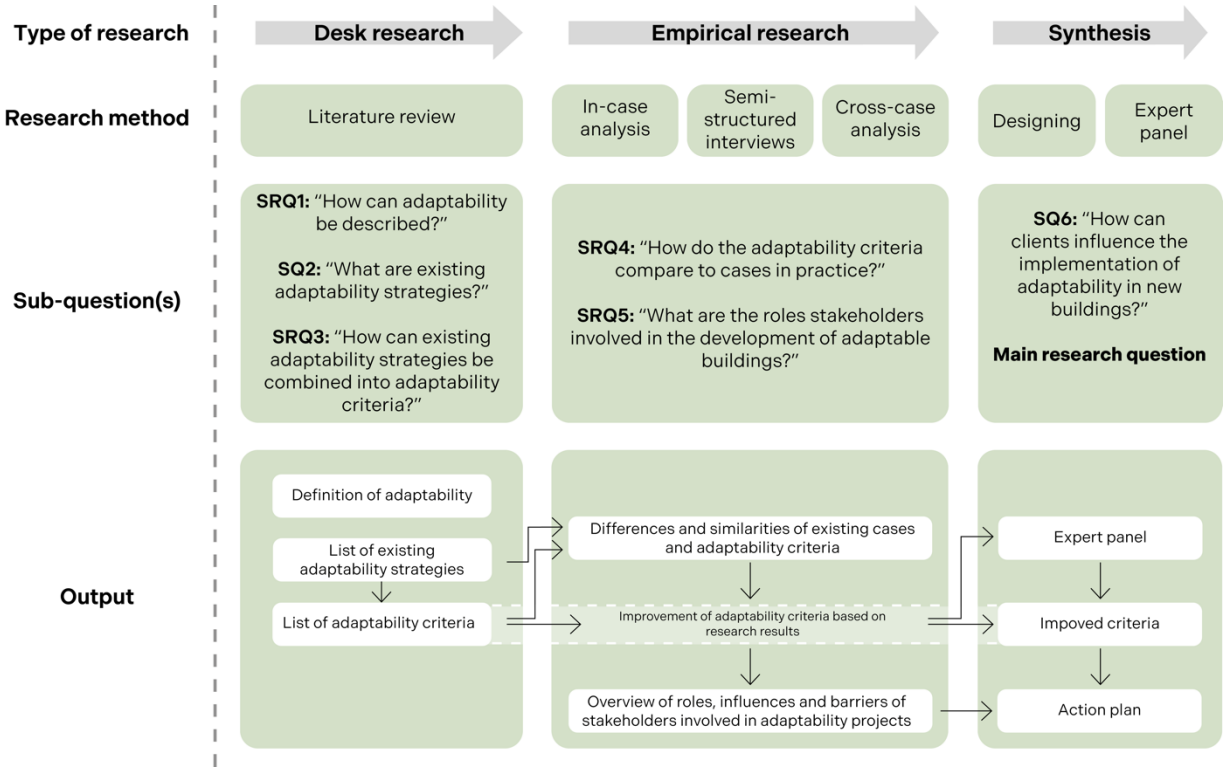


Figure 1 Research model (own figure)

Desk research

Buildings are developed to fulfill the demands of the users and/or owners, even though those demands are dynamic and change often. It can be stated that a building is in the first place not a goal, but a means to fulfill the demands of the user. Adaptability is a broad and layered concept. It is influenced by many internal and external factors. All of this results in an uncertain and unpredictable future. In the need for a sustainable built environment, buildings must be able to adapt to future scenarios. The buildings are at risk of becoming vacant or obsolete when their adaptive capacity is low, and they are not able to adapt to future demands of the user

In literature, the concept of adaptability is commonly defined by four characteristics: the capacity for change, the ability of the building to remain "fit" for purpose, value, and lastly, time. Time is presented to indicate the speed of change and to indicate changes of life (Blakstad, 2001; Schmidt III et al., 2010; Schmidt, 2014). According to Schmidt (2014) the concept of time is a very important addition, because in an attempt to make the building 'fit for purpose', it makes the building or the design susceptible for change and places it in context (Schmidt, 2014).

In this research the following definition for adaptability is used:

"The capacity to change the building's built-environment in order to respond and fit to the evolving demands of its users/environment maximizing value throughout its lifecycle."
(Schmidt III et al., 2009)

The development and understanding of adaptability in buildings is supported by a number of models and concepts that have emerged as a result of building adaptability research over time. One of the fundamental concepts in adaptability research is the research by Duffy (1990). Duffy (1990) introduced the concept that divides the building into "layers", based on their lifespan and capacity of change, rather than describing and measure the building in material terms. The introduction of this framework was the first step from seeing the building as a static object to seeing the building as an object connected to its lifecycle in a dynamic world. In the most recent research that was done by Schmidt III and Austin (2016), the layers of Duffy and Brand were revised and the layers *social* and *surroundings* were added, ending with the layers; *social, stuff, space plan* or *space, services, structure, skin, site* and *surroundings (Schmidt III & Austin, 2016)*.

For the development of the adaptability criteria, existing adaptability strategies and tactics were listed and categorized. This was done by linking the existing strategies to the shearing layers of Schmidt III and Austin (2016) and the adaptability dimensions of Van Ellen et al. (2021). The list of criteria has derived from the structured and categorized collection of adaptability strategies and criteria and resulted in ten criteria for the development of future proof buildings, shown in the table below.

The adaptability criteria focus on both the building as the position of context and stakeholders in the process and give an extra dimension to the existing strategies. The adaptability criteria related to the building design are allocated under *building aspects.* The criteria that describe the context of the project are allocated under *location & context*. The last theme is *mindset & team*, consisting of the criteria that focus on the "human side" of adaptability.

Considering the stakeholders, in this research, focus lies on three stakeholders with a high influence and high benefits, being the client (rent and sell), architect, and project manager because they have a steering role in the implementation of adaptability in development projects but with differences in their benefits (Pinder et al., 2013; Winch, 2009).

Table 1 Adaptability criteria, derived from literature

Building aspects	**Location & context**	**Mindset & team**
• Characteristics of the building • Over-dimensioning • Fluid-spaces & buffer zones • Demountable, modular & independent • Lay-out of the building & zoning • Rearrangeable	• The right location • Multifunctional • Non-physical context	• Flexible thinking

Empirical research

The empirical research involved a multiple-case study. The cases studied are *Laan van NOI, Slotervaart CVZ,* and *de Zoutmanstraat*. With the findings from the cross-case analysis the adaptability criteria are improved. In addition, the cross-case analysis gives information about the roles and influences of stakeholders and the barriers they experience for adaptability.

Many of the adaptability concepts from the literature review were mentioned by interviewees. *Over-dimensioning* (both in size and load capacity), *characteristics of the building,* and *demountable, modular & independent elements* were mentioned as most important for the transformation of a building from one function to another. The other adaptability criteria were mentioned as nice-to-haves in transformation because they do not affect the adaptability significantly.

Even though three of the ten adaptability criteria were mentioned as most important, they are not considered must-haves for adaptability. Other findings point out that the mindset and collaboration of stakeholders is the key to project success.

Overall, adaptable building aspects influence the adaptability of a building but are mostly considered nice-to-haves instead of must-haves in the over-all adaptability. When the building is not over-dimensioned, has a low architectural character, or has no demountable elements, adapting a building becomes challenging but is not impossible.

During the empirical research, the adaptability criteria as established before were tested and improved using findings from the multiple-case study. The case study showed that the success of implementing adaptability mostly lies with the stakeholders involved. Therefore, the adaptability criteria were improved with an extra focus on the roles of stakeholder. To support the adaptability criteria from literature and to bring focus to the process, a list of success factors related to the roles and collaboration of stakeholders has emerged. In addition, the findings showed that a crucial role in developing adaptable buildings lies with the clients, due to their influence and power in a project. For this reason, the action plan that is developed in the synthesis phase, focuses on the role of the client.

Table 2 Success factors for adaptable building developments

Success factors for adaptability	
1. Develop a future-proof design	7. Create a balance between ambitions and business case
2. Create a document with clear ambitions & goals	8. Select a designer with experience and expertise
3. Translate ambitions to measurable KPIs	9. Select stakeholders with a "Can Do" mentality
4. Ensure good municipal collaboration	10. Find innovative financial resources
5. Ensure knowledge about adaptability within the project	11. Keep reflecting on progress and process
6. Early involvement of project team	

From the case study it became clear that the mindset of stakeholders and the selection of the project team are key to success. Even though all stakeholders are important in project success, the influence and power those stakeholders have differ. The interplay between the implementation of adaptability criteria in new buildings and good collaboration are key to a high transformation potential in the future. In addition to that, the amount of and extent to which adaptable building aspects are adopted in a building, and how the project and process are managed, are directly influenced by stakeholders with the highest influence on the project, like the client, architect, and project manager.

The client has the highest influence on the implementation of adaptability in a project, because in the end the client is the main decision maker. Here, a distinction can be made between short-term involved clients that develop the project to sell after the design phase or completion, and the long-term involved clients that keep the building within their own portfolio. Both types of clients have a high influence on the overall adaptability in a project, but with a different ambition.

The project manager is also important for project success, which is often hired by the client. The project manager can influence the overall adaptability on different levels. When the client has the ambition to develop an adaptable building it is important to select a project manager that understands and represents its ambitions. On the other hand, the project manager can also motivate the client to 'be better' and implement more adaptability aspects in the projects, by understanding the impact of decisions on the project and the business case.

Together with the client the project manager selects the project team. This team must be a selection of stakeholders with an innovative and positive mindset. All stakeholders must adopt a 'Can Do' mentality. By thinking in solutions rather than challenges the chances to success become higher. In addition, the design team must have shared visions and ambitions with the client about adaptability and the project goals.

Synthesis

The three cases discussed in the cross-case analysis show different barriers for the development of adaptable buildings. This shows that adaptability is a complex concept with many challenges for stakeholders. However, to improve the process, barriers experienced by the stakeholders can be translated to success factors and opportunities that can be influenced directly and indirectly by the stakeholders with a steering role in the project.

The goal of the research was to develop an overall action plan for the implementation of adaptability in new development projects focusing on the role of the client and make the process more tangible and clearer. The action plan can be used by clients or other stakeholders as a guideline for developing adaptable buildings. The elements that are needed to shape the action plan are based on the findings from literature and the empirical research. Developing the action plan means that the developed strategies on adaptability (shown in adaptability criteria) are combined with the theory on the roles of the stakeholders involved in the process, and the opportunities or success factors experienced in practice.

As the action plan is a guideline for adaptable building development, it shows different elements, from the process of adaptability with corresponding actions, the amount of influence stakeholders have, the different stakeholders involved, and adaptability criteria, to success factors and the indirect influence a client has on the implementation of adaptability.

Conclusion

The findings of the different research elements lead to answering the main research question:

"What are the criteria for developing an adaptable building, and how can clients influence the implementation of these criteria in development projects?"

In current studies, focus lies on the physical aspects of adaptability (Brand, 1995; Schmidt III & Austin, 2016). While these aspects are crucial for achieving adaptability, the "human side" must be linked to the existing strategies. This helps to connect the influence that stakeholders have on the development process to tangible adaptability solutions and actions. In this research the technical aspects of adaptability are linked to the "human side" of the concept through an action plan.

The "action plan for adaptability", which combines all elements of the research into one unified model, provides the answer to the main research question. The success factors, together with the adaptability criteria form the basis for the action plan in which the influence of the client on adaptability projects is mapped out and made tangible to improve the implementation of adaptability in development projects.

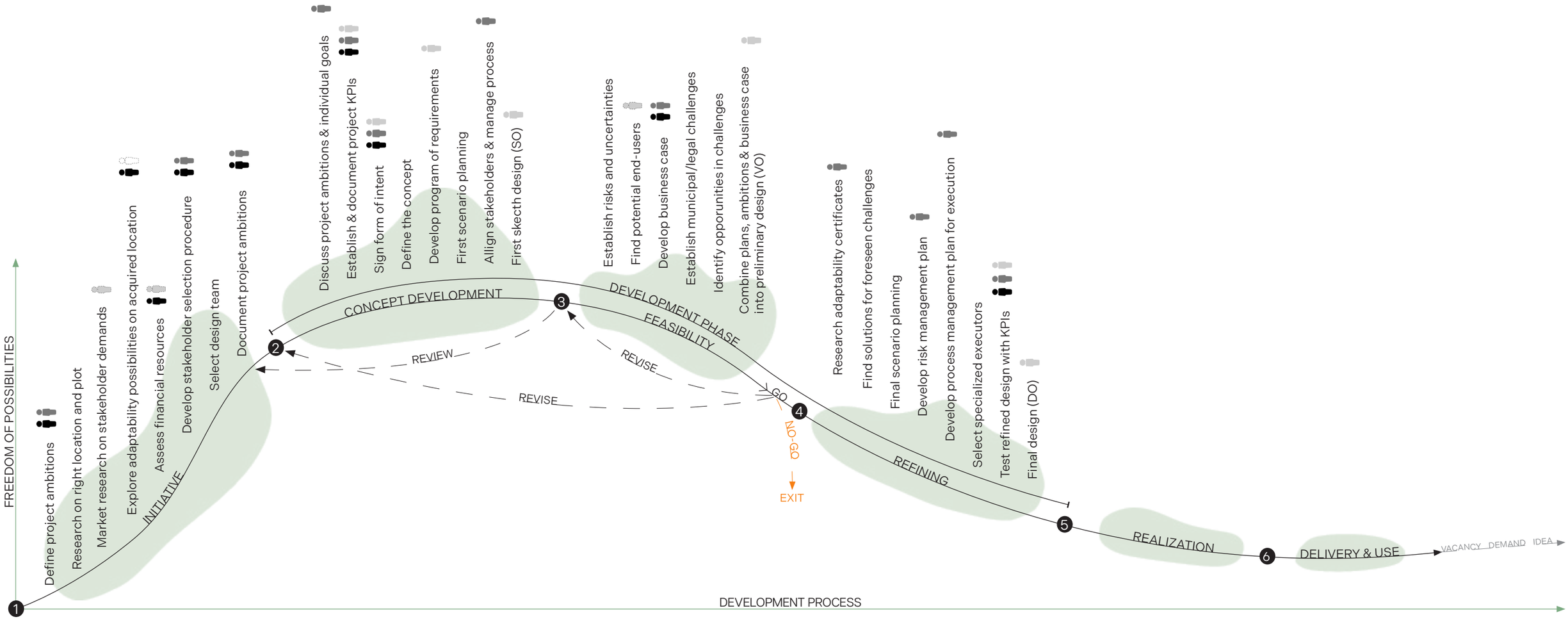
At the beginning of the research, it was stated that when it is understood **what** is needed for an adaptable building and there is more clarity about **how** and **who** can influence these elements, it becomes easier to implement adaptability in projects. Presenting these elements in a clear overview will increase the chance to project success for adaptability.

It can be concluded that **what** is needed in an adaptable building is clear to most real estate practitioners. However, **how** this can be implemented in projects, and **who** is responsible for influencing these elements, is unclear to many. The action plan in this research focuses on creating the clarity that is needed to make the influence clear and manageable for the client. It also gives insights on what actions must be taken.

The action plan can be used by clients or other stakeholders as a guideline for developing adaptable buildings. It can also be used to motivate and inspire other stakeholders. Even though the action plan is no guarantee to project success, to improve the functionality of the action plan it requires phasing with actions and milestones. The action plan shows different elements, from the adaptability criteria and success factors to the process of adaptability with corresponding actions, the amount of influence stakeholders have, and the indirect influence a client has on the implementation of adaptability.

The action plan is shown on the next page. The overall action plan can be found in Appendix IX: . There, the action plan that can be used by different practitioners is shown with a corresponding explanation.

ACTION PLAN
FOR ADAPTABLE BUILDING DEVELOPMENT



LEGEND

y-axis: freedom

development process phases

perceived amount of influence (schematic):

high

low

stakeholder:

- client
- project manager
- investor
- design team
- municipality

ADAPTABILITY CRITERIA

Building aspects

- Over-dimensioing
- Characteristics of the building
- Demountable, modular & independent
- Fluid spaces & buffer zones
- Lay-out of the building & zoning
- Rearrangeable

Location & context

- The right location
- Multifunctional
- Non-physical context

Mindset & team

- Flexible thinking

SUCCESS FACTORS

A. Develop a future-proof design
B. Create a document with clear ambitions & goals
C. Translate ambitions to measurable KPIs
D. Ensure good municipal collaboration
E. Ensure knowledge about adaptability within project team
F. Early involvement of project team
G. Create a balance between ambitions and business case
H. Select a designer with experience and expertise
I. Select stakeholders with a “Can Do” mentality
J. Find innovative financial resources
K. Keep reflecting on progress and process

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Part 1

Relevance

1 Introduction

In an ever-changing world, the resilience of our building stock is crucial in responding to evolving societal needs and environmental challenges (Cobouw & VBI, 2021; Ganzlebem & Marnane, 2019; United Nations Environment Programme, 2018). Currently, buildings are mono-functional, designed to meet immediate societal demands but not equipped to adapt, increasing the risk of vacancy as user needs evolve (Blakstad, 2001; Slob & Mohammadi, 2010).

Stewart Brand (1995) highlights in his book that buildings are static objects in a dynamic world, often unable to adapt to changing demands, technologies, economies, and societal shifts. He points out that all buildings are predictions, yet the ones designed for adaptability are the ones that endure (Brand, 1995).

Today's emphasis on sustainability brings into focus the construction sector's contribution to carbon emissions, accounting for almost 40% of the total (IEA, 2019). 30% of this emission is due to building construction. Currently, sustainable practices focus on raw materials, energy consumption, CO2 emissions, and circularity (Batbileg et al., 2018; PWC & Institute, 2018). Adaptability emerges as a solution, addressing the current inability of buildings to undergo functional transformations without extensive alterations. Peter Graham (2009) once said *"A sustainable building is not one that must last forever, but one that can easily adapt to change."* (Graham, 2009). This perspective underscores the importance of designing buildings with future value in mind (Askar et al., 2021).

This research focuses on this issue and what clients can do to influence projects, so we create a future proof building stock as soon as possible.

1.1 Problem statement

Even though several strategies have been developed and research has been conducted on the concept of adaptability, the transition from knowledge to implementation seems out of reach. As mentioned, the construction sector is responsible for almost 40% of carbon emission of which 30% is due to building construction (IEA, 2019). A solution for reducing this emission is adaptive reuse. However, our current building stock is not able to allow functional transformations without large changes. Therefore, we have to start developing our new buildings with its future value in mind, and this is where clients can contribute. Current studies mainly focus on the criteria of an adaptable building and not on the building as a "life cycle process". Only a number of studies also examine the cooperation of the parties in developing the proposed strategies (Pinder et al., 2013; Schmidt III & Austin, 2016; Schmidt III et al., 2010). Therefore, the goal of this thesis is to close this knowledge gap. Clients, involved in the development process, are experiencing too many risks and uncertainties. To be able to make a transition, it is therefore necessary to create certainties and find out what buttons to press for people to co-operate. This thesis will combine developed strategies and create an action plan for clients with both the building level and the process level in mind.

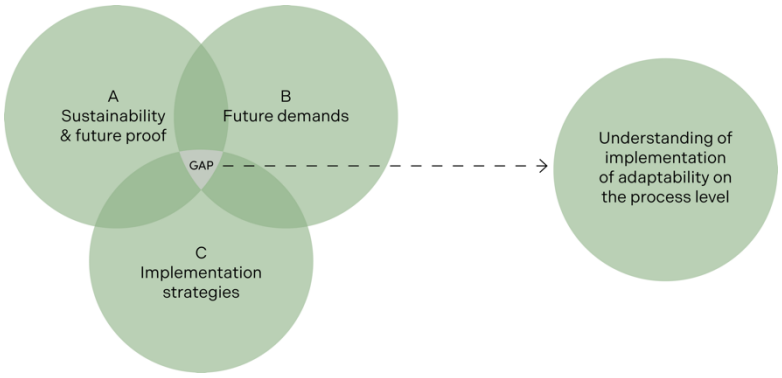


Figure 1-1 Problem statement with knowledge gap (own figure)

1.2 Societal and scientific relevance

Societal relevance

The ever-changing context of buildings, directly affects the demands of users, underscoring the need for adaptability (United Nations Environment Programme, 2018). Building owners must be able to respond to these evolving demands to prevent their properties from becoming vacant and obsolete.

Buildings significantly impact our environment and how we perceive it. As Remøy and van der Voordt (2009) note, when a building no longer serves its intended function and risks vacancy, it negatively affects users, owners, investors, local municipalities, and the real estate market on different levels. A building's adaptability to changing needs can mitigate these risks, reducing its impact on all stakeholders.

Furthermore, the construction industry, responsible for almost 40% of the carbon emissions produced and consumed (Huang et al., 2018), faces increasing environmental concerns (PWC & Institute, 2018). Adaptability in construction contributes to creating a healthier, more sustainable environment, aligning with the evolving demands of both users and society at large (Geraedts et al., 2014).

Scientific relevance

Research on adaptability in the built environment is scientifically relevant, particularly in addressing sustainable developments. This environment plays a crucial role in these societal challenges. While much of the existing research focuses on physical aspects like modular construction, flexible layouts, and smart systems (Brand, 1995; Schmidt III & Austin, 2016), the importance of stakeholder collaboration in projects is often underestimated. Such research contributes to sustainable development but also explores the process of building development and the human aspect, advancing knowledge and practices for a resilient and sustainable future (Geraedts et al., 2014). Through research in this field, researchers can contribute to advancing knowledge and informing practices that shape the future of our built environment.

It can be stated that the dynamic aspects, showed in the green circles below, influence the building at that particular moment. However, when those dynamic aspects change over time a future mismatch will arise. One of the solutions to deal with this future mismatch is adaptable buildings. By researching the complete set of roles, influences, and barriers of the stakeholders involved in the implementation of adaptability, a transition can be made.

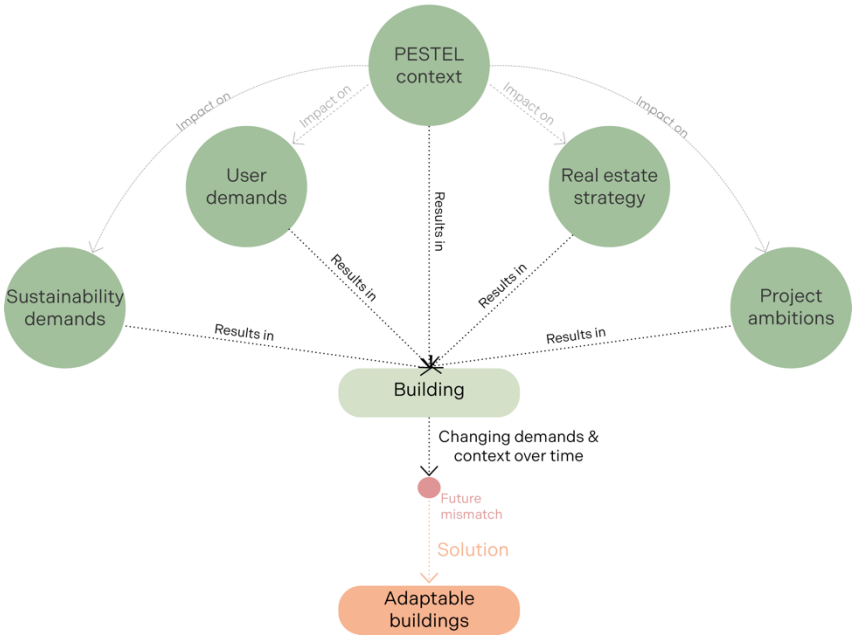


Figure 1-2 Conceptual framework (own figure)

1.3 Research questions

If the building is not considered as a living object and the cooperation side of adaptability is not understood, the implementation of adaptability is out of reach. Therefore, this research aims to learn from developed adaptability strategies, how they can be combined, and how an action plan can be developed to improve the implementation of adaptability. In order to reach the main goal, the following research question has been developed:

"What are the criteria for developing an adaptable building, and how can clients influence the implementation these criteria in development projects?"

To get a better understanding of the main themes and to support the main research question, the following sub-questions have been addressed:

SQ1 – How can adaptability in buildings be described?
SQ2 – What are existing adaptability strategies?
SQ3 – How can existing adaptability strategies be combined into adaptability criteria?
SQ4 – How do the adaptability criteria compare to cases in practice?
SQ5 – What are the roles of the stakeholders involved in the development of adaptable buildings?
SQ6 – How can clients influence the implementation of adaptability in new buildings?

1.4 Definitions and terms

In literature, terms and definitions of terms and concepts are often used interchangeably and don't necessarily mean the same thing. Therefore, it is important to state the definitions of the different terms and concepts, that are used in the research. Terms derived from the research questions and the research purpose are defined in this clause.

Table 1-1 Definitions and terms used in this research

Definition and terms
Adaptability: According to the Cambridge Dictionary adaptability means "An ability or willingness to change in order to suit different conditions." (Dictionary, 2023). But in the building context adaptability is defined as *"The capacity to change the building's built-environment in order to respond and fit to the evolving demands of its users/environment maximizing value throughout its lifecycle."* (Schmidt III et al., 2009).
Adaptability strategy: *"In general, there is no fixed adaptability strategy. It is a set of characteristics that allow the fulfilment of a client's needs and deliver a more adaptable building (according to a limited number of features)."* (Heidrich et al., 2017).
Stakeholder: *"A person or group of people who has a vested interest in the success of a project and the environment within which the project operates. Vested interest is defined as having possession of one or more of the stakeholder attributes of power, legitimacy, or urgency."* (Olander, 2007).

Part 2

Methodology

2 Research design

In Figure 2-1, the research model is shown. The model shows how the main research question has been answered by means of the sub-questions.

2.1 Type of research

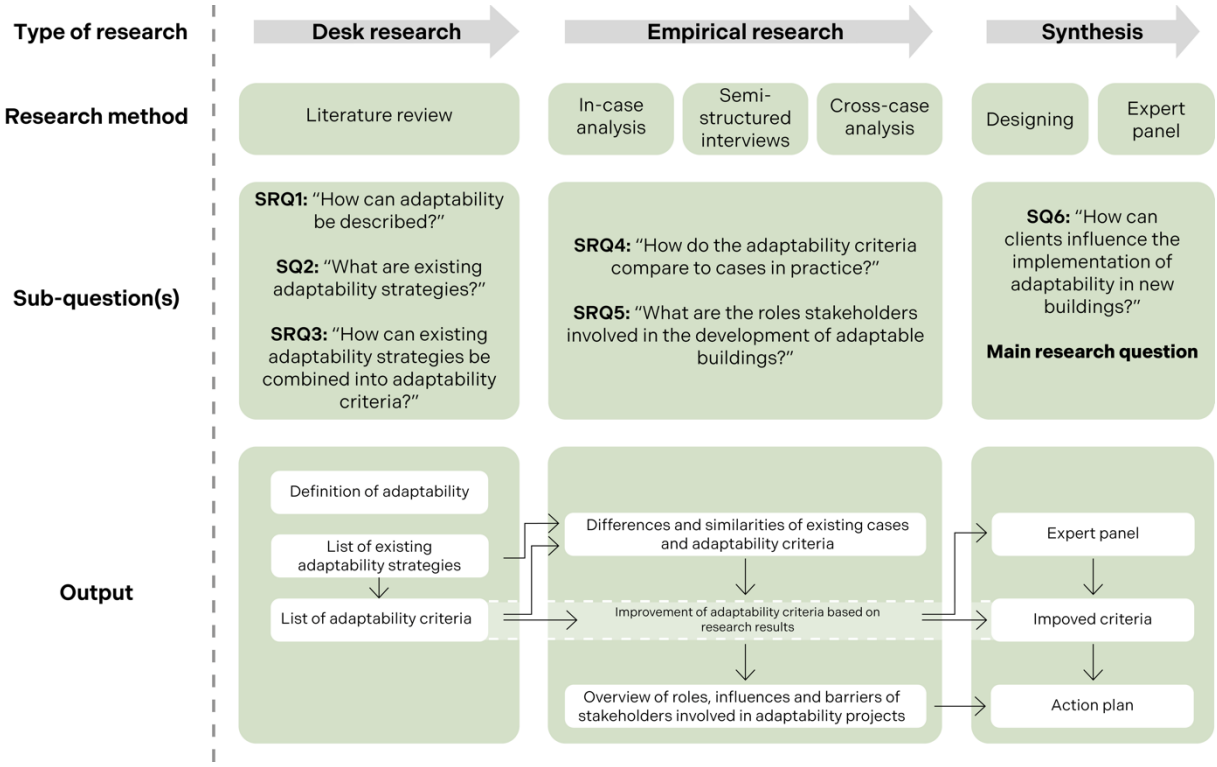
This research is based on the *multimethod* research, where different types of research methods are used of the same type (qualitative or quantitative). In this research the roles and influences of stakeholders are studied through literature and existing cases, meaning that qualitative research methods are most suitable because this is mostly concerned with producing argumentative descriptions, and studying stakeholders (Blaikie & Priest, 2019).

The goal of the research is to improve the current process of adaptability in construction projects by proposing a new strategy to implement the concept. According to Barendse et al. (2012), the research therefore has an operational approach. Additionally, the main research question tries to achieve the research goal through a 'How'-question. The 'How' indicates that the research is *prescriptive* to find a new approach for the current situation. The result of the research is a solution to a problem in a commonly researched area and can be applied in real-time building processes. Therefore, the output of this research is a proposal that can result in a transition (Bryman, 2016).

2.2 Research methods

As indicated in Figure 2-1, the research is based on literature combined with observations and evaluations from a multiple-case study with semi-structured interviews, and an expert panel. This indicates that the *multimethod research approach* is used , consisting of both *desk research* and *empirical research* (Blaikie & Priest, 2019; Patten & Galvan, 2019). Trough desk research knowledge is gathered about the concept of adaptability, different strategies are researched, and stakeholders are listed. Simultaneously, the collection of adaptability strategies is used to combine into a list of adaptability criteria. During the empirical part of the research, a multiple-case study is used to compare the criteria with practice. In addition, semi-structured interviews are held to establish the roles and influences of stakeholders with their experienced barriers. In the synthesis part of the research, the literature review and findings from the empirical research is combined to develop an action plan for clients, which is validated by an expert panel to improve the functionality. The different research methods create triangulation by researching the research question from more than one approach. It increases confidence and a more substantiated picture of the overall conclusion (Heale & Forbes, 2013).

Figure 2-1 Research model (own figure)



2.2.1 Desk research

The background information that is needed to create a foundation and to ensure that the right definitions are used, is collected through desk research, which consists of a literature review. The desk research is used to collect the right information for further phases, because introducing a new concept in the field of adaptability requires a proper understanding of the concept and what is already studied and developed (Cooper et al., 1998). In the overall research focus lies on adaptability strategies for new buildings within a Dutch context. For the literature review this focus is broader in order to collect all important data for developing the preliminary list of criteria and selecting the most important elements.

Knowledge base

A literature review is executed to ensure the knowledge base of the research is sufficient and the right definitions are used. The review forms the theoretical basis of the overall research from which the adaptability criteria and action plan are developed, next to the case studies and interviews.

In chapter 3 the key aspects of adaptability are described, stakeholders involved are listed, and different existing adaptability strategies are collected. The data and information are mainly researched from publications and journals in the field of adaptability using the *forward snowballing* approach. This approach refers to finding the right start set of literature and use the citations in those publications to broaden the literature study by including and excluding references (Wohlin, 2014).

Adaptability criteria

After laying the right knowledge base, the collected strategies are listed, categorized, and compared in order to get a clear overview of the existing adaptability strategies. The collection of the existing strategies is used to develop a comprehensive list of key criteria for adaptability. The list of criteria is a means to symbolize the ideal situation for the implementation of adaptability strategies in real estate projects in the Netherlands.

The goal of the following phases of the research is to find the right balance between *reality* and *provocation,* as shown in the model of Lindley and Coulton (2014), see below. The gray area in the figure illustrates the factual content. The green area in the figure shows the fictional content. The adaptability criteria are developed within the "provocation field", where the ideal future is explored and developed. By carefully building the adaptability criteria atop the reality, the story layer creates a believable context for adaptability in the development of buildings (Lindley & Coulton, 2014). To do that, the adaptability criteria is developed further into an action plan for clients with the data from the case analysis and the expert panel.

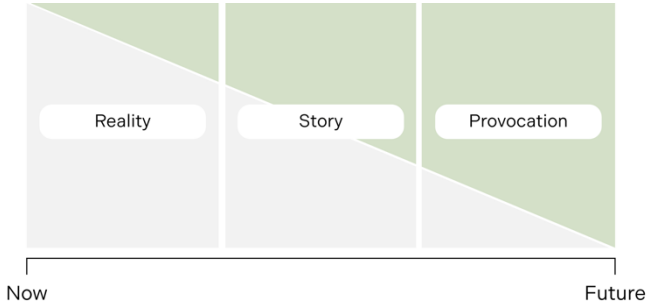


Figure 2-2 The three-layered model of Design Fiction. Adapted from Lindley and Coulton (2014)

2.2.2 Empirical research

To improve and test the preliminary list of criteria and to get an understanding of the stakeholders involved in the development of adaptability in buildings, a multiple case study is conducted. The advantage of a multiple case study is that it allows the researcher to analyze both inside of the case but also across the cases. Another advantage of using a multiple case study is that it improves the validity of the data (Gustafsson, 2017). For the research three cases are studied. Studying three cases makes it possible to go deeply into the content of the cases, but they can still be compared with each other through cross-case analysis in order to find similarities and differences, which improves the reliability of the results (Groat & Wang, 2013; Gustafsson, 2017). The empirical research consists of a multiple case study with a cross-case analysis and semi-structured interviews. The case study focuses on buildings that have been transformed from one function to another, within the Dutch context to establish "lessons learned".

In-case analysis

During the in-case analysis, the adaptability criteria from literature are tested in three transformation projects. This is done by analyzing documents and data from the cases. This information provided a good view on the adaptability of the project, which was validated through semi-structured interviews.

Semi-structured interviews

Semi-structured interviews are held to validate the findings from the in-case analysis and establish the roles and influences of stakeholders. The semi-structured interviews will get different reactions from the individual interviewees to an event or situation. The interviewees are free to react to the open question and the researcher is allowed to probe the responses but the goal is clear, which makes it semi-structured (McIntosh & Morse, 2015). The interviews are held with three stakeholders with a steering role in a development project, being the client, project manager, and architect. Even though the action plan is developed for clients, interviewing three different stakeholders gives a clear understanding on the roles and influences of stakeholders in development projects and the barriers they experience.

Cross-case analysis

In the cross-case analysis the findings from the three individual cases are compared to find comparisons and similarities across the three cases. This analysis is used to establish the main findings of the empirical research for the development of the action plan.

2.2.3 Synthesis

The last research method that is used is synthesis. The results from the literature study and the empirical research are used for the development of the action plan.

Research by design – Action plan

All findings from the research about the adaptability criteria, the roles and influences of stakeholders, the barriers they experience and the opportunities they see are combined into an action plan for clients.

The action plan will function as a guideline for clients to develop adaptable buildings in the Netherlands by overcoming different barriers, creating clarity about the direct and indirect influence a client has on the process, and incorporating that into a timeline.

Expert panel

After designing the action plan, an expert panel is used to validate the outcomes of the research. An expert panel is a qualitative interview where focus lies on a subject within the expertise of the experts (Döringer, 2021). The expert panel consists of three clients working in the built environment. Every expert reacts to statements given by the researcher and the developed action plan. The expert panel is used to get feedback on the action plan and the results from the case study.

2.3 Data plan and ethical considerations

In this research data from participants is involved to advance the practical insights. Therefore, ethical issues must be addressed. The data management plan is included in Appendix I: Data management plan.

During the research the following types of data are used:

- Literature data and document analysis
- Documentation of the multiple cases study and the cross-case analysis
- Personal information of participants from the case study interviews, and expert panel
- Notes, recordings, and transcripts from the semi-structured interviews
- Notes, recording, and a summary from the expert panel

Because of the human participation during the different interviews, all participants must sign a consent form before notes and recordings are gathered.

All data from interview notes, recordings, transcripts, and coding are owned by the researcher. The researcher takes full responsibility for processing, storing, and sharing the data during the research and after finishing the research. During the research the data will therefore safely be stored on the drive that is offered by the TU Delft. The final report will be uploaded on the publicly accessible TU Delft repository.

The well-being of research participants is important, and it is essential to ensure that by participating in the research they are not harmed in any way. Prior to their involvement, participants have been provided with clear information about the objectives of the part of research they are involved in. Participants had the right to decline answering any questions that make them uncomfortable or go against their privacy or ethical principles. To uphold ethical standards, all statements, and descriptions made by participants have been altered in a way that prevents their identification in the final documents. Participants will also be notified before the publication of the thesis.

2.4 Audience of the research

Because of the complexity of a construction project and the number of parties involved in those projects, the action plan derived from the research can be used by various actors in the Netherlands.

- **Clients - Developers and investors** can use the adaptability criteria to compare and reflect their own projects with the holistic situation. From that, they can use the action plan to actively steer on the implementation of (building) adaptability in their projects. Those projects can be sold or leased with a higher rate of return because adaptable buildings imply higher future value/returns.
- **Architects and engineers** can use the adaptability criteria as an underlayer for their work. The architects and engineers can use the action plan to understand their role in the project and actively steer and motivate other parties involved in the process to implement adaptability in the project for their clients.
- **Municipalities** can use the adaptability criteria as a starting point for a project, by understanding the principles of adaptable buildings. Municipalities can also use the action plan to understand their role in the projects and steer on the implementation of adaptability in developments within their area.

Finally, and perhaps most importantly, this study can be used by any party as a tool to create awareness of why parties should develop adaptable buildings, and why developing adaptable buildings is more sustainable than developing a building with many innovative sustainable features that are at hand at that particular moment.

Part 3

Desk research

3 Literature review

3.1 Adaptability

The built environment plays a crucial role in shaping human experiences, providing spaces for various activities and accommodation for diverse needs. The world is constantly changing, which has a big influence on the way people live and want to live (Ganzlebem & Marnane, 2019). As society evolves and faces rapid changes, the need for adaptable buildings becomes increasingly important. Adaptability is one of the ways to respond to the uncertainties that are underlying the future (Cobouw & VBI, 2021).

Buildings are developed to fulfill the demands of the users and/or owners, even though those demands are dynamic and change often. It can be stated that a building is in the first place not a goal, but a means to fulfill the demands of the user. Adaptability is a very layered concept. It is influenced by many internal and external factors. All of this results in an uncertain and unpredictable future. In the need for a built environment that is sustainable, buildings must be able to adapt to future scenarios. The buildings are at risk of becoming vacant and/or obsolete when their adaptive capacity is low, and they are not able to adapt to future demands of the user. In order to be able to implement adaptability strategies, it is important to understand the concept of adaptability.

3.1.1 The concept of adaptability

In literature, the concept of adaptability is commonly defined by four characteristics: the capacity for change, the ability of the building to remain "fit" for purpose or reduce the mismatch between the user and the building, value, and lastly, time. The characteristic of time is presented to indicate the speed of change and to indicate changes of life (Blakstad, 2001; Schmidt III et al., 2010; Schmidt, 2014). Additionally, adaptability in buildings or design is mostly developed through the concepts of time, change, buildings, and context. These four concepts are linked to the four characteristics as mentioned before and they articulate them further.

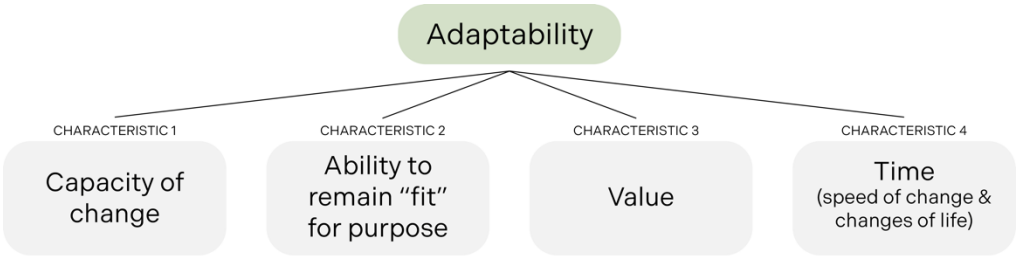


Figure 3-1 Four characteristics of adaptability (own figure)

According to Schmidt (2014) the concept of time is an important addition, because in an attempt to make the building 'fit for purpose', it makes the building or the design susceptible for change and places it in context. *Time* makes the transition between the traditional building as a static object to the building as a dynamic object that is unfinished throughout its entire life cycle. This gives the building a constant process of (re)defining itself in time, space, size, use, performance and location (Schmidt, 2014).

Buildings that are being developed without all four concepts of adaptability in mind (time, change, building and context) are static objects in a dynamic world which in time will create a mismatch in future the demands. In order to make a transition, buildings must not be seen as static objects but as a dynamic object that interplays between its form and the environment/context it is in. In that sense it is clear that one of the key factors influencing adaptability is the relation between the user and the building, which determines how well buildings serve the user demands (Blakstad, 2001). The longer the buildings can respond to the demands of its users and owners, the longer their functional lifecycles will be (Gijsbers & Lichtenberg, 2012).

In an attempt to clarify the complexity of the concept of adaptability, while using the literature and different interpretations it has, the following definition of adaptability is used in this thesis:

"The capacity to change the building's built-environment in order to respond and fit to the evolving demands of its users/environment maximizing value throughout its lifecycle."
(Schmidt III et al., 2009)

3.1.2 The concept of flexibility

In literature, adaptability and flexibility are often used interchangeably, yet they have distinct differences. Both concepts aim to extend the functional life cycle of a building (Gosling et al., 2008), but they approach this goal differently. Adaptability refers to a building's capacity for future changes to meet evolving user demands with minimal expense and effort, focusing on social use (Geraedts & Prins, 2015; Gosling et al., 2008; Schmidt, 2014). Flexibility, on the other hand, allows for quick, physical alterations to a building's fit-out, often initiated by users from a bottom-up approach, typically involving lower costs and short-term, low-magnitude changes (Addis & Schouten, 2004; Groak, 2002; Schmidt, 2014). In contrast, adaptability entails higher costs, long-term periods, and infrequent but significant changes, responding to both internal and external changes. This distinction highlights adaptability as a broader, more encompassing concept, while flexibility focuses more on immediate, physical rearrangements within a building.

In an attempt to clarify the concept of flexibility, while using the literature and different interpretations it has, the following definition of flexibility is used in this thesis:

"Flexibility is perceived as an adaptive response to environmental uncertainty. It is a reflection of the ability of a system to change or react with little penalty in time, effort, cost, or performance"
(Gerwin, 1993; Upton, 1994)

3.1.3 The adaptive capacity of buildings

Manewa (2012) highlights a discrepancy in the existing building stock, where structures are designed for long structural lives but typically for a single function, leading to a mismatch between its technical and functional lifecycle. This often results in buildings becoming vacant when they no longer meet current requirements. Adaptability extends a building's functional life by enabling it to respond to changing internal and external conditions, thereby increasing its potential lifespan (Manewa, 2012; Manewa et al., 2009).

In the built environment, adaptability refers to a building's ability to adapt and accommodate shifts in conditions (Schuetze & Willkomm, 2009). Characteristics that allow a building to maintain functionality throughout its life in a sustainable and economically profitable manner, despite changing conditions and requirements, are known as its adaptive capacity (Geraedts et al., 2014). Adaptive capacity is a key factor in assessing a building's sustainability. Buildings that can serve various types of users over their lifecycle are deemed sustainable, with long-term utility value being crucial. This capacity not only represents a building's long-term utility and future value but also transforms buildings from static to dynamic objects, reducing future mismatches between structure and function (Geraedts et al., 2014).

In an attempt to clarify the adaptive capacity of a building, while using the literature and different interpretations it has, the following definition of adaptive capacity is used in this thesis:

The adaptive capacity of a building includes all characteristics that enable it to keep its functionality during the technical life cycle in a sustainable and economic profitable way withstanding changing requirements and circumstances."

(Geraedts et al., 2014; Hermans et al., 2013)

3.1.4 Sustainability

In today's society, sustainability is more important than ever. The built environment is responsible for nearly half of the carbon emissions. In an attempt to reduce the carbon emission related to buildings, governments are looking for carbon neutral strategies and sustainable solutions (Wilkinson & Remoy, 2011). An efficient and sustainable way to limit the emissions is to develop buildings that are adaptable to changing demands and conditions, with the least effort and minor transformations to the building.

According to Eichholtz et al. (2010) an increased demand for flexibility and sustainability is shown in market developments as well as the realization that a circular economy is becoming more important. A circular economy, where processes have changed from linear to circular has become a new way of looking at sustainability, where buildings and materials are reused and recycled (Eichholtz et al., 2010; Geraedts & Prins, 2015). Sustainability, and with that adaptability, has become of major importance in judging the future of a building and its value.. Graham (2009) once said "*A sustainable building is not one that must last forever, but one that can easily adapt to change.*" (Graham, 2009). So, it can be stated that when a building is able to respond to changes in its environment, it is really sustainably.

3.1.5 Obsolescence and vacancy

Traditionally, building life cycles have been viewed as linear, starting with initiation and ending with demolition. This model assumes a sequential order, but today's unpredictable needs of future users and owners are challenging this concept. As a response, a circular life cycle model has been introduced, recognizing that a building continuously reacts to changes throughout its lifespan (Blakstad, 2001).

The circular life cycle development phases like concept, programming, design, and construction, followed by an ongoing cycle of use, operation, and adaptation. At some point, the building's future usability and value must be assessed, which may lead to the building becoming obsolete if it no longer meets the needs of owners or users. Vacancy and obsolescence often result from a mismatch between demand and supply in the building's environment (Langston et al., 2008; Remøy, 2010). Langston et al. (2008) categorize obsolescence into six types, *physical, economic, functional, technological, social,* and *legal obsolescence,* with functional obsolescence being particularly relevant. This type refers to changes in objectives and needs leading to a shift away from the building's original purpose.

When a building is structurally intact but functionally obsolete and still within its technical lifespan, transformation or adaptive reuse can be a solution. This process extends the building's life cycle by adapting it for new purposes, thereby preventing premature demolition and addressing financial obsolescence.

By entering a new life cycle through adaptation, the building remains relevant and functional, aligning with the principles of the circular life cycle model (Blakstad, 2001; Langston et al., 2008; Remøy, 2010).

3.1.6 Costs and benefits

Implementing adaptability in projects is often perceived as having higher initial investment costs, with speculative and unclear future benefits. However, adaptability is also a strategy to manage future uncertainties, potentially averting expensive modifications required to prevent building obsolescence. It's crucial to evaluate a business case not just based on initial investments but considering the entire life cycle costs of the building (Geraedts, 2009; Geraedts, 2008; Manewa, 2012).

Developers' and owners' willingness to invest in adaptability is influenced by their perception of its benefits. Life cycle cost analysis and risk assessments are essential first steps in quantifying potential future benefits (Arge, 2005; Schmidt, 2014). A significant barrier to invest in adaptability is the assumption that it incurs higher costs, partly due to the perception that adapting existing buildings is more expensive than new constructions. This assumption overlooks the fact that high adaptation costs often stem from a lack of adaptable features in the original design (Manewa, 2012). Research by Remøy et al. (2011) shows that adaptable office buildings are only 3% more expensive than standard ones, excluding land value, which can vary significantly.

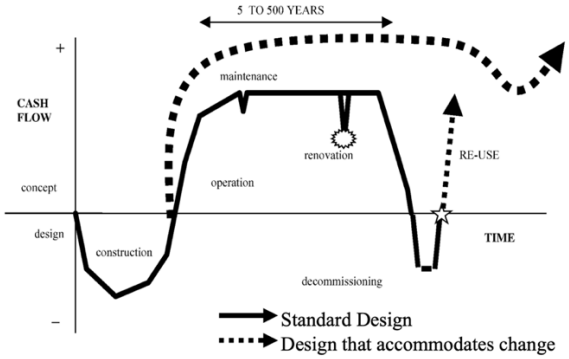


Figure 3-2 Potential impact of design to accommodate change (Slaughter, 2001)

Pinder et al. (2011) conducted a study on the business case for adaptable buildings, emphasizing the analysis of costs, benefits, and risks. It's often the case that the party bearing initial costs is not the same as the one benefiting later. For long-term investors, the slight increase in adaptable building costs is justifiable, as they stand to benefit from lower future adaptation costs, extended economic life, or higher rent. Short-term developers, on the other hand, are less inclined towards adaptability investments unless it positively impacts building value or is preferred over standard constructions.

Furthermore, adaptability aligns with sustainability concepts, a critical and highly demanded factor in the current building market. Sustainable buildings, often certified by standards like BREEAM or LEED, command a premium over less sustainable ones in both sale and rental prices. According to Pinder et al. (2011) certified buildings can fetch a 5% rental premium and a 25% sale price premium, making them more attractive to investors and developers. This highlights the growing market value of sustainability and, by extension, adaptability in buildings.

3.2 Adaptability strategies

The different dimensions of adaptability show the complexity of the concept. The understanding of adaptability is supported by a several models and concepts that have emerged from building adaptability research over time. This part of the desk research described the main frameworks and strategies that are used in research to understand and simplify adaptability. Additionally, the most important adaptability strategies are collected to create a list of adaptability criteria for buildings.

3.2.1 Frameworks

One of the fundamental concepts in adaptability research is the research by Duffy (1990). Duffy (1990) introduced the concept that divides the building into "layers", based on their lifespan and capacity of change. The introduction of this framework was the first step from seeing the building as a static object to an object connected to its lifecycle in a dynamic world. According to Duffy (1990) it is necessary to describe buildings in terms of time and lifespan of its components, rather than in material terms. Describing the building in terms of time was done through four layers: shells, services, scenery, and set.

All with their own corresponding timespan, before it requires change (Duffy, 1990; Schmidt, 2014). Brand (1995) follows the layers of Duffy and adds two layers. He defines the building as a set of "shearing layers" that change at different rates. In the most recent research that was done by Schmidt III and Austin (2016), the layers of Duffy and Brand were revised and the layers *social* and *surroundings* were added, ending with the layers; *social, stuff, space plan* or *space, services, structure, skin, site* and *surroundings (Schmidt III & Austin, 2016)*.

Brand (1995) states that the difficulty and costs of adaptation are related to the connection of the layers. The design will be guided by components with a slower changing rate, and rapidly changing components have an influence on components with a slower changing rate. So, the more connected the components are, the more difficult and expensive it is to adapt the building (Brand, 1995; Remøy, 2010; Schmidt, 2014). Schmidt III and Austin (2016) state that in order to create an immutable infrastructure around which change can occur, as many layers as possible must be kept outside of the structural layer.

Table 3-1 Building layers. Adapted from Schmidt III and Austin (2016)

Layer	*Timespan*	*Characteristics*
Surroundings	Eternal	Context of the building (physical – public space, buildings, infrastructure)
Site	Eternal	Legal boundaries
Skin	20 years	Exterior façade (cladding & roof)
Structure	30 – 300 years	Components for vertical loads and horizontal bracing
Services	7 – 15 years	Supply and transport of flows (water, energy, communication, movements)
Space (plan)	3 – 30 years	Components for enclosing spaces (layout)
Stuff	1 day – 1 month	Furniture
Social	Eternal	People in and around the building

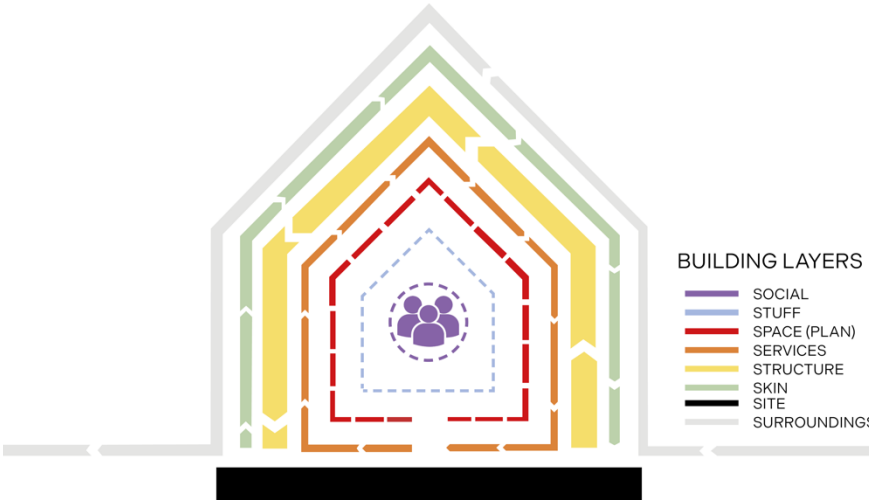


Figure 3-3 Building layers model. Adapted from Schmidt III and Austin (2016)

3.2.2 Change and the types of obsolescence

A more overarching theory that has influenced the adaptability is *change*. According to Blakstad (2001) the challenge with change is that social shifts often require a physical reaction which can result in a mismatch. Change in its forms is one of the most important drivers for adaptability. However, change is a very broad and vague concept. All changes are different and are connecting in a different way to the adaptability of a building. The nature, frequency, magnitude, level of control, visibility and impact of changes always differ (Schmidt III & Austin, 2016). Regarding the comparison between flexibility and adaptability it is stated that relatively quick changes that are required to meet the functional needs is not considered adaptability but can be a part of the overall adaptive capacity of a building (Gosling et al., 2008; Heidrich et al., 2017). In an attempt to create certainty about the future because of the increasing pace of change, researchers are categorizing the types of change in the built environment. As a result of the inability to define and accommodate change, Langston et al. (2008) divide the obsolescence of a building into six categories. These categories are *physical, economic, functional, technological, social* and *legal*, and cover almost all types of change in the literature (Langston et al., 2008).

3.2.3 Types of adaptability

In the research by Schmidt III et al. (2010), different strategies to describe the adaptive capacity of a building were identified. The 'Framecycle model' presents a framework for adaptability in which the different dimensions are the main strategies (Van Ellen et al., 2021).

According to Schmidt III and Austin (2016), a process of change is one where a shift in social demands requires a reaction on a physical level. This often results in a mismatch between the demands of the user or owner and the building object. However, not all changes require a reaction on a physical level. In some cases, the change can be handled on an organizational, individual or within the adaptive capacity of the building. When change and time are considered, a building is seen as a dynamic object and interaction between its form and the context it is in (users and environment), rather than as a static object (Schmidt III & Austin, 2016).

Table 3-2 Adaptability dimensions (Schmidt III et al., 2010; Van Ellen et al., 2021)

Dimension of adaptability	*Type of change*
Adjustable	Change of tasks by users
Versatile (flexible)	Changes of space and location of services, furniture, and equipment by users
Refit-able	Change of performance
Convertible	Change of function – space, services
Scalable/elastic	Change of size of the building
Movable	Change of location of fabric

3.2.4 Adaptability strategies

The concept of adaptability is a solution to avoid the obsolescence of buildings and the environmental and cost impacts that are associated with that. As adaptability is a way to maximize the life cycle of a building and its components, adaptability strategies are used to target the consequences and outcomes that result from environmental changes, and to promote the concept (Askar et al., 2021; Graham, 2005).

One of the starting points for adaptability, and an overarching adaptability strategy is *Design for Adaptability*. In the paper by Graham (2005), he states that in order to design a building with a high adaptive capacity, the designer must consider the life span of the building and the layers. (Graham, 2005). Being aware of the rate of change of the different building layers, allows the designer to create adaptability to building layers with a longer life-span and to make sure that layers are designed in such a way that the differences in changing rate are not affecting the layers (Graham, 2005; Schmidt III & Austin, 2016).

Another researcher that studied the assessment of the adaptive capacity of a building is Geraedts. Geraedts mentioned that adaptability ambitions should be incorporated in the early stages of a project (Geraedts, 2009). He developed a set of flexibility indicators that can be used to assess the adaptive capacity of a building. Similarly to the strategy by Schmidt III, he structured the indicator by comparing them to the shearing layers of Brand (Geraedts, 2016; Geraedts & Prins, 2016). Other researchers have developed guidelines to address adaptability from several perspectives or have developed design parameters to influences the adaptive capacity of the building in a positive way (Manewa, 2012).

The level of adaptability that is needed in a building is related to several factors such as the current function, the user demands, the owner demands and the market demands (Aytac et al., 2016). When a demand for adaptability solutions arises, the different types of obsolescence need to be taken into account. The types of obsolescence are influencing the focus of the strategy. In the end the adaptability strategy and solutions used, must equip the right problem. In the research by Langston et al. (2008) a link is made between the obsolescence and the life cycle of a building and shows that when the adaptive capacity of a building is higher, it is less likely to become obsolete. In this thesis, focus lies on the functional obsolescence by increasing the adaptive capacity for functional change.

3.3 Criteria for adaptability

To develop a list of the main criteria for adaptability, different adaptability strategies are researched, and criteria mentioned are listed. After researching and collecting the existing criteria, the collection is categorized. Categorizing the existing criteria is done to compare the different studies and to create some clarity within the long list of existing strategies. This is done by linking the existing strategies to the shearing layers of Schmidt III and Austin (2016) and the adaptability dimensions of Van Ellen et al. (2021). After categorizing the existing criteria, comparable criteria were linked to establish the main adaptability criteria.

The list of criteria has derived from the structured and categorized collection of adaptability strategies and criteria and resulted in ten criteria for the development of future proof buildings. The list of criteria with the different steps is shown in Appendix II: Adaptability criteria.

The adaptability criteria focus on both the building as the position the context and stakeholders have in the process and give an extra dimension to the existing strategies. To make the extra dimension visible and concrete, the criteria are allocated to three divisions.

Table 3-3 Adaptability criteria, derived from literature review

Building aspects	Location & context	Mindset & team
• Characteristics of the building • Over-dimensioning • Fluid-spaces & buffer zones • Demountable, modular & independent • Lay-out of the building & zoning • Rearrangeable	• The right location • Multifunctional • Non-physical context	• Flexible thinking

Building aspects

Multifunctionality is a recurrent theme in adaptability studies, resulting in high adaptive capacities when they can accommodate various functions and layouts. This flexibility is largely influenced by building aspects such as sufficient floor-to-floor height (>2.8m), optimal grid span (Geraedts, 2016; Schmidt, 2014), and a changeable façade. The location of essential elements like entrances, stairs, and elevators is crucial for transformation (Geraedts & Prins, 2015; Remøy et al., 2011).

In terms of building characteristics, most adaptable structures are function-neutral (Arge, 2005). The building's general makeup, including floor-to-floor height, width, and technical grid, is vital for adaptability. The building's identity and image also play a role, with the ability to modify the façade being important (Blakstad, 2001; Remøy & Van der Voordt, 2014; Schmidt III & Austin, 2016).

Over-dimensioning is a strategy for future-proofing buildings. This involves designing extra capacity in floor-to-floor heights, load capacity, building space, and installation capabilities (Geraedts & Prins, 2016; Pinder et al., 2017). Ensuring installations are accessible and not embedded in the structure is key (Nakib, 2010).

Fluid spaces and buffer zones, resulting from over-dimensioning, can be utilized to adapt to environmental changes and space demands without incurring additional costs (Geraedts, 2009). Geraedts and Prins (2016) suggest a surplus of at least 10% to facilitate future expansions. These spaces can serve as multifunctional or communal areas (Schmidt III & Austin, 2016).

Demountable, modular, and independent elements in a building meet user demands by allowing flexibility in expansion and function accommodation. This includes walls, facades, units, ceilings, and floors (Schmidt, 2014). Such elements require dry, accessible connections (Nakib, 2010; Schmidt, 2014).

The building's layout and zoning are fundamental for future functional replacements. An adaptable building should facilitate changes in space without being hindered by load-bearing walls or other structural elements. This flexibility can be achieved by organizing the layout in an open space or around cores (Nakib, 2010). Furthermore, rearrangeable fit-outs, which involve movable internal walls and spaces, enhance adaptability. This requires plug-and-play elements, non-fixed elements, and detachable connections (Geraedts, 2016; Schmidt, 2014), allowing for easy and cost-effective rearrangement.

Location & context

The adaptive capacity of a building is significantly influenced by its location and the context it is in. Optimal locations are those in mixed-function areas. Such diverse locations support functional changes and integration with its surroundings, enhancing adaptability (Nakib, 2010; Remøy et al., 2011). Additionally, accessibility by various transportation modes, proximity to amenities and services, and the quality of public spaces are essential in shaping a building's adaptive potential (Geraedts et al., 2014; Remøy & Van der Voordt, 2014). However, with selecting a location comes the building site. This relates to legal factors like a multifunctional zoning plan and the maximum building size permitted are crucial for enabling functional transformations (Nakib, 2010). Flexibility in zoning plans is necessary to accommodate diverse functions and potential expansions. Adequate surplus space on the site allows for future building expansion.

Apart from the physical criteria for adaptability, related to the building and the location, considerations of the context are also important. This relates to the economic, political, technological, societal, and legal context. According to Charitini (2019), the non-physical context of a building should be taken into account. However, when a building is designed based on its context, the building becomes static and not adaptable when the context changes. Therefore, a balance must be sought between the context and adaptability (Charitini, 2019). This also comes from the believe that an adaptable building is designed to solve a temporary problem (context) and therefore the solution should be temporary (building) (Hertzberger, 2005).

Mindset & team

The last criterium for developing future proof buildings through adaptability is *Flexible thinking*. Where the first criteria mostly focus on the building and its surroundings, this criterium is more human-centered. As mentioned, stakeholders affect buildings and the other way around (Blakstad, 2001). Therefore, it is important to address the human factor in the adaptability criteria. The project success of adaptable building developments depends on flexible thinking. Adaptability requires the stakeholders to focus on the economic life cycle of a building and capital growth instead of rent income. It requires to focus on reducing building decree differences between different functions like offices and housing (Nakib, 2010; Remøy, 2010). It also requires stakeholders to see the building as a life cycle instead of a moment in time. In addition, in flexible thinking executing parties must try to increase user involvement. By incorporating the needs of the users more effectively, the building will be able to better support the needs. In the following section, the stakeholders in adaptability projects are explained further.

3.4 Stakeholders

The adaptability of the building is influenced by the relation between the stakeholders and the building. This indicates that the "human side" of the concept is important. This statement is confirmed in the research by Schmidt (2014) where architects mention that adaptability is not solely a technical capacity but a mindset of all actors involved.

There is no better solution for adaptability projects than a good client, a good architect or designer, and the right budget (Schmidt, 2014). Therefore, it is important to understand what stakeholders are involved in adaptability projects and what their roles and motives are.

In the book by Winch (2009) he describes two types of stakeholders within construction projects, internal stakeholders divided into the demand and supply and external stakeholders divided into the private and the public side. Internal stakeholders are those contractually bound to the construction project and have an active role in the project. External stakeholders can be affected by the outcomes but have little or no influence on that outcome. The internal and external stakeholders differ on the level of influence they have on the project (Winch, 2009). The most influential stakeholders in the development of adaptability in buildings are listed by several researchers (Pinder et al., 2013; Schmidt III & Austin, 2016; Schmidt, 2014). In these studies, the focus lies on internal stakeholders – the people engaged in the building development process. The external stakeholders are often not taken into account. Combining the different studies, the following influential stakeholders can be listed. The stakeholders that are mentioned in both studies are shown in the figure of Winch on the next page and indicated in orange. The stakeholders in adaptability projects that were not listed in the figure of Winch are indicated in green, see Table 3-3.

Table 3-4 Stakeholders in adaptability projects. Adapted from Winch (2009)

Internal stakeholders		**External stakeholders**	
Demand side	*Supply side*	*Private*	*Public*
Client	Architects	Local residents	Regulatory agencies
Financers	Engineers	Local landowners	Local government
Client's employees	Principal contractors	Environmentalists	National government
Client's customers	Trade contractors	Conservationists	Researchers
Client's tenants	Materials suppliers	Archaeologists	Educations
Client's suppliers	Developers	Non-governmental organizations (NGO)	

The roles that different stakeholders have in the process of adaptable building developments can be mapped into a diagram where the benefits and the influences are plotted against each other. The diagram, as developed in the research by Pinder et al. (2013), shows the interplay between the influence and benefits of the different stakeholders in relation to the adaptability. Positioned in Q1, quadrant 1, are the 'Champions'. The 'champions' have a long-term interest in the building object. Therefore, it should be of great interest and within their power to develop a building with a high adaptive capacity. Q3, quadrant 3, shows the 'Gatekeepers'.

The 'Gatekeepers' are often stakeholders with an executive role in the project and thereby have a short-term interest. Bottom left of the diagram are the 'Outsiders', Q2. Those stakeholders are very likely to benefit from the adaptability of the building but have no power in and influence on implementing adaptability. The 'Outsiders' are often external stakeholders within an adaptability project. The last quadrant is Q4, illustrating the 'Bystanders'. Those stakeholders will probably not benefit from the implementation of adaptability, but also have no or little influence on that implementation (Pinder et al., 2013).

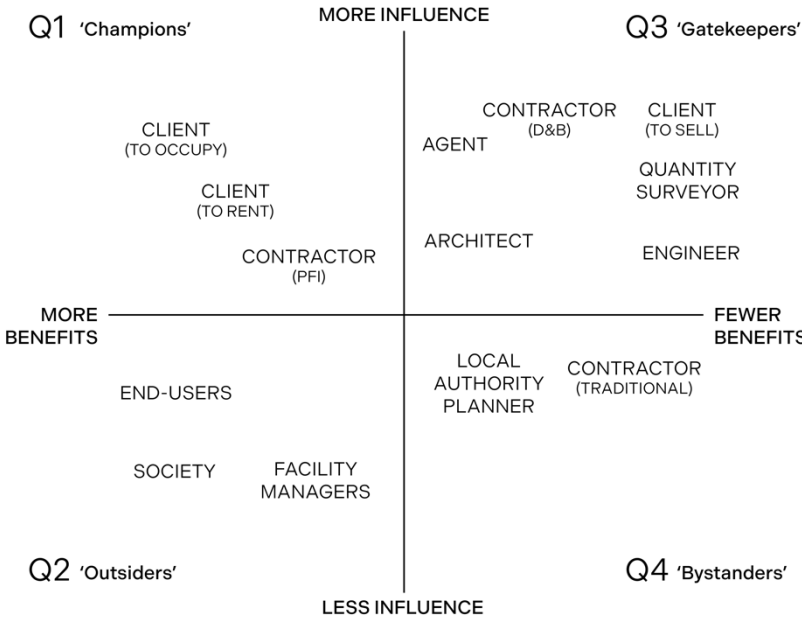


Figure 3-4 Stakeholder matrix in adaptability developments. Adapted from Pinder et al. (2013)

3.5 Conclusion desk research

This chapter, describing the findings of the desk research, focused on defining the concept of adaptability, collecting existing adaptability strategies, and combining those into adaptability criteria. From the desk research findings, the conclusions of the first three sub-questions can be drafted.

The built environment significantly influences experiences of its users by offering spaces that cater different activities and diverse needs. As the world undergoes constant transformation, this significantly affects lifestyles and living preferences (Ganzlebem & Marnane, 2019). With society in a state of rapid evolution, the demand for adaptable buildings grows, as they offer a means to respond to the uncertainties that lie ahead (Cobouw & VBI, 2021).

Buildings are crafted to satisfy the evolving demands of their users and owners. Essentially, a building is not an end in itself but a tool to meet user needs. Adaptability in buildings is a nuanced and complex concept, subject to a variety of internal and external influences, leading to a future that is both uncertain and unpredictable. To achieve a sustainable built environment, it is critical for buildings to have the capacity to adapt to future scenarios. Buildings with limited adaptive capacity are at risk of becoming vacant or obsolete if they fail to meet the changing demands of users. Understanding the concept of adaptability is essential for the successful implementations of adaptability strategies into building developments projects.

In literature, adaptability is commonly defined by four characteristics: the capacity for change, the ability of the building to remain "fit" for purpose, value, and lastly, time. Time is presented to indicate the speed of change and to indicate changes of life (Blakstad, 2001; Schmidt III et al., 2010; Schmidt, 2014). According to Schmidt (2014) the concept of time is a very important addition, because in an attempt to make the building 'fit for purpose', it makes the building or the design susceptible for change and places it in context (Schmidt, 2014).

In this research the following definition for adaptability is used:

"The capacity to change the building's built-environment in order to respond and fit to the evolving demands of its users/environment maximizing value throughout its lifecycle."
(Schmidt III et al., 2009)

The development and understanding of adaptability in buildings is supported by a number of models and concepts that have emerged as a result of building adaptability research over time. One of the fundamental concepts in adaptability research is the research by Duffy (1990). Duffy (1990) introduced the concept that divides the building into "layers", based on their lifespan and capacity of change, rather than describing and measure the building in material terms. The introduction of this framework was the first step from seeing the building as a static object to seeing the building as an object connected to its lifecycle in a dynamic world.

In the most recent research that was done by Schmidt III and Austin (2016), the layers of Duffy and Brand were revised and the layers *social* and *surroundings* were added, ending with the layers; *social, stuff, space plan* or *space, services, structure, skin, site* and *surroundings (Schmidt III & Austin, 2016)*.

For the development of the adaptability criteria, existing adaptability strategies and tactics were listed and categorized. This was done by linking the existing strategies to the shearing layers of Schmidt III and Austin (2016) and the adaptability dimensions of Van Ellen et al. (2021). The list of criteria has derived from the structured and categorized collection of adaptability strategies and criteria and resulted in ten criteria for the development of future proof buildings, shown in the table below.

The adaptability criteria focus on both the building as the position of context and stakeholders in the process and give an extra dimension to the existing strategies. The adaptability criteria related to the building design are allocated under *building aspects.* The criteria that describe the context of the project are allocated under *location & context*. The last theme is *mindset & team*, consisting of the criteria that focus on the "human side" of adaptability.

Considering the stakeholders, in this research, focus lies on three stakeholders with a high influence and high benefits, being the client (rent and sell), architect, and project manager because they have a steering role in the implementation of adaptability in development projects but with differences in their benefits (Pinder et al., 2013; Winch, 2009).

Table 3-5 Adaptability criteria, composed from literature

Building aspects	**Location & context**	**Mindset & team**
• Characteristics of the building • Over-dimensioning • Fluid-spaces & buffer zones • Demountable, modular & independent • Lay-out of the building & zoning • Rearrangeable	• The right location • Multifunctional • Non-physical context	• Flexible thinking

Part 4

Empirical research

4 Case study

4.1 Case study overview

For the case study, cases are selected based on selection criteria as defined in Table 4-1. As the study is focused on Dutch development projects with Dutch collaboration structures, it is important to select Dutch cases, specifically within one of the G4 cities because of the comparable, regulations, and policies by the municipality. Furthermore, this thesis focuses on creating an action plan for the developments with the potential to transform into other functions in the future. Because lessons must be drawn from practice by comparing it with overarching adaptability criteria, the case must be a transformation project where functional change has taken place. In addition, because most decisions are made in the initiative and design phase of a project. Therefore, it is important to select cases where the design phase is completed. Lastly, the cases must have a comparable collaboration structure, where Dev_ real estate is hired as the project manager and the client is a project development firm that works with own equity or in collaboration with an investor. For the case studies, cases of Dev_ real estate are selected to facilitate the collection of information and contact.

01 // Laan van NOI

1. Location The Hague
2. Transformation from offices into housing
3. Project on hold because of trials, design phase is completed
4. Egeria is the client and owner, Dev_ real estate is hired as project manager

02 // Slotervaart CVZ

1. Location Amsterdam
2. Transformation from hospital into health care function mix
3. Project in execution phase
4. Zadelhoff is the client and owner, Dev_ real estate is hired as project manager

03 // Zoutmanstraat

1. Location The Hague
2. Transformation from offices into housing
3. Project in execution phase
4. Zoutman BV was client and owner, Dev_ real estate was hired as project manager.

Table 4-1 Case selection criteria

1.	It is a project within one of the G4 cities in the Netherlands
2.	It is a building that is transformed from one function to another
3.	It is a case where the design phase is completed
4.	It is a case with a comparable collaboration structure as the other two cases where Dev_ real estate is hired as the project manager and the client is a project development firm that works with own equity or in collaboration with an investor.

01 // Laan van NOI
The Hague

01 // Laan van NOI

The first case that is studied is Laan van NOI. The building is located in the Bezuidenhout neighborhood in The Hague. The building is a typical post-war concrete building, designed by Kraaijvanger in the early 70s. The Batavia is a former office building but because there is no demand for this office building, the demand to transform it into a new function has risen.

For the case study this project has been selected because of its central location and facilitating role of the municipality. To accommodate the demand for housing and because of the obsolescence of office buildings, the municipality is facilitating a transformation to residential within this area.

Initiative & Program

As mentioned, the Batavia as an office is not demanded in the area. At the same time the demand for residential buildings in that area is high. Therefore, the building will be transformed into housing.

The transformation of the Batavia offers opportunities for a better connection with the shopping area close by, the improvement of the street and a better connection with surrounding buildings, the improvement of the avenue character of the Laan van Nieuw Oost-Indie, and the improvement of the walkability of the area.

According to the plan development framework of the municipality, the preliminary design has a program of approximately 190 apartments between 40 and 190 m2 and 17 ground-level terrace houses. In addition, 1.000m2 of commercial space will be located in the plinth of the building on the Laan van Nieuw Oost-Indië. There are 168 parking spaces on the site, the majority of which are located in the existing underground parking garage. A limited part of the project area is a strip of land located along the Carpentierstraat, owned by the municipality. On the Carpentierstraat, terraces houses will create the connection with the existing buildings on the other side of the street (Gemeente Den Haag, 2018).

Project details	*Laan van NOI – Batavia*
Location	The Hague - Bezuidenhout, Netherlands
Client / owner	Laan van NOI B.V. – Egeria
Architect	Geurst & Schulze
Development type	Transformation – Extension
Previous function	Offices
Size	± 16.500 m2
Main functions	205 appartements + 16 terrace houses
Secondary functions	± 1000 m2 communal space + 168 parking spots

Table 4-2 Project details - Laan van NOI

Vision and ambition

The municipality of The Hague is facilitating transformations of obsolete offices to other functions on a policy level outside of the Central Innovation District (CID) and are remote from big public transport nodes (Gemeente Den Haag, 2018). For the Batavia it was concluded that with the transformation proposal a desired spatial quality improvement can be made. The task of the transformation was to soften the fault line between pre- and post-war buildings in the area and heal it into one attractive part of Bezuidenhout. Transformation into housing is highly demanded in the Bezuidenhout area of the city because of the high demand for housing. The transformation from offices into housing will contribute to the functioning of the shopping structure by adding more residents and creating commercial spaces in the plinth of the building (Gemeente Den Haag, 2018; Geurst & Schulze, 2018).

Stakeholders

Municipality of The Hague

The Municipality of The Hague has a densification task. Mixing functions is a good instrument to achieve this and optimize the land use. In different documents the function mix of practice, office and business space with residential space is mentioned. Even though, the plans to transform the building into housing does not fit within the current zoning plan, the Municipality is changing the zoning plan because of their facilitating role in transformations of obsolete office buildings (Gemeente Den Haag, 2018).

Laan van NOI B.V. - Egeria

Laan van NOI B.V. is a company that was created for the development of the project. The company is an offshoot of Egeria, initiator, owner, and developer of the project. Laan van NOI is owner of the building (site), but the Municipality also owns a small strip of land located along the Carpentierstraat. Laan van NOI B.V. developed the plan proposal and had that drawn up by architect Geurst & Schulze (Egeria, 2018; Gemeente Den Haag, 2018).

Involvement of other stakeholders

In the plan development framework from the municipality of The Hague (2018) it is stated that the council of mayors and alderman take the opinions of stakeholders into account in their decision-making related to building developments. The initiator of a project must therefore be able to demonstrate how stakeholders are informed. To involve stakeholders in the early stages of a project, a meeting was arranged to discuss and present the project plans of the architect. Stakeholders present at the meeting are Laan van NOI B.V., the Municipality of The Hague, local residents, retailers association, and owners of adjacent office buildings (Gemeente Den Haag, 2018).

Adaptability criteria

Building aspects

From the assessment of different documents on the case in relation to the preliminary list of criteria, it can be stated that many of the adaptability tactics related to the building aspects criteria are available in the building. Overall, a high floor-to-floor height, small façade grid, shared and multifunctional spaces and the ability to expand or decrease in building size, provide the building to be adaptable to the changing need of users. However, the small structural grid span is a missed opportunity in the adaptability of the building.

Regarding the characteristics of the building, the Batavia is a typical post-war building which are often identified as concrete blocks. The architectural identity of the building does not blend well in its environment. Because the façade is a non-load-bearing façade consisting of small individual elements, the integration of the building with its environment can be realized without large adaptations. Even though the building was not designed with adaptability in mind, over-dimensioning is influencing the adaptability of the building positively. On the other hand, the position of access points, the number of shafts and ducts of sufficient sizes, and the presence of adequate overhaul pieces hindered the transformation.

One of the criteria that are beneficial for the adaptability of a building are demountable and modular elements. The typical 1970s façade of the Batavia is made of gravel concrete elements. At the time, the elements were individually mounted to the structure of the building. This increases the detachability of the building and makes it easy to replace the facade without major interventions.

Location & context

The central location of the building within The Hague is beneficial for the transformation potential. The area is a multifunctional area with a high demand for housing and service & amenities close by. With the right location of the building also comes the right building site with its zoning plan. The facilitating role of the municipality in changing mono-function zoning plans from offices to housing is incorporated in different policy document of the Municipality of The Hague (Gemeente Den Haag, 2018). Because of that the functional change in the zoning plan was done within a short period of time. Lastly, the space on the building site allows the building to expand.

In regard to the non-physical context of the project, the building is a good example for changes in the context of the market and economy. Due to objections of local residents the project was postponed for 1,5 years. At the time Egeria bought the project, the moment on the real estate time cycle was beneficia. However, due to the objections, the market collapsed had a negative impact on the project and the business case.

Mindset & team

The last criterium for a successful adaptable office building is the cooperation and mindset of stakeholders involved in the project. This criterium is mostly relevant in developing new adaptable buildings. The policy of the municipality of The Hague to facilitate transformations from offices to housing is a good start for flexible thinking. In addition, the meetings arranged to discuss and present the project plans to residents are positive for this criterium.

On the other hand, for the Batavia it can be stated that arranging meetings to involve stakeholders is not sufficient enough for involving users because local residents have objected to the plans and denounced the transformation because they believe there are insufficient facilities such as schools, general practitioners, and public spaces (Paling, 2023).

Adaptive capacity of the Batavia

Based on the findings from document data and news articles, it can be stated that several adaptability concepts were present in the building and allow the building to accommodate different users. Even though the building is initially not designed as an adaptable building, the building allows functional transformation. The central location of the building was one of the reasons for Egeria to buy the building. The multifunctional character of the area with many services & amenities nearby allows the building to accommodate different functions in the future.

02 // Slotervaart CVZ Amsterdam

02 // Slotervaart CVZ

The second project that is studied is Slotervaart CVZ. The former Slotervaart hospital is part of a cluster "de Plantijn" and is located in Amsterdam Nieuw-West. In the coming years the building will be transformed into a large Center for Care (Centrum voor Zorg). 'Het Kruisgebouw' is built in 1975 and will be renovated into the beating heart of the CVZ.

This project has been selected for the case study because of the vision of the client for this project. Zadelhoff believed that this building could be transformed into something special and decided to make that happen. They believed in the building's potential to enable functional change. In transformation projects and the implementation of adaptability, a strong vision and believe are important.

Initiative & Program

The project contains a large-scale renovation of "Het Kruisgebouw". It has 11 floors and 4 wings, with a total surface area of ± 44.000 m2 BVO. The building is built in the 70s and is outdated. Except for the structural shell, all structural components and installations will be renewed. The Center for Care will accommodate various cure and care functions.

The building will have a care-work function in the lower part of the building and care-living in upper parts. A living-working area will be developed in the area around the cross building. To create a highly urban mixed neighborhood 80.000 m2 will be added (Zadelhoff, 2021).

Vision and ambition

After the general hospital, which was privatized in 2006, went bankrupt on October 25, 2018, Zadelhoff took it over through a bankruptcy agreement in June 2020. At that time, agreements were made with the municipality regarding the further redevelopment of the building, with the aim of returning and maintaining healthcare in the neighborhood. Zadelhoff wants to preserve the social purpose of the former Slotervaart Hospital for the city of Amsterdam. The area will include a mix of functions that provide affordable care. The mission of the project is to maintain the social care function for the neighborhood. The ambition is to densify the area by adding a large number of square meters to the program and at the same time to increase the quality of public space (Zadelhoff, 2021).

Table 4-3 Project details Slotervaart 'Centrum voor Zorg'

Project details	*Slotervaart Centrum voor Zorg*
Location	Amsterdam – Nieuw West, Netherlands
Client / owner	Zadelhoff
Architect	Inbo
Development type	Transformation – Extension
Previous function	Hospital
Size	± 50.000 m2
Main functions	Cure + Care. Living (70%) and working (30%)
Secondary functions	Communal spaces, parking, and logistics

Stakeholders

Municipality of Amsterdam

As mentioned, the Municipality of Amsterdam made an agreement with Zadelhoff to transform the former Slotervaart into a healthcare center for the neighborhood. Mixing different functions in the building that are demanded in the new way of providing care, is a good solution for transforming the building in a health care center for the entire neighborhood (Zadelhoff, 2021).

Zadelhoff

Zadelhoff is owner of the building since 2020, private financer, and developer. Together with three stakeholders in the area Sanquin, Antoni van Leeuwenhoek hospital and health institution Cordaan, Zadelhoff has developed a vision for the area called Plantijn. The area will be greener and more densified, with space for living, working, education, innovation, and facilities. Zadelhoff wants to develop a hospital that is affordable and accessible by taking its goal of the 1970s in mind, creating a hospital for the people of Amsterdam in an affordable way. Focus lies on a healthy building where a connection is created between esthetics, functionality and quality for people and environment (Zadelhoff, 2023).

Adaptability criteria

Building aspects

Considering the adaptability aspects connected to the criteria that relate to the building aspects, many adaptability tactics are present in the cross-building. A high floor-to-floor height, wide structural grid, and the possibility to expand or decrease, allow the building to accommodate different types of users or functions.

Because the building was a former hospital, multifunctionality was already incorporated in its design. Hospitals often rearrange the division of functions within the building. Standardization and over-dimensioning allowed the building to accommodate those shifts, increasing the overall adaptive capacity.

In addition, the number and positions of stairs and elevators have a positive influence on the adaptability. Because of the use for hospital beds and changing occupation, big volumes and wide internal routes create a loose fit in the building. However, the material choice and independency of different layers are a missed chance.

The building is designed as a typical post-war building with a concrete structure and gravel concrete façade. The cross shape allows the building to have open floors with a core in the center. The core of the building is rigid, with no daylight and heavy walls. Additionally, the overall character of the building is strongly determined by its history. The building is known within as a hospital with a social purpose for the city of Amsterdam. Therefore, the municipality wants to preserve this social purpose focused on health care. This limits the possibilities for functional change.

Location & context

The cross-building has a large history and has always been used as a hospital. As mentioned, within the area the building has a high social value. Over the years the area around the former Slotervaart hospital has transformed into a health care focused area. Additionally, the building is easy to reach both by car and public transport.

Overall, the building is well located within the city of Amsterdam (Nieuw-West) and important services & amenities are close by. Regarding the building site, it has a mono-functional zoning plan. This has a negative impact on the overall adaptability of the building. On the other hand, the building site has a surplus of space.

For Slotervaart CVZ, the changes in context influenced the project. At the start of the project, the demand for nursing homes was high and Zadelhoff agreed with the municipality that the upper floors would be used to accommodate that demand. However, due to COVID-19 the demand had shifted and the agreements with the municipality were not sufficient anymore for the business case. After several discussions, both parties agreed to create educational functions in the upper floors.

Mindset & team

The way of thinking is an important element for the overall adaptability. Overall, the Slotervaart as a hospital was designed to accommodate changing demands. Even though this is done to accommodate changes within the hospital itself, the over-dimensioned aspects allow the building to also accommodate different functions. Keeping changing demands in mind during the design phase of a building is a key element in designing adaptable buildings. Another important aspect for flexible thinking is to think in opportunities. The belief of Zadelhoff to transform the cross-building into something new and seeing opportunities is characteristic for this project.

Adaptive capacity of Slotervaart CVZ

In can be stated that the adaptive capacity of the cross-building can be related to its former function, a hospital. To accommodate a continuous shift in demands, hospitals are often designed with adaptability in mind. Even though this is solely done to accommodate the needs of the hospital itself, overall, it can be stated that hospitals have a high adaptive capacity. In addition, the technical building requirements for hospitals and adaptable buildings are of a high standard. To conclude, the adaptive capacity of the cross-building is high due to over-dimensioning and multifunctionality of the building. However, the lack of disassembly potential in the building puts pressure on this adaptive capacity and with that the functional transformation potential.

03 // Zoutmanstraat
The Hague

03 // Zoutmanstraat

The last project that is studied is the Prins Hendrik building. The building is located at the Zoutmanstraat in The Hague. The building is a former office building and is transformed into housing. The Prins Hendrik building is built in 1969.

The project has been selected for the case study because it is a building that is transformed into another function. In addition, the project is selected because of the "rediscover vision" of Canopy investment, together with Rhodium Real Estate former owner, and developer of the building. Canopy beliefs that the reuse of the urban structure, applying sustainability and developing future-proof buildings must be a requirement for development.

Initiative & Program

The building is transformed from offices into housing. The ground floor is transformed into communal space and a parking garage. In the upper 5 floors 35 turnkey city apartments for private rental of a top-end quality is realized. The entire building is stripped to create the most sustainable solution. The balconies are insulated completely. The buildings must create better connection with the surrounding buildings (Schaeffer, 2017).

Vision and ambition

There is a major shortage of high-quality apartments within The Hague. This vacant existing office building on the Zoutmanstraat gives the opportunity to transform into a residential building. Canopy Investment and Rhodium Real estate initiated the project and seized this opportunity to develop plans for the transformation. The office building is a unique building in the Zoutmanstraat because of its contrasting architecture and building volume. The transformation of the building must give a boost to its environment (Schaeffer, 2017).

Table 4-4 Project details Zoutmanstraat

Project details	*Prins Hendrik building – 'De Zoutman'*
Location	The Hague – Zeeheldenkwartier, Netherlands
Client / owner	Canopy Investment and Rhodium Real Estate ('De Zoutman')
Architect	Studio Schaeffer
Development type	Transformation
Previous function	Offices
Size	± 4.000 m2
Main functions	Residential and communal space
Secondary functions	Parking

Stakeholders

Municipality of The Hague

As mentioned, the municipality of The Hague facilitates the transformation of obsolete office buildings into housing because of their densification task. Mixing function helps to achieve this and optimize the use of land.

Zoutman BV

'De Zoutman' or Zoutman BV is a collaboration between Canopy Investment and Rhodium Real Estate. Together they are owner, developer, and financer of the building. For Canopy Investment, this project fits their rediscover-vision. Reusing the urban structure, applying sustainability, and developing future-proof buildings are required for this vision (Canopy Investments, 2017). The visions of the project and Zoutman BV is to transform it into one of the best smart buildings in The Hague (Canopy Investments, 2017; Schaeffer, 2017).

Adaptability criteria

Building aspects

Some criteria related to the building aspects are present in the Prins Hendrik building. However, the most important elements, like a high floor-to-floor height, a wide structural grid, and the possibility to expand the building are challenging in the transformation of the building. The floor-to-floor height of the building is challenging for installations. The structural grid is small and not a common size. Overall, on a building level, the building is lacking standardization in the open floor. On the other hand, the number and position of stairs and entrances in the building are influencing the adaptive capacity of the building positively.

The Prins Hendrik building is a typical late 1960s building and thereby has a rough and concrete image that does not fit the urban context it is in. The façade of the building is not load-bearing. Therefore, changing the image of the building, by changing the façade, was possible.

The ambition to add a new layer to the building was not successful due to the lack of capacity surplus in the construction. Regardless of the fact that adaptability was not included in the design in the late 1960s, the building is successfully transformed into housing. However, the necessary interventions have been made to integrate the residential function into the building.

Location & context

The location is one of the most important criteria for the transformation of the Prins Hendrik building. The building is located in a multifunctional area with a high demand for housing. It is accessible by both public transport and by car and many services & amenities are nearby.

The central location of the Prins Hendrik building also brings its side notes. The building plot does not have much extra space and therefore limits the possibility to expand. In addition, the building is placed on the edge of the building plot which creates difficulties for creating outside space which is required for housing.
Another important element in the adaptive capacity of a building is the legal context. For the Prins Hendrik building, the zoning plan was mono-functional, which is not beneficial for the implementation of adaptability concepts. However, the municipality facilitated functional change in the zoning plan.

Mindset & team

The mindset of stakeholders is one of the most important criteria for success. Stakeholders must adopt a cooperating mentality, seeing opportunities and possibilities where others might see challenges. A good start for this is the beforementioned "rediscover vision" of Canopy Investment and the policy of the municipality of The Hague to facilitate functionally changes in zoning plans.

Adaptive capacity of the Prins Hendrik building

Several adaptability concepts related to the ten criteria were present in the Prins Hendrik building. Even though the building is initially not designed as an adaptable building, the building is successfully transformed from offices into housing. The assessment of the adaptability criteria has shown that the building was challenging to transform.
The building had a challenging floor-to-floor height, structural grid and was not over-dimensioned. In addition, the load capacity of the structure and the small building site did not allow the building to expand both vertically and horizontally.

The location of the building is mentioned by interviewees as a criterion for adaptability. 'Het Zeeheldenkwartier' is a popular area with a high demand for housing. Considering the lack of over-dimensioning and multifunctionality in the building, the location of the building can be pointed out as the main reason why the building is successfully transformed into housing. While this statement is true, the successful transformation of the building cannot be solely attributed to the building's location, but rather to the mindset of the project team. The stakeholders looked for opportunities to integrate the new function into the current building at points, where they encountered challenges in the physical condition of the building. Due to seeing and seeking opportunities instead of barriers, the building was successfully transformed.

4.2 Case study analysis

To get an understanding of the components that are essential for the development of adaptable buildings in the Netherlands, to study the roles and influences of different stakeholders involved in adaptability project, and to find out what barriers they experience in these developments, semi-structured interviews are conducted with project managers, clients, and architects within all three case studies.

4.2.1 Participation selection

In order to develop the right data, the selection of the interviewees is important (McIntosh & Morse, 2015). From each case the project manager, client, and architect are interviewed. During the interviews both themes adaptability and stakeholder involvement are discussed. To make sure the right interviewees are selected, the following criteria are used:

1. Are or have been involve in the development of the case
2. Are different stakeholders involved in the case
3. Are from different ages and genders
4. Have different years of experience within the field of project development

After accepting the invite for the interviews, the interviewees receive information about the research and the content of the interview, see Appendix III: Information interviews. In this document it is made clear that the interview is divided into four categories that are linked to the goal of the semi-structured interviews and the research.

In addition, the interviewees received the 'informed consent form' where information is given on how the data is processed and publicized, see Appendix IV: Informed consent form.

4.2.2 Case study analysis

After conducting the interviews, they are transcribed and analyzed. The analysis of the interviews is done in four steps.

01. Data allocation
02. Data categorization
03. In-case analysis
04. Cross-case analysis

01. Data allocation

The interviews were recorded using audio-devices. The audio is used to transcribe the interviews. Transcripts are used to link the information and data from the interviews to the different components, as shown in Appendix VI: Transcript categorization. Because the interviews were semi-structured, the information in the interview transcripts were still (partly) uncategorized. The transcripts of the interviews have not been included in the appendix of the thesis to ensure the privacy of the participants.

The transcripts of the interviews are analyzed using the three adaptability themes and the four themes from the interviews. These themes combined are translated into five components:

- Building aspects
- Location & context
- Mindset & team
- Barriers & driver
- Opportunities

02. Date categorization

After linking the interview data to a component, the data is allocated to different parts of the research. The themes *building aspects, location & context,* and *mindset & team* are also incorporated in the introduction of the three cases and their analysis on the adaptability criteria. This is done to make a distinction between project specific data related to the adaptability criteria, and data related to the roles and influences of stakeholders, prior to the development of the action plan.

03. In-case analysis

For each case study, an in-case analysis is done using information and insights from the interviews. Because the project specific data is incorporated in the case introduction and the assessment of the adaptability criteria, the in-case analysis of the three cases is mainly focused on the roles of the stakeholders, their impact, the barriers they experience, and the opportunities they see for the development of adaptable and futureproof buildings.

A distinction is made between *roles of stakeholders, barriers,* and *opportunities.* The findings are explained per case and supported by quotes from the interviewees in the following paragraphs.

04. Cross-case analysis

For the cross-case analysis the findings from the three case studies are compared between the three cases. The goal of the cross-case analysis is to find comparisons and differences across the three cases which results in an overall view on the adaptability criteria, and the roles and influences of stakeholders involved in adaptability projects.

4.3 In-case analysis Laan van NOI

Roles of stakeholders

All stakeholders interviewed for the Laan van NOI case were positive whether or not they can influence a project. Project manager 1 (2023) mentioned that his role is to manage the project and make sure all elements are brought together. On the other hand, during the initiative phase, the project manager is mostly a strategic advisor. In this case, the role of the project manager is to start the discussion about the future value of the building. Here, the project manager can influence what can be done within adaptability (Project manager 1, 2023).

According to the project manager, traditionally the business case is made by the project manager, often in collaboration with the client. Here, the financial (dis)advantages of adaptability can be shown and used to advise the client. In addition, all interviewees have mentioned that for the implementation of adaptability concepts the entire (design) team is needed. Therefore, it is important to select a (design) team that shares the same vision and ambition regarding adaptability and future proof buildings (Project manager 1, 2023).

The role of the architect is mostly focused on the quality and functionality of the plans. The architect can substantiate the adaptability ambitions through the design. According to architect 1 (2023), it is also the role of the architect to design something that is of cherished by people and therefore less likely to be demolished.

"Cherished is very close to sustainability. When you create buildings that people truly love, because it is ingrained in their collective memory, then effort is also made. And not just because it's protected, but because people simply understand it and it's worth keeping."

- Architect 1

During the interviews, the client (2023) mentioned that they are key stakeholder in the decisions that are made. The client decides the ambitions for the project, and therefore decides on the adaptability ambitions. However, for the case Laan van NOI, the client is a short-term involved client. This means that they purchase the building, develop a plan, and after obtaining the permits, sell it to long-term investors. Short-term involved clients are not likely to implement adaptability concepts in their projects because it does not directly add to the value of the building. However, during the interviews it is mentioned that when there is more demand for adaptable buildings, short-term involved clients are more likely to incorporate that in their plans (Client 1, 2023).

"Adaptability concepts cost money to build. Essentially, it doesn't add more value. Unless the respective investor assigns value to it, either because they believe in it, or they think that the fact that it is adaptable will ultimately generate more income."

- Client 1

Following the roles of the different stakeholders and influence they have on the implementation of adaptability it can be stated that all stakeholders have their individual interests in a project. According to the project manager, most stakeholders have the right intentions, however in the end all parties are driven by financial benefits and individual interests (Project manager 1, 2023). When those interests are somewhat contradictory, this goes at the expense of the ideal adaptable building (Client 1, 2023).

"If the interests are too divergent, it will not succeed. You need a common interest. When everyone continues to think too much about their own ideal image adaptability is out of reach."
- Client 1

Barriers for adaptability

Different barriers were mentioned by the interviewees of the Laan van NOI case. The project manager mentioned the regulations as the main barrier for adaptability. In the Netherlands all buildings are built based on function specific regulations stated in the building decree. However, the regulations stated by the municipality or in the building decree often change. Therefore, it is not certain whether a building that is designed as adaptable can actually be adapted to other functions in the future.

Another important barrier mentioned by the interviewees is the zoning plan. A building where many building aspects are implemented might not be adaptable when it has a mono-functional zoning plan. Therefore, cooperation of the municipality is needed (Project manager 1, 2023).

Economic barriers are experienced by interviewees of Laan van NOI for the implementation of adaptability. This is related to the financial feasibility of adaptability. Adaptability is a concept with a long payback period. Currently, some of the investments are only recouped when a building is transformed (Client 1, 2023). In addition to that, the architect states that they experience barriers in regard to their role When the client is not willing to implement adaptability concepts into the project, the architect has no power and has an executive role instead of a steering role.

Opportunities

According to the interviewees there are different opportunities to support the implementation of adaptability in development projects. First, a financial driver is needed to create a different kind of motivation for stakeholders. Currently, the implementation of adaptability concepts solely comes from an intrinsic motivation and a belief to be better for the world. When the intrinsic motivation is combined with a financial driver, it is likely that more stakeholders will implement adaptability concepts in their projects and motivate others.

"That's how the mechanism always works. Low-hanging fruit. First come up with low-hanging fruit, and then people start moving."
- Project manager 1

In addition to the financial driver of stakeholders, an incentive from the regulations is mentioned. According to the interviewees, regulations are an important motivation for the implementation of adaptability and create a communal interest for different stakeholders.

"Regulation is important. Once you establish something in the regulations, everyone just follows it. It's that simple."
- Architect 1

On the building level, the interviewees have mentioned that the most important element for functional transformation is the floor-to-floor height. When the floor-to-floor height of a building is higher than stated in the building decree, it is more adaptable for changes in function because there is more space for installations.

To implement more adaptable buildings, good collaboration with stakeholders is important.
First, the goals and ambitions for adaptability must be clear at the beginning of the initiative phase. In addition, these ambitions must be made measurable, through KPI's. According to the interviewees, all stakeholders are important in the overall process, despite their power and role. For the municipality, this means that they must remain actively engaged, in order to make this feasible rather than simply approaching it from an evaluative and facilitating point of view. Second, knowledge and expertise about adaptability is needed to develop a successful plan. Lessons learned must be shared within the project team.

4.4 In-case analysis Slotervaart CVZ

Roles of stakeholders

According to the interviewees of the Slotervaart CVZ case, the project manager, architect, and client were all part of the team of advisors during the initiative phase of the project. Together with the team they developed the concept and design of the project.

"Even if you have a super compelling story and someone doesn't want to hear it, then you have no influence. You can try to entice someone, but it's super difficult to entice someone who isn't interested."

- *Project manager 2*

All three interviewees mentioned that the vision of the individual stakeholders is crucial. Even though the client is the main decisionmaker. stakeholders must be transparent about their visions, communicate those and start the discussion. It is the role of the steering stakeholders to present their vision for adaptability to the client. This can be achieved by having knowledge and understanding the process (Project manager 2, 2023).

"Experiential wisdom can turn into conservatism. It is the role of the stakeholders to convince the client that it is better to create adaptable buildings and to substantiate this convincingly."

- Architect 2

The client of the Slotervaart CVZ case mentioned that a team with shared adaptability ambitions is needed. In this case, it is the role of the client to create clear ambitions and select the right people. Selecting the right people is a way to influence the mindset and mentality of the team (Client 2, 2023).

Barriers for adaptability

Different barriers are mentioned during the interviews with stakeholders. The architect mentioned the conservatism of stakeholders as a main barrier. This is mostly related to the assumption that adaptability comes with high costs. The conservatism also has to do with the payback period of adaptability concepts. The return of investment for adaptability has a longer payback period and therefore brings uncertainties for the investor (Architect 2, 2023).

Other barriers experienced by the interviewees, are political barriers. Adaptability ambitions are often hindered by municipal decisions. Many municipalities decide the building envelope of urban areas. This means that the number of buildable square meters is determined and what functions can be accommodated, which limits the development of adaptable buildings.

A social barrier experienced by the interviewees is the lack of knowledge. Steering stakeholders, like clients rely on the knowledge of their advisors. However, not all advisors have knowledge about the possibilities of adaptability. This lack of knowledge is limiting the implementation of adaptability in projects.

Additionally, economic barriers are experienced by the interviewees. This has to do with the investments and ambitions of a project. As mentioned, having a clear vision and ambition on adaptability is important.

Opportunities

Different opportunities to support the implementation of adaptability in development projects are mentioned by the interviewees. First, the starting point for adaptability must be a shared vision. This shared vision can be created by selecting the right team or by motivating people to do the right thing, an intrinsic motivation. To motivate people, knowledge about the concept is needed. When more people are motivated to develop adaptable building and share the same adaptability ambitions, adaptability becomes common practice. In that case, developing adaptable building is no longer the choice of a pioneer but a choice of the market (Client 2, 2023).

"I think that when it comes to CO2 reduction in the construction industry, you should aim to minimize demolition. So, all buildings that remain standing for a long time are the future."

- Architect 2

In addition to that, the awareness of the value of adaptability is considered as the most important opportunity. For the implementation of adaptability, a different kind of investment is needed. It is important to understand why a different kind of investment is made. This is not done for the initial business case. Instead, it is done for the residual value of another business case that comes later (Project manager 2, 2023).

"Adaptability is incorporated in the residual value of your building. You depreciate less quickly, in fact."

- *Project manager 2*

Another financial opportunity mentioned by the interviewees of Slotervaart CVZ is the appraised value of the building object. Currently, adaptability has no direct financial value. However, this could be changed when adaptability would be included as one of the sustainability rules for appraisal. In that case, you could receive a higher appraised value when adaptability concepts are implemented (Architect 2, 2023).

The client of the Slotervaart CVZ case mentioned that during a project the team should always ask themselves whether or not all adaptability ambitions and criteria should be implemented at this phase of the building's life cycle. Some elements might also be implemented later, through demountable elements. In that case a building can be made function specific for its first functional life cycle but still be adaptable for the next. Priorities must be made for the adaptability ambitions. This mentality can help short-term investors to see the financial benefits in the development of adaptable buildings (Client 2, 2023).

"Sometimes the question needs to be whether the adaptability ambitions really have to be executed at 100%, or whether some aspects could be scaled down to 70%, where in this case it may not be fully adaptable, but still just fine."

- Client 2

The last opportunity mentioned by the interviewees of the Slotervaart CVZ case is the flexibility of the zoning plan. According to the client, when a zoning plan is flexible, and the municipality would establish that for the future, banks are more willing to invest in adaptable buildings. Because in that case, the building can respond the functional changes and simultaneously the market risk for the bank is lower (Client 2, 2023).

4.5 In-case analysis Zoutmanstraat

Roles of stakeholders

According to the project manager of the Zoutmanstraat case, his influence is strongly dependent on the type of client. In the Zoutmanstraat case, the client is an independent developer and investor. This means that they are a private investors company and not part of an investment organization and thereby not independent of organizational ambitions and targets. The independence of the client resulted in a dynamic where the client had high sustainability ambitions and at the same time was open to the advice of the project manager and other parties. However, this also means that the investment primarily comes from their own equity, and fewer risks can be taken. According to project manager 3, it is the role of the project manager to create balance between the sustainability ambitions and their investment freedom (Project manager 3, 2023).

"As a project manager, you can provide guidance, but we don't make the decisions. When we're building something, we assist a client in realizing their vision or ambition. However, we can of course help shape that vision."

- Project manager 2

During the interviews the role of the municipality was often mentioned. In policy documents of the municipality, it is stated that because of the high demand for housing, the municipality is facilitating the transformation of obsolete office buildings into housing. However, according to interviewees this was not the case for the Zoutmanstraat case.

While the municipality facilitated the functional change from office to housing in the zoning plan, the cooperative role in transforming obsolete office buildings was not evident. The project manager mentioned that a policy can be made, but if this policy is not implemented towards the executing and assessing alderman, the process will not become more flexible. It is crucial that the municipality understands that for the transformation of an obsolete building, the municipality needs to be flexible in their cooperation and assessment, deviating from certain norms that are typically applied (Project manager 3, 2023).

"We were at the mercy of the whims of the municipality."

- Project manager 3

Another noticeable statement made by the interviewees are the challenges of the collaboration structure of the project. In the Zoutmanstraat case a construction team (in Dutch: Bouwteam) collaboration structure was utilized to improve the information flow and integration of all stakeholders and disciplines. As all stakeholders involved in the (design) team are important for the success of an adaptability development project, an integrated team would be useful for the project success. However, the construction team is seen as a barrier for the implementation of adaptability, because the team will get stuck when the pressure on costs and planning is high and as a result of that one stakeholder drops out or asks for more money (Architect 3, 2023).

Barriers for adaptability

A barrier mentioned by the project manager of the Zoutmanstraat case is the type of client in a project. Clients that keep a building object in their own portfolio for a long period of time are easier to motivate to implement adaptability concepts then short term involved developers. For these types of clients, extra investments made in the implementation of adaptability concepts is not recouped and therefore not beneficial for their business case.

"The momentum in the market is good. The market is shifting, and with these kinds of adjustments, you can make a difference."

- Client 3

Economic barriers are also experienced by interviewees. According to the client, the transformation from one function to another that is incorporated in adaptable building comes with capital destruction. This refers to the fact that a building loses capital value when it is initially developed for a residential function and is eventually transformed into a commercial function due to a reduction in rental prices per square meter (Client 3, 2023).

Opportunities

Different opportunities for the development of adaptable building are mentioned by the interviewees. The first opportunity mentioned is the technical quality of a building. When a building has a high technical quality and a high architectural quality, it is more likely that the building won't be demolished after its functional lifecycle. When the technical quality is low the building might become technically obsolete while its functional lifespan is extended through adaptability (Architect 3, 2023).

"Adaptability fits well in the current era because we all engage in reuse and sustainability, but in the end, we still build very traditionally, and that is actually quite strange."

- Client 3

On a financial level different opportunities are mentioned by the interviewees. In the field of sustainability, different financers are offering a discount in their interest rates when sustainable solutions are included in the building.
If this offer would also be applied to the implementation of adaptability, this financial incentive can motivate more parties to develop adaptable buildings (Client 3, 2023).

"We need pioneers who are willing to try it. All other stakeholders will follow."

- Client 3

To implement successful adaptable buildings collaboration between the different stakeholders involved and the right mindset are essential.

According to the interviewees, all stakeholders must have a "Can Do" mentality. This means thinking in possibilities and solutions, rather than problems and obstacles. In addition, the client must select a team with experience in the field of adaptability. The developer and the banks are partners. All other stakeholders can be selected based on the project ambitions (Project manager 3, 2023).

"You need a mindset where you think, 'if we can't go left, we'll go right. And what is needed if we go in that direction?'"

- Project manager 3

4.6 Cross-case analysis

In the in-case analysis the three cases are assessed on their adaptive capacity and the roles of the stakeholder involved. The goal of each component is to find similarities and differences across the three cases. The similarities and differences are needed to establish lessons learned, create an overall view on the success factors for adaptability and develop the action plan for the implementation of adaptability in new buildings.

To obtain the intended outcome for the development of de action plan the overall project details, the building aspects from the adaptability criteria and the mentioned success factors for adaptability are analyzed across the three cases.

4.6.1 Project details

Location & context

All three cases studied are located in central locations within large Dutch cities. These locations are all multifunctional and therefore beneficial for the adaptability of the building. Main services and amenities are close by, and the neighborhoods are multifunctional. Interviewees have mentioned the flexibility within the zoning plan as a starting point for adaptability. When a building site does not have a multifunctional zoning plan, adaptability concepts included in a building are often unnecessary. Additionally, the amount of space on the building site was mentioned as beneficial to the adaptability by many interviewees. However, the desire to have extra space on the building site is often contradictory to a business case connected to a project because extra space means sellable square meters.

It is important to note that, for adaptability, the role of the municipality is very important. Flexibility in the zoning plan, the regulations and the assessment of the design is highly needed for the success of adaptability. Lastly, different changes in context are experienced in the cases. However, those changes do not affect the adaptability of the projects. On the contrary, it can be argued that even though the context must be taken into account at the beginning of a project, adaptability in both projects and buildings can be used to accommodate those changing contexts.

"The location, I think, is crucial. Is it situated in an urban context where it makes sense to eventually change its function? If the answer is yes, then the flexibility in the zoning plan subsequently determines the functional value."

- Project manager 2

Type of building

Both Laan van NOI and the Zoutmanstraat are former office buildings with a column structure and open floor plan. Slotervaart CVZ was a former hospital which was designed with adaptability in mind. It appears that the former function of a building itself does not have much influence on the type of use after transformation, structural modifications that must be done and design. However, some building characteristics that are related to a function do influence the overall adaptability. For example, in both office buildings and hospitals the floor-to-floor height and column structure are beneficial for the adaptability. On the other hand, the availability for outside space of the former function can influence the transformation potential.

Vision & ambition

All three cases are initiated by private party clients. The client of Laan van NOI is a short-term involved developer whose goal is to make the highest profit within a short period of time. For this type of client, it can be stated that they are not willing to invest in adaptability if this is not explicitly requested by the buyer. On the other hand, the client of the Zoutmanstraat is also a short term involved client. However, this client had the intrinsic motivation to develop sustainable buildings with a higher future value, and the believe to be better for the world. The motivation and driver of the client to develop an adaptable building is important for project success. For the Slotervaart CVZ case, the client is a long-term involved party that keeps the project within own portfolio, has a high financial support and the believe that the building had the potential to be developed into a future proof object. The addition of the financial support to the intrinsic motivation and believe to be better for the world is beneficial for the implementation of adaptability and project success.

Key stakeholders

The mindset of the stakeholders and the selection of the project team are key to success. Many interviewees have mentioned that the entire team is needed to create a successful adaptable building. Interviewees have mentioned that the interests of the stakeholders must be brought closer together to create a successful adaptable building.

"Interests can hinder you from moving towards the same goal."

- Project manager 2

Even though all stakeholders are important in project success, the influence and power those stakeholders have differ. The project success starts with the vision and mentality of the initiator of the project, the client. The client must be open to the concept of adaptability. The other team members follow because they are selected by the client. To improve project success, this selection must be made based on corresponding ambitions for the project and its success. In addition, the presence of adaptability building aspects are influencing the adaptive capacity of a building. The amount of and the extent to which adaptable building aspects are adopted in a building are directly influenced by stakeholders with the highest impact and influence, like the client and its project manager. The client has the highest influence on the building aspects adopted in a design, because in the end the client is the main decision maker and financer of the project.

In all three cases studied, the role of the municipality was mentioned as a key role. Different interviewees mentioned that the project ambitions can be ideal for adaptability, but when the municipality is not cooperating, the project won't be successful. In addition, the Laan van NOI and Zoutmanstraat case were both located in The Hague. The municipality of The Hague has a policy to facilitate functional change in the zoning plan to improve the transformation potential of old office buildings. According to different interviewees, having a facilitating or cooperating policy is only beneficial for project success when this is further implemented in the entire municipal organization and process.

Lastly, the project manager is important for project success. According to the interviewees, the project manager can influence the overall adaptability on different levels. When the client has the ambition to develop an adaptable building it is important to select a project manager that understands and represents their ambitions. On the other hand, the project manager can also motivate the client to be better and implement more adaptability aspects in the projects by understanding the impact of decisions on the project and the business case. in addition, together with the client the project manager develops the project ambitions, KPIs and team selection procedure. All key decisions for further phases of the project and project success.

4.6.2 Buildings aspects

Besides the ambitions of the client, decisions made in the initiative phase and the selection of the right stakeholders, the adaptability of a building is influenced by the implementation of different adaptability building aspects in the design.

Must-haves & nice-to-haves

Many of the adaptability concepts mentioned in the literature review were mentioned by interviewees from the cases studies. *Over-dimensioning* (both in size and structural load capacity), *characteristics of the building,* and *demountable, modular & independent elements* were mentioned as most important for the transformation of a building from one function to another. The other adaptability criteria were mentioned as nice-to-haves in transformation because they do not affect the adaptability significantly.

Even though three of the ten adaptability criteria were mentioned as most important, they are not considered must-haves for adaptability. Other findings point out that the mindset and collaboration of stakeholders is the key to project success. Overall, adaptable building aspects influence the adaptability of a building but are mostly considered nice-to-haves instead of must-haves in the over-all adaptability. When the building is not over-dimensioned, has a low architectural character, or has no demountable elements adapting a building becomes challenging but is not impossible.

"If there is more space and capacity in the structure, more solutions are possible. The more it is over-dimensioned, the easier it is to come up with a solution and proceed from there."

- Project manager 1

Interpretation of challenges in building aspects

Striking elements have emerged from the interviews in relation to the document analysis of the cases and literature. The first striking element is the floor-to-floor height. The floor-to-floor height of the three cases differ. However, the sufficiency of the floor-to-floor height is interpreted differently per case in relation to the transformation potential. In case 2 and 3 the floor-to-floor height is mentioned by interviewees as challenging, even though the floor-to-floor height of case 1 is lower but not considered challenging. This relates to the "Can Do" mentality mentioned during the interviews. The mindset of the team to see opportunities where others see challenges is crucial for a successful development project.

The second striking element is the load bearing façade in relation to an open floor plan. Literature points out that open floor plans with columns and a non-load-bearing façade are important for the adaptability of the building. However, a load-bearing façade was often mentioned as beneficial for transformation because it allows the floor plan to be open and eliminates the use of columns and load-bearing walls. Even though, this statement might be correct. In relation to other adaptability criteria, a load-bearing façade entails challenges. When a building has a load-bearing façade, it makes horizontal expansion more complicated, and the façade is more difficult to change or replace.

"In many office buildings, you see a load-bearing facade to create flexibility in an open floor. However, for an adaptable building, you want it to be easily stripped down to a hull or frame. If that facade is load-bearing, it can be difficult to adjust, and that is not beneficial for the adaptability of that building."

- Architect 3

Architectural character

During the interviews the architectural character of a building was often mentioned as an important aspect influencing the adaptability of a project. The architectural character of a building touches upon the "soft side" of adaptability. Humans often attach to objects like buildings. When people think a building has a high architectural character, it often influences the adaptability positively. More effort is made to fit the new function into the building with its characteristics, and less changes to the building are made to preserve the architectural value.

"Ugly buildings that do not fit within their surroundings will be demolished no matter how adaptable they are."

- Architect 1

When all adaptability criteria from literature would be implemented in a design, this would often result in a building with a lower architectural character because of its standardized shapes and function neutrality. In the cases the importance of the architectural character is pointed out. Different stakeholders mentioned that a building must be designed for the demanded function. However, the ability to adapt in the future must be taken into account to create a future-proof building.

4.6.3 Success factors

Different success factors and opportunities were mentioned by interviewees. From these findings it became clear that the success of implementing adaptability mostly lies with the stakeholders involved in the project. Therefore, the success factors mentioned by interviewees were studies to support the adaptability criteria as they lack focus on collaboration and the roles of stakeholders. In the table below the success factors mentioned are listed. The success factors have emerged from lessons learned from the findings of the case study and analysis of the different barriers & drivers experienced by interviewees, see Appendix VII: Barriers for adaptability. It is important to note that these success factors were not experienced in the cases but were mentioned by the interviewees associated with these projects as opportunities for future development projects.

Table 4-5 Most important success factors from cross-case analysis

Laan van NOI	*Slotervaart CVZ*	*Zoutmanstraat*
Future-proof design	Future-proof design	Future-proof design
Clear and measurable ambitions	Strong vision of the client	Clear vision and ambitions
Sufficient revision documents	Possibility to expand	Extra space on plot
Multifunctional zoning plan	Multifunctional zoning plan	Multifunctional zoning plan
Knowledge about adaptability	Knowledge about adaptability	Knowledge about adaptability
Strong architectural character	Balance between architectural character and function neutrality	Strong architectural character
Municipal support	Good communication with municipality	Cooperating municipality
Early involvement of project team	Early involvement of project team	Early involvement of project team
Good selection procedure for project team	Clear project team selection procedure	Clear selection procedure of project team
Corresponding business case with ambitions	Balance between ambitions and business case	Clear view on influence of adaptability on business case
Clear communication about individual interests	Communicate and substantiate visions	Clear communication of individual interests
Financial value of adaptability & support of financers	Financial value of adaptability	Financial support of investors and banks
See opportunities instead of challenges	Thinking in opportunities instead of barriers	"Can Do" mentality
Find common goal and shared ambitions	Critical attitude of all stakeholders	Long-term focused mindset
Knowledge about own role and influence	Knowledge about own role and influence	Knowledge about own role and influence

Similarities

From the cross-case analysis it became clear that, in contradiction with literature, most success factors are human factors related to the roles of stakeholders and collaboration. First, interviewees have mentioned that all stakeholders involved in a project must adopt a 'Can Do' mentality, which also relates to the interpretation of building aspects as mentioned before. By thinking in solutions rather than challenges the chances to success become higher. Even though the power and influence of stakeholders differ, all roles are important and a link in the chain. Second, many barriers experienced by the interviewees are related to lack of knowledge about adaptability and the influence of adaptability on the project, the design, or the business case. Stakeholders must understand that a different kind of approach by stakeholders is needed where all stakeholders work towards a common goal with shared ambitions, a different kind of investment is made, design principles are focusing on both the demanded function and being future-proof, and the overall mentality of stakeholders involved differs with traditional development projects.

To achieve project success, knowledge about all aspects of adaptability and its influence on the project must be present or acquired.

Third, interviewees have mentioned the importance of the initiative phase. During the initiative phase the client, together with the project manager, sets the project goals, ambitions and overall vision which must be made measurable in KPIs. This phase is also used to develop a clear selection protocol for selecting the right project team. Stakeholders with a shared ambitions and the right mentality are needed. In addition, the entire team must be aware of the influence of adaptability on their role, and responsibilities in and on the project.

Fourth, the financial value of adaptability is mentioned by interviewees as one of the key elements for project success. Adaptability is a concept with a long payback period. The investments are currently only recouped at the time the building is transformed. The long payback period brings a lot of uncertainties for developers and investors. Interviewees have mentioned the opportunities for creating a financial trigger for adaptability, like the appraisal value, discounts on the interest rates with the bank, and certificates. Those examples are already being applied to sustainability initiatives and are therefore proof of a direct motivation for stakeholders to develop sustainable buildings.

Lastly, the interviewees mentioned the regulations from the government and the municipality. As mentioned, the zoning plan connected to a specific building site has a significant impact on the adaptability. A monofunctional zoning plan is not beneficial for the flexibility of the future value in relation to the applied adaptability concepts. In order to create certainties for clients and investors, a multifunctional zoning plan is demanded. A multifunctional zoning plan reduces the market risk because building owners can always respond to the demands of the market.

Differences

The possibility to expand is mentioned in two of the three case studies. For the Zoutmanstraat case the extra space related to the possibility to add balconies to the building because of outside-space regulations in housing and therefore does not require a large amount of extra space. In the Slotervaart CVZ case, the client owns the entire area and therefore has a lot of extra space. Extra space on the building plot is beneficial for the business case but not directly related to the adaptability of a building when this limited amount of extra space is not limiting the possibility to create outside space.

Communicating individual interests is mentioned in two of the three cases studies. According to interviewees, the individual interests of stakeholders in a project are often influencing the possibility to work towards the same goal. Therefore, they state that individual interests must be brought closer together in shared ambitions and goals. In the Slotervaart CVZ case this is not mentioned.

It can be stated that statements about individual interests of stakeholders can be related to the selection of the project team. when the right stakeholders with the right mentality and shared ambitions are selected, the influence of the individual interests on the project are expected to be lower.

4.7 Conclusion empirical research

The three cases discussed in the cross-case analysis show different barriers for the development of adaptable buildings. This shows that adaptability is a complex concept with many challenges for stakeholders. However, to improve the process, barriers experienced by the stakeholders can be translated to success factors and opportunities that can be influenced directly and indirectly by the stakeholders with a steering role in the project.

Political barriers are related to the regulations and zoning plan, which can only be influenced by the municipality. However, on a project level the decisions made by the municipality can indirectly be influenced by the project team. Economic barriers can be related to the investment costs, return on investment, and the financial value of adaptability in general, which can both directly and indirectly be influenced by the client.
Social barriers experienced relate to the knowledge of the concept and the selection of the right team, which can directly be influenced by the client and the project manager. Technological barriers relate to the quality of the building and the implemented adaptability criteria and can directly be influenced by the project team.

From the cross-case analysis different lessons learned from transformations are used in designing the action plan:

- Developing an adaptable building starts with the right drivers for adaptability and a clear ambition of the client that must be made measurable through KPIs.
- Adaptable building aspects influence the adaptability of a building but are mostly considered nice-to-haves instead of must-haves for adaptability. When the building is not over-dimensioned, has a low architectural character, or has no demountable elements adapting a building becomes challenging but is not considered impossible.
- The collaboration and mentality of the project team is most important for project success.
- The initiative and sketch design phase are considered as most important for project-success. In these phases decisions are made regarding ambitions, KPIs and selection of the project team.
- The role of the municipality is very important. The project team can have the right ambitions but when the municipality is not cooperating, achieving project success is more difficult.
- The knowledge of stakeholders about adaptability has significant influence on the implementation of adaptability.

During the empirical research, the adaptability criteria as established before are tested and improved using findings from the multiple-case study. The case study showed that the success of implementing adaptability mostly lies with the stakeholders involved. Therefore, the adaptability criteria are improved with an extra focus on the roles of stakeholder, see Appendix II: Adaptability criteria.

To support the adaptability criteria from literature and to bring focus to the process of adaptability, a list of success factors related to the roles and collaboration of stakeholders has emerged. In addition, the findings showed that a crucial role in developing adaptable building lies with the clients, both long-term and short-term involved. For this reason, the action plan will focus on the role of the client.

"I believe that success lies more in the stakeholders around the project than in the technology. We all know technology is there, but it's about the mentality of the stakeholders surrounding it."

- *Client 2*

Table 4-6 Success factors for adaptability

Success factors for adaptability	
• Develop a future-proof design • Create a document with clear ambitions & goals • Translate ambitions to measurable KPIs • Ensure good municipal collaboration • Ensure knowledge about adaptability within the project • Early involvement of project team	• Create a balance between ambitions and business case • Select a designer with experience and expertise • Select stakeholders with a "Can Do" mentality • Find innovative financial resources • Keep reflecting on progress and process

Part 5

Synthesis

5 Proposal

The goal of the research was to develop an overall action plan for the implementation of adaptability in new development projects focusing on the role of the client. The action plan can be used by clients or other stakeholders as a guideline for developing adaptable buildings. This chapter represents the action plan that was made based on the findings from literature and the empirical research. The first paragraphs focus on the goal of the action plan and the audience. After describing the context, the action plan is shown and described. The last paragraph shows the findings from the expert panel that is used to validate the action plan.

5.1 Shaping the action plan

The elements that are needed to shape the action plan are based on the findings from sub-questions 1, 2, 3, and 4. Developing the action plan means that the developed strategies on adaptability (shown in adaptability criteria) are combined with the theory on the roles of the stakeholders involved in the process, and the opportunities or success factors experienced in practice. The theories that are used for the action plan have derived from the literature review, the in-case analysis, and the cross-case analysis.

In the research proposal, all information available on adaptability and its implementation is used for developing an over-all action plan. Due to the complexity of the concept, the uncertainties for stakeholders, and the different roles of all stakeholders involved it is impossible to capture all elements and combine that into an action plan for all stakeholders.

The case studies showed that many barriers are experienced in developing adaptable buildings. In addition, the time frame of a building is extended through adaptability, which makes it difficult to capture the right context as it can change and influence a building significantly. There is no solution that is suitable for all adaptable building developments.

Therefore, the following rules apply to the action plan:

- The action plan shows a possible solution for developing a successful adaptable building. Success is not guaranteed.
- The action plan shows a difference in the amount of influence the client or other stakeholders have in different development phases.
- The action plan uses checkpoints and moments of reflection where the progress on KPIs must be monitored, and decisions are made. It is possible that the outcome of these checkpoints means that a step back must be taken.
- The value and implementation of adaptability criteria and success factors might differ per project. The criteria and success factors must be assessed based on the project ambitions, business case and type of client.

In the cross-case analysis several steps have been taken to improve the adaptability criteria from literature based on experiences in practice. In the case analysis it became clear that many barriers mentioned by stakeholders were relevant in practice, but not mentioned in literature.

Therefore, a list of success factors related to the roles and collaboration of stakeholders has emerged to supplement the adaptability criteria. This was done in several steps: (1) the barriers experienced by interviewees were listed, (2) the barriers were categorized based on the PESTEL principle, (3) the barriers were translated to success factors and opportunities, (4) the success factors and opportunities were compared across the three cases studied. This resulted in a list of 12 success factors for adaptability focusing on the "human side" of the process and 10 adaptability criteria focusing on *building aspects, location & context*, and *mindset & team*, that were used for the development of the action plan.

The action plan is developed by combining findings from different adaptability theories described in this research:

(1) The basis adaptability criteria from the literature review.
(2) The improved and added adaptability criteria from the case studies.
(3) The success factors and opportunities from the semi-structured interviews and cross-case analysis that were stated as lessons learned by interviewees.

In terms of the influence a client has in the process, a division is made between direct and indirect influence. The indirect part of the action plan shows a list of actions a client can take to indirectly influence the process with the corresponding stakeholders. The indirect influence of the client mostly relates to stakeholders outside the project team, and external factors influencing the success of developing adaptable buildings.

The direct part of the action plan shows the overall process, the sub-processes, the actions connected to the sub-processes, the amount of influence they have and the connected stakeholders.

5.2 Audience

The initiator of a project, the client, is the target audience for the action plan. The client has the highest influence in a project. In development project clients often hire a project manager to guide the process. Therefore, the action plan can also be used by project managers to steer and motivate the client to develop an adaptable building. In addition, the action plan can be used by all direct stakeholders involved in the project team to motivate other stakeholders, to use it as a guideline or to understand the process.

The action plan can be used in different ways:

- To understand. The action plan can be used to understand the influence of adaptability on the project, the roles of different stakeholders and the business case.
- To steer. The action plan can be used to actively steer on the implementation of adaptability in projects. The overview on the impact, key aspects and process can be used as a guideline for stakeholders and gives overview on what is to come in the process.
- To motivate. The action plan can be used to create awareness of why parties should develop adaptable buildings, and why developing adaptable buildings is more sustainable than developing a traditional building. It can be used as a tool to motivate stakeholders and substantiate visions.

5.3 The action plan

Even though the action plan is no guarantee to project success, to improve the functionality of the action plan it requires phasing with actions and milestones. In the following paragraphs, all elements of the action plan are described.

The overall action plan can be found in Appendix IX: . There, the action plan that can be used by different practitioners is shown with a corresponding explanation.

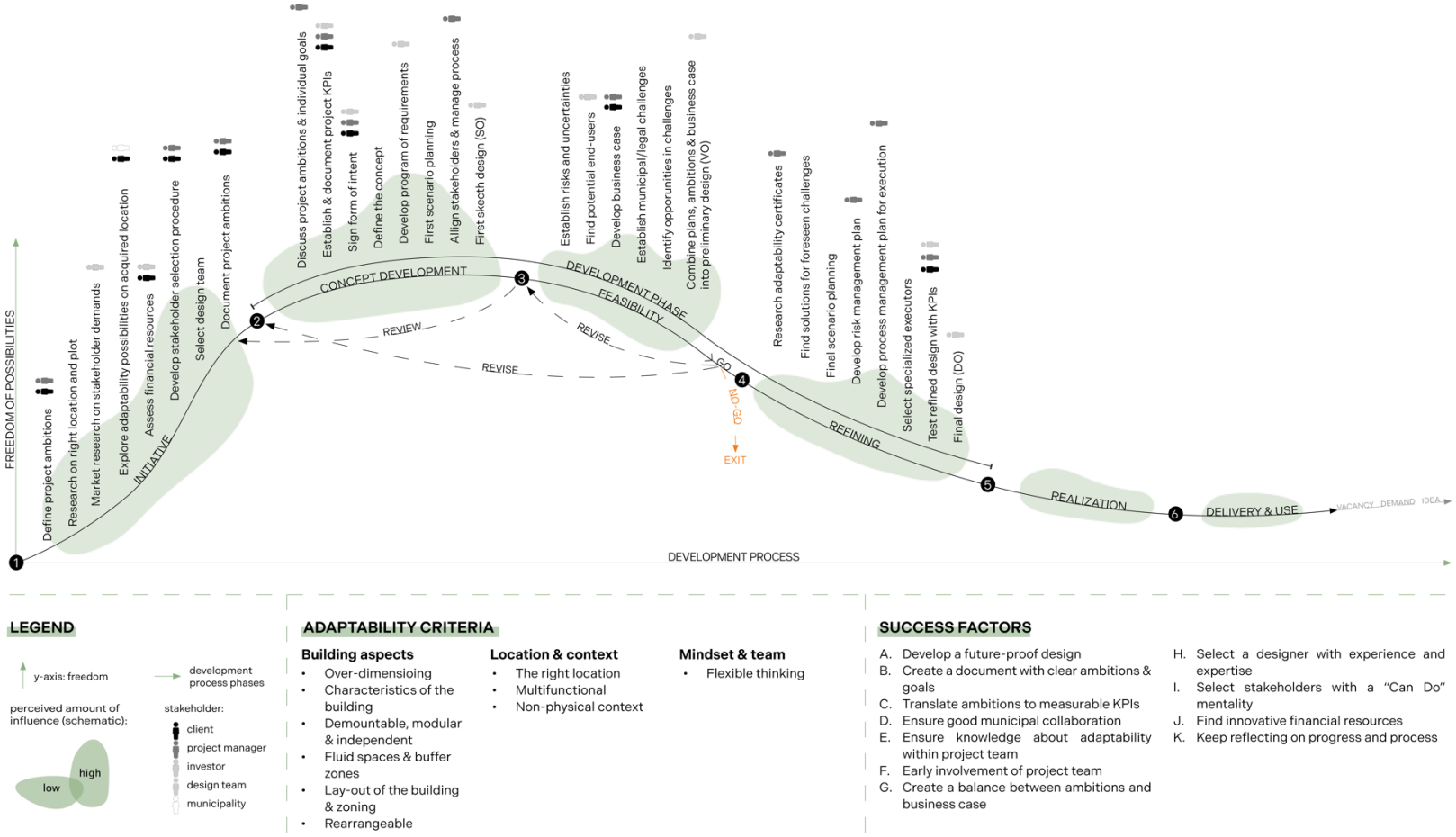


Figure 5-1 Action plan for adaptable building developments (own figure)

Start

The action plan is a guideline for adaptable building development. It shows different elements, from the process of adaptability with corresponding actions, the amount of influence stakeholders have, the different stakeholders involved, and adaptability criteria, to success factors and the indirect influence a client has on the implementation of adaptability.

The action plan can be read from left to right, starting at the bottom left corner where the initiative phase starts. On the y-axis the freedom of possibilities in the process is schematically shown. The x-axis shows the different phases of the project. The process line of the action plan shows different numbers, representing the starting point of the different project phases. These points are also checkpoints where a moment of reflection takes place and 'lessons learned' between stakeholders are shared. The different phases also have activities and tasks that influence the project success for adaptability. Several tasks are appointed to a stakeholder. This stakeholder is responsible for the task. When there is no stakeholder appointed to a task, the team must discuss the expectations and a plan to achieve the task. In addition to the tasks and stakeholders that are represented in the different phases, a green shape is shown in each phase. The green shape represents the (schematic) amount of influence the client has in that particular phase. In the first phases the green shape is bigger, meaning that the client has more influence on project outcomes. As the project progresses and more decisions are made, the client's influence decreases.

At the bottom of the action plan the ten adaptability criteria focusing on the physical aspects of a building, and the eleven success factors focusing on the process and collaboration side of the project are shown. Those elements are perceived as most important focus points in developing adaptable buildings and have emerged from the literature review and empirical research.

Phase 1 – Initiative phase

The development of an adaptable building starts with an idea or ambition of the initiator, being the client. This phase is the kick-off of the project and starting point for the development of an adaptable building. Adaptable building developments can start from different drivers:

- As a response to a rising demand for future-proof and adaptable buildings
- As a strategy to reach sustainability goals
- From an intrinsic motivation to be better for the world
- As a strategy to create a competitive position in the market

The initiative phase is drawn by activities that shape the basis of the project and is very important for project success. In this phase the client often acquires a project manager to guide the process of the concept development or the entire development process including execution. This phase is where the location acquisition takes place, ambitions are set, and the right project team is selected. Finding an advisor from the municipality and an expected buyer for the building will ease the development of the project and the possibilities. A clear set of goals and ambitions are important and must be documented.

Type of client

Short-term involved and long-term involved clients have a different approach in developing an adaptable building where the first one sells the project after obtaining the permit or completion and the latter one retains ownership of the building within own portfolio. At the beginning of the project, it is good to keep in mind what the impact of the differences in approach is on the project ambitions, financial return on investment, involvement, and payback period. The impact of those elements in relation to adaptability should be incorporated in the project KPIs.

Stakeholder mindset

The success of a project, particularly one focused on developing an adaptable building, heavily relies on the mindset of stakeholders and the selection of the project team. Transparency about the project's adaptability goals is crucial, along with making these goals measurable. While shared project ambitions are essential, honesty in aligning personal goals with project ambitions is vital; misalignment may indicate a stakeholder's unsuitability for the project. Stakeholders must recognize that developing an adaptable building requires a unique approach, often involving the smoothing out of personal interests to reach common ground.

All stakeholders, regardless of their level of influence in the project, are integral to the project, from initiation to completion. Embracing a "Can Do" mentality, focusing on solutions rather than challenges, significantly enhances the likelihood of success.

Even though clients make final decisions and provide funding, every role within the project team is a crucial link in achieving the project's goals. This collaborative and solution-oriented approach is key to successfully developing adaptable buildings.

Project team selection

Developing an adaptable building requires a team that is willing to step out of their comfort zone and has a mentality where opportunities are seen instead of challenges. It is important to select the right parties for the different roles involved in the different project phases. The client must select a team based on the project ambitions established by the client and the project manager. There are certain requirements a suitable party must meet in order to be included in the project team. A party suitable for the development of an adaptable building must...:

1. Have shared visions and ambitions with the client about adaptability and project goals.
2. Have knowledge and expertise in the field project development and adaptability.
3. Have a "Can Do" mentality.
4. Be able to smooth its interests and individual ambitions.
5. Be open, honest, transparent, and positive.
6. Be critical about decisions made in the project.
7. Must have a strong sense of responsibility.

Location acquisition

Developing a successful adaptable building requires the right location & context, which means the urban area, the building site itself, and the political context it is in. Placing the building in a mono-functional area must be avoided when developing an adaptable building. Instead, areas with mixed functions and where functional changes can be enhanced are preferred (Remøy et al., 2011). Buildings in the dynamic and mixed-use areas should be integrated in the environment and designed to intertwine with the built environment (Nakib, 2010). In addition, buildings should be placed in a location that is central and expresses culture (Remøy, 2010). When the right location is selected based on aspects that accommodate the function, there are other elements that must be considered. For the building site, the first important consideration are the legal aspects of the site, like the maximum number of square meters that can be built (Nakib, 2010). Another important aspect is the surplus of space on the site that allows expansion of the building when needed (Geraedts, 2016).

In order to accommodate functional change in adaptable buildings flexibility in the zoning plan is required. However, this does not necessarily mean that the zoning plan must be multifunctional at the start of the project. A building plot with a multifunctional zoning plan is ideal but a building plot with a monofunctional zoning plan and a cooperating municipality that is willing to facilitate a functional change in that zoning plan is also sufficient. In this case, it is important to note that, for creating adaptable building, the role of the municipality is very important.

Flexibility in the zoning plan, the regulations and the assessment of the design is highly needed for the success of adaptability.

Phase 2 – Development phase

After shaping the foundation of the project in the location acquisition, project ambitions and team selection the development phase can start. The development phase consists of concept development, feasibility, and refining the plan. According to the case study findings, the lack of knowledge is a large barrier in adaptability projects. Therefore, it is important to ensure clarity on the definition of adaptability within the project team and acquire knowledge about the concept when this is lacking.

Concept development

During the concept development the ambitions from the client are translated to measurable project KPIs and a sketch design. The concept development brings a large number of possibilities, and many stakeholders are involved. It is the role of the client, together with the project manager, to translate the project ambitions into a program of requirements. Together with an innovative architect, the program of requirements can be translated into a sketch design that is adaptable but at the same time has a high architectural character and value. For the sketch design, the building aspects as stated in the adaptability criteria must be considered where focus lies on *over-dimensioning, characteristics of the building,* and *demountable, modular, and independent elements.*

The concept development phase has the highest peak of influence that can be made because possibilities are explored. Following phases are further elaborations of decisions made in the initiative and concept development phase, and the amount of influence decreases. Because the concept development phase lacks tangible deliverables, the complexity is high.

Feasibility

In the feasibility phase the developed concept is narrowed down into a more feasible plan. Where the concept development entails endless possibilities, the feasibility phase tries to combine all plans with the project KPIs and business case. The combined plan is a preliminary design. The feasibility phase requires rounds of reflection which can result in iteration when those elements are not aligned, and the project plan is not feasible. In this case the financial sources can be reassessed, or the design must be changed.

It is important to note that a different business case underlies an adaptable building development. The investment is not just made for the business case of the first functional lifecycle but also for the residual value of another business case that lies beyond.

Refining the plan

After developing a feasible plan, the refining phase is used to create the final plan. The final plan is a feasible translation of the project ambitions, the selected adaptability criteria, and the business case. In the redesigning phase the execution is prepared, scenario planning and risk management is done, and experienced executors are selected by the contractor.

In addition, research is done on how the adaptability can be embedded in sustainability certificates.

Phase 3 – Realization phase

The realization phase is a phase where little influence can be exerted on the project outcomes. However also during construction, the project team must monitor the progress and check the feasibility of the project. It is the role of the contractor to communicate progress, obstacles, and risks with its subcontractors and share this information with the project team. Lessons learned must be shared with the team and feedback must be provided. Also, in the realization phase stakeholders must hold on to their flexible mindset to be able to respond to changes in the plans that can be made. Flexibility throughout the entire development process is important.

Phase 4 – Exploitation phase

Adaptability is a concept with the goal to extend the functional lifecycle of a building beyond its first user. Therefore, the exploration phase is a phase that must not be forgotten. After completing the project, the project team must provide a sufficient set of revision documents. The revision documents are of great importance when the demand changes and information is needed in the future.

5.4 Validating the action plan

To validate the action plan, an expert panel is organized. During the expert panel the action plan is discussed to validate the results and receive recommendations for improving the final version of the action plan.

Expert selection

The experts are selected based on certain selection criteria. The expert panel is held with three people, working as clients in the built environment, preferably with experience in the development of adaptable buildings. The participants must at least be familiar with the theme's 'adaptability' and 'future-proof buildings'. In addition, because the participants are experts in an expert panel, they must have five or more years of experience within the field of project development. Lastly, to create more support and to increase the reliability of the results of the research, the participants are not involved in the case studies of the research. To summarize, the experts...:

1. Are clients within the field of project development, preferably long-term involved.
2. Are familiar with the theme's 'adaptability' and 'future proof buildings'.
3. Have five or more years of experience in the field of project development.
4. Are not involved in the semi-structured interviews from the case study.

After inviting the experts, they receive additional information about the research and the expert panel. During the expert panel the action plan is validated.

In addition, the informed consent form in Appendix IV: Informed consent form is shared prior to the expert panel where the data processing methods and data publication are mentioned. In order to be able to fully participate in the expert panel and be able to translate the feedback into the final action plan, the expert panel is recorded and processed. The data is used to develop the final action plan that helps to implement adaptability in the development of new buildings in the Netherlands.

Findings of the expert panel

To conduct the expert panel, the expert panel protocol is used, see Appendix VIII: Expert protocol. The protocol gives an introduction on the research and the goal of the expert panel. Following the introduction, four extreme statements from the cross-case analysis and development of the action plan are discussed. Lastly, the action plan is showed and validated by the experts.

Statement 1: "All new buildings must be adaptable to transform to another function in the future."

All experts in the panel semi disagree with the first statement. The experts state that depending on the location, it would be good to think about adaptability and future functions. However, adopting adaptability concepts in a project are related to extra investment costs or a lower return on investment. It is therefore not feasible to develop all new buildings as adaptable buildings. In order to develop more adaptable buildings and reduce financial barriers, focus must lie on demountable elements.

On the other hand, the experts mentioned that stakeholders must consider incorporating sustainability to the highest extend in all new buildings. In addition, the experts mentioned the importance of the quality of the first function. A building must accommodate all functions it houses as sufficient as possible. It is therefore important to create the best design as possible for the first function but keep transformation to future functions in mind.

Statement 2: "A client is responsible for having knowledge about adaptability and buildings in-house. If they do not have this, it must be acquired."

According to the experts, the client is always responsible for the acquired knowledge in its team. However, it is not required to have all knowledge in-house. A developer can make use of its advisors. In that sense, it is the responsibility of the client to acquire the right advisors with the right knowledge. In addition, the experts argue that other stakeholders in the design team are also responsible for having knowledge in regard to their role, to communicate their knowledge, and to cooperate in moving towards the same project goal. According to the experts, it is crucial for a client to be involved in the project. Because of the steering role of the client, projects where a client has a distance from the design team are less likely to succeed.

Statement 3: "For adaptable buildings, the municipality is the most crucial party to work with. If they do not cooperate, the development of adaptable buildings is impossible."

The experts disagree on this statement. They argue that the client is responsible for the project. The role of the municipality is crucial but is a more serving role. Their role is to assess the project plans. Additionally, the experts state that it is likely that municipalities are willing to cooperate in a project that is focusing on the future value of its purpose in the urban area. However, in order to convince the municipality, it is important to create strong plan with clear ambitions. When the municipality sets adaptability as a priority, it is more likely that they incorporate that into their regulations instead of being an internal stakeholder in project teams.

Statement 4: "It is necessary that certificates for adaptability are developed to give it financial value."

The experts agree partly with this statement. According to the experts, adaptability should be incorporated into sustainability certificates, rather than developing new ones. On the other hand, when adaptability is not incorporated in certificates, adaptability will be valued through demands. The financial value is interesting, but according to the experts the value is incorporated in the demands and the flexibility of the zoning plan. In the field of sustainability certificates, the certificates are often a requirement and not an aspect investors are willing to pay extra for. On the other hand, when a building has a multifunctional zoning plan, the experts state that investors are likely to make a small extra initial investment. Lastly, the experts state that it is the responsibility of the client to look beyond the financial value of investments they make and develop from the believe that this is the right thing to do.

Validation of the action plan

Additional to the statements, the action plan is discussed. This is done by asking what their first impression is, if it is clear, and if they think it is useful in practice.
The experts have mentioned that it is important to limit extra contact moments in the timeline. Therefore, it is crucial to include all important stakeholders and knowledge early in the process but at the same time reduce the number of stakeholders involved in the design team. Therefore, the client must communicate the responsibilities of the members of the design team at the beginning of the project.

In line with the beforementioned elements, according to the experts, the role of the "adaptability experts" is unnecessary. In the preliminary version of the action plan an adaptability expert was added to monitor the feasibility of the project and to inform all stakeholders. However, the experts have mentioned that it is the role of the client, together with the project manager, to monitor the feasibility of the project and communicate the ambitions and program of requirements with the architect.

In regard to the role of the municipality, their role is to develop policies and assess project plans. Therefore, including an advisor within the municipality is not needed. However, a meeting can be scheduled to discuss the ambitions for adaptability and discuss about a multifunctional zoning plan.

In addition, the experts have mentioned that the sequence of the actions needs to be reconsidered. In the preliminary version the actions are numbered. In their opinion, many actions are recurring actions and do not occur in a specific order.

The feedback from the experts in the expert panel is incorporated in the final version of the action plan.

Part 6

Discussion, conclusion & reflection

6 Discussion

This section of the thesis focusses on the discussion of the research design and findings. In addition, the limitations of the research are described followed by recommendations.

6.1 Discussion on research design

The research is divided into three main research methods. First, the desk research where literature is reviewed, and the adaptability criteria are established. Second, the empirical research where the adaptability criteria are tested in practice and the roles of stakeholders are studied. Last, the synthesis where findings from literature and practice are combined into an action plan which is verified through an expert panel.

Desk research

This research focuses on two main topics, adaptability, and the roles of stakeholders. Due to the rising interest in the complex concept of adaptability and the demand for adaptable buildings, a lot of literature was available. However, most literature about the topic focuses on the building aspects and characteristics. Little research is done on the implementation of the concept and how stakeholders must collaborate to develop more adaptable building. Therefore, a significant part of the action plan is based on the view of the author. Although the goal of the empirical research was to focus on the assessment of the adaptability criteria, the missing link between adaptability and stakeholder collaboration in literature was also addressed in the success factors that were added.

In an attempt to acknowledge the subjectivity of the action plan, data from different stakeholders is used to develop the action plan which is then verified with experts in the field of project development.

Empirical research – Case study

The analysis of the case study was done through collecting document data and semi-structured interviews with different stakeholders. To gather enough knowledge on the different cases in regard to the adaptability and the roles of the stakeholders, document data analysis was done prior to the interviews. The findings from literature and document data were used to develop an interview protocol. The interviews were divided into four parts, the roles of the stakeholders, the barriers experienced, the assessment of the criteria, and possibilities for developing adaptable buildings. Despite the fact that different types of clients, long-term involved and short-term involved, were interviewed and their interests differ, all clients were engaged in the interview and willing to elaborate on the questions which gave interesting insights.

Empirical research – Interviews

In the case analysis, the interviews were proven to be a significant addition to the literature. Where literature gave a utopic view on the concept of adaptability, the interviews gave insight in the barriers that were experienced by the stakeholders, what their perspectives were on the roles of stakeholders, and opportunities they saw in developing adaptable buildings.

The interviews focused on topics in the present and future, but also on changes in the market. Therefore, the interviewees seemed very interested in the topic and the research output. On the other hand, during the interviews, it was established that the key success factor for adaptability lies with the collaboration of stakeholders, and that adaptability criteria focusing on the physical aspects of an adaptable building were less significant to project success. Therefore, the interviews and with that findings from the case studies mostly focus on the collaboration side instead of the assessment of the criteria as initially envisioned.

When different stakeholders within their own projects are interviewed, it can be expected that their input might be biased. However, all interviewees were willing to be critical on the team collaboration and the project success of their own project. In addition, despite the small sample size of the interviews, due to time and feasibility reasons, the insights provided were sufficient and valuable for the research and gave different perspectives on the topic. The insights from the interviews were used to evaluate literature findings and new findings were formulated after analyzing the findings across the three cases. In summary, the data gathered, including document data, and conducted interviews, proved to be effective methods that successfully met the goals of the empirical research.

Synthesis – Expert panel

The action plan was developed after synthesizing the cross-case findings with the literature review. Literature is mostly focused on the physical characteristics of an adaptable building. A focus on the collaboration of stakeholders is missing. To acknowledge that, the action plan is validated through an expert panel to substantiate the research. This validation process was crucial for the usability of the action plan for clients. In addition, the validation via an expert panel provides an extra step in bringing theory and practice around adaptability closer together.

6.2 Discussion on research findings

In this research three types of findings are presented: literature findings, findings from the empirical research, and the developed action plan.

Relation between findings and research proposal

When the final action plan is compared to the initial objectives, which was not focused on the client and was supposed to create a clear view on the roles of the different stakeholders, the end product is more tangible and concrete as it focusses on the entire process, makes a division between direct and indirect influences, includes opportunities, and zooms in on the most impactful stakeholders in the development of adaptable buildings, being the client, the project manager and its project team.

Transformation versus new-built

Now that the research is finished, it is questioned whether or not the focus on transformation project in the case studies was beneficial for the research outcome. As mentioned, the initial objectives of the research were focuses on assessing the adaptability criteria and establishing the roles of stakeholders. In that case, studying transformation projects and drawing lessons from that would be beneficial for the research outcomes.

As the case study findings mainly focused on the process and the stakeholder mindsets, the benefit of studying transformation projects diminished. However, this change in focus was quickly discovered and the focus in the interviews shifted to the stakeholders. The stakeholders interviewed were also active in new-built projects, which resulted in managing the challenge and collecting the right research data.

Focus on physical aspects

A key barrier identified in this research is the lack of knowledge about the implications of adaptability for the development process. While the impact of adaptability on design is generally understood and acknowledged, implementing it in the project remains a challenge. In the empirical research it was established that the adaptability criteria from literature mostly focus on the physical aspects of adaptability and are because of that not sufficient enough for a successful adaptable building. Therefore, to support the adaptability criteria from literature and to bring focus to the process of adaptability, a list of success factors related to the roles and collaboration of stakeholders has emerged. This offers a more comprehensive perspective on how adaptability relates to stakeholder, emphasizing the need for involvement and understanding.

Value of the research

The findings from the interviews have also provided other valuable input for the research. The findings either confirmed statements from the literature, refuted and enhanced it, or created new insights that were not yet discovered in the literature review.

The differences in the interview findings add value to the research outcome and create recommendations.

The findings from both the literature study and the empirical research address the rising interest in developing adaptable buildings, which means that this research is of value for the present and the future. Many interviewees pointed out that current barriers they experience are most likely be tackled in the foreseeable future. However, these statements are currently assumptions. Now, it is important to create more incentives and certainties to convince stakeholders of the added value of adaptability. Additionally, the positive feedback of both interviewees and the expert panel reflect the importance and significance of the research. This means that the topic must be further explored to create a more future-proof built environment.

6.3 Research limitations

Despite the positive impact this research can have to develop a more future-proof built environment, there are also some limitations to this research. The research is conducted in a limited timeframe. Therefore, some choices in the research were made with time in mind and not exclusively focused on what is best for the outcomes of the research.

Case study research

As mentioned, the number of cases studied, and stakeholders interviewed might have influenced the research outcomes. An increased number of cases studied, and stakeholders interviewed could result in a more effective action plan. However, the small number of cases selected also resulted in the possibility to go thoroughly into the case but also be able to analyze the cases cross-case. In addition to reflecting on the validity of the research, despite the small number of cases studied, different similarities and differences are noticed in the interview findings.

Bias towards graduation company

On the line of research validity, all selected cases have a collaboration structure where internship company Dev_ real estate is hired as the project manager. The involvement of the internship company might have resulted in a biased view on the cases. However, to acknowledge this limitation, the experts in the expert panel are all clients from different companies, not being Dev_ real estate and not involved in the case studies from the empirical research.

Financial support of the client

The projects selected for the case study were all of different sizes, in different cities, and with different types of clients. Two of the clients have a large financial support, which can influence their motivation to develop adaptable building because more risks can be taken. However, to get a clear view on the different adaptability drivers of clients, the client of the third case is a small investment company which has a different risk profile. The different risks a client can take in a project might influence their motivation for implementing adaptability in a project. However, when the perspectives of the three clients are compared, no striking findings can be connected to this limitation. In addition, to acknowledge this limitation, the expert panel is used to validate the findings and eliminate errors regarding this limitation.

Research context

The last limitations can be related to the context of the research. First, it is important to note that the research was developed within the Dutch context and the action plan was developed for clients within the Dutch context. Although, the goal of implementing adaptability is to develop adaptable buildings all around the world, actors or researchers must be aware that some components of the strategy might vary in different geographical contexts. Second, the developed action plan is validated by the expert panel. However, the functionality of the action plan in practice is not validated. Therefore, the action plan must be reviewed after it is being used and errors must be eliminated and improved in order to keep its long-term value.

7 Conclusion

The goal of this research was to find how to successfully implement adaptability in development projects and their processes. The research goal had three dimensions:

(1) To combine existing adaptability strategies and tactics.
(2) To understand the collaboration and roles of stakeholders involved in adaptability.
(3) To make the implementation of adaptability in a development process more tangible for clients through a guideline.

This chapter summarizes the answers to the sub-question and the main research question. After answering the main research questions, recommendations for further research and for practice are presented.

7.1 Research questions

The main research question of the research was: *"What are the criteria for developing an adaptable building, and how can clients influence the implementation of these criteria in development projects?"*. To get a better understanding of the main themes and to support the main research question, six sub-questions were asked. The main themes of the research were: adaptability, existing strategies, adaptability criteria, roles of stakeholders, and influence of the client. Each sub-question addresses a main theme and is a step towards answering the main question.

SQ1 Adaptability – How can adaptability in buildings be described?

The purpose of this sub-question was to define and understand the complex concept of adaptability and its underlying aspects, and to create a fundamental basis for further parts of the research.

In this thesis, the concept of adaptability can be described as the ability of a building to respond and fit to the evolving demands in its context, and thereby to maximize the value throughout its life cycle and reduce the future mismatch. The concept of adaptability is defined by the capacity for change, the ability to remain "fit" for purpose, value, and time. Adaptability in new building developments is designing the building to accommodate functional change in the future and thereby contribute to a future-proof urban area.

SQ2 Existing strategies – What are existing adaptability strategies?

From the findings of the literature review, it can be concluded that the concept of adaptability is very complex. The different dimensions of adaptability show the complexity of the concept. In literature many researchers have developed frameworks, models, and strategies in an attempt to understand and simplify the concept of adaptability. However, all strategies developed seem to have a fundamental basis, the shearing layers of Duffy (1990). Duffy (1990) divided a building into layers based on their lifespan and capacity of change. The introduction of this framework was the first step from seeing a building as an object connected to its lifecycle in a dynamic world.

The interdependency between the different layers is seen as one of the key enablers for adaptability. In order to create an immutable structure around which change can occur, as many layers as possible must be kept outside of the structural layer (Duffy, 1990). Brand (1995) follows the layers of Duffy and adds two layers, using; *site, structure, skin, services, space plan* and *stuff*. In the most recent research that was done by Schmidt III and Austin (2016), the layers of Duffy and Brand were revised and the layers *social* and *surroundings* were added *(Schmidt III & Austin, 2016)*.

SQ3 Adaptability criteria – How can existing adaptability strategies be combined into adaptability criteria?

Within literature, most strategies and adaptability tactics focus on the physical aspects of a building such as modular construction, flexible layouts of the buildings, and over-dimensioning (Brand, 1995; Schmidt III & Austin, 2016). While these aspects are crucial for adaptability, other important dimensions are often overlooked. The "human side", added in the revision of the building layers by Schmidt III and Austin (2016) helps to connect the influence of stakeholders in the process to tangible adaptability solutions and actions. When existing adaptability strategies are compared and combined, ten adaptability criteria can be listed, see below.

SQ4 Adaptability criteria – How do the adaptability criteria compare to cases in practice?

Many of the adaptability concepts mentioned in the literature review were mentioned by interviewees from the cases studies. *Over-dimensioning* (both in size and structural load capacity), *characteristics of the building,* and *demountable, modular & independent elements* were mentioned as most important for the transformation of a building from one function to another. The other adaptability criteria were mentioned as nice-to-haves in transformation because they do not affect the adaptability significantly.

Even though three of the ten adaptability criteria were mentioned as most important, they are not considered must-haves for adaptability. Other findings point out that the mindset and collaboration of stakeholders is the key to project success. Overall, adaptable building aspects influence the adaptability of a building but are mostly considered nice-to-haves instead of must-haves in the over-all adaptability. When the building is not over-dimensioned, has a low architectural character, or has no demountable elements adapting a building becomes challenging but is not impossible.

Table 7-1 Adaptability criteria derived from literature review

Building aspects
- Characteristics of the building
- Over-dimensioning
- Fluid spaces & buffer zones
- Demountable, modular & independent
- Lay-out of the building & zoning
- Rearrangeable

Location & context
- The right location
- Multifunctional
- Non-physical context

Mindset & team
- Flexible thinking

SQ5 Roles of stakeholders – What are the roles of the stakeholders involved in the development of adaptable buildings?

From the case studies it became clear that the mindset of the stakeholders and the selection of the project team are key to success. Even though all stakeholders are important in project success, the influence and power those stakeholders have differ. The interplay between the implementation of adaptability criteria in new buildings and good collaboration between stakeholders are key to a high transformation potential in the future. In addition to that, the amount of and the extent to which adaptable building aspects are adopted in a building, and how the project and overall process are managed, are directly influenced by stakeholders with the highest impact and influence on the project, like the client, architect, and project manager.

The client has the highest influence on the implementation of adaptability in a project, because in the end the client is the main decision maker. Here, a distinction can be made between short-term involved clients that develop the project to sell it after the design phase or after completion, and the long-term involved clients that keep the building within their own portfolio. Both types of clients have a high influence on the implementation of adaptability in a project, but with a different ambition.

The project manager is also important for project success. The project manager can influence the overall adaptability on different levels. When the client has the ambition to develop an adaptable building it is important to select a project manager that understands and represents their ambitions.

On the other hand, the project manager can also motivate the client to be better and implement more adaptability aspects in the projects by understanding the impact of decisions on the project and the business case.

Together with the client the project manager selects the project team. This team must be a selection of stakeholders with an innovative and positive mindset. All stakeholders must adopt a 'Can Do' mentality. By thinking in solutions rather than challenges the chances to success become higher. In addition, the design team must have shared visions and ambitions with the client about adaptability and the project goals.

SQ6 Influence – How can clients influence the implementation of adaptability in new buildings?

In this research it became clear that the success of implementing adaptability mostly lies with the stakeholders involved. The adaptability criteria from literature mostly focus on the physical aspects of adaptability and are because of that not sufficient enough for a successful adaptable building. Therefore, to support the adaptability criteria from literature and to bring focus to the process of adaptability, a list of success factors related to the roles and collaboration of stakeholders has emerged. In addition, findings showed that a crucial role in developing adaptable building lies with the clients, both long-term and short-term involved. The client is the initiator and main decision maker of the project and has the highest influence on the implementation of adaptability. All success factors can directly be influenced by the client to improve project success. The success factors are listed on the next page.

Table 7-2 Success factors for adaptability, derived from empirical research

Success factors for adaptability	
1. Develop a future-proof design	7. Create a balance between ambitions and business case
2. Create a document with clear ambitions & goals	8. Select a designer with experience and expertise
3. Translate ambitions to measurable KPIs	9. Select stakeholders with a "Can Do" mentality
4. Ensure good municipal collaboration	10. Find innovative financial resources
5. Ensure knowledge about adaptability within the project	11. Keep reflecting on progress and process
6. Early involvement of project team	

7.2 General conclusion

The answers to the sub-questions together lead to answering the main research question:

"What are the criteria for developing an adaptable building, and how can clients influence the implementation of these criteria in development projects?"

In current studies, focus lies on the physical aspects of adaptability (Brand, 1995; Schmidt III & Austin, 2016). While these aspects are crucial for achieving adaptability, the "human side" must be linked to the existing strategies. This helps to connect the influence that stakeholders have on the development process to tangible adaptability solutions and actions. In this research the technical aspects of adaptability are linked to the "human side" of the concept through an action plan.

The "action plan for adaptability", which combines all elements of the sub-questions into one unified model, provides the answer to the main research question.

The success factors, together with the adaptability criteria form the basis for the action plan in which the influence of the client on adaptability projects is mapped out and made tangible to improve the implementation of adaptability in development projects.

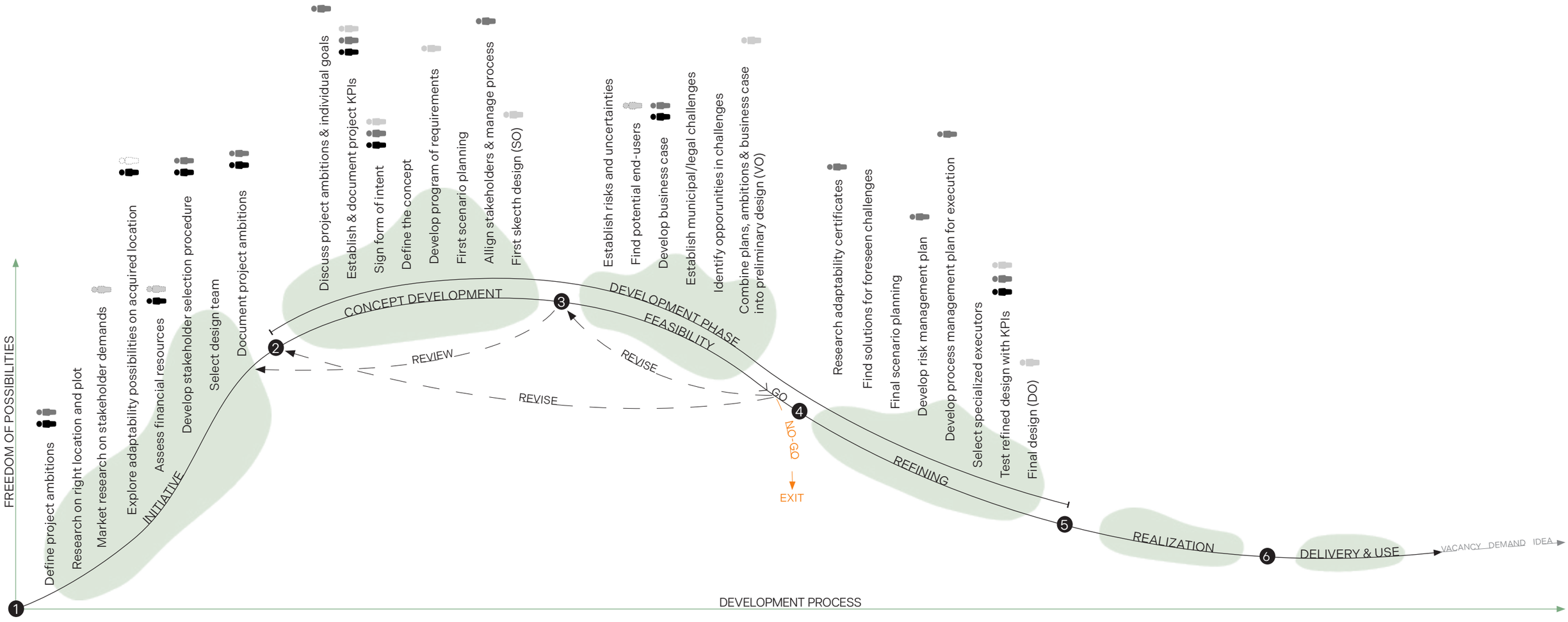
At the beginning of the research, it was stated that when it is understood **what** is needed for an adaptable building and there is more clarity about **how** and **who** can influence the different elements, it becomes easier to implement adaptability in development projects. Presenting these elements in a clear overview will increase the chance to project success for adaptability.

It can be concluded that **what** is needed in an adaptable building is already clear to most real estate practitioners. However, **how** this can be implemented in development projects, and **who** is responsible for influencing the different elements, is unclear to many. This action plan focuses on creating the clarity that is needed to make the influence clear and manageable for the client. It also gives guidance to the client and insights on what actions must be taken.

The action plan can be used by clients or other stakeholders as a guideline for developing adaptable buildings. It can also be used to motivate and inspire other stakeholders or to start the discussion about the concept. Even though the action plan is no guarantee to project success, to improve the functionality of the action plan it requires phasing with actions and milestones.
The action plan shows different elements, from the adaptability criteria and success factors to the process of adaptability with corresponding actions, the amount of influence stakeholders have, and the indirect influence a client has on the implementation of adaptability.

The action plan is shown on the next page. The overall action plan can be found in Appendix IX: . There, the action plan that can be used by different practitioners is shown with a corresponding explanation.

ACTION PLAN
FOR ADAPTABLE BUILDING DEVELOPMENT



LEGEND

y-axis: freedom

development process phases

perceived amount of influence (schematic):

high

low

stakeholder:

- client
- project manager
- investor
- design team
- municipality

ADAPTABILITY CRITERIA

Building aspects

- Over-dimensioing
- Characteristics of the building
- Demountable, modular & independent
- Fluid spaces & buffer zones
- Lay-out of the building & zoning
- Rearrangeable

Location & context

- The right location
- Multifunctional
- Non-physical context

Mindset & team

- Flexible thinking

SUCCESS FACTORS

A. Develop a future-proof design
B. Create a document with clear ambitions & goals
C. Translate ambitions to measurable KPIs
D. Ensure good municipal collaboration
E. Ensure knowledge about adaptability within project team
F. Early involvement of project team
G. Create a balance between ambitions and business case
H. Select a designer with experience and expertise
I. Select stakeholders with a “Can Do” mentality
J. Find innovative financial resources
K. Keep reflecting on progress and process

7.3 Recommendations

Based on the research findings, the conclusion of the research question, and feedback from interviewees and the expert panel, recommendations for practice and further research can be made.

7.3.1 For practice

Sharing knowledge

In the research it is observed that the pace of change is increasing, and mis-matches occur. This changing world is affecting the demand for adaptable and future-proof buildings. However, knowledge about the impact of adaptability on the project is lacking. Therefore, it is important to continue to share knowledge about the concept of adaptability and different roles of stakeholders and to reflect on that. When knowledge within a team is missing, this knowledge must be acquired in order to successful develop an adaptable building.

Involve the municipality

Since the regulations and the zoning plan are crucial in the adaptability of a building. The municipality is needed for developing adaptable buildings. It is the role of the developer and project manager to ensure good collaboration with the municipality and to explore possibilities. Many barriers experienced by the project team cannot be influenced because they require decisions from the municipality. Involving the municipality in early stages can provide new insights.

Challenges might be relative

Challenges in developing adaptable buildings might be relative and depend on your mindset and interpretation. A "Can Do" mindset is required, where possibilities are seen instead of challenges and barriers. Communication and collaboration are important to prevent opportunities from being seen as barriers.

Updating the action plan

As mentioned, the pace of change is increasing. Therefore, the action plan must be reviewed and updated every few years as certain barriers could have been solved, new barriers could have emerged, and certain tactics need to be updated. The action plan in this research is not a fixed solution but it is a tool that must be adapted and updated to address the mismatch in the future.

7.3.2 For further research

Stakeholders

This research focuses on the client, project manager and architect. However, one of the main findings is that all stakeholders involved in the project are crucial for project success. Therefore, further research must be done on different stakeholders involved in the development of adaptable buildings and what actual influence they have.

Municipality

On the same line as the stakeholders involved, the municipality is pointed out as a key stakeholder in the development of adaptable buildings. This research provides opportunities for the municipality and actions for the client to influence and motivate the municipality. However, research on the role of the municipality from the municipality's viewpoint would be an interesting and valuable addition to this research.

Value of adaptability

This research identifies economic barriers for implementing adaptability in buildings. Clients have an indirect influence on these barriers, as they impact the process and the overall feasibility of incorporating adaptability. Often, adaptability criteria are not economically viable and do not enhance a building's financial value. Clients, despite deciding on the business case, cannot directly influence the value of adaptability, which is also affected by laws, regulations, and certificates. Future research could explore the value of adaptability, the client influence on economic barriers, certificates for adaptability, and its impact on the business case. These areas could potentially provide incentives for investors and developers to create more adaptable buildings.

Context of adaptability

Based on the literature, the context of projects on different levels, like the political, social, technological, environmental, economic, and legal context, is important in the development of buildings. The context influences the project on different levels. However, the goal of an adaptable building is to be independent of contextual changes. In further research, the contextual changes influencing adaptability projects must be researched. A balance between contextual changes and the ambitions of adaptable building developments must be sought.

Collaboration structures

The collaboration in a project team is often documented and contracted in a certain collaboration structure. Experience of the interviewees has pointed out that a *construction team* where the contractor is involved in early design phases is not beneficial for implementing innovative ideas when pressure on quality, planning, and budget rises. Many stakeholders blame the failure of a construction team on the contractor. However, when these statements are compared to other findings, this issue can be related to the knowledge of the client and other team members. To establish the best collaboration structure for the development of adaptable buildings, further research must be conducted.

8 Reflection

1. Topic

During the master track Management in the Built environment, focus lies on the processes and management of construction and urban development by guiding stakeholders and creating financial beneficial projects of high-quality. To do so, the project is managed on both the process and object level. My interests lie in the collaboration of all stakeholders where the influence of the client is central. In addition, the climate, and the world around us is changing, and we must have a second look at the way we are developing buildings. Therefore, it was clear for me to combine those two aspects, which would allow me to develop an action plan that can help to motivate people and give guidance to developing adaptable buildings.

2. Relevance

In this research I have answered the question: *"What are the criteria for developing an adaptable building, and how can clients influence the implementation of these criteria in development projects?".* As mentioned, the world around us is constantly changing. As a result, many researchers have studied the concept of adaptability. However, most studies focus on the building aspects of an adaptable building. In addition, adaptability is a complex concept with a lot of layers. During the research every article I read or person I spoke to, gave new insights about the topic and layers of the concept. The new insights with every step I took make this research interesting. But with that, it is also good to decide where I draw a line.

There are so many aspects that influence the implementation of adaptability, but it is simply not possible to include all of them in the research. Therefore, constantly reflecting new insights to my main goals and research question has been a recurring thing for me.

As explained in the introduction, the construction sector is responsible for almost 40% of the carbon emission. 30% of this emission is due to building construction. A solution for this is adaptive reuse. However, our current building stock is not able to allow functional transformations without large changes. Therefore, we have to start developing our new buildings with its future value in mind, and this is where clients can contribute. This research focuses on this issue and what clients can do to influence projects, so we create a future proof building stock as soon as possible.

3. Product

I was too ambitious. I thought I could do it all. Even though during my P2 it was stated that it was an ambitious plan, I thought I could manage. But it was not possible. Due to time and experience in research it was not possible to define all important adaptability criteria and success factors for developing an adaptable building. Being able to define all important aspects requires thorough qualitative and quantitative research. Because I was not able to include all elements in my research, some findings seem 'open doors' and require a more thorough look.

For future research on the concept of adaptability, researchers can use this thesis as a basis and extent the research further by focusing on subjects within adaptability that have been excluded from this study or not explored in depth. The literature study can be used when focusing on adaptability in general. The action plan can be improved by adding new insights.

Partly due to the fact that laws and regulations differ per country and this research involves interviews with stakeholders active in the Dutch real estate market, this research focuses on Dutch clients and the Dutch market. However, the basis of the action plan is made using global adaptability research. The results of this research can be used by all Dutch clients. When translated to other countries, the functionality depends on the laws and regulations. Moreover, the action plan can also be used by other stakeholders as a guidance for their own role or to visualize the process to other stakeholders.

4. Method

In the beginning, it became clear quite quickly that I wanted to focus on future-proof buildings and adaptability. However, defining a focus point and delineating my research proved to be challenging. After determining my focus on collaborations among stakeholders, the next step was to decide on the methods to be employed. The exploratory literature review indicated the need for a deeper dive into the literature. Given that adaptability is not a common approach to develop, the literature often remains somewhat utopian. For this reason, I opted to conduct case studies to bridge the gap between the utopian ideals in the literature and practical implementation. While the research primarily focuses on the development of new buildings, my empirical research delved into transformation projects to extract "lessons learned." Exploring the barriers experienced during transformation projects and identifying the opportunities perceived by stakeholders laid a foundation for developing a new model. I believe this was successful because the resulting model represents a first attempt to eliminate stakeholder uncertainties and provide more guidance for the successful implementation of adaptability in buildings.

At the beginning of the case analysis, it was a bit of a struggle on how the interviews could be translated to findings. This was done by first transcribing all interviews in detail, and then categorizing them with different codes. The codes were connected to the elements needed for the development of the action plan and were related to the adaptability criteria from literature. During the development of my action plan, I realized that the barriers derived from the interviews needed further categorization. This made the development of the action plan more manageable, allowing for a clearer allocation of actions to stakeholders, distinguishing between direct and indirect influences.

Most of the feedback I received on my research were linked to how I approached the different steps and my view on the concept. This allowed me to take a second look at my research, and to critically examine my own process, where does my focus lie, and what do I do and why.

5. Process

My graduation company Dev_ real estate guided me during the research and helped me with relevant cases and the connection with relevant interviewees. The decision to select all cases within my graduation company meant that I had to be extra critical of the outcomes to avoid biased results. As mentioned, adaptability is a complex concept with many different definitions. To make sure everyone involved in the research had a clear understanding of what adaptability means in this research, I had to properly describe the concept throughout the entire research. Understanding the different aspects connected to adaptability, helped me to really go into the concept during interviews and encourage people to think about the concept beyond their first thoughts.

After finishing my desk research and diving into the available literature about adaptability and its strategies and was struggling with the transition from one research method to another. In the literature study I focused on the details of adaptability, while for the empirical research I had to adopt a different attitude where I zoomed out more and focused on the processes that made it possible. Ultimately, it helped to make this transition gradually and first focus on gathering interviewees and writing an interview protocol.

I really enjoyed the graduation process, thanks to the theme tutors, my mentors, and my graduation company. In the beginning I was really struggling with where my focus lies and where my research would end. I wanted to research all different elements of adaptability and thought everything had to be included. However, at a certain point I understood that I simply had limited time. Accepting that was sometimes difficult for me because I wanted to do everything the best I could, but my mentors and graduation company helped me with that. The meetings with my theme also helped me to get in touch with fellow graduation students and to discuss the development of my research plan. In addition, the individuality of the research was sometimes difficult. Graduating at a company helped me with that because I was making full working days and weeks, made detailed plannings for my deadlines and had several meetings with my mentors from MBE and my graduation company.

Overall, I think this was a successful year which introduced me to the field of academic research which I enjoyed. I look back on a very educational year with a lot of independency and challenges that passed in the blink of an eye!

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Appendices

Appendix I: Data management plan

Plan Overview
A Data Management Plan created using DMPonline

Title: The implementation of adaptability as a tool to create future proof office buildings in the Netherlands.

Creator: Esra van der Weijden

Affiliation: Delft University of Technology

Template: TU Delft Data Management Plan template (2021)

ID: 125671

Start date: 13-02-2023

End date: 06-02-2024

Last modified: 06-06-2023

The implementation of adaptability as a tool to create future proof office buildings in the Netherlands.

0. Administrative questions

1. Name of data management support staff consulted during the preparation of this plan.

This research follows a standard template. So, consultations with the data steward, Diana Popa, has been omitted.

2. Date of consultation with support staff.

2024-02-06

I. Data description and collection or re-use of existing data

3. Provide a general description of the type of data you will be working with, including any re-used data:

Type of data	File format(s)	How will data be collected (for re-used data: source and terms of use)?	Purpose of processing	Storage location	Who will have access to the data
Age, gender, e-mail, profession, background, years of experience within project development.	.csv files	Through semi-structured interviews and an expert panel	To determine the roles and influences of parties involved in the development of adaptable office buildings in the Netherlands	SURF drive	The researcher
Data about multiple cases in the field of adaptability	.cvs files	Through a multiple case study and cross-case analysis	To compare the adaptability criteria with practice and improve the quality of the criteria	SURF drive	The researcher
Signed consent forms	.pdf files	Filling in the form before the start of the interviews and expert panel	Ethics	SURF drive	The researcher
Anonymized data about the roles and influences of parties involved in adaptability projects	.cvs files	Through semi-structured interviews and an expert panel	To determine the roles and influences of parties involved in the development of adaptable office buildings in the Netherlands	SURF drive	The researcher

Recorded voice files	.mp3 files	Through semi-structured interviews and an expert panel	To process the data from the interviews and expert panel as accurate as possible	SURF drive	The researcher
Transcripts	.docx files	Through semi-structured interviews and an expert panel	o process the data from the interviews and expert panel as accurate as possible	SURF drive	The researcher and the participants of the interviews and expert panel

4. How much data storage will you require during the project lifetime?

- 250 GB - 5 TB

II. Documentation and data quality

5. What documentation will accompany data?

- README file or other documentation explaining how data is organized
- Methodology of data collection

III. Storage and backup during research process

6. Where will the data (and code, if applicable) be stored and backed-up during the project lifetime?

- SURFdrive

IV. Legal and ethical requirements, codes of conduct

7. Does your research involve human subjects or 3rd party datasets collected from human participants?

- Yes

8A. Will you work with personal data? (information about an identified or identifiable natural person)

If you are not sure which option to select, first ask your Faculty Data Steward ***for advice. You can also check with the*** privacy website ***. If you would like to contact the privacy team: privacy-tud@tudelft.nl, please bring your DMP.***

- Yes

8B. Will you work with any other types of confidential or classified data or code as listed below? (tick all that apply)

If you are not sure which option to select, ask your Faculty Data Steward ***for advice.***

- No, I will not work with any confidential or classified data/code

9. How will ownership of the data and intellectual property rights to the data be managed?

For projects involving commercially-sensitive research or research involving third parties, seek advice of your Faculty Contract Manager ***when answering this question. If this is not the case, you can use the example below.***

The data from the semi-structured interviews and the expert panel will be made anonymous. The participants will get an ID name based on their profession and years of experience. For example, Developer_1(4) is the first participant who is a developer with 4 years of experience. The personal data will be deleted after the project, and the anonymized data remains. The anonymized data will be shared to the participants.

10. Which personal data will you process? Tick all that apply

- Data collected in Informed Consent form (names and email addresses)
- Signed consent forms
- Special categories of personal data (specify which): race, ethnicity, criminal offence data, political beliefs, union membership, religion, sex life, health data, biometric or genetic data
- Gender, date of birth and/or age
- Email addresses and/or other addresses for digital communication
- Names and addresses

Special categories of personal data: profession, years of experience in the field of project development.

11. Please list the categories of data subjects

Different stakeholders within the field of project development, with different ages, and years of experience.

12. Will you be sharing personal data with individuals/organizations outside of the EEA (European Economic Area)?

- No

15. What is the legal ground for personal data processing?

- Informed consent

16. Please describe the informed consent procedure you will follow:

All participants of the interviews and expert panel will be asked to fill in a form in which they are asked to give their informed consent.

17. Where will you store the signed consent forms?

- Same storage solutions as explained in question 6

18. Does the processing of the personal data result in a high risk to the data subjects?

If the processing of the personal data results in a high risk to the data subjects, it is required to perform a Data Protection Impact Assessment (DPIA). **In order to determine if there is a high risk for the data subjects, please check if any of the options below that are applicable to the processing of the personal data during your research (check all that apply).**
If two or more of the options listed below apply, you will have to complete the DPIA**. Please get in touch with the privacy team: privacy-tud@tudelft.nl to receive support with DPIA.**
If you have any additional comments, please add them in the box below.

- None of the above applies

22. What will happen with personal research data after the end of the research project?

- Personal research data will be destroyed after the end of the research project
- Anonymized or aggregated data will be shared with others

The anonymized or aggregated data will be shared with the expert panel in order to receive feedback on the outcomes of the multiple case study. Additionally, the action plan that is developed during and after the expert panel will be shared with different actors within project development.

23. How long will (pseudonymized) personal data be stored for?

- 10 years or more, in accordance with the TU Delft Research Data Framework Policy

24. What is the purpose of sharing personal data?

- For research purposes, which are in-line with the original research purpose for which data have been collected
-

25. Will your study participants be asked for their consent for data sharing?

- Yes, in consent form - please explain below what you will do with data from participants who did not consent to data sharing

As mentioned earlier, the data of participants from the interviews and expert panel who do not consent to data sharing will be made anonymous and unidentifiable.

V. Data sharing and long-term preservation

27. Apart from personal data mentioned in question 22, will any other data be publicly shared?

- All other non-personal data (and code) underlying published articles / reports / theses
- All other non-personal data (and code) produced in the project

29. How will you share research data (and code), including the one mentioned in question 22?

- All anonymized or aggregated data, and/or all other non-personal data will be uploaded to 4TU.ResearchData with public access

30. How much of your data will be shared in a research data repository?

- 100 GB - 1 TB

31. When will the data (or code) be shared?

- At the end of the research project

32. Under what license will be the data/code released?

- CC BY-NC-SA

VI. Data management responsibilities and resources

33. Is TU Delft the lead institution for this project?

- Yes, the only institution involved

34. If you leave TU Delft (or are unavailable), who is going to be responsible for the data resulting from this project?

My supervisor Dr. H.T. (Hilde) Remøy MSc will be responsible for the data after I leave TU Delft.

35. What resources (for example financial and time) will be dedicated to data management and ensuring that data will be FAIR (Findable, Accessible, Interoperable, Re-usable)?

4TU.ResearchData will be used as a resource to data management and will ensure that the data will be FAIR. I do not expect to exceed the free of charge available 1TB amount of data, and therefore there are no extra costs of long-term preservation.

Appendix II: Adaptability criteria

Step 1: Collecting adaptability strategies and criteria

Adaptability concepts, models, strategies

(Duffy, 1990) (Brand, 1994) (Schmidt III & Austin, 2016)

Space plan
Sliding walls
Demountable walls
Non-load bearing walls
Glass walls

Structure
Wide spands
High storey height
Increased load capacity
Prefabricated members

Services
Easy access
Capacity surpluss
Zoning

Skin
Demountable
Standardised
Exchangeable

Stuff
Standardised
Modular
Moveable

Space
Standardisation
Big-volume and locations

(Schmidt III, 2014)

Adjustable (task)
Plug & play elements
User control
Stackable (easily stored)
Non-fixed objects)
Detachable connections
Operable elements

Convertable (function)
Loose fit
Raised floors
Simplicity & legibility
Dropped ceilings
Multi-functional spaces
Excess service capacity

Versatile (space)
Movable walls
Variety of room sizes
Wide corridor widths
Frame construction
Flexible ducts
Storage space
Excess service points

Scalable (size)
Product platforms
Local materials
Known techniques
Structural redundancy
Modular units
Extra space
Dividable / joinable rooms

Refitable (performance)
Access points
Standards shapes
Dry connections
Coordinated systems
Interchangeable component
Minimze points of contact

Movable (location)
Inflatable
Component weight
Kit-of-parts
Easy connections
Collapsable
Component scale

(Remoy & van der Voordt, 2014)

Location
Urban location and situation
Multifunctional areas
Character of the urban area
Accessibility (car, public transport, parking)

Building
Building character (cultural, historical, symbolic)
Facade (removable, replaceable)
No load-bearing walls and columns
Structure grid
Free floor height
Installations

(Manewa, 2012)
Plan depth
Floor to Ceiling Height
Structural Design
Fire Safety design
Services System
Building Size
Building Height
Technical Span
Building Proximity

(Geraedts et al., 2014)
Change unit size or division
Design/rearrangement change
Functional change
Change number of units
Move facilities in/outside
Change in lay-out &finishing units
Expandability horizontal & vertical
Decreasability horizontal & vertical
Moveability of the building

(Remoy, de Jong & Schenk, 2011)

Legal
Flexible zoning plan
Building code comparable for offices and housing
Mixed use locations

Technical
No load bearing facades
Good technical state of the construction
No pre-spanned prefab floors
Removable reuse or refit of installations and shafts
Possibility for horizontal extension
Possibility for vertical extension
No integration of structure and installations

Functional
Structural grid that fits housing and efficient floor lay-out for housing
Position of entrances, stairways and elevators that fit housing
Daylight admission: equivalent to 10% of floor surface for housing
Possibility of attaching interior walls to the facade
Basement usable or storage or parking

(Remøy, 2010)

Market
Focus on sustainability and adaptability of new developments
Focus on capital growth instead of rent income
Knowledge about user preferences and building characteristics
Realistic value assessment of office buildings
Multi-disciplinary or joint venture development & investment organisations
Develop mixed-use zoning plans
Reduce building decree differences between offices and housing
Facilitate and stimulate urban redevelopment and transformation
Stop urban expansion by more expensive Greenfield developments

Location
Mixed-use locations with facilities for offices and housing
Develop and redevelop locations well accessible by public transport
Develop locations with good quality public space

Building
Design building structure as columns and free floors
Large size structural grid, small size facade grid
Adaptable structure and facade
Over dimensioned structure to fit several life spans
Replaceable facade
Maintainable facade and maintanance of the facade.

(Sadafi et al., 2014)
Increase building regularity
Increase system and material simplicity
Partitionable core
Specifications for connections, strucural and installations
Recude intersystem interaciton
Reduce intrasystem interaction
Modular coordinated systems
Prefabricated components
Design over-capacity
Increase system predictability
Flow through system layout
Optimize interior space use

(Arge, 2005)

Generality
Building width
Floor to floor height net
Technical grid

Flexibility
Modularity
Plug & play building elements
Ease internal movements

Elasticity
Building form or organisation of space
Functional organisation
Fire sprinkling
EIB/LonWorks - space configuration

Geraedts, 2016)

Site
Expandable site/location
Multifunctional location

Facilities
Customisability / controlability facilities
Surplus of facilities shafts and ducts
Modularity of facilities

Structure
Surplus of building space/fl
Surplus of free floor height
Access to building
Positioning obstacles/columns in load

Space plan
Distionction between support - infill
Horizontal access to building

Skin
Facade windows to be opened
Daylight facilities

(Nakib, 2010)

Socio-professional
Flexible thinking
User involvement

Economical
Invest in design and construction

Spatial and functional
Independent layers
Multifunctional spaces
Mobile and demountable components
Elasticity & divisibility in building
Space optimization
Modularity
Fluid spaces
Buffer zones
Internal circulation routes
Extra space and height

Structural
Expandable load capacity
Wide structural grid
Dry connections

Technical
Accessible technical components and installations
Pluggable connections
Prefabricated and standardized components
Over-measure energy
Independent subsystems

Facade
Versatile envelope
Independent envelope

Step 2: Categorizing the collected strategies and criteria

Building layer	Adaptability type	Adaptability strategy – tactics										
Site	Movable, scalable, Convertible	Multifcuntional site (legal)	Expandable site/location	Extra building & site space	Decreasable site	Creation of public space						
Surroundings	Movable, Convertible, Versatile	Multifunctional location	Character of the area	Accesibility (car, parking)	Accessibility (public transport)	Proximity	Good quality of public space	Service & amenity provision	Urban location and situation			
Skin	Versatile, Refitable, Convertible, Scalable, Movable	Demountable	Standardised	Exchangeable	Minimze points of contact	Easy connections	Removeable & replacable	Non load bearing	Daylight admission	Small facade grid	Versatile & independent	Expandable
		Maintainable	Opening facade windows	Image, character & identity								
Structure	Versatile, Convertible, Scalable, Movable	Wide spans	High storey height	Increased & expandable load capacity	Prefabricated members	Frame construction	Dry connections	Modular	Extra space	Easy connections	Maintainable	Wide structural grid (columns)
Services	Versatile, Refitable, Scalable, Convertible, Movable	Not integrated with installations	Position of entrances	Position of stairways & elevators	Over dimensioned	Generality	Access (vertical & horizontal)	Position of shafts & ducts	Expandable (horizontal & vertical)	Decreasable (horizontal & vertical)	No pre-spanned prefab floors	Plan depth
		Easy access	Capacity surplus	Zoning	Flexible ducts	Excess service points	Modular	Coordinated systems	Loose fit	Simplicity & legibility	Adjustable	Easy connections
		Flexible (legal)	Removable	Not integrated with structure	Surplus of shafts and ducts							
Space plan	Versatile, Refitable, Convertible, Movable	Sliding walls	Demountable walls	Non-load bearing walls	Glass walls	Standardisation	Big-volume and locations	Moveable walls & units	Variety of room sizes	Buffer zones	Standard shapes	Dry connections
		Dividable & Joinable spaces	Wide internal circulation routes	Rearrangement of space	Flexible zoning plan (legal)	Access to building	Space optimization	Fluid spaces	Interchangeable component	Loose fit	Raised floors & dropped ceilings	Extra space
Stuff	Adjustable, Versatile, Movable	Standardised	Modular	Moveable	Plug & play elements	Non-fixed objects	Detachable connections	Operable elements	Stackable			
Social	Adjustable, Versatile, Refitable, Convertible, Scalable, Movable	User control	Multifunctional spaces	User knowledge	User involvement	Shared spaces	Urban location and situation	Invest in design and construction				

Step 3: Translating to ten adaptability criteria and three main themes from literature

	Criteria for adaptability	Layers	Adaptability strategy – tactics										
Building	**Multifunctional**	Structure, Social, Skin, Services, Space plan	High storey heights	Expandable (horizontal & vertical)	Decreasable (horizontal & vertical)	Raised floors & dropped ceilings	Shared spaces	Multifunctional spaces	Small facade grid	Wide structural grid (columns)	Versatile & independent	Position of entrance, stairs, elevators, services	Flexible zoning plan (legal)
	Characteristics of the building	Skin, Structure	Daylight admission	Identity, character & image	Plan depth	Generality	Non load bearing facades	Non load bearing interior walls					
	Over-dimensioning	Structure, Space plan, Services	High storey heights	Increased & expandable load capacity	Extra space	Installation capacity surpluss	Surplus of shafts and ducts	Raised floors & dropped ceilings	Expandable (horizontal & vertical)				
	Fluid spaces & buffer zones	Space plan, Social, Structure	Extra space & buffer zones	Big-volume and locations	Expandable (horizontal & vertical)	Wide internal circulation routes	Loose fit	Shared spaces					
	Demountable, modular & independent	Skin, Structure, Service, Space plan	Demountable facade	Minimze points of contact	Visible, accessible and dry connections	Removable & replaceable elements	Non load bearing facades	Versatile & independent elements	Standardised elements	Prefabricated members & modular	Frame construction	Not integrated installation and structure	No pre-spanned prefab floors
			Sliding walls, glass walls	Demountable walls									
	Lay-out of the building & zoning	Skin, Structure, Space plan	Small facade grid	Non load bearing interior walls	Wide spans	High storey heights	Frame construction	Wide structural grid (columns)	Position of entrances	Position of stairways & elevators	Access (vertical & horizontal)	Position of shafts & ducts	Standard shapes
			Flexible zoning plan (legal)	Space optimization	Loose fit								
	Rearrangeable	Structure, Service, Space plan, Stuff	Access (vertical & horizontal)	Flexible ducts	Excess service points	Loose fit	Simplicity & legibility	Adjustable	Removable elements	Movable walls & units	Non load bearing interior walls	Variety of room sizes	Standard shapes
			Dividable & Joinable spaces	Rearrangement of space	Flexible zoning plan (legal)	Space optimization	Interchangeable component	Plug & play elements	Non-fixed objects	Detachable connections	Operable elements	Stackable	
Location & Context	**The right location**	Site, Surroundings	Multifunctional location	Character of the area	Accesibility (car, parking)	Accessibility (public transport)	Proximity	Good quality of public space	Service & amenity provision				
	The right building site	Site	Multifcuntional site (legal)	Expandable site/location	Extra building & site space	Decreasable site	Creation of public space						
Mindset & Team	**Flexible thinking**	Social	Flexible (legal)	User control	Multifunctional spaces	User knowledge	User involvement	Shared spaces					

Step 4: Revised adaptability criteria after case studies

	Criteria for adaptability	Layers	Adaptability strategy – tactics										
Building	**Characteristics of the building**	Skin, Structure	Daylight admission	Identity, character & image	Plan depth	Generality	Non load bearing facades	Non load bearing interior walls	Wide structural grid (columns)	Position of entrance, stairs, elevators, services			
	Over-dimensioning	Structure, Space plan, Services	High storey heights	Increased & expandable load capacity	Extra space	Installation capacity surpluss	Surplus of shafts and ducts	Raised floors & dropped ceilings	Expandable (horizontal & vertical)				
	Fluid spaces & buffer zones	Space plan, Social, Structure	Extra space & buffer zones	Big-volume and locations	Expandable (horizontal & vertical)	Wide internal circulation routes	Loose fit	Shared spaces					
	Demountable, modular & independent	Skin, Structure, Service, Space plan	Demountable facade	Minimze points of contact	Visible, accessible and dry connections	Removable & replaceable elements	Non load bearing facades	Versatile & independent elements	Standardised elements	Prefabricated members & modular	Frame construction	Not integrated installation and structure	No pre-spanned prefab floors
			Sliding walls, glass walls	Demountable walls	Small facade grid								
	Lay-out of the building & zoning	Skin, Structure, Space plan	Small facade grid	Non load bearing interior walls	Wide spans	High storey heights	Frame construction	Wide structural grid (columns)	Position of entrances	Position of stairways & elevators	Access (vertical & horizontal)	Position of shafts & ducts	Standard shapes
			Flexible zoning plan (legal)	Space optimization	Loose fit								
	Rearrangeable	Structure, Service, Space plan, Stuff	Access (vertical & horizontal)	Flexible ducts	Excess service points	Loose fit	Simplicity & legibility	Adjustable	Removable elements	Movable walls & units	Non load bearing interior walls	Variety of room sizes	Standard shapes
			Dividable & Joinable spaces	Rearrangement of space	Flexible zoning plan (legal)	Space optimization	Interchangeable component	Plug & play elements	Non-fixed objects	Detachable connections	Operable elements	Stackable	
Location & Context	**The right location**	Site, Surroundings	Multifunctional location	Character of the area	Accesibility (car, parking)	Accessibility (public transport)	Proximity	Good quality of public space	Service & amenity provision	Expandable site/location	Extra building & site space	Decreasable site	Creation of public space
	Multifunctional	Social, Skin, Services, Space plan	Multifunctional spaces	Flexible zoning plan (legal)	Multifunctional location	Accessibility	Good quality of public space						
	Non-physcical context	Social	Moment in real estate cycle	Market position	Political situation	Urban location and situation	Environmental situation						
Mindset & Team	**Flexible thinking**	Social	Flexible (legal)	User control	Multifunctional spaces	User knowledge	User involvement	Shared spaces	Shared team ambitions	Adaptability project KPIs	Can Do' mentality	Knowledge about adaptability	Invest in design and construction

Appendix III: Information interviews

Allereerst wil ik u bedanken voor uw tijd en de medewerking aan mijn afstudeeronderzoek. In dit document kunt u aanvullende informatie vinden over mijn afstudeeronderzoek en het interview.

Het onderzoek

Mijn afstudeeronderzoek gaat over het implementeren van aanpasbaarheid in ontwikkelingsprojecten. Hierbij focus ik mij voornamelijk op hoe de verschillende partijen die betrokken zijn bij een project, samen aanpasbaarheid kunnen implementeren en welke criteria er zijn voor het ontwikkelen van een aanpasbaar gebouw. Dit onderwerp is ontstaan vanuit het ideaalbeeld dat de meest duurzame gebouwen, gebouwen zijn die gebouwd worden voor de lange termijn en die dynamisch kunnen meebewegen met veranderingen in hun omgeving. Op dit moment wordt er veel gesproken over flexibiliteit en aanpasbaarheid, maar zijn de gebouwen nog niet zo ingericht dat dit ook daadwerkelijk geïmplementeerd kan worden. Het is daarom van belang voor dit onderzoek om goed in beeld te krijgen wat er nodig is voor de implementatie van aanpasbare gebouwen en hoe verschillende betrokken partijen daarin samenwerken. Het doel van mijn afstudeeronderzoek is om een actieplan te ontwikkelen voor direct betrokken partijen in een ontwikkelingsproject waarmee inzichtelijk wordt gemaakt wat er nodig is om aanpasbaarheid te implementeren in nieuwbouwprojecten en wie wanneer welke rol speelt in dit proces.

Om dit doel te behalen onderzoek ik transformatie projecten waarbij ik het adaptief vermogen van deze gebouwen toets aan de hand van de opgestelde criteria. Daarnaast ga ik in gesprek met de projectmanagers, eigenaren en architecten van deze projecten. Door middel van deze gesprekken wil ik inzicht krijgen in de rol van de partijen tijdens de processen en hier lessen uit halen voor de ontwikkeling van een actieplan voor nieuwbouwprojecten.

Het interview

Het interview zal niet langer dan een uur duren. Ik heb hiervoor een aantal vragen opgesteld die betrekking hebben op het afstudeeronderzoek. Gedurende het interview zullen criteria voor een aanpasbaar gebouw aan bod komen, zal ik vragen stellen over barrières en drijfveren voor de implementatie van aanpasbaarheid, zullen we het hebben over uw rol in het project en zal ik, mits tijd over, afsluiten met een aantal vragen over uw beeld over kansen voor toekomstbestendige ontwikkelingen vanuit uw rol.

Het interview zal opgenomen worden door middel van audioapparatuur, zodat ik volop gebruik kan maken van de informatie die besproken is. Daarnaast wordt gevraagd het toestemmingsformulier te lezen, eventuele vragen te stellen en deze vervolgens te ondertekenen.

Mocht u naar aanleiding hiervan vragen hebben dan kunt u uiteraard contact met mij opnemen.

Vriendelijke groet, Esra van der Weijden

Appendix IV: Informed consent form

Geïnformeerde toestemming omtrent deelname aan onderzoek naar de implementatie van aanpasbaarheid in nieuwe kantoorgebouwen.

Onderzoek: Aanpasbaarheid als een tool voor de implementatie van toekomstbestendige kantoorgebouwen
Onderzoeker: Esra van der Weijden
Opleiding: MSc Management in the Built Environment
Universiteit: Technische Universiteit Delft, Faculteit Bouwkunde
Afstudeerorganisatie: Dev_ real estate

Naam van het onderzoek	Aanpasbaarheid als een tool voor de implementatie van toekomstbestendige kantoorgebouwen
Doel van het onderzoek	Dit onderzoek wordt uitgevoerd door Esra van der Weijden. Het doel van het onderzoek is het ontwikkelen van een methodiek voor de implementatie van aanpasbaarheid op strategisch niveau door middel van een actieplan.
Gang van zaken	Gedurende het interview zullen u vragen worden gesteld over de aanpasbaarheid van gebouwen en de rol van verschillende partijen bij de implementatie van aanpasbaarheid in nieuwbouwprojecten.
Risico's en ongemakken	Er zijn geen fysieke, juridische of economische risico's verbonden aan de deelname aan het interview en onderzoek. U bent niet verplicht te antwoorden op vragen die u niet wil beantwoorden. Deelname aan dit onderzoek is vrijwillig en u kunt zich ten alle tijden terugtrekken zonder hier toelichting voor te geven.
Privacy en gegevens	Gedurende en na afloop van het onderzoek wordt uw privacy maximaal beschermd. Vertrouwelijke informatie of persoonsgegevens worden op geen enkele wijze gedeeld. Voor het publiceren van de onderzoeksproducten worden uw gegevens geanonimiseerd. In publicaties zullen anonieme gegevens of pseudoniemen gebruikt worden. Hierbij zal wel uw rol in het project (bijv. projectmanager , eigenaar of architect) verwerkt worden in het

	onderzoek. De audio-opname van het interview, formulieren of andere documenten verbonden aan het onderzoek zullen verzameld en opgeslagen worden in een daarvoor beveiligde omgeving van de TU Delft.
Vrijwilligheid van deelname	Deelname aan het onderzoek is geheel vrijwillig. De deelnemer kan ten alle tijden deelname aan het onderzoek stopzetten. Daarnaast is het niet verplicht antwoord te geven op vragen die door de onderzoeker gesteld worden. U bent in de vrijheid om voorafgaand aan het onderzoek te beslissen om af te zien van deelname. Dit zal geen gevolgen voor u hebben. Tevens kunt u tot 5 werkdagen na afloop van het interview de gegeven toestemming voor gebruik van de data intrekken. Mocht u besluiten om te stoppen met de deelname aan dit onderzoek, of als u klachten of vragen heeft, of enige vorm van ongemak of schade ervaart, neem dan alstublieft contact op met de leider van dit onderzoek: Esra van der Weijden (e.a.vanderweijden@student.tudelft.nl).
Toestemmings-verklaring	Door ondertekening van dit formulier bevestigt u dat minimaal 18 jaar oud bent; dat u geïnformeerd bent over het onderzoek, de manier waarop gegevens verzameld, verwerkt en opgenomen worden in de eindproducten en de eventuele risico's die u zou kunnen lopen. Bij ondertekening bevestigt u onderstaande onderdelen en gaat u akkoord met deelname aan het onderzoek: 1. Ik heb informatie ontvangen over het onderzoeksproject. Het doel van dit interview en mijn deelname is helder en ik weet wat dit betekent. 2. Ik doe vrijwillig mee aan dit onderzoek, en ik begrijp dat ik kan weigeren vragen te beantwoorden en mij op elk moment kan terugtrekken uit het onderzoek, zonder een reden op te hoeven geven.

3. Het interview zal ongeveer een uur duren. Ik geef de onderzoeker toestemming audio-opnames en schriftelijke aantekeningen te maken.
4. Ik geef toestemming om het benoemen van mijn rol (bijv. projectmanager, eigenaar of architect) in het desbetreffende project te verwerken in het onderzoek. Overige persoonlijke informatie zal worden geanonimiseerd.
5. Ik geeft toestemming dat de geanonimiseerde data gebruikt zal worden voor academische doeleinden aan de TU Delft.
6. Ik ga ermee akkoord dat mijn uitspraken, ideeën of andere onderdelen in anonieme quotes gebruikt zullen worden in eindproducten van het onderzoek.
7. Ik geef toestemming dat de afstudeerscriptie na afronding gepubliceerd zal worden in het onderwijsdepot van de TU Delft, waarvan de geanonimiseerde interview data bijgedragen heeft aan de resultaten.
8. Ik geef toestemming om na het interview benaderd te worden door de onderzoeker voor opheldering van onduidelijkheden of aanvullende informatie als dat nodig is.
9. Ik heb dit formulier gelezen en begrepen. Ik heb eventuele vragen kunnen stellen en deze zijn naar tevredenheid beantwoord.
10. Ik heb een kopie ontvangen van dit formulier welke ook door de onderzoeker is ondertekend.

Handtekening en datum	**Naam onderzoeker**	**Naam deelnemer**
	Datum en plaats	**Datum en plaats**
	Handtekening	**Handtekening**

TU Delft

Appendix V: Interview protocol

Voorafgaand aan het interview

- ☐ Uitnodiging verzonden
- ☐ Informed consent getekend
- ☐ Tijd en locatie afgestemd en verzonden
- ☐ Teams en opname klaarzetten en testen (tweede telefoon eventueel)

Start interview

- ☐ Bedanken voor meewerking interview
- ☐ Controle informed consent
- ☐ Wijzen op opnemen interview en toestemming vragen ter controle
- ☐ Aanzetten opname en back-up opname apparatuur
- ☐ Korte introductie interview en onderzoek

Na afloop interview

- ☐ Vragen of de geïnterviewde nog iets kwijt wil of vragen heeft
- ☐ Verdere verloop kort toelichten
- ☐ Laten weten dat de scriptie gedeeld kan worden indien gewenst
- ☐ Dank mail sturen met het transcript ter controle

Interview categorieën

Introductie

Het interview is onderverdeeld in vier verschillende categorieën. De categorieën zijn gekoppeld aan het conceptual framework van het onderzoek.

Categorie 1- Rol van stakeholders
Categorie 2 – Barriers en drivers
Categorie 3 – Criteria voor de ontwikkeling van aanpasbare gebouwen
Categorie 4 – Kansen voor toekomstbestendige ontwikkelingen

Introductie van het interview

Goedemorgen, allereerst wil ik u bedanken voor het meewerken aan mijn interview en voor uw tijd. Graag zo ik ook nogmaals willen vragen of u instemt met het maken van een opname van dit interview. Voordat ik begin met dit interview zal ik mijzelf even voorstellen, mijn onderzoek introduceren en de gang van zaken voor het komende uur. Mijn naam is Esra van der Weijden en ik ben momenteel bezig met mijn afstudeeronderzoek van de master Management in the Built Environment aan de TU Delft. Mijn afstuderen doe ik in samenwerking met en onder begeleiding van Dev_ real estate.

Mijn afstudeeronderzoek gaat over het implementeren van aanpasbaarheid in ontwikkelingsprojecten. Hierbij focus ik mij voornamelijk op hoe de verschillende partijen die betrokken zijn bij een project, samen aanpasbaarheid kunnen implementeren en welke criteria er zijn voor een aanpasbaar gebouw. Dit onderwerp is ontstaan vanuit het ideaalbeeld dat de meest duurzame gebouwen, gebouwen zijn die gebouwd worden voor de lange termijn en die dynamisch kunnen meebewegen met veranderingen in hun omgeving. Op dit moment wordt er veel gesproken over flexibiliteit en aanpasbaarheid, maar zijn de gebouwen nog niet zo ingericht dat dit ook daadwerkelijk geïmplementeerd kan worden. Het is daarom van belang voor dit onderzoek om goed in beeld te krijgen wat er nodig is voor de implementatie van aanpasbare gebouwen en hoe verschillende betrokken partijen daarin samenwerken. Het doel van mijn afstudeeronderzoek is om een actieplan te ontwikkelen opdrachtgevers in een ontwikkelingsproject waarmee inzichtelijk wordt gemaakt wat er nodig is om aanpasbaarheid te implementeren in nieuwbouwprojecten en wie wanneer welke rol speelt in dit proces.

Het interview zal niet langer dan een uur duren. Ik heb hiervoor een aantal vragen opgesteld die betrekking hebben op het afstudeeronderzoek. Gedurende het interview zullen criteria voor een aanpasbaar gebouw aan bod komen, zal ik vragen stellen over barrières en drijfveren voor de implementatie van aanpasbaarheid, zullen we het hebben over uw rol in het project en zal ik, mits tijd over, afsluiten met een aantal vragen over uw beeld over kansen voor toekomstbestendige ontwikkelingen vanuit uw rol. Mocht u gedurende het interview extra informatie toe willen voegen aan de onderdelen die ik aan bod laat komen dan hoor ik dat graag. Wanneer we in tijdsnood komen, dan zou het kunnen zijn dat ik u zal sturen op het kort houden van uw antwoord. Heeft u verder nog vragen voorafgaande de start van het interview? Zo niet, dan kunnen we beginnen.

Categorie 1- Rol van stakeholders

1) Kunt u iets over uzelf vertellen? Wie bent u en wat is uw huidige functie?

2) In hoeverre is duurzaamheid opgenomen in de bedrijfsstrategie van uw bedrijf? Waarin is dat terug te zien?

In mijn onderzoek maak ik gebruik van casestudies waarbij ik specifieke projecten bekijk en test wat het adaptief vermogen van dit gebouw is n.a.v. de criteria en wat de rollen van de betrokken partijen zijn.

3) Kunt u iets vertellen over uw rol binnen dit project?

4) Kunt u iets vertellen over de samenwerking binnen dit project?

5) Heeft u volgens u invloed op het implementeren van duurzaamheidsconcepten zoals aanpasbaarheid in projecten? Zo ja, in welke fase?

Categorie 2 – Barrières en drijfveren

1) Wat verstaat u onder een aanpasbaarheid?

2) Wat verstaat u onder een aanpasbaar gebouw?

3) Er zijn verschillende barrières voor de implementatie van aanpasbaarheid in ontwikkelingsprojecten op verschillende vlakken zoals politiek, economisch, sociaal, technologisch, milieu en juridisch vlak. Welke barrières ervaart u vanuit uw perspectief en rol in de markt en in het project?

4) Naast barrières zijn er ook drijfveren en benefits voor de implementatie van aanpasbaarheid. Welke drijfveren en benefits ervaart u?

Categorie 3 – Criteria voor de ontwikkeling van aanpasbare gebouwen

Het project heeft een functionele transformatie ondergaan waarbij de voormalige functie van kantoren is getransformeerd naar wonen.

1) Kunt u iets vertellen over de totstandkoming van het idee om het gebouw te transformeren naar een andere functie?

2) Leende het gebouw zich, volgens u, voor transformatie naar een andere functie?

3) Wat was er goed? Wat was er slecht?

4) Wat had volgens u geholpen als hier in de ontwikkeling van het pand in eerste instantie rekening mee was gehouden?

5) Wat is er volgens u nodig om een succesvol aanpasbaar gebouw te ontwikkelen dat in de toekomst zonder veel kosten en moeite aangepast kan worden naar een alternatieve functie?

Categorie 4 – Kansen voor toekomstbestendige ontwikkelingen

1) Wat zijn volgens u kansen voor het ontwikkelen van aanpasbare gebouwen, ook kijkend naar u rol?

2) Wat zijn voor u kansen voor de samenwerking in het ontwikkelen van aanpasbare gebouwen?

3) Welke partijen zijn voor u cruciaal om ervoor te zorgen dat gebouwen in de toekomst aanpasbaar zijn?

Afsluiting van het interview

Ik denk dat we de belangrijkste vragen hebben behandeld. Heeft u nog vragen of verdere opmerkingen die van belang zijn voor mijn onderzoek? Graag wil ik u hartelijk danken voor uw tijd en medewerking aan dit onderzoek. De gegevens worden geanonimiseerd. Als u nog vragen heeft kunt u mij per mail bereiken. Daarnaast zal ik het uitgewerkte transcript naar u mailen ter controle. Mocht er iets niet juist zijn of mocht u iets anders bedoeld hebben, is dat de kans om dat aan te geven, zodat dit gewijzigd kan worden. Na afloop van mijn afstudeeronderzoek zal ik u, indien gewenst, het rapport toesturen.

Appendix VI: Transcript categorization

Interview quotes + statements

Building aspects

Projectmanager

Case 1: Kijk het gebouw an sich, dat kun je zien gewoon vanuit de
Case 1: Je kunt de gevel vrij makkelijk aftrekken, zo'n
Case 1: Wat hiermee heeft geholpen is dat draagvermogen dat
Case 1: Er zitten echt wel dingen in die de kans op succes
Case 1: En schachten, dat was van het begin af aan een ding.
Case 1: Natuurlijk kun je proeven doen en kijken hoeveel erin zit,
Case 1: Als er meer ruimte is, dan zijn er ook meer oplossingen
Case 2: Leent dit pand zich om er nog iets anders mee te doen.
Case 2: Ja, en het klimaat is een heel belangrijk iets, en dan niet
Case 2: Terwijl als je kijkt naar bijvoorbeeld voldoende capaciteit
Case 2: Dus dit pand had heel veel techniek in zicht. Zowel
Case 2: Je hebt dus al die functies in overmaat om dan
Case 2: Wat geholpen had als daar beter over nagedacht was is
Case 3: Wat je daar heel sterk zag, was dat de constructie van
Case 3: Het was ook een gebouw met galerijen naar buiten toe,
Case 3: Als je dus al weet dat het kantoorgebouw wat je maakt

Architect

Case 1: Die bouwstructuur is wel belangrijk hè. Kijk, we zijn gewer
Case 1: Ja, kijk, het is een oud kantoorgebouw. Die hebben gewoo
Case 1: Ja, de diepte. Het is toch een gebouw voor een kantoor of
Case 1: Het karakter en architectonische waarde van een gebouw
Case 1: Die bouwstructuur is wel belangrijk hè. Kijk, we zijn gewer
Case 1: Wat ook nog zou helpen voor je flexibiliteit is het mengen
Case 2: Investeren in die hogere hoogte en in een hogere plint, dat
Case 2: Bovenin leek het wat meer met al die bed-kamers op won
Case 2: De kern is heel gefixeerd. Het is eigenlijk een heel simpel
Case 2: Dus de vrije vloeren werken heel erg goed, maar de kerne
Case 2: De bovenste verdieping wordt opgetopt. Dat komt door ov
Case 2: Het centrale traphuis is onder-gedimensioneerd. Het is ont
Case 2: Dus de robuustheid van het kruisgebouw, zoals ze dat noe
Case 2: Een royale stramienmaat. Overmaat in de verdiepingen. Z
Case 3: En ik denk ook, en dat is altijd wel met flexibiliteit of mixe
Case 3: Zo kan je natuurlijk ook redeneren. Dat je het echt bouwt
Case 3: Aan de voorkant zit natuurlijk al buitenruimte. We hebben
Case 3: Eigenlijk heel goed, want hij was dus helemaal te pellen n
Case 3: Alleen de verdiepingshoogtes waren wel echt laag. Dus da
Case 3: Maar je had wel vrije vloervelden. En ik vond de ontsluiting

Eigenaar

Case 1: Dus het is de vorm, de constructie en het stramien waardo
Case 1: Je moet gewoon echt kijken naar hoe hou je de huidige ka
Case 2: En het gebouw zelf leent zich er ook heel erg voor. Het is
Case 2: Nou, het is niet een heel efficiënt gebouw. De kern in het
Case 2: Die kern, daar zitten alle liften en daarmee ga je naar bov
Case 2: Dan heb je denk ik een beetje ruimte nodig waar dat je ecl
Case 3: Eerst wilden we het slopen. Alleen bij slopen dat ga je in
Case 3: Het was een gebouw dat relatief diep was, dus we konder
Case 3: Je moet je echt richten op hout in plaats van beton als het

Location & context

Projectmanager

Case 1: Het gebouw is getransformeerd omdat het meer waarde
Case 1: Plus ook nog een keer het feit dat er een stukje nieuwbouw
Case 2: In die zin moet het op een locatie staan waarin ook de aar
Case 2: De locatie, dat staat dan denk ik ook op nummer 1. Is het
Case 2: Nu zijn heel veel bestemmingsplannen letterlijk krimpfolie
Case 3: En we hebben uiteindelijk ook wel gesproken over een hee
Case 3: Locatie speelt daar inderdaad wel echt in mee. Ik bedoel,

Architect

Case 3: Want ik denk dat dat ook belangrijk is, is denk ik de steden
Case 3: Dus voldoet het gebouw ook in de breedste zin, dus meer

Eigenaar

Case 1: In de basis is het tot stand gekomen dat op deze plek binn
Case 2: Maar in al die bestemmingsplannen moet je gewoon heel

Mindset & Team

Projectmanager

Case 1: In dit specifieke project heel weinig, maar dat heeft alles
Case 1: Je rol als projectmanager is het realiseren van het project.
Case 1: Want kijk, vanuit de klassieke rolverdelingen zou je norma
Case 1: Want als je dan teruggaat naar NOI, naar Egeria, die dit o
Case 1: Mensen willen niet direct meer betalen voor de meerwaa
Case 1: Los van het feit dat ik helemaal van overtuigd ben dat de
Case 1: Is dat er heel erg gekeken is, aangestuurd vanuit de
Case 2: Op het moment dat jij als één van die drie stakeholders e
Case 2: Dit moet je willen, omdat het beter is voor de wereld en o
Case 2: Nou, ik denk vrij veel, omdat wij eigenlijk van de hele initia
Case 2: En dus je vraag, hoe zijn we daar leidend in geweest? Ja,
Case 2: Ja, er zijn ook maar weinig partijen die dat kunnen. Het vr
Case 2: Dit is hier nooit neergezet met het idee om dit aanpasbaa

Case 3: Dus als je nou zegt van hier zat een gemeente die maakte
Case 3: Maar we hebben wel nog zitten te steggelen over de hoev
Case 3: Nou, ik denk dat wat er gebeurd is, je kan een heel mooi b
Case 3: We waren overgeleverd aan de grille van de gemeente.
Case 3: Nou, maar dat is denk ik wat ik zeg, je kan nog zo'n mooi
Case 3: Ik denk dat je, zeker bij dit soort opdrachtgevers, die niet

Architect

Case 1: Partijen zoals een belegger, die zijn daar wel meer in geïn
Case 1: Er zit nog geen label aan aanpasbaarheid en dat zou wel h
Case 1: Maar we gaan wel een beetje die kant op. Omdat beton,
Case 2: Als je op het minimum qua kosten ontwerpt, wordt het oc
Case 2: Als je dan begint met, qua kosten kan dat niet, dan komt j
Case 3: En ik denk dat bij iedereen die intentie er wel is, maar ik h
Case 3: Ik weet niet hoe dat exact zat. Maar mijn ervaring met ee

Eigenaar

Case 1: Ons businessmodel is in principe aankopen van een opport
Case 1: Ja, zeker, want wij staan natuurlijk aan de wieg van het be
Case 1: Aanpasbaarheidsconcepten kosten geld om dat te bouwen
Case 1: Dus de bouwtijd plus de overlast plus de techniek zijn een
Case 1: Het allerbelangrijkste bij ons vooral het draagvlak van de g
Case 1: Ik heb hier heel veel discussies over gehad bij een ander p
Case 1: Nou kijk, als je een gebouw voor elkaar wil krijgen, dan he
Case 1: Een conclusie, dat het inderdaad gewoon is dat als de bela
Case 1: Je ziet natuurlijk nu een verschil ontstaan voor
Case 2: Ik ben ook veel bezig met tenders, dus dat zijn prijsvragen.
Case 2: En het Slotervaart is natuurlijk een heel goed voorbeeld va
Case 2: Nou, ik denk ten eerste een sterke visie over welke
Case 3: Wij waren een bouwgroep aangegaan. Dat wil zeggen,
Case 3: Canopy zat er 50 in, wij zaten er 50 in, met allebei onze
Case 3: Ik denk dat je wel invloed hebt op aanpasbaarheid. Als je
Case 3: Duurzaamheid is echt een must-have nu, het wordt gewoc
Case 3: Maar het is misschien niet echt iets voor nieuwbouw, maa
Case 3: Want uiteindelijk, wij zitten in een traject van tussen de 7
Case 3: Ik denk dat heel veel eigenaren, dan kijk je vooral naar het
Case 3: Dus om je even aan te geven hoe traditioneel, hoe moeilijl
Case 3: Het past wel in de huidige tijd als het ware, want we doer

Barriers & drivers

Projectmanager

Case 1: Barrier - Wet- en regelgeving is wel echt een grote hoor.
Case 1: Barrier - Uberhaupt verandering van wet- en regelgeving
Case 2: Driver - Maar het staat op een locatie waarin die aanpasba
Case 3: Barrier - Want aanpasbaarheid kan vaak bouwkundig, maa

Architect

Case 1: Barriere - Ja, vooral geld eigenlijk wel. Meestal heeft het
Case 2: Barriere - Ja, dat is conservatisme, wat ik al noemde. Daa
Case 2: Kansen - Wat ik nu zie is dat op overheidsniveau het Paris-

Eigenaar

Case 1: Barriere - Financiële haalbaarheid. Wij hebben natuurlijk
Case 1: Barriere - Wij zijn meer cyclus afhankelijk van het vastgoe
Case 1: Barriere - Wat is het grootste risico? Het feit dat je zo afh
Case 2: Barriere - Als je het bijvoorbeeld hebt over bepaalde tende
Case 2: Barriere - Ik denk ook kennis. Dus dat je wel merkt dat de
Case 2: Barriere - Geld, natuurlijk, die zal je al veel horen. Dan hee
Case 2: Kansen - Heel veel nieuwe producten die er wel zijn die pa
Case 3: Barriere / Kans - Omdat ik merkte dat als je puur naar de
Case 3: Driver - Omdat we het wilden houden, maar we wilden oc
Case 3: Kansen - Het momentum in de markt is goed. De markt is
Case 3: Barriere - Ik denk dat het enerzijds gemak is. Het is natuur
Case 3: Barriere - Ik denk dat de barrières die je tegen zou komen,
Case 3: Barriere - En waar je dan weer mee te maken hebt, is dat
Case 3: Barriere - Balans tussen multifunctioneel bestemmingspla
Case 3: Barriere - Het is zo lastig en het bouwen is zo traditioneel.

Opportunities + visie op de toekomst

Projectmanager

Case 1: Het zou kunnen helpen als aanpasbaarheid inderdaad
Case 1: Ja, je kan ook andersom denken. Dat je denkt, in de mate
Case 2: Ik denk 100% het besef van de waarde van die
Case 2: En het zit eigenlijk in de restwaarde van je gebouw. Je sch
Case 2: En dan helpt het dus erg als je goed kan uitleggen
Case 2: En dan helpt het dus erg als je goed kan uitleggen
Case 3: We weten allemaal dat het goed zou zijn en je wil je
Case 3: Ik denk dat ook een van de dingen die heel belangrijk is,
Case 3: Dus dat, en aan de andere kant is het natuurlijk zo dat als

Architect

Case 1: Het oprekken van je verdiepingshoogte. Als je echt die
Case 1: Regelgeving is belangrijk. Zodra je iets in de regelgeving
Case 1: Wat ook nog zou helpen voor je flexibiliteit is het
Case 1: En die materiaalkeuze, dat kan wel van belang zijn, want
Case 2: Dat een bedrijf nou eens even de opbrengsten kant van
Case 2: Het gaat ook over dat je het risico hebt dat je met een af
Case 2: Wat in de circulariteit ook een belangrijk begrip is, is
Case 2: Ja, en dat is bij duurzaamheid ook zo geweest, maar nu
Case 3: Dus misschien zit daar ook wel een kans in dat je op
Case 3: Dus als je op die manier je flexibiliteit inbouwt, dus door

Eigenaar

Case 1: Nou als je het even helemaal doortrekt, als daar straks
Case 1: Voor mij is het belang er als projecten heel erg
Case 2: Soms is het zo dat als je ergens aan begint, dan is het
Case 2: Om even te beginnen met de basis. Dat is dan toch vaak
Case 2: Bij wonen zie je al dat die verdiepingshoogte ook steeds
Case 2: Terwijl als dat wel mogelijk zou zijn dan kreeg je en
Case 3: De kans is, en ik denk dat het veel meer bij deze tijd
Case 3: Real Estate Finance, ING. En die zit vooral nu heel erg te

Rollen van stakeholders - samenwerking

Projectmanager

Case 1: Als je dit wil moet je die ambitie heel duidelijk met
Case 1: Zo werkt het mechanisme altijd. Ja, laag hangend fruit. M
Case 2: Op het moment dat jij als één van die drie stakeholders ee
Case 2: Jouw vraag is hoe implementeer je dat in de
Case 2: Dus je begint met een initiatief om een kantoor te maken.
Case 2: Als je dan vraagt welke stakeholders hebben waar
Case 2: Ja, en ik denk dus dat je als initiatiefnemer heel goed
Case 2: Ik denk dat je de opdrachtgevers krijgt en de projecten
Case 2: En daarmee heb je er invloed op. Ja. Maar als je er een
Case 2: Ja, en daarom heb je dus wel een rol als architect, als
Case 2: Dit moet je willen, omdat het beter is voor de wereld en
Case 3: Can Do. Het kan, en niet het kan niet. Dat is wel de
Case 3: Maar ik denk dat je ook een team moet hebben staan
Case 3: Anders lopen we het elkaar alleen maar heel erg moeilijk
Case 3: En dan moet je als team durven zeggen, ja dit is wel
Case 3: En dat is wel belangrijk dat het team daarin mee kan.

Architect

Case 2: En ik denk dat als je het over CO2-reductie in de
Case 2: De conservatieve haal je een klein stapje vooruit. En bij
Case 2: Nou, als het een partij is die het kantoorgebouw nog een
Case 3: Soms heb ik wel eens het idee dat een gemeente en de
Case 3: Voornamelijk die samenwerking tussen de Rijksoverheid,
Case 3: En ik denk dat bij iedereen die intentie er wel is, maar ik

Eigenaar

Case 1: Als er gewoon een kwalitatief super gebouw staat, dan
Case 2: Ik denk dat het meer zit in de stakeholders om het
Case 2: Het zou heel fijn zijn als je rondom je bestemmingsplan
Case 2: Je moet ook wel een team verzamelen die dat ook ziet.
Case 2: Het is een mega zachte kant natuurlijk, die in alle
Case 3: Je moet echt vanuit de kern en vanuit bouwkundige
Case 3: Je moet partijen hebben die door meerdere generaties
Case 3: Je moet partijen selecteren die hier ervaring mee
Case 3: En we hebben bij dit project bedacht, misschien is het
Case 3: Zo veel verschillende partijen die ermee te maken
Case 3: En misschien dat de architect, daar heb je natuurlijk een

Rollen van stakeholders - cruciale partijen

Projectmanager

Case 1: Eigenlijk simpelweg alle partijen die bij een reguliere
Case 1: Alleen misschien, dat durf ik niet te garanderen, maar mis
Case 2: Ik denk uiteindelijk dat het de ontwikkelaars zijn. Omdat
Case 2: In wiens belang is dat? Voor wie is het belangrijk om dat
Case 2: En verder denk ik dat de belegger alles bepalend is. Dus
Case 2: Er zijn beleggers, zoals bijvoorbeeld een pensioenfond
Case 3: Ik denk dat ook heel veel inderdaad wel ligt bij de
Case 3: Wat nog wel interessant is over die gemeente. Ik denk
Case 3: Dus als je zoekt naar wat is flexibel, dan denk ik dat een

Architect

Case 1: Ik zou het in eerste instantie dan bij de beleggers zoeken.
Case 2: Dat is dan ook echt de functie van de architect. Om te
Case 3: Ik denk dat dat bijna een soort apart bedrijf kan worden,
Case 3: Het zou bijna een onafhankelijke partij moeten zijn die

Eigenaar

Case 1: Een combinatie van de belegger en misschien de
Case 1: De ontwikkelaar gaat er in dat geval niet op vrij te gaan
Case 2: Je hebt wel echt een belegger of een investeerder nodig
Case 2: Het begint eigenlijk allemaal een beetje bij de procedure
Case 2: Het hele ontwerpteam is cruciaal. Je hebt iedereen
Case 2: Juist omdat het aanpasbaar is wordt voor de ene
Case 3: De ontwikkelaars en de banken. Banken financieren het
Case 3: Je hebt pioniers nodig die het gaan proberen. En de rest
Case 3: Als je zou gaan bouwen om te verkopen, dan denk ik dat
Case 3: Dat we altijd met die twee petten op kijken. Eén
Case 3: Waar je ook mee te maken hebt met beleggers, dus
Case 3: En dat is echt heel raar als je naar het buitenland kijkt,
Case 3: Echt het concept. Dus als je bijvoorbeeld kijkt naar de
Case 3: Je hebt echt de instituten en de ondernemers, en
Case 3: En het is echt niet goed of fout, want die instituten die
Case 3: Dat is het lastige, want de gemeente zegt vaak dat het
Case 3: Ik denk één dat het veel meer bij deze tijd hoort,
Case 3: Dus ik denk dat de kans, denk ik dat je die met name in

Leuk voor mn rapport

Case 1 - Projectmanager: Omdat, los van het duurzaamheidsrespe
Case 2 - Eigenaar: Door belangen word je geremd om naar hetzelf
Case 3 - Eigenaar: Wordt gepraat over bouwteam opnieuw. Missc
Case 3 - Eigenaar: Want je weet ook niet waar we met z'n allen h
Case 3 - Eigenaar: Benoemen waarom NL. Omdat ze geen mixed-
Case 3 - Eigenaar: Reden waarom ik nieuwbouw kies - Het past w

Appendix VII: Barriers for adaptability

Step 1: Coding the barriers

Coding barriers

Political	Economic	Social	Technological	Environmental	Legal
Policies	Business case	Knowledge	Availability	Location	Regulations
Government	Costs	Mentality	Technologies		Zoning plan
Municipal viewpoint	Value	Visions	Skills		
Certificates		Ambitions	Quality		
		Culture			

Step 2: Categorizing the barriers

Political barriers	Csae	Client has direct influence on barrier	Client has indirect influence on barrier	Coding
Difficult to get municipality on board because zoning plans are still very mono-functional	1			Municipal viewpoint
Multifunctionality is not included in the Dutch building decree	1			Government
Dependency of the market cycle of real estate	1			Government
Adaptability is not included in laws	2			Government
Difficult to convince municipality when products or materials are not yet certified	2			Certificates
The building envelope in a location is limiting options for adaptability	2			Municipal viewpoint
Adaptability is not included in any Certificates	2			Certificates
Willingness to develop adaptable building but held back by the lagging behind in municipal support	3			Municipal viewpoint
Policies of the municipality are not implemented towards the executing and assessing alderman	3			Policies + municipal viewpoint
The municipality does not understand the impact of implementing adapability on the development process	3			Municipal viewpoint

Economic barriers	Csae	Client has direct influence on barrier	Client has indirect influence on barrier	Coding
It does not fit within the business case	1			Business case
Financial feasibility. Adaptability has a long pay-back period and therefore not feasible for short-term involved developers	1			Business case + value
Demolition might be cheaper then redevelopment	1			Costs
Higher investment costs	2			Costs
Adaptability does not have a financial value	2			Value
High financial risks due to uncertainties	3			Risks
Capital destruction after functional change	3			Business case

Social barriers	Csae	Client has direct influence on barrier	Client has indirect influence on barrier	Coding
Interests of different stakeholders are contradictory	1			Ambitions
Not included in the program of requirements	1			Ambitions
Conservative stakeholders	2			Mentality
Lack of knowledge and expertise	2			Knowledge
Adaptability is a container concept	2			Knowledge
Stakeholders in the project team are hindering the process	2			Ambitions + mentality
The whole chain of stakeholders is needed for project succes	2			Mentality
Ambitions are not shared within the project team	2			Ambitions
Strictly framed program of requirements	3			Ambitions
Stakeholders see challenges instead of opportunities	3			Mentality
Position of the client. Short-term involved client do not keep it in their own portfolio	3			Ambitions
It is not clear what is needed to develop an adaptable building	3			Knowledge

Technological barriers	Csae	Client has direct influence on barrier	Client has indirec influence on barrier	Coding
Demountable elements cannot be fabricated	1			Availability
The quality of the building is low and functional change is not possible after its functional life cycle	1			Quality
Adaptability is often standard and general	2			Skills
Innovative sustainable products are not yet certified	2			Technologies
Traditional design options are easier to build for contractors	3			Skills

Environmental barriers	Csae	Client has direct influence on barrier	Client has indirect influence on barrier	Coding
Developing adaptable buildings is not possible because of mono-functionality in the urban area	2			Location
Developing adaptable buildings is not possible in some cities or central locations in cities (e.g. policy restrictions)	3			Location

Legal barriers	Csae	Client has direct influence on barrier	Client has indirect influence on barrier	Coding
Difficult to get municipality on board because zoning plans are still very mono-functional	1			Regulations & zoning plan
Changes in regulations	1			Regulations
Multifunctionality is not possible in the Dutch building decree	1			Regulations
Adaptability is not included in the regulations	2			Regulations
Willingness to develop adaptable buildings but held back by the lagging behind in municipal support	3			Regulations
Regulations are limiting design options for adaptability	3			Regulations
Lack of multifunctional zoning plans	3			Zoning plan

Step 3: Dividing into indirect and direct influences

Indirect influence barriers

Political	Case	Coding
Difficult to get municipality on board because zoning plans are still very mono-functional	1	Municipal viewpoint
Multifunctionality is not included in the Dutch building decree	1	Government
Dependency of the market cycle of real estate	1	Government
Adaptability is not included in laws	2	Government
Difficult to convince municipality when products or materials are not yet certified	2	Certificates
The building envelope in a location is limiting options for adaptability	2	Municipal viewpoint
Adaptability is not included in certificates	2	Certificates
Willingness to develop adaptable building but held back by the lagging behind in municipal support	3	Municipal viewpoint
Policies of the municipality are not implemented towards the executing and assessing alderman	3	Policies + municipal viewpoint
The municipality does not understand the impact of adapability on the development process	3	Municipal viewpoint

Economic	Case	Coding
It does not fit within the business case	1	Business case
Financial feasibility. Adaptability has a long pay-back period and therefore not feasible for short-term involved developers	1	Business case + value
Demolition might be cheaper then redevelopment	1	Costs
Higher investment costs	2	Costs
Adaptability does not have a financial value	2	Value
High financial risks due to uncertainties	3	Risks
Capital destruction after functional change	3	Business case

Social	Case	Coding
Adaptability is a container concept	2	Knowledge

Technological	Case	Coding
Demountable elements cannot be fabricated	1	Availability
Innovative sustainable products are not yet certified	2	Technologies
Traditional design options are easier to build for contractors	3	Skills

Environmental	Case	Coding
There are no indirect environmental barriers		

Legal	Case	Coding
Difficult to get municipality on board because zoning plans are still very mono-functional	1	Regulations & zoning plan
Changes in regulations	1	Regulations
Multifunctionality is not possible in the Dutch building decree	1	Regulations
Adaptability is not included in the regulations	2	Regulations
Willingness to develop adaptable buildings but held back by the lagging behind in municipal support	3	Regulations
Regulations are limiting design options for adaptability	3	Regulations
Lack of multifunctional zoning plans	3	Zoning plan

Direct influence barriers

Political	Case	Code
There are no direct political barriers experienced in this research	-	-

Economic	Case	Code
There are no direct economic barriers experienced in this research	-	-

Social	Case	Code
Interests of different stakeholders are contradictory	1	Ambitions
Not included in the program of requirements	1	Ambitions
Conservative stakeholders	2	Mentality
Lack of knowledge and expertise	2	Knowledge
Stakeholders in the project team are hindering the process	2	Ambitions + mentality
The whole chain of stakeholders is needed for project succces	2	Mentality
Ambitions are not shared within the project team	2	Ambitions
Strictly framed program of requirements	3	Ambitions
Stakeholders see challenges instead of opportunities	3	Mentality
Position of the client. Short-term involved client do not keep it in their own portfolio	3	Ambitions
It is not clear what is needed to develop an adaptable building	3	Knowledge

Technological	Case	Code
The quality of the building is low and functional change is not possible after its functional life cycle	1	Quality
Adaptability is often standard and general	2	Skills

Environmental	Case	Code
Developing adaptable buildings is not possible because of mono-functionality in the urban area	2	Location
Developing adaptable buildings is not possible in some cities or central locations in cities (e.g. policy restrictions)	3	Location

Legal	Case	Code
There are no direct legal barriers experienced in this research	-	-

Appendix VIII: Expert protocol

Introductie

Goedemiddag, allereerst wil ik jullie bedanken voor deelname aan mijn expert panel en voor uw tijd. Voordat ik begin zou ik nogmaals willen vragen of jullie akkoord gaan met het maken van een geluidsopname. Dan zal ik mijzelf even voorstellen, mijn onderzoek introduceren en de gang van zaken voor het komende uur toelichten. Mijn naam is Esra van der Weijden en ik ben momenteel bezig met mijn afstudeeronderzoek van de master Management in the Built Environment aan de TU Delft.

Mijn afstudeeronderzoek gaat over het implementeren van aanpasbaarheid in ontwikkelingsprojecten. Dit onderwerp is ontstaan vanuit het ideaalbeeld dat de meest duurzame gebouwen, gebouwen zijn die gebouwd worden voor de lange termijn en die dynamisch kunnen meebewegen met veranderingen in hun omgeving. In mijn onderzoek kijk ik naar de rollen van de betrokken partijen met de focus op de opdrachtgever. Hierbij heb ik gekeken wat er nodig is voor een aanpasbaar gebouw op zowel gebouw niveau als proces niveau, welke invloeden een opdrachtgever kan uitoefenen en welke barrières er momenteel worden ervaren. Deze informatie heb ik gebruikt om een actieplan te maken. Het actieplan kan gebruikt worden door opdrachtgevers als handleiding voor aanpasbaarheid en om duidelijkheid te scheppen over waar en hoe zij invloed kunnen uitoefenen op dit proces.

Dit expert panel zal ongeveer een uur duren. Hierbij zal ik beginnen met een aantal stellingen met betrekking tot het actieplan en daarna kunnen we het actieplan bespreken. Heeft u verder nog vragen voorafgaande de start van het interview? Zo niet, dan kunnen we beginnen.

Stellingen

Stelling 1 – Visie en ambitie

Alle nieuwe gebouwen moeten aanpasbaar zijn voor de toekomst en getransformeerd kunnen worden naar een andere functie.

Stelling 2 – Rol van de opdrachtgever / ontwikkelaar

Een opdrachtgever is verantwoordelijk voor het in huis hebben van kennis over aanpasbaarheid en gebouwen. Als zij dit niet hebben moet dit in huis gehaald worden.

Stelling 3 – Cruciale partijen

Voor aanpasbare gebouwen is de meest cruciale partij om mee samen te werken de gemeente. Als zij niet meewerken is de ontwikkeling van aanpasbare gebouwen onmogelijk.

Stelling 4 – Opportunities

Het is noodzakelijk dat certificaten voor aanpasbaarheid worden ontwikkeld om het financiële waarde te geven.

Actieplan

- Wat is uw eerste indruk als u kijkt naar het actieplan?
- Wat is er duidelijk of onduidelijk?
- Zouden jullie het actieplan toepassen?
- Zo ja, hoe zouden jullie dat doen?
- Zo nee, wat zou er nodig zijn om dit wel bruikbaar voor jullie te maken?

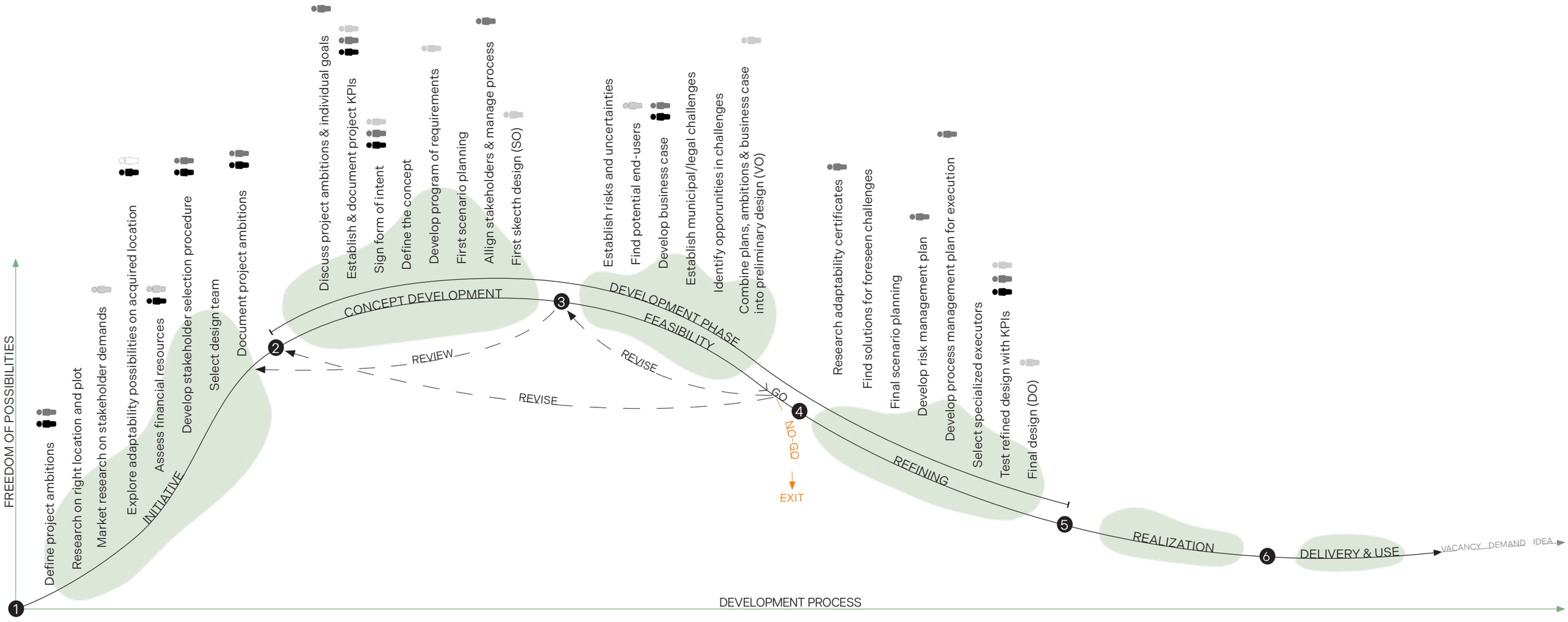
Afsluiting van het expert panel

Ik denk dat we alles hebben behandeld. Hebben jullie nog vragen of opmerkingen die van belang zijn voor mijn onderzoek? Graag wil ik jullie hartelijk danken voor de tijd en medewerking aan dit onderzoek. De gegevens worden geanonimiseerd. Als jullie nog vragen hebben kunnen jullie mij per mail bereiken. Na afloop van mijn afstudeeronderzoek zal ik u, indien gewenst, het rapport toesturen.

Appendix IX: Deliverables

On the next page the action plan for adaptable building developments is shown. This action plan is the main deliverable of this research. The action plan can be used by real estate partitioners. The action plan is supported by a more elaborate reading guide and describes how the action plan is used and what important elements must be considered in developing an adaptable building. When additional information is needed, it is advised to consult the research report.

ACTION PLAN
FOR ADAPTABLE BUILDING DEVELOPMENT



LEGEND

y-axis: freedom

development process phases

perceived amount of influence (schematic):

high

low

stakeholder:

- client
- project manager
- investor
- design team
- municipality

ADAPTABILITY CRITERIA

Building aspects

- Over-dimensioing
- Characteristics of the building
- Demountable, modular & independent
- Fluid spaces & buffer zones
- Lay-out of the building & zoning
- Rearrangeable

Location & context

- The right location
- Multifunctional
- Non-physical context

Mindset & team

- Flexible thinking

SUCCESS FACTORS

A. Develop a future-proof design
B. Create a document with clear ambitions & goals
C. Translate ambitions to measurable KPIs
D. Ensure good municipal collaboration
E. Ensure knowledge about adaptability within project team
F. Early involvement of project team
G. Create a balance between ambitions and business case
H. Select a designer with experience and expertise
I. Select stakeholders with a “Can Do” mentality
J. Find innovative financial resources
K. Keep reflecting on progress and process

Action plan for adaptability

What is it?

Adaptable buildings are a unique and innovative way of developing buildings. An adaptable building development process requires a different approach in comparison to traditional buildings. This guideline shows an action plan for the development of adaptable buildings. In this action plan different elements can be found from the process of adaptability with corresponding actions, the amount of influence, different stakeholders and adaptability criteria to success factors and the indirect influence on the implementation of adaptability.

At the bottom of the action plan, you can find the ten adaptability criteria focusing on the physical aspects, and the eleven success factors focusing on the process and collaboration side. Those elements are perceived as most important focus points in developing adaptable buildings. Information about the adaptability criteria can be found in the research report. Information about the success factors is described on the following page.

The goal of this action plan is to make the implementation of adaptability more tangible and clear. Not just for you but also as a tool to motivate and steer others. With this model you can start the discussion and develop a succesful adaptable building.

How to use it.

This action plan can be used during the entire process of the project. However, when you are planning on using it, make sure you use it from the very beginning of the process. Use it as a tool to understand the process or to steer and motivate other stakeholders.

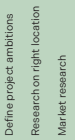
The action plan is read form left to right, starting at the iniative phase.

Phase: Each phase represents a part of the process with certain set of activites.

Influence: The (schematic) amount of influence the client has on the process.

Y-axis: (Schematic) amount of freedom in possibilities.
X-axis: Development process phases.

Stakeholder: Some actions are appointed to a stakeholder. This role is responsible for this action. When there is no role appointed to an action, the team must discuss the expectations and a plan.



Activity: The phase related tasks that influence the project success for adaptability.

For and by whom?

The client

I am the initiator of the project. I establish the project ambitions and make the final decisions.

I want:
- Profit
- To reach the goals
- Competitive position

The project manager

I realize and manage the project. I make sure all stakeholders are alligned and the goals are reached.

I want:
- Good collaboration
- Efficient process
- Time, budget & quality

The design team

We design and construct the building in line with the ambitions and business case of the client.

We want:
- Future-proof building
- Improved well-being of users
- Brand appraisal

The investor

I have the financial resources for this project. I use or rent the building and monitor the demand.

I want:
- Profit
- Reduced future mismatch
- Improved well-being of users
- Low-risks

The municipality

We facilitate municipal collaboration and enforce compliance of regulations.

I want:
- Reduced future mismatch
- Allignment with environment
- Future-proof & sustainable building

Success factors for adaptability

1. Develop a future-proof design

A future-proof design where adaptability criteria are implemented helps to reduce the future mismatch. It also helps to reduce the large changes that must be made to the building in the future to match the demand.

2. Create a document with clear ambitions & goals

The goals and ambitions of the client must be translated into an ambition document. This document consists of demands, ambitions, goals and whishes, and must be used to keep everyone on the same track.

3. Translate ambitions to measurable KPIs

Translating the ambitions from the ambition document into measurable KPIs can help to monitor the progress and steer the process.

4. Ensure good municipal collaboration

Municipal support is important because the process of adaptability differs from traditional buildings. Good collaboration with the municipality helps with permit applications and assessments of the design.

5. Ensure knowledge about adaptability

Stakeholders must understand the impact of adaptability on the development process and associated actions. Knowledge about the concept is important. When knowledge is lacking, this must be acquired.

6. Early involvement of project team

Early involvement of the project team helps to reduce and manage risks & uncertainties. It also improves the available knowledge within the team during concept development.

7. Create a balance between ambitions and business case

Many adaptability criteria can be implemented in an adaptability project. However, because the payback period of adaptability is different and not all criteria are required in the first functional life-cycle, a balance between ambitions and the business case is needed.

8. Select a designer with experience and expertise

Developing an adaptable building requires a different mindset. An innovative designer with experience and expertise in adaptability, that is willing to start the discussion with the client about the feasibility of its ambitions, is prevered.

9. Select stakeholders with a "Can Do" mentality

Stakeholders involved in the project must have a different mindset. They must see opporunities where others see barriers and challenges. Stakeholders must be open, and willing to think outside of the box.

10. Find innovative financial resources

Adaptability requires a different type of investment. Innovative financial resources that either understand the differences and see the project potential, or are open to innovative ideas are needed.

11. Keep reflecting on progress and process

An ongoing process of monitoring the progress and reflecting on the process helps to detect challenges in early stages. Sharing 'lessons learned' within the project team also improves the project success.

Indirect influence on the implementation of adaptability

The development of adaptable buildings can, next to direct influence, indirectly be influenced by the client or other stakeholders. The indirect influence mostly relates to the stakeholders outside the project team, and external factors influencing the project success of developing adaptable buildings.

1. Communication and contracting with **municipality.**

- Start a conversation with the municipality about their vision on developing adaptable buildings and point out that their role is crucial for project success. It is important to gather information about how they assess multifunctional building designs.
- Talk about flexibility in regulations for adaptable buildings, the building envelope, and the zoning plan.
- Start a conversation about incentives for the development of adaptable buildings and look for common ground.
- Make sure that agreements made with the municipality are recorded in contract documents.

2. Communication and contracting with the **government.**

- Start a conversation with the government about the lack of guidance and support for developing adaptable buildings in laws, regulations, and certificates.

3. Communication with companies in **sustainability certification.**

- Create awareness at certification companies for the need of including adaptability in sustainability certificates. Point out that it is difficult to motivate and convince stakeholders to develop adaptable buildings when it does not have a direct incentive through certificates.
- There is a need for a certificate for adaptable building to create incentives and to assign (financial) value to adaptability.

4. Communication with **investors and banks.**

- Start a conversation with investors about the demand for adaptable buildings and the benefits for their building portfolio.
- Make them aware of the different type of investment they will make and the positive effect of adaptability on the market risk of their building.

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