MANAGING METABOLISM

enabling re-adaptive housing possibilities in the Netherlands

REAL ESTATE MANAGEMENT – HOUSING

(Nakagin Capsule Tower, source: Getty Images)

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0. ABSTRACT

The combination of a current housing shortage and a mis-match of people their living needs and actual living space or financial size, leads to dwellings being newly build, renovated, transformed or demolished. In theory, flexible architectural principles should offer a strong solution to adaptability of buildings and prevent such measures, however in practice this seems not the case.

Previous research has primarily focused on the architectural component of adaptability; however, the aspect of organizational management still need more research. There is a dearth of information on the practical outcomes of these adaptive construction principles, particularly in terms of organizational and management concerns. The primary issue is the applicability of adaptive principles, as since earlier stated that these have their own respective problems in practice.

This thesis researches if adaptive housing can function as a feasible project possibility for new constructed housing stock, in terms of organisational and process related aspects.

The research question: " *In what way can (future) newly constructed adaptivity ability housing in the Netherlands be managed? '' will be answered through four phases:* theoretical framework (literature study), case studies (empirical study) , interviews (new insight), recommendations and discussion (validation).

Phase I starts with literature review in order to understand the theories behind re-adaptive buildings. Phase II is to look at actual buildings built of the theories mentioned in phase I and how these work out in practice and therefore practical information is gained. The short listed case studies are being further used in Phase III, where stakeholders of those case studies are being interviewed. This is done to gain even further understanding of the barriers and enablers of these projects. Recommendations are made based on enablers and barriers from the data of phases I,II and III. This is taken to phase IV, where these recommendations are being reflected on by a professional building management panel and improved, leading to answering the main research question.

The research can be seen as a snowball, that accumulates in knowledge throughout the research.

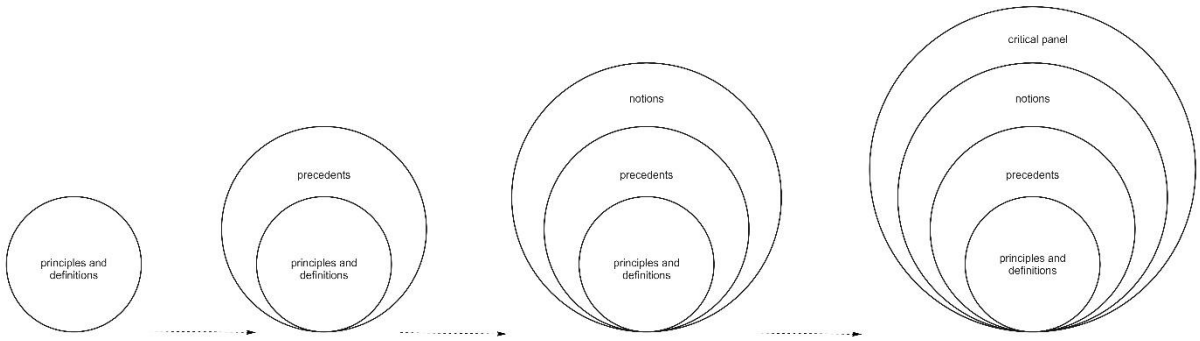


Figure 1: accumulation of information

CONTENT

INTRO DUCT ION

1. INTRODUCTION

By 2034, the prognoses is a housing increase demand of 1.16 new homes (Groenemeijer et al., 2021). The prognosed housing shortage of one million housing can include replacing and renovating older dwellings (Asselbergs, & Spoormans, 2020). Housing stock and its increase relatively holds a fair share of additional new stock as a result of adapting buildings either through splitting, renovating or changing the use of the dwelling or combination. This counted for almost 33.000 dwellings in 2021 (CBS, 2021a) and 25.000 in 2020 (CBS, 2021b). It is also expected by 2034 to have a different composition of shares between single-family housing and multi-family housing. Furthermore, there is a difference in family size and its m2, lots of people live either too big or too small than their needs. The needed room space also individually differentiates (Groenemeijer et al., 2021; Stadszaken, 2020).

The topic of adaptive housing is relevant and worth investigating since it could provide a possible solution and forms a significant part of the issues as stated above. As existing buildings can create new housing through splitting, renovating and/or transformation, it prevents it for demolition or transformation to other functions.

Geraerdts (2015) stated that there is an increase in demand for both flexibility and sustainability, together with a growing understanding of the importance of circular economy. According to Spoormans, Jonkman and Asselbergs (2020), adapdability plays an important role into this and is defined as the degree to which a structure can be modified to meet changing needs or a different purpose. Renewability and adaptability, having elements that allow flexibility and hence a wider range of interpretation, is more sustainable and makes continuous adaptation easier and less expensive. A building is more sustainable when it can keep its functional life cycle longer rather than becoming vacant, being demolished and/or require big renovations (Geraedts, 2016).

Knowledge about the implications and possibilities of flexible and adaptive housing has great importance for using these theories more often and releasing some pressure on the housing shortage along with preventing future mismatches between space supply and demand.

The possibilities of adaptive and flexible building and their general features has been studied and documented extensively and received their relative considerable attention in the building environment, in Japan with Metabolism and its Dutch counter parts Structuralism and Open bouwen.

However when we look at an examples of buildings with principles on flexibility and adaptability, they do not function as expected. For example, Metabolism's the Nakagin Capsule Tower is now in heavy decay with lots of technical issues and a high vacancy rate waiting to be demolished (Magalhães, 2013; Ishida, 2017;Messynessy, 2016; Heilmeyer, 2021), Structuralism's Centraal Beheer Gebouw is also in decay (Giele, 2021)and vacant and the Open Bouwen's Solids also largely vacant (NUL20, 2013).

Despite the importance of adaptivity, the gap can be found in its less attention paid to the practical side and its organisational management concerns. Previous research mainly concern themselves with the architectural side of adaptability, however the aspect of organisational management still needs further investigation. A large body of data concerning the practical outcomes, especially with regards to organisational and management concerns, of these adaptive building principles have not been reported. The central issue is that the validity of adaptive building.

The question therefore remains how the theoretical implications can be implicated in practice. It's of interest not to only compare the adaptive theories and projects, but also draw lessons from these. Hence, additional research on the organisational and management aspect of adaptive housing projects is needed.

The purpose is to document the barriers and enablers of adaptive housing, making the aim of the thesis to propose organisational and management recommendations for newly adaptive housing construction in the Netherlands. This is done by literature review on metabolism, structuralism and open bouwen. This is followed

by case studies and interviews with the stakeholders of those case studies. After proposing recommendations, this will be discussed in a professional panel as well in order to validate the outcomes.

The remainder of this thesis is divided into five sections: the methodology, the literature framework, the case studies, interview outcomes and the validation.

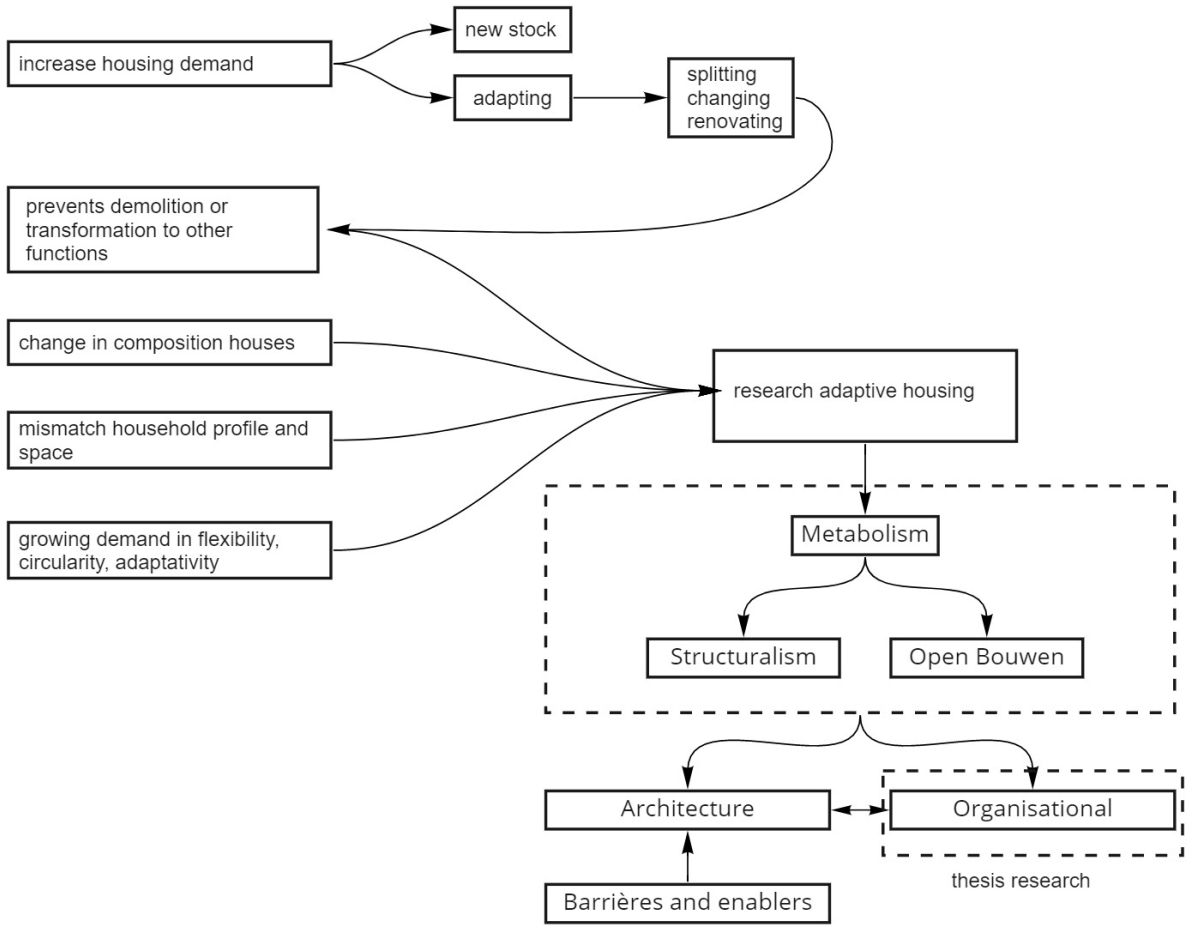


Figure 2: Research overview

1.1. PROBLEM DESCRIPTION

According to prognoses of ABF Research, there will be a housing shortage of one million houses in the Netherlands by 2035. A quarter of a million of those houses has to be accounted for by newly constructed housing, the rest can also include replacing and renovating older dwellings. Existing buildings can therefore also create new buildings through splitting dwellings, renovate them to prevent demolition or transform of other function buildings (Jonkman, Asselbergs, & Spoormans, 2020).

Based on the amount of starters looking for housing, home sharers aged 25 years old and up, the increase share of older children that live at home, the doubling of the amount of homeless people and the rising house pricing, it is expected that the total housing stock will increase with 12.4% by 2034, where 1.16 million homes are expected to be added and 168.000 will be withdrawn (Groenemeijer et al., 2021).

It's not only the prognoses of the population growth (expected to increase 10.5% by 2034), but also the increase of the number and different types of households. This is as an result of changing housing preferences, immigration, ageing population and the relatively higher concentrations of housing demands in urban areas. Currently, 64% of the existing stock is single-family and the other 36% is multi-family. In 2035, this will be 51% single-family and 49% multi-family (Groenemeijer et al., 2021). See figure 3.

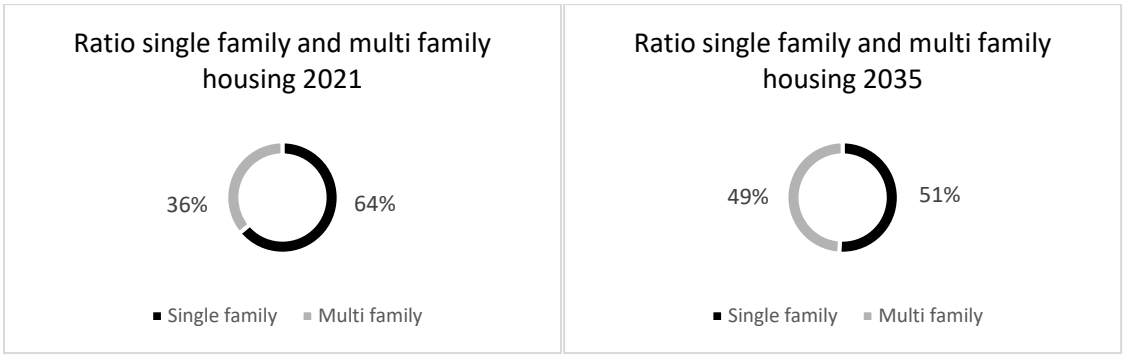


Figure 3: Change in ratio single family and multi family housing (source Groenemeijer et al.m 2021 ; illustration Shajwan Jabar)

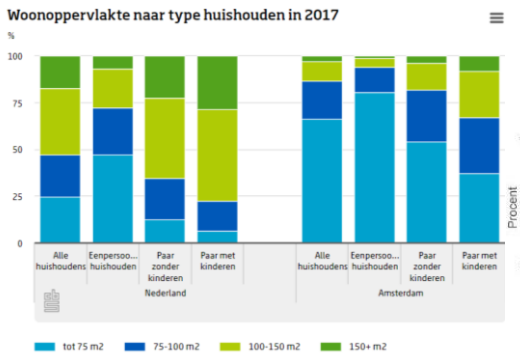


Figure 4: Difference in household and space (CBS, 2018)

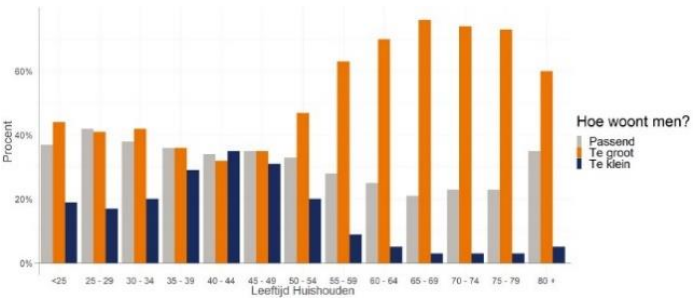


Figure 5: Mismatch of household and space (Stadszaken, 2020)

As can be seen in figure 4, when living spaces are put against households, there is a peak in over-dwelling households in the age group over 50 and the age group of 35-50 years old live way too small. The age group over 50, the empty nesters, used to need this space for their family, however now the children left home and there is a surplus in space. Also, since the house often is largely repaid, the housing costs are relatively low (Stadszaken, 2020).

In practice, this issue of people having too little or too much space according to their needs is difficult to solve. The moving flow is difficult to achieve as there are all kinds of laws and practical objections. People with too much space prefer keeping this than perhaps having a shortage in the future, elderly people who now live in a social rental rather stay than move with a significant price increase, empty nesters instinctively pay only little

for their home as they have paid it off very often and moving to a new home is relatively more expensive (Stadszaken, 2020).

To tackle these issues, currently there are a variety of possibilities:
1. Use the current housing supply
- However this is very low and demand is much higher. This leads to people living in houses that are too expensive, too big, too small or too far away for them.
2. 'Normal' New development
- Usually expensive for future residents as developers are able to make bigger profits because the demand is much higher than supply (except for little amount of social housing). Furthermore, not sufficient enough because of long waiting lists and high demands.
3. Renovation and transformation
- Sometimes very difficult for developers in terms of feasibility and possibilities

Furthermore, these possibilities still do not or nihilistic provide a solution for issue of mismatch between how people live and how they rather live, in terms of space. Also people value the place they live in (social relationships and social capital), making moving to a different area also less desirable and adaptiveness of a house a preference.

Adaptive housing could be a possible solution to these mentioned issues. Academically there is an increasing interest in adaptive constructions (involving the selected terminologies including retrofitting, renovation, rehabilitation, refurbishment, material reuse, building conversion and adaptive reuse) (Shahi *et al.*, 2020). As can be seen in figure 6, this concerns a very high increase in papers published on building adaptation strategies.

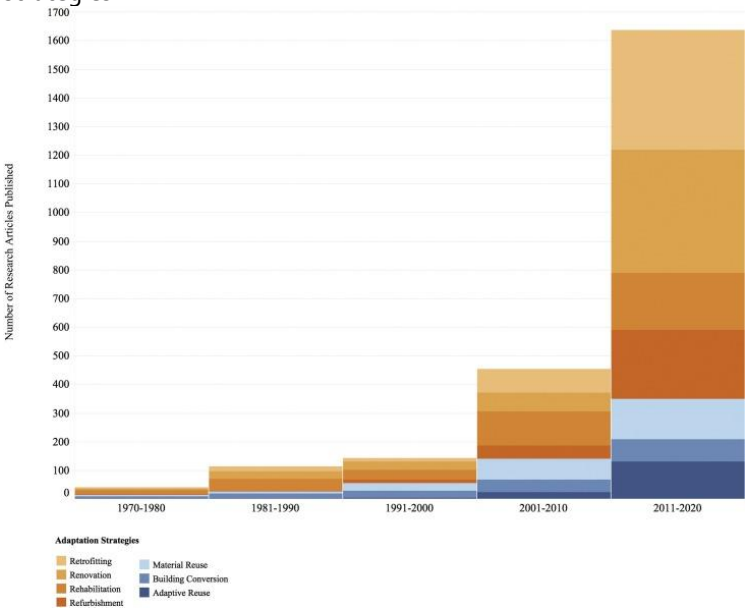


Figure 6: High increase of papers published with adaptation strategies (Shahi *et al.*, 2020)

According to the market developments, there is also an increasing demand for both flexibility and sustainability, along with a growing understanding of the importance of circular economy (Geraedts, 2016).

In practice we can see that in 2021 so far (from December 2020 to November 2021), the current housing stock counts for 9.202.409 dwellings, 79.727 (0,87%) of this number is newly constructed and 13.912 is demolished. What's most interesting, is that 33.209 (0,36%) of this current stock is accounted for additional new stock as a result of splitting, renovating or changing the use of the dwelling. 17.822 (0,19%) dwellings are withdrawn from the total housing stock as a result of merging or changing the use of dwellings (CBS, 2021a).

In 2020, the total housing stock was 7.891.785, with 70.080 (0,89%) newly constructed. Of the total stock, 24.695 (0,31%) accounted is as a result of splitting, renovating or changing the use of the dwelling and 16.415 (0,21%) have been withdrawn from this stock as a result of merging or changing the use of dwelling (CBS, 2021b).

Looking at these numbers, a relative big amount (0.36% in comparison to 0.87%) of additional housing stock comes adapting the dwelling (splitting, renovating or changing the use of the dwelling into housing, i.e. adapting the dwelling). Figure 7 shows how much of the newly added stock concerns 'additional new', which includes the result of splitting, renovating or changing the use.

Figure 7: Proportion new building stock : new development and adapting current stock (Source: CBS 2021a/b ; illustration Shajwan Jabar)

'Re-using' buildings has great benefits in terms of sustainability as existing buildings hold great amounts of materials, energy and captured CO_2. However, still many buildings are getting demolished because redevelopment isn't always beneficial in terms of technical difficulties, financial aspects, supply/demand mis matches and alternative solutions are more attractive. All of these features are related to the building's renewability and adaptability, where certain characteristics might allow more flexibility and hence a wider range of alternative interpretations. This also makes continuous adaption easier and less expensive because buildings may be adapted to new uses with fewer significant changes. Because the demand for real estate is always changing, renewability and adaptability are equally vital. Demand-oriented development aid only in the short-term coordination of supply and demand. Also, supply takes multiple years to catch up with the demand as building projects usually take years (Spoormans, Jonkman and Asselbergs, 2020).

Adaptability plays an important role into this and is defined as the degree to which a structure can be modified to meet changing needs or a different purpose (Spoormans, Jonkman and Asselbergs, 2020). A building is more sustainable when it can keep its functional life cycle longer rather than becoming vacant, being demolished and/or require big renovations (Geraedts, 2016).

Furthermore, (easily) re-adaptive housings also benefit the flow of residents living in the right housing for them with regards to needed space and the possibilities of keeping their social capital and value to the place they live in.

When thinking of incorporating adaptivity into its architecture, metabolism is a great example of implementing these principles. Metabolism had seen buildings as regenerative rather than static, and its architects designed megastructures with both permanent and ephemeral components to allow them to develop over time. From this theoretical ideology, it implemented its idea into built buildings. This is where the structure is the only thing that is a given. The structure is built in such a way, that it can be enlarged over time when needed. In between this structure, housing units can be adapted in terms of spatial organisation, growth or shrinkage according to their desired and needs at that time. Elements of the building units can be re-used or dissected in a way that the materials can be re-used in a different function. The repositioning, adding and removing elements can represent sociological change, allowing the edifice to be renewed indefinitely and preventing decaying (Kurokawa, 1977; Koolhaas *et al.*, 2011). Structuralism and Open Bouwen are the Dutch counterparts to Metabolism with more or less similar principles. Figure 8 shows the overlap and differences between these theories.

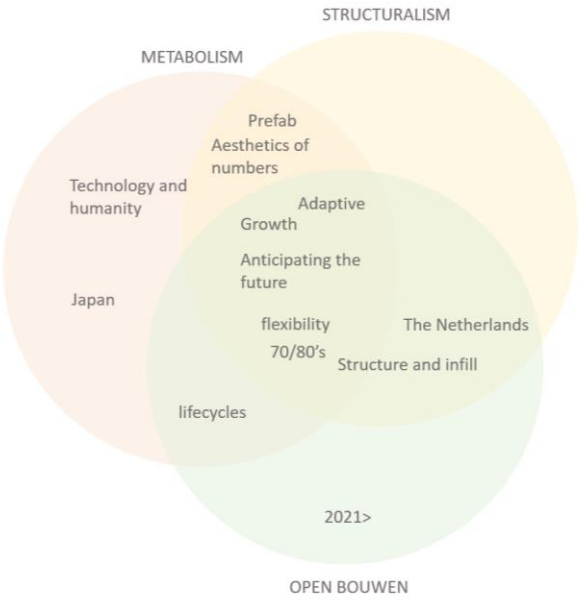


Figure 8: Overlap and differences between Metabolism, Structuralism and Open Bouwen (Shajwan Jabar)

However when looking at examples of buildings with principles on flexibility and adaptability, they do not function as expected. It's interesting to note that some of these buildings that were designed with flexibility in mind, are either already being demolished or are up to being so. This can either be seen flawed in terms of flexibility relating to the design process, but not so much to reusability or because the building could be considered utterly flexible. The issues then arise from space management, new comfort and climate requirements and demolition being cheaper (van den Heuvel and Frausto, 2012).

For example, Metabolism's the Nakagin Capsule Tower is now in heavy decay with lots of technical issues and a high vacancy rate waiting to be demolished (Magalhães, 2013; Ishida, 2017;Messynessy, 2016; Heilmeyer, 2021), Structuralism's Centraal Beheer Gebouw is also in decay and vacant (Giele, 2021) and the Open Bouwen's Solids also largely vacant (NUL20, 2013).

Structuralism has had its own difficulties as well. It's that exactly the reason of repetitive modules can work retroactive as it limits the possibilities of irregular forms or higher ceilings. Furthermore, wayfinding can become an issue with the configuration of many similar modules. Despite the characteristics of being an open structure and flexibility for future growth or adaptation, many of the structuralism buildings now seem to have difficulties being adapted as such with programmatic possibilities along with other shortcomings such as the indoor climate (van den Heuvel and Frausto, 2012).

Open Building also has its fair share of problems as a new research showed how the Solids, a well-known example of the principles of open bouwen, seems to face inefficiency as well as the Solid on Ijburg is vacant. The chance that the initiator Stadgenoot or other developers/landlords will build more Solids is not unlikely as it seems that the concept is too risky, too expensive and possibly too unsuitable for the core tasks of the corporations (Platform 31, 2013).

PROBLEM STATEMENT

The combination of a current housing shortage and a mis-match of people their living needs and actual living space or financial size, leads to dwellings being newly build, renovated, transformed or demolished. In theory, flexible architectural principles such as metabolism, structuralism and Open Bouwen should offer a strong solution to adaptability of buildings and prevent such measures, however in practice this seems not the case. So, where does this go wrong?

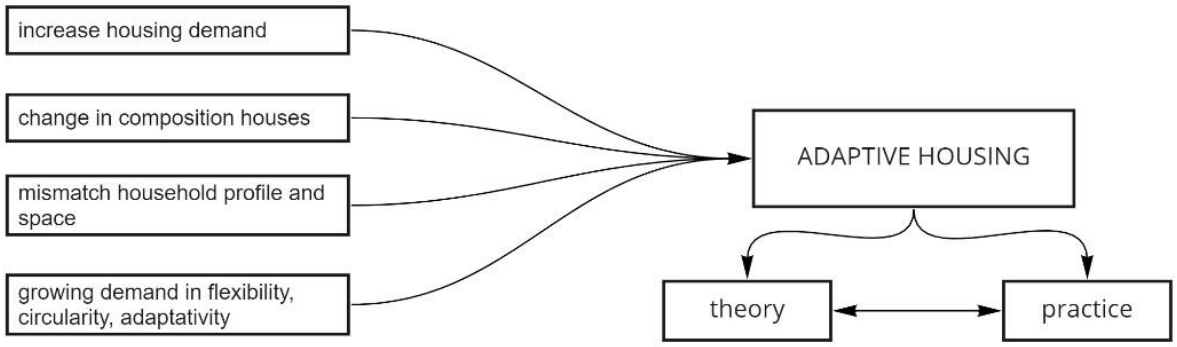


Figure 9: Problems leading to researching adaptive housing (Shajwan Jabar)

1.2 RESEARCH AIM

Previous research has primarily focused on the architectural component of adaptability; however, the aspect of organizational management still need more research. There is a dearth of information on the practical outcomes of these adaptive construction principles, particularly in terms of organizational and management concerns. The primary issue is the applicability of adaptive principles, as since earlier stated that these have their own respective problems in practice.

The intention of this thesis is to research and explore in what way re-adaptive housing, as metabolism suggested, can be managed properly for these ideas to work out practically as housing in the Dutch context. It re-explores the possibilities within the metabolism movement and its Dutch counterparts and what the exact bottlenecks are, and offers a management proposal for new structures with adaptative principles.

As this research concerns itself with the housing market in the Netherlands, metabolism has to be related back to the Netherlands in order to put the right architectural theory in the right context. Metabolism is a starting point, and from there on similar concepts in the Netherlands will be looked at and further used in the research. With regards to metabolism, there is not one specific theory that aligns completely. Therefore, two concepts will be used that together overlap metabolism its whole concept. These are structuralism and open bouwen.

This thesis 'Managing Metabolism' researches if re-adaptive housing can function as a feasible project possibility for new constructed housing stock, in terms of organisational and process related aspects. Existing Metabolism, Structuralist and Open Bouwen buildings will be researched through the in-depth research and analysis of the different notions, barriers and enablers.

This prevents future mis-matches between housing demands and supply and minimizes the changes of big renovations, transformations, decaying and demolition. The direct stakeholders benefitting from this thesis are inhabitants, developers, housing associations, investors and municipalities.

In order to reach this aim, the following research question has been formulated:

" In what way can (future) newly constructed adaptivity ability housing in the Netherlands be managed? "

1.3 RELEVANCE

ACADEMIC RELEVANCE

There is an academic domain gap in the built environment, namely architecture and management. Not only is this thesis the interdisciplinary connecting link between architecture and management in the build environment, it fills the gap of research between theory and practice domains, of how the theory of (re-)adaptive building principles work out in practice. A deeper understanding of the enablers and barriers is researched. Also re-adaptivity will be defined.

The academic addition of this thesis is not only the observation of, but also understanding the observations to also making new recommendations and proposals based on this from the tender phase till maintenance phase.

It also links the gap of research between Metabolism, Structuralism and Open Bouwen.

Furthermore, the interviews and surveys will provide insight and new information on the thoughts of this kind of housing building from the a multi-stakeholder perspective such as the perspectives of developers, investors, municipality and the inhabitants.

Lastly, the group members of metabolism had planned to follow up the theoretical manifesto with a practical evaluated report, this never happened because of opinion diversity among the members. The following years after, each group member continued his own work (Kurokawa, 1977; Koolhaas *et al.*, 2011). Therefore it's also worth investigating how metabolism practically functions and what its barriers and enablers are. This thesis fills in the missing theoretical gap of the in-depth research of metabolism buildings and the success and fail factors of this.

SOCIETAL AND PRACTICAL RELEVANCE

Buildings are normative, meaning buildings are related to the way people live and behave and therefore the building and human behaviour are interrelated as they create a particular set of standards. Therefore, it has great potential to propose itself as a tool for social and behavioural change of inhabitants. This links back with the argument that real estate is more than a time-stamped object; it is a living collective form that constantly must be integrated into its current context in order to ensure its survival and prevent big renovations, transformation, vacancy or even demolition on a larger scale. A structure that is intended as a living creature to continuously support the lives of the individuals that live inside with principles of growth and transformation across time.

This research can lead developers, investors and the municipality into the decision of building metabolism housing in a redefined way. Building parties directly benefit from this as metabolism housing, possibly, leads to less need for transformation, big renovation, decay and even demolition of their properties. If there is a positive outcome, developers can build better re-adaptive housing and thus the inhabitants directly benefit from this. Now they live in a house that is fitted for their needs and also can be changed into their change of needs instead of having to move house when housing needs change. Secondly they can continue to build on to their social capital. If there is a negative outcome, which is also possible, further research can be built on specifically the negative outcomes. It could also be possible that the conclusion of this thesis is that it is a hopeless matter and it would be a better solution to just demolish everything.

METHO DO LOGY

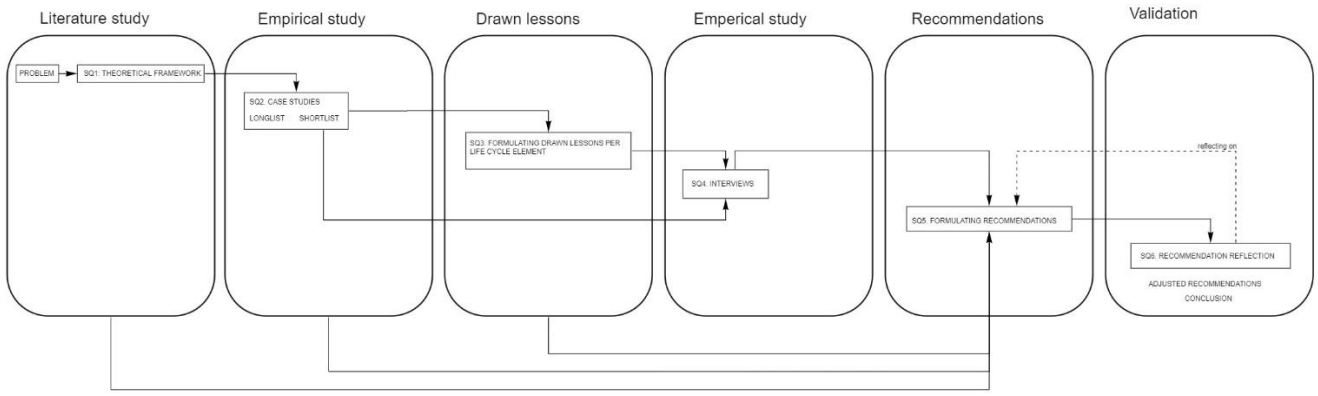


Figure 10: Methodology concatenation (own illustration)

2.1 RESEARCH QUESTIONS

MAIN RESEARCH QUESTION

Based on the previous stated problem statements, the following main research question is formed:

> *''In what way can (future) newly constructed **re-adaptive** housing in the Netherlands be managed?''*

ADAPTIVITY / ADAPTIVE RE-USE / RE-ADAPTIVE

Adaptivity, adaptive re-use and re-adaptive are three very similar definitions. It's important to understand the fundamental difference between these definitions as 're-adaptive' will be further used in this research.

ADAPTIVITY

Adaptivity ability is defined, based on definition used in the 'adaptief vermogen' paper by Rob Geraedts in which he uses adaptability definitions by R.B, Richard (from his strategies to generate individualised buildings) and T., Schuetze (from his 'Designing Extended Lifecycles') and the definition in the report 'definition framework for building adaptation projects' by Sheida Shahi et. Al, (Sanchez & Haas, 2019; Sugden & Khirfan, 2017), (Bullen & Love, 2011; Conejos, Langston, & Smith, 2011; Langston et al., 2008; Larkham, 2002).

The definition of adaptability is as follows:
''Buildings with user-related transformation potential, that is easily adaptable to multiple functions and/or changing requirement, where the building components are based on the historic – obsolete and derelict lifespan of the building with a minimum effort and loss of quality. Adaptable systems are needed to meet the challenge of changing requirements, wishes or tastes and is a sustainable alternative to demolition. Adaptable buildings are open to change and offer freedom of choice for the first users and the subsequent users. It considers the new requirements, socio-cultural demands and environmental regulations as it seeks to maximize reuse and retention of the existing structure. This improves economic, environmental and the social performance of the building.''

Adaptability goes along with the need for change, which is linked to the buildings element's lifecycles. Adaptability with regards to the structure, skin, system and space is taken into account (Shahi *et al.*, 2020).

ADAPTIVE RE-USE

Re-use, on building scale, links to renewing the use of a dwelling from its original function. Adaptive re-use then refers to enabling (adapting) dwellings to suiting new existence, conditions and functions once it is no longer suitable for its original function (Bullen and Love, 2011; Velthuis and Spennemann, 2007).

RE-ADAPTIVE
The difference between adaptive re-use and re-adaptive is that adaptive re-use is more linear. The 're' in re-adaptive is an important key aspect. It's not about adapting alone, but rather going back and forth in adapting as well. Adaptive re-use changes A to B, and perhaps in the future to C. Re-adaptive is adaptability in a more circled way where A can change to B, but also to C and back to A. Re-adaptive however seems not to be defined in literature.

In short, the three terms can be defined as follow:

ADAPTIVITY: Building components are easily adaptable to other functions, changing requirements and therefore open to change and offering freedom.
ADAPTIVE RE-USE: Adapting dwelling to a *new* existence, conditions and/or function.
RE-ADAPTIVE: Adapting dwellings to new existence, conditions and/or functions, repeatedly and being able to return.

RE-ADAPTABILITY
Adaptability, the ability to adapt then becomes re-adaptability: the ability to adapt back and forth, repeatedly. Re- adaptability can be dived into two parts: re-adapt and the ability. Re-adapt refers to the architecture side of the research and the ability to the management side. The ability, of the re-adaptive factors, is the to-be defined overarching main theme throughout the research. Questions such as what this ability exactly is, what it needs, what it stimulates and what it hinders are research components.

In order to get to an answer to the main research questions, there are subquestions which are formulated below with a brief description.

SUB QUESTIONS

SQ 1: What are principles and definitions for re-adaptive building?
The aim of this research question is to understand the principles of 'adaptive' building and making a definition out of this. From this, a theoretical framework view can be used further into the research as it is then clear what the definitions and important principles are of the chosen theories, making it clear what to look for and find out in the case studies and interviews.

Metabolism is taken as an initial starting point and then is related back to the Dutch context by using its two very similar theories, Structuralism and Open Bouwen. For the theoretical framework, projects in both Japan and The Netherlands will be researched. These theories will be further researched on its origin, philosophy, materialization, rates of change (lifecycle elements) and concluded with a definition.

Example Metabolism, structuralism and Open Bouwen – Expo Tower, Centraal Beheer Gebouw and Molenvliet (sources: C. Zeballos, M. Sprangh and Coucil Open Bouwen)

SQ 2: How does these principles and definitions manifests itself in projects?
Precedents will be analysed through the theoretical framework from SQ 1. The aim of this is to get a better understanding of how theoretical ideas manifest itself into actual built projects. The case studies will not be reviewed and/or ranked in the sense of stating that one is more adaptive than the other. The case studies are as a background for the interviews and gaining understanding of different elements and their barriers and enablers. This case study part consists three parts: 1) metabolism case studies, 2) structuralism case studies

and 3) open building case studies. All case studies include a long list of 10 case studies. These are to function as an overview of practices of the theory. From this long list, 2-3 case studies are chosen for the short list. The short list case studies are studied in-depth.

SQ 3: What are the enablers and barriers?
Based on the case studies, the enablers and barriers will get in the picture. When studying the case studies, the question is what can be learned from them? What turned out to be elements that either strengthened or weakened the adaptability of the building?

The lessons drawn on enablers and barriers will be categorized per category of the life cycle elements: structure, skin, system and space. Research also will be done on interconnection between certain elements. Does one success element lead to another success element? Is there an 'either-or' situation?

Important factors, adapted from Eriksson & Westerberg 2011, can include: the cost, time, build quality, environmental impact, work environment, innovation (Eriksson and Westerberg, 2011). It can also include resilience, aesthetical, quality functionality, use and frequency use of changeable elements, state of decay, current use and public values.

SQ 4: With a focus on the short-listed case studies, what are specific conceptions from direct stakeholders to be taken into account with regards to the management and organisational aspects of re-adaptive housing?
After having analysed the case studies in terms of the theoretical framework and its enablers and barriers, it's interesting to interview some of the direct stakeholders of these projects as well. This will be done to gain extra and/or deeper understanding of the project, as well as validating the enablers and barriers as set in SQ 3.

SQ 5: What are critical notions to recommend with regards to the design phase, construction phase, operational phase, maintenance phase and dismantling phase?
Based on RQ 3 and 4, lessons can be learned and therefore recommendations can be formulated to enhance re-adaptive building for housing in the Netherlands. For this research question, first the role of a project management and their assignments with regards to organisational and management matters in each phase, needs to be made clear. Then this can be related back to the enablers, barriers and new gained other information from SQ 3 and 4.

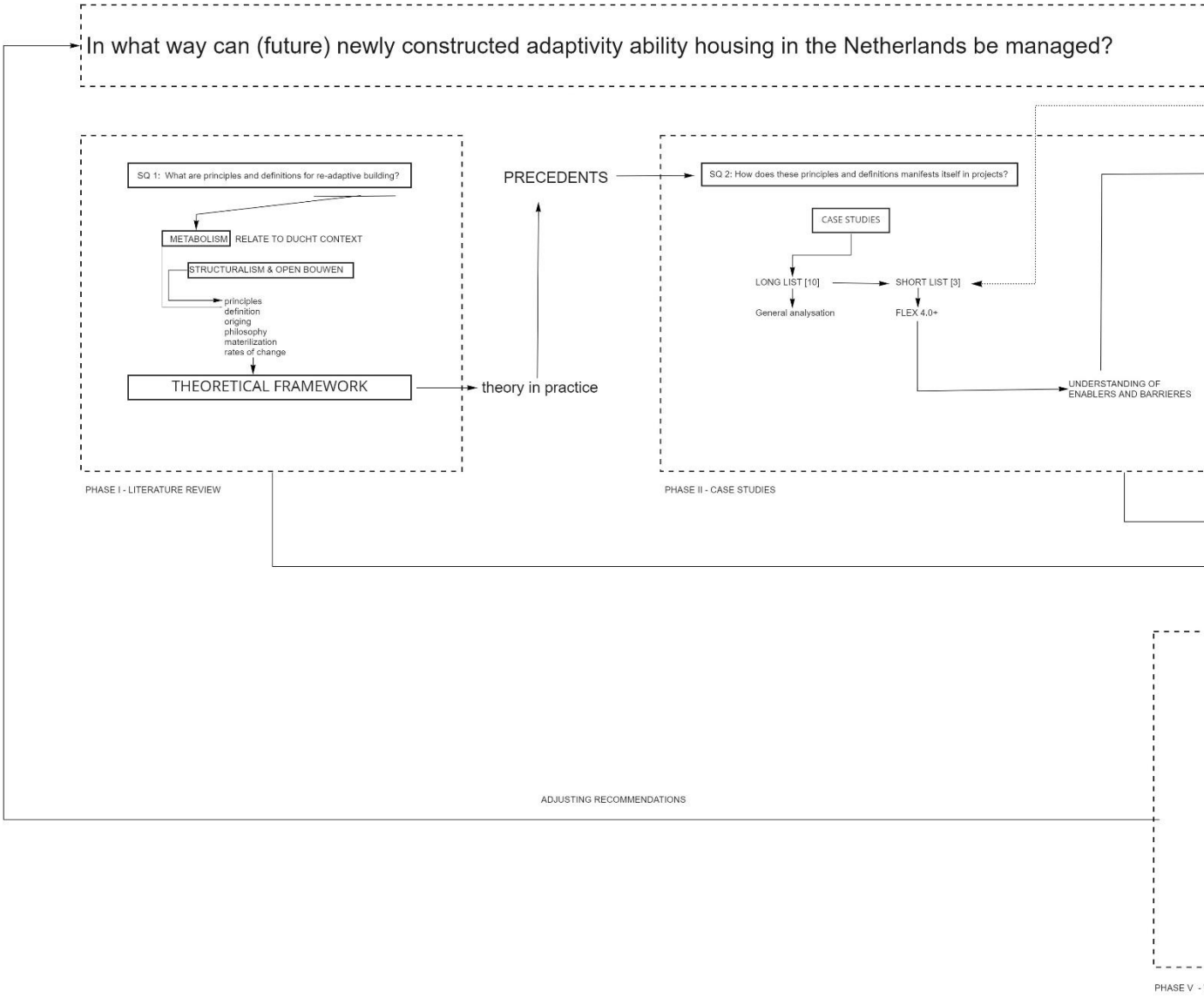
SQ 6: How do professionals reflect on these critical recommendations?
Before the final recommendations and proposal, and therefore answering the main question, they first will get through a critical backlight from professionals. This is done so the recommendations can be reflected, criticized, discussed and either left out or changed. By validating the outcome by professionals in the field of building development and management, the outcome is more practice-based and implementations are more clear. This results in the final recommendation.

2.2 RESEARCH FRAMEWORK

There are in essence four phases to this research. The phases are linked to each other and show the connection and reason between each. The structure of the thesis follows along with the phasing structure. This can be seen in figure 11.

The phases are: theoretical framework (literature study), case studies (empirical study) , interviews (new insight), recommendations and discussion (validation).

Phase I starts with literature review in order to understand the theories behind adaptive building. When creating this theoretical framework, case studies can be looked with this specific view on, which leads to the second phase. Phase II is to look at actual buildings build of the theories mentioned in phase I and how these work out in practice and therefore practical information is gained. Theory is being linked with the practice, and lessons can be learned from this. The short listed case studies are being further used in Phase III, where stakeholders of those case studies are being interviewed. This is done to gain even further understanding of the barriers and enablers of these projects. Recommendations are made based on enablers and barriers from the data of phases I,II and III. This is taken to phase IV, where these recommendations are being reflected on by a professional building management panel and improved, leading to answering the main research question.



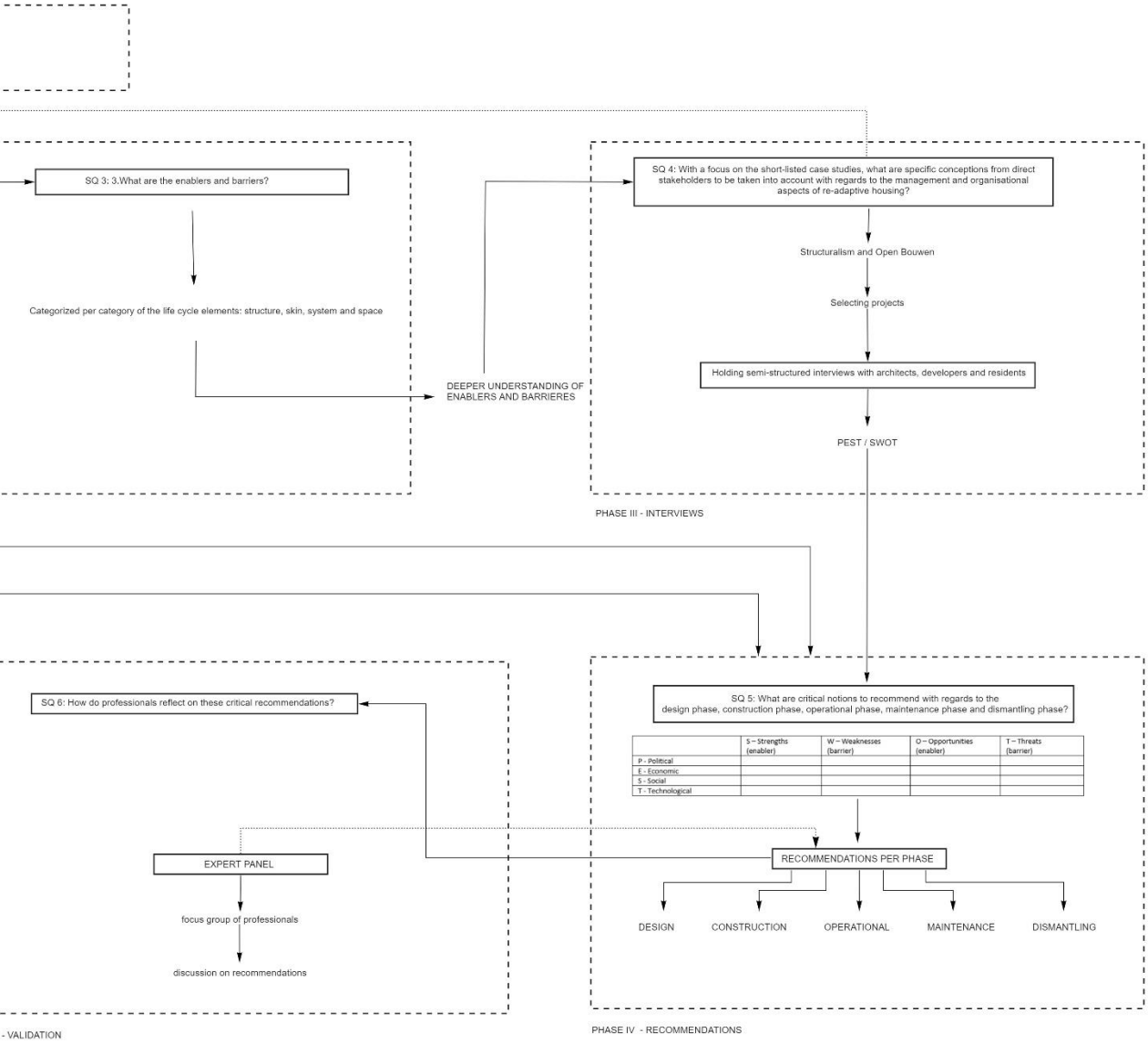


Figure 11: Research framework (Shajwan Jabar)

2.2.1 TYPES OF STUDY

INDUCTIVE

The research is inductive as it infers theoretical concepts (Metabolism, Structuralism, Open bouwen) and patterns (enablers, barriers) from observed data (theoretical framework, case studies, interviews, expert panel). The research should be logical, confirmable and repeatable in the same steps, leading to a same outcome. First the adaptive building theories gets observed, followed by collection of data leading to a new management proposal.

This thesis is both an exploratory in the sense of exploring the possibilities of adaptive housing, followed by explanatory research as in why it is feasible or not for the Dutch housing market.

EXPLORATORY

As metabolism, or re-adaptive, housing in the Netherlands has not been studied or very ill defined, this thesis tests its feasibility. It explores the first steps of this becoming a possible housing solution for the Dutch housing market. More extensive studies can be followed up.
The problem will be defined more precisely through the theoretical framework and case studies, additional insights will be gained through interviews. The end objective will be a management proposal with important notions to be taken during each stage, however priorities for further research through isolating key variables will also be established.

EXPLAINATORY

As this thesis also seeks to explain the phenomena of metabolism buildings and its reason why it stopped in the 1970's. It seeks to answer the 'why' and 'how': what where the issues? Why was this so? And how can these issues be minimized?'. By identifying the barriers and enablers, and their causal relationship the dots can be connected leading to an attempt of understanding the cause and effect relationship of metabolism housing. This will be done through case studies, surveys and semi-structured interviews.

QUALITATIVE RESEARCH

The case studies will lead into intensive knowledge about the small number of very well related projects. The case studies will show the process, how it was done and what the outcome has been leading to the barriers and enablers. The collection of information for these case studies, will be a range of data collection techniques such as literature review, interviews, archives and observations. The most important features will be a strong relationship (either overlap or inconsistencies) between the theoretical framework, making the assumptions explicit and forming the basis for the data collection.

2.2.2 RESEARCH SET UP PER PHASE

Table 1: Research overview

[WHAT]	Secondary research question	Literature data collection	Empirical data collection
THEORETICAL FRAMEWORK	SQ 1: What are principles and definitions for re-adaptive building?	Literature review	
PRECEDENTS State of art	SQ 2: How does these principles and definitions manifests itself in projects? SQ 3: 3.What are the enables and barriers?	Literature review	Case studies Long list and short list
CONCEPTIONS	SQ 4: With a focus on the short-listed case studies, what are specific conceptions from direct stakeholders to be taken into account with regards to the management and organisational aspects of re-adaptive housing?		Semi structured interviews: focus on Dutch short listed case studies Analysed with Atlas TI. software
IMPROVEMENT ASPECTS	SQ 5: What are critical notions to recommend with regards to the design phase, construction phase, operational phase, maintenance phase and dismantling phase?	Variety of scientific papers, columns, other master thesis's and journal articles for background or supporting information	Recommendations
PROPOSAL RECOMMENDATION MANAGEMENT PLAN	SQ 6: How do professionals reflect on these critical recommendations?	Variety of scientific papers, columns, other master thesis' and journal articles for background or supporting information	Expert consultation with professional panel.

PHASE I : LITERATURE REVIEW

In order to understand the case studies and to know what to look for, literature study is conducted.
The literature study is on Metabolism and its Dutch counterparts Structuralism and Open Bouwen. The theoretical framework will include each theory its origin, philosophy, definition, materialization, rates of change and concluding it with its definition. The definition will be based on multiple definitions.

The definitions between the theories are then being compared to understand in what they differ and in what they overlap.

Furthermore, the difference between western and east-Asian notion with regards to building (heritage) will also be included as theories from different cultures are being compared.

Note that metabolism has the principle of adaptivity and this also includes different approaches. The following elements will not be included further: Artificial land, ocean Cities, air cities and other urban development designs, so the focus is only on building scale. Also, the link between technology and humanity is discussed within metabolism. Although this is an important factor, especially in contemporary times, this also will not be taken into account to narrow the research down to specific building related elements. Lastly, Group Form, as mostly stated by Fumihiko Maki, will also not be taken into account because this relates more to expanding the building through making it a collective form of individual units rather than the flexibility and adaptability of it. This is similar to the aesthetics of numbers with Structuralism. For the same reason, this also will not be further researched.

As sustainability is fundamentally a very important part of the reasoning behind this research, the amount and influence of sustainable materials and installations will not be further mentioned and taken into account. It is just stated that by building adaptive buildings, the building will be more sustainable. Exact numbers, other

reasoning and influences will not be mentioned, as this research concerns itself with the management of adaptive elements. Input for the literature study is from scientific articles, books, journal article, conference papers, documentaries, columns, archives, educational and scientific search engines such as the TU Delft online library, TU Delft repository, and ResearchGate.

PHASE II : CASE STUDIES

After the first phase, empirical study is done in additional to the literature studies. This is done to get a better understanding of how Metabolism,Structuralism and Open Bouwen function in practice so that lessons can be drawn from this. The case studies are of great importance for the research as literature doesn't provide much information.

The following gathering tools will also be used during the case study research: documentation, archival records, direct observation and the physical artifact itself. In phase III, interviews will be held as an enlargement of the case studies. Interviews are also part of case study gathering tools (Yazan, 2015).

SELECTION CRITERIA

The selection for the case studies is based up on what literature defines as metabolism buildings (Project-Japan, Metabolism in Architecture and Metabolism in Architecture), structuralist buildings (Structuralism in Dutch Architecture and the Future of Structuralism), and Structure and Infill buildings (OpenBouwenCo and de Drager documentary).

From here on, a selection of 10 case studies is made based on the decarmination as stated in SQ1 and other general criteria: no urban planning, no city-planning, based on the amount of available information, not choosing projects that have strong similar principles that are being used in a successor or more notable project that is of larger scale and/or more well-known, not projects that are design only, preferably also housing, no functions that are too difficult to relate to housing (such as theatres), no transformation projects, top-ups do.

Specific Metabolism criteria: no group form, not choosing projects that have too strong of a relation to artificial ground or prefab rather than adaptive elements, no portable capsules.

Specific Structuralism: no sculptures, no projects that only focus on the aesthetics of numbers.

Open bouwen: For OpenBouwenCo sustainability is an important aspects as well. They define this as matters with regards to energy and resource use, use of biobased materials, using sustainable installations etc. This focus on sustainability will not be regarded as relevant for this thesis as the focus lies more on flexibility and adaptability to either grow or shrink. This does however, interlink with the different lifecycles of elements and materials. This division between different lifecycles will be taken into account.

From the 10 case studies, a short list is made of 2-3. This selection is based on the amount of information available/how much of a 'well known' example it is, whether it is still standing or got demolished, preferably functions as housing, to what extent it relates back to the definition of the theories and possibly its interconnection with the other theories. See the appendix for the exact break down of case studies chosen.

SELECTION

Table 2: Selected case studies

Listed	Metabolism	Structuralism	Open Bouwen
Short	**Nakagin Capsule Tower**	**Centraal Beheer Gebouw**	**PATCH 22**
	Sky House	**'t Karregat**	**Molenvliet**
	Yamanashi center	**Diagoon woningen**	**Solids**
Buffer – short	***Shizuoka center***	***De Drie Hoven***	***NEXT 21***
Long	House K	Cluster Zuid	Superlofts
	Nitto Food cannery	Orphanage	Het Schetsblok
	Odakyu drive-in	De Flint	CiWoCo
	Takara Beautillion	De Kasbah	Top Up
	Toshiba IHI pavillion	College Delft	New West
	Big roof expo	De Bastille U/t	Fenix 1

ANALYSATION
The ten long listed case studies will be analysed on:
Standard building information [building year / location / architects / layout]
How does this relate back to its fundamentals?
Do they still stand? Are they demolished (what is there now), transformed (into what), renovated (what parts) or kept the same? What is the reason for this?

For the short listed case studies the FLEX 4.0 will be used:
FLEX 4.0 is the result of several earlier versions of adaptive capacity assessment instruments and includes many flexibility key performance indicators. It is partly based on the support and infill theory of John Habraken. The instrument was developed through an extensive international literature surveys on adaptive capacity, sustainability and financial real estate business cases. Along with this, a substantial number of professionals on both demand and supply side were consulted, leading to the updated version of the flexibility assessment instrument, the FLEX 4.0 (Geraedts, 2016).

However, some changes have been made with regards to the original FLEX 4.0 (Geraedts, 2016) and the one used in this research. Some questions are taken out, rephrased, replaced. Questions related to overview, life cycles, separation between equipment space and architectural space, financing, process management, flexibility organisation and opportunities to shrink or grow have been added. See the appendix for FLEX 4.0+.

PHASE III: INTERVIEWS
Based on the short listed case studies, interviews are being conducted with the related stakeholder.

This will be done through interviews of direct stakeholders of the people involved with the case studies. For this, only the Dutch case studies will be used (Structuralism and Open Bouwen). This is because of relevance, since it is in the Dutch context and secondly it is more functional. It is expected that it would be quite difficult to do interviews with the Metabolism related case studies because these are 1) in Japan, 2) date back to 1970 and 3) most of the architects have passed away. The outcome of this research therefore is mostly related and applicable to the Netherlands. It could be applicable to other countries if these are relatable to the Netherlands in terms of housing culture, building strategies and policies.

SELECTION CRITERIA
For this sub-question, first there will be a selection made of the short listed case studies. This is because in terms of time, it's not possible to interview multiple stakeholders of all the (6-8) short listed case studies. Metabolism case studies will not be used for the interviews as it might be difficult to contact Japanese stakeholders. In stead, 1 case study for Structuralism and 1 case study for Open bouwen will be used for the interviews. Possibly, a third case study (of either) will also be used for the interviews if necessary.

Stakeholders are the actors that have a direct benefit or loss as a result of the project.Usually in a building development the following stakeholders are included in the process: the municipality, the initiator, the financer, the developer, the contractor, the architect, the construction engineer and other advisors. The stakeholders are categorised as internal (demand and supply) and external stakeholders (private and public) (Winch, 2010). See table below.

Table 3: Project stakeholders (Winch, 2010).

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

Most important stakeholders in this case are:
- The Developer (internal-demand) : reasons why they develop, financial aspects, principles etc.
-The architect (internal-supply) t: they have a strong influence and relevance towards the design. Usually also are a central point
- The residents (external-private) : the ones actually living in the building
- The municipality (external-public): with regards to zoning and their ideas for the city.

SELECTION

Interview choice for Open bouwen:

Solids already has a very in-depth reflection analysis, interviewing for this case study might be less beneficial. It is more beneficial to rather focus on other case studies. Patch22 is chosen, since this has the most up front contacting information and is newly built making it interesting to interview and gain information for an contemporary project.

Interview choice for Structuralism:

'T Karregat is a multifunctional commercial space, so it is not housing-related. Therefore, it will not be chosen for interviews. De Drie Hoven is largely destructed, is missing information about the developer and also is currently closed and empty with no residents living in there. This will not be chosen to interview as well.

Diagoon woning is missing some information on the developer, however residents live in it and it also has the same architect as Centraal Beheer Gebouw. Since the Centraal Beheer Gebouw is supposed to be transformed into living and working space, this is also interesting to be interviewed with regards to the developer. With regards to the CBG, only the developer needs to be interviewed because the architect is the same as the Diagoonwoning (this can be merged into one interview) and there are no residents living there yet. These two projects will be combined for the interviews for the Structuralism part.

Residents/users of the projects:

This is done through surveys in stead of the semi-structured interviews. This is because questions related to the residents are usually more directed and can also possibly be answered through multiple choice questions. Also, the number of residents are sustainably bigger than the number of other stakeholders per project. Therefore, in order to be able to validate certain aspects, the research needs more answers from this group simply because the group is bigger. In terms of time and availability, this is expected to be difficult leading the choice to be surveys with a possibility to follow-up with semi-structured interviews.

Table 4: contact information first selection interviewees

	PATCH 22	CBH	Diagoon
Architect	Tom Frantzen office@frantzen.nl / 020-3090355 Openbuilding.co or through Thijs Asselberg openbuildingco@gmail.com	Herman Hertzberger office@ahh.nl (+31) 020 676 58 88 *Also gives possibility to interview on De Drie Hoven	
Developer	Lemniskade Projecten BV info@lemniskade.nl +31203090350 Or through Tom Frantzen himself	Geen idee, navragen TNC had redevelopment plans, however sold to Certitudo Capital info@tcnpp.com +31 (0)30 230 92 30 Redevelopment: Certitudo Capital info@certitudo.com +31(0)73-76 00 200	N/D
Residents	Yes Johan van Hasseltkade 266, 1032 LP Amsterdam	No residents Adress: Prins Willem-Alexanderlaan 601 7311 NB Apeldoorn	Yes Gebbenlaan 32 2625 KB, Delft
Municipality	Amsterdam	Apeldoorn	Delft

However, if these stakeholders are not available or not willing to participate in the interview, there is a buffer list of other interviewees (from the short listed case studies), as shown below.

Table 5: contact information second selection interviewees

	Molenvliet	'T Karregat	Solids
Architect	Frans van der Werf frans@vdwerf.nl +31 6 53 15 65 53	Frank van Klingeren Passed away in 1999	Baumschlager Erlebe (Oostenrijk) office@be-wien.com +43 1 90 49 165 Tony Fretton STUDIO@tonyfretton.com +44 (0)20 7284 2000
Developer	N/D	Stichting Projectontwikkelingsbureau AMRO	Kristal Projectontwikkeling (020) 487 31 04 Stadgenoot 020 - 511 8000
Residents	Yes, however exact adress not clear.	No residents Adress: Urkhovenseweg 6, 5641 KE Eindhoven	IJburglaan 467 1087 BS Amsterdam Eerste Constantijn Huygensstraat in Amsterdam Oud-Wes
Municipality	Papendrecht	Eindhoven	Amsterdam

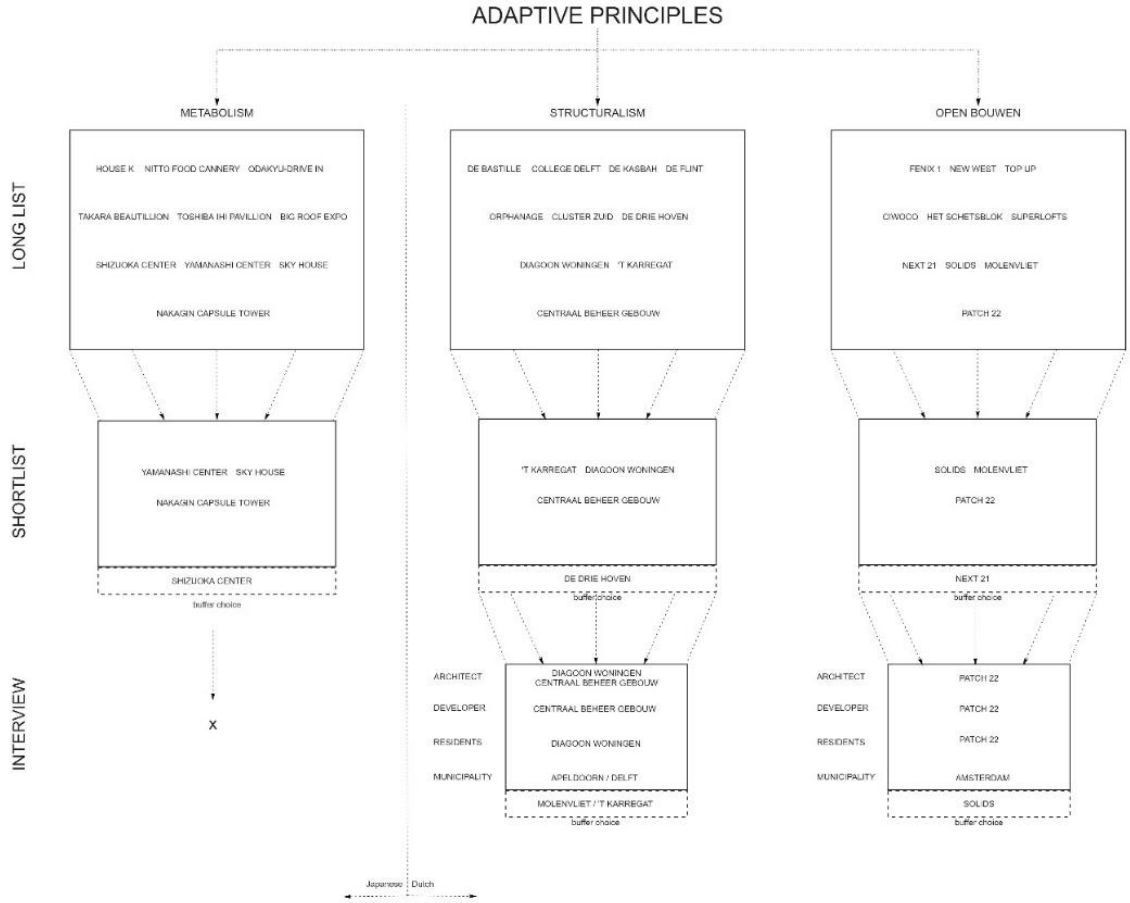


Figure 12: Structure long list – short list and interview case studies

INTERVIEW STRUCTURE

Semi-structured
As the main purpose of the interviews is to draw lessons from the projects, the interviews are semi-structured, allowing for flexibility in the interview and resemble more an in depth conversation than asking for structural statements. The questions will be arranged from least difficult or general to more detailed and more difficult. This helps with slowly building confidence with the interviewee (Jacobs and Furgerson, 2012).

Opening and closing
The interview will start with a script, with critical details about the study along with a reminder on the informed consent. This will also help to alleviate any concerns that the participant might have about confidentiality (Jacobs and Furgerson, 2012).

The interview also closes with the script, where the interviewee will be remembered about contacting information when there may be need to have clarification information and/or additional remarks. The ending script also helps with letting the interviewee know how the research will further proceed and what they can expect from it afterwards (Jacobs and Furgerson, 2012).

Structure questions
Although the interviews allow flexibility, there still is a structure with certain topics to it to provide guidance and make sure same topics are discussed per different stakeholder.

This structure is similar to SWOT in combination with PESTEL. PEST(EL) considered the context factors that can influence the project. SWOT interprets these factors and organize these as either strengths, weaknesses, opportunities and threats. The combination of the PEST and SWOT, provides the structure and brings together the different elements.

The interview is on the project's enablers and barriers
- Enablers (S-Strenghts and O-Opportunities)
- Barrieres (W- Weaknesses and T-Threats)

The questions in terms of enablers, barriers and thus lessons drawn are based on findings during the literature review and case studies. The used elements of the PESTEL:

P Political - Questions on how the municipality intervenes and has effects on the project (mostly related to developer and municipality).
E Economical – Questions on financial aspects such as payment and budgeting over time (mostly related to developer)
S Societal – Questions such as the societal side effects, social attitude towards this and residents profile (mostly related to residents)
T Technology – Questions on technology incentives, innovation and design related aspects (mostly related to architects)
(E Environmental – Questions on environmental policies and sustainability matters) (mostly related to architects)
(L Legal - Questions on laws, legislation and regulation) (mostly related to developers and municipality)

Environmental and the Legal aspect of the PESTEL will not be further used in this research. If it comes across, it's still welcomed to be mentioned however it is not a key element any more. Reasoning for this is because political and legal are closely related and therefore will just become political. Environmental will be taken out as this is a very big overarching theme on its own, and therefore is not feasible to be taken into account. Also, because it is earlier stated that sustainability will be mentioned as a result of re-adaptive housing, however not be discussed/researched itself any further.

Table 6: SWOT/PEST

	S - Strenghts	W - Weaknesses	O - Opportunities	T - Threats
P - Political				
E - Economic				
S - Social				
T - Technological				

See appendix for the semi-structured interview questions.
See appendix for the interview protocol and the interview summary lay-out.

During the literature research and case studies, the PEST can possibly be further developed with more additional factors.

DATA COLLECTION

After contacting the interviewees, a date, time and manner of interview (face to face or videocall) will be set. During the interview, when given permission of the interviewee, the conversation will be recorded for transcribing reasons. As soon as possible after the interviews are conducted, they will be transcribed, summarized and sent to the interviewee's for validation. Also, each interview will include a short remark chapter on the sphere of the interview and the impression of the interviewee. This will not be sent to the interviewee. In order to make it less of a burden for the interviewee to read the transcription and summarisation, mostly only very directed and precise questions will be asked. This does not mean however, that there is no room for explorative questions.

For the residents, this will mostly be done through surveys. Flyers will be made with a short explanation and QR code. These will be mailed to them. Also, some residents just will be visited and directly asked if they are willing to participate in a short interview. When possible, these interviews will be collected and analysed the same way as the interview of the architects, developers and/or municipality.

ANALYSATION

After remarking the most notable citations and useful informations, these will be summarized in order to see if there is a common or opposite theme. These returning themes will then be used in Atlas Ti.

The interviews will be put in Atlas Ti and will be examined in combination with the other data sources. This allows for a discovery of links between different elements and domains of a project. It might become difficult to find exact interconnection between the different projects and different actors with Atlas Ti. Therefore Atlas will be used to get a better understanding of the interview itself on its own. Although it's expected it would be very nihil, an attempt will be made to try to find whether the different interviews can be linked and show similarities and/or differences. Thirdly, the interviews it self will be summarized and manually analysed with the focus on the to-be-researched factors (barriers, enablers, risks, possibilities, limitations etc.). Findings will be filled in the SWOT/PEST table:

	S – Strengths (enabler)	W – Weaknesses (barrier)	O – Opportunities (enabler)	T – Threats (barrier)
P - Political				
E - Economic				
S - Social				
T - Technological				

Lessons per PEST theme will then be summed up and recurring patterns will be identified. Lessons learned from the literature review and case studies can be added to this table as well.

The surveys will be done through a digital automatic system called SurveyMonkey, that automatically collects and analyses the data.

PHASE IV: RECOMMENDATIONS

The insights and retrieved data from the literature study, empirical study and the interviews will be converted in recommendations in this phase. This is similar to steps 6 till 8 of mentioned above. This table will be further developed with also insights gained from the literature study and empirical study. Furthermore, these recommendations (barriers and enablers of PESTEL themes) then will also be divided per building phase: design phase, construction phase, operational phase, maintenance phase and a possible dismantling phase. Table 6, will reoccur five times per phase.

Framework specifically for management and organisational aspects is later to be determined.

This table functions as a starting point to be validated during the professional validation panel. The recommendations in the tables are stated as statements so that the panel can agree or disagree and give their reasoning.

PHASE V: VALIDATION

The research overview with the formulated solution directions will go through a critical 'second-round'. In this round, it will be presented as feedback to the interviewed parties and/or outside project managers. This can either take place in the form of individual interviews, or as a focus group where several of them are present at the same time and room. A focus group is preferred as this can create interesting conversations and they can hook on each other's comments. It is expected that this could be difficult because of busy schedules and possible new COVID-19 measures, a back-up plan are the individual interviews. In this way, an extra critical layer gets added to the notions and measures to be taken during each phase. After implementing the comments, the final proposal can be made and the main research question can be answered.

The recommendation tables from phase III are the starting point for the expert panel discussion. They can vote for or against, with stating their reasoning for it. Discussion is then very effective as there is a direct dialogue between the different stakeholders in a project, making the recommendations multi-layered.

SELECTION CRITERIA

The panel needs to include architects, developers and project managers. This diversity is needed in order to create a multi-perspective discussion on the recommendations.

SELECTION

To give space to the research process, the panel is not yet selected as it is based on steps in the research. During the interviews, panel participants will be asked as suggestion.

DATA COLLECTION AND ANALYSATION

There is a very high preference of having the discussion with the panel face to face in stead of videocall because discussing in a group on video call usually becomes difficult to follow and speak in practice. The preferred time and place is at the TU Delft BK, with a time frame two to max two and half hours. With 6 participants (two of each profession), this gives them more or less 20 minutes per person, and 4 minutes per person per buildingphase, speaking time.

During the discussion itself, each participant is also given a paper version of the statements and three cards: red (disagree), green (agree), yellow (neutral). This can be very quickly and easily be expressed and noted. Similar to the interviews, the discussion is recorded, transcribed, summarized and will be send to the participants. Furthermore, here also the transcription will be marked on interesting comments and outcomes. From this on, the recommendation of phase III will be adjusted and upgraded.

2.3 DATA PLAN

Data is obtained through literature study, empirical study, interviews and validations. Since the interviews and validation expert panel are based on stakeholders and professional's opinions and experiences, this information is sensitive and thus data protection and ethical considerations become extra important.

DATA PROTECTION

Based on Wilkison et al. (2016), the FAIR (Findable, Accessible, Interoperable and Reusable) Guiding principles are handled:

-Findable	Published on the Technical University of Delft educational repository link: https://repository.tudelft.nl Uniquely identified by student number 5229960 on the name Shajwan Jabar
-Accessible	Data can be accessed freely on the open TU Delft repository. If original data is missing or website is out of air, information requirements can be inquired by email to: shajwanjabar@hotmail.com
-Interoperable	All information, including interviews, survey outcomes and panel discussions will be translated into English. Preferably these data findings will be conducted in English at the start in order to prevent translation mistakes. Formal, accessible and broadly applicable language and vocabulary will be used All data references can be found at the end of the thesis in the reference chapter. Here every resource is cited in APA-style.
-Reusable	The data meets domain-relevant community standards. Particularities and/or limitations related to the data will be stated clearly. The date and place of the interviews, surveys and expert panel discussions will be stated. Whether it is raw or processed data will also be stated. The transcription (raw data) of the interviews, surveys and expert panel discussion will not be directly attached to the thesis. These can be retrieved upon request through email on shajwanjabar@hotmail.com. However, some (parts of) data might not be shared upon request of participants. Sensitive information will not be shared with third parties. Some information might be anonymized, blurred or (partly) left out in order to ensure confidentiality. This is upon request of the participants and will be stated when applicable.

2.4 RESEARCH OBJECTIVE

The research included understanding of the context through literature review, exploring potential enablers and barriers through case studies in the empirical study, additional information through interviews and validation through the professional panel.

The research objective is finding the barriers and enablers for re-adaptive housing, splitting in Metabolism, Structuralism and Open Bouwen and how these are interrelated, how the adaptive elements are related to each other and lasty how these can be managed. As stated in the introduction, the research aim was to draw lessons from adaptive building projects for newly to be constructed housing projects in the Netherlands. These drawn lessons are then proposed as recommendations for to be constructed projects. These recommendations are divided per building phase (design phase, construction phase, operational phase, maintenance phase and dismantling phase).

These recommendations offer a more streamlined proposal for building re-adaptive housing, ensuring more possibilities with regards to building these kinds of projects. Re-adaptive housing offer a solution for the housing shortage, match of household profile to spaces and sustainability requirements.

RESEARCH OUTPUT

The research deliverable will be a list of drawn lessons, to be taken into account when re-adaptive housing new construction will be build. The recommendation-list will include all include PEST elements, if applicable, and be per building phase.

2.5 RISKS AND ALTERNATIVES

The first risk that there is not sufficient enough information about the selected case studies. This is prevented by beforehand having the case studies also selected on the amount of information available. May there still be not enough information, then another case study from the list can be chosen. If all case studies end up being too difficult to fully analyse, then the analysation criteria's will have to be adapted. The flex 4.0+ is very extensive, therefore leaving out parts will not result in having a too superficial analysation.

The second risk that may occur is that the interviewee's are not willing to participate. This is also prevented by having multiple options and a 'buffer-list' of possible interviewee's. If all stakeholders of the short listed case studies do not want to participate, then stakeholders from a project from the long-listed case study will be contacted. Once they agree to participate, this project will be turned into a short-listed case study i.e. more extensively researched and then interviewed about. If it turns out, that no stakeholders from the whole list (short listed and long listed) does not want to participate, then extern professionals in the same field will be interviewed. The questions that relate directly to the case studies then will have to be changed into more discussion-like and opinion based questions.

The third risk is having not enough participants for the professional panel. To prevent this, the search for a panel will happen as soon as possible. When having a internship, employees from this company can be used. If this is not possible either, then faculty teachers at the TU Delft can be contacted.

2.6 TIME PLANNING

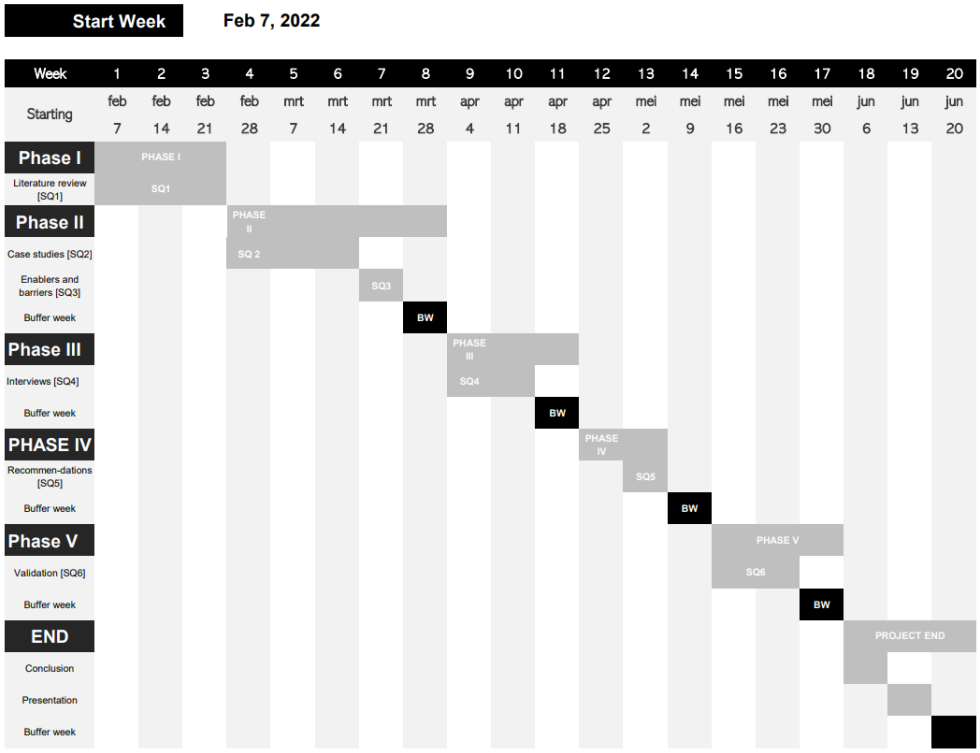


Figure 13: time planning

P1 [October 2021]
During the P1 phase the preliminary research proposal has been prepared and presented on 22-10-2021 with a positive review, followed by the P2 phase.

P2 [January 2022]
The research proposal has been further elaborated during this phase, which is now this report and will be presented on 28-01-2022 during the P2 presentations.

P3 [February 2022]
In this phase, the actual research as being proposed in the P2 will begin. The P3 concerns itself with the research on literature review, the case studies and the semi-structured interviews. This will begin from 7th February 2022 to 18th April.

P4 [April 2022]
The P4 phase is the analyzation of the P3 phase. The research findings and research objectives will be given to a number of bodies that were interviewed during the p3 phase in this phase, leading to expert panel, the final conclusions and recommendations that will be written at the end. This phase starts 25th April to 30th may.

P5 [June 2022]
Last comments on the P4 will be implemented into the final version of the thesis, which will be presented in June 2022.

Table 7: activities per product

Product	Activities
PHASE 0 P2 plan	Problem description and statement Research aim and its relevance Research methodology including research questions
PHASE I Literature framework [SQ1]	Scope Collect literature and other information Defining re-adaptive Defining metabolism, structuralism and open bouwen Theory principles, origin, materialization, rates of change Compare theories Understanding the theoretical framework, for looking into the case studies
PHASE II Case studies [SQ2] Enablers and barriers [SQ3]	Collect case studies Select long list case studies Select short list case studies Find documentation, archival records and hold direct observations Analyse long listed case studies generally through Analyse short listed case studies according flex 4.0+ Form enablers and barriers Management and organisational framework Try to fill in SWOT/PEST
PHASE III Interviews [SQ4]	Select case studies from short listed Select interviewee's Find contact information and contact interviewee's Set date Adjust interview questions and protocol Send interview questions and protocol beforehand Adjust questions if needed Hold interview, record Transcribe interviews Make short remark of sphere of interview Summarize interviews and remark useful information Send summary and transcription to interviewee's Analyse interviews with Atlas Ti Fill in SWOT/PEST Sum up the lessons learned per PESTEL theme, identify recurring patterns and state the amount of times a certain enabler/barrier is mentioned and by who. Lessons learned derive from this, along with the case studies and literature review.
PHASE IV Recommendations [SQ5]	Make recommendations based on literature review, case studies and interview insights. Develop SWOT/PEST table further. Make this table per phase: design, construction, operational, maintenance and dismantling.
Phase V [SQ6] Validation	Select professional panel Make and send invitations, set date and place Hold professional panel Transcribe discussion Summarize discussion Send summary and transcription to participants Analyse discussions with Atlas Ti Make recommendations per phase

2.7 PERSONAL MOTIVATION AND STUDY TARGETS

This research started from an own personal interest in metabolism, which was then later linked to current problems as it seemed a good fit. Not only is metabolism in specific the personal interest, but very much also how architecture and management are linked to each other. Although the master is the same and results in the same diploma, the track differ from each other and are rarely -if never- really linked back to each other.

When doing research on adaptive housing, mostly was related to architectural design matters. How this could be managed and organised, was nihilistically found. This results in higher motivation for the research as curiosity becomes bigger.

My personal study target is mostly that I keep enjoying the research. Even though it is mandatory, I want to feel like I'm researching because I want to do so. This is what I also mostly kept in mind during setting up my P2, I tried to add research elements that I'd personally enjoy and make them cohesive in the end. I purposely have multiple types of study (literature, case studies, interviews, expert panel) so that I have a variety of types of research strategies where I can learn from. Most of it is also new for me, so I'm aware of trial and error. My target in the end is learning about re-adaptive housing, from both its architectural and management side. Furthermore, I especially hope to get a better picture of management as a whole, where there are links between architecture and management and how this develops throughout the building process.

2.8 REFLECTION

Although the main idea of the research (re-adaptive housing) has stayed more or less the same during the P1 and P2, the research methods and outlines have been constantly changing. It started off with just literature studies and some case studies. Comparing and relating a Japanese concept to the Netherlands, became a problem as these are two different contexts. Therefore, a similar Dutch principle needed to be included. The problem then became, that there is not one principle that completely overlaps Metabolism. This lead to using two principles – Structuralism and Open Bouwen. Using just case studies for recommendation also wasn't enough as there could be still a lot of information missing, making interviews very interesting. After then formulating recommendations, it was clear that these need to be validated as well – resulting into a validation with expert panel phase. The research has been evolving itself throughout P1 and P2 with more steps.

The RM2 course that has been given along with the P1 and P2 has been very helpful with understanding the research outline, the interlink, how to set up an interview and being an introduction to Atlas Ti. Almost everything I have learned during the RM

2, I have used in this research.

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Appendix

1. CASE STUDIES

1.1 METABOLISM

CASE STUDY LIST METABOLISM				
Project	Year	Function	Characteristics	Current status
Nakagin Capsule Tower **Kisho Kurokawa** **Tokyo**	1972	Housing	Two cores with plugged-in capsules. 30% bought by companies for overlays of its employees, 30% families who use this as an extension to their own house eg study room etc. , 20% bachelors and the other 20% miscellaneous. Capsules individually and independently cantilevered to shaft, so removing should could be done without disturbing the other capsules.	About to be demolished
Sky House **Move-net for Sky House** **Kikutake**	1958 1962	Housing	Hanging moving-nets under house to add more space and detach them when it's no longer needed	Still standing, housing(ArchEyes, 2020)
Yamanashi Press and Broadcasting Center **Tange**	1964	Broadcasting center	Communication shafts (joint cores). These cores provide future growth, which happens in 1974.	In 2013 renovated In 2016 additional measures for earthquake resistance(SOSburtalism, n/d)
Capsule Summer House K Kiso Kurokawa	1972	Housing	Four capsules with standardized dimensions, same as nakagin capsule tower. Intention to change the configuration of the capsules over time.	Still standing, mainly because the designer, owner and landowner were all the same person, there is no development around the site and the small scale of the building.
Nitto Food Cannery Kurokawa	1963	Restaurant	Single unit. Plan was for more. Interesting structure. Eight squares where the corner trusses have extruding steel flaps, so they are ready to plug in a new square/module whenever it is wished.	?
Odakyu Drive-in Kurokawa	1969	Roadstyle diner	First Metabolist building with changeable elements. Combining space frame and capsules. Structural space frame with the use of prefab extension joints.	?
Shizuoka Press and Broadcasting Center Tange	1967	Broadcasting center	Single core with office spaces attached to the cure.	Still standing Newspaper publisher(Merin, 2013)
Takara Beautillion Expo 70 Kurokawa	1970	Expo	Cubic structural frame made out of curved crosses, where capsules can be plugged in. Future growth is facilitated with extrusions, as if it is caught in the process. Similar to Odakyu drive in.	Dismantled after expo
Toshiba IHI Pavilion Expo 70 Kurokawa	1970	Expo	Interesting principle, although it is very conceptual. Structural space framework consist tetrahedral units, foreseeing expansion and erasure. Able to make unlimited amount of new forms because of the possibility of growth in fourteen directions.	Dismantled after expo
Big roof expo '70 Mid-air (Awazu) Golgi-structure (Maki) Capsule (Kurokawa)	1970	Expo	Extremely large frame of 292 meters long and 30 meters high, making huge plaza underneath with hanged elements -Egg like capsule of glass -Framework with installed capsules -Residential capsules	Dismantled after expo

PROJECT	SHORTLISTED	REASON
Nakagin Capsule Tower	Yes	Shows the plug-in capsules best, very 'typical' example, media coverage, a lot of information, about to be demolished, shows a lot of things that went wrong
Sky House	Yes	Shows continuous growth, still standing, smaller scale, dwelling scale
Yamanashi center	Yes	Shows growth over years, still standing. A good overlap between structuralism and metabolism as this building is also discussed in literature as a structuralist building.
Shizuoka center	Yes (Buffer)	.. still doubting to add this one too because has similar elements such as the shizuoka center,tonogaya apartments, sony tower, big box and koito building.
House K	No	Is like a 'smaller' version of nakagin tower.

Nitto Food cannery	No	Interesting structure, therefore worth the mention. However not enough information to be found about it and it concerns a restaurant typology.
Odakyu drive-in	No	Interesting structure, therefore worth the mention. However not enough information to be found about it and it concerns a restaurant typology.
Takara Beautillion	No	Was part of the Expo '70 – more a prototype and conceptual.
Toshiba IHI pavillion	No	Was part of the Expo '70 – more a prototype and conceptual.
Big roof expo	No	Was part of the Expo '70 – more a prototype and conceptual.

CASE STUDY LIST METABOLISM – NOT FURTHER USED IN RESEARCH			
Project	Year	Function	Characteristics and why not explanations why not taken into account for research
Box-type apartments Kurokawa	1962	Housing	Four types of capsules in framework and residents can configurate this according to their needs and wishes. Design only and similair idea in Nakagin Capsule Tower, which is already being used.
Pumpkin house Ekuan	1964	Housing	Capsules swivel around core. Not much in-depth information. Design only.
Tortoise house	1967	Housing	Not much in-depth information. Interesting framework however. Repeatable orthogonal units, creating the space frame that facilitates future growth. This similar principle can be seen in the Nitto Food Cannery and the Odakyu drive-in, which are already being used.
Device Plaza icw Main Gate expo '70 Ekuan	1969	Plaza	Relates more to artificial ground and prefab, rather than really re-adaptability and. Maybe, re-adaptive in a sense that it can be placed over any growing city, similar to structuralism.
Phone booth Ekuan	1953	Phone booth NTT	Just one capsule on its own.
Tonogaya Apartmens Kikutake	1956	Housing	Shoe boxes outside of each window are the prototypes of the capsules used in the move-net, which is already being used.
Plastic Ski Lodge	1962	Housing	Portable capsule – not much related to this research
Yadokari Hermit Crab Capsule Ekuan	1969	Housing	Portable capsule - not much related to this research
Moving Capsule Kurokawa	1970	Housing	Portable capsule - not much related to this research
Mushroom house (K Residence) Kisho Kurokawa Central lodge	1960 1967	Housing	First (and only) build mushroom house. Interesting form of the building – sprout from the ground, views focused towards to ground. Not much related to re-adaptivity and/or flexibility.
World Health Organization	1960	WHO headquarter	A-frame with creating levels of artificial ground. Interior plaza to enforce communication both visually and mentally Related to city – creation artificial ground, not re-adaptability. Also design only.
Kodomo-no-kuni Kikutake	1967	Summer school	Related to creating and building on artificial ground with creating diamond-shaped buildings. Similarity with structuralism, however no mention of flexibility / re-adaptability.
Main gate expo '70 Otaka	1970	Elevated plaza	Artificial ground connecting south and main expo site.
Sony Tower Kurokawa	1976	Showroom and offices	Pipes, elevators and the stairs can be seen in the exterior of the building. Capsules function as the conventional office and showroom space. Same capsules used as in Nakagin Capsule Tower. In 2006 building is demolished. Similar principles as the broadcasting centers, which are being used.
Marunouchi Project Isozaki	1963	Housing	Structure hovering over existing buildings. New structure is tetrahedrons stacked. Design only.
Um Al-Kanhazeer Kurokawa	1975	Conference hall, hotel, casino, sports, shopping	Build-up method with attached units (capsules) for the bath units. Attached from outside. Design only.
Big Box Seibu Kurokawa	1974	Multi Shopping, restaurant, bowling, sauna, sports etc.	Black box with capsules attached. Capsules hold functions of stairways, toilets and piping. Wall structure with no columns, free interior alterations possible. Similar to the Yamanashi and Shizuoka Press and Broadcasting centers, which are being used in stead.
Koito Building Kurokawa	1974	Office	Capsules are used here for an office building. The capsules for the bath units and air-conditioning units were prepared at a factory and attached to the building. Similar to the Yamanashi and Shizuoka Press and Broadcasting centers, which are being used in stead.
Expo Tower Kurokawa	1970	Expo	Denuded realization of the Tower-shaped community designs from 1958. Core is a space frame with capsules being attached to it. Similar to his work at Big roof expo 70.

As this research focuses on the building-level and not city planning/urban planning, naturally the following cases will not be taken into account as well: Linear City (Kurokawa), Wall City (Kurokawa), Argricultural City (Kurokawa), Sakaide Artificial Ground (Otaka), Stratiform

Structure Module (Kikutake), Yamagata Hawaii Dreamland (Kurokawa), Mina (Muna) Pilgrim City (Tange and Ekuan), Marine City (Kikutake), Ocean City (Kikutake), Disaster Prevention City (Kikutake), Floating City Kasumigaura (Kurokawa), Shallow Sea-Type Community (Kikutake), Marine City (Kikutake), Ocean City (Kikutake), Floating Factory Metabonat (Kurokawa), Marine City Hawaii (Kikutake)l, Aquapolis Okinwa Ocean Expo 75 (Kikutake), KIC (Kikutake), IT Aquapolis (Kikutake), Capsule Village (Kurokawa), Office buildings city mega structure (Tange and Isozaki), City in the Air Sinjuku (Isozaki), Ikebukuro plan (Kikutake), Tjsukiji Plan (Tange), Helix City (Kurokawa), Tetra Project (Kikutake), Clusters in the Air (Isozaki), Dwelling City (Ekuan), Tree-shaped community (Kikutake), Golgi-structure (Maki), Tower shaped community (Kikutake)
Furthermore, group form was also a part of metabolism. These buildings are also not included: Shinjuku Project (Maki and Otaka), K-Project (Maki) and Hillside Terrace (Maki).

1.2 STRUCTURALISM

CASE STUDIES STRUCTURALISM				
Project	Year	Function	Characteristics	Current status
Centraal Beheer Gebouw 116 Herman Hertzberger Amsterdam (Heuvel, 1992)	1972	Office	Concrete Geometric floorplan. multiplied and repetitive structure Spreading structure Open structure inside 'City-like'/labyrinth	Decaying Waiting for re-use (Van den Bergen, 2007; Giele, 2021; architectuur.org, n/d)
'T Karregat 134 Frank van Klingeren Eindhoven (Heuvel, 1992)	1973	Multi-use Supermarket, primary schools, sports hall, small shops and community centre.	Large structural steel, continuous roof with free spaces (no partitioning walls) underneath, leaving it up to the users.(Archdaily, 2016)	Multi-use cultural center School / day-care centre / community facilities Renovated(Niesten, 1973; Archdaily, 2016)
Diagoon woningen 112 Herman Hertzberger Delft (Heuvel, 1992)	1971	Housing	Structural framework with slit levels around vide and two fixed cores, giving the inhabitant freedom of individual spatial design (Knudsen, 2015) Example of structure and infill (drager en inbouw)(Von der Nahmer, 2019)	Housing(Knudsen, 2015; Von der Nahmer, 2019)
De drie Hoven 144 Herman Hertzberger Amsterdam (Heuvel, 1992)	1974	Housing for elderly who are physically and mentally challenged	Geometric floorplan. multiplied and repetitive structure Open structure inside 'City-like'/labyrinth (Polygoonjournaal, 1975; Hidden Architecture, 2016; housing our mature elders, 2018)	2 of the 3 towers demolished Some units have been combined to make a larger apartment. (housing our mature elders, 2018; Iersel, 2018)
Cluster Zuid / Faculteit of Arts 190 Joop van Stijgt Leiden (Heuvel, 1992)	1982	University	Structuralist dimensioning Clear grid of mushroom-shaped concrete columns Concrete (De Zwarte Hond, no date)	University Renovated by Zwarte Hond (start 2021)(De Zwarte Hond, no date)
Orphanage Aldo van Eyck Amsterdam (Heuvel, 1992)	1960	Orphanage	Concrete Geometric -orthogonal grid- floorplan. multiplied and repetitive structure Open structure inside 'City-like'/labyrinth The 'first' structuralist building Breaking down hierarchy of spaces Spreading structure (Fracalossi, 2019; Haan, n/d; WikiArquitectura, n/d)	Office Partly exhibition/museum Three specifically children's designed spaces were kept in memory of. National monument(Iersel, 2018; Van der Vliet, 2018; Haan, n/d; WikiArquitectura, n/d)
De Flint 166 Onno Greiner Amesfoort (Heuvel, 1992)	1977	Theatre	Geometric floorplan. multiplied and repetitive structure(Prins *et al.*, 2016)	Theatre(Flint, n/d) Partly burnt down, new addition (1994)(Prins *et al.*, 2016; GGH, n/d)
De Kasbah 126 Piet Blom Amesfoort	1973	Housing	Building density is 4 times higher than an usual neighbourhood(Bussink, 2021)	Housing(Bussink, 2021) Gemeentelijk

(Heuvel, 1992)				monument (architectuur.org, 2013)
College Delft Hendriks, Campman and Tennekes (Heuvel, 1992)	1977	College	Cross shaped building. Cruciform connected in a way so that each of them is a module removed from another. Moveable walls making it flexible.	?
De Bastille University of Twente Piet Blom	1969	Center campus	Basic structure that should be easily extendable in the future. Building able to be build in different phases.	Renovation by Mei Architects in 2004, now restaurant and offices.(Mei architects and planners, n/d)

PROJECT	SHORTLISTED	REASON
Centraal Beheer Gebouw	Yes	Shows structuralism in a very 'typical' way. Very well known and document example.
't Karregat	Yes	Interlink between structuralism and metabolism (Odakyu Drive-in / Big roof expo)
Diagoon woningen	Yes	Interlink between structuralism and open bouwen
De Drie Hoven	Yes (Buffer)	Both aesthetics of numbers and flexibility within building in terms of combining units. Also, two towers were demolished: so interesting: why?
Cluster Zuid	No	Less relevant because of function, less focus on adaptability
Orphanage	No	Although first structuralist building with structuralist characteristics, spaces and sizes are very specifically designed – lacks flexibility component.
De Flint	No	Less relevant because of function, big theatre space. Also, more aesthetics of number, not so much including the flexibility in terms of walls etc.
De Kasbah	No	Very structuralist building in sense of 'aesthetics of number', less focus on flexibility within the housing building itself.
College Delft	No	Less relevant because of function and scale.
De Bastille U/t	No	Less relevant because of function, no mention perse of flexibility of space and rooms.

CASE STUDY LIST STRUCTURALISM – NOT FURTHER USED IN RESEARCH		
Project	Function	Characteristics and why not explanations why not taken into account for research
Prix de Rome / Joop van Stigt / 1962	Children's village	Only design
Chapel for 'Kerk en de Wereld' / Aldo van Eyck /1964	Chapel	Only design
Town Hall / Herman Hertzberger / 1966 Town Hall / Herman Hertzberger with Leo Heijdenrijk, Gert Boon and Jan Verhoeven / 1968 Town Hall / Leo van Heijdenrijk / 1977	Town hall Valkenswaard Town Hall Amsterdam Town Hall Lelystad	Only design Only design Only design
Church-building / Leo Heijdenrijk / 1968	Church - building	Only design
Student restaurant / Piet Blom / 1964	Temporary student restaurant for U/T	Converted farmhouse
Staff canteen / Joop van Stigt / 1964	Staff canteen for U/T	Similar use of repetitive grid and material use with other projects that are of larger scale, to housing-related and/or more well-known.
Sculpture pavilion / Aldo van Eyck / 1966	Sculpture pavilion for Sonsbeek	Sculpture
The Zilveren Schor / Onno Greiner / 1967	Meeting centre for Dutch youth	Similar use of repetitive grid and material use with other projects that are of larger scale, to housing-related and/or more well-known.
Temporary Town hall / Joop van Stigt / 1968	Temporary Town hall	Similar use of repetitive grid and material use with other projects that are of larger scale, to housing-related and/or more well-known.
Applied Mathematics and Computing Centre / Leo van Heijdenrijk and Jos Mol / 1973	Education - Applied Mathematics and Computing Centre for U/T	Maintaining landscape character was a key factor. Structuralism comes in as using 'building blocks' by building in different phases with it, making it into an extensions phase by phase.
Social services and Dwellings / Abe Bonnema / 1975	Offices	Prefab concrete skeleton and standardization – not enough to be considered
Library / Wim Davidse / 1976	Library	Very similar to Central Beheer gebouw in terms of spatial, voids and material use for skeleton CBH is on a larger scale
Huburtushuis / Aldo van Eyck / 1978	Centre for single parents in need of temporary shelter	Concrete skeleton is strongly manipulated and subordinate to spatial wishes
Muziekcentrum / Herman Hertzberger / 1979	Music centre	Difficult to relate to housing because of very different function (big music hall)
PEN offices / Abe Bonnema / 1982	Offices	Six buildings linked by bridges with prefab construction and repetitive grid.. ? Just not enough
Amsterdam Academic Medical Centre / Duintjer, Kramer and Van Willegen with D. van Mourik / 1983	Teaching hospital	Phasing design, making parts of the building simple and continuable altered able when in use and possible to extent in

		future. Not a textbook example. Function to unrelatable to housing.
Minestry of Education and Science / Flip Rosdorff / 1984	Offices	Repetitive blocks. Octogonal towers. Concrete structure. No mention of flexibility or growth.
Estec / Aldo and Hannie van Eyck / 1989	Service building and offices of Estec	Towers linked with others buildings that have irregular floor plans. Partly also steel structure with different measures, depending on load.
Ministry of Social Affairs and Employment / Herman Hertzberger / 1990	Offices	Ministry building – difficult to obtain certain information
Kubus Woningen / Piet Blom / 1984	Housing	Similair to Kasbah, but just a lot more difficulty in terms of shape (making it less flexible).
Willibrordus Church / Afrikahuis Joop van Stigt / 1968	Multifunctional Church/pastorate/housing for personnel/garden halls	Strong geometric floorplan of five linked octagons, concrete(Stigt et al., 2014). It's a very simplified version of other cases.
Pastor van Ars Church / Aldo van Eyck / 1963	Church	

1.3 OPEN BOUWEN

CASE STUDIES OPEN BOUWEN				
Project info	Year	Function	Characteristics	Current status
PATCH 22 Frantzen et al. Amsterdam (Hannema, 2016; Frantzen et al, 2017; Open Building Co, 2020)	2016	Housing Office Parking	Hollow floors and removable top floor Lack of shafts in the apartments Having the piping and cabling taken horizontally to central shaft in core Agreements for a fixed ground lease Flexible positioning of functions within building Devision walls between dwellings can be easily removed or added making dividing or merging dwellings possible Gross heights of 4m Escape routing regulations for both housing and offices applied New kind of land-lease contract with Amsterdam, in terms of future alternative use	Housing
Molenvliet Rotterdam Frans van der Werf (van Hoogstraten, 2011; Council on open building, 2021a)	1977	Housing	First experiment of the theory Drager (hoofdstructuur), met fictieve plattegronden en fictieve huizen Structural framework if uniform cast-in place concrete. Co-creation with future residents and architect for spatial floor plans and infill. Resulting in different façade composition per dwelling	Housing
Solids 1&2 Ijburg / Amsterdam Baumschlager Eberle Solids 11 Oud West / Amsterdam Tony Fretton (Vastgoed journaal, 2009; ArchDaily, 2012; Mensink, 2013; NUL20, 2013)	2011	Mixed use, including housing	Structural framework (structure) with infill Without predetermined destination Renters are free to use space as they wish Expected lifecycle is 200 years However expectations didn't come true, and might be regarded as a 'failure'. Very well evaluated. Habraken also calls this a example of Open Bouwen	Mixed use, including housing
NEXT 21 Yositika UTIDA, Shu-Koh-Sha Architectural and Urban Design Studio Osaka, Japan (Zuidema, 2015; Kendall, 2016; Council on open building, 2021b)	1993	Housing	Systemized construction Variety of units, designed by 13 different architects Freely designed within set of rules for positioning elements Utility distribution is under raised floors and above ceiling Natural greenery with wildlife habitat Sustainability: treating waste and drainage on site, minimizing compound burden of building, energy efficient, Structural framework, façade, interior and mechanical systems are independent of each other with each an own life cycle. large-scale renovations have been carried out, such us dividing one unit into two. Every seven years a new phase starts – with new users and approaches to developments	Housing
SuperLofts Marc Koehler Architects 2019 / 2022 / 2017 / 2022 /	Delft, Utrecht, Almere,	Housing	Flexible and open framework that can be adapted to changing use cycles. Prefabricated modular concrete framework (support) is one unit,	Housing

2016 / 2021 (Open Building Co, 2020)	Amsterdam (rent), Amsterdam (buy) and Groningen		with different units stacked to create larger framework. Building system (infill) can be updated in independent cycles: support structure used endlessly, facades updated every 25 years, HVAC systems every 10 years and interior every 5 years. Gradual investments for buyers who can grow into their space Sustainability: systems can be reused or recycled independently, smart façade integrated energy saving.	
Het Schetsblok ANA Architects Amsterdam (Open Building Co, 2020)	2017	Housing Parking Storage boxes	Inhabitants were integrated in design decision making with also separate tenders for infill Customized and adaptable dwellings Structure can adapt over time Flexibility offered – but requires extensive work (re-installment installations and insulation) Splitting or adding number of dwellings is possible through renewed deed of division. Short façade element life cycle because of anticipated adaptation	Housing
CiWoCo GAAGA Architects Amsterdam (Open Building Co, 2020)	2018	Housing Offices	Flex zones in apartments, which are up to the inhabitants what they do with it Light, non-load bearing inner and dwelling-separating walls used. Making it easy to combine dwellings and/or rooms. Installations not poured into the structural framework, but in the lowered ceilings and retaining walls.	Housing Offices
TOP UP Frantz et. Al Amsterdam (Open Building Co, 2020)	2019	Housing	Building materials can be re-used Function of building can change. Individual lofts can be combined to make larger appartments. Loft keep their apartmentrights and can later be split off. Spaces in dwellings have freedom of layout.	Housing
NEW WEST Olaf Gipser (Open Building Co, 2020)	2020	Housing Commercial Parking	Social cohesion Open building principles of infill and structure Half of units are generic double heigh casco Two/thirds have custom designed layouts with co-creation with the future residents One third is rental	same
Fenix 1 Mei Architects & Planners Rotterdam(Helleman, 2019; Open Building Co, 2020; Mei architects and planners, 2021)	2019	Housing, Offices Commercial hotel Theater Sports Parking	Steel table construction frame for new conctrete construction placed over existing loods from 1992 With co-creating with buyers in terms of size and sometimes with the use of a vide one dwelling is over two building layers. The minimum loft is 40 m2 of living space and 11 meters of balcony. This loft can be enlarged with extra m2, whereby the increase is by leaps and bounds of 20 m2 of living space and a spacious 5 m2 balcony. Lots of media coverage and many awards	same

PROJECT	SHORTLISTED	REASON
PATCH 22	Yes	
Molenvliet	Yes	
Solids	Yes	
NEXT 21	Yes (Buffer)	
Superlofts	No	
Het Schetsblok	No	
CiWoCo	No	
Top Up	No	
New West	No	
Fenix 1	No	

CASE STUDY LIST OPEN BOUWEN – NOT FURTHER USED IN RESEARCH		
Name / architect / year	Function	Characteristics and why not used further in research
Juf Nienke SeARCH / RAU / DS nvt	Housing Retail Parking	Prefabricated timber stacked or paired to create larger framework All modules are demountable so building is able to adapt to future needs however: Not build
MaMa One Marc Koehler Architects nvt	Housing	Idem as Juf Nienke (timber modules with flexibility inside dwelling and possibility to add/remove, however not build)
Object ONE Space&Matter	Housing Public spaces	Structural framework to municipal grid with basic connections, stack of units Not all plots need to be housing so there is room left for outdoor space and/or future

nvt		extensions, offering flexibility. Plot passport: rules of play about the (im)possibilities of the plots. Not build.
Silodam MVRDV 2003 (Frearson, 2015; Sundermann, 2016; MVRDV, n/d)	Housing Offices Commercial Public	Variety of dwellings with different typologies, increasing the individuality and leading to smaller communities of subcultures together, however not much re-adaptativity/flexibility
Frame Koschuch Architects 2019 (Pintos, 2019)	Housing Office Commercial	Volumetrically of a geometric ensemble and all sided raster = all round flexibility, however not much more.
Het Bosbad GAAGA 2019 (*Wonen in de weelde, de rust en de ruimte van Bosbad Eindhoven*, 2021; *Het Bosbad, Eindhoven — GAAGA*, n/d)	Housing	Very high focus on sustainability (Biodiversity, natural materials, circular materials, limited energy demands, natural materials), not so much on re-adaptivity
Lunetten 1981 Frans van der Werf (den Boer, 2020)	Housing	Drager and inbouw (structure and infill) principle and co-creation with future residents and architect for spatial floor plans and infill. Very similar to Molenvliet. Molenvliet is chosen instead because it can be marked as the first real project of the theory.
Stories OLAF Architects 2021 (Heutink, 2021; Olaf Gipser architects, 2021; Weessies, 2021)	Housing Commercial Parking	CPO project, Circulair material use. Steel, concrete, CLT wood Future residents had direct influence and were part of decision making -> freedom of choice for floor plans Interesting part is more about the use of timber for high rise building, rather than the freedom of choice of floor plans, which is also already mentioned in the other used projects.
De Hoofden(Era Contour, 2015) 2015 Marc Koehler et al.	Housing Mix-use	Collective self build prject (CPO) S**tructural framework of 5 m high, floors and walls can be placed per preference.** Façade is collectively decided of the inhabitant groups. Not much about re-adaptivity.
BlackJack BNB Architects & BO6 Architects 2016 (Raaij, 2017; BO6 architects, n/d)	Housing Offices Hotel Commercial	Variety in dwelling, co-creating with future residents. From 45 – 200 m2, studio's to maisonettes. Units can be added per 50 m2. Façade has a grid of 2.4 meter with different façade elements. Based on function, façade element can be chosen to be open, closed, in between etc. Column structural casco -> flexibility in facade and spatial floor plans Use of CPO. Similair to PATCH22 and Top up.

2. FLEX 4.0+

Concerning:	Issue	Solution
Layer site Is about whether there is a surplus of space and if the location itself is capable of supporting multiple functions	But not about how the zoningsplan (bestemmingsplan) and the municipality can have an influence on this	Add new question: 2A. To what extent does the municipality have influence on the adaptability of a building? and 2B. What does the zoning plan says for this site and to what extent can this be changed?
1. Does the site have a surplus of space and is the building located at the center?	Too specific Exact number too specific, take a more holistic view into account	Take out and change into What does the area around it looks like? How can the surrounding space (site) influence the building? How does the site level influence the building level?
3.Does the building or user units have a surplus of the needed usable floor space?	Related mostly to structuralism – less related to Open Bouwen and metabolism	Still take into account, however be aware of this difference.
4.What is the size of the usable floor surface?	Size of usable floor is dependable of the total size of building / units	Take out question
5.Have positioning/measurement modular rules for constructions components been used?	Mostly related to Structuralism, to some extent to Metabolism. Less to Open Bouwen.	Still take into account, however be aware of this difference.
6.Has use been made of a horizontal zoning system, including intermediate margins?	More related to Open bouwen than Metabolism and Structuralism.	Still take into account, however be aware of this difference.
7.Are sufficient stairs/elevators present in the building?	Dependable of type of building and size of building.	Take out and change into: What are the horizontally and vertically moving elements (stairs, halls, lifts etc.) and how does this relate back to its adaptability of the building?
9.How large is the load bearing capacity of the floors in the building?	Too specific. Surplus is already taken into account	Take out
12. How many minutes is the fire resistance of the main load bearing construction?	Too specific.	Take out
16. How is the thermal and acoustic insulation between the different storeys in the building?	Too specific	Take out
19. How is the thermal and acoustic insulation quality of the façade of the building?	Too specific	Take out
21. Does the capacity of (the sources of) the facilities have a surplus capacity?	Way too speficic	Take out
27. Multifunctional building/units Is the building capable to support different functions like offices, living, care and shops?	Answer to this more or less already is discussed in most of all the other questions -> whether certain performances support a rearrangement or transformation of functions, so the that the building can better meet the changing users' demand	Leave out. Not take this question into account.

Adjusted FLEX 4.0:

Layer	Sub layer	Flexibility Performance	Assessment values	Remarks
1.SITE		1.Surplus of site space ~~Does the site have a surplus of space and is the building located at the center?~~ What does the area around it looks like? How can the surrounding space (site) influence the building?	~~1. No surplus at all~~ ~~2. 10-30%~~ ~~3. 30-50%~~ ~~4. >50%~~ [more open and explorative']	The more surplus space on site, the better the building can be expandable horizontally
		2.Multifunctional site/location Is the location capable to support more functions, like offices, living, care and shops?	1. Just one 2. Two functions 3. Three functions 4. >3 functions	The more a location around a building supports more different functions of the building, the more a building can easily be rearranged or transformed to other functions
		2A & B To what extent does the municipality have influence on the adaptability of a building? [2A] What does the zoning plan says for this site and to what extent can this be changed? [2B]	1. Influence in terms of restricting it. 2. Doesn't take adaptability into account. 3. Promotes it, however not actively 4. Influence in terms of funding, zoningplan etc. Is in favor of. Not restricting. 1. Very limited and rigid. 2. Very limited, however open for change 3. Is open to large variety, however not everything 4. Can be anything, no requirements	The more a location around a building supports more different functions of the building, the more a building can easily be rearranged or transformed to other functions
2. Structure	Measurement	3.Available floor space of building Does the building or user units have a surplus of the needed usable floor space?	1. No, no surplus at all 2. 10-30% 3. 30-50% 4. >50%	The more surplus, the more easily it can be rearranged or transformed into other functions, the better the building can meet to changing user demands
		~~4. Size of floor buildings~~ ~~What is the size of the usable floor surface?~~	~~1. <400 m2~~ ~~2. 400-600 m2~~ ~~3. 600-1000 m2~~ ~~4 >1000 m2~~	~~The larger the usable floor surface, the more easily units in a building can be rearranged or transformed to other functions~~
		5. Measurement system Have positioning/measurement modular rules for constructions components been used?	1.No rules for modular coordination 2.<50% implemented 3.>50% 4.>90%	The more project independent, demountable and replaceable construction components have been implemented, the more easily a building can be rearranged/transformed to other functions
		6.Horizontal zone division/layout Has use been made of a horizontal zoning system, including intermediate margins?	1.No zoning system without margins 2.10-30% intermediate margins 3.30-50% intermediate margins 4.>50% intermediate margins	To more margins are used in the zoning system of the building, the more easily a building/unit can be rearranged/transformed to other functions
		7. Presence of stairs/elevators ~~Are sufficient stairs/elevators present in the building?~~	~~1.Only one decentred located~~ ~~2.One central located~~ ~~3.Different wings, with each central core~~ ~~4.One central and several decentred per wing~~	The more stairs/elevators are available in the building, the more easily a building/units can be rearranged, rejected, extended or transformed to other functions

		What are the horizontally and vertically moving elements (stairs, halls, lifts etc.) and how does this relate back to its adaptability of the building?	[more open explorative]	
		8. Extension/reuse of Is there a possibility to add new stairs/elevators to the building and reusing the existing ones?	1. Not without drastic expensive measures 2.Can be accidently added and existing reused 3.Can be limited added and existing reused 4.Can be easily be added without drastic measures	The more stairs/elevators are available in the building, the more easily a building/units can be rearranged, rejected, extended or transformed to other functions
	Construction	~~9.Surplus of load bearing capacity~~ ~~How large is the load bearing capacity of the floors in the building?~~	~~1. <3 kN/m2~~ ~~2. 3-3.5 kN/m2~~ ~~3. 3.5-4 kN/m2~~ ~~4. >4 kN/m2 and several areas > 8 kN/m2~~	~~The larger the load bearing capacity, the easier a building can be rearranged, transformed to other functions, or vertical extended, the better a building can meet to changing user demands.~~
		10.Shape of columns How are the columns in the building shaped?	1. Round shaped and/or have vertical different sizes 2.Octogonal shaped 3. Rectangular shaped 4. Square shaped	The less deviate from a square column, the better a building/units can be rearranged
		11.Positioning of facilities zones Are facilities zones and vertical shafts located at central building level and/or local unit level?	1. All located at central level 2. Located at central level and occasionally local level 3. Located at central level and limited at local level 4. Located at central level and at local level as well	The more facility zones/shafts are located at unit level, the easier a building can be rearranged, transformed to other functions
		~~12.Fire resistance main bearing~~ ~~How many minutes is the fire resistance of the main load bearing construction?~~	~~1. 30 minutes~~ ~~2. 60 minutes~~ ~~3. 90 minutes~~ ~~4. 120 minutes~~	~~The higher the fire resistance of load bearing construction, the easier a building can be rearranged/transformed to other functions,~~
		13.Extendible building/units horizontally Is it possible to expand the building horizontally for new extensions to the building/user unit?	1. Not possible at all 2. Very limited possible, only at one side 3. Limited possible, at more sides 4. Easily possible, at all sides	The more a building/unit can be expanded, the easier a building can be rearranged or transformed to other functions or expanded, the better a building can meet the changing user demands.
		14.Extendinable building/units vertically Is it possible to expand the building vertically, for adding new floors or a new basement?	1. Not possible at all 2. Limited possible, only a few units 3. Possible after total rearrangement 4. Possible	The more of a building can be vertically expanded, the easier a building can be rearranged or transformed to other functions or expanded, the better a building can meet the changing user demands.
		15.Rejectable part of the building/unit Is it possible to reject part of the building for selling/renting to third parties?	1. Not possible at all 2. Possible to reject 10-30% of the building/units 3. Possible to reject 30-50% of the building/units 4. Possible to reject >50% of the building/units	The more a building can be vertically rejected, the easier a building can be rearranged or transformed to other functions or expanded, the better a building can meet the changing user demands.
		~~16. Insulation between stories/units~~ ~~How is the thermal and acoustic insulation between the different storeys in the building?~~	~~1. Insulation does not meet current demands of offices~~ ~~2. Meets current demand of offices~~ ~~3. Meets current demands for housing and care too~~ ~~4. Meets 10% above current demands for all functions~~	~~The better the thermal and acoustic insulation between different storeys the easier a building can be rearranged or transformed to other functions or expanded, the better a building can meet the changing user demands.~~
3. Skin	Facade	17.Dismountable façade To what extend can façade components be dismantled in case of transformation?	1. Components can't/hardly be dismantled without demolition 2. Small part can be dismantled (>20% < 50%) 3.Large part can be dismantled (>50 % < 90%) 4. All façade components are easily dismountable	The more façade components are easily dismountable, the more easily a building can be rearranged or transformed to other functions.
		18. Location/shape daylight In what way are the façade/daylight openings positioned and shaped?	1. Large closed surfaces 2. Small horizontal open surfaces 3.Large open surfaces, with different heigh sizes 4.Large continuous horizontal open surfaces, connections according to planning grid	The more regular open surfaces in the façade according to the planning grid, the better a building can meet changing demands in functions, quality and finishing of the building
		~~19. Insulation of façade~~ ~~How is the thermal and acoustic insulation quality of the façade of the building?~~	~~1. Does not meet current demands for offices~~ ~~2. Meets current demands for offices~~ ~~3. Also meets current demands for housing and care~~ ~~4. Meets 10% above current demands for all functions~~	~~The better thermal and acoustic insulation of the façade, the easier a building can be rearranged or transformed to other functions, to better it can meet changing user demands.~~
4. Facilities	Measures and Control	20. Measure & control techniques Is it possible to control/measure facilities on building level as well on user unit level?	1.Takes place only at central building level 2.On central level and occasionally on unit level 3. On central level and limited on unit level 4. On central level and completely on unit level	The more possibilities for measurement and control of the facilities on unit level, the more easily units in a building can be rearranged or transformed to other functions
	~~Dimensions~~	~~21.Surplus capacity of facilities~~ ~~Does the capacity of (the sources of) the facilities have a surplus capacity?~~	~~1. No surplus at all~~ ~~2. 10-30%~~ ~~3. 30-50%~~ ~~4. >50%~~	~~The more surplus capacity of the facilities, the easier a building can be rearranged or transformed to other functions, to better it can meet changing user demands.~~
	Distribution	22. Distribution facilities Does the building have a specific distribution facility for hot/cold water, heating, cooling, gas?	1. One for all different sources 2.For some of the different sources 3. For two of the different sources 4.No specific distribution	The less specific distribution equipment facilities have, the easier a building can be rearranged or transformed to other functions, the better a building can meet changing user demands
		23. Location sources facilities What is the location of the central facility sources?	1. Located at only one central location 2. Located at several locations 3. Located at a central location and decentred location 4. Located outside the building at city level (district heating)	The more facility sources are localized at decentred level, the easier a building can be rearranged or transformed to other functions, the better a building can meet changing user demands
		24. Disconnection of facility Can the compoinents of the facilities be easily disconnected?	1. Can't be disconnected or demounted 2. Hardly be disconnected or demounted 3. Partly be disconnected or demounted 4. Can be disconnected very easily and completely demountable	The more facility parts can be disconnected or demounted, the easier a building can be rearranged or transformed to other functions, to better it can meet changing user demands.
		25. Accessibility of facility To what extend are facility components good accessible?	1. Hardly or not accessible (eg concreted in) 2.Limited accessible (partly on support and infill level) 3. Good accessible (lot on infill level) 4. Very good, most components at infill level	The higher the accessibility of facilities components, the more easily units in a building can be rearranged or transformed to other functions,

		26. Independence of user units In what way are the user units independent related to services as pantry, toilet facilities?	1. No services available at user unit level 2. 1-2 services available 3. 2-4 services available 4. >4 services available	The more services are available at unit level, the more independent the units are opposite other units in the building, the more they meet individual user demands.
5. Space	~~Functional~~	~~27. Multifunctional building/units~~ ~~Is the building capable to support different functions like offices, living, care and shops?~~	~~1. Support only one function~~ ~~2. Supports 2 functions~~ ~~3. Supports 3 functions~~ ~~4. Supports >3 functions~~	~~The more a building supports different functions of a building, the more easily a building can be rearranged or transformed to other functions.~~
	Technical	28. Disconnectable, removable To what extent are the user units in a building removable, relocatable?	1. Is not removable, relocatable 2. Only relocatable with drastic expensive measures 3. Units are easy relocatable, constructured with demountable components 4. Easy relocatable, constructures with 2d/3d modules, transportable by road	The more the units consist of demountable and reusable components, the better the units are relocatable to another location in our outside the building
		29. Disconnectable, removable To what extent are inner the walls in the building easily replaceable?	1. not replaceable without drastic/expensive interventions 2. Not replaceable, but good destructible 3. Replaceable by dismantling and rebuilding at another location 3. Easily replaceable without radical/expensive interventions	The more inner walls can be easily replaced, the more easily a building can be rearranged or transformed to other functions, the better a building can meet to changing user demands
		30. Disconnectable connection detail Which detailed construction is applied between the interior walls and support structure and façade?	1. Penetrating connections 2. Wet connections (mortar, sealant, glue) 3. Bound connection elements 4. Unbound dismountable connections	The easier the connection of interior walls can be dismounted, the easier a building can be rearranged or transformed to other functions
		31. Possibility of suspended ceilings Is it possible to apply suspended ceilings and to adapt these to the different user demands?	1. Results in free floor height of <2.60 m 2. Results in floor height of 2.5 – 2.7 m 3. Results in floor height 2.7 – 2.8 m 4. Results in floor height of > 2.8m	The higher the free storey height, the better the building can meet the changing demands concerning functions, facilities, finishing and quality of the building
		32. Possibility of raised floors Is it possible to apply raised floors and to adapt these to the different user demands?	1. Results in free floor height of <2.60 m 2. Results in floor height of 2.5 – 2.7 m 3. Results in floor height 2.7 – 2.8 m 4. Results in floor height of > 2.8m	The higher the free storey height, the better the building can meet the changing demands concerning functions, facilities, finishing and quality of the building

Furthermore, FLEX 4.0 doesn't also include all the questions needed for this research. This leads to adding the following questions:

What's missing	Questions
An overview	What does the structure include? What are the structural elements [core, walls, floors, beams etc.] What are the wet and dry rooms? Where are the shafts for installations? What does the wayfinding look like? What are the walking routes? [entrance, halls, lifts, stairs etc.] How did the building come into being with regards to the building phases? Everything at once or build in phases? What are the functional units and space units? What is de household profile of the inhabitants?
Life cycle	When dissecting the building, what are the different life cycles of the building elements?
Separating equipment space and architectural space	What is the possibility with regards to separating equipment spaces (kitchen, bathroom etc.) and architectural spaces (living, dining, bedroom etc)
Financing	Sold, rent, at once? In payments? If you want larger, then what? Possibility to sell? What do you pay for collectively, what individually
(Process)management	What was the tender like? What requirements? What were difficulties during the design phase? What are important maintenance notions?
Flexibility organisation process	Who makes what decision? What are the decision processes like? In what extent there is a structure in the decision making and to what extent there is freedom for change during the whole process? (think about Approval flexibility, elaboration flexibility, implementation flexibility)
Opportunities to shrink or grow	Once a resident want to grow their dwelling by extra rooms, how can this be met and what is the process behind this? Once a resident want to shrink their dwelling by extra rooms, how can this be met and what is the process behind this?

3. INTERVIEW QUESTIONS AND PROTOCOL

Interview protocol

Shajwan Jabar

Algemene informatie

Geïnterviewde: [Naam]

Functie: [Functie]
Organisatie: [Bedrijf/organisatie]

Interviewer: Shajwan Jabar
Functie: Master student 'Management in the Built Environment', TU Delft

Datum: [Datum]

Onderwerpen en opmerkingen

Het gesprek zal de volgende onderdelen behandelen:

( ) 0: Achtergrond van de geïnterviewde en project
( ) 1: Interview vragen
( ) 2: Open discussie
( ) 3: Overige opmerkingen

Tijdens het gesprek zijn de volgende documenten verkregen of ingezien:

_____

The interview will start with an explanation of the research and its posed problem with objective. Then the project will shortly be discussed which is based on the previous case study research, followed by the interview questions. The interview consists mostly structured questions, however it is also open to freestyle.

The interview protocol also consist an opening and closing. The opening is the explanation of the research, providing a guideline and understanding of the reason behind doing this research. This way the interviewee better understands the information is needed. Here also, shortly the informed consent will be mentioned once again. The informed consent has been send and signed beforehand, the document for this can be found at the appendix.

The opening also functions to build rapport and a more comfortable environment with the interviewee's in order to gain an open conversation throughout the interview. In this part we will discuss their project and some easy chit-chat. This is necessarily not part the interview questions and therefore is not written down in the protocol.

The closing gives the interviewee an extra opportunity to share some additional conceptions, thoughts or remarks that have not been discussed in the interview itself.

The interview questions will be send beforehand, so the interviewee has already an understanding of what the interview is going to be like and can think about answers beforehand. Depending on how the interview goes and the interviewee's response, additional questions might pop in the head or it becomes clear certain questions are already answered, the interview protocol also gives room for this natural flow.

The questions can be related to each phase and SWOT/PEST
DP = Design Phase
CP = Construction Phase
OP = Operational Phase
MP = Maintenance Phase
DMP = Dismantling phase

P = Political
E = Economic
S = Social
T = Technological

Interview questions

DP = Design Phase
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General questions for both architects and developers:

Q1. How important and relevant do you think adaptive housing is for the current and future housing context in the Netherlands? [S/OP]
Q2. What are your thoughts on growing and shrinking space? [OP/MP/DP]
Q3. What were your main and least objectives and desires for the project?
Q4. During the project, what were things you figured out from the start that you definitely wanted to be incorporated (or definitely not) and why? [DP]
Q5. During the project, what were things that turned out to be different in practice than you expected it to be? What was the expectation and what was the outcome? Why was there a difference? How would you do this the next time? [DP/CP]
Q6. What are general the biggest difficulties and barriers? How do you think these could be solved?
Q7. With what other actor you have the most and least connections with? Why? How are you related? What between you and them clashes? Why and how can this be solved? What goes best between you and them? How come?
Q8. What are some things that work out in the design, but just not in practice [DP/CP/T]?
Q9. Were there parts of the design that changed during the construction phase? [DP/CP]?
Q10. What were important environmental policies and/or other sustainability matters related to this project and your process? [P]
Q11. How does the municipality intervene and has an effect (either positive or negative) of such projects? How would you like to be supported by the municipality? [P]
Q12. What are the things you would have done differently if you could do the project over (overall / especially related to adaptability / at that moment vs now)?
Q13.What are the most important laws, legislations and regulations you have to take into account with adaptive housing? [L/DP]

For architects
Q1. What are the design key elements with regards to adaptivity? [DP/T]
Q2. What kind of technologies are used? Why / why not, what are new possible technologies [DP/MP/T]
Q3. What are the elements in this building that are designed to be changed over time? How should these be replaced, in how many years and why? [MP/DMP]
Q4. How this building best can be maintained and what are the elements that need to be maintained? [MP]
Q5. In what way can the building be dismantled if needed? Or what and how are element that are designed for dismantling? [DMP]
Q6. How can change (grow/shrink) be integrated in the design? [OP/DP]
Q7. Did you as a designer, had to take certain aspects into account because of construction costs and/or profits? What were these? How did you take this into account? [E/DP]

For developers

Q1. Can you explain the financial aspect of adaptive buildings? Would you rather sell or rent these kind of projects? And what does this mean for the adaptive part of it, when you add or remove certain elements, do residents pay/receive extra money? Do they pay a certain amount of money beforehand and can make use of its budget along the time? Eg they want a bigger room, for reasons you need an extra stairs. Do they pay for this? Even though in the future others will make use of it too? [DP/OP/MP/E]
Q2. How is the developer part of making sure residents can change their housing in terms of growth and shrinkage? How could residents let you know what they want to change? What is the process? [OP/MP/S]
Q3. How is the developer influence the growing and shriking spaces? What is your say in this? What are your preferences in this? [OP/MP/S]
Q2. What is the financial aspect of adaptive housing, eg what are un-usual costs and/or revenues? What makes the budgeting/financial vitability different than normal housing? [E]
Q3. Is there usually budget to try things? Without being sure it will work out? [DP/OP/T/E]
Q4. What are your consumer's and their level of disposable income? How is still likely to change in the upcoming years? Demand for this? [E/S]
Q5/ What kind of technologies are used? Why / why not, what are new possible technologies [T]
Q6. As you are not making the design yourself, what were for you some of the most difficult elements to applicate to the construction? What are elements where you find the developer clash with the architect in terms of design [DP/OP/T]?
Q7. How much were you related to the design phase, how much you'd like? [DP]
Q8. Would you rather be related to maintenance phase, why? [MP]

For municipality
Q1. What are you conceptions on adaptive housing?
Q2. What are the most important laws, legislations, policies and regulations stakeholders have to take into account when building adaptive housing? How does policies positively or negatively affect it? [P]
Q3. This could also mean a change of functions, in what cases do you agree or disagree with giving a building freedom of functions? [OP/P]
Q4. What if this means a difference in households? That change over time? How does this relate to neighbourhood planning? This can also mean a difference in household values changing over the years. Is this something the municipality opposes? Why? [OP/P]
Q5. What if this means a change/adaptivity of façade and the aesthetical look? How does the municipality stand in that? [OP/P]
Q6. How could you possibly offer more to other stakeholders to positively influence adaptive housing? [DP/P]

For residents
Q1. What is your age, gender, education, social capital social mobility? Do any of these influence your choice in adaptive housing? Are this about to be changing over time? [S]
Q2. What were your main objectives for buying/renting this house? What are the key factor to influence for you to buy/choose for this type of project [S]?
Q3. Can you give me a description of your household profile from the beginning till now? how do you think will change in the future? What kind of space do you think aligns with this [S]
Q4. do you see yourself needing more or less space in the future? Yes/no, can you elaborate further, give me more details (what space, where, how much, why) [OP/S[
Q5. Are you aware of all the possibilities with regards to the flexibility of your house
Q6. Did you already alter your house? What, why, how? [OP/S]
Q7. Do you expect it to, in the future? what, why, how? [OP/S]

Casus specific questions
-Room for new questions derived from literature study and case studies.

INFORMED CONSENT

Dear [insert name],

As a solution to the high housing shortage in the Netherlands, adaptive housing is being researched. Current housing stock and its increase relatively holds a fair share of additional new stock as a result of adapting buildings either through splitting, renovating or changing the use of the dwelling or combination. Furthermore, there is a difference in family size and its m2, lots of people live either too big or too small than their needs. The needed room space also differentiates over the years.

As there also is an increase in demand for flexibility, sustainability, circular economy, renewability and adaptability in housing, the topic of adaptive housing is relevant and worth investigating since it could provide a possible solution and forms a significant part of the issues as stated above. As existing buildings can create new housing through splitting, renovating and/or transformation, it prevents it for demolition or transformation to other functions.

Knowledge about the implications and possibilities of flexible and adaptive housing has great importance for using these theories more often and releasing some pressure on the housing shortage along with preventing future mismatches between space supply and demand.

Previous research mainly concern themselves with the architectural side of adaptability, however the aspect of organizational management still needs further investigation. This thesis concerns itself with drawing lessons from adaptive buildings (metabolism, structuralist or open bouwen), to provide recommendations for new adaptive housing construction in the Netherlands mainly focusing on the organizational and management side to it.

The possibilities of adaptive and flexible building and their general features has been studied and documented extensively and received their relative considerable attention in the building environment, in Japan with Metabolism and its Dutch counter parts Structuralism and Open bouwen. The [insert name project] has been part of my research and therefore your conceptions would be of great value. In the interview, you will be asked about specific questions on the [insert project name].

The interview will be held by 'Management in the Build Environment' master student Shajwan Jabar, the researcher of the thesis. The thesis is being guided by Lidwine Spoormans and Gerard van Bortel, both teachers at the TU Delft BK Faculty.

The interview itself will take about an hour. And, if consented, will be audio recorded for later transcription.

Please note, that you will be asked again in during the interview about your participation consent and whether you agree for audio recording. You are freely able to state that you don't want to participate, at any time given. An explanation is not required. Furthermore, you are free to dismiss any question asked.

When agreed to participate to the interview, please fill in and sign this letter and retour a PDF copy. A copy with the interviewer's signature then will be send back to you. Your information will be handled truthfully.

When you have any questions and/or remarks, don't hesitate to contact:

Shajwan Jabar
shajwanjabar@hotmail.com

0684676075

When agreed to participate, please fill in the statement below.

Kind regards,

Shajwan Jabar

INFORMED CONSENT

To be filled in by interviewee [name] and interviewer [Shajwan Jabar]

I, [name], declare that I have been beforehand informed about the research its objective, method and purpose. Any questions I had, were answered clearly and satisfactorily.

Any interview questions that I did not want to answer, I have stated and those questions will be taken out of the interview. I am aware of the right that I don't need reasoning for this.\

I am aware that audio material will be collected, transcribed and used exclusively for this research.

I am aware of the right to withdraw participation or not answer all questions, without stating the reason, at any given time.

This form has been read by me, and I agree to the participation of this interview for the research.

Audio transcription can be shared to third parties afterwards, when asked [YES] [NO]
Transcription summary can be shared to third parties afterwards, when asked [YES] [NO]
I'd like a copy of the transcription [YES] [NO]
I'd like a copy of the transcription summary [YES] [NO]
I'd like a copy of the thesis [YES] [NO]

Place:

Date:

Name participant (first and lastname, in blockletters]

Signature participant:

'I have informed the participant about the research and declare I will be prepared to answer any questions related to the research'

Place: Delft, the Netherlands

Date:

Name interviewer: Shajwan Jabar

Signature interviewer: