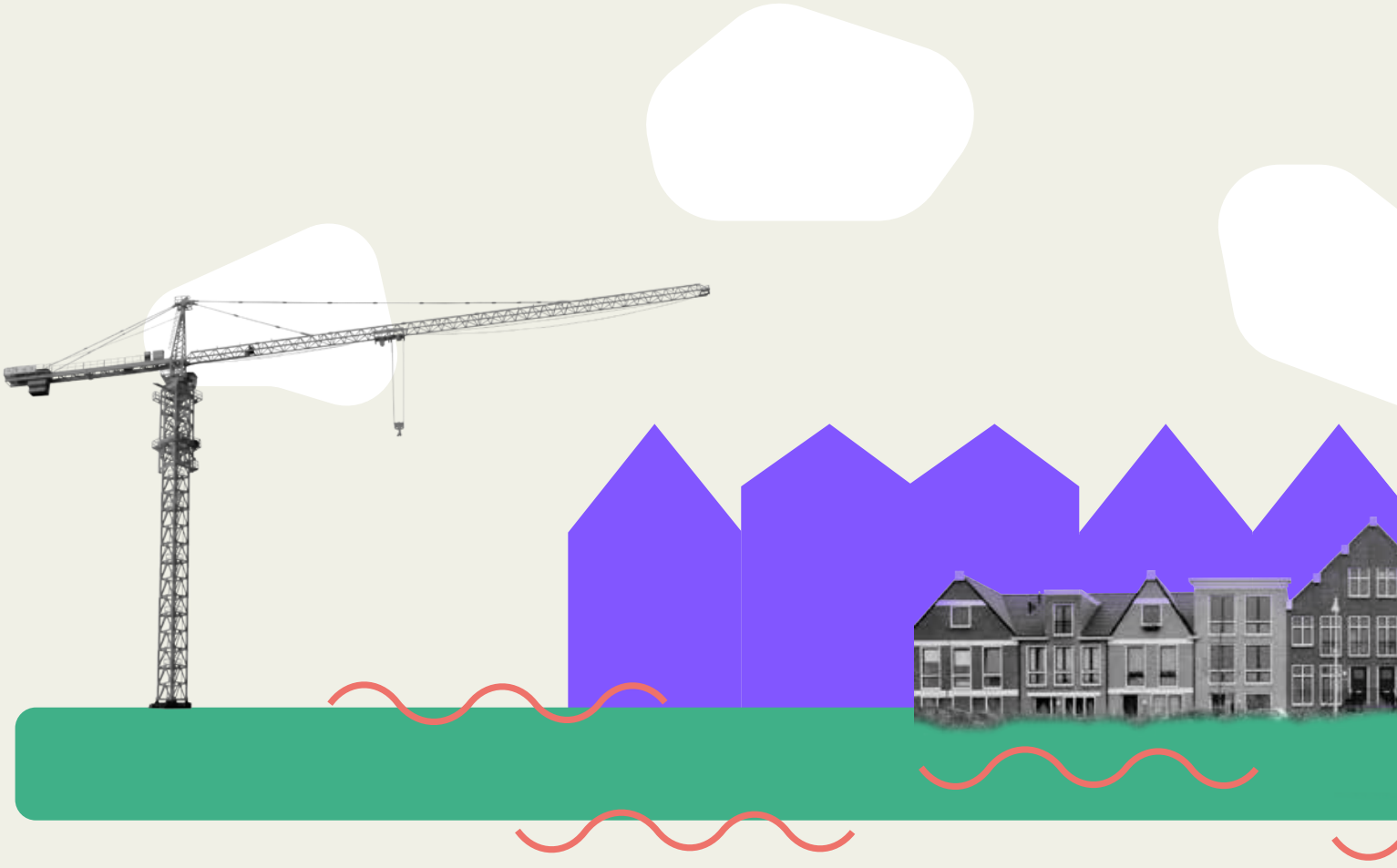
Floating urbanisation

researching the preconditions for urban development
on surface water in the Netherlands



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P5 report | 3 november 2022

Colophon

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Preface

Eight years ago, I started my very first architecture project, here at the faculty. The assignment was to design a holiday home for a brother and sister somewhere in a tiny greenish area between Delft and Rotterdam. After weeks of hard work I presented my design; a floating house consisting of three separate units that could be lowered into the water. It feels as if it has come full circle with the subject of my final assignment being floating urbanisation.

Because of this research project I met many interesting, water-loving people and I had intriguing conversations about building on water, the future of the Netherlands and the systems we created to keep this country running. I enjoyed speculating about the future of the built environment in combination with the climate change that we face. These conversations and trains of thought nuanced my ideas about floating urbanisation. First I thought floating urbanisation to be ***the*** solution to solve the housing crisis and respond to the rising water levels. I realise now that floating urbanisation should be one of the many solutions to keep the Dutch built environment a safe and enjoyable place to live.

To all the people that contributed to this project in some way; whether you guided me in the right direction, were a sparring partner, commented on my draft reports, listened to my endless explanations of floating buildings, participated as an interviewee, attributed to the expert panel discussion, corrected my English or provided me with distraction in tough times: it was all very much appreciated, thank you.

Tessie
Delft, November 2022

Executive summary

Introduction

Substantiated estimations tell us that due to the changes in our climate, with rising sea levels and extreme water levels in rivers as results, coastal areas have to cope with an increased flood risk in the coming years (IPCC, 2013). How we should deal with that in the coming years is researched and discussed in literature. Rijcken (2022) argues that we should maintain and strengthen our water barriers around valuable areas and give up some land in exchange for more water in less valuable areas. Rotmans and Verheijden (2021) sketch another solution for the future of the Netherlands. We have to establish a different relationship with water, we can no longer repel it. We have to create more space for water on our land and use that water in our advantage.

Figure I | Example of a floating house in Amsterdam, photo by author

One thing is for sure: rapid urbanisation and the rising sea level force us to apply new solutions to fulfill the growing need for accommodation within the city. One of the solutions for this problem could be building on surface water. There are a few pilot projects with floating buildings in the Netherlands.
The aim of this research is to understand which preconditions are needed to make the development of larger scale floating urbanisation in the Netherlands possible and which parties can influence this process. The main research question that will be answered in this research is:

What are the preconditions for the development of floating urbanisation in the Netherlands?

The answer to the main question will be found by answering the following five sub questions:

1. What is floating urbanisation?
2. Which actors influence the development of floating urbanisation?
3. What issues arise during the development of floating urbanisation?
4. What solutions have been used to continue the development?
5. What structural changes have to take place to make floating urbanisation future proof?

Methodology

This research uses a mixed method approach. The methodology can be divided into three steps: theory, practice and synthesis. The different(sub) questions are answered in one of the steps through the use of different research methods, as shown in figure II. The first step consists of literature analysis and establishes an answer to the first three sub questions. This implies, finding out what the definition of floating urbanisation is, understanding which actors are involved and identifying the type of issues that could arise during the development of this urbanisation.

In the second step, case study research and validation with an expert panel are utilised. On the basis of predefined selection criteria, two case studies are selected. The cases are analysed through the use of semi-structured interviews. The results of the case studies are checked with an expert group to enlarge their generalisability. Analysis of all the outcomes and the answers to the sub questions are used to provide an answer to the main question. As a final deliverable, a guide for the municipalities is created. This one pager gives a clear overview of the obstacles that are within the influence of the municipality and the possible action they can undertake to change them.

Theory

The definition for floating urbanisation, derived from literature, and used for this research is: a piece of land (that can be flooded) or water has been given an urban purpose, and the buildings that arise are adaptable to changing water levels.

Winch (2010) has described in his tectonic approach how construction projects are managed. The people involved can be divided into direct and indirect actors. The direct actors operate on the process level, these are the people that make the project. The indirect actors operate on the governance and institutional level. The governance level consists of actors that influence the (initiation of the) project by making policy or setting requirements. The institutional actors shape the context wherein the other actors operate.

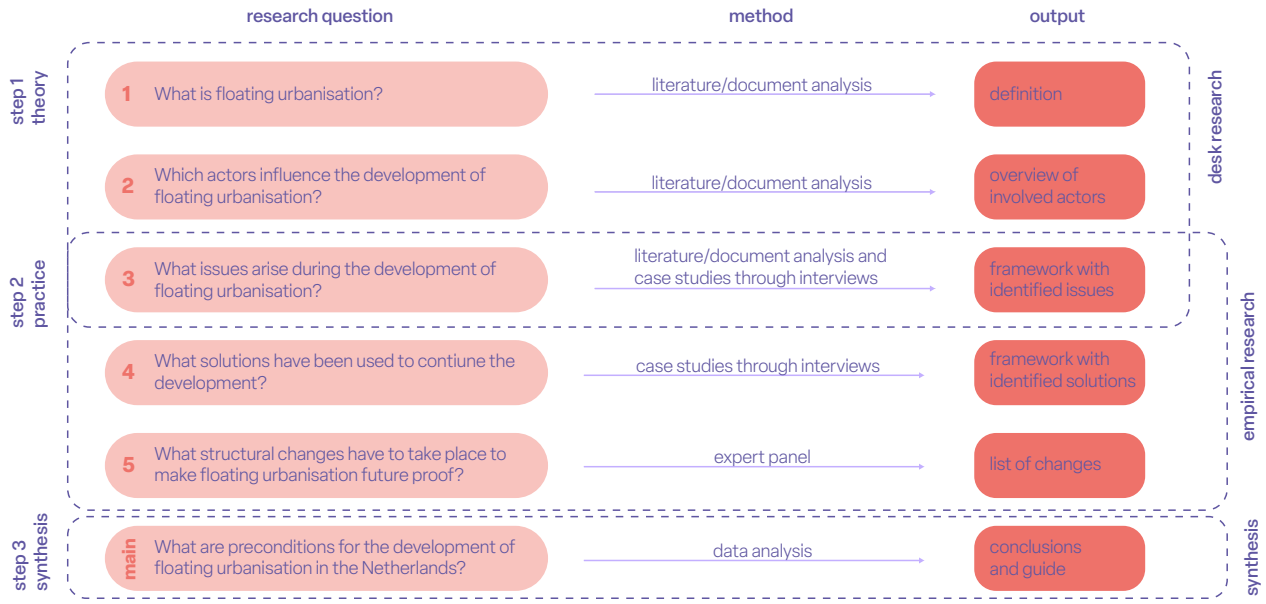

Figure II | Schematic overview of the methods used per sub question

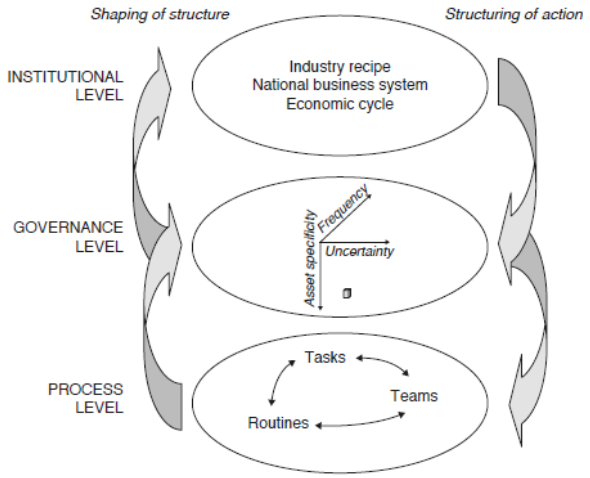

Figure III | Tectonic approach (Winch, 2010 p. 11)

The actors involved in the development of floating urbanisation can be categorised in the three perspectives: the public, the private and the societal perspective.

Derived from literature are issues that arise during the development of floating urbanisation. These issues have to do with a lack of knowledge and skills from different stakeholders in the development process, insufficient regulation and legislation, difficulties with standard infrastructure, technical concerns especially when it comes to scale, impact on the environment and ecology and the public perception of floating buildings. These issues are categorised into seven themes that, together with the involved actors, serve as a framework for the analysis of realised projects.

Findings

Two cases have been analysed through semi-structured interviews to understand the issues that arose and the solutions that have been used. Analysis of the interviews indicated the issues with the biggest impact on the project. First of all, the involved actors indicate a lack of knowledge and experience with floating urbanisation. The actors used the knowledge and experience they had and adopted them to help with the project. For example, the constructor knew how to build one ground level houseboat and used that experience to construct a three-storey floating villa. The other gaps were filled with learning by doing, actors started the project with little knowledge and educated themselves and each other along the way. Secondly, the interviewees mention unclarity about the legal status of floating buildings and the applicable building regulations as obstacle. These issues were overcome by applying the existing legal structures to the situation and request for exceptions when needed. The third indicated issue is financial. The preparation and construction costs were relatively high. The infrastructure that had to be build was more expensive than the infrastructure on land and the development costs of a unit are higher because it is not a standard building. The solution for these costs was to develop high segment dwellings that yield more revenue. Another financial obstacle was that banks were hesitant to provide mortgages loans, which does not benefit the sales. After consultation with three banks concerning the legal construction that had to give them some certainty, two were willing to provide the loans.

After the case analysis, a validation session with an expert panel was used to discuss the structural changes that can make floating urbanisation future proof. Suggestions for structural changes were discussed. For the legal problems, adjusting the law about the legal

status of floating buildings and complementing the building regulations for floating buildings, should do the trick. The financial problems could be solved by scaling up the projects, in size and number. This will result in economies of scale which paves the way for affordable housing. When there are more floating houses, banks will have more reason to start with providing mortgage loans.
However, the majority of the experts thinks that there will no need to implement those changes because there is no significant demand for floating buildings.

Conclusion

What are the preconditions for the development of floating urbanisation in the Netherlands?

The preconditions as they are now make the development of floating urbanisation in the Netherlands possible. This is proved by the fact that there have been realised a few projects. However, the current conditions are not ideal. This results in a time consuming and costly development process. If the conditions were to be improved it is likely that more floating urbanisation projects would see the light of day. The other way round is also true, if more floating urbanisation projects are initiated, there is more incentive to improve the preconditions.

There is one precondition that is only briefly touched upon in this research but could be designated as crucial: there has to be a suitable location available. Not a single project will be realised without a location.

Recommendations

For society

i. Share the gained knowledge
ii. Innovate the design of floating urbanisation
iii. Don't forget houseboats
iv. Adjust the building regulations
v. Understand the necessity for floating buildings
vi. Use a holistic approach to complex building problems

For science

i. Make a comparison with other water resilient buildings
ii. Research the impact of each aspect on the quality, costs and time
iii. Find out where the costs are
iv. Research the environmental impact
v. Understand the market demand

Abstract

Due to climate change, the built environment will have to deal with rising surface water levels in the future. We could cope with this situation by making our buildings adaptable to changing water levels and develop floating urbanisation. Although quite a few floating projects have been realised in the Netherlands they are mostly of the smaller scale (1-20 buildings). To serve as a robust solution the floating urbanisation projects need to scale up. The aim of this research is to understand the preconditions that are needed to do so. The method used is mixed and combines literature research, case studies and a validation panel. The results have been grouped in seven themes: knowledge & skills, regulation & legislation, exploitation & economy, infrastructure & planning, technology & scale, environment & ecology and public perception. Topics within these themes that play an important role in the success of a project are developing parties with the required knowledge and skills, the presence of suitable legislation, an appropriate location and a bank willing to provide mortgages. The preconditions as they are now make the development of floating urbanisation in the Netherlands possible. Improving these conditions will make it easier to develop more floating urbanisation projects. If these improvements are needed on the short term or the long term depends on the context of that time.

Keywords: floating urbanisation, development conditions, building adaptation

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1 Introduction

Predicting the future is something we humans are incapable of. With the help of technology and computer models we have become quite good at developing substantiated estimations. These estimations tell us that due to the changes in our climate, with rising sea levels and extreme water levels in rivers as results, coastal areas have to cope with an increased flood risk (IPCC, 2013). This is nothing new for the Netherlands that always had to deal with imminent water. There are numerous examples of water barriers that have been constructed to keep the water out, the most well-known being the Deltawerken that were constructed after the flooding in 1953. These technical measures keep the water out and prevent flooding of the hinterland. However, in the climate debate the emphasis has shifted from mitigation strategies only, to combining mitigation and adaptation strategies (IPCC, 2013). Modern water management is based on technical as well as spatial measures, technical measures alone are not enough (Voogd, 2006). The approach in the Netherlands has followed this change and became more integrative (Van Der Brugge et al., 2005).

An example of a more integrative approach is the project Ruimte voor de Rivier (Space for the river) that was started in the year 2000. The main goal of this project was to create or reserve more space for river water in order to mitigate the risks of high water levels or flooding. Existing dikes were reinforced, new dikes were constructed and river beddings and floodplains were enlarged. However, the pressing housing shortage requires space for new dwellings. Municipalities allow the construction of these dwellings in areas that flood a few times a year and have been appointed to the Ruimte voor de Rivier project only years before, without appropriate measures to keep dry feet in these homes (Pointer, 2021).

What the approach should be in the coming years is researched and discussed in literature. Rijcken (2022) argues that we should maintain and strengthen our water barriers around valuable areas and give up some land in exchange for more water in less valuable areas. Rotmans and Verheijden (2021) sketch another solution for the future of the Netherlands. We have to establish a different relationship with water, we can no longer repel it. We have to create more space for water on our land and use that water in our advantage. Their vision is that by 2121 the Randstad consists mostly of water and that numerous floating neighbourhoods and multiple floating towns will be realised. To achieve that, a combined approach for water management and the built environment should be established.

Whatever the approach will be, the one thing that is for sure is that the water will come and people will have to live somewhere. Constructing buildings in areas with a risk of flood is not impossible, as long as measures have been taken to protect the buildings from the water in one way or another. Pols et al. (2007) describe two different approaches that deal with reducing the risks of flood damage. The first approach is to take technical measures that diminish the chances of floods. These measures impact the surroundings of the buildings, e.g. by building a dyke or giving more space to water. The second approach is to take measures that diminish the damage that is caused by floods. According to Pols et al, this second approach is achieved either by making changes to the design of the building or making them floatable. Floating urbanisation is expected to reduce vulnerability of urban areas by reducing flood impact (De Graaf, 2009).

There are numerous examples of floating buildings all over the world. In countries such as Vietnam, Bangladesh, Malaysia and Indonesia floating houses or houses on poles are rather commonplace. These homes are made of cheap materials that are found locally and usually inhabited by fishermen. Building on or above the water is practical for the fishermen but also necessary to protect the house and its inhabitants from the water. However, these floating homes are not suitable for the larger scale urban development that is desired to tackle the housing shortage and danger of flooding in dense urban areas.
Rapidly growing port cities in vulnerable lowland areas are suitable locations for new floating development but in many of these areas no floating projects have been implemented. One of the global frontrunners, when it comes to floating projects, is the Netherlands (Ambica & Venkatraman, 2015). Next to that, the problems present in the Dutch delta are similar in delta areas all over the world. In order to understand what is needed for the implementation of medium sized or larger floating projects one should look at areas where most floating projects are already realised (Dal Bo Zanon et al., 2020). It is therefore only logical to look into Dutch projects for this research.

1.1 Research aim

Rapid urbanisation and the rising sea level force us to apply new solutions to fulfil the growing need for accommodation within the city. One of the solutions for this problem could be building on surface water. Most of the larger cities, that deal with a housing shortage, are on the waterfront, especially in The Netherlands. Cities such as Rotterdam and Amsterdam even have some unused harbours, for example the Rijnhaven in Rotterdam (De Blauw, 2015), that could be appropriate for this type of development. Construction-wise it should be possible to build on water, see for example the well-known houseboats in cities and rural areas of the Netherlands or the floating office in the Rijnhaven of Rotterdam that was opened in September 2021.

Figure 1 | Floating office by Powerhouse company, photo by Mark Seelen

Although quite a few floating projects have been realised in the Netherlands, their size is mostly on the smaller side and they are situated on the edges of rivers or lakes (De Graaf, 2009). Most of these projects consist of one or a few buildings. The development of neighbourhoods or larger scale projects lags behind (a list of the projects that were identified until now can be found in appendix 1). Schuwer (2007) predicts that projects will be of a larger scale in the future and that municipalities will collaborate on these projects because they have limited possibilities for floating urbanisation within their own municipal borders. The question remains, what is needed to scale up the floating urbanisation projects? That is where this research comes in.

Figure 2 | Houseboats in Rotterdam, photo by author

1.2 Research questions

The aim of this research is to understand which preconditions are needed to make the development of larger scale floating urbanisation in the Netherlands possible and which parties can influence this process. This is shown in figure 3.

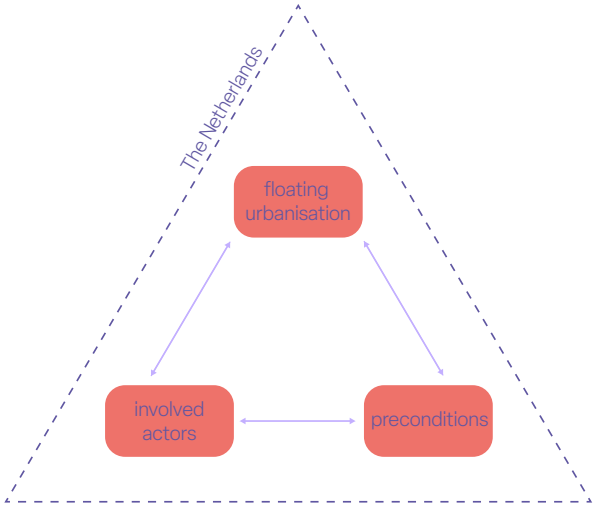

Figure 3 | conceptual framework

The main research question that will be answered in this research is:

What are the preconditions for the development of floating urbanisation in the Netherlands?

The answer to the main question will be found by answering the following five sub questions:
What is floating urbanisation?
Which actors influence the development of floating urbanisation?
What issues arise during the development of floating urbanisation?
What solutions have been used to continue the development?
What structural changes have to take place to make floating urbanisation future proof?

These sub questions are addressed in the presented order because the outcome of each question will be input for the follow-up questions (see also chapter 2, Methodology).

1.3 Scientific and societal relevance

Previous research has been done into the issues that occur when floating buildings are developed. Two students have written their thesis within this theme. Schuwer (2007) has researched the success and fail factors of living on the water. He only focused on housing and not on urbanisation in general. The conclusions of his research are used as input for the literature research of this thesis in order to test them. Next to that, some time has passed since his research and it is very likely that practice has changed, that is another reason for the relevance of this research. The conclusions of van Dijk (2021) are solely based on the experience of a few attendants of a conference about floating solutions. Therefore, his conclusions will be critically examined before they are used as input for this research. The other research that has been done either focuses on one aspect (mostly the technical aspect) or it is merely theoretical. With this thesis a complete overview of relevant issue topics and the actors that can influence those issues will be added to the existing theories. Next to that, this research will try to point out if theories about floating urbanisation development comply with what happens in practice.

This thesis contributes to the knowledge about the development process of floating urbanisation and is relevant for future floating urbanisation projects. Floating urbanisation could be desirable as an answer to the problem of city densification and rising sea levels. Not only the Netherlands but also other countries can profit from the experiences and newly found solutions of the Dutch (Dal Bo Zanon et al., 2020). The outcomes of this thesis could be used as a starting point to overview the obstacles that have to be overcome, and perhaps save some time in the process of developing floating buildings. Next to that, this thesis can be used as a source of information for the discussion on the relevance of floating urbanisation.

2 Methodology

Floating urbanisation and the preconditions for this type of development is a relatively new topic, an thus not much theory is available. Therefore, the start of this research is inductive. With the help of scientific literature and other documents, general ideas about floating urbanisation and issue themes are derived. The remainder of this research is retroductive, trying to understand the mechanism of floating urbanisation development and pinpointing the hiccups of that mechanism (Blaikie & Priest, 2019). An appropriate research method for new topics is case study research. Case study research combines different data collection methods. Results of these data collection methods can be qualitative, quantitative or both (Eisenhardt, 1989). The outcomes of this research are of the qualitative type.

2.1 Research approach

This research uses a mixed method approach. The method can be divided into three steps: theory, practice and synthesis. The type of research and the methods focus on different (sub) questions as shown in figure 4.

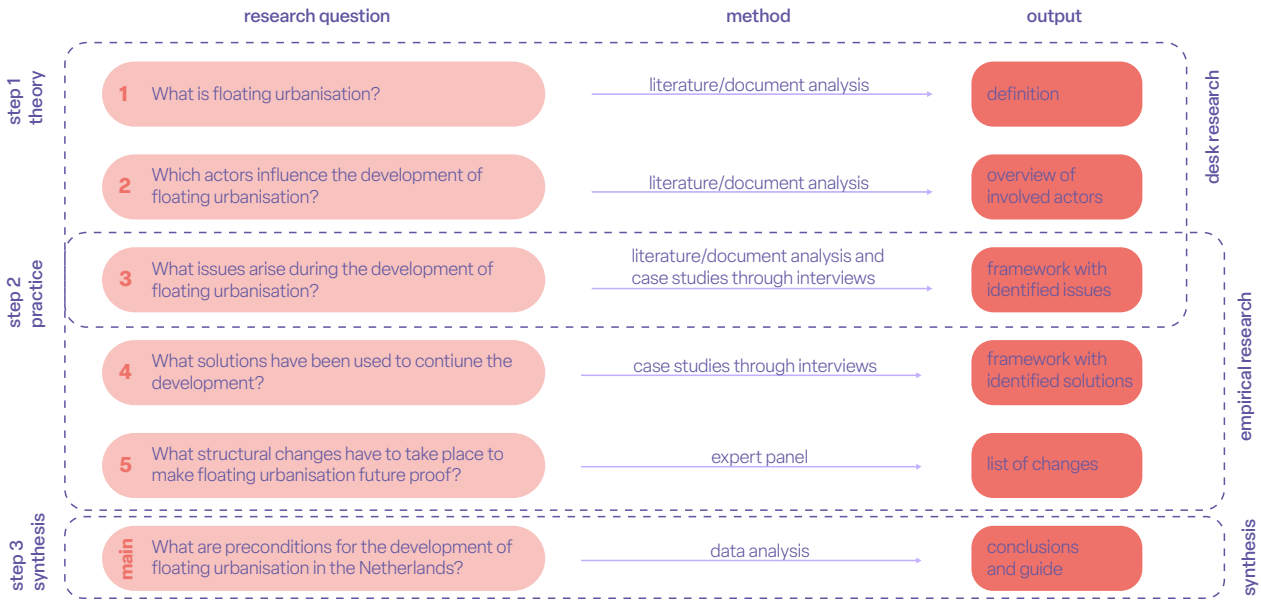

Figure 4 | Schematic overview of the methods used per sub question

2.1.1 Theory

This step consist of desk research. First, a document analysis is executed. The goal of this analysis is to get an overview of the current state of floating urbanisation projects (see list in appendix 1). Floating urbanisation projects that are planned, projects that are currently in use and projects that were never realised are gathered in an overview of projects. This is helpful to understand the current number and scale of projects, and it ensures an easy case selection later in the process. Types of documents that are used for this analysis consist of municipal documents, design platforms, websites of project developers or architects and newspaper articles.

Subsequently, a systematic literature review is executed. The objective of the literature review is to give a preliminary answer to the first three questions. This implies, finding out what the definition of floating urbanisation is, understanding which actors are involved and identifying the type of issues that could arise during the development of this urbanisation. A search query was developed in an iterative way to find the relevant literature. There are two aspects that define the subject for this research, the floating aspect and the urbanisation aspect. Synonyms for these aspects are used to find all the relevant available literature in English and Dutch (see figure 5). The document analysis has demonstrated that the scale of projects in the Netherlands is not on a city level but on a smaller level, neighbourhoods or buildings. This was taken into account with the composition of the search query.

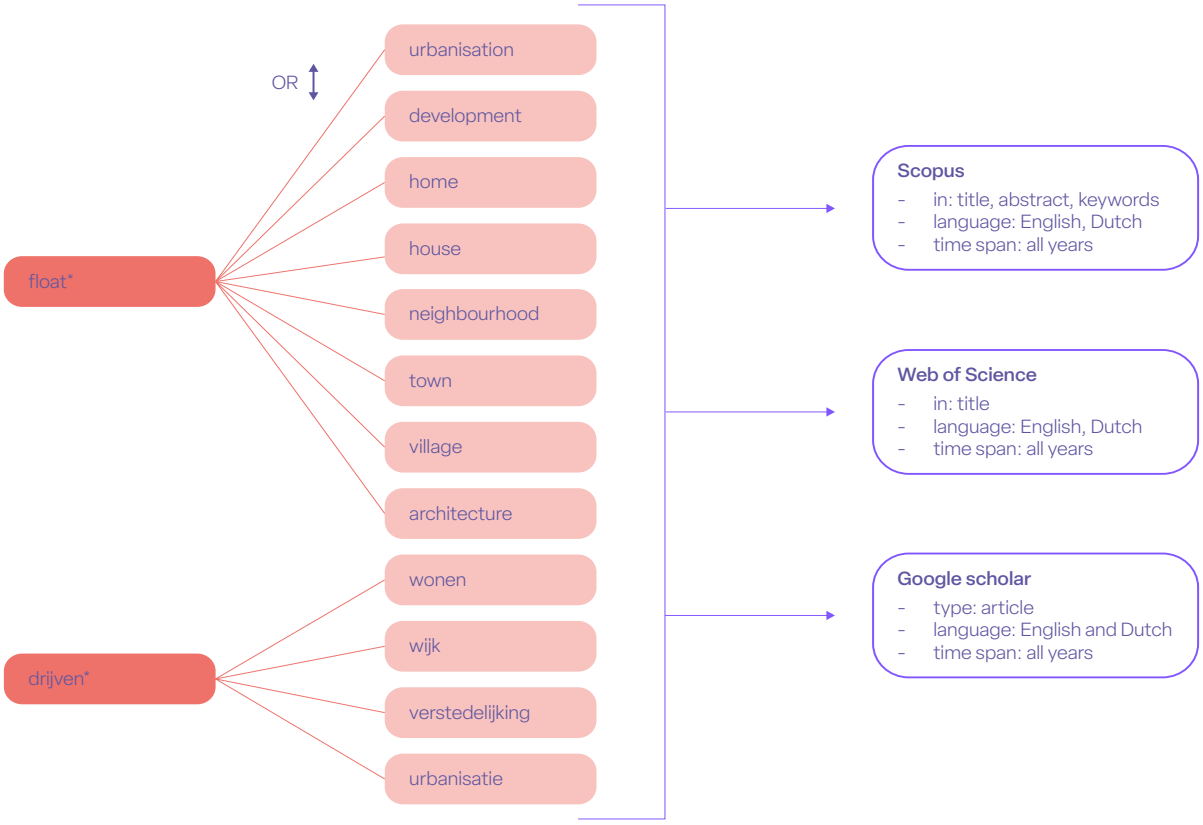

Figure 5 | Composition of the search query

This search query was used in search engines Scopus, Web of Science and Google Scholar, and resulted in a total of 247 articles. The articles are scanned on their relevance for this research by reading the title, key words and abstract. After the scan, 36 articles turned out to be relevant. The relevant literature is used as a starting point. The information and references in these documents can lead to more relevant references and projects that were not found though the search query itself, this is called the 'snowballing effect'.

Based on the relevant literature and documents a definition of floating urbanisation for this research is derived. Furthermore, an actor analysis is executed. This type of analysis is of great use for public problems (such as global warming and housing shortage) because many individuals, groups and organisations are involved, affected or have partial responsibility to act. A crucial aspect for solving the problem is figuring out who these actors are (Bryson, 2004). Next to this actor analysis a framework with the development barriers and conditions is developed. The cases (in the next step) are analysed trhorugh the use of this framework. The themes of the different issues found in the research paper of Penning-Rowsell (2020) is used as a starting point for the framework. Barriers and conditions that were found in other literature and documents are fit into this categorisation and arranged per development phase. As a final step of the literature research, the identified barriers and conditions are linked to the actors that can influence them.

2.1.2 Practice

The second step consist of case study research and a check with an expert panel. On the basis of predefined selection criteria, two case studies are selected. The cases are analysed through the use of semi-structured interviews. The results of the case studies are checked with an expert group to enlarge their generalisability.

The case study method is a helpful method when you are researching the characteristics of real-life events, for example organisational and managerial processes or neighbourhood change (Yin, 2018). Through a case study, an example of a phenomenon is examined in practice (van Thiel, 2010). It is more powerful when conclusions arise from two or more different cases than from a single case (Yin, 2018). More than one case gives the researcher the possibility to analyse the gathered date within each case and across cases (Gustafsson, 2017). Therefore, two floating projects are selected based on predefined selection criteria. Public, private and societal actors from these projects are interviewed in a semi-structured interview to understand what issues they encountered. For each perspective (public, private, society), at least two interviews per project are held. This makes it possible to verify or deny experiences. This results in a minimum of twelve interviews, six interviews in per case. The categorisation of themes that was developed in the first step (desk research) is used to structure the interview and focus on the relevant subject areas.

The outcomes of the interviews are analysed per case and also cross-case. In case analysis means that the responses of the three different actor perspectives are compared within the case. In the cross-case analysis, the results of the two cases are compared to each other. The focus of this analysis is to find out what issues occurred in practice and what solutions were used to solve them. The results of these interviews are compared to the development framework that was created during the desk research. After this comparison, a selection of issues that are subject for the discussion with experts is made. Issues are selected when they stand out after the comparison with theory, occur in both cases and have the most impact on time, expenses and quality of the project.

An expert panel is used to validate the research

results. This type of validation is common in the field of health and medicine to reach consensus on controversial subjects (Fink et al., 1984). It comes down to a qualitative (group) interview based on a topic that focuses on specific knowledge of the expert (Döringer, 2021). For this research, the expert panel is a group discussion concerning the structural changes that have to take place to solve the selected issues on the long term. The panel consists of five people that work in the field of one of the selected issues. Each person brings in the expertise to reflect on one or more of the selected issues from a broader perspective than solely case specific.

2.1.3 Synthesis

The results derived from theory and practice are used to draw conclusions on the sub questions and the main question. This implies that preconditions that were found in this research and apply to floating urbanisation in the Netherlands are defined. This information is gathered in a guide for the municipality of Rotterdam. This guide uses graphics to give a clear overview of the obstacles that are within the influence of the municipality and the possible actions they can undertake.

2.1.4 Data analysis

In each step of the research method the gathered data is analysed. In the first step, the documents found through the literature and document review are compared to each other. This comparative study results in a framework with the barriers and conditions in each phase of the process and the actors that can influence these issues. This framework is used as input for the second step, to structure the case study interviews.

The data gathered in the second step (empirical research) are analysed in-case and cross-case. Yin (2018) describes this technique as 'multiple-case holistic'. Within case analysis helps to cope with big volumes of information. There is not one approach for this analysis but the overall goal is to become familiar with each case (Eisenhardt, 1989). The framework that was used to structure the interviews, perhaps with some adjustments, could be helpful here. Another advantage of in case analysis is that it can support cross-case analysis. When each case is analysed in the same way it is then possible to compare the outcomes of these analyses and find similarities and differences. After the analysis of the data the results of the case studies are presented to the expert panel to understand their impact in a larger context.

In the third step the outcomes of the data analysis are used to answer the sub questions, the main research question, and develop a guide for easy access to the information.

2.2 Data plan and ethical considerations

The data collected in this research is gained through literature and document reviews, interviews and knowledge from practice. Core elements of scholarly research are its transparency, reproducibility and reusability. This applies to the research in its entirety but is even more important for the gained data. Good data management facilitates achieving these core elements. Wilkinson et al. (2016) formulated four principles to help maximise the added-value and to guide researchers. The principles findability, accessibility, interoperability and reusability are applied to the processed data of this research by the following undertakings:

The final thesis is to be published on the educational repository (accessible via: https://repository.tudelft.nl/) of the Technical University of Delft.

(Meta)data that is not part of this publication can be requested by sending an email to the author (tessie.maarschalk@live.nl)

All information is written in formal English. The translation of Dutch terms is written in brackets right behind the term. A summary of the

interviews that are held in Dutch are translated to English.
The gathered data is saved in a common file format (e.g. pdf). These files are structured and their provenance is described in detail.

However, sensitive data (such as personal information of interviewees) will not be shared without prior permission of the involved person. This means that as a general principle the data is anonymised. This anonymisation is only resolved when strictly necessary. Three other ethical considerations, formulated by Diener and Crandall (1978, as cited in (Bryman, 2012), are taken into account. To ensure that participants are not harmed, participation to in research is on a voluntary basis and participants can always decide to leave a question unanswered or stop the interview. Secondly, participants are informed beforehand about the goal of the research, the method used and the way in which their information is used. By providing clear and truthful information about the research deception of the participants is prevented.

3 Theory

To answer the first three sub-questions (see paragraph 1.2), a literature and document study is executed. The information gained will be used for the empirical study.

3.1 Definition floating urbanisation

The introduction demonstrated that the Netherlands is an incubator for floating urbanisation. Using the Netherlands as a research area is the first demarcation of this project's scope, and the answer to the first research question will define the scope of this research further. The first research question is: *What is floating urbanisation?*

Floating urbanisation is derived from combining two verbs: float and urbanise. To float means to rest on the surface of or to be suspended in a fluid, usually water. In general, urbanisation refers to the process of shifting a population from rural to urban settlements. However, the term is also often used to refer to a change of land-use when plots are sold and given urban purposes such as houses or offices (Mcgranahan & Satterthwaite, 2014). In this thesis, urbanisation refers to the latter. Urbanisation can take place on both small and large scales. An example of large-scale urbanisation is the realisation of towns or even cities. Adding one building is also considered urbanisation; that specific area is becoming more urbanised. The floating projects that have already been realised are mainly on a small scale (1-20 buildings, see appendix 1). This research focuses on urbanisation on a larger scale than what has been realised before, which could be called the neighbourhood scale. Floating urbanisation means surface water is used for urban purposes (De Graaf, 2009). Rotmans (2021) defines floating urbanisation through his self-developed swaying principle ('meedeinprincipe'). This principle implies that buildings that are adaptable to the water level, which means they are buoyant and movable, are defined as floating buildings.

Floating urbanisation can occur on the surface water of (artificial) lakes, rivers or even the sea. It is also conceivable that the buildings are not permanently floating but can float in times of high tide or flood; this is called amphibious urbanisation (Ministerie van Volkshuisvesting Ruimtelijke Ordening en Milieubeheer [VROM], 2009). The area where floating buildings are constructed obtains a double function, accommodating water and buildings. Combining two functions in one area is a form of multiple-area use (Habiforum, 2001). Multiple area use leads to more efficient usage of the scarce available land.
To accommodate buildings in an area that has a risk of flooding or is permanently covered

by water, measures have to be taken. These measures fall into the category of measures that diminish the damage caused by water, which was mentioned in the introduction (Pols et al., 2007).

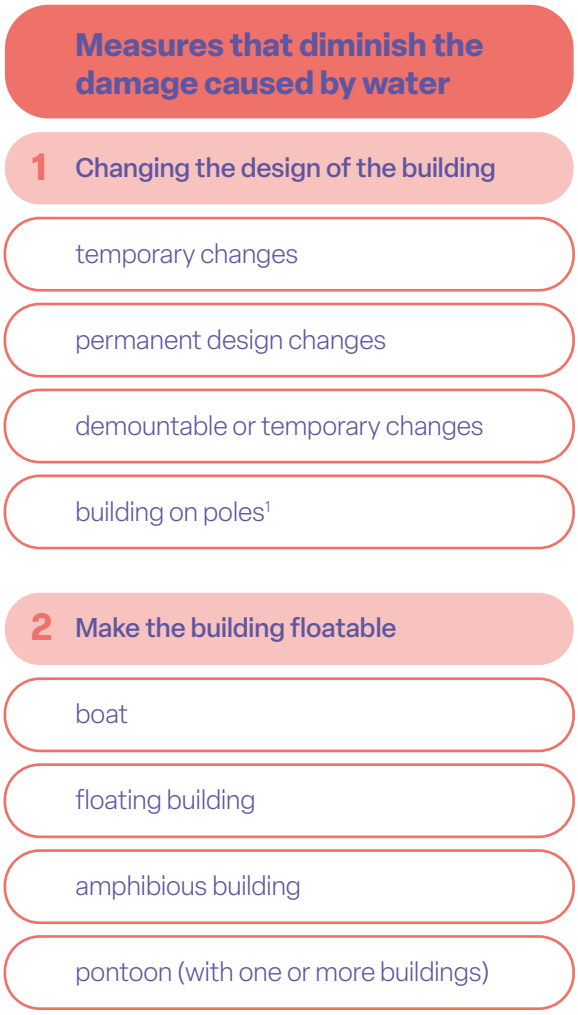

Figure 6 | Adaptation measures for buildings in water areas (Pols et al. 2007)

Diminishing the damage caused by water can be achieved by either changing the design of the building or making the building floatable. When the floating urbanisation definition of de Graaf and Rotmans' (2021) swaying principle is applied to the categorisation of Pols et al. (2007) it becomes clear that only buildings that fall into the second category of measures should be considered floating urbanisation. The difference between floating and amphibious buildings is that the first is designed for permanent accommodation on the water, whereas the latter can operate in dryland conditions and during flood events (Penning-Rowsell, 2020). A boat can be distinguished from the other three types by its ability to navigate by itself (Pols et al., 2007).

It is not uncommon to promote floating urbanisation projects as the first floating project in the city. This is striking since houseboats have been around for a long time. In 1652, a municipal regulation prohibiting living on boats in Amsterdam was adopted (Kistemaker, 2000). These were the very first houseboats, even though these boats could still navigate by themself. There are different types of houseboats: boats that have been transformed into houses and can either navigate by themselves or not and houses that have been constructed on a platform that floats. The differences between the latter houseboats and the floating developments nowadays are not that evident. Both are primarily rectangular-shaped housing designs constructed on a concrete floater, and both are buildings for the Environmental act and the Housing Act (Wabo & Woningwet), as explained by the Council of State (Raad van State, 2014). As a mortgage provider for both housing types, Rabobank distinguishes between houseboats and floating houses. Houseboats have to be registered as ships and be attributed a mooring permit. For floating houses, the leasehold or ownership of the plot is required because the mortgage is established on the plot and the building (Rabobank, 2022). The most significant difference is found in the formation of the two types. Groups of houseboats are built or towed one by one in an organic way, whilst floating buildings are developed all at once with a predetermined plan (Rijcken, 2006). Due to their different realisation method, houseboats are left out of the scope of this research.

For this research, changes or additions to the built environment will be considered *floating urbanisation* when a piece of land (that can be flooded) or water has been given an urban purpose, and the buildings that arise are adaptable to changing water levels. In practice, this means that the buildings are boats, floating buildings, amphibious buildings or constructed on pontoons.

3.2 Actor analysis

Neither the development of floating urbanisation nor the conditions that are required for this development exist in themselves. Floating urbanisation has to be made by people. The realisation of floating urbanisation becomes possible through the creation of the right development conditions. Because people set these conditions, we first have to identify these involved parties and understand their interests and objectives in the process. After their identification, the development conditions that they set can be analysed. This analysis will give an answer to the second research question: *Which actors influence the development of floating urbanisation?*

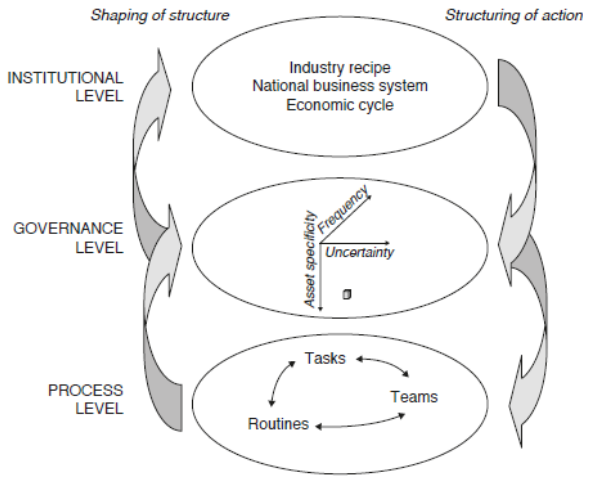

Figure 7 | Tectonic approach (Winch, 2010 p. 11)

Organisations, people or social entities that have an interest in a certain system or are able to influence it are the actors. Actors can be involved in the problem, affected by the outcomes or have means that are essential for the creation of a system (Enserink et al., 2010). For a development process, these actors can be divided into three main categories; the public actors, the private actors and the actors that represent society. Within the three main categories, there are actors that can either directly or indirectly influence a system (Enserink et al., 2010). Direct influence means that the actor can influence the development process. Indirect influence implies that an actor can influence the process by managing or steering the actors with direct influence. However, the influence does not only work in one direction. What happens in the process has an impact on the decisions made by the direct actors on governance level and the actions of the direct actors also shape the operations of the indirect actors on the institutional level. This system of influencing the process and other levels of actors has been visualised in the tectonic approach in figure 7 (Winch, 2010).

Combining the categorisations of influence and the public, private, and societal dimensions leads to a model for the actor analysis that is based on the model used by Czischke (2018) and is shown in figure 8. The direct actors operate on the process level, and the indirect actors operate on the governance and institutional level. The institutional actors influence governance actors of all three perspectives, even though they are public actors. They shape the context wherein the other actors operate. This model is filled out with the use of literature and documents.

The public dimension knows the most obvious hierarchy. Local entities, such as municipal departments and regional waterboards, have a facilitating role and, therefore, direct

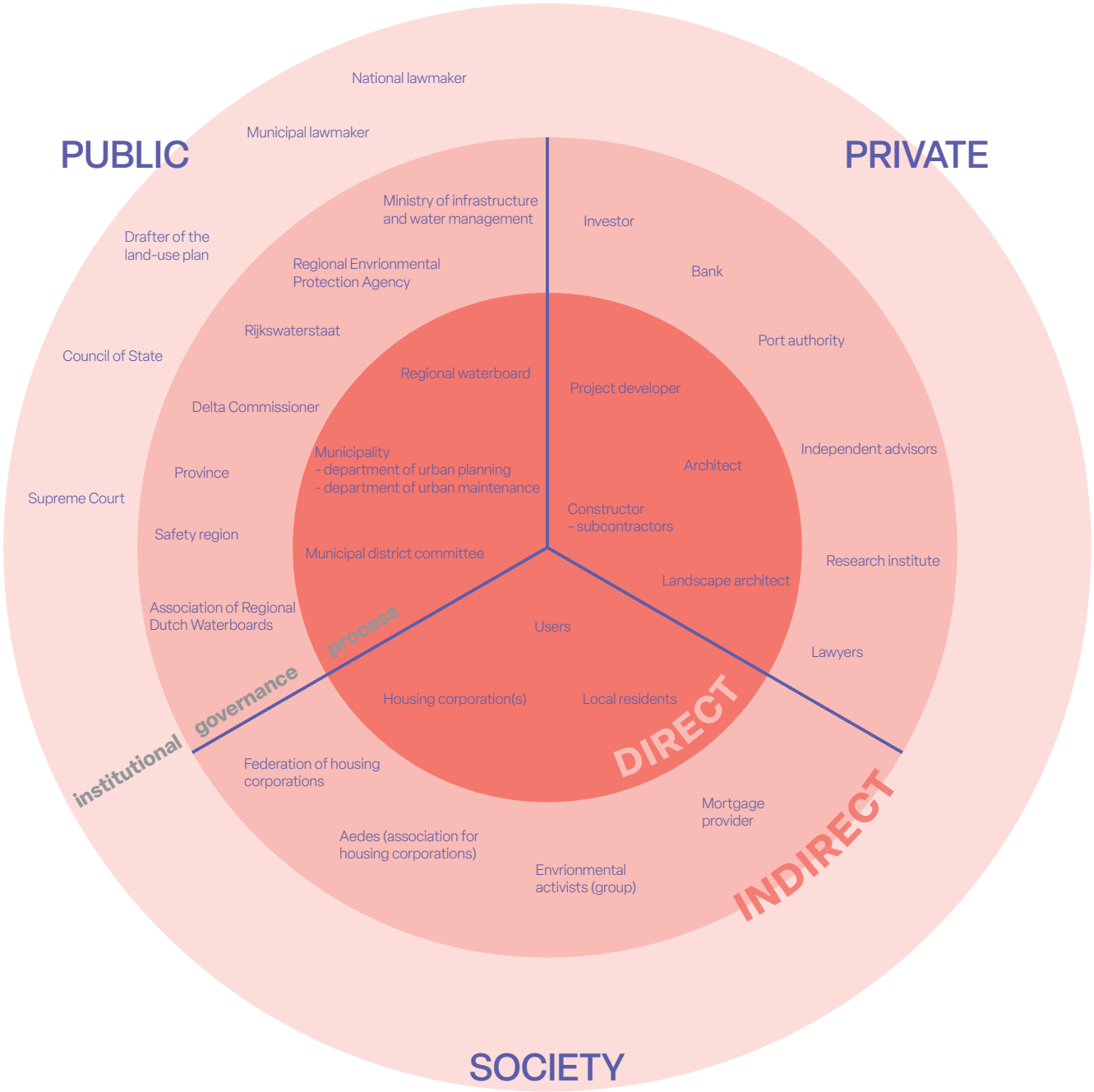

Figure 8 | Involved actors

influence on the potential development of floating urbanisation. They can decide if, where and when floating urbanisation is realised through the use of their policy documents. However, these actors are not completely free to do as they wish. They are dependent on the decisions, regulations and policy documents of 'higher' entities (Gaaff, 2015). For example, the municipal land-use plans have to comply with the provincial structuurvisie (structural vision). This structural vision, in turn, must comply with the national water strategy of Rijkswaterstaat.

For the private dimension, the hierarchy is not as clear, but its actors with direct influence are certainly dependent on the decisions and actions of indirect actors. A project developer can only go through with their plans as long as the investor has given his permission to fund the project. The architect in his place is influenced by the research of (private) research institutes about new methods and materials for the design.

Society actors are the least affected by other actors. Housing corporations (if involved in the project) are partly steered by umbrella organisations but they are not strictly regulated by them. Buyers of the houses are dependent on the willingness of banks to grant them a mortgage loan. This willingness is dependent on the risks involved for the mortgage provider (Personal communication A, 7 September 2022). Actors are not only influenced by actors from the same dimension. Actors from other categories can also have an impact on the decisions and actions taken by direct actors. An example is the urban planning department of the municipality that puts out the development to tender, after which the developers or architects lodge their designs according to the conditions of the tender (Van Ballengooijen, 2012).

The case study research will focus on the direct actors and their influence on the development of floating urbanisation. It is good to keep in mind that these actors do not operate with complete freedom. The validation with experts and the guide that are the epilogue of this research will

3.3 Development conditions

Ton van Namen addressed in an interview the seemingly endless string of problems that occurred with the creation of the floating neighbourhood Waterbuurt in Amsterdam (Palfrey, 2021). Several reasons for the laborious development processes of floating urbanisation can be found in literature. The barriers and conditions that were found have been gathered to give a preliminary answer to the third research question: ***what issues arise during the development of floating urbanisation?***
Penning-Rowsell (2020) gives an overview of the barriers to floating domestic building innovation in developed countries. These barriers have to do with a lack of knowledge and skills from different stakeholders in the development process, insufficient regulation and legislation, disconnection with current infrastructure, technical concerns, especially when it comes to scale, impact on the environment and ecology and the public perception of floating buildings. His categorisation is adopted and used as a starting point. Barriers and conditions that were formulated by other writers and researchers are integrated into this categorisation.

Knowledge and skills	
Barriers	**Conditions**
Lack of knowledge from public parties in many aspects of the development: planning, permitting, feasibility and construction (Penning-Rowsell, 2020). This causes reluctance to facilitate floating urbanisation (De Graaf, 2009; Kloos and de Korte, 2007).	Early involvement of stakeholders and local residents helps to meet their needs better and diminishes the chances of delay (Schuwer, 2007; Van Dijk, 2021).
Limited experience of private parties resulting in a small group of companies willing to bid or floating development projects (Gemeente Woerden, 2019; Kloos en de Korte, 2007;Penning-Rowsell, 2020). The tender requirements are sometimes too high, market parties cannot fulfill those requirements (De Blauw, 2015)	A PPP or another kind of collaboration form is needed to overcome different ambitions and share costs and risks (Koster, 2014; Schuwer, 2007).
Lack of scientific knowledge to support environmental assessments, this is especially important for the impact on the water quality (De Graaf, 2009; Kloos & de Korte, 2007).	Knowledge from realised projects should be transferred to municipalities, waterboards and contractors (De Graaf, 2009).

Figure 9 | Identified aspects in category knowledge and skills

Knowledge and skills

The first category is knowledge and skills (see figure 9). Public parties lack the knowledge and expertise in a number of fields related to the development (planning, permitting feasibility and construction). This causes a certain reluctance to facilitate floating urbanisation (De Graaf, 2009; Kloos & De Korte, 2007; Penning-Rowsell, 2020). Next to that, with limited knowledge, it is challenging to write out a fitting tender. Tender requirements could be too high to fulfil by the few private parties that have enough experience and are willing to bid for floating development projects (De Blauw, 2015; Gemeente Woerden, 2019; Kloos & De Korte, 2007; Penning-Rowsell, 2020). There is also a gap in the knowledge about the impact of these projects on the local environment (De Graaf, 2009). The experience gained in the projects that do take place should be shared with parties that are involved with the development of other floating projects (De Graaf, 2009). Helpful in this knowledge sharing could be a Public-Private Partnership, or another form of collaboration between the different actor perspectives (Koster, 2014; Schuwer, 2007). The early involvement of stakeholders helps to understand their needs and the context of the project (Schuwer, 2007; Van Dijk, 2021).

Regulation and legislation

The regulation and legislation barriers (see figure 10) have to do with civil law and public law. The Dutch regulations are not yet tailored to certain aspects of floating urbanisation. Due to the mobility aspect of floating houses, their legal status in civil law is uncertain (Architectenweb, 2004; De Graaf, 2009; Koster, 2014; Penning-Rowsell, 2020). This has a negative effect on the number of providers and the conditions for taxation and mortgages (Penning-Rowsell, 2020). The Dutch Supreme Court ended this discussion in 2012 and explained that floating houses are movable property (Hoge Raad, 2012). The buildings because they fall within the definition of a ship (property, not being an aeroplane, that is destined to float and (have) float(ed), based on their construction), and ships are considered movable property in general (Hoge Raad, 2010). This does mean that a floating building cannot be split into apartments since only immovable property can be split (Flikkema et al., 2021; Ploeger & van der Plank, 2021).

Floating buildings are considered buildings in the field of public law. This means the building regulations apply. The Council of State decided that in a case in 2014 (Raad van State, 2014). However, these regulations were made for buildings on land and cannot be applied one on one to floating buildings. Additions to these regulations (Regeling Bouwbesluit 2012, 2022) and an explanatory document by the responsible ministry (Ministerie van VROM, 2009) have been made. Still, developers report that the absence of clear and binding building regulations for floating buildings makes it hard to understand what they can and cannot do (De Graaf, 2009; Penning-Rowsell, 2020; Van Dijk, 2021). Next to that, spatial planning departments and water management departments do not always align their policies. This results in situations where safety requirements set by water management authorities cannot be met (Schuwer, 2007).

Regulation and legislation	
Barriers	**Conditions**
The legal status of floating homes is uncertain. As a consequence, taxation and mortgages are difficult to obtain (Architectenweb 2004; De Graaf, 2009; Koster, 2014; Penning-Rowsell, 2020)	Clear rules and regulations for building on the water (or adaptation of the landrules) are needed (Kloos & de Korte, 2007; Koster, 2014)
There is a lack of coordination between the municipal policies of water management and spatial planning (Schuwer, 2007)	
Property law prohibits ownership of units on a floating island as a floating island is seen as movable property and cannot be split (Flikkema et al. 2021; Ploeger & van der Plank, 2021)	
The lack of a binding regulating document with technical guidelines and standards makes it difficult for contractors to understand the applicable rules for floating houses (De Graaf, 2009; Penning-Rowsell, 2020; Van Dijk, 2021)	

Figure 10 | Identified aspects in category regulation and legislation

Exploitation and economy

The third identified category of impediments is economical (see figure 11). Compared to similar buildings on land, the floating equivalents are more expensive. This is caused by high implementation and material costs (Baart de la Faille et al., 2011; Bradecki & Konsek, 2020; Schuwer, 2007). Next to that, there is extra investment needed because the infrastructure has to be realised as well, and there is no economy of scale due to the small size of the projects (De Graaf, 2009; Koster, 2014; Penning-Rowsell, 2020). De Graaf (2009) argues that public parties lack experience with the exploitation of water. This is at odds with the long history of houseboats in the Netherlands, especially in Amsterdam (Callegaro, 2020). A learning process is required to take floating urbanisation through the take-off stage and convince investors that there is a steady market demand (De Graaf, 2009; Van Dijk, 2021).

Infrastructure and planning

The barriers within the category of infrastructure and planning are gathered in figure 12. The design of the projects is limited by the available construction site and the transportation route to the final location (Ronzatti &Lovric, 2020; Schuwer, 2007). Fire safety measures also affect the design possibilities; this especially concerns enough escape routes to the land (Belder, 2019; De Graaf, 2009; Schuwer, 2007). Enough public space and parking space in the surroundings of the floating urbanisation could be a limitation when the development takes place in an already dense urban area (De Graaf, 2009; Penning-Rowsell, 2020). Another barrier is that developers' and municipalities' interests in water management and housing planning are not aligned (Penning-Rowsell, 2020). Spatial planning by public parties should allocate space to floating urbanisation. This also gives developers insight into the possible locations for their plans (Penning-Rowsell, 2020; Singelenberg, 2008; Schuwer, 2007).

Exploitation and economy	
Barriers	**Conditions**
Extra investment (compared to land based project) is needed because the infrastructure has to be developed as well and no economy of scale (De Graaf 2009; Koster, 2014; Penning-Rowsell, 2020)	There is need for a learning process for floating urbanisation to go through the take off stage (De Graaf, 2009)
Investors are hesitant because they are not convinced that floating urbanistion will develop in a full grown market (De Graaf, 2009; Van Dijk, 2021)	
Waterboards and municipalities have no experience in the commercial exploitation of surface water for economic development (De Graaf, 2009)	
High implementation and material costs (Bradecki & Konsek, 2020; Schuwer, 2007). Costs for a floating greenhouse are a lot higher than the same building on land: 32,8 vs 18,5 mln (Baart de la Faille et al., 2011)	

Figure 11 | Identified aspects in category exploitation and economy

Infrastructure and planning	
Barriers	**Conditions**
Conflicting interests of developers and municipalities about water management planning and spatial planning for housing (Penning-Rowsell, 2020)	A location nearby a bigger city has a major influence on the success of a project (Schuwer, 2007)
Transportation routes, lack of yard facilities and construction in highly urbanised places can limit the construction of (especially bigger) buildings (Ronzatti & Lovric, 2020; Schuwer, 2007)	Land-use plans and national/provincial plans should include space for floating urbanisation (Penning-Rowsell, 2020; Schuwer, 2007)
Lack of public space and parking space in the close surroudings of floating urbanisation (De Graaf, 2009; Penning-Rowsell, 2020)	Extra measures for fire safety should be taken into account because floating homes should also abide by the housing law (Belder, 2019; De Graaf, 2009; Schuwer, 2007)

Figure 12 | Identified aspects in category Infrastructure and planning

Technology and scale

The technological barriers are confined to the use of certain materials (Schuwer, 2007) and the balancing of the houses, which proves to be difficult (Belder, 2019). Neither consensus on the preferred materials, nor on the favourable construction method has been reached. This could be explained by the fact that the different physical contexts ask for other construction methods. There is a need for the integration and combination of the best practices of current techniques to enhance the design of floating buildings (Penning-Rowsell, 2020).

With the enlargement of the scale of the projects, special attention should be paid to the availability of public space (on land or floating), infrastructure and utility units. The current designs and connections with the land do not deviate that much from houseboat designs (Penning-Rowsell, 2020; Schuwer, 2007; Van Dijk, 2021). There lies an opportunity to experiment with innovative design solutions when larger-scale projects are realised. Floating buildings in future projects should be not only able to withstand high water levels but also other severe weather conditions such as drought, with extremely low water levels, and strong winds.

Technology and scale	
Barriers	**Conditions**
The use of sustainable /natural matrials should be obvious because of the natural environment but it turns out that it is not (Schuwer, 2007)	Current techniques should be integrated into a design that provides the desired level of safety, sustainability and cost-effectiveness (Penning-Rowsell, 2020)
The lack of public recreational space is a limiting factor for scaling up- research abuut utility units and infrastructure on the water is required. Right now, the focus is still on shapes that we are familiar with (houseboats) (Penning-Rowsell, 2020; Schuwer 2007; Van Dijk, 2021)	Different aquatic environments call for different technical properties, shallow water (<1,5 m) is especially difficult (Penning-Rowsell, 2020)
Balancing the houses proves to be difficult, during construction and use (Belder, 2019)	The buildings should also able to withstand drought or severe conditions (Bradecki and Konsek, 2020)
No agreements are made about the maintenance phase in most realised projects (Schuwer, 2007)	

Figure 13 | Identified aspects in category Technology and scale

Environment and ecology

Environmental and ecological impacts form the next category (see figure 14). What stands out is the limited research that has been done on this aspect of floating urbanisation, although this type of development is more often than not presented as sustainable. It is certain that leaching materials are harmful to the aquatic environment (Bradecki & Konsek, 2020). Researchers suspect that the blocking of sunlight and the hindrance of water flow impact the water quality (Bol and Tobe, 2015; Schuwer, 2007). Pedroso de Lima et al. (2022) published their research about the impact of floating urbanisation on water quality and aquatic ecosystems during the execution of this research. They monitored dissolved oxygen levels, water temperature and ecological indicators over the course of ten months in different locations. The presence of floating buildings has both positive and negative consequences for the aquatic environment. The oxygen level, which is an indicator of the water quality, was lower but did not go beneath the threshold of 4.5 mg/l. Still, further research is required to understand the complex chemical/biological/physical processes that take place under floating structures and the long-term impact of their presence.

Public perception

The perception of this type of development is influenced by the fact that floating urbanisation is relatively new. The unfamiliarity with floating urbanisation causes a hesitant attitude of the society actors towards living on the water. Living in floating houses is not generally 'accepted' by the public (De Graaf, 2009; Penning-Rowsell, 2020; Schuwer, 2007; Singelenberg, 2008). The main reasons for that have to do with the accessibility of the houses and safety, but also financial capabilities are a limiting factor. Schuwer (2007) also reports that municipal actors tend to show restraint because they are unfamiliar with floating urbanisation. It is likely that this hesitant attitude will be overcome once the urgency of building on surface water becomes higher. Right now, this urgency is not felt (Schuwer, 2007).

Environment and ecology	
Barriers	**Conditions**
Environmental assessments might become a standard requirement (Penning-Rowsell, 2020)	Floating buildings can have impact on the water quality mainly because direct sunlight is blocked, first research results show that this impact is very little (Bol and Tobe, 2015) . This requires more research also because it can influence the permitting process (De Graaf, 2009; Penning-Rowsell, 2020; van Dijk, 2021)
Titanium and other materials that are used are harmful for the aquatic surroundings (Bradecki and Konsek, 2020)	
Limited waterflow and sunlight could cause algae growth (Schuwer, 2007)	

Figure 14 | Identified aspects in category Environment and ecology

Public perception	
Barriers	**Conditions**
Stakeholders are hesitant to get involved because they are unfamiliar with the principle of floating houses, especially municipalities (Schuwer, 2007)	Market research is needed to help understand the demand and develop a 'fit plan' for that specific demand (Schuwer, 2007)
There is no real urgency for floating urbanisation (Schuwer, 2007)	Potential users should to embrace the potential of living on the water permanently but people tend to be risk averse. Especially safety and accessibility are a threshold (De Graaf, 2009; Penning-Rowsell, 2020)
Living in floating houses is not generally 'accepted', cultural values can hinder the acceptance of floating urbanisation (Singelenberg, 2008; Schuwer, 2007)	
Floating urbanisation could disbalance the historical context of a city (Bradecki & Konsek, 2020)	
Financial uncertainty deters the potential users (Penning-Rowsell, 2020)	

Figure 15 | Identified aspects in category Public perception

The terminology used to indicate the identified aspects is quite definitive. Penning-Rowsell (2020) uses the term barriers for issues that occur in floating urbanisation. Schuwer (2007) talks about the success- and failure factors (succes- en faalfactoren). These terms might be too strong for what takes place in practice. Neither the barriers identified in literature are insurmountable, nor are the conditions essential for the realisation of the project. This is proved by the fact that there are finished floating urbanisation projects in spite of the presence of these barriers and conditions. Therefore, more accurate terms for the identified issues would be ***obstacles*** and ***improvements*** for the development of floating urbanisation.

However, it could be that other projects have been initiated but never made it to the realisation phase for one or more reasons and that there are barriers and conditions for floating urbanisation. These unrealised projects are not included in the studies because they remain unknown to the public and, thus, to the researchers. An interesting addition to the existing literature would be to find out if these projects exist and what the barriers and missing conditions for their recision are.

An overview of the above-mentioned obstacles and improvements can be found in the development framework in appendix 1. The different phases of the building life cycle (plan, build, use, maintain, repair/recycle and learn) have been used to structure this framework. Most of the aspects that were found take place during the planning phase and could therefore be essential or problematic for the actual realisation of the project. However, issues that arise in later phases but are foreseen can have an effect on the realisation.

After filling out the development framework, the actor perspectives are added. Public, private, and society actors can influence different obstacles and improvements, which one is influenced by which category is visualised in this layer. The public and private parties can influence more aspects than the society parties. Some obstacles and improvements do not fall within the responsibility of one specific actor, and some are influenced by all actors; these are left blank. The aspects in the regulation and legislation category are all influenced by the parties that draw up these rules and regulations, the public actors. The technological aspects fall

under the influence of the private parties that are responsible for the design solutions in the project. The environmental obstacles are mostly not influenced by one of the parties because they are about the impact of the buildings on the local environment. The perspective on this development is under the influence of each actor since your perspective is formed by what you perceive. The aspects of the other three categories are influenced by the public and private parties.

The framework is a summary of issues that could arise during the development of floating urbanisation projects and will be used to give direction to the second part of this research. The aim of that part is to find out if the theory is in line with what happens in practice and to give nuances to theoretical aspects. Interviewees from the three different perspectives will be questioned about their experiences to get the complete picture. The aspects can be confirmed or denied, and additional aspects could come up.

4 Practice

4.1 Cases

During the literature study, a list of identified projects in the Netherlands was made (Appendix 2). The case studies for this research are selected from this list based on predefined selection criteria (figure 16). Cases should be situated in a city in the Netherlands and entail at least fifteen units that are floating or amphibious. Furthermore, the project has to be realised completely and has multiple parties involved in the development process. Based on these criteria, two cases are selected: Nassauhaven in Rotterdam and Waterbuurt West in Amsterdam.

1 Situated in the Netherlands

2 Realised and in use

3 At least fifteen buildings

4 Floating or amphibious buildings

5 Multiple parties involved in development

Figure 16 | Case study selection criteria

Figure 17 | Dwelling Waterbuurt West (photo by author)

Figure 18 | Lofts Nassauhaven (photo by author)

4.1.1 Waterbuurt West

This project is part of the artificial islands city expansion IJburg. One of the islands has an inland lake, which is where the Waterbuurt is situated. IJburg is located in the east of Amsterdam, a 30-minute bike ride away from the central station. The eastern part of the Waterbuurt is realised through private commissions, whilst the western part is realised on a project basis (Van Ballengooijen et al., 2012). Therefore, only Waterbuurt West is used as a case for this research.

The tender for this project took place in 2001. Eleven years later, in 2012, the last houses were delivered. The main parties that were involved in this lengthy process are shown in figure 22. Steigereiland had been designated a pilot area for new methods of housing development, and developing floating housing was one of the things the municipality of Amsterdam wanted to test here. One of the submissions for the tender of Project team IJburg came from the developer Woodstone & Sparkey. This developer formed a syndicate with developer Monteflore and Housing Corporation Eigen Haard. The urban plan was designed by Villanova architects. The design of the houses was done by architect Marlies Rohmer and construction was carried out by ABC Arkenbouw. There was close contact with the utility companies to connect the houses to the necessary infrastructure. The involved public parties include the water authority Amsterdam, project team IJburg, the development department, the district council and the engineering team, all from the municipality of Amsterdam.

The project includes, among a few other types of dwellings, 55 floating houses. These floating houses all have their own pontoon. Some are connected, either with two or three houses in a row. Housing corporation Eigen Haard was involved from an early stage because they aimed to develop floating social housing. Unfortunately, this was financially not viable because there is a fixed maximum rent for social rent dwellings, and the costs for this type of development could not be covered with this rent. In the end, it was decided to change the social rentals into 18 free-

Figure 19 | view from the alley on the jetty, photo by author

Figure 20| movable ramp, photo by author

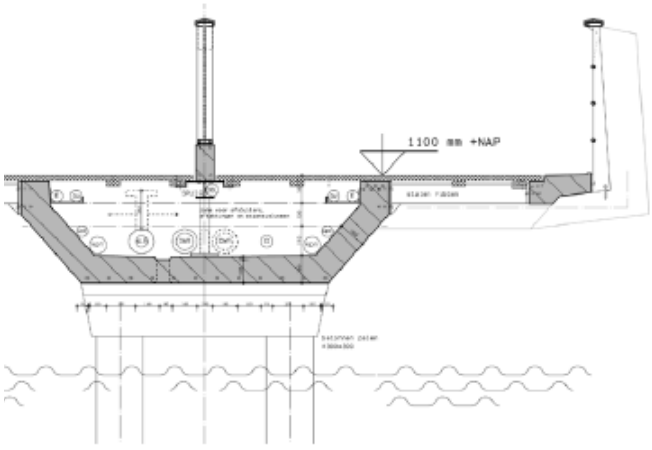

Figure 21 | cross-section of the jetty , Villanova Architecten

sector rentals that are not restricted by a rent cap. The intended social rent dwellings found a place in the apartment building on the quay.
The houses are accessible via four alleys underneath the apartment block on the quay that is connected to public jetties (figure 19). These jetties are open to the public and function as streets. The design, especially the dimensions, of these jetties was adjusted to be able to install the utilities underneath the walking surface of the jetty (see figure 18). Each house has a movable ramp from the jetty to the front door. There is space next to each house to dock a boat. Connections between the jetties were made to provide more escape routes. There was deliberately chosen not to add floating green because the municipal designers thought that it would not suit the urban look of the neighbourhood (Van Ballengooijen et al., 2012). Not all residents of the houses share that opinion, and some have attached floating gardens or flowerpots to compensate for the absence of green (figure 23).

Figure 23| public jetties that serve as street, photo by author

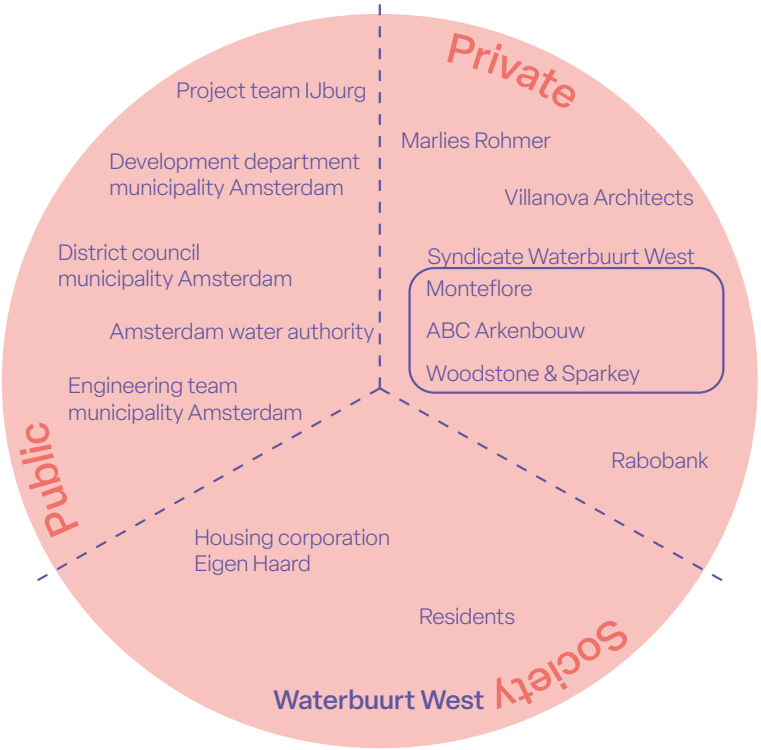

Figure 22| Involved parties, Waterbuurt West

4.1.2 Nassauhaven

The Nassauhaven is located in the east of Rotterdam, in a neighbourhood that is called Kop van Feijenoord. A significant percentage of the homes in this neighbourhood are social housing. The area has been appointed a focus area by the National Programme Rotterdam-South. This means that the area can count on extra investments to improve the number of homes, utilities and public space. The project in the Nassauhaven is one of the results of this programme.

The project is a pilot in Rotterdam and was realised between 2012 and 2020. It consists of eighteen floating lofts and a tidal park situated in an old harbour basin. The basin has a direct connection to the Nieuwe Maas which means that the water in the basin is subject to the tides of the river, a difference of approximately two meters. On one side of this basin is a residential area, and the other side is covered with a small park. At the end of the basin, there is a movable bridge. There is a pedestrian bridge that splits the basin in two, and ten houses float on the south side and eight on the north side of this bridge. The houses of 134-177 m^2 are coupled, and each pair has a small bridge that connects the houses with the quay. This bridge can adapt to the height differences caused by the tides.

The involved actors are shown in figure 26. The tender for the project was won by Public Domain Architects. Initially, they partnered up with Van Hattum en Blankevoort (part of the VolkerWessels concern), but that partnership did not last. The latter pulled out because they could not reach an agreement on the construction of the houses with the construction companies that are part of their concern, explains interviewee NB1. Public Domain

Figure 24| entrance bridge to the lofts, photo by author

Figure 25| mooring pole to keep the loft in place, photo by author

Architects was able to finance and develop the project without a partner too, which meant that the project could be continued without significant delays. Multiple departments of the municipality of Rotterdam were involved. These included the area development team of Feijenoord, the project managing team and market and contract specialists supported by an external advisor from Brink. From an early stage, the mortgage department of Rabobank Rotterdam was involved and had meetings with the developer and the municipality. The party that built the lofts was Bik Bouw.

Figure 27| connected lofts, photo by author

Figure 28| lofts and tidal park on the right, photo by author

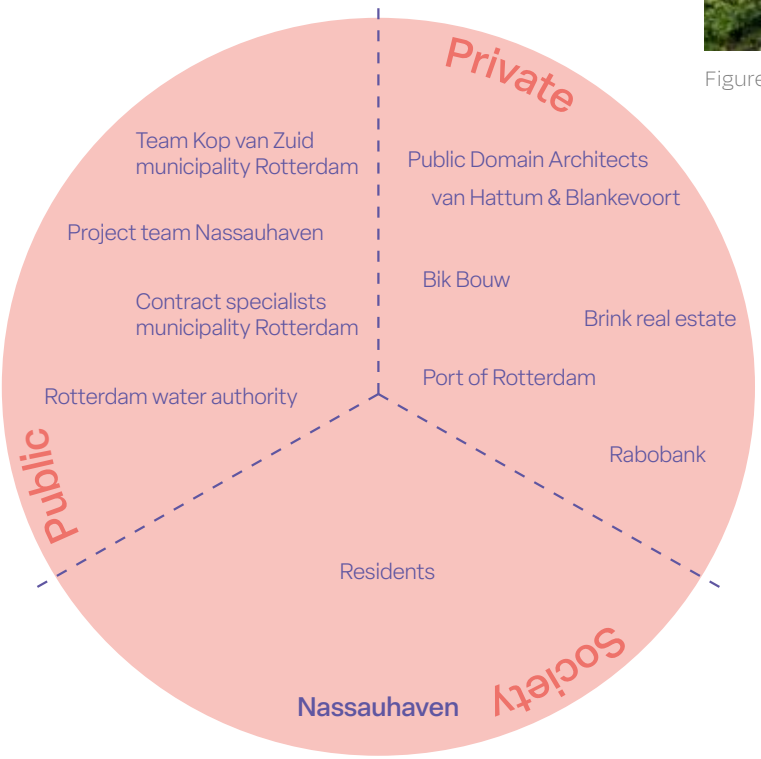

Figure 26| Involved parties, Nassauhaven

4.2 Interview preparation

Getting in touch with people that were involved in the projects was done via colleagues at the municipality of Rotterdam, LinkedIn, by visiting the neighbourhoods and through back channels. These actors are informed about the purpose of the interview and the privacy safeguarding measures (see appendixes 2 and 3). The interview is structured according to the seven themes that were derived from the theory part and takes approximately 45 minutes. To make the most out of this limited time, the interviewees received a list of statements (appendix 4) beforehand. The list is based on the theory and has one or two statements per theme. Five responses to the statements are possible, varying from totally agree to totally disagree. The filled-out list of statements gives insight into the themes that caused the most trouble for that actor and are interesting to discuss in the interview.

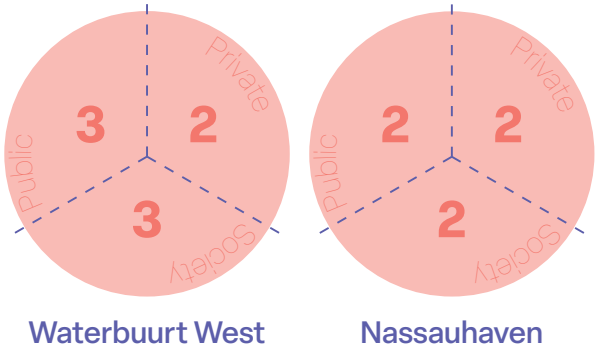

Figure 29| Distribution of interviewees

Eight persons that were involved in the development of the Waterbuurt West and six persons that participated in the development of the lofts in the Nassauhaven have been interviewed. Figure 29 shows from what perspective these interviewees were. A complete list of interviewees is included in appendix 5. The semi-structured interviews will give insight into the issues that occurred during the development, construction and maintenance of the floating projects.

4.3 Statements

4.3.1 Analysis

The results of the statements give a first glance at the topics that caused friction during the development of the projects. The responses of the interviewees serve multiple purposes. First of all, they indicate the interesting themes for the interview that follows. An indication of issues during the project is when the participant disagrees with a statement. Next to the interview preparation, the results of the statements can be used for a rough in-case and cross-case analysis. Comparing the participants' results from different perspectives and comparing the projects to each other. These results are used to adjust the preliminary answer to the third research question: ***what issues arise during the development of floating urbanisation***?

4.3.2 Results

The responses of all participants have been gathered in figure 31. The participants from the Waterbuurt West disagree the most with the statement about the knowledge present. This statement is quickly followed by both statements on regulation and legislation that are also negatively valued. The statement that has been given the most positive reaction is about the use of new techniques. Most participants think that the newness of the project did not impact the willingness to participate. What stands out is the different responses given to the statement on the financing of the project. Public parties value this statement negatively, whilst the private and societal parties give positive as well as negative answers. Overall, it can be said that the societal participants were more positive than the public and private parties.

Interviewees from the Nassauhaven give the least appreciation to the statement about the municipality's experience with commercial exploitation. Other statements that have been

valued relatively negative are the statements about the knowledge and experience present. The most positive reaction was given to the statement about the use of new techniques, similar to the Waterbuurt West. The responses of the Nassauhaven participants also differed the most on the statement about financing the project. The responses of the private and societal parties were more positive in general, with the sidenote that participant NB1 only responded with four or five, which has a major influence on the results.

On the basis of these results it can be concluded that most friction was caused within the themes Knowledge and skills, Regulation and legislation and Economy and exploitation. That one of the obstacles is a lack of required knowledge and skills can be explained by the fact that floating urbanisation is relatively new. The involved parties are still learning, this was also highlighted in literature (e.g. De Graaf, 2009; Penning-Rowsell, 2020). The uncertainty about the legal status and the applicable building regulations are two other mentioned obstacles. Both subjects, but especially the legal status are widely reported in literature that was written during the development of the projects. However, more recent literature outlines that the legal status is clear, the problem is that this legal status limits the useable legal instruments (Ploeger & van der Plank, 2021). The financial side of the project is experienced as obstacle by the public and private parties. The literature describes the higher costs involved and hesitant investors as obstacles. However, the interview results show that in these projects the financial issue had more to do with the few banks that were willing to provide mortgages and had to be persuaded by the project developers. This explains why the residents do not report the financing as obstacle, the public and private parties dealt with it.

This first glance at the experiences of the interviewees is kept in mind during the interviews and the preparation for the discussion with the expert panel.

Figure 30| docked boat in the 'garden', photo by author

	Theme	Statement	Interviewees					
			Public		Private		Society	
			NA1	NA2	NB1	NB2	NC1	NC2
1	knowledge and skills	At the start of the project we had enough knowledge about the planning, required permits and necessary scientific research	2	1	4	1	-	2
2		At the start of the project we had experience with building on surface water	2	1	4	2	1	1
3	regulation and legislation	The uncertainty of the legal status of floating buildings did **not** complicate the project	2	1	4	2	4	4
4		It was clear what regulation and legislation was applicable to the project	-	1	4	2	2	4
5	exploitation and economy	There was **no** problem with finding financing for the project	1	1	4	4	5	3
6		The municipality and the water authorit had sufficient experience with the exploitation of water	1	1	4	1	-	2
7	infrastructure and planning	The land-use plan took floating urbanisation into account before the start of the project	1	1	-	1	5	4
8		The transportation route to the project location did **not** limit the design	3	3	4	1	-	1
9	technology and scale	New building techniques were used in this project	5	4	4	4	4	3
10		Scaling up this project is easy (taking into account the available public space)	3	3	4	4	-	4
11	environment and ecology	The possible environmental impact was researched before the start of the project	4	1	-	-	-	4
12	public perception	The novelty of floating urbanisation did not impact the willingness to participate in the project	2	3	4	3	4	2
13		Building on the water is urgent	4	-	5	2	-	4

Figure 31 | Responses to statements

Nassauhaven

Interviewees

Public			Private		Society		
WA1	WA2	WA3	WB1	WB2	WC1	WC2	WC3
2	2	2	2	1	3	2	1
2	4	3	1	5	2	1	2
1	1	2	1	2	3	4	2
2	2	1	4	2	2	3	2
-	2	1	5	1	2	4	3
4	2	2	1	1	2	5	2
4	-	4	1	5	4	5	4
2	2	2	3	2	4	2	2
-	5	4	4	5	2	4	4
2	3	3	4	4	2	5	2
3	5	4	1	3	4	4	3
-	2	4	4	5	4	5	3
4	2	3	3	2	5	3	-

1	totally disagree
2	disagree
3	neutral
4	agree
5	totally agree
-	no answer

Waterbuurt West

4.4 Interviews

4.4.1 Analysis

During the interview, the participants nuance their responses to the list of statements by explaining what happened during the development of the project and why that was an obstacle. The follow up question is about the solutions they used to overcome these obstacles. The results of the interviews are used to give an answer to sub question four: *What solutions have been used to continue the development?*
Analysis of the interviews is done in three steps. First, each interview is paraphrased, and the information is categorised into themes. The themes that are used are the same themes that came out of the theoretical research. Secondly, an in-case analysis per theme takes place. Different issues and events that were addressed by the interviewees are combined to create the whole picture of what happened. As a third step, the two cases are compared to each other, the cross-case analysis. The results of this analysis are described underneath, followed by a table that also shows the actors that could influence each issue and the solutions that they used or proposed. Important to note here is that these results are a representation of the experiences and recollections of the involved actors. It could be that their experiences deviate from what took place.

4.4.2 Results

Knowledge and skills

Developing buildings on water requires special knowledge and skills. Not only those to make a heavy construction float but also knowledge and skills to develop the infrastructural elements such as jetties, electricity, access to drinking water and fire safety.
In both cases, the project was a pilot for the city because the municipality had no experience with developing floating houses. Their experience with houseboats and pilot projects with innovative housing solutions on land was only partially helpful (see chapter 3 for the difference between floating urbanisation and houseboats). The newness of the development resulted mostly in prolonged processes. The knowledge that was gained in Waterbuurt West is gathered in an information booklet after delivery of the project. Although the project in the Nassauhaven started after Waterbuurt West was finished, the involved parties did not analyse or learn lessons from the project in Amsterdam. This is partly due to contextual differences between the two cities. The projects deal with different local regulations, different urban structures and, most important different water. The Waterbuurt West is realised on internal, stagnant water whilst the water in the Nassauhaven is subject to the tides of the river.
Another obstacle that occurred in the municipal project teams is that the replacement of people after a few years meant some loss of knowledge. Loss of knowledge when people are replaced is unavoidable, even if the know-how of a project is transferred from the old to the new team member, the tacit knowledge will be lost (Nath et al., 2018).
The companies willing and able to take part in the tender are limited in number, especially in the Waterbuurt, but also in the Nassauhaven number of submissions was low. Next to that, the contractors and developers that do take part had some experience with building on water (mostly projects of a single building) but never with projects of this scale. Also, there are very few examples to learn from because the projects are among the first. Before the Waterbuurt West, there had never been a floating project on that scale. The Nassauhaven was the first floating project with multiple buildings in Rotterdam, and the floating pavilion was the first building. Other projects with a similar scale can be counted on the fingers of two hands. As a result of the limited experience and few examples,

What	Who	Solution	Alternative	N	W
Little knowledge about the construction of floating buildings and public docks	Municipality/ developer	Learn from the pilotproject and trust the experience of others	Evaluate and use the gained knowledge for future projects	x	x
Pilot project, learning from other projects is not always possible because of the different context	Municipality	Information booklet with gained experience in this project	-		x
Changes in the projectteam cause loss of knowledge	Municipality	Transfer knowledge to successors as good as possible	-	x	
Few tender entries because few parties with the required experience and capacity	Market parties	-	-		x
Some experience with floating objects (e.g. houseboats) and/or projectdevelopment on land	Municipality/ developer	Use the experience and translate it to this project	-	x	x
Unfamiliar with the installation of cables and pipelines on docks	Utility companies	Meetings with utility companies to gain knowledge, find solutions and change the jetty design	Get the utility companies on board early in the process		x
Technological defects due to lack of knowledge or cheap solutions	Constructor	Repairs and aftercare, a repairplan was made	-	x	x
Minor maintenance of the rental homes is difficult (no experience)	Maintenance company/ landlord	Let the regular companies do the best they can	-		x

Figure 32| Paraphrased answers knowledge and skills

development and construction processes take longer and ultimately cost more per unit. This meant that only high-segment housing was profitable in both projects (see also: Exploitation and economy). The houses in both projects had a lot of technical defects that could be associated with a lack of experience and knowledge on floating buildings or cheap solutions that are not suitable for use on the water.

Other stakeholders that need to build up experience and knowledge are utility companies. They were unfamiliar with installing cables and pipes on jetties, normally those lie underground. The consequences of this knowledge gap are explained under IV Infrastructure and planning. Now that the houses are realised and in use, it turns out that maintenance of the houses requires other skills than the maintenance of houses on land. The maintenance company that takes care of the rental homes in the Waterbuurt West needs particular techniques to maintain the floating houses, e.g. floating scaffolding to clean and paint the façade on the waterside.

Regulation and legislation

The two main issues encountered with the legislation applicable to floating buildings have to do with two different fields of law, civil law and public law. There is dissent about the legal status of floating buildings. When the letter of the law is followed, floating buildings are considered movable assets in terms of Dutch civil law. This was decided by the Supreme Court (Hoge Raad, 2012). However, in both projects,

the houses were considered immovable and also treated that way by the municipality, with regard to municipal taxes. In the Waterbuurt West the houses are registered twice in the land registry. The land plot that happens to be covered by water is registered as immovable property and given out in leasehold. The concrete floater, which is movable property, is branded and registered as a ship. One of the reasons for this construction was that there would be two registered properties that served as collateral for the mortgage loan. This gives the bank that provides the mortgage loan more certainty, see also Exploitation and economy (van Ballengooijen et al., 2012).
In the Nassauhaven, the harbour basin ground was split into eighteen plots. These water plots are given out in leasehold, whereas the sale of plots was the standard in municipal policy at that time. The municipality as lessor considered that the leasehold would provide them more influence and control, which was desirable in this pilot project. In general, when a plot is given out in leasehold, and a building is built on that plot, the leaseholder automatically becomes the owner of that building. This is called accession. Ownership as a consequence of accession is only applicable to immovable property. The house has to be durably united with the land to be subject to accession. Floating houses are not durably united with the land (which is exactly why the Supreme Court explained they are movable property). That the municipality considers the floating houses to be immovable property does not make them legally immovable property.

Interviewee NB2 explains that the municipality, in consultation with Rabobank, decided to establish a right of superficies as well. This right is dependent on the term of the leasehold and was thought to provide extra certainty for the mortgage loan. A right of superficies is used to prevent that the owner of a plot becomes the owner of the immovable property on that plot as a consequence of accession. However, in this situation, there is no accession because the house is not durably united with the land, thus nothing to prevent. The established right of superficies is void. The house buyers are owners of a ship (the house) and have the plot in leasehold. The property boundary for the lofts in the Nassauhaven lies at the border the water basin. The quay is a public residential area, just like the street adjacent to land property borders.

In both projects, all houses have a separate pontoon, although these pontoons are sometimes connected, which makes it look like two or more houses share the same floater. Interviewee WB1 mentioned that they soon rejected the idea of constructing more than one house on a floater because it is legally impossible to split movable assets into apartment rights (Ploeger, H.D., van der Plank, 2021). A floating (and thus movable) building can consist of multiple units when these are rented out. Splitting the asset into apartment rights is not needed. The downsides to this legal structure are that the users only have tenancy rights, and the owner can only sell the building as a whole. This legal structure was not used in the Waterbuurt West, since all rental homes have their own floater.
The newest floating urbanisation project in Amsterdam, Schoonschip, did construct two dwellings on one floater. To make that legally sound, there is an association established for each double house with the two homeowners as members (Greenprint Schoonschip, z.d.). This legal structure could complicate the future transfer of ownership. The reasons to choose for an individual floater for each house in the Nassauhaven were not discussed in the interviews.

Different from civil law is public law. Floating buildings that are fixed in such a way that only movement in the vertical direction is possible

What	Who	Solution	Alternative	N	W
Houses are movable assets, thus limited legal instruments available. The plot is immovable	National law-makers	Waterplots given out in leasehold, houses registered as ships, two cadastral registrations	Do it like these projects or adjust the national law	x	x
Two houses on one pontoon is very complex	-	Build every house on its own pontoon and connect them	New legislation, the relevance of the new law stimulated by more innovative projects	x	x
Unclear what regulations apply to floating buildings, some rules are only advisory	National law-maker/ Municipality	Make use of the existing rules as much as possible and come up with additions/ solutions to the building regulations	Make the building regulations fit for floating urbanisation	x	x
Unclear what preparing for construction entails on water	Municipality	Discussion and consultation with lawyers and tax authority	Learn from practice and develop standards (as already exist on land)	x	x

Figure 33| Paraphrased answers regulation and legislation

fall into the category buildings (bouwwerken) of the Housing Act. This is noteworthy because the criteria for immovable property and buildings are not that different. In both definitions, the object has to be connected with the ground with the addition that immovable property has to be connected *durably*. The floating houses meet the requirements of buildings (this was confirmed in Raad van State, 2014) but not those of immovable property because their connection is not considered durable (see above).
A consequence for structures that are considered buildings is that the building regulations (Bouwbesluit 2012) apply. There were no specifications for floating buildings in the building regulations, which is why the ministry of Spatial Planning, Housing and the Environment (VROM) made a publication that explained the application of the building regulations to floating buildings (VROM, 2009). When the Waterbuurt was initiated, this explanation was not available yet. The developers of the Waterbuurt West put considerable time into figuring out how to comply with the requirements. Still, a lot of exceptions to the building regulations had to be granted in this project. The regulations that were hard to apply one on one concerned: access to the house, the amount of fluctuation and deviation, fire safety and connection to the sewer. With the Nassauhaven, which was realised a few years later, there was a little more clarity on how to apply the building regulations. However, there was still extra attention needed to make sure that the buildings stayed within the limits of the regulations.

Another issue that was encountered in both projects is that there is no standard (yet) for what preparing for construction (bouwrijp maken) entails on the water. In certain cases, the costs for the preparation qualify for VAT recovery in land-based projects. If this situation applies to the preparation of water plots and what costs qualify for the VAT deduction in these projects was not clear to the municipalities. The municipality of Amsterdam made an arrangement with the tax authority. However, this solution was tailored for the Waterbuurt West situation and could not be generalised according to the tax authority.

What	Who	Solution	Alternative	N	W
Hard to calculate required financing of a home upfront	Municipality/ bank/user	Make estimations	-	x	
Extra costs to prepare the surroundings for the development, that are charged in the house price	Municipality/ developer	Develop high segment housing so that the price can compensate	Scale up so the costs per unit go down	x	
Financially not feasible to realise rental homes in the social sector	Housing association/ developer	No social rent housing	-		x
No experience with selling waterplots, some experience with exploitation of water (houseboats)	Municipality	Figure out how to exploit water plots	-	x	x
Banks are hesitant to grant mortgages for floating houses	Bank	Houses are treated as immovable assets, leasehold connected to surface rights or combined with registration	-	x	x

Figure 34| Paraphrased answers exploitation and economy

Exploitation and economy

Both projects were pioneer projects which made it hard to calculate the required financing upfront. There are no standardised prices, like there are for preparation works on land (bouwrijp maken), to make a substantiated estimation. The costs, and therefore the price, of floating urbanisation are currently higher than similar buildings on land. These costs are higher because most processes in a pioneer project take more time, which means more money, and the site preparation is more costly. Necessary infrastructure, such as water supply, was not in the proximity of the projects and had to be installed. Due to these relatively high costs, it was not feasible to realise social housing in the Waterbuurt West. The housing association did manage to have mid-sector rental housing realised instead. Next to these rental houses, there are intermediate and high-segment owner-occupied houses. The Nassauhaven consists of high-sector houses; houses in a lower segment would not have been feasible.

Floating students, another initiative in Rotterdam that tried to develop multiple studios for students on an old barge, had to pull the plug because it was financially not viable, and they could not find a suitable location for their ship.

The municipality had no experience with selling water plots and exploiting the water. How to create water plots and in what way they could be transferred was new to them. The experience with houseboats and single floating buildings was not relevant to the exploitation of these projects.

The hardest part of the financing was that only two banks were willing to provide mortgage loans. At least, that is what the public and private parties say, but the society parties (users) think otherwise. This is also shown in the responses to the statements before the interview. In Waterbuurt West, it took numerous meetings with two different banks before they agreed to provide mortgage loans. This resulted in a mortgage loan for the plot and another mortgage for the house that is registered as a ship. In the Nassauhaven, Rabobank was involved from an

early stage. Because of the legal structure that was used (see regulation and legislation) it was possible to offer mortgages as if they were immovable property, albeit on less beneficial terms and with a few extra conditions. The Triodos bank was also willing to offer mortgage loans. As a result, the buyers could choose between the two banks. One of the interviewed residents feels limited because of this scarce supply whilst the other two are happy that they could at least choose between two banks.

Infrastructure and planning

In the Waterbuurt West, it was not only for the first time that a floating neighbourhood would be developed, but it was also for the first time in the Netherlands that floating public streets, shaped like jetties, would be realised. This took serious commitment from the municipal project team and the developer involved. It turned out that the initial jetty design was not strong enough and had to be redone, which caused major delays. A consequence of these floating streets was that the cables and pipes, which normally lie underground, had to be installed on the jetties. This required new installation methods, which caused more delays. After close collaboration and consultation with the

What	Who	Solution	Alternative	N	W
The public dock design was not strong enough, this caused major delays	Municipality/ developer	Redesign of the dock by the developer	Consult with the constructor in an early stage to prevent construction mistakes		x
Constructing the utilities cannot be done in the regular way (as it is done on land).	Utility companies	Figure out new ways of installing cables and pipes/ installing the fuse box in the quay		x	x
Fire safety can not be organised in the regular way	Developer/ architect/ fire brigade	Handcarts at the entrance of each dock, pipes for extinguishing water and heat screens on the end of the dock	In practice, the fire brigade throws a pump in the lake and extinguishes the fire with that water (even though it's against the rules)		x
Smallest lock or bridge determines the maximum sizes of the buildings	Developer/ constructor	Understand from the start on what route the floating buildings will have to be transported	-	x	x
Land-use plan was not fit for development, no participation of private parties	Municipality	Adjust or make the land-use plan	Consultation of market parties that have experience with floating buildings before land-use plan is determined	x	x
Not clear who is responsible and financially viable for dredging	Waterboard/ Municipality/ Port Authority	Municipality took on the responsibility	Clear agreements on responsibilties regarding water maintenance	x	x
High impact on the adjouning land is forgotten	Municipal urban planning	Car sharing system due to the limited space available	Floating amenities to save space on land	x	x
Uncertainty on the needed depth of the basin in combination with the tides	-	Draw up worst case scenarios and prepare for that		x	

Figure 35| Paraphrased answers infrastructure and planning

utility companies, the public jetties with utilities underneath were accomplished (see figure 21 at the beginning of this chapter). The municipal project team of the Waterbuurt indicated that in a future project, they would involve the utility companies from an earlier stage, their expertise on this subject is much needed.
The utilities in the Nassauhaven have to cover a shorter distance, from the quay to the homes is approximately twenty meters. After consultation with the utility companies, it was decided to install the fuse box in the quay. The connection from the fuse box to the house, which has to be installed on the bridge, was the responsibility of the developer. The maintenance responsibilities of all the utilities between the quay and the house lie with the homeowner.
The long public jetties caused another complication: fire safety. The normal regulations of the fire department could not be met; therefore, extra measurements had to be taken. However, when a small fire broke out in Waterbuurt Oost, the fire brigade did not use any of these extra facilities. They threw a pump into the internal lake, pumped up the water and started to extinguish the fire. This is against their regulations that prescribe that only tap water should be used.

The smallest lock or bridge on the route from the building site to the project location was decisive for the size and shape of the buildings in both projects. This is something that all parties were aware of from the beginning. The route to the Nassauhaven was also taken into account when a new building site for the lofts had to be found.

In both projects, the land use plan had to be adopted. In Amsterdam, the land use plan was drawn up for the whole of IJburg; this included the floating houses from the beginning. In Rotterdam, the land use plan had to be changed. The private parties were disappointed that they were not consulted in this process, their experience could have prevented small mistakes from happening. Assigning a destination to the water was not a problem in the land use plans.
A point of discussion between the water authority and municipality of Amsterdam was who would be responsible for dredging the internal lake and keeping it at the correct depth. In Rotterdam, there was haggling over the responsibility of dredging the basin to prepare it for the lofts. In both cities, it was eventually the municipality that took on the responsibility and had the sludge removed.

Actors from both projects mentioned that the impact of floating urbanisation on the adjacent land should not be forgotten, especially when projects on a larger scale are realised. Some amenities, such as car and bicycle parking, distribution boxes or trash bins remain on land. Perhaps these functions can be realised on the water in the future. For now, a floating project takes up space on the adjacent land.

Another mentioned planning issue that is of importance for the future is drought. The required water depth factors in periods of extreme drought. The required depth of the Nassauhaven basin is based on calculations for extreme scenarios, with drought and low tide. If these scenarios were extreme enough remains to be seen.

What	Who	Solution	Future	N	W
Balancing the houses is difficult in practice, calculation is no guarantee for practice	Contractor	Makeshift additions to balance the homes	More possibilities within the original design to tweek the balance	x	x
The buildings were floating too high on the water	Developer	Filling the balance holes with concrete	Do not design based on theory only, but do tests	x	
A lot of technical defects shortly after delivery and due to wear	Developer	Fix the broken parts	Understand what parts are the most sensitive to wear		x
Innovative and sustainable ideas were not realised in the end	Developer	-	Closer monitoring by the client (=municipality)	x	
An issue for scaling up is distance to the necessary infrastructure (cables, pipes, waste bins) and fire measures, the land programme takes space too	-		New ways of building on water that are less dependent on the land		
Scaling up is possible when public/shared/private space is well defined	Developer/architect	-	Design iteration		
A diverse housing supply is good for the city, floating homes are a part of that so we should scale up	Municipality/developers	-			
Questionable whether you should build on water due to the quality it takes away from public space with other functions as well	Municipality	Limit the amount of projects	Make more heavy use of the land in the east of the Netherlands		
Higher buildings are technologically difficult and take away the view of others	-	No high buildings	-		
Unclear whether there are enough suitable locations for new projects	Municipalities/province	Be careful with water allocation	More research on potential locations		

Figure 36| Paraphrased answers technology and scale

Technology and scale

The biggest technological issue, mainly reported by the users, is balancing the houses. In the Waterbuurt West, the difficulties began when the residents moved in. When the furniture was moved in, the houses tilted accordingly. When the furniture is rearranged, or when a renovation such as installing a new bathroom takes place, the house will tilt differently. The houses can be balanced by filling tanks underneath the pontoon with air or gas. This has to be redone by a specialised company every five years and once more when someone moves out because the weight of household effects is different and the houses are connected.

How the lofts in the Nassauhaven would float in the harbour basin was calculated upfront, but in reality, it proved to be different. When the lofts were towed in, it turned out that they floated too high above the water, which is why the intended tilt holes in the concrete pontoon were completely filled. This took away the possibility of filling those holes partly to balance the house after the furniture was placed. Containers filled with air were placed under the four corners of the houses to make balancing possible. Other technical defects occurred shortly after delivery or after a few years when signs of wear occurred. The cause of these defects is not always clear.

All new buildings deal with defects, but the consequences of a broken or loose part when the building is floating could be more severe. One of the houses in the Waterbuurt West was in serious danger of floating away because the connection with the poles broke.
The dwellings in the Nassauhaven were supposed to be very innovative when it came to sustainability. After delivery, it turned out that this goal was not achieved. The project manager blames himself for not monitoring this more closely. Also, what was seen as innovative or sustainable changed over the years of project preparation.

All interviewees indicated that floating urbanisation on a bigger scale would be possible. A design problem for large-scale projects (that can be overcome) is that the distance to the land cannot be too far to ensure fire safety and proximity to land-based amenities. When floating urbanisation takes place on a bigger scale, there should be more public or shared space on the water. However, the views on the desirability of scaling up differ. Developing more floating urbanisation projects is desirable because it contributes to a diverse housing supply. Optimists see a lot of potential locations for this development on existing water but also on new water when land is flooded. On the other hand, surface water and (river)banks in the Netherlands serve other functions too. Functions such as a habitat for birds and water animals, a place for recreation, (temporary) events, transportation and port operations. These cannot coexist with floating urbanisation. Furthermore, when the floating buildings increase in size, they take away the view of the water for the people on land. Another obstacle to scaling up is the scarcity of suitable locations. This observation is confirmed by the municipal water team in Rotterdam but could be different in other cities.

Environment and ecology

There is little known about the environmental and ecological impact of floating buildings. Pedroso de Lima et al. (2022) have done research to understand the impact of floating structures on the water quality, an important factor for a diverse ecology. The research has its limitations since it observed the water quality for a maximum of ten months. The long-term impact of floating structures on the water quality and ecology remains unknown.
During the development of the Waterbuurt West the only hard restriction that had to be taken into account was the ban on leaching materials. Next to that, the parties involved did factor in implementing some other measurements based on common sense. There was deliberately chosen to construct the houses not on site but elsewhere in an enclosed environment to make sure that no pollution due to the construction process could take place. When deciding on the density of the neighbourhood, it was taken into account that enough sunlight should be able to strike the water's surface because sunlight is a major influence on the water quality. However, a lot of floating additions to the houses have appeared since then. The technical water quality is alright, but the ecological water quality could be better. Twenty years after the completion of the houses, a part of the inland water is made more shallow to stimulate the growth of water plants that will also influence the water quality.
To prepare the harbour basin in Rotterdam for the houses, it had to be dredged to take out one meter of contaminated sludge and attain the required depth. The sludge was contaminated due to the former industrial function of the harbour. Diminishing the environmental impact was high on the agenda of the developers of the Nassauhaven, but in the end, the lofts turned out less sustainable than the tender proposal promised. This is the result of budget cuts and the fact that what was seen as the most sustainable changed over the course of the

project. However, they did manage to make the lofts almost self-sufficient by installing solar panels and a heat pump or pellet stove. The developers did not have to factor in enough sunlight on the water's surface since the tides provide a constant flow of water in the basin. A tidal park was realised along with the lofts in the Nassauhaven. This park accommodates various plant- and animal species. The residents of the lofts report that there have been researchers that monitor this park and take samples now and then. The results of this research cannot be found (yet).

The long-term impact on the environment and ecology of the projects in Waterbuurt West and the Nassauhaven remains unknown since there are no research results available on this subject.

What	Who	Solution	Alternative	N	W
unclear what the impact on the environment and ecology is	-	Little regulation on what was alowed, tides were thought to help water quality	Do measurements beforehand and afterwards	x	
Limited regulations and research on the protection of the local environment and ecology	Lawmaker	-	Opportunities to enhance under water life by facilitating fish and algae homes under floating terraces		x
No leachable materials allowed	Construtor	Other materials were used instead		x	x
Ecological water quality is low due to non-green borders, lack of sunlight	Municipality/ Water authority	Only technical tests were done beforehand, now part of the bottom of the lake is raised	Learn from this project and do more research for future projects		x
What was seen as sustainable changed over the course of the project	-	Changes in the type of installations used	-	x	
Ecology in the area is improved by the tidepark that was part of the project				x	

Figure 37| Paraphrased answers environment and ecology

Public perception

Being able to develop floating urbanisation is one thing, but when the public has reservations about living on the water, it will be hard to find residents for the homes. None of the interviewees knew for sure what the demand for floating urbanisation was. What stood out in both projects is the number of applications, way more than the available dwellings. However, living on the water is not for everybody, for one, because the houses are in the high segment and also because maintaining a floating house requires special attention and skills. Some of the interviewees report that the people living in the floating homes are water sports enthusiasts or have had some connection with water all their life. Nonetheless, for some residents, the floating aspect was not a decisive aspect in choosing this house. They report the central location and the wide view as features that made them buy the house.

Some interviewees think floating urbanisation is urgent, whilst others think it is only a nice and unique addition to the Dutch housing stock. The reason for the urgency lies in the fact that we have to discover the possibilities with building and water now because it is inevitable that we will have to deal with more water in the future. Floating urbanisation is one method that we should explore better. On the other hand, floating urbanisation will not solve the current housing problem, which makes it for some interviewees less urgent or not urgent at all.

The perception of the residents in both neighbourhoods is that they keep very close contact with their neighbours because they face similar struggles with maintaining their houses (e.g. to balance the house). What also attributes to the sense of belonging is that the projects are of medium size, and it is possible to remember everyone's face. The residents of the area surrounding the Nassauhaven were not so content with the development in the first place. It took away their view of the park, and they were unfamiliar with houses floating on water. Now that the project has been there for some time, they also see the upside of the floating homes. It is a point of reference for the neighbourhood, and the park is used more because of the increased social safety.

What	Who	Solution	Alternative	N	W
The demand for floating buildings is unknown	-	For projects of this size not a problem	Do research	x	x
The number of residents that want to live on the water is limited (due to the house prices)	Residents	Not an issue for this project, living on the water is appealing	-	x	x
A non standard project makes stakeholders hesistant to get involved	-	This project attracted people that are not afraid to be in a pilot	Dive in the deep and learn as much as possible for future projects		x
Learning how to live with water is urgent because we will have to deal with the rising water inventually	All actors	Floating urbanisation is one of the possibilities		x	x
Floating urbanisation will not solve the housing problem	-		Should we keep building on the water?		x
Social cohesion due a ´common enemy´	Residents			x	x
Gentrification of a disadvantaged neighbourhood	Residents			x	

Figure 38| Paraphrased answers public perception

In short

The list of statements indicated which themes caused the most issues during the development of the projects. Those themes are: Knowledge and skills, Regulation and legislation and Economy and exploitation. The interviews help to understand the obstacle that had to be overcome and the solutions have been used. First of all, there was a lack of knowledge and experience with floating urbanisation. The actors used the knowledge and experience they had and adopted them to help with the project. For example, the constructor knew how to build one ground level houseboat and used that experience to construct a three-storey floating villa. The other gaps were filled with learning by doing, actors started the project with little knowledge and educated themselves and each other along the way.

For the second theme, the interviewees mention unclarity about the legal status of floating buildings and the applicable building regulations as obstacle. These issues were overcome by applying the existing legal structures to the situation and request for exceptions when needed.

Within the financial theme there are two main obstacles. The preparation and construction costs were relatively high. The infrastructure that had to be build was more expensive than the infrastructure on land and the development costs of a unit are higher because it is not a standard building. The solution for these costs was to develop high segment dwellings that yield more revenue. Another financial obstacle was that banks were hesitant to provide mortgages loans, which does not benefit the sales. After consultation with three banks concerning the legal construction that had to give them some certainty, two were willing to provide the loans.

4.5 Expert panel

4.5.1 Preparation

As a final element of this empirical research, validation through the use of an expert panel was executed. The outcomes of the expert panel will provide an answer to the last sub question: *What structural changes have to take place to make floating urbanisation future proof?* Five experts took part in a 1,5-hour conversation. There was chosen for a group conversation because the discussed topics are interconnected and touch upon multiple areas of expertise. The reaction of one of the experts could trigger thoughts and responses of one of the other participants. The experts work at companies or institutions that are part of the indirect actors, as analysed in the first part of this research (see chapter 3.2). The expertise of each participant lies with one of the subjects of the conversation. The participants are the team leader climate adaptation from the ministry of infrastructure and water management that takes part in the Deltaprogramme, two legal advisers; one with a focus on property law and the other with a focus on building regulations, a mortgage loan policy maker of a bank and a sustainable market specialist of an urban development company.

Expert panel participants

- **A** team leader climate adaptation at ministry of Infrastructure and Watermanagement
- **B** legal advisor on property law
- **C** building regulations advisor
- **D** policy maker at a dutch bank
- **E** market specialist sustainable urbanisation

Figure 39| Expert participants A-E

Not all the results of the case studies are discussed with the expert panel because of the limited available time. To guide the discussion in the preferred direction, the conversation was held using five predefined statements. The participant with (the most) expertise on the statement was asked to respond first, after which the others could respond to the first respondent or the statement itself. The statements were:

I The mortgage conditions for floating housing should be at least the same as those for houses on land
II New legislation is the only option to settle the discussion on movable/ immovable property
III The building regulations need a separate chapter for floating buildings
IV Developing social rent housing on the water is financially not viable
V Floating urbanisation is the future in the Netherlands

The selection of these topics was made beforehand. Topics that were chosen for this discussion occurred in both cases and were also mentioned in literature. By having all the conversations and processing that information, it came to my understanding that these are the topics that play an important role in the success of future floating urbanisation. They were of considerable influence on the time, costs and quality of the projects and/or they triggered other issues. These topics were a major part of the conversation in almost all interviews, be it with similar or different views of the interviewees.

The first subject is mortgage loans. Fifty per cent of the public and private parties of both cases mentioned the limited number of banks willing to provide mortgage loans as one of the obstacles to the development. However, the residents reported little difficulties with getting

a mortgage on their house, and the consulted literature does not report it at all.
The legal status of floating buildings in property law is the second subject for the expert panel. This is a topic that has been widely described in literature (e.g. De Graaf, 2009; Penning-Rowsell, 2020; Ploeger & van der Plank, 2021). It was also mentioned by ten out of fourteen interviewees (the residents did not bring it up).
Building regulations, and the lack thereof, were a topic in both cases. That it is unclear what building regulations apply to floating urbanisation was also derived from literature.
The fourth topic was introduced based on the interviews. The housing corporation that was involved in Waterbuurt West explained that it was financially not viable to develop social rent housing (with a cap on the rent). The developer of the Nassauhaven also reported that they chose high-segment dwellings to get a sound business case. Other interviewees from both cases confirmed that it was only viable to develop housing with a relatively high price per square meter. That costs for floating urbanisation are higher, compared to similar projects on land is also described in the consulted literature.
The last topic deals with the urgency of floating urbanisation. Whether floating urbanisation is urgent and what the future will bring was discussed with all interviewees. The views of the participants differentiated varied a lot. Schuwer found in 2007 that there was no urgency for floating urbanisation yet. Some time has passed since, and perhaps his view is outdated.

Not all experts engaged in the discussion of each statement because they did not always feel like they could add something to what had been said by the others. During the discussion of the statements, we also touched upon other connected aspects of floating urbanisation.

4.5.2 Outcomes

I The mortgage conditions for floating housing should be at least the same as those for houses on land

Mortgage loan conditions are influenced by a combination of factors. Expert D explains that the conditions are based on a risk assessment made by the bank. Right now, there is only a slight difference in the conditions for floating houses and houses on land. This difference has to do with the fact that floating buildings are relatively new, and banks cannot oversee the (potential) risks. They demand that the plot of the floating house is in leasehold, that an extensive valuation report is made up, and the premium is 0,2% higher than the premium for a land-based house.
The bank not only distinguishes houses on land from floating houses but also houseboats from floating houses (Rabobank, 2022). Expert C does not see why there is a differentiation between houseboats and floating houses. This distinction is made because of the different legal structures used; the bank matches up with the taxation specifications, explains expert D. Expert B adds that the legal structure behind the purchase of the house is of influence in this risk assessment. A leasehold gives more certainty than a mooring permit because the latter could be withdrawn more easily. They also explain that the movability of the house not necessarily means that it is an uncertain object as collateral, mortgage loans for ships and trailers exist too.
The resiliency of the house with regard to climate change is not taken into account when this risk assessment is made. Expert A suggests that a more specific risk assessment that includes the adaptivity to climate change, not only for floating houses but for houses in general, would be desirable. Expert E adds that this could also be an interesting assessment addition for insurance companies.

In conclusion, the realisation of similar conditions is dependent on the risk assessment by the bank. Expert D does think it realistic to have these similar conditions in the future when the bank is able to oversee the risks involved better. They will have to make a more detailed risk assessment based on more experience with mortgage loans for floating buildings and perhaps with climate adaptivity as a factor.

II New legislation is the only option to settle the discussion on movable/immovable property

This discussion has been going on for years, and the final word about it has not been said, even though the Supreme Court has ruled that floating houses are movable property (Hoge Raad, 2012). Expert D explains that the bank also struggled with this subject and that they decided to add to their policy that a mortgage should be advanced on the plot and the building before the ruling of the Supreme Court was published.

Expert C disagrees with the Supreme Court. The difference between mooring poles and piles of houses on land is, from a technical point of view, not that different, which is why floating buildings should have been considered immovable property. He is of the opinion that the law should be changed to make that happen.

In the view of expert B: yes, that is the only way to overcome this issue. The legal instruments that are available for land-based real estate development are not useable when those buildings float on water. One of these instruments is the division of a building into two or more apartments. There are two ways to change this; make those instruments also applicable to registered ships or make floating buildings legally immovable property in certain cases. This would also make sure that legal structures, as used in the Waterbuurt West, with a registered house and a plot in leasehold with two mortgages, become something of the past. The leasehold itself is Expert E adds to this that it should not only be legally sound but also understandable and beneficial for the consumer.

III The building regulations need a separate chapter for floating buildings

The building regulation expert explains that a separate chapter suits the structure of the building regulation law because it works with a system with general provisions and more specific legal provisions that are applicable only to certain types of buildings. He is of the opinion that the building regulations need an update when it comes to floating buildings. Right now, the focus is on the aspects strength, buoyancy, and stability. He thinks that we need to draw conclusions from what happens in practice, based on that, we should adjust the rules and/or provide the correct information. Right now, there is a lot of room for interpretation which causes confusion and stretching of the regulations when it suits the developer.

The other experts refrain from a substantive reaction to this statement.

IV Developing social rent housing on the water is financially not viable

Expert A thinks that floating urbanisation is not compatible with social housing. This has to do with the spatial quality that does not suit that type of development and the higher costs involved. It makes more sense to develop multiple-story buildings, what social dwellings mostly are, on land. When that happens in an area with (the danger of flooding) water, you could raise these buildings on poles or plan non-vital functions in the first two stories, e.g. a parking garage. Expert C adds that constructing social rent housing on the water could be done without making them float, e.g. by building them on poles. This is less costly but also makes the buildings resilient to the water.

He also argues that the distinction between temporary buildings and permanent buildings in this context is of importance. Temporary buildings could be floating, and the financing of these buildings will probably come around because the movability can be used in the business case. He also makes the remark that he himself is not an advocate for temporary housing.

Whether floating houses in the lower segment are a viable business case is relative and dependent on the location. For example: when you compare floating buildings with an apartment block on land, the apartment block will be less expensive for sure. However, when the land has to be raised first before construction of the buildings can happen, floating buildings might be a financially interesting alternative. Expert B thinks that our current construction methods will not be attainable in the future and that, after the comparison with the alternative of raising the land, floating buildings will be considered more often.

V Floating urbanisation is the future in the Netherlands

The views of the experts differentiated on this statement. There are three different perspectives. From the first perspective, there is a demand for floating buildings, but it is a niche. First of all, because there are few appropriate and available locations, and the locations that are available are not spacious enough for larger scale projects, according to expert E. He does think that old industrial harbours are a promising location for floating urbanisation. The second reason for floating urbanisation to remain a niche has to do with the cost-benefit analysis. Floating urbanisation will only be realised when it is beneficial compared to alternative methods of development. Expert C agrees with this vision and adds that there will be few situations where making floating buildings is less expensive than other methods of adaptive buildings, e.g. building on poles. Not only the financial aspect is taken into account with the cost-benefit analysis. Expert E believes that in the future, consideration of the CO_2 emissions related to the development will play a bigger role.

Experts E and C also point to an aspect of floating urbanisation that has not been explored so much but could increase the number of floating projects. Floating urbanisation is very suitable for temporary projects; if the buildings are not needed anymore, you can simply tow them elsewhere. It could be of great use, e.g. for temporary housing or sports events that only take place once.

The second perspective is outlined by expert A. He foresees that we will use floating or amphibious buildings in areas with height differences where the lowest parts are unsafe for land-based buildings. The use of these water-adaptive buildings is a great way to make profit from land that cannot be used otherwise. Another possible location for floating urbanisation is next to rivers that are likely to flood. The same goes for these areas; floating buildings could be a way to combine space for the river with a residential function and still gain profit from the area.

Expert B sees it differently. She argues that floating urbanisation is the future because our current methods of constructing buildings are not tenable in the future. This is the third perspective. There is more than enough water in the Netherlands, and technically it is possible to construct larger floating buildings, but the current Dutch legislation is in the way of the realisation of these buildings. Developing rent apartments only is not a solution to overcome indivisible property because for a landlord it is too risky not to be able to sell the building. She is convinced that if the property law issue is

overcome, floating urbanisation is not only the future for the Netherlands but for the rest of the world.

The three perspectives have in common that floating urbanisation has *a* future in the Netherlands. If, on the short and the long term, that will be one with many large projects or one with fewer and smaller projects remains to be seen. The effect of this future on the urgency of floating urbanisation today was not touched upon by the experts.

In short

There are structural changes possible to facilitate the scaling up of floating urbanisation development. These changes consist of amending the national law, adjusting the mortgage policy of a banks and choosing to construct floating houses when the alternative is more expensive. However, the majority of the experts thinks that there will no need to implement those changes because there is no significant demand for floating buildings on the short term.

5 Guide

During the execution of the empirical part of this research I did an internship at the municipality of Rotterdam. As a final deliverable for the municipality, I created a guide to understand the role of the municipality in floating urbanisation development.

Two projects were analysed to understand the obstacles that had to be overcome by the actors that were directly involved. This is an analysis of the process level. The results show that there is room for improvement in the process of floating urbanisation development. The improvements are made on the governance and institutional level. The governance level consists of actors that influence the (initiation of the) project by making policy or setting requirements. The institutional level concerns the regulatory context wherein the governance and process level exist. The validation with the expert panel, with people that operate on the governance level, was used to explore the changes on the governance and institutional level.

The obstacles that are within the influence of the municipality are used as a starting point for the guide. These obstacles are followed by suggestions for improvement, required means for those actions and corroborating other actors on the governance level. Some of the obstacles can also be influenced by changes on the institutional level.

The guide (see next page) can be used by municipalities that consider to develop floating urbanisation. It is a means to understand the subjects that require the attention or active involvement of the municipality.

Floating urbanisation guide for municipalities

suggestions for action to get the most out of floating urbanisation projects

	process level observations	governance level suggestions action
Public perception	is floating urbanisation the solution to combine the built environment with rising water levels?	compare floating urbanisation with other water adaptive solutions within the context of the location and the water management system
Regulation and legislation	limited legal instruments available (because it is movable property)	learn from the legal solutions in realised floating urbanisation projects
	building regulations are not sufficient	watch out! the applicability of the building regulations is limited (tidal water and waterways are excluded) and they merely focus on strength and stability
Exploitation and economy	preparing the water and realising floating buildings is more expensive than a similar project on land	be aware that a sound business case for affordable housing on the water is hard due to the high costs
Infrastructure and planning	utilities are not fit for installation on floating objects	be aware that extra attention is needed to install utilities for floating buildings
	what are the possible locations?	research into available and appropriate locations, analysis of the building typology that suits the location
Technology and scale	little innovative designs (houses that could have been built on land)	use the strenghts of the water to enhance the design (unusual shape, temporality, diversity)
	what scale of floating urbanisation is wanted?	take into account that water serves a public purpose, large scale projects should also add to public space (not only take it away)
Environment and ecology	long term influence on environment and ecology is unknown, water quality could be diminished	(scientific) research into possibilities to stimulate the environment and ecology and the the long term negative impact due to floating urbanisation
Knowledge and skills	lack of knowledge about the development process	learn from existing projects
	gained knowledge is barely shared, loss of information when people are succeeded	document the lessons learned and make these available to other interested parties

means	partners	institutional level suggestions
research initiate or contribute to (scientific) research, applied to a specific location	research institute	
advise consult a legal advisor that understands how the current legal instruments can be utilised in this project	legal advisor national lawmaker	two possible adjustments to the law: make the legal instruments available for movable property or regard floating buildings immovable property in some situations*
tender use the tender requirements to fill the gaps of the building regulations	national lawmaker	adaptation of the building regulations with rules that are better tuned in to the practice of floating urbanisation and do not exempt most of the Dutch water
policy increase the number of units to create economies of scale	project developer architect	
tender include self-sufficiency in the tender requirements or involve utilty companies in an early stage	utility companies national lawmaker	adjust the building regulations to make self-sufficient buildings easier (with regards to drinking water, electricity, sewage)
policy use the policy instruments to allocate functions to the water. Floating urbanisation just one of the functions	-	
tender stimulate design innovation in the tender requirements, use the experience of developers to prepare the tender	developers of floating urbanisation	
policy consider the aim of the new project and regulate the scale of the project through policy	-	
tender / subsidy tender the research or subsidise exologists that do the research	scientists	regulate the maximum impact and/or minimum ecological addition that these projects should have
evaluation experiment with projects and evaluate	-	
gather knowledge other projects	other municipalities	
share knowledge publish the evaluation and share within the organisation	-	

*suggestions made by Ploeger & van der Plank, 2021
**e.g. research done by PosadMaxwan

6 Conclusion & discussion

6.1 Conclusion

The answers to the five sub questions have been given throughout the report and will be repeated here briefly. These sub conclusions substitute the answer to the main question.

1 What is floating urbanisation?

Floating urbanisation, for this research, is when a piece of water or a piece of land that can be flooded has been given an urban purpose and the buildings that arise are adaptable to changing water levels.

2 Which actors influence the development of floating urbanisation?

The development, that will say the actual design, construction and maintenance, of floating urbanisation is influenced by the direct actors. These include municipal project teams, architects, investors, real estate developers, water authorities, mortgage providers and residents.
Other actors who influence the development of floating urbanisation are the indirect actors. These include national lawmakers and policy makers of municipalities and banks. The indirect actors cannot influence *if* floating urbanisation will be developed. However, they can make it easier or more difficult to develop floating urbanisation. They can have impact on the preconditions for floating urbanisation in the Netherlands.

3 What issues arise during the development of floating urbanisation?

The issues that arise have to do with the required knowledge and skills, the regulation and legislation, the financing and technological execution. Next to that, there is little to no information about the impact of floating urbanisation on the environment and ecology, the market demand for floating buildings and the urgency of this type of development.
All issues that arise go back to the fact that floating urbanisation is a relatively new form of development. Involved actors do not have all the required knowledge and skills, there is not yet an airtight legal property law construction, the applicable building regulations do not fit the type of buildings completely, banks are hesitant to provide financing and technical defects occur more often than with buildings on land.

4 What solutions have been used to continue the development?

The solution for most issues started with getting the involved actors around the table and figuring out how to use the means at hand in a

way that suits the floating urbanisation. Mostly this meant adopting rules, practice or means for buildings on land. For some issues that worked out well, for example with fire safety regulations that were adopted from those of apartment blocks (the dock was compared to the stairwell) or the combination of leasehold and registration to split the mortgage in two. As interviewee NB2 put it: 'With the existing ways of land allocation and possible agreements you will come a long way.' This is true for many other issues, you can come a long way with the existing means. Other issues that could not be solved, even after repeated consultation of the actors, had to be left out. Examples of that are the social rent dwellings in the Waterbuurt West and two houses on one pontoon in both projects. More issues and their solutions can be found in chapter 4.4.2.

5 What structural changes have to take place to make floating urbanisation future proof?

There are no 'must-have' structural changes that should take place to make development of floating urbanisation possible. The preconditions as they are now allow the realisation of floating urbanisation. However, there are some 'nice-to-have' changes that could enhance the development process which makes it easier, less time consuming and less expensive for the parties involved. This might lead to more or larger projects. The most important changes are: new legislation that explains the legal qualification of floating buildings in property law, improved building regulations for floating buildings that provide clarity for the developer(s), mortgage provision without hesitation and under favourable conditions, larger scale projects to make the dwellings more affordable.

Important to mention is that the solution to manage increasing water levels in the built environment is not necessarily creating floating buildings. Therefore, future proof circumstances for floating urbanisation could be achieved by changing nothing. Which way it goes is dependent on the share of floating projects in the future. Structural changes have higher chances of being implemented when there is more floating urbanisation (initiated). In other words: the amount of projects and the structural changes are interdependent.

What are the preconditions for the development of floating urbanisation in the Netherlands?

The preconditions as they are now make the development of floating urbanisation in the Netherlands possible. This is proved by the fact that there have been realised a few projects. However, the current conditions are not ideal. This results in a time consuming and costly development process. If the conditions were to be improved it is likely that more floating urbanisation projects would see the light of day. The other way round is also true, if more floating urbanisation projects are initiated, there is more incentive to improve the preconditions.

There is one precondition that is only briefly touched upon in this research but could be designated as crucial: there has to be a suitable location available. Not a single project will be realised without a location.

6.2 Discussion

The executed research will be discussed to understand the value of the activities and the findings. The research has been executed with precision but it does have its limitations. The executed methodology, the used theories and the gathering and analysis of data are critically reviewed underneath.

6.2.1 Methodology

Qualitative research does not have a standard set of measures that ensure its validity although there is consensus about the importance and the operationalization of the validity (Hayashi et al.,2019). A more descriptive term for validity is trustworthiness (Onwuegbuzie & Johnson, 2006). The methodology of this research will be analysed by means of the five validity criteria that were proposed by Paiva, Leão and Mello (2011). The five criteria being: triangulation, the construction of a research corpus, a clear, rich and detailed description of the executed research, surprise and feedback of informants. These criteria respond to the validity and reliability of the research. Kirk and Miller (1986) describe validity as the degree of confidence with which conclusions can be drawn from an analysis, and reliability as the consistency with which the research technique will evaluate a phenomenon in the same way throughout multiple attempts. The analysis of the validity and reliability is reflected in several limitations of the research.

Triangulation

Triangulation entails that information from three different positions is compared and cross-checked. The consistency of the information from different sources can be assessed and several facets of the studied phenomenon can be explored by the researcher. This element supports the validity of the research. Each case is studied from three different perspectives (public, private, societal) which allows to check the consistency of the derived information within each case. The initial research method entailed three case studies, to obtain cross-case triangulation. This had to be adjusted to two cases because there were no interested interview participants for the third case. This project could not be replaced because none of the other Dutch projects met the selection criteria.

Construction of a research corpus

A research corpus is constructed to guarantee the quality of the study, this is indicated by data-saturation. A high number of conducted interviews helps to achieve data-saturation, an extra interview would not provide useful additional information. The conducted interviews provide similar information in most of the themes. However, some subjects have only been brought up once (e.g. the VAT deduction) which suggest that data-saturation is not yet achieved.

Description of the executed research

Giving a clear and detailed prescription of the context, approach and phenomenon that is studied improves the transferability of the research. This not only supports the validity, because it is clear how the results were obtained, but also the reliability. Other researches can find coherent results by with different attempts. In the research report, a balance between to the point and detailed descriptions is sought. Lengthy explanations are thought to diminish the clarity of the text. Important to note here is that qualitative research is always subject to the interpretation of the researcher, different attempts will never result in the exact same findings.

Surprise

The research process is not a tunnel that leads to the illuminated results in the end. There should be flexibility to adapt to unexpected

changes brought up by the research field and the findings. Surprise ensures validity and reliability. An aspect that went unnoticed in the first place and was added later is the meta question whether floating urbanisation is needed. The necessity of floating urbanisation was assumed at the start of the research. This assumption was questioned during in some of the interviews. Another unforeseen element was the availability of locations. During the internship at the municipality of Rotterdam (where the empirical part of the research was executer) this aspect was brought to the researchers attention and adopted in the research.

Feedback of informants
This element is also known as confirmability. It is a verification of the information obtained from the informant too understand if the phenomenon studied is accurately portrayed. Participants of the case studies and the expert panel were not given the opportunity to correct the information that was obtained during their conversation, this diminishes the validity of the data. However, the interview participants did have the opportunity to explain their responses to the list of statements and nuance the answers given.

6.2.2 Theory
The literature review focused on the definition, the involved actors and existing theory about preconditions of floating urbanisation development. This review provided the framework wherein the empirical research took place.
The definition of floating urbanisation is one of the demarcations to shape this framework. The definition allowed to take several types of water adaptive buildings as case study for the empirical part of the research. However, the projects that were analysed all consist the floating building type because projects with other types of buildings on the required scale did not exist. The definition has to be narrowed down to not be misleading. ***Buildings that are adaptable to changing water levels*** should be adjusted to ***floating buildings***.

The actor analysis was based on available literature and documents that described delivered floating urbanisation projects. This analysis was not validated thoroughly. The interview participants were not asked to check whether all involved parties were included in the actor analysis. This check would have enhanced the validity. However, the actor analysis was updated if the participants were to mention any additional parties.

Seven themes, adopted from Penning-Rowsell (2020), are the final element of the theoretical framework. The themes are: Knowledge and skills, Regulation and legislation, Exploitation and economy, Infrastructure and planning, Technology and scale, Environment and Ecology and Public perception. The advantage of this broad perspective is that the subjects described in different sources are all included, this creates an overview. This broad perspective has a trap. It could give the impression that all possible subjects are included, which is unlikely in practice. All the more reason to stay

open to the validation criterium surprise. A disadvantage of the many themes is that there is not much time to dive into the details of each subject. This leads to more general conclusions and recommendations.

6.2.3 Data gathering and analysis

The findings of the empirical part of this research can be discussed. There are some limitations to the gathering of data. Next to that, the findings are placed in a bigger picture.

Limitations

A first limitation is that only two projects were used for the case study. With fewer cases there is an increased change finding results that are not general but coincidentally appear in both cases. The fact that only two cases were used for this study limits the validation of this research. With two cases the results cannot be considered generic, they are an interpretation of the researcher. Still, it provides an overview of the status quo and serves as a starting point for more extensive research.
Next to that, one of the cases was realised over ten years ago. The identified issues could have been solved in the meantime. However, the internship at the municipality gave me the opportunity to talk to people that are currently working on projects on the water and understand the problems that they face nowadays. This helped to filter out the possible irrelevant information.

Another limitation for finding the desired information is that the interviewees might have difficulties remembering how things went since some of them worked on the projects ten or twenty years ago. This is partly mitigated by using the information booklet of the Waterbuurt West that was written at the time to verify the stories of the participants.
For the Nassauhaven I coincidentally only spoke to two residents that entered the project a few years after the initiation, when the process was well underway. They told me that they had a relatively good experience compared to early adapters that had to deal with a lot of problems that occurred in the first years after they bought the house that still had to be build. This might give an unjust positive view on the project.

The newness of the subject made it sometimes more difficult to find answers to the questions because I did not know exactly what I was looking for. This meant asking questions that I thought to be relevant and adjusting those questions or digging deeper if the answer was not yet satisfactory.

Findings

One of the conclusions is that the relevance for adaptation of the preconditions increases when the number of floating urbanisation projects increases and vice versa. Another conclusion is that floating urbanisation is a niche, which is why the need to adapt the preconditions is minimal. Kemp et al. (1998) argue that a niche can create a level playing field for sustainable solutions so that they can eventually compete with more established, alternative technologies. Thus, the relevance of a niche phenomenon can increase which could result in the phenomenon becoming one of the standard solutions. Pesch et al. (2017) explain how the formation of a niche works and that it resembles the multiple streams approach of Kingdon. Kingdon´s approach attempts to explain how public policy is created. It posits three streams of activity in the policy process: the problem stream, the solutions stream and the political stream. The consists of the identified issue, in this case: rising water levels that endanger our built environment. The solutions stream concerns the formulation of (policy) alternatives, the phenomenon that gives an answer to the problem: floating urbanisation. The political stream refers to the political climate at that time, are the politicians admissible for the phenomenon? The three streams come together

in a 'window of opportunity' once the problem is high on the public agenda, the solution is politically feasible and the political environment is favourable. Floating urbanisation can grow into an alternative solution and become more urgent in this window of opportunity.

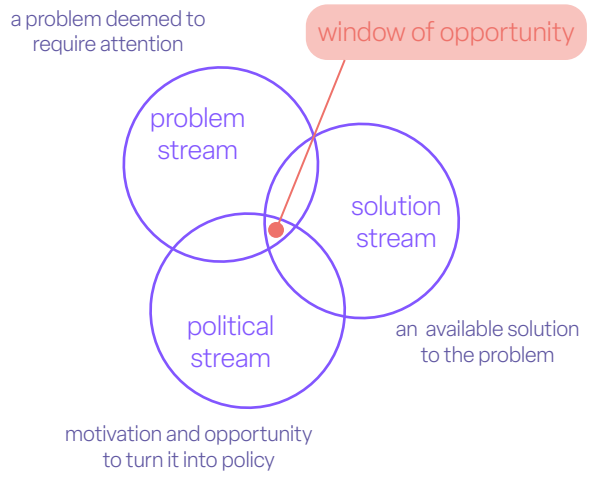

Figure 40| Kingdon's three streams approach

Based on this research, it is not possible to draw hard conclusions on the need to change the urgency for floating urbanisation. I suspect that there is no need for floating urbanisation on the short term. The current housing crisis demands large scale projects with affordable houses on multiple locations that are preferably finished today (or tomorrow). This research proved to me that floating urbanisation is none of those things. The projects are small scale and can be realised on limited locations, the houses are costly and the development process takes a long time. Floating urbanisation does not solve the problems that we have to face today thus there is no urgence for this niche phenomenon.

However, this could be different in the future. The need for floating buildings on the long term is dependent on the water management approach of the Netherlands. Rotmans' (2021) view the future Dutch water management is that we will give back most of the land in the west to the water. This scenario gives more than enough reason to start experimenting with floating urbanisation now. A completely different scenario is sketched by Dick Butijn and Ties Rijcken in a newspaper article by Schreuder (2022). In their vision, there is no need to create more space for water on the land. Instead, we should, and are also able to, protect the land with a second coastline (figure 42). This scenario allows us to keep using the land and construct buildings like we have always done.

If one of these two scenarios will be executed is hard to predict. From my point of view, it is most likely that we will end up with a combination of the two scenarios, some of the land will be protected by reinforced dunes and dikes whilst in other parts the water is given free rein. Floating urbanisation can be used to exploit the areas that are flooded or are endangered by unintended floods. It can be part of the solution to make our built environment water resilient. However, the results of this research show that there is room for improvement in the development process and the design of floating buildings. The best way to do so is by experimenting with projects. These experiments can improve the design to use the features of the water and no longer a simple box that floats. Next to that, new projects will help gaining experience and knowledge on the infrastructural, legal and financial aspects that can shorten the development process and cut the costs.

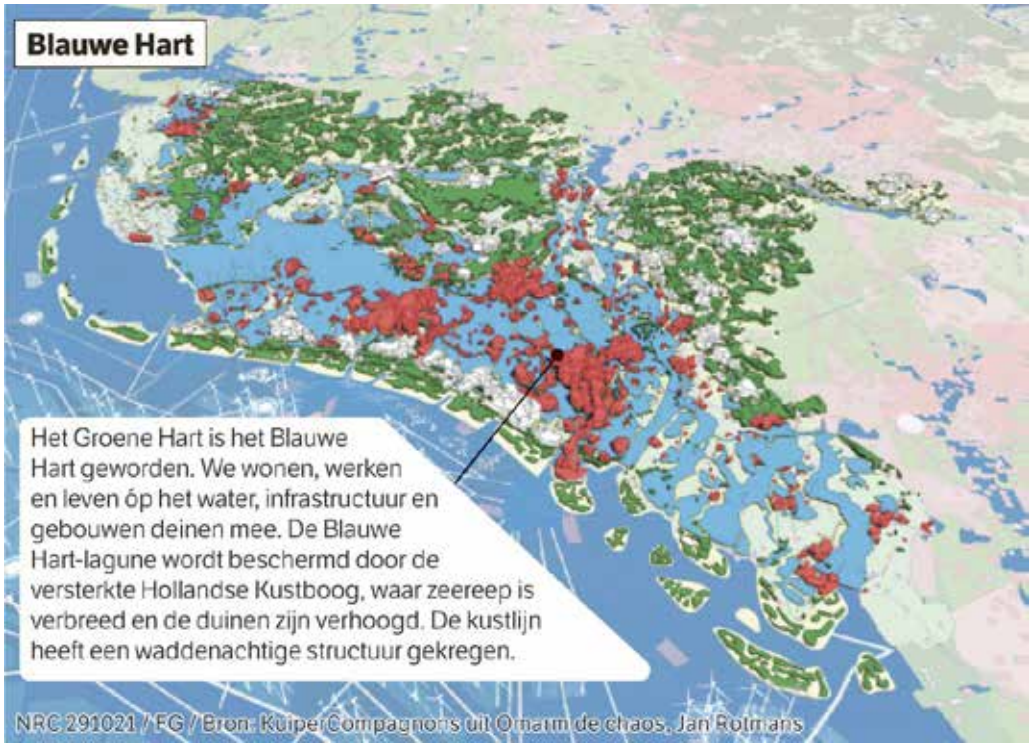

Figure 41 | Rotmans' view on the future of the Netherlands, image by KuiperCompagnons

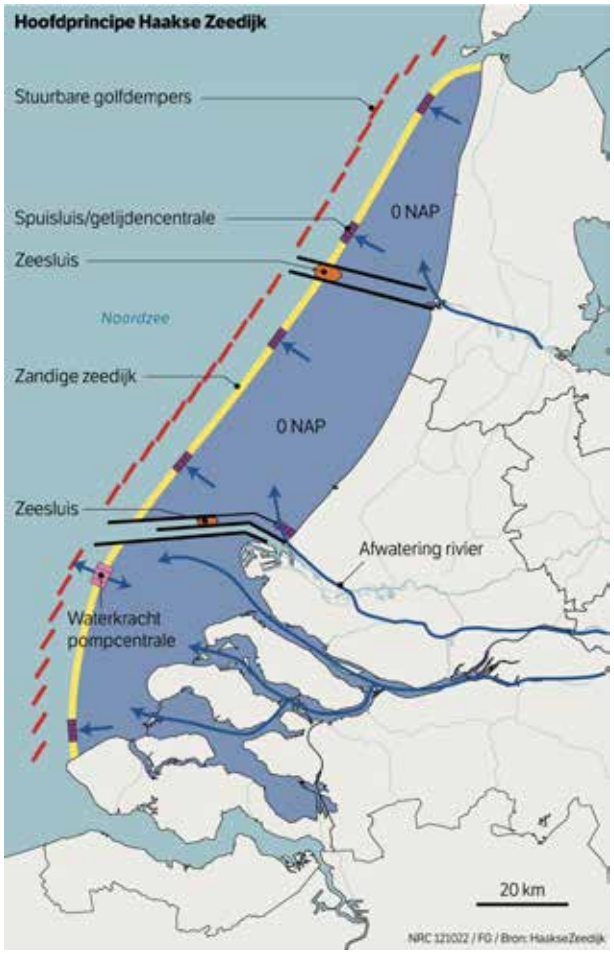

Figure 42| Second coastline, image by NRC

6.3 Recommendations

Based on this research, some recommendations for practice and future research can be made. These recommendations add to the specific actions for the municipality that are gathered in the guide (chapter 5) or set out additional actions for other actors.

6.3.1 For society

i. Share the gained knowledge

Pilot projects with floating urbanisation are only useful when the lessons learned are accessible to other parties. Other parties that are directly involved in other projects could profit from this information. Next to that, based on knowledge and experience from practice it is easier for policy makers and other indirect actors to make the correct adjustments to the preconditions.

ii. Innovate the design of floating urbanisation

Floating urbanisation has seen quite safe designs until now, houses that could have been built on land are placed on floating pontoons and connected to the land by jetties or bridges. The possibilities with floating urbanisation and the possibilities to enhance the ecology with the design should be explored. This exploration should not look at the design as self-contained but within the bigger context of the location and the water management system of the Netherlands.

iii. Don't forget houseboats

A third thing that stood out was that houseboats are barely considered floating urbanisation. Both projects were promoted as the first floating projects of the city whilst both cities have a long history with houseboats. Even though there are differences between the two types of dwellings, there are also similarities. Floating urbanisation can learn from the expertise of houseboats that was gained over multiple years, for example on balancing the object. Houseboat owners on the other hand can draw lessons from legal structures, modes of financing and technical solutions that are used in floating urbanisation projects.

iv. Adjust the building regulations

The building regulations hold regulations for floating urbanisation. However, these rules do not apply when the buildings float on tidal water or in water where motorised boats can sail. Next to that, the regulations only focus only on strength and stability and do not explain how more detailed subjects such as accessibility, fire safety and tilt are restricted in this situation. The regulations should be adjusted or explained according to the needs of practice.

v. Understand the necessity for floating buildings

Another exploration, into the necessity of floating urbanisation, is also required. At first glance floating urbanisation or making floating houses seems like a logical solution when you combine the housing problem with the rising water levels.

However, when you really look into the type of housing that is required, the current costs of building on the water, and the dike system that we have in the Netherlands the conclusion might be that floating urbanisation is not the key to success. For example, in the future scenarios discussed by Schreuder (2022) there is no need for water adaptive buildings because the Netherlands is protected by an extra dike in the North sea. A more detailed plan for how we will manage the rising water in the future is needed to decide if there is a role of floating urbanisation and what that role looks like.

vi. **Use a holistic approach to complex building problems**

Complex problems, such as rising water levels and the housing shortage, can never be seen apart from their context. In order to solve these problems you have to look at the bigger picture and preferably kill more birds with one stone. The landscape and architecture firm Delva designs promising examples of how water and buildings can coexist and solve local issues at the same time.

6.3.2 For science

i. **Make a comparison with other water resilient buildings**

For further research it would be interesting to compare floating urbanisation with other water solutions. To make buildings floatable is one way to make them resilient to rising water levels. There are various other options to achieve the same result, e.g. building on poles, plan more space for water storage in the project or building on mounds. The comparison look at the differences in preconditions or it could help to understand what solution can be used best in what situation.

ii. **Research the impact of each aspect on the quality, costs and time**

This research shows what the obstacles and conditions for floating urbanisation are and who is able to influence them. A follow-up research could be used to comprehend which aspects have the most impact on the quality, costs and length of the project. Improving the aspects with a big impact will be of most use for the development process, especially if the improvement is easy to implement.

iii. **Find out where the costs are**

The results showed that it was not financially viable to develop affordable housing. Before cheaper floating houses can be developed it should be understood where the costs are. Does it help to have economy of scale or are the costs per unit high, no matter what you do?

iv. **Research the environmental impact**

The impact of floating urbanisation on the environment and ecology has been researched on a relatively short term (10 months). Research on the long term impact could not only provide insight in the downsides of floating urbanisation but could possibly shine a light on the ways to deploy floating urbanisation to improve the local flora and fauna.

v. **Understand the market demand**

The burning question that remains after this research is: what does the market for floating buildings look like? This entails the market demand for floating buildings as well as the potential locations in the Netherlands. Both could be interesting subjects for future research.

7 Reflection

7.3.1 Product

The master track Management in the Built Environment provides students with knowledge and skills to understand problems and find solutions for the development of our built environment on a small and big scale. The gained knowledge and skills were applied and improved to successfully complete this research and add to the existing knowledge of a specific type of urban development. The aim of this research was to provide insight and suggest improvements in the process of developing an (innovative) urban area. Thus, this research connects seamlessly with the aim of the master track.

The available literature on floating urbanisation is not extensive, most papers focus on an aspect of floating urbanisation. This thesis connects the different disciplines with each other and with practice. It provides an overview of the status quo for all actors involved in floating urbanisation. The report could also be a used to understand the gaps in research on floating urbanisation and serve as a starting point for further research.
The results and conclusions of this research are gathered in a guide, an infographic of one page. This document gives an overview of the observed obstacles, suggestions for changes on two different levels of influence. The guide will improve the transferability of the research because a short document is easier to fathom than a ninety plus page report.

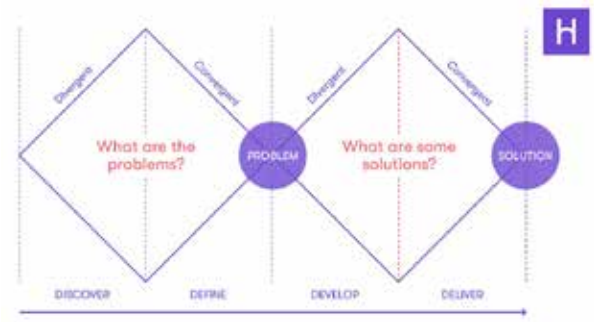

Figure 43| Double diamond method, image by Howspace

7.3.2 Process

The method for this research had to be one that allowed me to comprehend the bigger picture but as well as to dive into details when necessary. Looking back, I grasp that I went through two phases of divergent and convergent research, known as the double diamond method. The first phase took place in during the desk research, all available literature was scanned and read after which it was converged into a framework with most findings, the issues in the field. The empirical research was the second diamond. The identified issues were input for this part. What followed was diverging research into the solutions that are used in practice, and a check if these issues were not merely theoretical. The final converging stage focused on pointing out

the most influential issues and their solutions with the help of the expert panel. The end result is a proposal for solutions on governance and institutional level.

During this process I learned that as a researcher you should always be open for other views and outcomes than those you initially expected. Before I started this research I thought it was evident that the Netherlands was in desperate need of more floating urbanisation and that I simply had to find the issues that stopped that from happening. Over time I realised that this view needed nuancing. On the short term there is probably no big demand for floating buildings. The current situation in the Netherlands, with a shortage on affordable housing requires different typologies. On the long term however, floating urbanisation could be ***a*** solution but not necessarily ***the*** solution. This is dependent on what our future water management system will look like. The issues and matching solutions are not evident and universal, they are context specific which means they are dependent on the time, the location, the design and the involved actors.

7.3.3 Planning

Between the delivery of the theoretical part and the empirical research was a natural break because I had to complete some courses for my other degree. This break had a positive impact on myself and the planning of the research. For me it was pleasant to have my mind on other things and to take some distance from the subject. During the break I was able to start the preparation of the empirical research (in particular approaching the interviewees) which allowed me to start the interviews immediately after I finished the courses. My peers told me that starting the empirical part, after you just finished the theoretical part, was the hardest but that did not apply to me.
Another result of this break was that I had to execute my empirical research partly during the summer holiday with the risk of absence or full agendas of the interviewees. This risk was avoided by planning the interviews well before and the expert panel quickly after summer.

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2 overview of projects in the Netherlands
3 information letter before the interview
4 informed consent for the interview
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6 list of interviewees for the case studies

Development framework

	Knowledge and skills	Regulation and legislation	Exploitation and economy	Infrastructu
Plan	Lack of knowledge from public parties in many aspects of the development: planning, permitting, feasibility and construction causes reluctance to facilitate floating urbanisation. Penning-Rowsell, 2020; de Graaf, 2009; Kloos and de Korte, 2007	The legal status of floating homes is uncertain. As a consequence, taxation and mortgages are difficult to obtain. Ploeger & van der Plank, 2021; Penning-Rowsell, 2020; de Graaf, 2009; Koster, 2014; Architectenweb 2004	Extra investment (compared to land based projects) is needed because the infrastructure has to be developed as well and no economy of scale exists. Penning-Rowsell, 2020; Koster, 2014; de Graaf 2009	A location nea major influenc project. Schuwer, 2007
	Little experience of private parties results in a small group of companies willing to bid for floating development projects. Parties cannot fulfill the high tender requirements. Penning-Rowsell, 2020; gemeente Woerden, 2019; De Blauw, 2015; Kloos en de Korte, 2007	There is a lack of coordination between the municipal policies of water management and spatial planning. Schuwer, 2007	Investors are hesitant because they are not convinced that floating urbanistion will develop in a full grown market. van Dijk, 2021; de Graaf, 2009	Land-use plan plans should i urbanisation. Penning-Rowsell,
	Early involvement of stakeholders and local residents helps to meet their needs better and diminishes the chances of delay. van Dijk, 2021; Schuwer, 2007	Clear rules and regulations for building on the water (or adaptation of the landrules) are needed. Koster, 2014; SEV, 2008; Kloos & de Korte, 2007	Waterboards and municipalities have no experience in the commercial exploitation of surface water for economic development. de Graaf, 2009	Conflicting int municipalities planning and s housing. Penning-Rowsell,
	A PPS or another kind of collaboration form is needed to overcome different ambitions and share costs and risks. Koster, 2014; Schuwer, 2007	Property law prohibits ownership of buildings on a floating island, as a floating island is seen as a movable object. Flikkema et al. 2021; Ploeger & van der Plank, 2021	High implementation and material costs compared to the same building on land. Bradecki & Konsek, 2020; Baart de la Faille et al., 2011; Schuwer, 2007	
Build	Lack of scientific knowledge to support environmental assessments, this is especially important for the impact on the water quality. De Graaf, 2009; Kloos & de Korte, 2007	The lack of a binding regulating document with technical guidelines and standards makes it difficult for contractors to understand the applicable rules for floating houses. van Dijk, 2021; Penning-Rowsell, 2020; de Graaf, 2009		Extra measure be taken into homes should law. Belder, 2019; de G
				Transportation facilities and c urbanised plac construction o buildings. Ronzatti & Lovric,
Use				Lack of public in the close su urbanisation. Penning-Rowsell,
Maintain				
Repair/ improve				
Learn	Knowledge from realised projects should be transferred to municipalities, waterboards and contractors. de Graaf, 2009		There is need for a learning process for floating urbanisation to go through the take off stage. de Graaf, 2009	

Legend

green	conditions
red	barriers
black	solved issue
	public
	private
	society

ure and planning	Technology and scale	Environment and ecology	Public perception
rby a bigger city has a ce on the success of a	Current techniques should be integrated into a design that provides the desired level of safety, sustainability and cost-effectiveness. Penning-Rowsell, 2020	Environmental assessments might become a standard requirement. Penning-Rowsell, 2020	Stakeholders are hesitant to get involved because they are unfamiliar with the principle of floating houses, especially municipalities. Schuwer, 2007
s and national/provincial nclude space for floating 2020; SEV, 2008; Schuwer, 2007			There is no real urgency for floating urbanisation (yet). Schuwer, 2007
erests of developers and about water management spatial planning for 2020			Market research is needed to help understand the demand and develop a 'fit plan' for that specific demand. Schuwer, 2007
			Living in floating houses is not generally 'accepted', cultural values can hinder the acceptance of floating urbanisation. SEV, 2008; Schuwer, 2007
s for fire safety should account because floating also abide by the housing raaf, 2009; Schuwer, 2007	Different aquatic environments call for different technical properties, shallow water (<1,5 m) is especially difficult. Penning-Rowsell, 2020	Titanium and other materials that are used are harmful for the aquatic surroundings. Bradecki and Konsek, 2020	Floating urbanisation could disbalance the historical context of a city. Bradecki & Konsek, 2020
n routes, lack of yard onstruction in highly ces can limit the f (especially bigger) 2020; Schuwer, 2007	The use of sustainable /natural matrials should be obvious because of the natural environment but it turns out that it is not. Schuwer, 2007		
space and parking space rroudings of floating 2020; de Graaf, 2009	The lack of public recreational space is a limiting factor for scaling up - research about utility units and infrastructure on the water is required. Right now, the focus is still on familiar shapes (houseboats). van Dijk, 2021; Penning-Rowsell, 2020; Schuwer 2007	Limited waterflow and sunlight could cause algae growth. Schuwer, 2007	Potential users should to embrace the potential of living on the water permanently but people tend to be risk averse. Especially safety and accessibility are a threshold. Penning-Rowsell, 2020; de Graaf, 2009
	Balancing the houses proves to be difficult, during construction and use. Belder, 2019		Financial uncertainty deters the potential users. Penning-Rowsell, 2020
	The buildings should also able to withstand drought or severe conditions. Bradecki and Konsek, 2020		
	No agreements are made about the maintenance phase in most realised projects. Schuwer, 2007		
		Floating buildings might influence the water quality mainly because direct sunlight is blocked, first research results show that this impact is very little. This requires more research van Dijk, 2021; Penning-Rowsell, 2020; Bol and Tobe, 2015; de Graaf, 2009	

2

List of projects

#	name	location	status	amount of buildings	scale
1	Booneiland	Almere	realised	19	street
2	Schoonschip	Amsterdam	realised	46	building block
3	Waterbuurt	Amsterdam	realised	55	building block
4	Floating homes	Blaricum	to be developed	20	street
5	Hortus Boatanicus	Boskoop	realised	1	building
6	Harnaschpolder	Delft	realised	6	street
7	Drijvende waterwoningen	Gouda	to be developed	-	neighbourhood
8	Boothuizen	Harderwijk	realised	20	neighbourhood
9	Floating Roses	Lansingerland	not realised	1	building
10	Floating quarter	Leidsche Rijn (Utrecht)	realised	19	street
11	Warande	Lelystad	realised	8	street
12	Amphibious homes	Maasbommel	realised	14	street
13	Watervilla	Monnickendam	realised	1	building
14	Demo Drijvende Kas	Naaldwijk	realised	1	building
15	Marina olderhuuske (vacation homes)	Roermond	realised	80	neighbourhood
16	Nassauhaven	Rotterdam	realised	18	street
17	Floating office	Rotterdam	realised	1	building
18	Floating farm	Rotterdam	realised	1	building
19	Recycled park pavilion	Rotterdam	realised	1	building
20	Floating farm poultry	Rotterdam	to be developed	1	building
21	Rijnhaven	Rotterdam	not realised	-	neighbourhood
22	Floating prison	Rotterdam	realised	1	building
23	Wikkelboat	Rotterdam/Den Bosch	realised	1	building
24	Waterwoningen	Tersluis (Groningen)	to be developed	15	street
25	Drijvende waterwoningen	Terwijde (Utrecht)	to be developed	14	
26	Modular water dwellings	The Netherlands	not realised	-	building
26	Floating villas	Urk	realised	7	street
27	Waterrijk	Woerden	realised	12	street

3

Informatie voorafgaand aan deelname van het onderzoek

Algemeen

Titel	Floating urbanisation. Researching the crucial conditions for urbanisation on surface water in the Netherlands.
Universiteit	Technische Universiteit Delft, faculteit Bouwkunde
Studie	Management in the Built Environment
Student/onderzoeker	Tessie van der Voort Maarschalk

Bij deze wil ik u graag uitnodigen om deel te nemen aan mijn afstudeeronderzoek over drijvende verstedelijking. In deze brief vindt u achtergrondinformatie over het project. Naast de ondersteuning van de TU Delft word ik ook geholpen door de afdeling stadsplanologie van de gemeente Rotterdam. De resultaten van het onderzoek zullen bijdragen aan de benodigde kennis over bouwen op het water in Rotterdam. Mocht u nog verdere vragen hebben dan beantwoord ik die graag.

Achtergrondinformatie drijvende verstedelijking

Dat Nederland sinds jaar en dag zich probeert te beschermen tegen het water dat ons omringt, is bij iedereen bekend. Het stijgende waterpeil in combinatie met het tekort aan woningen maakt dat eerder naar innovatieve oplossingen wordt gekeken. Eén van de mogelijke oplossingen is bouwen op het water. De meeste steden in Nederland, waar het tekort het grootst is, bevinden zich aan de oevers van een rivier. Dit water is een potentiële locatie voor uitbreiding van de stad.

Er is al een aantal projecten met drijvende woningen gerealiseerd in Nederland. Deze projecten blijven echter vrij klein in schaal (gemiddeld 20 woningen). Terwijl op de lange termijn mogelijk hele delen van Nederland weer onder water komen te staan en grootschalig bouwen op het water onvermijdelijk is.[1] De centrale vraag in dit onderzoek is dan ook: welke randvoorwaarden zijn nodig om drijvende verstedelijking op grotere schaal te realiseren? In de eerste fase van het onderzoek heb ik aan de hand van literatuur een raamwerk gemaakt van bestaande projecten en de obstakels die tijdens de totstandkoming van die projecten overkomen moesten worden. In het nu volgende deel van het onderzoek wordt dit raamwerk verder uitgewerkt. De bestaande projecten komen hierbij goed van pas. Ik vraag aan verschillende partijen (publieke, private en maatschappelijke) of ze open staan voor een interview over hun ervaringen bij een bepaald project. De drie projecten die gebruikt worden zijn: de Nassauhaven in Rotterdam, Schoonschip in Amsterdam en Waterbuurt West, ook in Amsterdam.

Het doel van het interview is om kennis op te doen over de praktische ervaringen van de verschillende betrokken partijen. Het interview zal ongeveer 45 minuten in beslag nemen. In principe is het interview online maar een gesprek op locatie is ook mogelijk. Voor het interview zijn met name de belemmeringen die zich voordeden tijdens de ontwikkeling en hoe die werden opgelost relevant. Denk hierbij aan juridische, planologische, milieutechnische en sociale problematiek. De verzamelde data wordt gebruikt om de drie projecten te analyseren en vervolgens met elkaar te vergelijken. Met deze informatie wordt een handleiding geschreven om toekomstige ontwikkelaars van drijvende projecten een handje te helpen. Uw deelname aan dit onderzoek is volledig vrijwillig. Mocht u dat willen dan is terugtrekken te allen tijde mogelijk zonder reden op te geven.

[1] Zie bijvoorbeeld een toekomstscenario geschetst door Jan Rotmans in het NRC van 1 november 2021: https://www.nrc.nl/nieuws/2021/11/01/hoogleraar-transitiekunde-de-randstad-ligt-in-2121-aan-het-blauwe-hart-a4063863

4

Geïnformeerde toestemming

U gaat deelnemen aan het onderzoek genaamd 'Floating urbanisation'. Dit onderzoek wordt uitgevoerd door Tessie van der Voort Maarschalk van de TU Delft, in samenwerking met de gemeente Rotterdam. Ik vraag u om onderstaand formulier in te vullen zodat voor beide partijen duidelijk is dat vertrouwelijk wordt omgegaan met (persoonlijke) gegevens en andere data. Antwoorden zullen worden geanonimiseerd en uw persoonlijke gegevens worden na afloop van het onderzoek direct vernietigd.

Het doel van dit onderzoek is om inzicht te krijgen in de randvoorwaarden voor het opschalen van drijvende verstedelijking. Met de resultaten kan een handzaam document voor toekomstige projecten worden ontwikkeld. Het interview zal ongeveer 45 minuten in beslag nemen. De data zal gebruikt worden als bron van informatie voor het onderzoek. U wordt gevraagd om voorafgaand aan het interview te reageren op een lijst met stellingen. Tijdens het interview worden deze stellingen verder besproken.

Uw deelname aan dit onderzoek is volledig vrijwillig, en u kunt zich elk moment terugtrekken zonder reden op te geven. Zelfs na afloop van het interview is dit nog mogelijk. Verder bent u vrij om vragen niet te beantwoorden.

Als u vragen heeft over het onderzoek of de omgang met gegevens kunt u contact met mij opnemen via: t.p.vandervoortmaarschalk@student.tudelft.nl of +316 81 22 50 83.
U kunt ook de verantwoordelijke assistent professor benaderen, dat is Erwin Heurkens (TU Delft), E.W.T.M.Heurkens@tudelft.nl.

Vink aan wat voor u van toepassing is

	JA	NEE
A. Deelname aan het onderzoek		
1. Ik heb de informatie over het onderzoek gelezen en begrepen, of deze is aan mij voorgelezen. Ik heb de mogelijkheid gehad om vragen te stellen over het onderzoek en mijn vragen zijn naar tevredenheid beantwoord.	☐	☐
2. Ik doe vrijwillig mee aan dit onderzoek, en ik begrijp dat ik kan weigeren vragen te beantwoorden en mij op elk moment kan terugtrekken uit de studie, zonder een reden op te hoeven geven.	☐	☐
3. Ik begrijp dat van het (online) interview een video-opname wordt gemaakt zodat het gesprek kan worden getranscribeerd en geanalyseerd.	☐	☐
B. Persoonlijke gegevens		
4. Ik begrijp dat de persoonlijke informatie die over mij verzameld wordt en mij kan identificeren, zoals mijn naam en functie, niet gedeeld worden met derden.	☐	☐
5. Ik begrijp dat de persoonlijke data die over mij verzameld wordt, vernietigd wordt in november 2022	☐	☐

	JA	NEE
C. Informatieverwerking en -opslag		
6. Ik begrijp dat na het onderzoek de geanonimiseerde informatie gebruikt zal worden voor academische doeleinden (afstudeerscriptie).	☐	☐
7. Ik geef toestemming om mijn antwoorden, ideeën of andere bijdrages anoniem te quoten in resulterende producten.	☐	☐
8. Ik geef toestemming om de afstudeerscriptie waar mijn geanonimiseerde data deel van uitmaakt te publiceren in het onderwijsdepot van de TU Delft (repository.tudelft.nl) opdat deze gebruikt kunnen worden voor toekomstig onderzoek en onderwijs.	☐	☐

Handtekening deelnemer

_____	_____	_____
Naam deelnemer	Handtekening	Datum

Ik, **de onderzoeker**, verklaar dat ik de informatie en het instemmingsformulier correct aan de potentiële deelnemer heb voorgelegd en, naar het beste van mijn vermogen, heb verzekerd dat de deelnemer begrijpt waar hij/zij vrijwillig mee instemt.

_____	_____	_____
Naam onderzoeker	Handtekening	Datum

Met vriendelijke groet,

Tessie van der Voort Maarschalk
T.P.vandervoortmaarschalk@student.tudelft.nl
+316 81 22 50 83

5

Stellingen drijvende verstedelijking

	Stelling	Volledig oneens	Niet mee eens	Neutraal	Mee eens	Volledig mee eens	Niet van toepassing
1	Bij aanvang van het project hadden we voldoende kennis over de planning, de benodigde vergunningen, het relevante wetenschappelijke onderzoek en de haalbaarheid	☐	☐	☐	☐	☐	☐
2	Bij aanvang van het project hadden we al ervaring met bouwen op het water	☐	☐	☐	☐	☐	☐
3	De onzekerheid omtrent de juridische status van drijvende woningen leverde **geen** complicaties op	☐	☐	☐	☐	☐	☐
4	Het was duidelijk welke wet- en regelgeving van toepassing was op het project	☐	☐	☐	☐	☐	☐
5	Het vinden van financiering voor het project leverde geen problemen op	☐	☐	☐	☐	☐	☐
6	De gemeente en het betreffende waterschap hadden voldoende ervaring met de commerciële exploitatie van water	☐	☐	☐	☐	☐	☐
7	Het bestemmingsplan hield al rekening met drijvende bebouwing voor aanvang het project	☐	☐	☐	☐	☐	☐
8	De aanvoerroute van de woningen naar de locatie heeft geen beperkingen voor het ontwerp opgeleverd	☐	☐	☐	☐	☐	☐
9	Voor het ontwerp zijn nieuwe bouwtechnieken gebruikt of ontwikkeld	☐	☐	☐	☐	☐	☐
10	Dit project is makkelijk op te schalen (hierbij is de hoeveelheid publieke ruimte van belang)	☐	☐	☐	☐	☐	☐
11	Voorafgaand aan het project is onderzoek gedaan naar de mogelijke milieu-effecten	☐	☐	☐	☐	☐	☐
12	Het feit dat bouwen op het water relatief nieuw is heeft geen invloed gehad op de bereidheid om mee te doen aan het project	☐	☐	☐	☐	☐	☐
13	Bouwen op het water is urgent	☐	☐	☐	☐	☐	☐

6

Interview participants

#	Project	Role	Perspective
WA1	Waterbuurt West	project director	public
WA2	Waterbuurt West	urban planner	public
WA3	Waterbuurt West	junior projectmanager	public
WB1	Waterbuurt West	developer	private
WB2	Waterbuurt West	constructor	private
WC1	Waterbuurt West	resident	society
WC2	Waterbuurt West	resident	society
WC3	Waterbuurt West	manager at housing corporation	society
NA1	Nassauhaven	projectmanager	public
NA2	Nassauhaven	projectmanager	public
NB1	Nassauhaven	architect/developer	private
NB2	Nassauhaven	contract specialist	private
NC1	Nassauhaven	resident	society
NC2	Nassauhaven	resident	society