Designing resilient coastal neighbourhoods
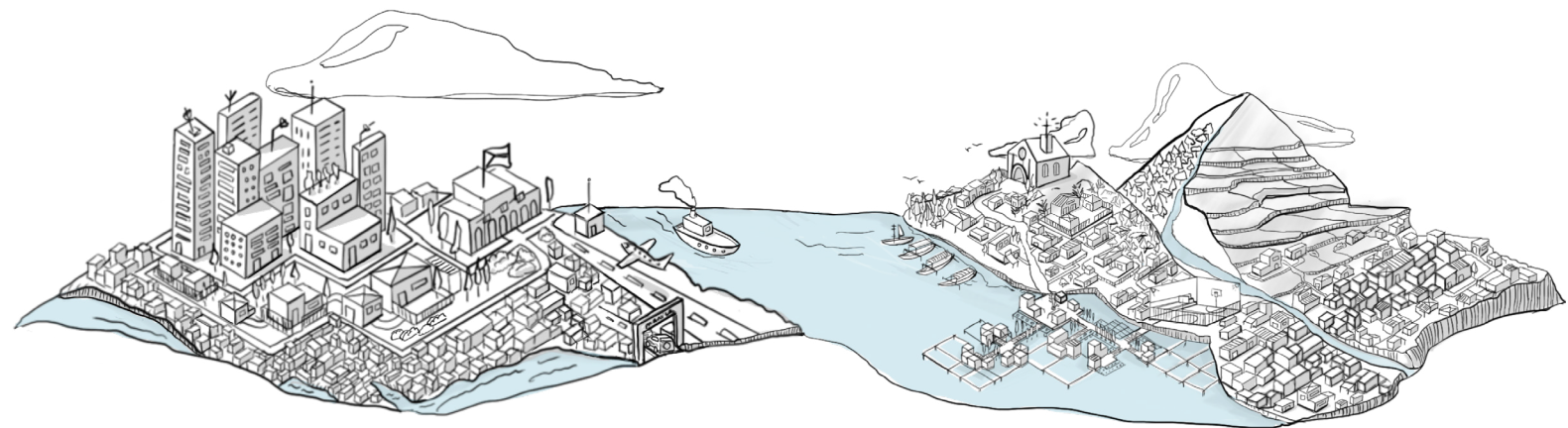
Co-creating a hybrid settlement framework for the city of Hagonoy, Philippines.

TUDelft

Master thesis
Alazne Echaniz Jurado

Finch
Floating
Homes

Master thesis
Delft, September 2021

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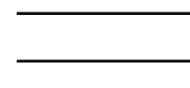Assistant Professor of Network-driven Systemic Change

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Graduation Report

Designing resilient coastal neighbourhoods

Co-creating a hybrid settlement framework for the city of Hagonoy, Philippines.

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To my family and friends at home (in Spanish)

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Executive Summary

The Philippines is a country where most of the human settlements are on the coast. Rapid urbanisation caused by economic development and annual population increment affects the housing situation in the country. In addition, climate change has increased the prevalence of natural disasters, such as floods, typhoons, rising sea levels, tidal movement, and heavy rainfall. In the city of Hagonoy, citizens struggle with the effects of natural disasters, particularly in housing conditions. Typically, locals employ ad-hoc solutions suchlike raising the dwelling one floor higher every few years, which is a costly and inefficient solution in the long term.

The Filipino society is a close-knit ecosystem formed by different stakeholders with contrasting interests and needs. When combining the stakeholders with the increasing environmental pressures, it becomes an even more complex problem. This thesis presents an exploration in implementing long-lasting solutions in coastal rural areas to form resilient communities in the light of the arising problems.

A holistic approach is necessary to generate a neighbourhood that corresponds to the living conditions and resists natural hazards. Firstly, literature and historical research were done to study the events that generated the current society. Secondly, participatory design sessions involved the end-user in the designing process and explored their daily needs. Then these insights were brought together in a system map of people, elements and spaces, and a city map, visualising locals' desires for the future community and analysing the solution space. Finally, the co-design of a floating neighbourhood was conceptualised based on an existing pilot floating home and the required living conditions.

The generated hybrid neighbourhood shows potential to create a resilient neighbourhood where the citizens' desires are placed in the middle of the community planning. Accessibility, sociability and incrementality attributes were perceived as vital to ensuring social acceptance. The neighbourhood extension illustrates the community's possibility to grow and increment in a non-invasive manner while respecting the dynamics of the existing city. On this basis, the concept of co-creating a hybrid neighbourhood should be considered when designing resilient communities in coastal rural areas in the Philippines and countries under similar circumstances.

Report structure

The structure of this report has nine different chapters, which unfold as follows:

CHAPTER 1 introduces the topic of the thesis, the target area and stakeholders involved in the project. Then, it describes the employed design approach, research questions, and scope of the project.

CHAPTER 2 explains the research context and the local culture by doing a literature review and context observation, which finalises the targeted area's problem statements. Next, research of the existing floating settlements allows identifying working principles and takeaways for the project.

CHAPTER 3 aims to gain insights into the existing barangay, the inhabitants' habits and routine, and their desires by performing a participatory design process with the interviewees. The user research brings light to the desirability aspect of the project. Besides user research, literature review is done. The information allows understanding the design neighbourhood principles and user experience to support the requirements creation during the floating neighbourhood development phase

CHAPTER 4 means to define the social and physical opportunities the previous chapter presents as an analysis of the context and turn them into design opportunity areas. It lists the requirements the result must achieve and finalises the vision statements at the community and dwelling levels.

CHAPTER 5 explores the connection-relations among the different elements of the current land-based and future floating settlement. It analyses the active infrastructures and the benefits of sharing them with the new extension of the city. To boost the interaction among both communities to act as one.

CHAPTER 6 presents the final concept for the floating neighbourhood design. Detail the features and spaces of the extension of the current community into the water.

CHAPTER 7 conceptualizes the proposed design in the previous chapter. Then, it elaborates on the requirements a floating platform should fulfil. Finally, it gives detail about the production of the module and the integration of the clusters into the context.

CHAPTER 8 evaluates the presented concept by studying different aspects such as desirability, feasibility, and viability and a roadmap where the development of the floating settlement.

CHAPTER 9 concludes this thesis with future recommendations, a final discussion, and a personal reflection on the graduation project.

Terminology

The glossary introduces the used terminology during the report (Global Housing Design, 2021; Kendall, 1976 ; Merriam-Webster, 2021).

Township

The wider zoom lens is where we look at the scale of the whole residential community.

Neighbourhood:

.At this scale, the focus is on an area defined in its physical configuration and residents' social interaction.

Barangay

Basic socio-political unit of roughly thirty to one hundred families.

Cluster:

This is the smaller scale of an association of dwelling units, where there is a clear physical and social connection between the dwellers.

Realm

Space between private and public can be seen as an extension of the dwelling, where children play, and parents chat and interact with the neighbours.

Dwelling:

This is the scale of the individual residential unit that performs as the physical support for the domestic practices of a household.

Basic Unit

This is the minor scale where the essential elements that create a dwelling unit are described. Then, by clustering, basic units' neighbourhoods and cities are generated.

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If not mentioned the illustrations are made by the author

CHAPTER 1

Introduction
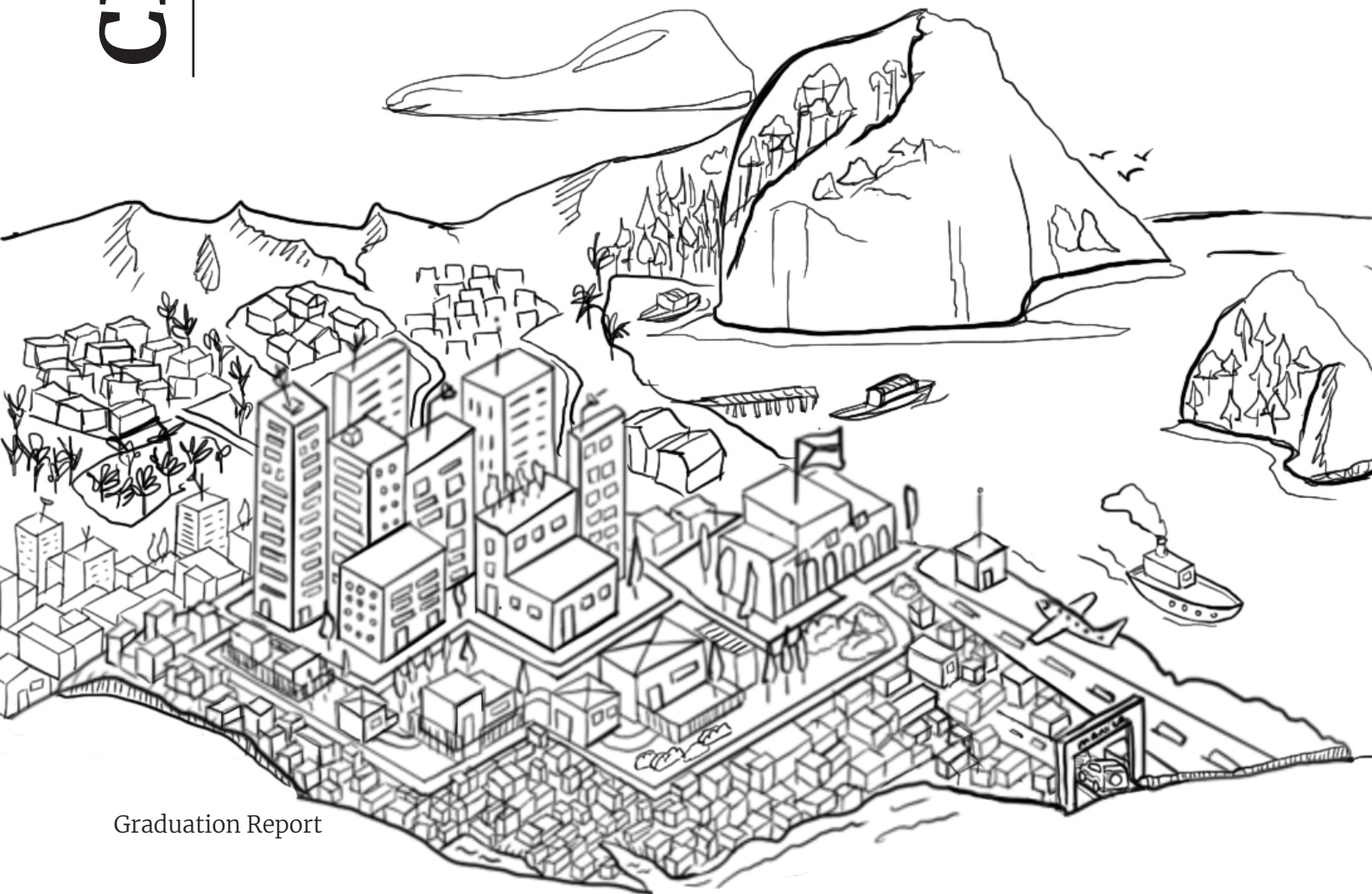
This chapter introduces the project assignment and stakeholders, describes the approach and problem statement. Then, it presents the targeted context of the project. Ending with is a project overview.
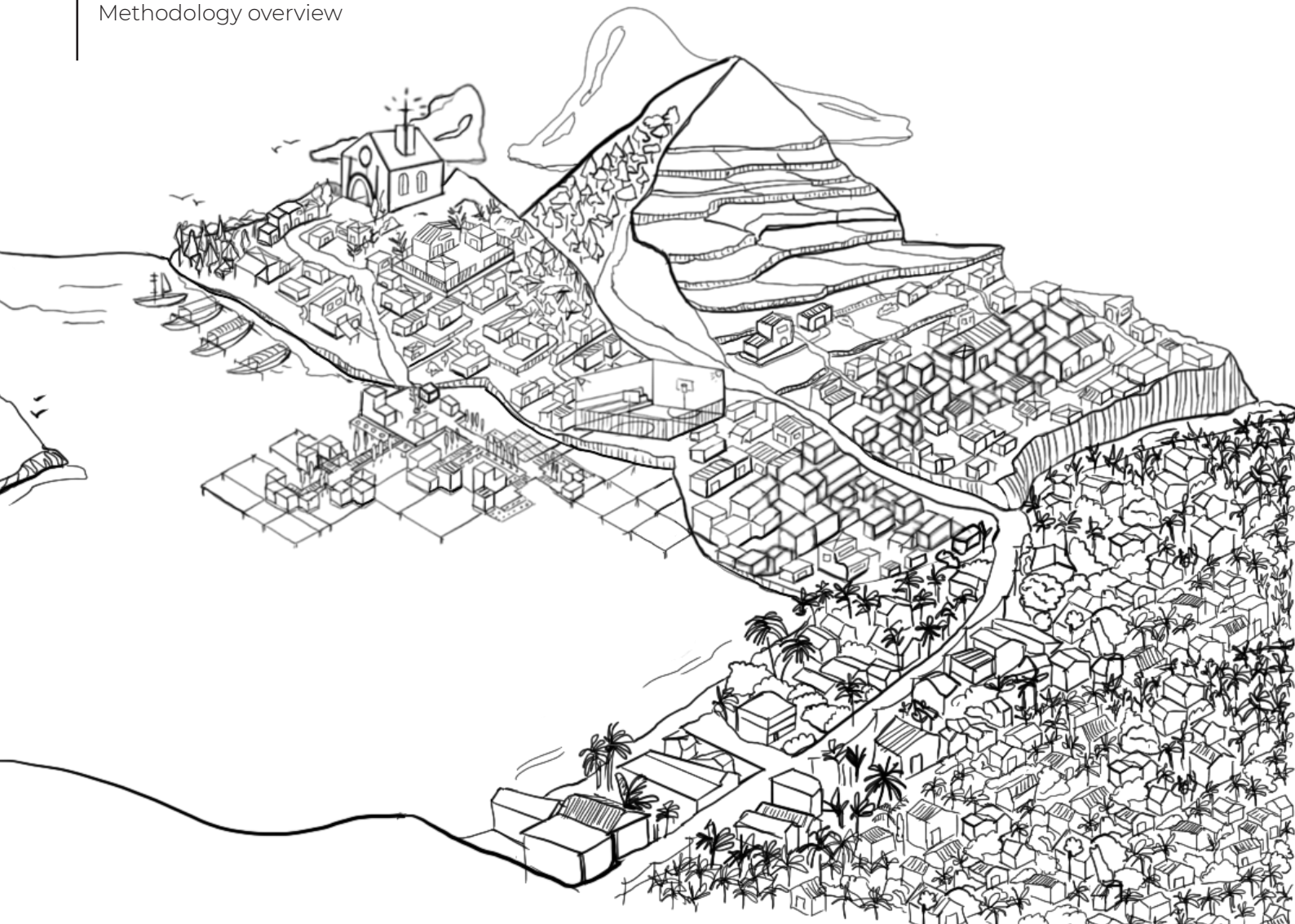
Introduction

The Philippines is an archipelago comprising 7.107 islands (Habitat for Humanity, 2020), where most human settlements are alongside the coastal areas. The rapid urbanisation generated by the economic development and growth of the Filipino population (World Bank, 2016; Macrotrends, 2021) is negatively impacting the housing situation in the country (van Schaik, 2016). In addition, Climate change has increased the prevalence of floods, heavy rainfalls, and sea rise levels (UN-Habitat, 2020; World Economic Forum, 2020). All these factors lead to the degradation of the natural resilience, causing land subsidence, especially in the coastal settlements. adapt.

Besides, housing in the Philippines is not adapted to the aforementioned pressures, and these effects are most apparent in rural areas such as Hagonoy. Moreover, the lack of available space often means the poorest in society build settlements in regions prone to natural disasters.

This project is executed in collaboration with the PhD candidate Pieter Ham, who works for Finch Floating Homes (Finch Floating Homes, 2021), a Dutch company with experience building sustainable modular floating housing for the Philippines (Figure 1). Currently, they are developing a floating neighbourhood in Hagonoy, a city located on the island of Luzon. The focus of this graduation project is to collaborate on the development of this floating community.
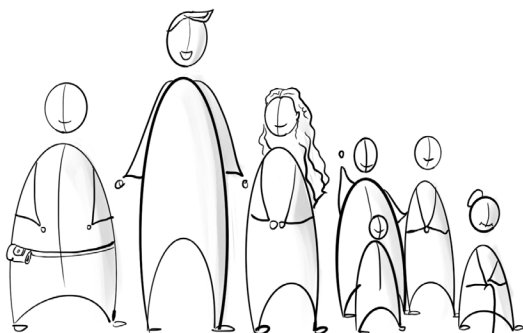
Figure 2- Stakeholders involved in the thesis

Graduation Report

1. Initial project assignment

Creating a neighbourhood is complex, as it must deal with different stakeholders, natural threats, socio-economic uncertainties, established dynamics, cultural living patterns, etcetera. Moreover, the Filipino cities need room to expand, as the population keeps on growing without enough available land for all. Due to the nature of the project, the risk of ending with an unpleasant neighbourhood design rejected by the local inhabitants is high. Throughout architectural history, entire neighbourhoods were created to provide housing in critical situations, the Peabody buildings in London or the Grand Housing programme in Addis Ababa. However, they ended up being either rejected by society or not adjusting to the needs of the inhabitants, becoming dysfunctional (Global Housing Design, 2021).

The study of the past events proves that the neighbourhood's social acceptance is critical to determine its success. It is considered a success the integration into the context without damaging the environment or altering the society. Simultaneously, allowing the expansion of it by the local inhabitants' initiative over the years.

Therefore, the initial assignment of the project was to study a way of making the shift towards a floating neighbourhood in the current rural area of Hagonoy, Philippines, by designing an implementable neighbourhood concept. The proposal should consider the inhabitants' social and physical needs, resulting in a suitable and desired floating neighbourhood.

2. Project Stakeholders

The stakeholders that contributed to making this graduation project an enjoyable experience are (Figure 2): from the faculty of Industrial Design Engineering (IDE) of the Delft University of Technology (TU Delft), Sine Celik and Ernest Van Breemen, from the faculty of Civil Engineering Pieter Ham and lastly, the members of the community of Hagonoy.

Finch
Floating
Homes

Figure 1- Finch Floatings Home's Pilothouse (TU Delft Stories, 2021)

Context of the project

Attributable to the country's strategic location in Southeast Asia, other countries have conquered the Philippines throughout history, from the Spanish invasion until the American Colonial era. Thus, all the historical events lead to the creation of the Philippines Republic era (Figure 3). Furthermore, several aspects of the country, such as language, religion, political system, architectural elements, and urban design, reflect each colonial era (Yamaguchi, 2006).

The development of the private sector, the heritage of the American colonial era (Lorenzo, 2016; Raffle, 2021; Yamaguchi, 2006), combined with the historical tendency to socially divide (Doeppers, 1972), lead to the fragmentation of society and the polarisation of the classes (Appendix 5). The private sector has a vital influence in the country as it contributes to developing the infrastructure, owns the land, and manages the significant business. Meanwhile, the middle and lower-income society highly depends on the higher-income ones (Raffle, 2021).

Lastly, the country is tightly linked to the water as it relies on it to survive (source of food and employment) and suffer natural disasters brought by the water (floods, sea-level rise, etcetera) and affect their daily lives housing conditions. Therefore, the scenario is complex due to several factors, such as society, environment, and infrastructure. The picture (Figure 4) illustrates how the different factors influence each other, describing the existing tension points in the scenario, where 'B' stands for balancing and 'R' for reinforcing (Diehl, 2020).

1521	1898
Prehistoric Era	*Spanish Colonial Era*
Spanish Arrival to the Archipelago	Spanish- Amercian War

Figure 3- Brief historical timeline of the Philippines
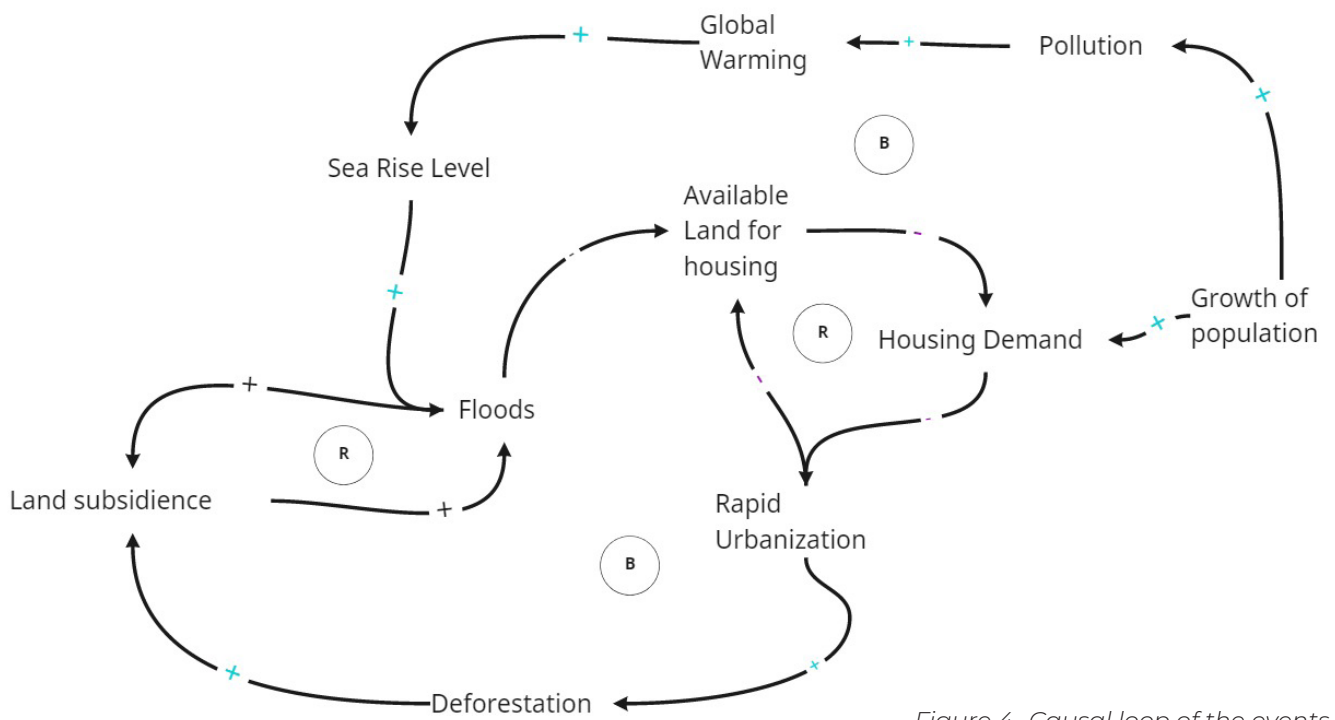
Figure 4- Causal loop of the events happening in the Philippines

1945

American Colonial Era

Philippine Republic Era

End of the II World War

Project Approach

1. Design Challenges & Opportunities

The main design challenge is to create a desirable yet feasible floating neighbourhood that locals accept and promote the culture's development. Creating a sustainable community can improve living conditions by providing physical and social wellbeing (Gharai, 1999). In addition, the project aims to inspire other areas in the Philippines or other countries in Southeast Asia that are also suffering from similar conditions.

The status of the project is a pilothouse located in Macabebe (Figure 1). This house is adequate for the target area and affordable. Nonetheless, to bring the project to the next stage, from floating home to a modest neighbourhood, while ensuring approval from the locals, the following topics should be studied (Global Housing Design, 2021):

· Which are the neighbourhood dynamics in Hagonoy?
· Living patterns of the Filipinos.
· Essential elements of the neighbourhood to start the transition.
· Which are the working principles in other communities? Can we implement one in the context?

Figure 5- Double diamond methodology overview

2. Methodology

This thesis project has four phases, grouped in two consecutive series of diverging and converging (Figure 5), known as the Double Design Diamond (Design Council, 2007). A mixed-methods approach is followed through the four phases, integrating quantitative and qualitative methods that allow data collection, analysis and synthesis, ideation, and conceptualisation. The project aims to answer the following main research question (RQ):

How can we design a floating neighbourhood made with prefabricated homes accepted by the Filipinos' living patterns and allow (social and physical) growth over time?

The main research question decomposes into secondary questions that follow the stages proposed in the double diamond method.

· **Discovering:** How did this problem come to happen? Why is it hard to solve it?
· **Defining:** Could we implement the solution in the context? Which are the essential elements in the neighbourhood? Which living patterns need to be considered when designing the first floating community?
· **Developing:** How can the identified needs and requirements be implemented into the context of the pilot floating home and target area?
· **Delivery:** Does the proposed design fulfil the established requirements? Which are the future opportunities (expansion)? Which are the learnings and future recommendations?

3. Relevance of the project

The effects of Climate change in coastal areas and flood-prone areas expose that housing in the Philippines is not adequate to withstand the environmental pressures (Figure 6). Due to the lack of space and poor housing infrastructure, a shift towards floating settlements is needed (Ham, 2018; van Schaik, 2016).

At the same time, the attachment of the local population to the land (Lorenzo, 2016) where they grew up prevents them from moving, even if they must stand challenging living conditions. Therefore, throughout the years, they have become resilient and developed several short-term solutions. Nevertheless, being aware of the situation, they are searching for new possible alternatives.

4. Limitations

This approach has several limitations; for starters, the entire study is done online without face-to-face contact or personal experience. This limitation has an impact on understanding and experiencing the culture. Therefore, a generative session is designed to compensate for it where the designer and the participant co-create together (Sanders & Stappers, 2018).

Secondly, being aware that the required time to design a neighbourhood is higher than the available one, this study only focuses on the conceptual design of the neighbourhood centre.

Lastly, to collect the required knowledge for the project, aside from the literature review, context observations and interviews, an extra online EDx course in 'Global Housing design' (Global Housing Design, 2021) is done.

Figure 6- Housing situation in Macababe (TU Delft | Stories, 2021)

Methodology Overview

Here is an overview of the entire process (Table 1), used methodology and obtained results. The goal of the illustrations was to provide a methodological overview of each stage of the project. The structure of this thesis follows the double diamond model, and its highlighted accordingly to the phase of the project.

Discovering

WHY?

Objective

How did this problem come to happen? What makes it hard to solve it? What has been done to solve it?

HOW?

Methods and Activities

Literature Review and desk research

- Context Research/ User research
- Stakeholder analysis
- State of art of floating settlements
- Interview and generative session with the target group

WHAT?

Outcome
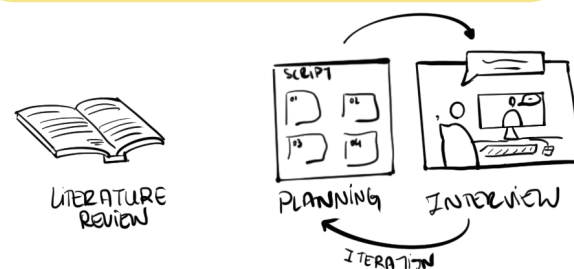
- Framing of the system
- Background of the world floating settlements
- Persona & Scenarios
- Timeline

WHEN?

Stage in the project
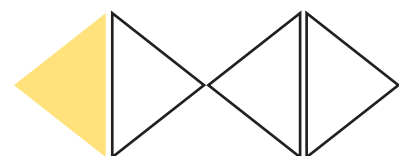
Table 1- Project methodological overview

Defining

Could the solution be implemented in the context? What does the current community need?

- · Analyse the interview outcomes
- · Reality Vs Theory analysis

- · Essential elements of the neighbourhood
- · Design Requirements
- · Vision statement

Development

How can we build a functioning and liveable community?
How can the opportunities and needs be integrated into the future design proposal?
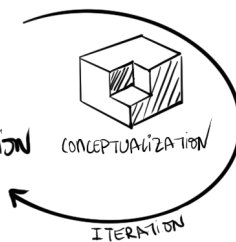
- · Ideating and exploring possible design proposal
- · Visualizing the outcome
- · Iteration of design

- · Idea generation
- · One selected concept

Delivery

How does the design proposal contribute to the existing neighbourhood?
How will this solution evolve over time?

- · Evaluating the selected concept
- · Analysing the outcome of the test
- · Iterating the idea

- · Idea validation and evaluation
- · Roadmap
- · Concept proposal
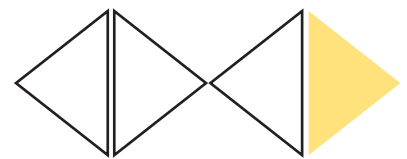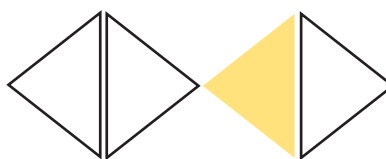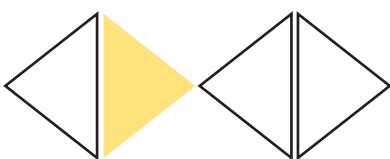
CHAPTER 2

Understanding

Introduction

This chapter introduces the context area and the inhabitants of Hagonoy by describing the problems the local society is struggling with. Next to the context, the solution space is explored by studying locally and globally employed solutions in similar situations.
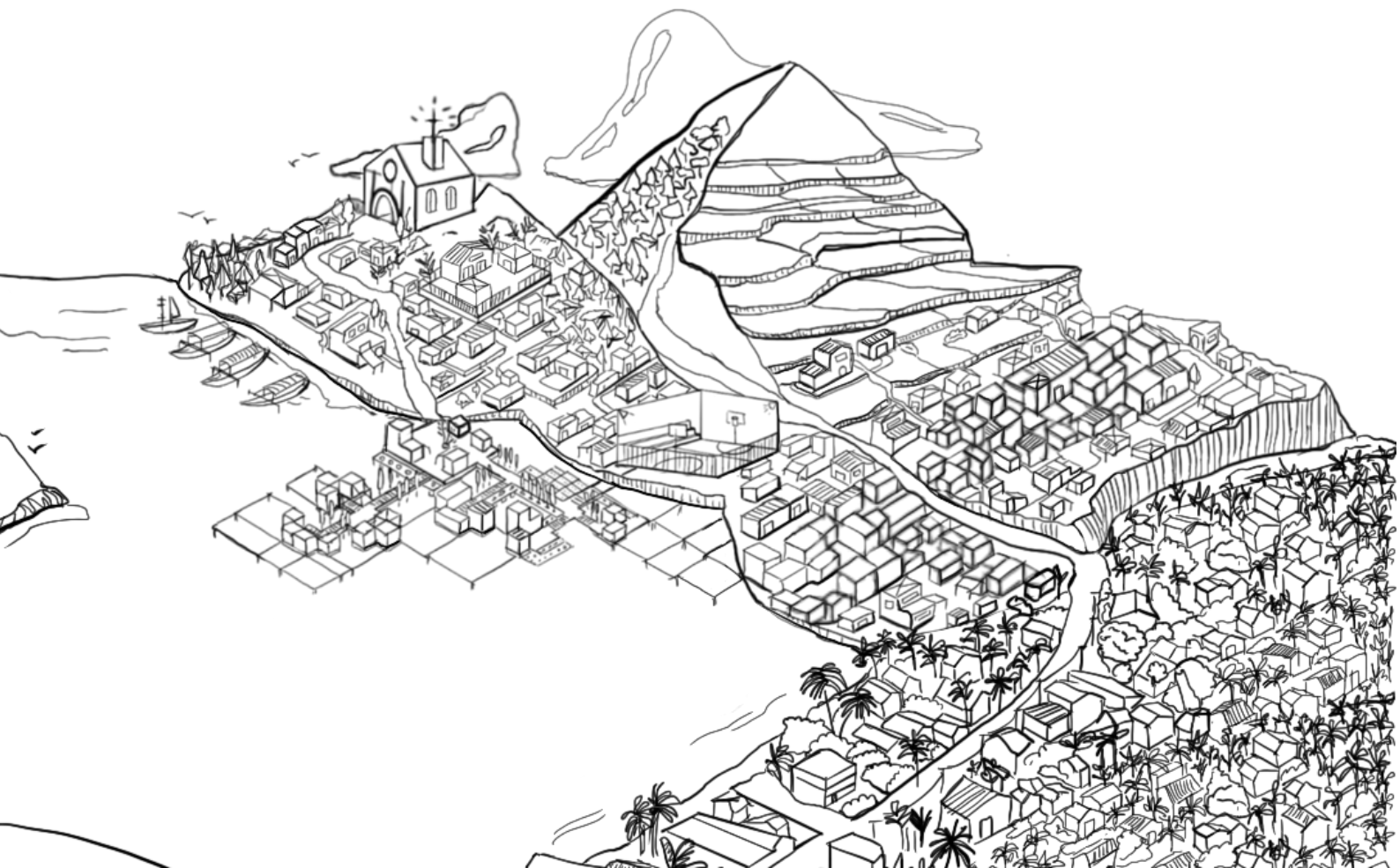
Approach

The chapter aims to gather the information to answer the following questions:

- *How did this problem come to happen? Is it possible to solve or diminish the effects?*
- *Which are current active solutions?*
- *Which new alternative could be implemented into the context and why?*

Considering the nature of the questions, the employed methodology in this chapter is research-based. Different literature resources and field observation are combined to develop a system frame. The diverse categories, which form the system frame, give an overview of the target area and group. The timeline and system map infographics summarise the insights of the study. After this exploration of the context follows the description of the main problems happening in Hagonoy.

Lastly, to explore the globally active solutions, further literature research and observation are combined. Understanding the active principles and implementing the learnings into the project is essential for this thesis, so the same mistakes are not repeated. An illustrated map with crucial information presents the outcome of the performed study. The complete analysis can be found in the appendices [6].

ARCHITECTURE
House typology according to the each era

Bahay Kubo

1521

Prehistoric era

Spanish arrival to archipelago

HISTORICAL EVENTS

Settlements/ Neighbourhoods
Development of the urban settlements

Coastal margins, lake shores and rives courses dotted with villages.
Basic socio-political unit is the Barangay (Doeppers, 1972).

Hagonoy, Bulacan

1.Introducing Hagonoy

Hagonoy is a town in the coastal region of Bulacan Province, the island of Luzon, with a total population of 126.329 inhabitants (Municipality of Hagonoy, 2021). It is approximately 54km from the capital city, Metro Manila. Hagonoy comprises 26 Barangays, each containing a smaller cluster unit called Purok (Kendall, 1976).

Similarly, like in any urban area of the country, the people and city of Hagonoy reflect the colonial eras in the architecture, habits, religion, traditions, and celebrations (Yamaguchi, 2006). Additionally, the timeline (Figure 7) gives a better understanding of the community's evolution and the relationship between past and present. It illustrates these by relating them to the architecture and settlements formation.

The timeline concludes that certain aspects, such as the shape of the coastal village, follow the land morphology (Doeppers, 1972) and the admiration for the American culture is embedded in the society, in the housing typology, sports, food, etcetera (Yamaguchi, 2006) until becoming part of their own culture (Lorenzo, 2016).

Further information on the timeline can be found in the appendices [5].

Bahay Na Bato   Bungalow   Mix of house typologies

1898   1945

Spanish colonial era   *American colonial era*   *Philippine republic era*

the   *Spanish- American War*   *End of the || World War*

Creation of church-centred villages. Points of activity and cultural exchange (Doeppers, 1972).

Introduction of the concept 'planned neighbourhood' into the country, due to sanitation reasons among others (Urbandwellersph, 2017).

In the provinces, the Filipino elite expressed their social and economic success by building their "dream: American-style house (Yamaguchi,2020).

Land scarcity generates housing Backlog.

Rural areas the dwellings are being created one on top of the others in the available land.

Figure 7- Timeline of the development of Hagonoy
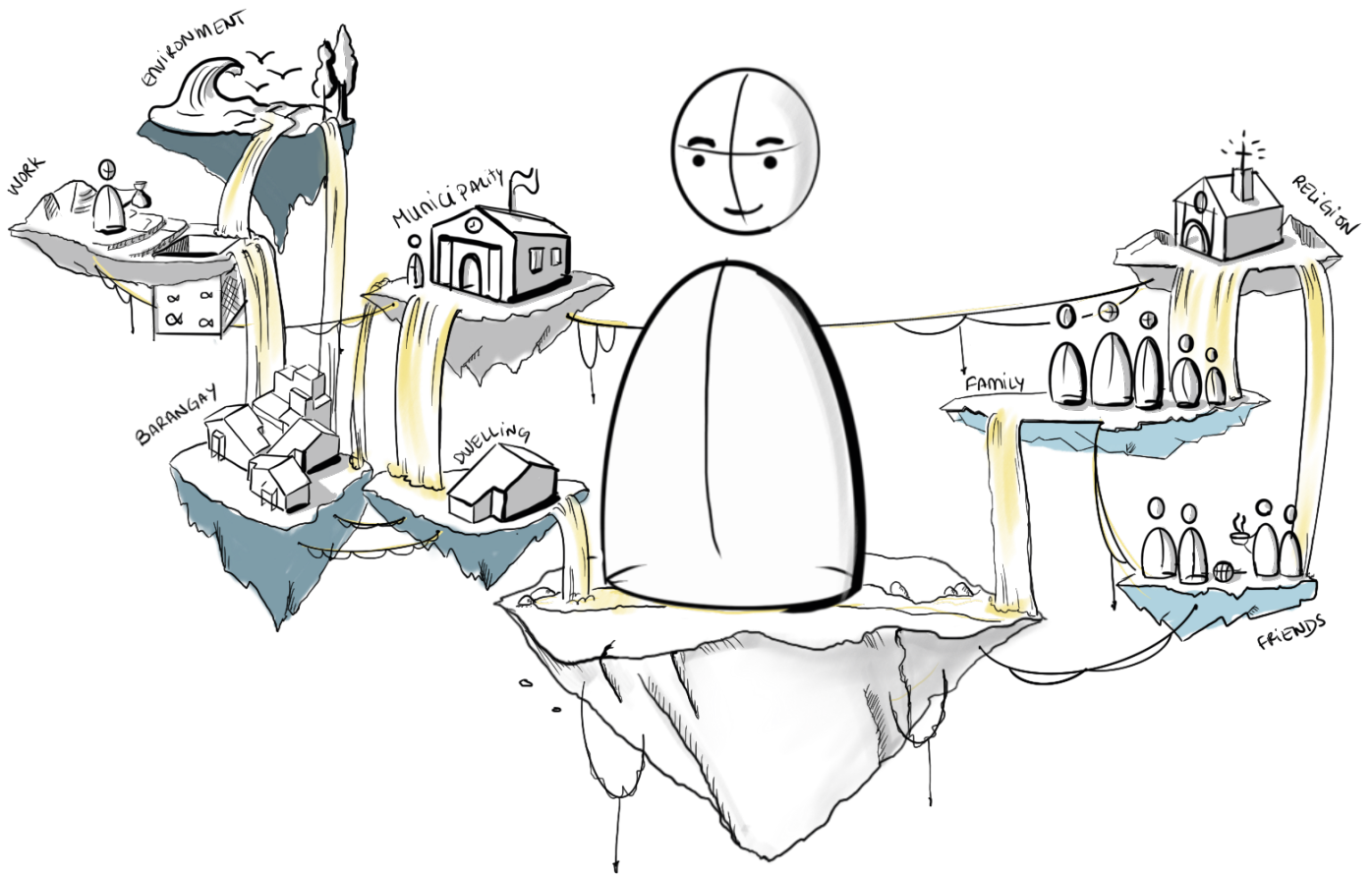
Focus of the project

The focus of the project is designing for the connection points between habitat, society and natural disasters.

While embracing the complexity of the context and considering relationships and exchange of values between the different elements.

Legend:
Waterfalls= influence
Fishing rods= connection

Habitat and community

Environmental pressures

Family and friends support

Relationships and exchange of values
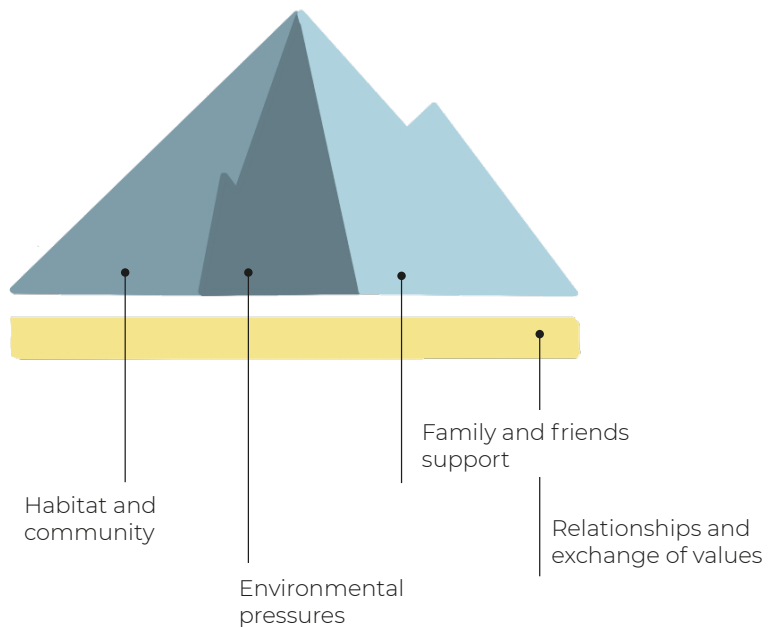
Figure 8- Representation of the complex system of the society

2. Framing the context

Like any other society, the Filipino is a complex one. Therefore, this section explores the local context by framing the context in four main fields, following the step proposed by the 'Systemic design toolkit' (Ellen MacArthur Foundation, 2019). Only two categories (culture and practices) will be further developed in this report from the four areas presented as part of the research focus.

With the division of the system into categories and the description of values and relations, it becomes clear that complexity should be embraced to design for this context. Therefore, the project's focus is the pillars of the system; habitat, environmental pressures, and society (Figure 8). The reasoning for this selection is the direct relationship and dependence between the end-user and them. Although there are plenty of elements and stakeholders involved, only the illustrated ones will be mentioned for the sake of the thesis.

Economic
The aquaculture industry takes more than 70% of Hagonoys' land and employment (Hagonoy Water District, 2016). Approximately 50% of the men are fishermen, 25% are drivers, and the others own different business scales from local stores (Sary-Sary) to the more significant fish farm business. In contrast, women are domestic workers, sellers at the market, small business owners, social workers or housewives (Appendix 4).

Institutional Structure
The private sector provides the infrastructural development of the country (Rey, 2020). In Hagonoy, the personal business controls the aquaculture industry by owning the fishponds and the available land (Appendix 4).

Culture
Filipinos are very family-oriented culture; they love gathering with their families and sharing food every week. They are very well-known for their hospitality and cheer. They live in big family groups, seeking social and economic support, and intergenerational living is ordinary practice (Kendall, 1976; Lorenzo, 2016) (Appendix 4).

Practices
Filipinos (80% of the population (Habitat for Humanity, 2021)) follow Catholicism. They celebrate the town's patrons and barangay's festivities once or twice per year by having a public party in the street (McDonnell, 2019). They love celebrating with family and friends, music, and food (Municipality of Hagonoy, 2021).

Introduction to the problem

Figure 9- Inhabitants of the rural areas of the Philippines continuing with their routine despite the water (Aljazeera America, 2016).

As mentioned previously, housing in Hagonoy is not adapting to environmental pressures (floods, heavy rainfalls, tidal movement, etcetera). Combining the informal settlement constructions quality with the lack of available space for living and land subsidence, an average of 4.5 centimetres per year (Ham, 2018; Keukens, 2020), leads to inhabitable housing conditions. Nevertheless, Filipinos do not want or cannot leave their land and homes due to sentimental or economic reasons, even though this means coping with hindrances (Figure 9).

In addition, the local economy is highly dependent on the land, which is strongly damaged by the effects of climate change. They cannot produce rice or create fish ponds in the available fields as these get inundated with seawater, destroying the crops and overflowing the fishponds.

Figure 10- Sample sunk house of Mercado

1. Current solutions

The picture (Figure 10) is an example of a typical house condition in Mercado, where the building is sinking and swampy water on the patio. The most common practice to solve the mentioned problems are raising the walls and roofs of the dwelling every few years.

This ad-hoc solution is only functional for a few years, and then the owners have to repeat the same process. Thus, the effort is costly and inefficient in the long term; nonetheless, it is the most straightforward practice that inhabitants can afford while providing a rapid solution for their current problems.

2. New solutions

Although the situation might seem complicated to solve, there is room for new solutions in the Hagonoy. Throughout history, inhabitants created the cities along the river (Doeppers, 1972)(Figure 7), becoming the densest areas. An alternative to the riverside settlements' construction could be the fields behind it: fishponds, rice fields, or vacant fields (Figure 11). The illustration represents the available space (blue lines around the city's mass). The two boxed sketch illustrate the fields and their current lack of function. However, it should be noted that not all are public and available to be used. The available fields can be used as living space and implement the demanded dwellings. Moreover, most of them belong to private businesses or are taken by the aquaculture industry; therefore, selecting the right vacant field is vital to prevent conflicts amongst stakeholders.

To conclude, considering the land conditions implementing floating settlements around the current town will provide the much-needed living space.

- River
- Road Grid
- Available land
- City
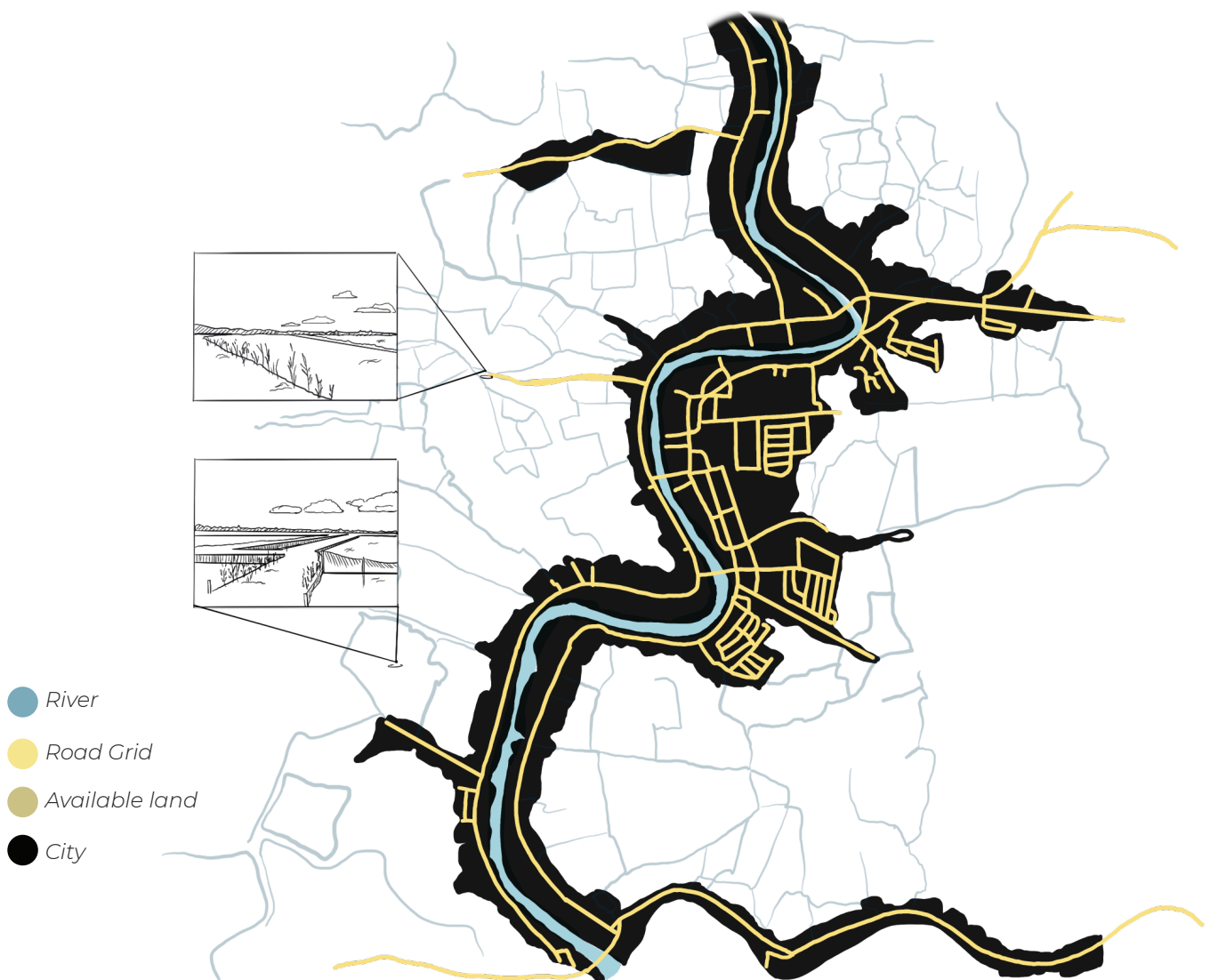
Figure 11- Available space around the city of Hagonoy

Floating settlements

This section explores some of the most famous floating towns/villages around the world. Acknowledging that making the shift towards living on the water is feasible, this thesis does further literature review and observation to expand the knowledge. Historically floating communities have always been there, evolving and growing until becoming a township. This study aims to understand their evolution over the years and analyse the takeaways as a reality check for the future development of the floating community in Hagonoy.

Therefore, the study starts by zooming out and researching floating neighbourhoods around the world. Then by comparing them, following the categories proposed during the EDx (Global Housing Design, 2021) course, typology, clustering and incrementality, a general overview is gained (Figure 12) where the individual and common characteristics become apparent. The whole comparison table can be found in the appendix [6].

Shoreline community

Schoonship, The Netherlands (1997)

Shoreline community

Salunito, San Francisco (1940)

Las Balsas, Ecuador (1942)

Ho Long Bay, Vietnam (19th Cetury)

Island Settlement

Shoreline community

Ganvie, Benin (16th Century)

Island Settlement

Tonle Sap, Cambodia (11th-13th Century)

Island Settlement

● *Allows incrementality*

● *Partly allows incrementality*

● *Does not allows incrementality*

Figure 12- World floating settlements comparison illustration

Table 2- World settlements introduction and analysis

Cambodia | Tonle Sap

The ancient floating village is located in the biggest freshwater lake in Cambodia. It hosts almost 170 floating villages (MI News Network, 2019). It was originated between the 11th and 13th centuries due to the intense rice production and fish farming happening in the lake, which brought wealth to the empire. Nowadays, the village hosts many Vietnamese refugees from the war and provide them with a home (Floramo & Villadiego, 2014).

The village consists of houses connected with wide passages to allow the circulation of boats. However, the water is highly polluted due to the floating dwellings and the lack of environmental awareness (Lau-Bignon, 2015).

Ecuador | Las Balsas

During Spanish colonialism, Ecuadorian native people moved to the water and found a strategic shelter in Babahoyo (García, 2020).
Nowadays, the owners make the houses with the available materials without prior knowledge, resulting in unsuitable dwellings. However, active projects are working to provide adequate housing for the inhabitants (Bamba, 2020) and want to show Ecuadorian pride through them.

Benin | Ganvie Lake Village

Ganvie is a village with 3.000 buildings that stands on stilts in the middle of Lake Nokoue, Africa (Ganvie Lake Village, 2011). The founders of the villages arrived at the beginning of the 17th century, spacing from invaders.

Nowadays, their circulation and mobility around the village are exclusively by boat. Therefore, fishing and tourism are the primary industries in Ganvie. And finally, there are several public services within the villages, such as schools, hairdressers, and mechanical services (WoodCulture, 2012).

Vietnam

Since the 19th century, approximately 1.700 fishermen and aquaculture farmers live almost isolated in boats or floating communities in the zone of Ha Long Bay, Vietnam (Halong Hub, 2020). The dwellings are floating on empty oils drums or bamboo stilts.

Later, in 1955, the number of 'floating villages' in Vietnam decreased due to rural reorganisation and management caused by riverine and water pollution (Malakova et al., 2017).

San Francisco | Sausalito

Over 400 floating homes sit in the suburb of San Francisco. The neighbourhood, Sausalito, echoes a great bohemian history that began almost a century ago. Artists, musicians, writers, and hippies congregated, searching for an alternative and economical lifestyle. As a result, the neighbourhood flourished, becoming well-known among the city's art scene (McDonnell, 2019), with singular and unique dwellings.
The vibrant neighbourhood is accessible by land and water (Born, 2019), keeping the inhabitants well connect to the city.

The Netherlands | Schoonshcip

Historically, the Netherlands is a country with a tight relationship with water. To cope with the rising sea levels, the Netherlands has decided to join the floating community movement and build Schoonshcip (Schoonschip, 2016). With 105 residents, the neighbourhood expects to grow in the upcoming years (Opray, 2020).

The neighbourhood has a share mobility network on land. There is existing parking for cars and bikes outside the neighbourhood. Even more, there is an electrical vehicle rental system for the locals.

1. Analysis

From the analysis (Table 2 & Figure 12), the synthesis is as followed:

The initial reason to move to the water determines the evolution of the settlements. The most common reasons are war/ political refugees or searching for an alternative living due to economic/environmental motives (Appendix 6).

The typology of floating settlement directly relates to its livelihood; in other words, the easy or difficult access has led the population to develop specific living patterns. It also determines the level of dependency the community has with the nearest land base urban settlement. The two main typologies of settlements are island (a village or cluster of dwellings without any connection to the mainland and surrounded by water) and Coastal/shoreline (the homes located near the shore with several links to the continent).

On the one hand, the recent settlements, created after the 20th century, have well-structured urban planning with pedestrian paths, connections to the mainland and organised circulation around the community. On the other hand, the ancient ones are independent dwellings growing organically. They require water mobility, causing the dependency of inhabitants on private vehicles.

Lastly, the incrementality and clustering among the dwellings had a considerable influence on the development of the settlements. Both categories are strongly related to the living patterns of the local society (family and social gatherings, services, and facilities clusters, etcetera.). When comparing the different countries, the oldest settlements have more freedom than the recent ones. Thus, allowing the culture to grow at their phase, adjusting to their needs and promoting independence from society.

2. Learnings

1. Provide sufficient local gathering places where residents can interact.
2. Allow mobility through water and land inside for the community to improve the connectedness with the vicinity.
3. Ensure the accessibility to/from the mainland to foment the interaction between the existing and floating settlement.
4. Introduce designated areas for public services and facilities for the convenience of the inhabitants.
5. Offer farming possibilities (fish or vegetables) within the neighbourhood to increase the local autonomy.
6. Allowing cluster and dwellings incrementality is beneficial for developing the community and local appropriation of the settlement.
7. Promote community feeling and collective effort towards a liveable environment through connector elements amongst dwellings and communal areas.

Chapter Conclusions

Chapter 2: Understanding

This section summarises the findings and reflects upon the research done to gather input for the next chapter. The existing society has the motivations and means to make the shift towards a floating community. After exploring and studying the existing floating neighbourhood, it could be said that the solution could be easily implemented in the targeted area, as long as the target group is aware of the need to transition towards the water. Additionally, the variety seen throughout the world floating neighbourhoods showcases the possibility of developing a working system adapted to each culture. Lastly, from the global analysis, it can be concluded that the existing typologies are not fully functional; therefore, the possibility of combining them could be an exciting alternative to explore in this project.

CHAPTER 3

Analysis

Introduction

This chapter seeks to explore means to empower the citizens of Hagonoy to communicate their needs and desires for the future floating community. So then, the users' needs are placed in the centre of the neighbourhood planning. Next to the user research, further desk research on theoretical design principles guides the thesis to develop an operational and functional neighbourhood concept.
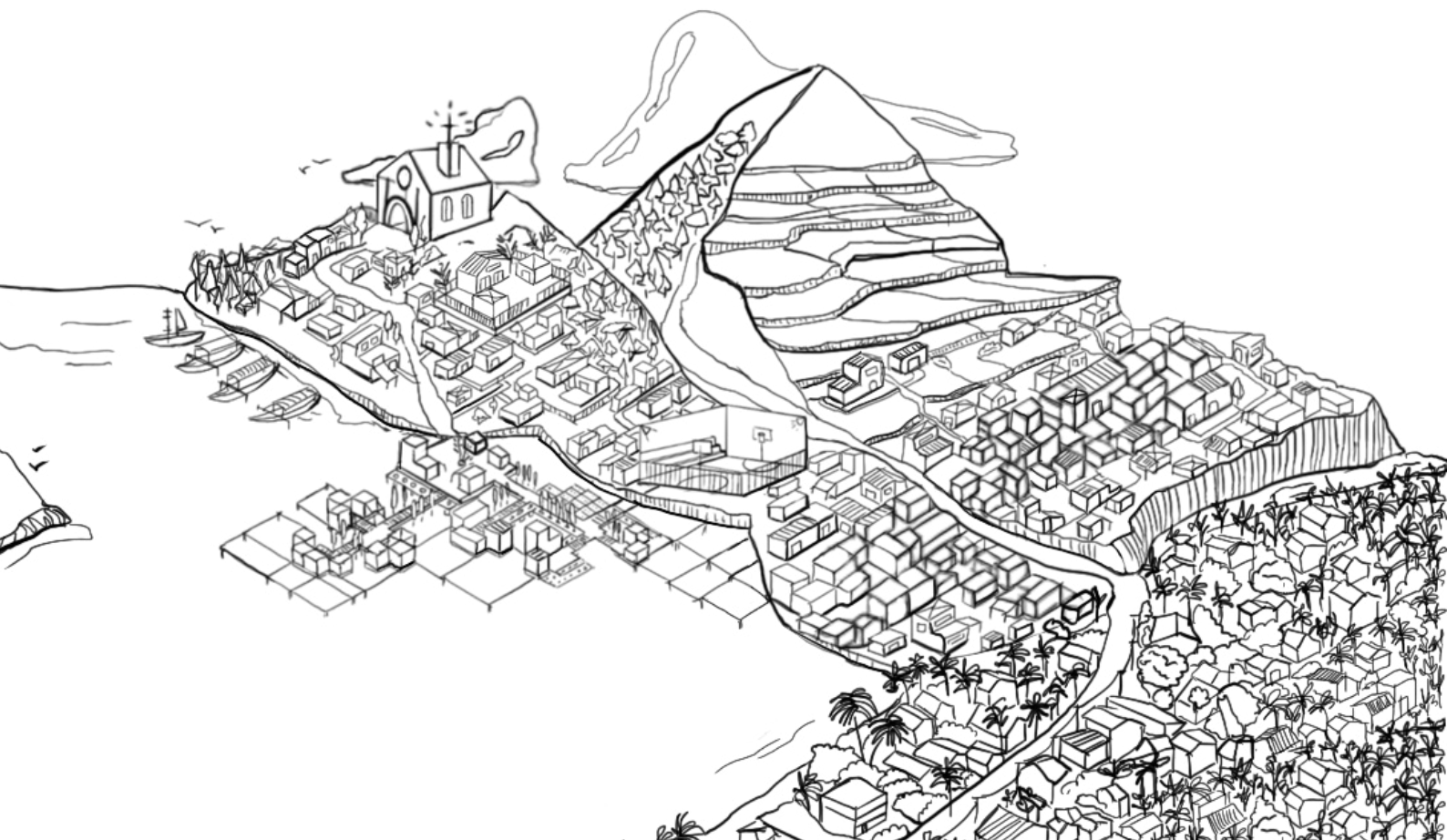
Approach

The approach carried during this study is action research base. This methodology integrates a cyclic process of action and reflection (Figure 13) and puts theory into practice by involving the end-user in the procedure (Emerald Publishing, 2021; Reason & Bradbury, 2001). The employed methodologies combine interviews with participatory design sessions following the core idea of 'Play the City' (Tan, 2014) using a toolkit that enables participants to express and communicate their understanding of their status and while assessing how the shift towards a floating community could be beneficial or a burden (Sanders & Stappers, 2018).

This approach provides valuable insights for the thesis, as it implicates the end-user, considers the vested interests of all stakeholders, identifies existing conflicts, and discovers alternative solutions (UN-Habitat worldwide, 2014). All these factors are fundamental to building a liveable and accepted community that improves the quality of life for its citizens. Nevertheless, the participants' knowledge must be combined with neighbourhood and habitat design principles to achieve this goal. These theoretical principles aim to decrease the gap between theoretical research and practical experience (section: Literature Theory models).

The participant interviews consist of one-on-one meetings followed by an iterative process to ensure that the subsequent interviews could be more effective. Thus, reflecting and iterating after each. Finally, in the theoretical analysis, only the applicable principles for the context are listed.

The infographics and three personas' profiles illustrate the outcomes of this user research. It is important to note that the outcome of the exercises is a summary of the insights gathered during the different meetings.
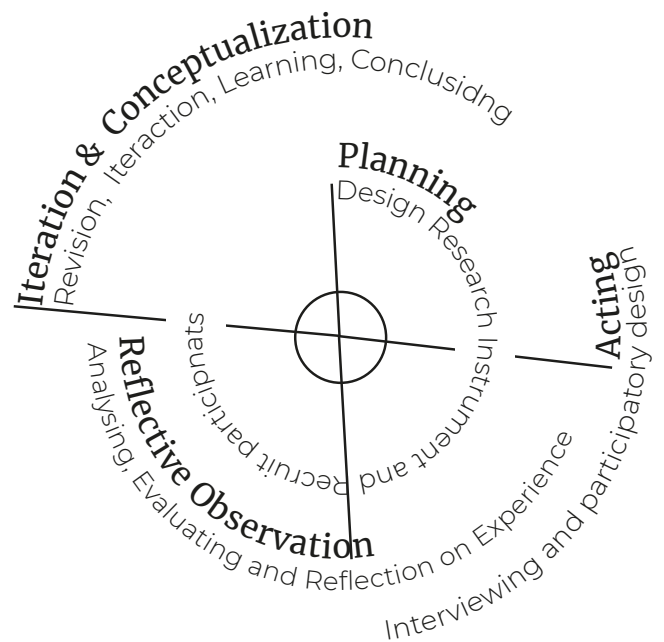
Figure 13- Ethnographic cycle during the analysis

User research

1. Introduction

The goal of the user test is to invite the users to share their habits and routine to understand the hazards faced in Hagonoy and how it impacts their daily life. Next, a distinction of the different social and gender perspectives and the claims each has.

Through the interview and participatory session, the answer to the following questions is pursued:

1. *What is the daily routine of a citizen of Hagonoy? Which are their motives, and how do their background and personal experiences influence them?*
2. *Which are the elements the participants consider essential in their neighbourhood?*
3. *What are they missing in the present community?*
4. *How would they distribute the identified elements in the newly available space?*

For this thesis, the recruited participants are a sample of the end-user, people living in the city of Hagonoy. To have a target group as realistic as possible, the recruited participants belong to different social classes and are from different genders. A total number of eight participants have been interviewed; five belonged to the target group, while the remaining three are stakeholders of the project or share a similar background to the end-users.

2. Research instrument

The main challenges faced during these sessions are that everything is performed online and different cultural backgrounds. Therefore, the designed toolkit must be simple, communicative, empowering the participants and relatable to their town (Sluiter, 2019).

The questions and structure of the session intended to guide the participants by first immersing themselves in the recent experiences (Figure 14_ Board 01 to 03), then activating their memories and feelings. Afterwards, from the memories (Figure 14_ Board 04), a jump towards the dreamed future is done by asking them to describe their dream neighbourhood (Figure 14_Board 05). The last step helps the participants to generate ideas and express their wishes regarding the future of their community by combining the present needs and the good memories (Sanders & Stappers, 2018). The process of designing the instrument can be found in the appendix (Appendix 2).

The exercise of 'Day in the life' (Figure 14_Board 03) intends to create a sample day for the people of Hagonoy. By performing this exercise, the deeper knowledge levels (tacit and latent) are explored. (Sanders & Stappers, 2018). The created toolkit, a Miro board, is a map of the targeted area in Hagonoy. The illustration represents the current situation and the available space for the development of the floating settlement (Figure 14_ Board 05) simplistically. It must be said that this toolkit aims to generate a shareable visualization with the participants rather than an accurate representation of the context.
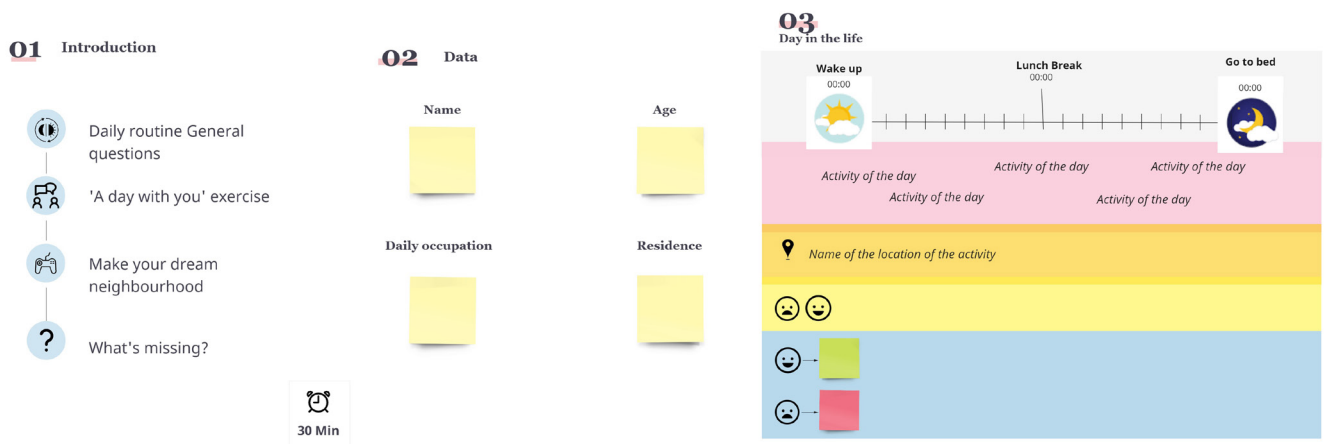
Figure 14- Interview set up overview

3. Action

The main activities during the meeting are questions and exercises executed together with the participants. Following the structure mentioned in the previous section, the participants are guided towards the last board, where their active participation is required. Instead of showing the board right away, specific questions are asked to get them to start imagining their dreamed neighbourhood while the interviewer starts locating the elements into the map. Afterwards, the board is shared with the participant and together, they could iterate, modify and talk about the illustrated neighbourhood.

4. Reflective Observation

After each session, the board is analysed. Each of the participants generated a Purok based on their prior knowledge and background. Although it was challenging to start creating the neighbourhood, the participants communicated their needs and desired future for the community. Throughout the session, the presented elements increased based on the previous meetings (Appendix 2).

04 Past memories

Back in time

05 Make your neighbourhood
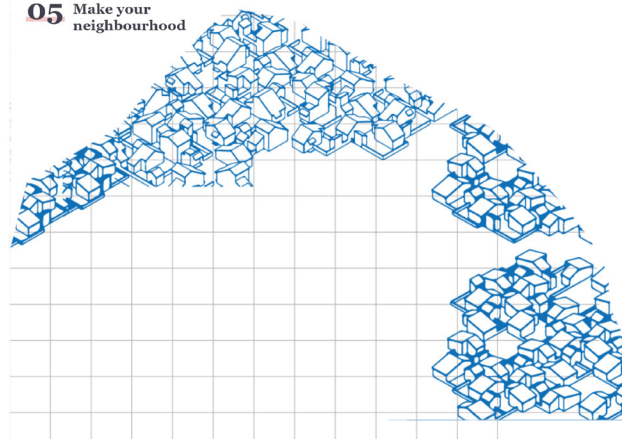
Family house

Big Family house

Fish Farm

Vegetable garden

Boat

Connections to the land

Church

School

Municipality

Hospital

Restaurant

Shop

Sports facilities

Karaoke

Swimming area

Gathering space with greenery

Outcomes

The outcomes of the interviews are presented by answering the questions made in the introduction section of the user test.

1. What is the daily routine of a citizen of Hagonoy? Which are their motives, and how do their background and personal experiences influence them?

The daily activities and habits are gathered by executing the first three boards of the interview set up. Then, two scenarios are created from the first exercise, a day in the life, one representing a sample weekday and the other representing a sample Sunday. The development of scenarios offers an overview of their activities, relating them to their values and personal experience.

1.1 Scenarios
Scenario 1: Weekday
The typical day will begin by waking up early and travelling in the middle of the traffic to work for workers and business owners. Then, they work until 5 pm, and they happily go back home to have dinner with the family. After dinner, they socialise either outside the home or inside with relatives or friends (Figure 16).

Scenario 2: Weekend (Sunday)
During the weekend, the main activities are going to the church and be with the family. Every weekend they have family gatherings after the mess where they eat, sing, and have fun with their beloved ones. Sunday is their favourite day of the week (Figure 15).

1.2 Scenario Conclusions
These scenarios showcase that the main socialising activities happen during the evening after the family dinner. The main difference between social classes and gender is the social nodes. The higher class socialises inside the gated community, which they usually share with family and relatives. Furthermore, if they want to socialise with friends, they rotate houses on each occasion. At the same time, the working class socialises on the street in restaurants, nearby shops, or sports facilities. Regarding gender, men socialise more during the week and outdoors while women stay home talking with the neighbours or with the family and socialise more on the weekends.
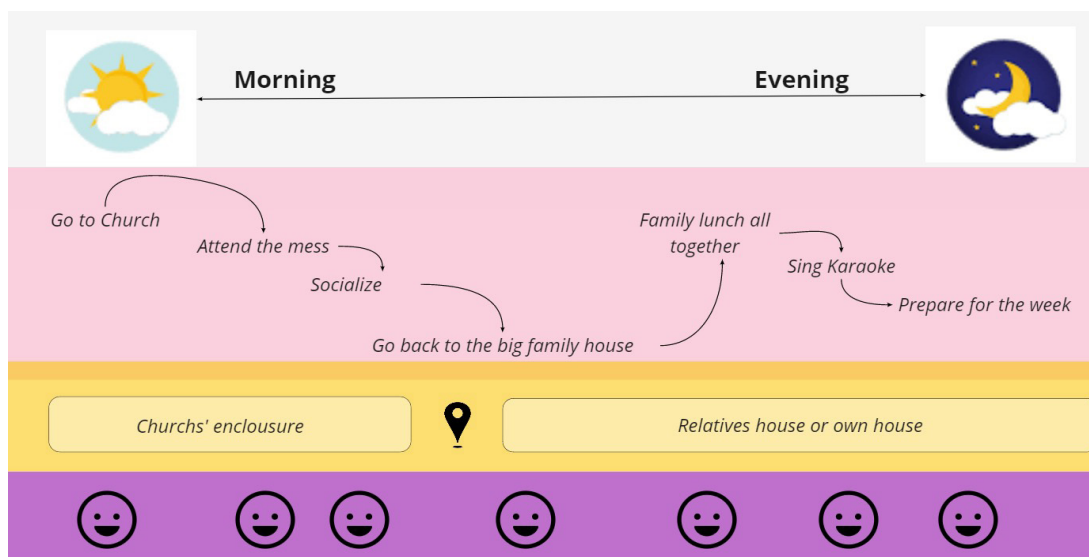
Figure 15- A weekend day sample summary
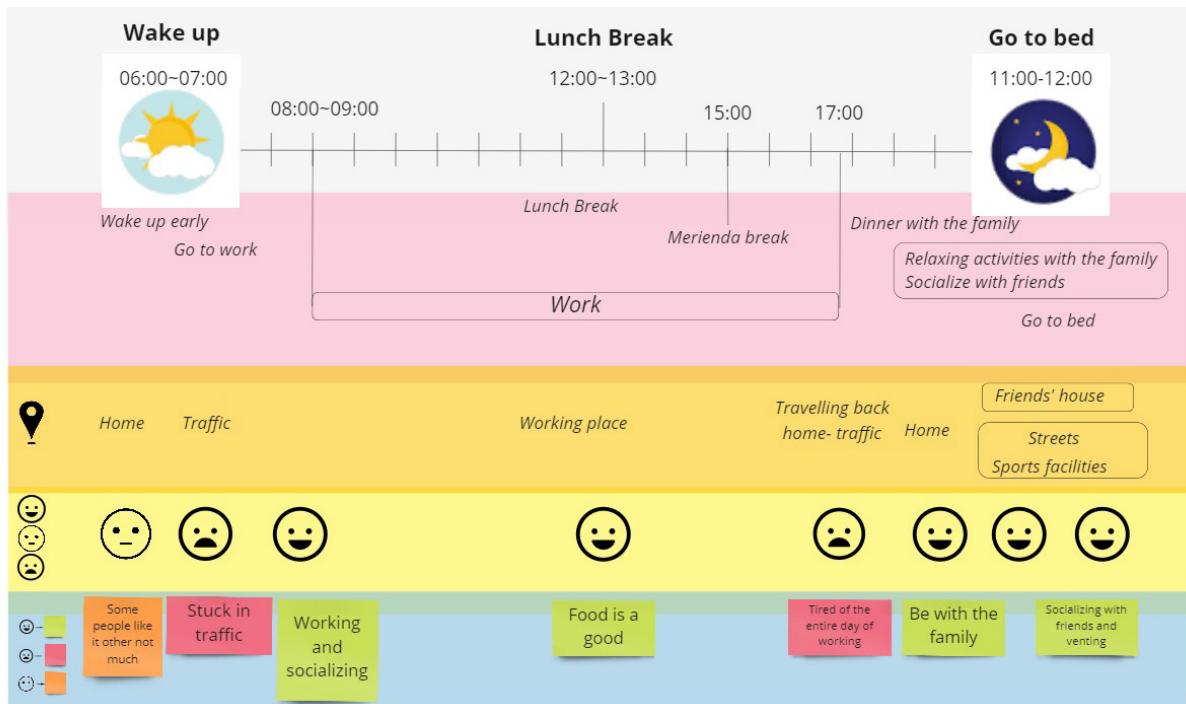
Figure 16- A weekday sample summary

2. Which are the elements the participants consider essential in their neighbourhood?

During the meetings, these are the most repeated elements (Figure 17) by the participants. In addition, the participants argue what value did each element add to their daily life and community. The next chapter details the relationships and values.

Figure 17- Essential elements to create the neighbourhood according to the participants.

3. What are they missing in the present community?

For starters, in the current community, they lack the space to expand in an organised way. As mentioned in the lecture of professor Shlomo Angel (UN-Habitat worldwide, 2014b), the city needs to make room to allocate the growth. To continue, the community has no designated space near their household to hang out and socialise with their family and friends. Lastly, pollution and floods ruin the land and water, depriving them of the possibility to grow food/fish around their dwelling.

4. How would they distribute the identified elements in the newly available space?

Participatory Session outcome

When executing the second exercise, the fragmentation of the society became clear. The economic status highly influenced the 'dream' neighbourhood of the participants. This phenomenon is mentioned during the literature research and is part of the American heritage (Yamaguchi, 2006). For example, in the figure below (Figure 18; left illustration), the gated communities can be seen by clustering the family dwellings. In contrast, the working class was more oriented to make a living from fishing (Figure 18; right illustration) and afford a house.

The urban planning of the floating community led to discovering what they consider a "basic unit" and a family cluster (Figure 19). This unit is the core element in the development of the neighbourhood.
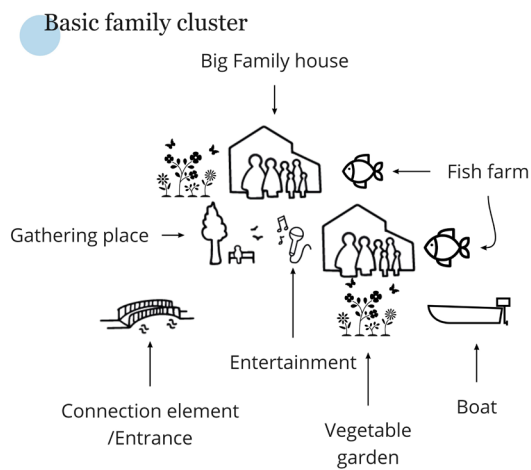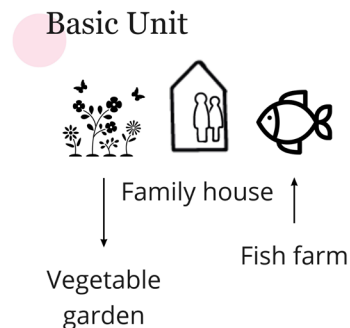
Figure 18- Basic Units
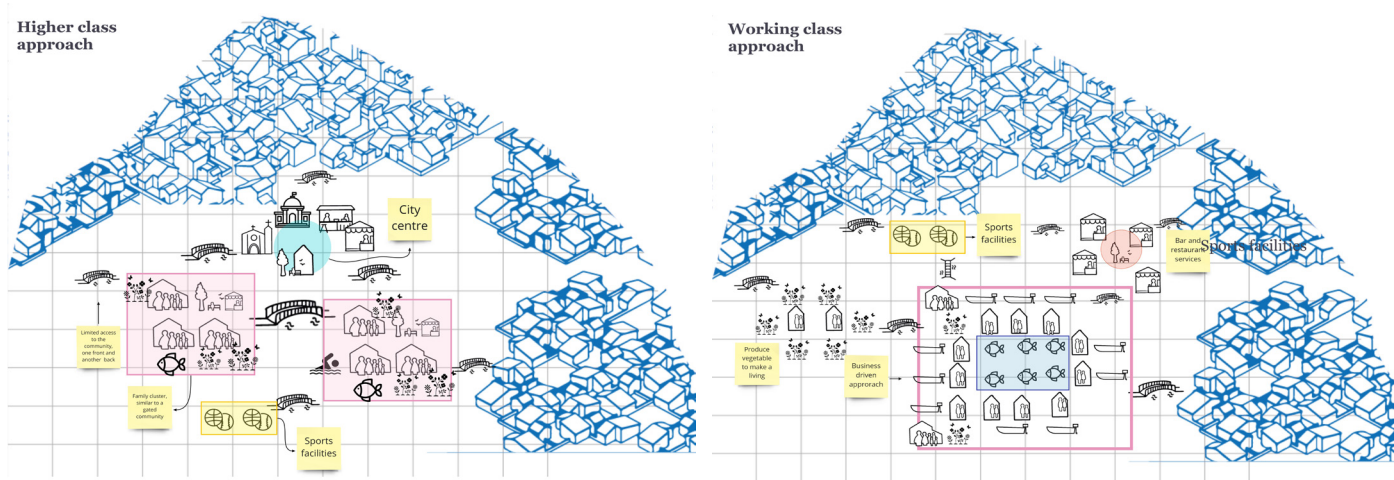
Figure 18- Outcome of the exercise 'Make your dream neighbourhood.

*The figures above summarised the different outcomes of the participants.

Persona

Persona is a technique to create a representative user model based on previous user research (Service Design Tools, 2021)(van Boeijen et al., 2017). The purpose of the persona is to understand the target groups' interests, experiences, behaviours, and needs.

Three different groups of users could be identified during the interviews based on gender, social class, and age, resulting in different persona profiles. Besides, the quotes inside the bubbles are the actual quotes of the participants.

"I want to have my own house"

Introduction
Jose, 27 years old.
Firshermen
House near the main street

Hard-working fishermen who works 6 to 7 days per week. By the end of the day, he wants to go back home and chill outside his house with his friends and family.
He has the responsibility of bringing money home for his family (3 kids, 2 parents and 1 brother). He rents the house from the landlord (private owner).
He loves celebrating the fiestas and singing karaoke with his family and friends as a way of venting from the hard daily routine.

Introduction
Angel , 48 years old.
Local business owner
Gated community

He is a fish farm business owner, runs the business with the family, lives with his family (2 kids, wife, and parents in two households). He loves his neighbourhood. He socializes with this friend in the gated community and goes to church on the weekends.
He loves the natural elements around his house

"I love the sunset view from my house"

Introduction
Rosario, 37 years old.
Municipality worker
Fenced house

She works for the local municipality; she loves helping the local people. She cares about the development of the neighbourhood and she works hard to improve it.
At the end of the day, she arrives home and likes to rest and be with her family (2 kids and her mother). On the weekends she attends church and visits her relatives.

"Our zone is pretty much like a big family."

Theory models

Generic principles for neighbourhood Design
Faraiba Gharai

Habitat Bill of Rightsv
Human settlements

F
Functional
Aspects

P
Perceptual
Aspects

O
Operational
Aspects
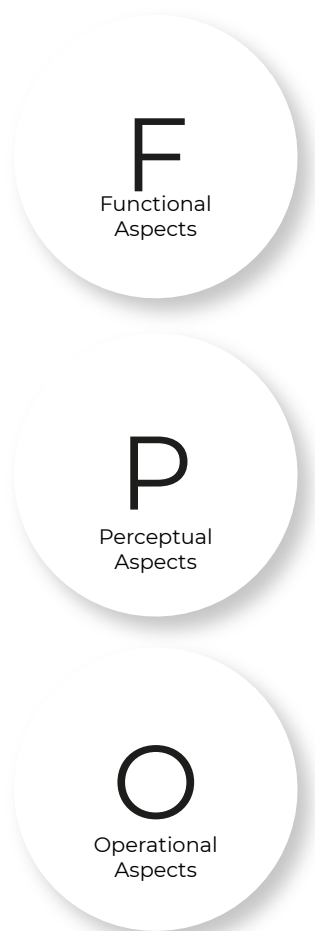
Figure 20- The aspects of the neighbourhood according to the theoretical models.

The proposed concept must bring together the practical knowledge gained from the user research (section: User research) with the theoretical principles and guidelines found in the literature to ensure the solution is implementable and accepted by the citizens. Combining context study and analysis of neighbourhoods' design will generate realistic and applicable design criteria, resulting in a feasible and accepted floating neighbourhood.

The employed principles can be found in Generic principles of neighbourhood design made by Dr Fariba Gharai (Gharai, 1999) and Habitat Bill of Rights by the National Committee (National Committee for Human Settlements, 1976). The literature suits this thesis as the authors/organisations wanted to bridge the practical and theoretical world by providing principles and guidelines for designers, architects, and urban planners.

The selected theories analyse settlements/ cities in different levels, one at a neighbourhood and the other at a habitat/ dwelling. Both are equally important for this thesis. The studied aspects of the settlements are three: perceptual, functional, and operational (Figure 20). When doing the analysis, it should be clear about the limitations of the principles, as they have been created for the inland human settlements.

The explanation and full text of the principles stated in the tables (Table 3) are in the appendix [7].

Generic Principles of Neighbourhood Design

Perceptual Aspects	Functional Aspects	Operational Aspects
Visual inputs related to the fixed features of the environment compromises the layout.	*Essential functions of a neighbourhood centre*	*The first section has a salient role in meeting the psychological needs of the residents*
1. Differentiation and image of the centre	1. Service and Facilities	1. Contact with nature and sustainability
2. Identity	2. Public life	2. Sustainability and management
3. Variety and Complexity	3. Accessibility	
4. Human scale		

Habitat Bill of Rights

Dwelling

1. The interior and exterior layout of new dwellings should incorporate a contemporary reflection of the cultural values and living patterns of the prospective residents.
2. The size of the dwelling unit should be determined by the total basic requirements for everyone in a family.
3. The territory of the dwelling unit should be distinct from the public.
4. The entrance to the dwelling should have a sense of gateway.

Clustering

1. Dwellings should be planned in clusters related in size to the optimum grouping of residents who can recognize and know their neighbours and whose children play together. The planning of low-income housing areas should provide for the grouping of dwellings into recognizable clusters.
2. The means of access, whether it is a street, a court, pedestrian path is of primary importance in establishing the character, identity,
3. The cluster should not be thought of in isolation, but as an interconnecting element of a larger community.
4. Each cluster should be comprehensible as a group of families within the community whether it is in a low- or high-density neighbourhood.
5. The cluster should be organized to encourage face to face contact and cooperation between the residents and foster a sense of identity and belonging for those who live within the cluster.

Table 3- Generic Principles of neighbourhood design

Analysis of Hagonoy

After all the exploration and recollection, this section brings together the insights to execute a reality check. First, the city map illustrates the ongoing activities in the different locations (Figure 21). The bubbles visualize how and where the citizens of Hagonoy carry out most of their daily activities.

Then, the actual context is compared to the previously listed principles. Finally, analyse how Hagonoy does not correspond to the principles stated in the previous table (Table 3.)

Men chilling near their tricyles talking with friends.

The city hall and main square of Hagonoy are located in the north part of the city.

Streets constantly under construction.

The importance of celebrating the patrons. Lack of space to celebrate.

Common street where people are hanging out and the cars are passing in the middle.

Increment of the back of the house to have shade.

Figure 21- Assessment of the city of Hagonoy

Perceptual Aspects

The barangay's central social node figure is not visible in most of them; when planning the development, the focus is on the individual housing, neglecting the community's needs.

For instance, the town of Hagonoy has one city centre, but it is not easily accessible for all the inhabitants.
In Hagonoy, the social status reflects the variety in house typology.

_ *Fragmentation of the society*

Operational Aspects

It is visible in settlement the necessity of contact with nature. They have a strong relationship with natural elements around the dwellings, rely on the elements for survival. In contrast, modern communities do not have visible connections with nature aside from the water one.

Functional Aspects

In Hagonoy, the gatherings nodes are the religious spaces, outside shops, bars, or sports facilities

_ *Services and facilities have a tight relationship with social gatherings.*

Pedestrian paths are barely visible, letting the pedestrians share the road with the vehicles generating dangerous situations. Moreover, the lack of walkable area and the considerable distances between the infrastructure forces the locals to circulate with a vehicle.

Dwelling

The size of the dwelling is not adequate for the number of families members. Moreover, there is no designated public space where face to face interactions can happen in the Purok. Typically, the common realm spaces are in the gated communities of higher-income families.

_ *There are porch openings in front of the dwellings, also called the realm, to socialise with neighbours.*

Dwelling and housing in rural areas do not match the emerging demands of climate hazards.

_ *Forces the locals to employ ad-hoc solutions.*

Learnings

1. The central figures are equivalent to social nodes. Social nodes foment social gatherings and interaction among the neighbourhoods.
2. Linkages and connections are vital to remove the isolation of the community. Moreover, these connectors can be integrated into the urban planning of the vicinity in different ways (Figure 22), such as pathways, public areas, urban elements, etcetera. The positioning of the urban furniture or other elements in relation to the human body can generate an effect. This effect can occur to a group of people, creating a common feeling which revolves around the object.
3. The introduction of the floating community should provide the missing elements identified by the participants.
4. The clustering and urban planning style should adjust to different social classes' needs without enhancing social fragmentation.
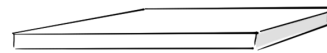
Umbrella Effect
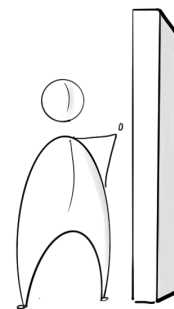
Light post effect
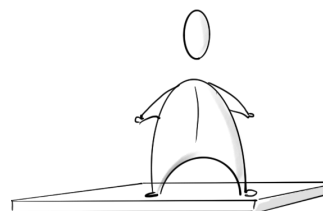
All on the same boat effect

Figure 22- Types of connector elements

Chapters conclusions

Chapter 3: Understanding

The current community is aware of the gravity of their situation, how their housing and conditions have worsened in the last 30 years. This awareness is vital to impulse the transition towards the floating community.

When analysing, it becomes apparent that the present neighbourhood does not meet the principles stated in theory; however, these flaws can be turned into design opportunities (chapter 4). Hence, implementing the floating settlement could compensate for the lack of space to grow and make the community safer. In addition, the city itself offers many opportunities for improvement. Nonetheless, as Hagonoy is such a big city, it has been decided that the focus will be only on one Barangay, Mercado, for this thesis.

CHAPTER 4
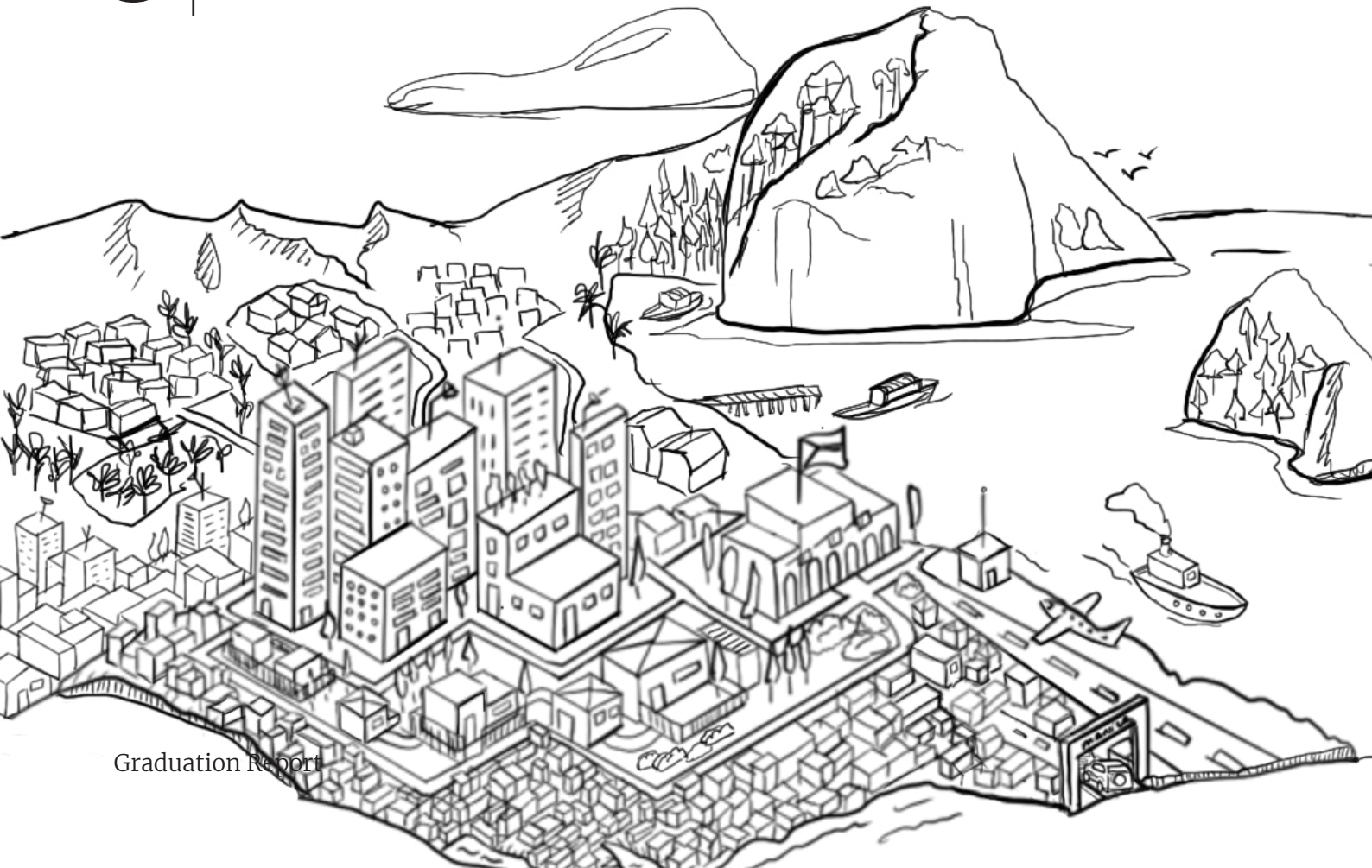
Introduction

This chapter converges the previous analysis by presenting the discovered design opportunities and defining the social interactions that create a 'Liveable community'. Next, listing the design requirements based on the analysis and synthesis of the previous chapters (2 & 3). Then, finalising with the vision statements.
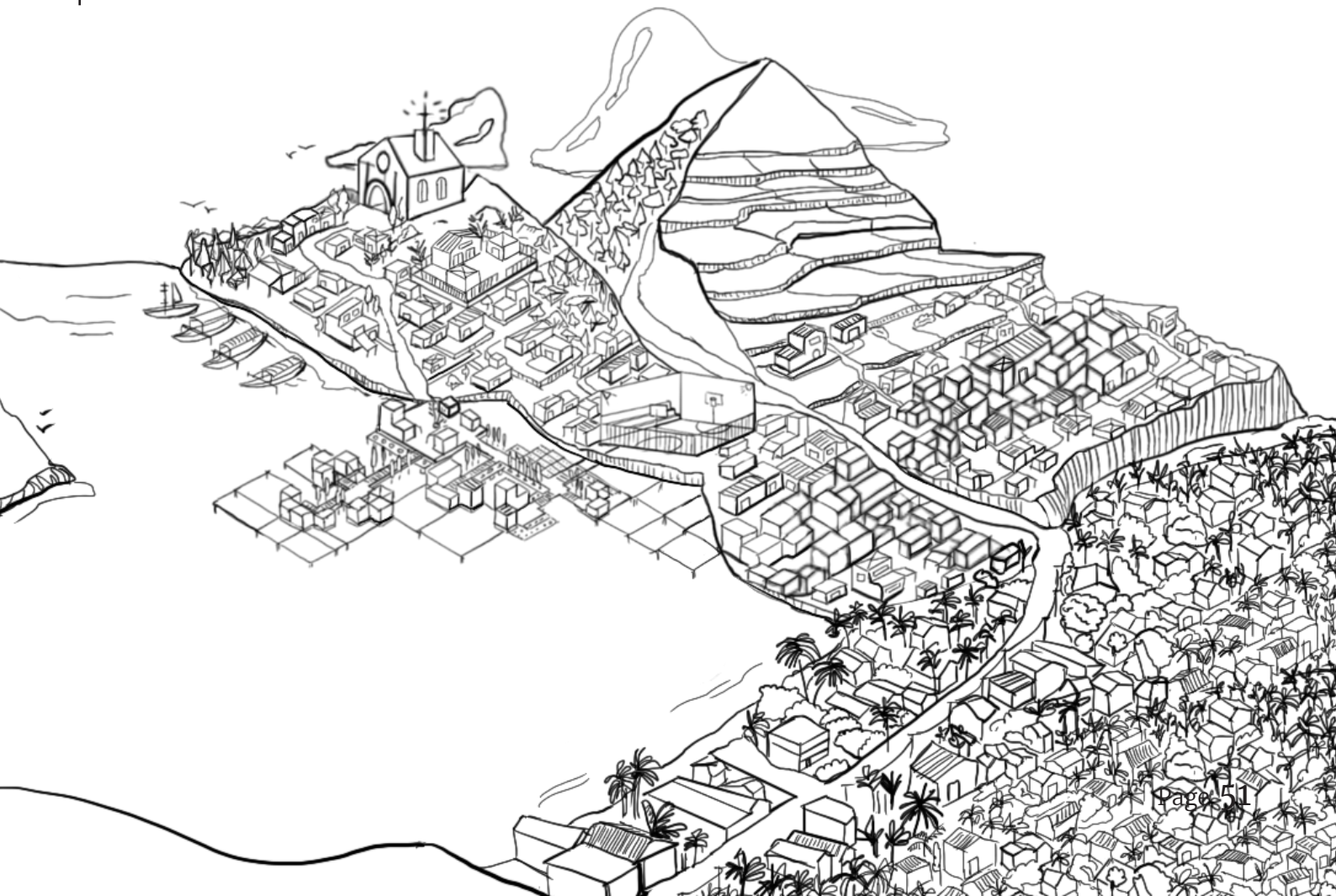
Approach

This section of the thesis focuses on converging all the previous studies by defining the guidelines and criteria the subsequent phases of the project must follow. In addition, this chapter turns the identified challenges (section: Analysis of Hagonoy) into design opportunities. This approach seeks to promote innovative solutions in the upcoming chapters. Finally, creating the list of requirements will help evaluate the proposed design solution in the project's evaluation (deliver) phase.

Besides the desk research criteria, the requirements expressed by the stakeholders are summarised and integrated into the project.

Lastly, this part of the project focuses on shaping the outcome of the thesis. Therefore, two vision statements express the envisioned result; one for the neighbourhood and the other for the dwelling scale.
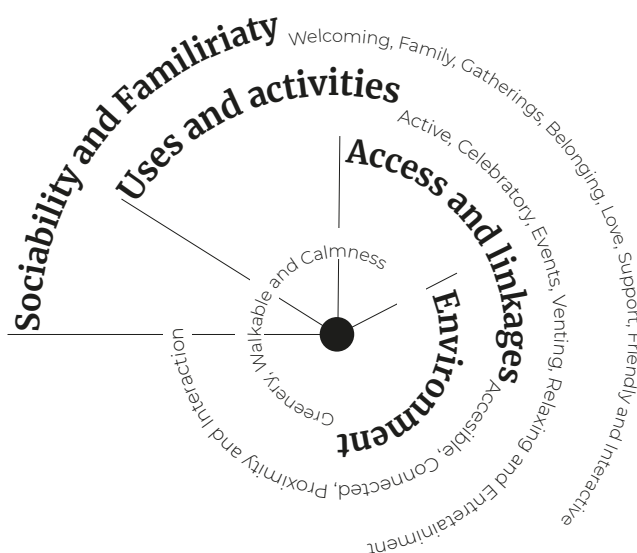
Figure 23- Definition of attributes that make a good place.

Social interactions

When doing the user research, it became apparent that their willingness to shift towards a new floating community is highly dependent on the possibility of fulfilling their daily needs. According to the participants (Appendix 4), it is imperative to cover the following aspects: social gatherings, services and facilities, religion and the most important one, family. The following overview, "what makes a good place?" illustration, is generated by combining these aspects with the model presented by Public Space (Project for Public Spaces, 2020) (Figure 23). The model is complementary to Maslow's pyramid, where they specify vital attributes that contribute to achieving the fundamental and psychological needs(Maslow, 1943). Architectural elements and urban planning can facilitate creating the "good neighbourhood" by designing for intangible attributes. Designing for intangibles attributes requires designing for interactions. They can bring many benefits to the community. Social interactions contribute to creating relationships among the neighbours, increasing trust and community (Desmet & Fokkinga, 2020; Williams, 2005). The relationships that should happen in the floating community are:

- **Proximity relationships:** "Form of social relationships with individuals who are physically closer to them. People who are around each other more are more likely to develop a social relationship". (Williams, 2005) (Moreland,1987). It could also be defined as passive contact (Abu-Ghazzeh, 1999).
- **Functional relationships:** "Form of social relationship, which is developed from the need, for instance, the need to obtain advice, helps or expertise, or socialise" (Williams, 2005).
- **Social similarity:** "Precondition of compatibility in social relations, for example, like-minded people" (Abu-Ghazzeh, 1999).

Design Opportunities

This assessment of the city of Hagonoy (Figure 21) shows the potential design opportunities in the targeted area, which by addressing them, the inhabitants' daily lives can improve. From the assessment and definition of the attributes to make a place suitable/liveable, the following design opportunities are listed:

1. The community is very dispersed and divided due to the morphology and the social division. Therefore, facilitating gatherings in the city centre can enhance the community feeling and develop an accessible and connected central social node per Purok where everyone could access.
2. Pedestrians and vehicles share the same road, creating dangerous situations in the middle of the Purok. Increasing pedestrian movement within the neighbourhood by **creating paths** that connect the public spaces with the dwelling clusters will simultaneously reduce traffic and noise pollution and improve safety in the vicinity.
3. The **clustering of the dwelling** can promote face to face interaction at different levels. In other words, the arranging of the clusters could promote proximity with neighbours.
4. The urban planning should create **physical space** between family clusters to avoid overlapping and lack of privacy for the local families. By clustering family/relatives/friends' dwellings as islands, the outcome is a clear visual and spatial differentiation of the spaces.
5. The high density of dwellings in the neighbourhood has left the community without any **natural elements** or greenery fields. Therefore, integrating natural elements in the settlements as part of the urban development plan can benefit the inhabitants and the environment.
6. Utilising **natural resources** to produce supplies is a way of promoting the autonomy of the inhabitants through farming.

Requirements

Based on the analysis and interviews, a list of requirements is developed (van Boeijen et al., 2017). The goal of the requirements is to establish guidelines on the creation and development of the design. The criteria will be classified as demand or wish and functional, perceptual, or operational (Figure 20).

	Requirement
1	The solution shall not be ought to isolation. [Clustering, connectivity, Functional aspect (accessibility)]
2	The solution should be able to accommodate growth when the inhabitants require more space. [incrementality]
3	The positionings of the dwellings should encourage face to face interaction. [Familiarity, livelihood]
4	The community shall have an accessible central node. [functional and perceptual aspect]
5	The solution should allow the integration of natural elements. [operational]
6	The solution shall promote the autonomy of the inhabitants. [operational aspect]
7	The solution must allow the self-expression of the inhabitants. [Perceptual Aspect]
8	The solution should allow different levels of privacy according to the desires of the inhabitants. [Functional aspect (public vs private life)]
9	The solution must be implementable within the existing context.
10	Answers the living patterns of the community.
11	A gradual transition between public and private space.
12	The communal spaces should have good visibility from the pathways.
13	Position the basic facilities and access points on share roads or paths.

Table 4- General Requirements of the project

Demand/ Wish	Measurement	Value
Demand	The capability of connecting to the nearby dwellings. Access points to the mainland.	At least one connecting system. It should have at least one connection point per cluster.
Demand	Around the clusters, there should be space to build at least two more dwellings.	1.5 to 3m around the dwelling.
Demand	The number of gathering spaces around/ in the dwelling.	Presence of more than one designed space per three households.
Demand	The presence of an open figure and the number of paths accessing the public space.	More than three routes.
Demand	The number of trees or gardens around the dwelling or pathways.	At least one greenery field per dwelling.
Wish	Possibility of farming	3/5 inhabitants should have space around their homes to install a fish farm or a local vegetable garden.
Wish	Decoration of the façade. Implementation of natural elements. Incrementality of the dwelling.	Between the porch and the space in front should contain at least 4m2 available for decoration and self-expression.
Wish	Presence of different spaces within the household.	At least one public and one private.
Demand	Feasibility of developing a solution integrated into the pilot floating home developed by Finch Floating homes.	Only the entrance of the pilot floating home can be modified.
Demand	Double-check with 'a day in the life exercise'.	80% of the daily activities can be performed in the new urban planning.
Wish	Presence of connecting elements that provide a transitional space	One connector element in between public, semi-private and private spaces
Demand	Integration of open spaces in the communal areas.	50% of the communal space should be visible.
Demand	The presence of connector enablers in urban design.	At least two pathways should be connected to the public spaces and basic facilities.

Vision

The vision on a neighbourhood scale:

Design a desirable neighbourhood that is optimised for the present and future needs of the Hagonoy community and provides resilience towards changing environmental conditions.

The desirability aspects must be addressed to develop a socially accepted neighbourhood. To achieve this aspect, the attributes described in figure 23 must be addressed. Now the question remains, how?

I want to design for the living patterns of the citizens of Hagonoy by connecting settlements and creating adaptable spaces that allow social and family gatherings in the floating community.

The space should be capable of incrementing, allowing growth and change over time, to adapt to the need of each family dwelling or community space. Then, bridging the spaces within the community and to the mainland makes it accessible, not isolated, for all the inhabitants.

Chapters conclusions

Chapter 4: Defining

The criteria developed from the gathered insights, requirements from the stakeholders, and research provide a clear direction for the project. It provides fundamental guidelines the solution should meet to ensure the satisfaction of the main stakeholders. The evaluation of the requirements determines the success of the design solution in an objective manner.

CHAPTER 5

Introduction

This chapter explores the solution space in the current context. Gathering all the insights from the previous chapters and the requirements, this chapter analyses how the new community could be integrated with the existing one. The result of the combination is the creation of a hybrid neighbourhood composed of inland and floating settlements.

Analysis of the settlements

During the thesis, the target area is the city of Hagonoy; however, for the sake of the project, the first hybrid neighbourhood development happens in the barangay of Mercado. The decision is based on the available land around and the location of the barangay.

1. Inland settlement

The main elements of Mercado are the church, located in the north, the municipality hall near the road, the shopping centre in the middle and the basketball court on the furthest part of the main road of the barangay (Figure 24). The city's morphology follows the landscape, resulting in an elongated settlement without any central figure (square or open spaces) where social gatherings happen.

As shown in the illustration (Figure 24), most services and facilities are near the main roads and crossroads. However, the further from the main road of Hagonoy, the fewer services can be found. Additionally, there is no space for pedestrian paths between the dwelling or next to the main roads due to the barangay's dwelling density.

Basketball Court

Fishermen houses

Water access points

Main road of Mercado

Shopping Mall

Local Services

Mercado's Church

Main road of Hagonoy

Municipality Hall
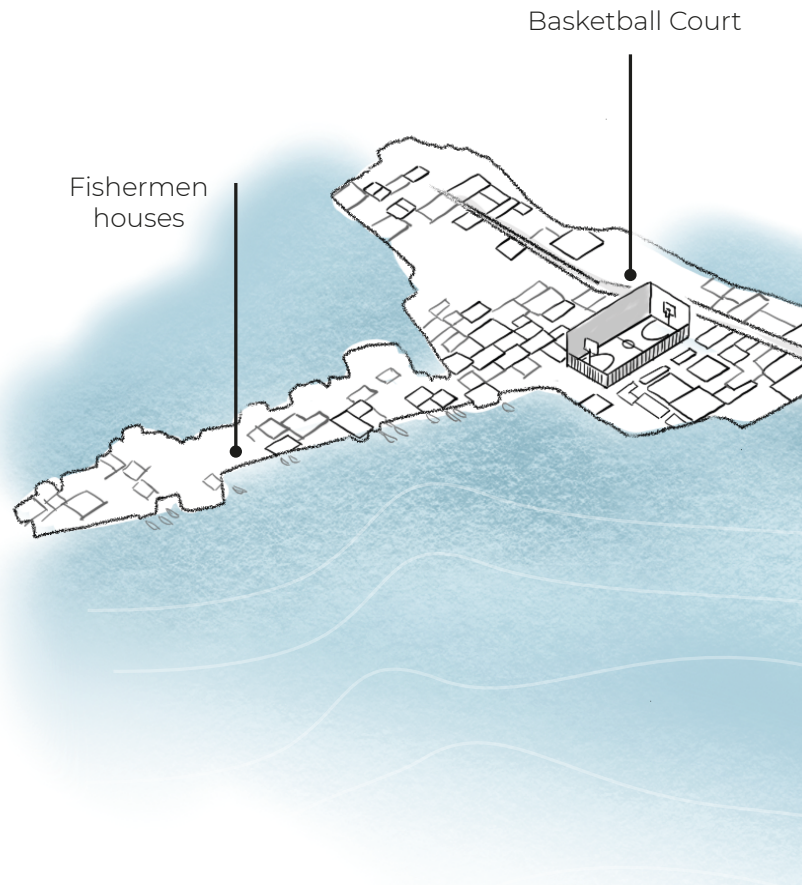
*Figure 24- Existing infrastructures
in the barangay*

2. Stakeholders in Mercado

The barangay is a socio-economical unit (Kendall, 1976) composed of different stakeholders. The social structure in Mercado could be clustered into five main groups (Figure 25) (Appendix 4). The first two groups are the aquaculture industry owners, related to fish-related business (selling and buying) and the fishing boat or fishpond financing. The third group are the ones working outside of the town, the commuters. The last two, which comprise 60% of the people, are the workers for groups number one and two plus the domestic and social workers, mainly women.

The stakeholders can be related to physical facilities of the barangay such as dwellings, shops, public buildings, etcetera. The positioning of the clusters in diverse neighbourhood areas according to their needs (Figure 24). The word cluster refers to the combination of functions and elements within a space. For instance, the fishermen's dwellings are closer to the shoreline or near the water access from the road. Many small businesses are located near the main road; sary-sary stores, restaurants, shops, and other facilities. Most of the time, these businesses are a house 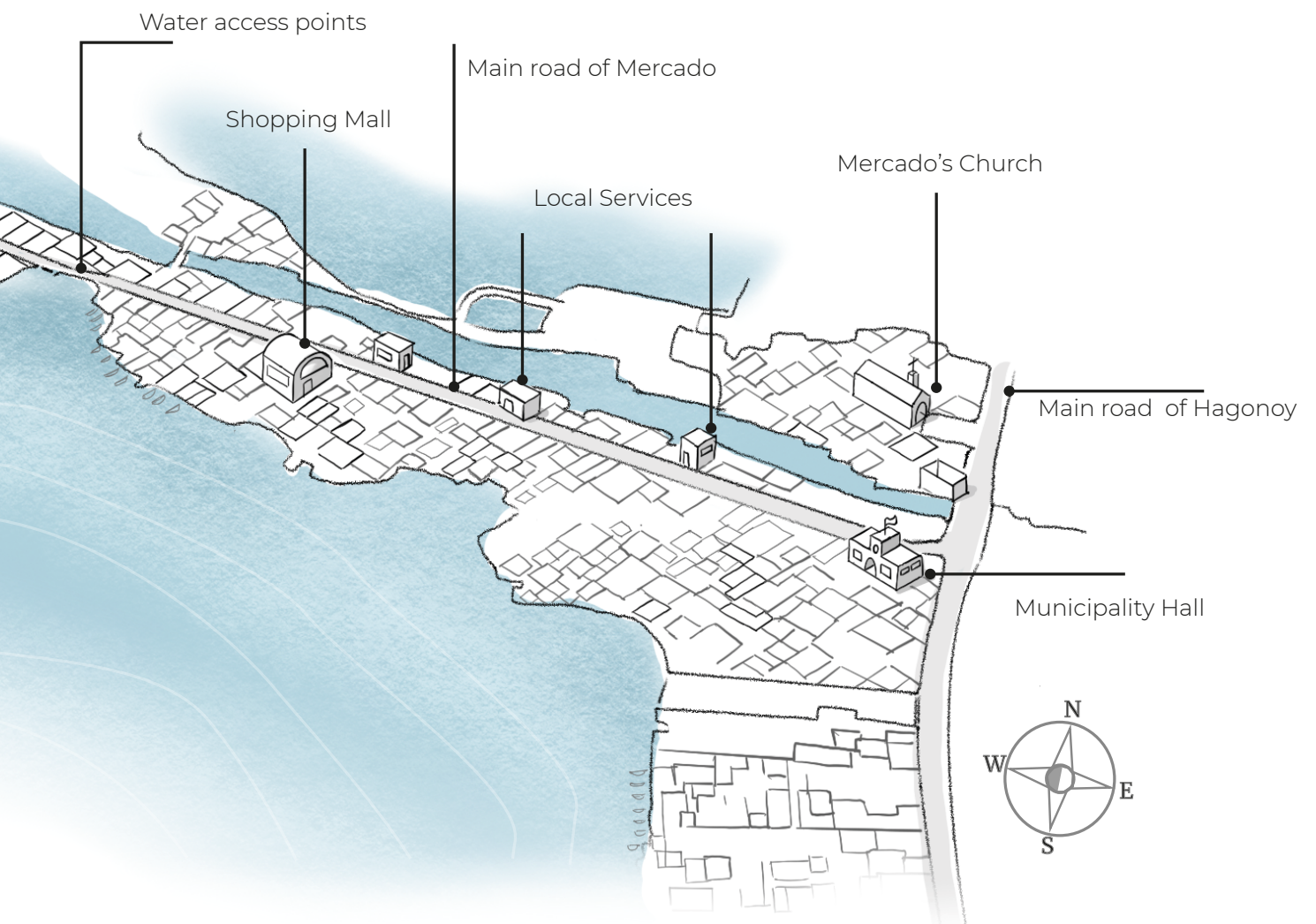extension of the owners themselves. The location near the main road provides them with the required visibility to attract clients. It can be concluded that the strategic positioning of the dwelling and facilities clusters conditions the dynamics and livelihood of Mercado.

3. Hybrid settlement

The terminology hybrid refers to the coexisting of settlement types: inland dwellings with floating ones. Naturally, this new scenario can offer plenty of advantages to the locals, aside from improving housing and living conditions. Moreover, the goal of the floating neighbourhood is not only to answer the housing demand but also to attend to the desires and needs expressed by the end-user and offer new opportunities. Likewise, the expansion of the community should address the missing elements mentioned by the participants during the co-creation session in the previous chapter (Chapter 3). These are open gathering spaces, family gathering areas, the incrementality around the house and integration of green elements, among others.

Lastly, with the extension of the community, new stakeholders can emerge from this new scenario, for example, gardeners or new constructions companies. Implementing these should not disturb the existing equilibrium among the previous stakeholders but expand the network and co-exist in harmony.
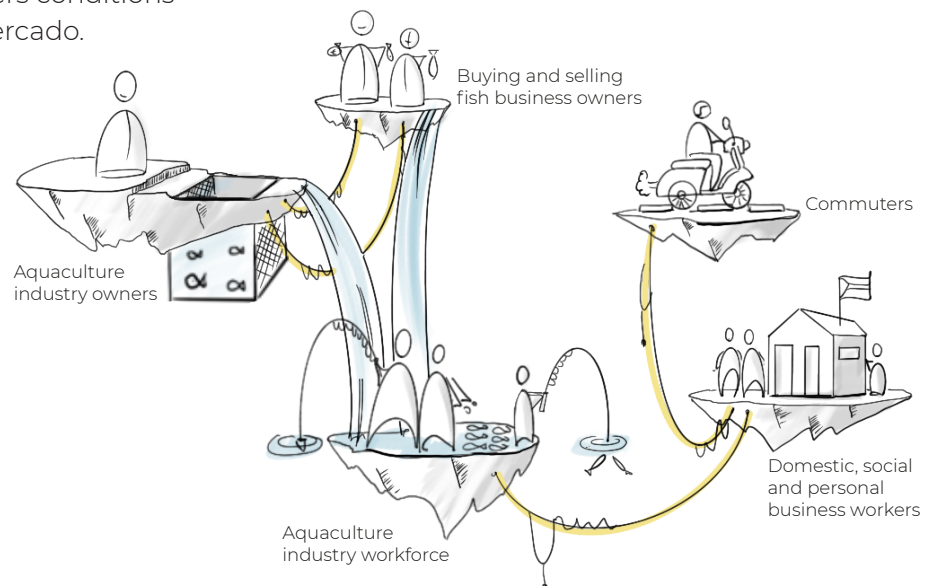
Figure 25- Project stakeholders

Aquaculture industry owners

Buying and selling fish business owners

Commuters

Domestic, social and personal business workers

Aquaculture industry workforce

Urban Planning of the neighbourhood

This section explains the interaction between the inland and floating settlements and the positioning of the architectural/ urban elements in the available space. It analyses the arrangement of each cluster according to the relationship and the exchange of value with the stakeholders.

The goal of neighbourhood planning is to offer a smooth and accepted transition towards the water. Next, develop a plan for the city to grow organically, respecting the structure of the existing barangay, to finally become a Purok or a Barangay itself. Lastly, the implemented neighbourhood should be an extension of the existing city, in other words, an organic growth into a township. In chapter eight, a proposal for future expansion is presented.

1. Introduction

Based on the required social interactions (Chapter 4,) the positioning of clusters in the context should correspond with the desired relationships and value exchange. The mentioned relationship is about citizens, community, and buildings, articulated in the organisation of the buildings, sidewalks, public and private spaces, and realms (Meyer et al., 2008). In this neighbourhood design, these are the critical things to dive into besides the homes, as there are already ongoing studies in their projection(de Haan, 2020; Ham, 2016, 2018; van Schaik, 2016).

To summarise the project's scope, what is essential in the floating neighbourhood to function as a floating neighbourhood are: communal spaces, pathways, social gathering spaces, etcetera. Hence, this thesis will detail how to integrate these elements into the extension of the community to ensure the neighbourhood livelihood, connectedness, and accessibility (Figure 21).
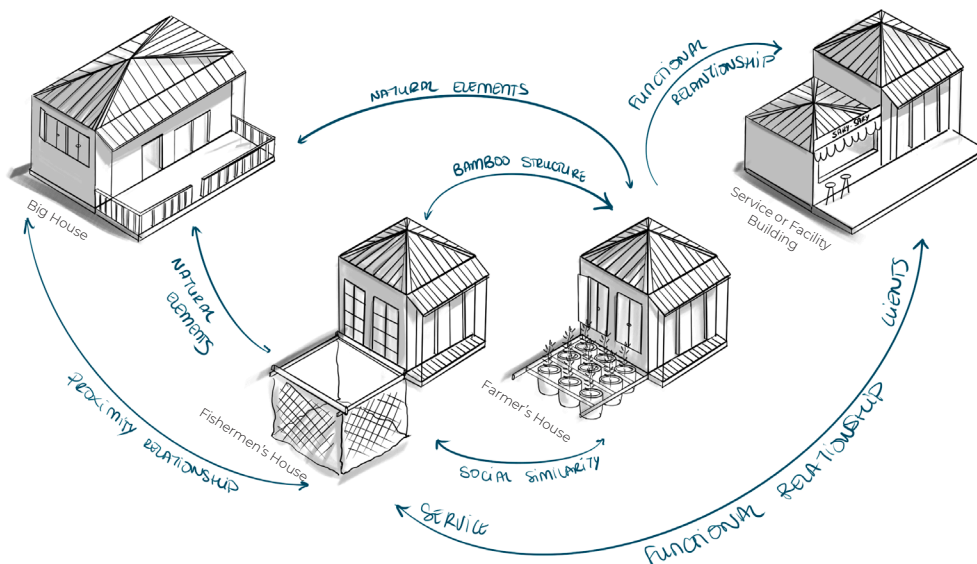
Figure 25- Value exchange and connection elements
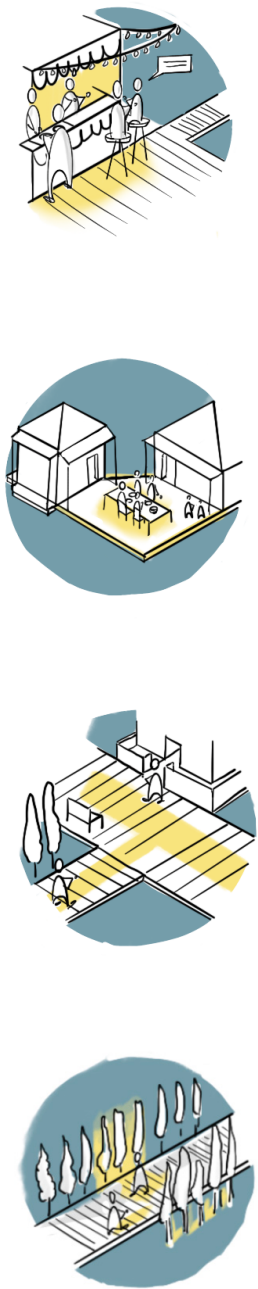
2. Cluster system

Firstly, the key to achieve social interactions, which will lead to establishing relationships and later desirability of the community, is controlling the proximity among individuals. The closer they are, the higher the chance of encountering each other (Abu-Ghazzeh, 1999). Another determining factor is the functional distance, which is dependent on the positioning among the architectural elements of the neighbourhood, the mediator spaces, the public spaces or even dwellings orientation (Abu-Ghazzeh, 1999; Meyer et al., 2008). Both factors must be implemented in the planning of the neighbourhood. Additionally, specific clusters need to be near each other as they share physical infrastructure, such as the platform. Then, intangible elements are shared between the clusters, such as the much-desired fishpond views or the greenery areas near the houses. Lastly, the dependence on others to survive (functional relationships).

There is a need for connection systems amongst the clusters (Figure 26) to ensure the relations and exchange of values. The different ways of connecting the elements can generate public or private space, provide communal space, or create pathways uniting the neighbourhood. These aspects are necessary to ensure the satisfaction of different stakeholders regarding the dynamics and planning of the community.

Figure 26- Use of the connectivity system generating interactions.

3. Zoning plan

Once the functions and elements of the floating community are defined, the next step is to understand how to connect both settlements to function as one. Moreover, to safeguard both parties (inland and floating community) are satisfied with the neighbourhood extension proposal design, the current privileges and needs should be prioritised when designing. According to the inland settlement analysis, existing access points and infrastructure, the floating community should provide additional services and facilities, public areas, pathways, and greenery areas. Without depriving the view towards nature (fishponds and plants), Hagunoeños love (Appendix 4).

Firstly, the location ideation of the creation is based on the needs of space for living, gatherings, and existing infrastructures. To continue, the highlighted areas in the water have an offset from the shoreline to allow the implementation of a canal; this will help the circulation and mobility. Lastly, based on the access points, three entrances are located per floating settlement; this guarantees the secure evacuation of the citizens in case of an emergency and avoids the isolation perception of the community.

One learning of the world settlements exploration (section: Floating settlements) is the importance of being able to move through and around the settlement. Additionally, using both circulation means (water and land) can improve the interaction between settlements and develop space logistics by designating areas for circulation and leisure. When considering all these factors, the existing infrastructure (basketball court, shopping mall, church, etcetera (Figure 24), water access points, and the morphology of the barangay, the floating community should be in the highlighted areas (Figure 28).

Basketball Court

Densely populated housing

Shopping Mall

Local Services

Adequate area for floating community location

Water access points which are connected to the main road of Mercado

Road grid in Mercado
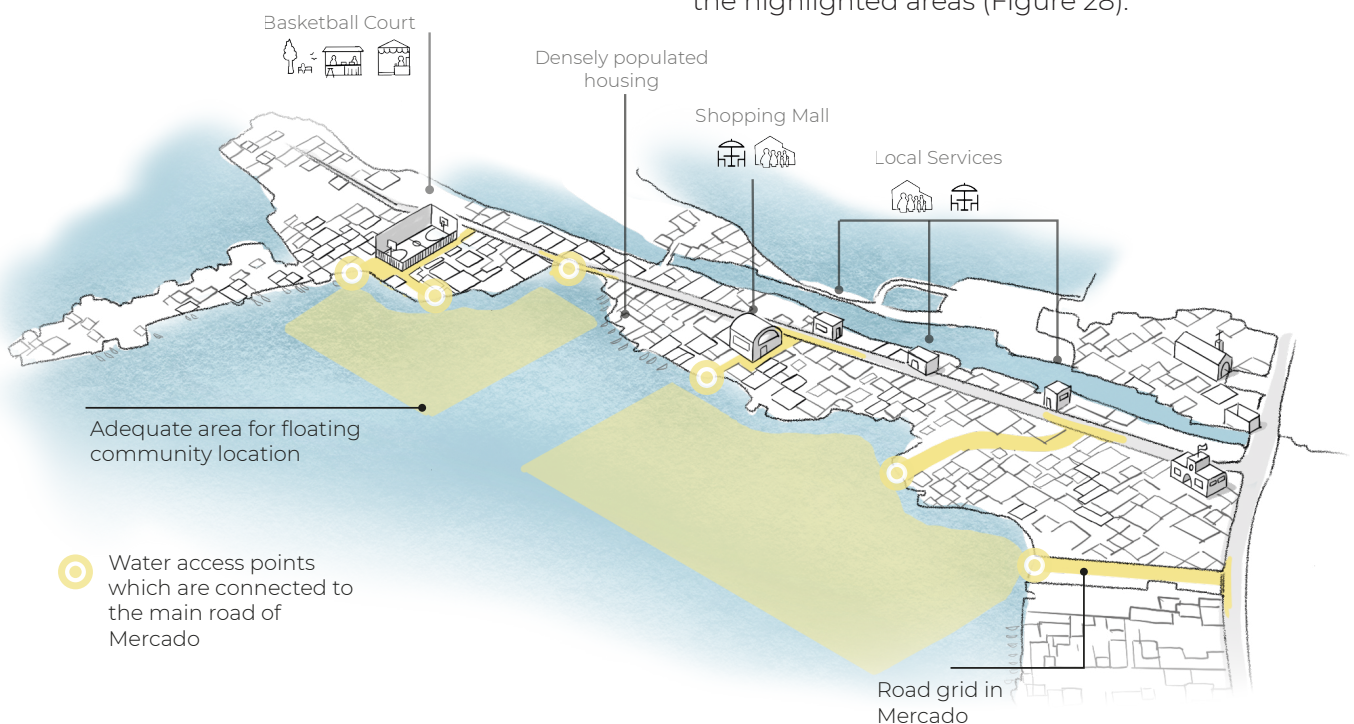
Figure 27- Floating community in Mercado

Introduction

This chapter presents the final design for the hybrid neighbourhood. It starts by detailing the functions of the architectural and urban elements of the neighbourhood and finalizing with the introduction of the conceptualization element of the following chapter.
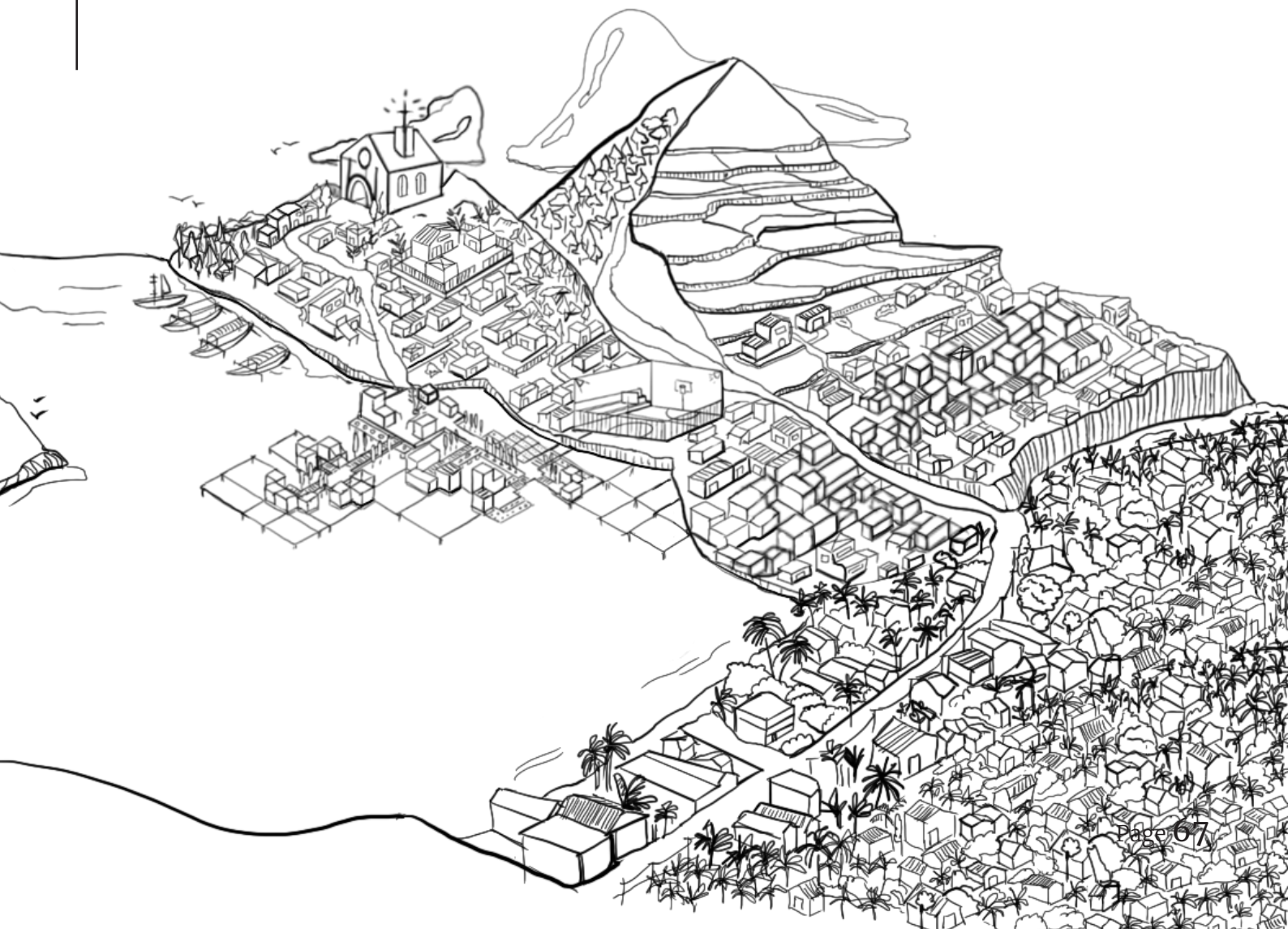
Final Concept

Hybrid Neighbourhood
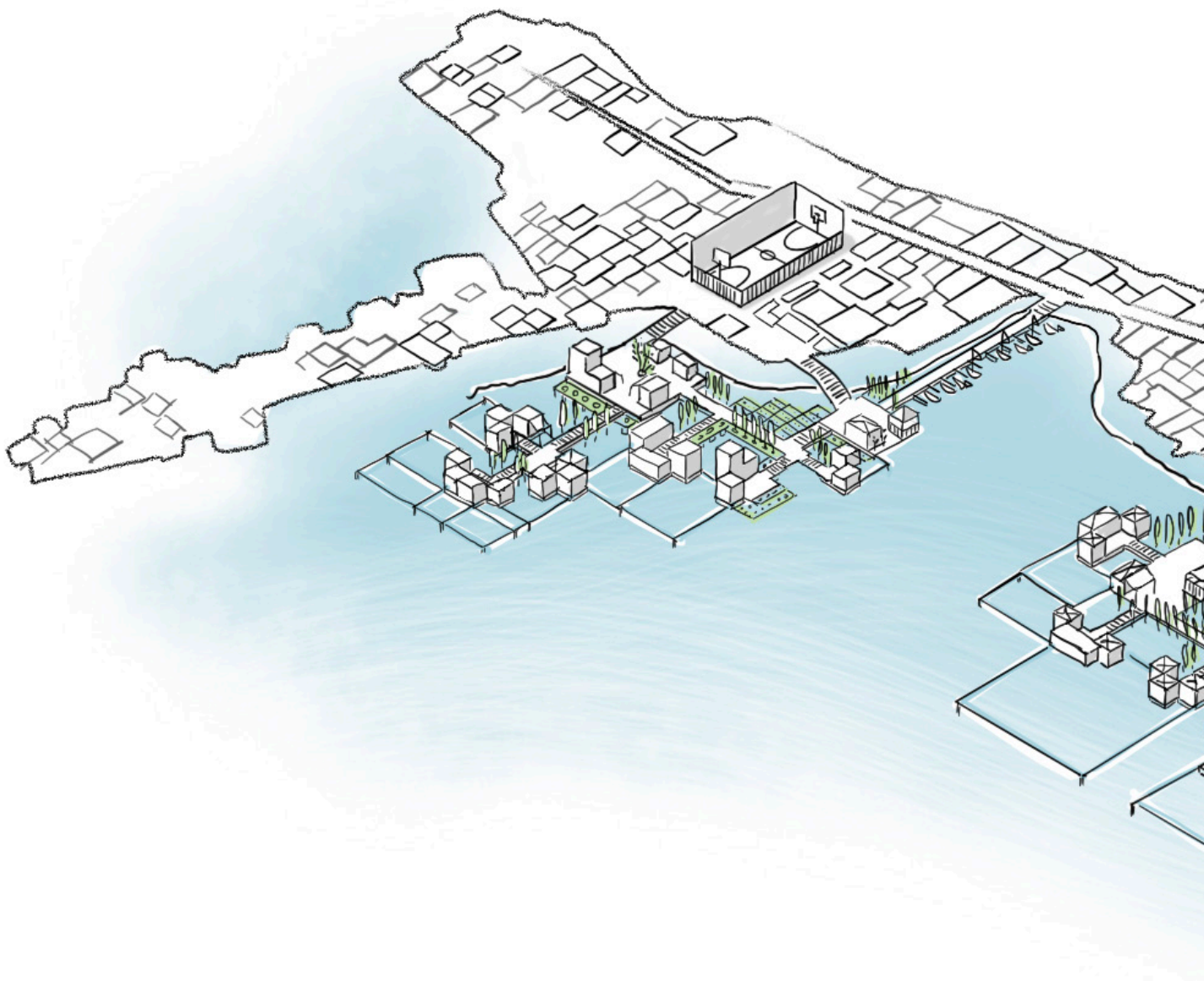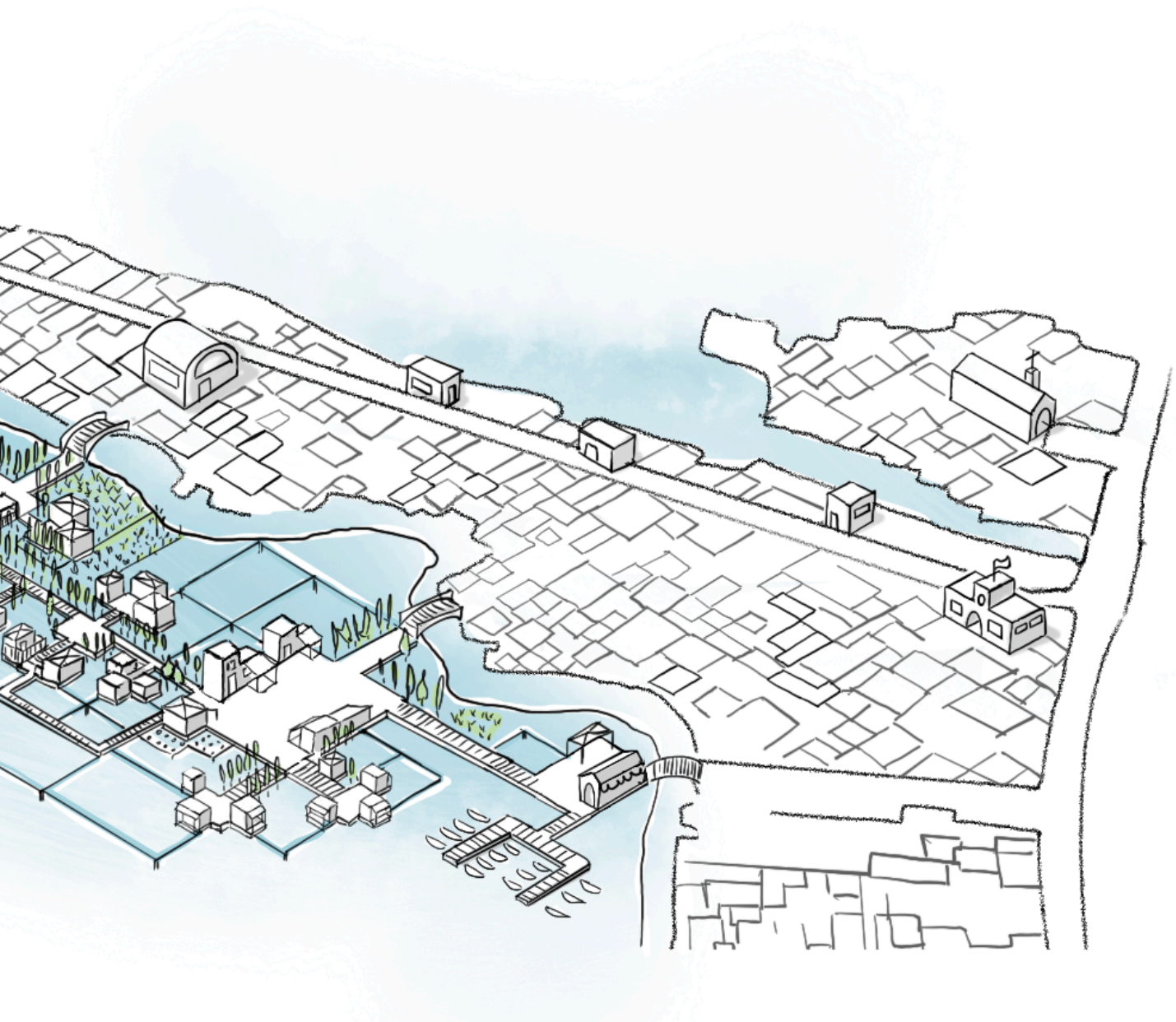
Figure 29- Hybrid neighbourhood concept

Based on the insights gathered through the co-creation game, research and several iteration loops (Appendix 8), a concept proposal for a hybrid neighbourhood has been developed, where the floating community is integrated as an extension of the existing barangay. As required in the previous chapter, the floating neighbourhood operates and expands in a non-invasive way with inviting touchpoints to ease the old and new integration.

The new floating expansion for the city of Hagonoy puts the needs of the local community in the centre while embracing their fragile relationship with water. The new framework offers housing, and for the citizens in need a chance to gain autonomy by employing the water fields around the dwellings to create fish farms and floating vegetable gardens. These new dynamics facilitate restoring relationships with water and reactivating the local industry, currently paralyzed by natural disasters. The following paragraphs explain the holistic approach used during the floating community design.

1. Community and grid planning

The extension of the city towards the water is divided in two. The smallest is located near the basketball court and the other between the shopping mall and crossroads (Figure 29). This distribution is used to optimise the existing infrastructure and provide functions with the floating community. For instance, the west side of the barangay lacks services and facilities, but at the same time has a basketball court. During the co-creation session, the participants clearly stated that they like to hang around the basketball court and socialise there (Appendix 4). Therefore, the new community has a public square with sary-sary stores, bars, and restaurants near the basketball court, covering the need of a social gathering space. The rest of the community is built similarly (Figure 30).

Another critical attribute of the neighbourhood is connecting elements and spaces through pathways; this is a requirement to develop a good place to live (Figure 23). The roads and pathways of the floating community have several touchpoints with the existing one to facilitate integration and ease the accessibility. The pathways, which also are adjusted for tricycles circulation, connect the entire neighbourhood promoting pedestrian moment. Walking paths are of high importance for the minorities of the society (children and women) (UN-Habitat for a better urban future, 2016), promotes their autonomy and safety. The pathways' width varies according to the demands of each space, also as a guiding component to direct citizens towards the designated social nodes.

To finalise, the urban planning of the entire neighbourhoods develops from the needed closeness to family. The Filipino culture revolves around the family unit; that is why they live near each other (Lorenzo, 2016). Hence family clusters have been designed to maintain this relationship and remove the idea of isolation attached to floating homes.

Local services

Open structures to
gather

Public square
design

Communal space in
between dwellings

Semiprivate space
design

Container gardening

Access points from
the mainland

Combination of
dwelling and
sary-sary store

Vegetable
garden attached
to the home

Pathway grid
design

Fish-farms
next to the
home

Water access
points

Public space
implementation
per entrance

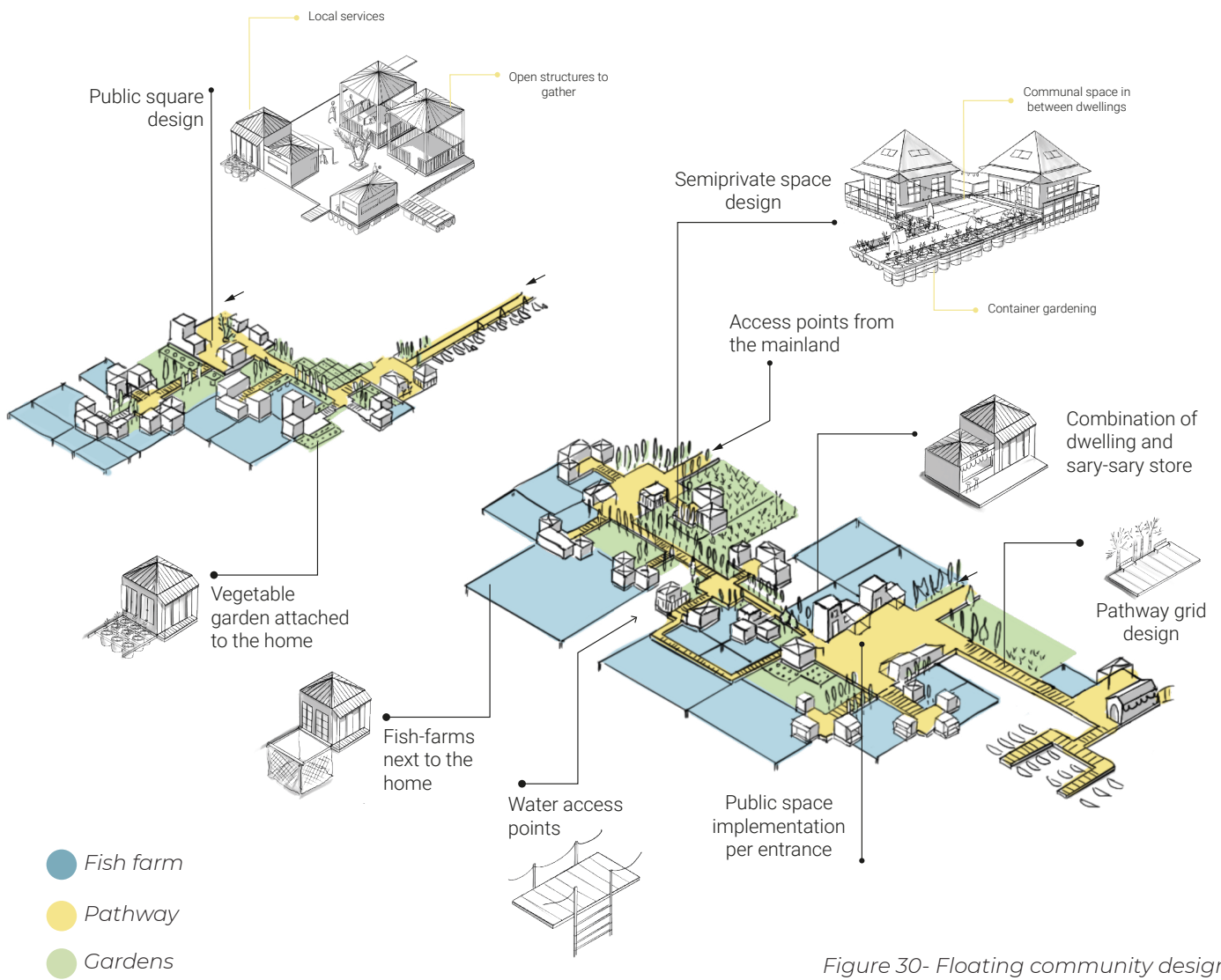Fish farm

Pathway

Gardens

Figure 30- Floating community design

2. Spatial design and livelihood of the community

On the contrary, to the existing community, the extension of the community offers a framework so the citizens can increment their dwelling while having an urban structure, guided by the open spaces. Each space is designed to allow diverse activities. The designed spaces and functions are:

Table 5- Space Design summary table

Neighbourhood Level	*Big Public Space*	There are public spaces in each entrance designed to promote the interaction between land and floating residents. It functions as social gathering node for all the citizens.
	Small Public Space	An open space located in the crossroads of the pathways. It is wider than the pathway, and its purpose is to generate an open space for neighbours or pedestrians to chat and socialize when walking.
Dwelling Level	*Semi-private space/Realm*	The connection from public to private spaces is made through a semi-private space. This space is generated in the communal space of the floating houses. It belongs to the family; however, it is partly visible from the main road. The partial- visibility allow neighbours to join another family if there is any celebration/ entertainment going on (Karaoke, Birthday, etcetera.) Space is designed to be an open space where, if wanted, a tarp could be placed on top to provide shade, becoming a welcoming (fresh and familiar) space for the family members.
	Private Space	They are designed for each family at the backside of their homes. It is a back porch where they can enjoy the calm and the water view with their beloved ones. The porch's shade located at the back of the home, combined with the mild wind coming from the water, makes the space ideal for the hottest moments of the day. *This is an idea that is not further detailed in this thesis project.

Neighbourhood Level

The location of public spaces promotes the interaction between settlements. People from both communities will make use of these spaces as it complements the existing infrastructure. Firstly, as seen in the visualization (Figure 31), open gathering structures inspired by the traditional Bahay Kubo are placed to make a visual and functional distinction of public social nodes over other spaces. Next, this space must be open and perceived as welcoming for visitors; therefore, each space has at least two access points. Lastly, the spatial design of the squares promotes wind circulation through the space and offers the view of the fishponds, tree plantations and gardens.

The other public space is designed for the neighbours' encounter or chilling space. These are created similarly to the square, but without any building on them and smaller in size.

Dwelling Level

Filipino culture is a family-oriented culture with traditions and habits that involved gathering with many relatives (Lorenzo, 2016)(Appendix 4). As much as they like to socialise and celebrate, they also need some calm and quiet time to be with their close family. Therefore, it is imperative to integrate these living patterns into the dwelling.

Based on the user research and desk research, the existing homes in the rural areas of Hagonoy have different levels of privacy within the dwelling. It goes from public space in front of the house, semi-private in the house's porch, to completely private in the backside of the house (van Schaik, 2016) (Figure 32). When clustering the houses according to the family groups, the positioning of the houses can create a communal space in the middle, named realm. The realm is an open space where the families could host celebrations, traditions, and everyday activities (Figure 30).

Figure 31- Sample of public and neighbourhood encounter space
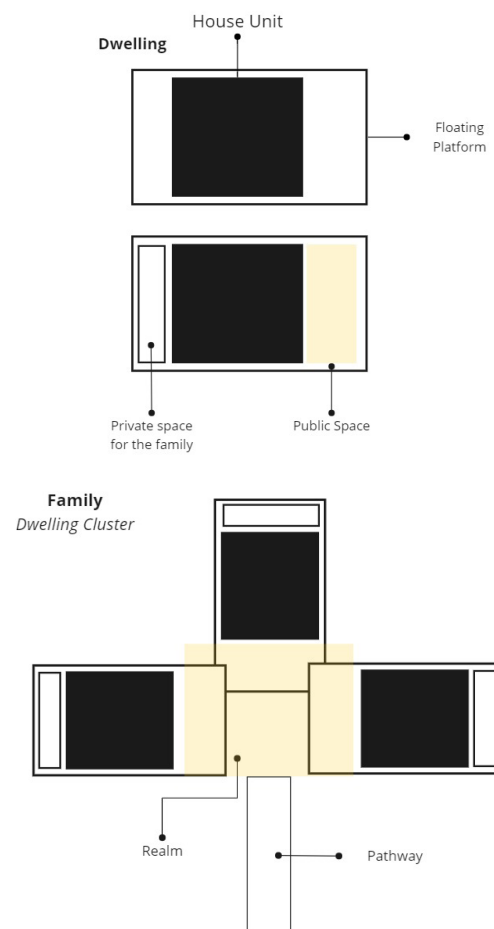
Figure 32- Space division of the dwelling

3. Natural elements

The floating community is a combination of nature and urbanization. The added value of the new location is the chance of using the available resources around the dwellings and spaces to make a profit and improve the life quality of the community. For starters, the targeted end-user are fishermen and gardeners, among others. These stakeholders can use the field around their homes to create structures to farm and produce, increasing their autonomy and creating new small businesses. Furthermore, due to the family cluster orientation, the fish farms can be delimited by the dwellings of the family or relatives, making the most of the structure. Then, continuing with the ongoing mangrove tree plantation programmes (Velez, 2020), the vacant fields of the community could be filled with trees, which clean the water and become nurseries for the fish.

Lastly, one way of engaging the community in taking care and maintaining the streets and water clean is by involving them in community gardening programmes. This strategy avoids water and land pollutions and increases the presence of natural elements in the extension. Furthermore, the strategy follows the logic that it will last longer if the community collaborates into the maintenance. However, this only is confirmed once the community starts living in the dwellings.

Chapters conclusions

Chapter 6: Concept presentation

When looking back at the chapter, the final concept of neighbourhood is developed based on the needs and space in Mercado. The current urban infrastructure and the opportunities offered by the floating community can make an improvement in the daily life in the barangay.

The linkages and public spaces generate social interactions and simultaneously increases the desirability factor. Thus, it could be concluded that an element that enables the connection between spaces such as platform or pathway creates the demanded bridges in the community.

CHAPTER 7

Conceptualization

Introduction

This chapter develops the concept presented in the previous chapter. It starts by detailing the neighbourhood. Firstly, it describes each designed space's needs and numbering the required floating module for such a neighbourhood design. Then, the required national agreements in floating structures are listed to introduce them later in the previously developed concept. Once the demands, regulations and the idea are clear, the detailing of the module design starts. Finally, the chapter finalises with the integration of the module in the floating community.
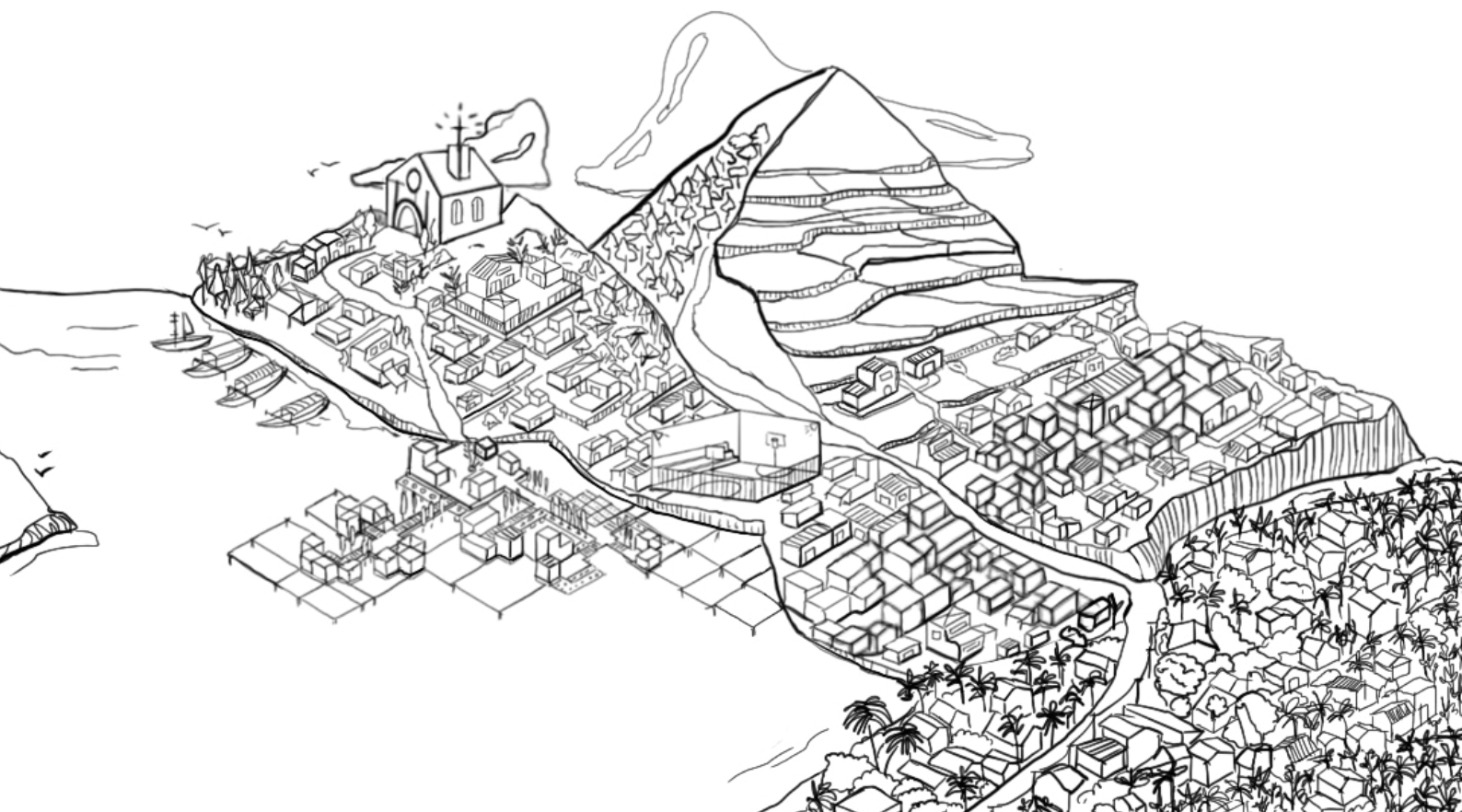
Neighbourhood Conceptualisation

This section describes the conceptualisation of the neighbourhood from idea to detailed concept. To reach this level is imperative to take care of the logistics and regulations the neighbourhood must fulfil, therefore research into the Dutch National floating structures agreement is done. Afterwards, the detailing of the small neighbourhood elements follows the guidelines established in this section.

1. Introduction to the neighbourhood essential elements

The modularity of a platform module offers the flexibility and adaptability the concept requires. Furthermore, the community can create the space on-demand through the combination of the module. In simple words, the module could be comparable to a Lego brick where the citizens can extend their community with it, creating the desired spaces and functions. This feature addresses the incrementality factor specified in the criteria (Table 4).

The pilot floating home rests on a floating platform formed by several modules(Ham, 2016). These modules consist of connected to a drums wooden frame with cover panels on top, which stand the load of the dwelling and its inhabitants. The dimensions determined by the precedents researchers and architects are taken as constraints to maximise the compatibility with the pilot floating home. Therefore, this thesis will continue with the core idea of connected platform modules to create and link the spaces in the neighbourhood.

To summarise, the extension of the community is composed of floating dwellings (or similar) through floating platform modules.

2. Assessment of needs

More than one module type should be conceptualised to address each space's different demands and functions indicated in the concept design (Figure 30). Therefore, following the strategy used during the construction of other floating cities, each part of the floating community should fulfil different requirements. For example, in Venice, the floor and structure were built according to weight, required rigidity, and building type on top (Foraboschi, 2017).

In order to create such a strategy, the possible scenarios (Figure 27) and the requirements of each must be analysed. According to the final concept design and the intended interactions, these are the possible scenarios that can occur in the neighbourhood:

1. Pathways. Only one or two persons will be at the same time on top of the platform. The narrow pathway design does not mean to be a gathering place. [Scenario 1]
2. Realm: From two to 12 people approximately. Comfortable space to stand and talk. [Scenario 2]
3. Public spaces. Gatherings from 12 onwards. The platform must resist the weight and movement of small crowds [Scenario 3].
4. Private space: Being with the family in the dwelling cluster [Scenario 4].

From the modules required for each of the scnearios above, the missing module type is the one meant for the pathways [Scenarios 1]. Because the pilot floating home uses a module type with vertical drums designed to stand big loads (de Haan, 2020; Ham, 2016) [Scenario 4] .The second and third scenarios are a mix of module typology that can stand big loads and connect different spaces. So, summarizing, there are two modules: connector modules (type 1) [scneario1] and big loads module (type 2) [scenario 4].

3. Regulations and logistics

The creation of the logistics and mobility in the neighbourhood follows the floating structures agreement written by the Dutch Government (Delft, 2011). The reason to follow agreements instead of national regulations is that floating structures do not have international regulations yet. Therefore, these agreements are taken as a reference. First, the applicable agreements are listed as stated in the document. To later describe the implementation into the extension of the city. From the document, only sections five and six apply to the project.

5.3.1. Emergency access and exist: A common jetty serving as an escape route or access route, and the connection of the scaffolding with the shore must be at least 1.50m wide.

5.3.2. Fence along the pier/jetty: If the height difference between the jetty floor and the connecting water is less than 1m and the width of the scaffolding does not comply with 5.3.1, a fence (floor partition) must be fitted along the scaffolding. Be brought to meeting points of traffic flows (e.g. crossings of walkways).

5.3.3. Climbing/ Holding devices: In the absence of a balustrade along the jetty or the walkway, a person falling into the water must be able to climb out of the water independently (e.g. with the help of a climbing facility) or float for some time.

5.3.4. Lighting
  1) A walkway and scaffolding accessible to people must have a lighting installation that provides an illuminance of at least 1 lux on the walkway's floor or jetty.
  2) If an escape route leads over the walkway or scaffolding referred to in requirement 1, a lighting installation must be installed to provide an illuminance of at least 10 lux on the floor of the walkway or jetty and the connections to the floating structure.

5.3.6. Accessibility for wheelchair users: A floating structure to be built must be sufficiently accessible and accessible for wheelchair users.

5.3.7 Accessibility of floating structure for road traffic: For the accessibility of floating structures for removal vans, garbage trucks, ambulances, fire weather vehicles and the other expected traffic are the urban planning regulations of the municipal authorities.

6. Outdoor piping: The outdoor piping construction must consider the following requirements: environmental resistance, freezing, mechanical properties, etcetera.

4. Implementation of the agreements into the logistics of the neighbourhood

For this project, the dimensions of the current house platform module and the agreement regulations are considered guidelines that the pathway module must follow. Thus, resulting in a module with a minimum dimension of 1.5 meters in width and 3 meters in length, that is the same as the previous project (de Haan, 2020).

Starting from the module dimensions, the rest of the neighbourhood is built (Figure 34). Finally, the concept is scaled into the targeted area based on the presented concept(Figure 30). The visualization below represents only one of the two settlements, the smallest one from the top view as settlements are alike. The highlighted spaces show how some of the agreements mentioned above are integrated into the extension. Lastly, the circles on the right indicate the logistics in the urban planning of the neighbourhood (Figure 34-37), such as the pathways and road grid planning, the location of the public spaces, etcetera.
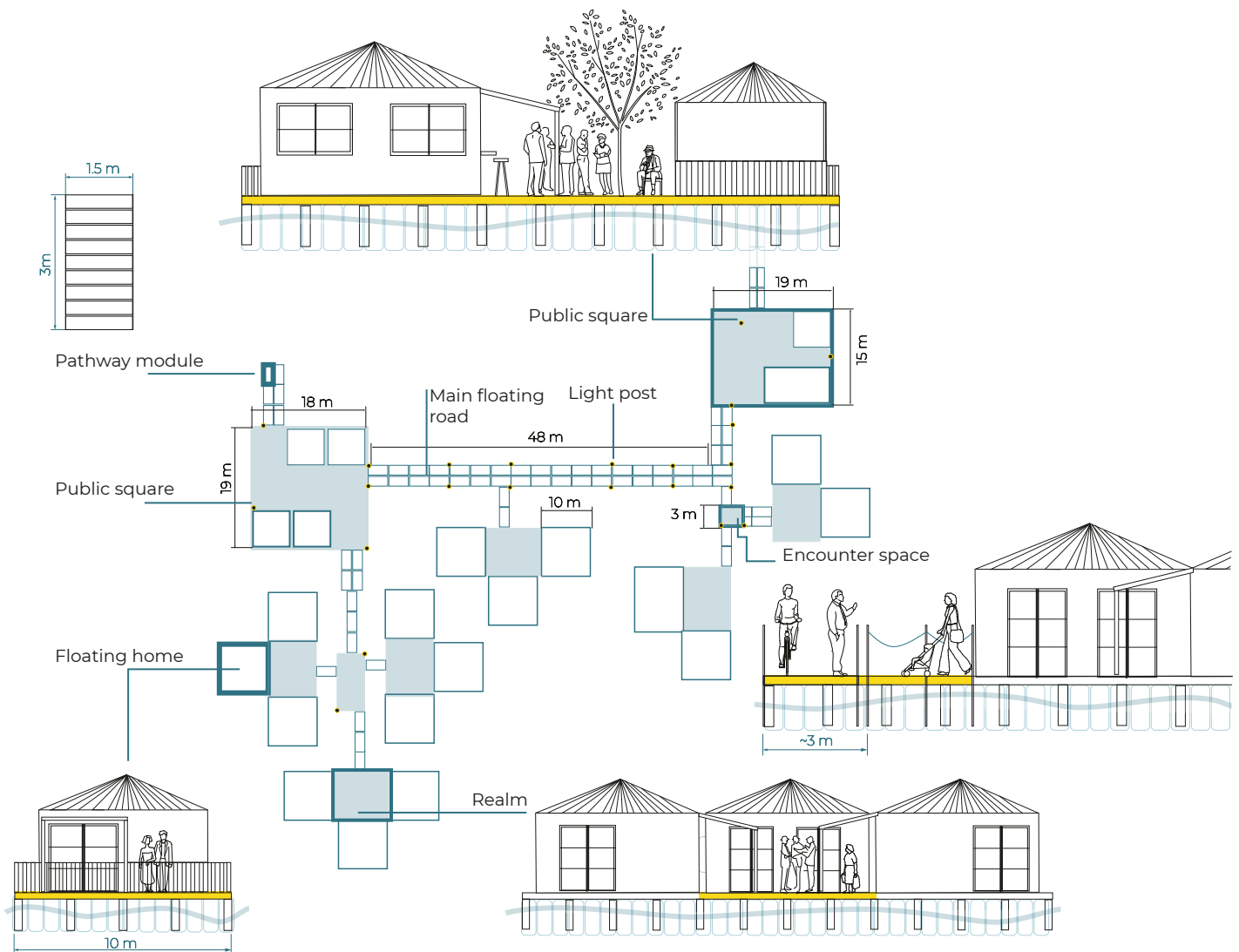

Figure 33-Top view neighbourhood distribution and spatial design

Figure 34: top view of the entire neighbourhood

Figure 35: pathways and road grid of the barangay (Mercado)

Figure 36: greenery fields around the neighbourhood

Figure 37: public and semi-private space in the community

Platform Module Conceptualization

This section describes the design process and evolution of the platform module. The design and posterior detailing of the platform starts by establishing criteria based on the floating structure agreements and the targeted context requirements. Then, through an ideation process, several ideas are generated. Afterwards, based on the stability and material criteria, one concept is selected to continue forward. To finalise the elaboration on the assembly, manufacturing, and transportation of the module in the context. The iteration and progress of the platform design and requirements detailing can be found in the appendices [9].

1. Platform Design Criteria

The development of the requirements is done following the POC (Program of Criteria) methodology (van Boeijen et al., 2017). The presented requirements are the latest version, after sharpening and iterating them to fulfil the context demands the best (Appendix 9). Resulting in the following requirements:

2. Standard module

Firstly, three concepts are developed during the ideation phase; however, due to the stability and use of materials, one of the designs stands out compared to the other two (Appendix 9). After the iterations, the module design looks as follows (Figure 38):

Table 6- Platform requirements

	Requirements for the platform module	Value	Demand/Wish
1	*It should stand the weight of four people per module.*	*> 300 kg*	*Demand*
2	*The module should have connectors that allow an easy attachment in the X and Y-axis directions.*	*0° and 90°*	*Demand*
3	*The assembly of the modules should allow movement in the vertical axis (Z-axis). The water line should be at least 20 cm below the wooden frame structure.*	*>20 cm*	*Demand*
4	*The gap in between modules should not be more than 7cm.*	*< 7cm*	*Demand*
5	*The generated platform design ought to be stable. Do not have a heeling angle higher than 4°.*	*90°*	*Demand*
6	*Each module must be replaceable in case of malfunctioning.*		*Wish*
7	*The construction and assembly should be done in the Philippines by the locals.*		*Demand*
8	*The platform design should be compatible with the current floating homes.*		*Demand*
9	*Each module should contain a safety element integrated into the assembly.*		*Wish*
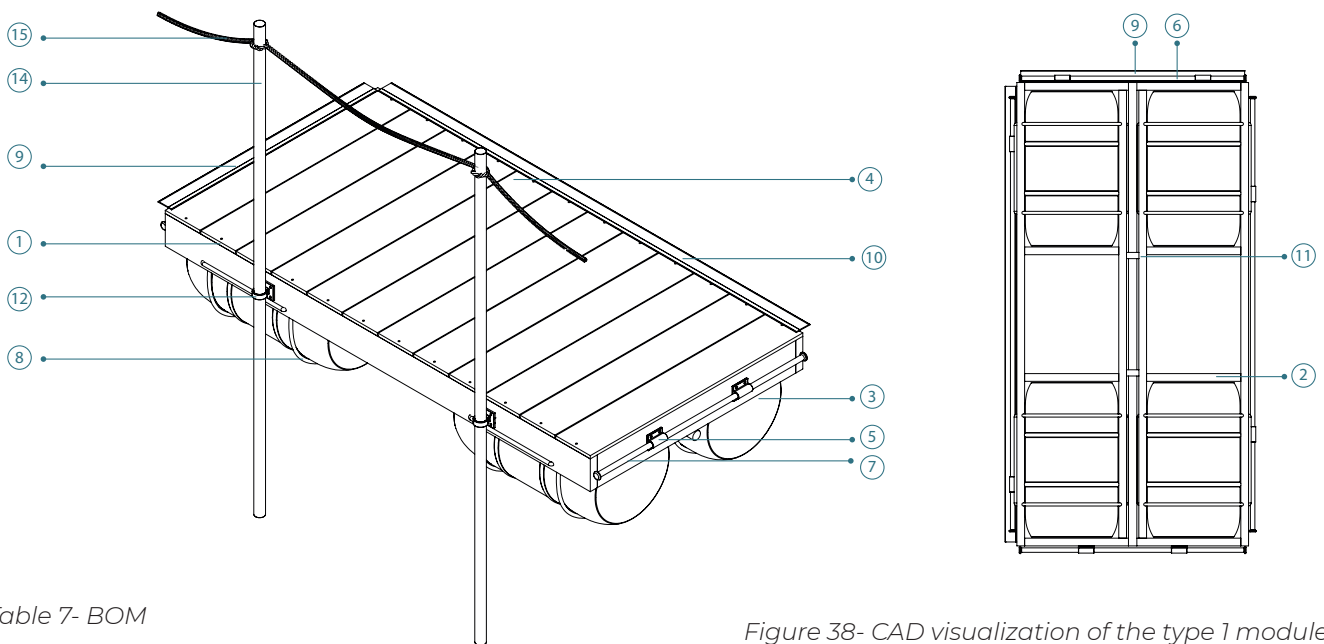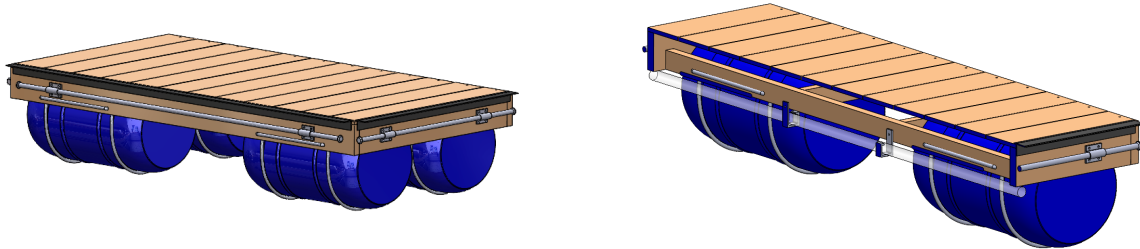
Figure 38- CAD visualization of the type 1 module design

Table 7- BOM

	Element name
1	Frame
2	Inner structure
3	Drums
4	Top cover panels
5	External horizontal connectors
6	Sliding Pin (Short)
7	Sliding Pin (Long)
8	Rope
9	T connectors (Short)
10	T connectors (Long)
11	Wood screws
12	Hooks (optional)
13	External Vertical connector (Optional)
14	Bamboo stilts (Optional)

Table 7 lists two optional elements that they should use when the module creates a pathway that leads to the realm of the dwelling cluster. The optional features are: the hooks (n°12) are designed to carry the necessary infrastructure to the house, for example, the sewer or water system. Next, the vertical connectors (n° 13) are designed for bamboo stilts (n° 14) located on each side of the connectors. These are a safety element to the pedestrians walking on it.

The details of the size and assembly can be found in the appendices [12].

3. Module variants

This project aims to introduce greenery areas in the vicinity of the houses to promote farming and make the neighbourhood aesthetically pleasing. Therefore, another type of module is created, named the greenery module type 2. There are two variants of the greenery module (the vertical and the horizontal) (Figure 39). The greenery module aims to create a floating field around the house. The inner structure with the drums allows for planting vegetables such as peppers, tomatoes, and other vegetables as it is being done in other countries, for example, Bangladesh (VOA Learning English, 2014).

The first one consists of eight drums aligned vertically with an inner structure and two pieces of rope holding the drums together. The module design has the same barrels and orientation as the floating school (de Haan, 2020), but the frame has a different assembly mechanism. Four drums form the second version in a horizontal position. The drums have a horizontal cut that allows gardening inside.
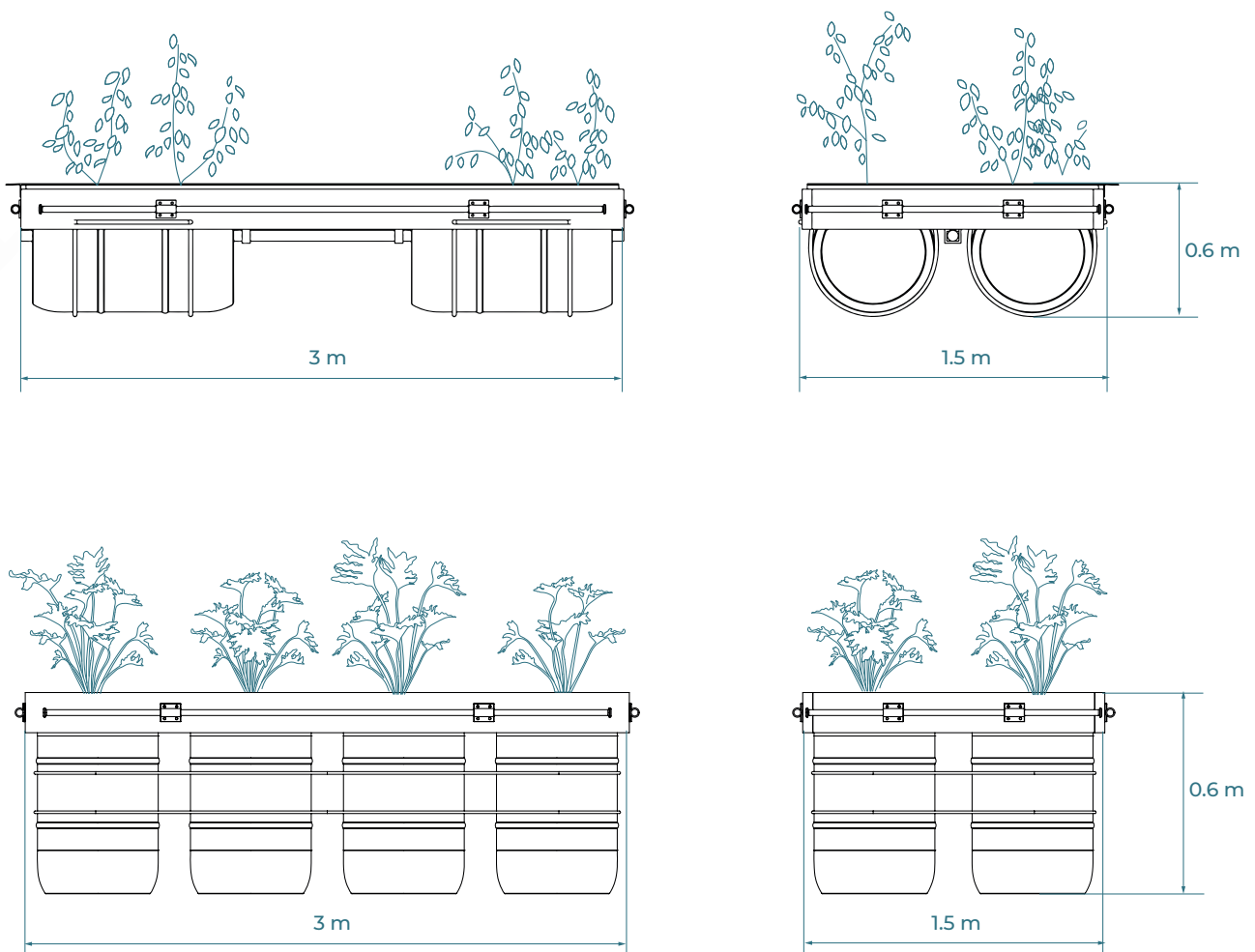

Figure 39- Vertical Greenery module (left) and horizontal greenery module (right)

4. Assembly of modules

The assembly of the modules is critical to creating the extension of the city. The assembly must be simple, resistant, semi-rigid, and able to disassemble if needed repair or replacement. The connection system must allow the structure to rotate and translate (Figure 41). These movements influence and consequent resistance from the other modules provide the assembly more stability (Ham, 2016).

The essential elements of the assembly are the sliding pins and the T connectors (Figure 41). The assembly between the modules happens horizontally through a sliding pin with two parts that connect and create a rigid cylinder. The horizontal connectors are only symmetrical by the Y-axis, allowing a simple connection to other modules and grid creation.

Part 6: T connector

Part 9: Sliding Pin

Part 7: Horizontal Connecotr
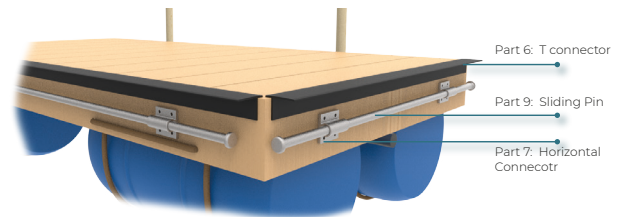
Figure 41- Connection system

Step 1: Creation of the frame
Locate the beams of the floor and screw them together.
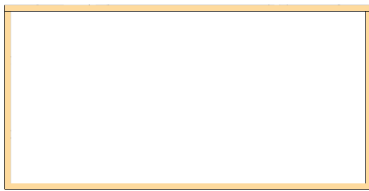
Step 2: Inner structure
First place the drums inside the frame to mark the location of the inner structure. Next, screw them to the frame and flip the structure.
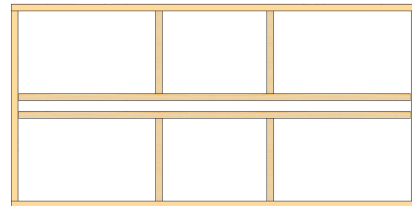
Step 3: Drums
Place the drums in their position and tight them with the rope to the frame. Then, flip the structure again.
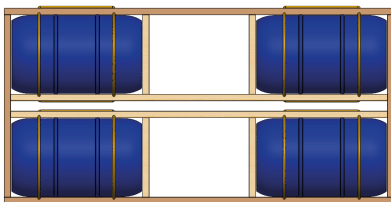
Step 4: Integration of connectors
Screw the side connector plates to the wooden frame. If needed, screw the hooks or bamboo plates to the frame.
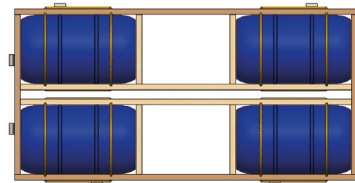
Step 5: Creation of the floor
Add the rectangular panels to the frame and screw them to it. Next, take the structure and place in the water.
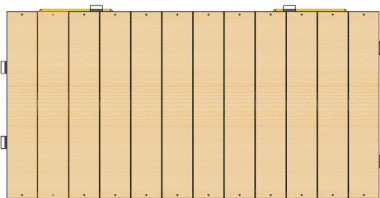
Step 6: Assemble of modules
The connection of two modules happens once they are floating in the designated position with a certain spacing between them. Then the sliding pin attaches the parallel modules (Figure 41).

The following figures (Figures 42-44) showcase some assembly configurations.

Figure 40- Assembly of module type 1 step by step.

Assembly between type 1 and 2 modules

All the modules use the same connection system, so they can all be easily attached. Furthermore, the system allows the assembly to create a playful modules grid in perpendicular and parallel configurations (Figure 43), generating pathways, small and more significant spaces. Additionally, the spacing or gap between modules is covered in the final design, thanks to a rubber connector located on edge (n°9 and n°10) (Table 7).

Finally, the connection between modules with different drums orientation is an attention point in the assembly process. Each module type is designed to stand different loads; therefore, the waterline height should be similar in both scenarios. However, in the case of a waterline height difference, the modules should not be attached to the other but the bamboo poles on the side, allowing the creation gap between the modules. Depending on the neighbourhood area, integrating a slope is compulsory to facilitate access to all the end-users (Delft, 2011). Nonetheless, in the realm of the dwellings cluster, the gap can become functional and become a bench to sit down.

5. Manufacturing and Transportation

The prefabrication and modularity technology allows fast production and assembly of the module. According to the previous works on the region, the selected materials and standard parts can be found in the region of Bulacan. However, these two aspects of the design cannot be validated under the current conditions and stage of the project. Therefore, further field research and contact suppliers understand the manufacturing capabilities and transportation methods.
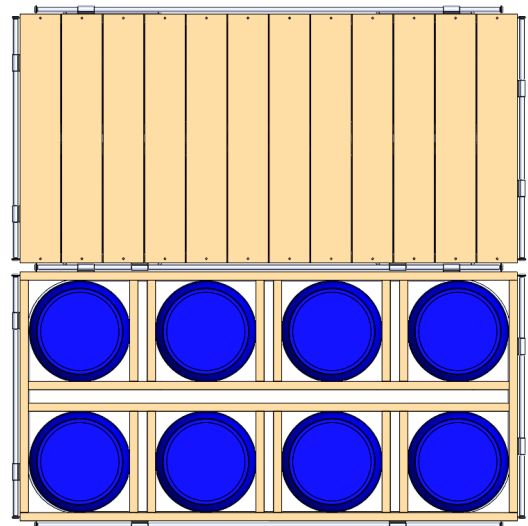
Figure 42- Assembly of greenery and standard module.

Figure 43- Assembly of modules lineal and perpendicular direction
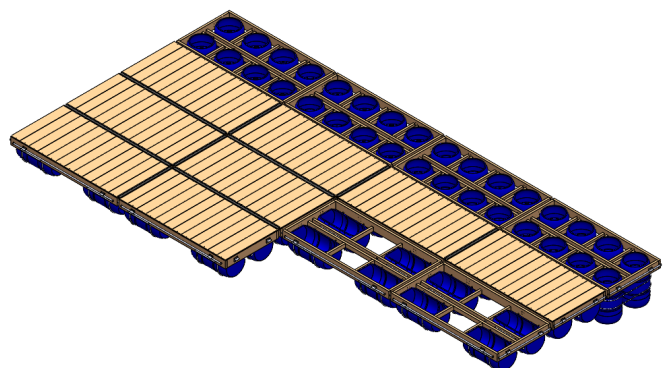
Figure 44- Sample of transition between the public area towards the semi-private space

Integration of module into the neighbourhood

1. Incorporation into the context

During the conceptualization of the neighbourhood, the configuration of modules and dwellings generates different spaces where desired interactions occur (Figure 34). Afterwards, the detailing of the platform and the assembly of modules describe how can those elements be built. This section showcases how can the designed platform module create the proposed extension of the community. It should be noted that the project's focus is the platform and foundation of the neighbourhood rather than the detail of the dwellings themselves.

The first designed space is the realm between the dwellings (Figure 45). The proper design of this space is of extreme importance to address the sociability and family attributes described in the social interaction section by providing the space to gather with close relatives and family, so the inhabitants will not feel isolated either lonely. Furthermore, the dwellings' orientation allows the wind to cross the communal space, and if desired by the end-user, a tarp could be installed in the structure of the home to create shade in the realm.

The second is based on the connections of the floating platforms, and different spaces are generated. The main difference is that the space to encounter the neighbours (Figure 46) connects pathways, not dwellings. Nevertheless, it is wide enough to allow casual encounters and develop functional proximity relationships.

Lastly, the public area is the biggest platform of all, and it is designed to be the social node (Figure 47). The architectural elements inside the square are open structures to gather, restaurants and service facilities. This space will not be equally occupied during the entire day the crowdest moment it is expected to be during the evening, especially after the working day. Therefore, space must allocate gatherings while allowing some space for some urban furniture.
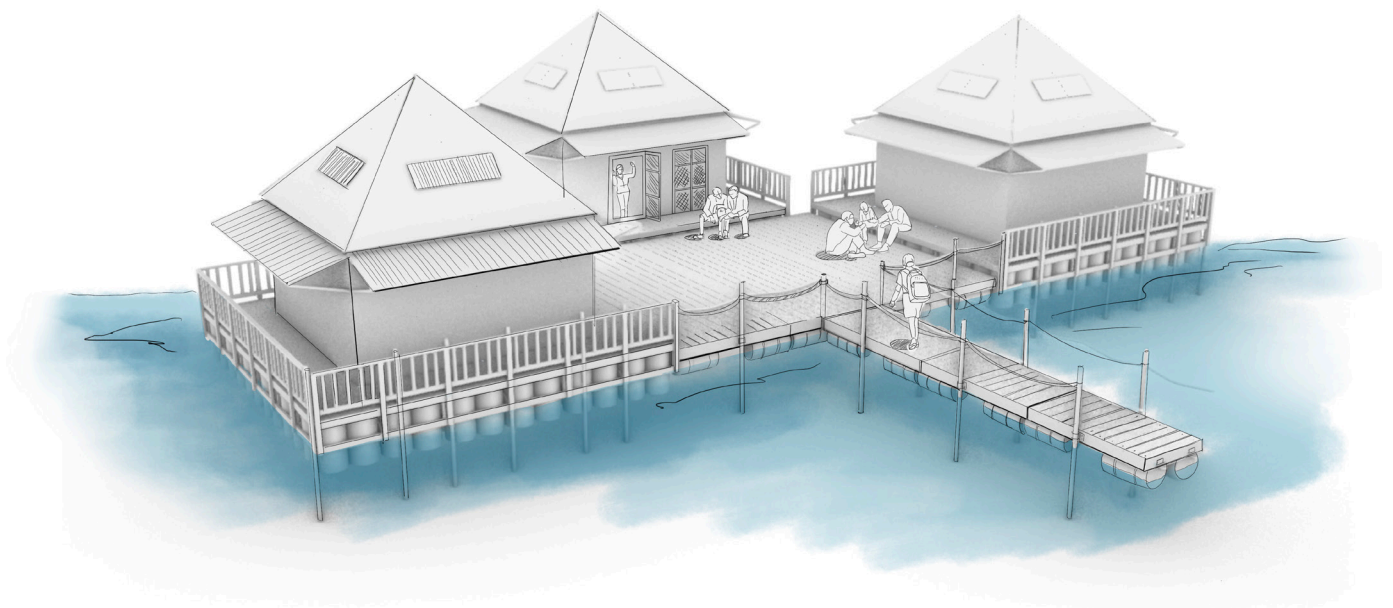
Figure 45- Dwellings cluster and realm space
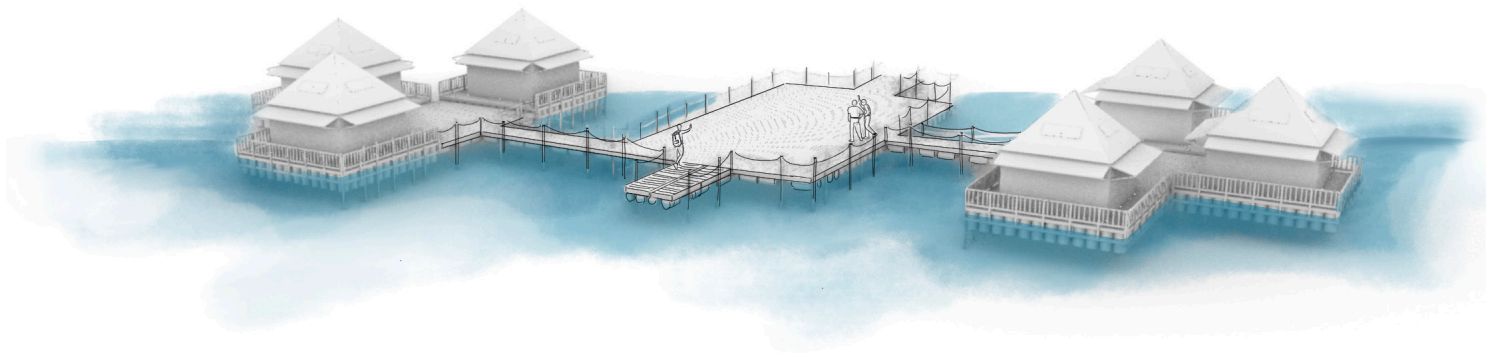
Figure 46- Neighbour's encounter
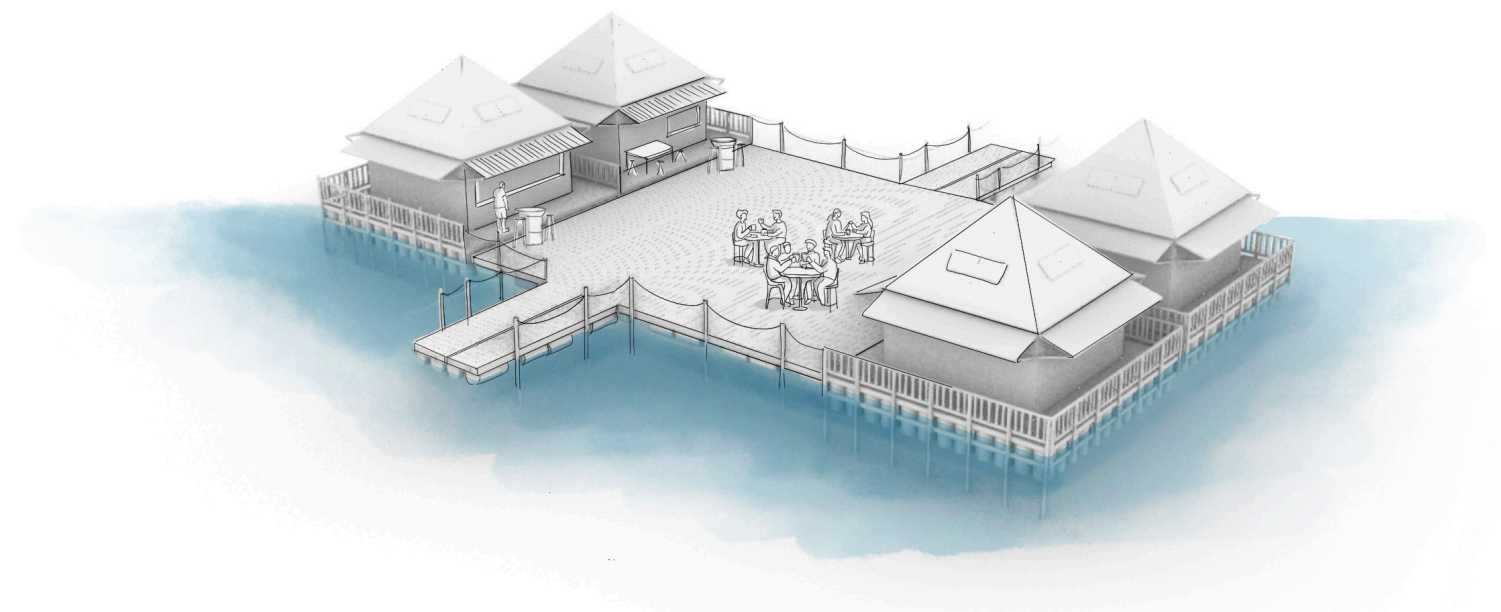
Figure 47- Public spaces

2. Incrementation of the spaces

When studying the living patterns of Filipinos, the tendency for incrementality became apparent; this relates to the desk research done in other floating villages/cities (Section: Floating settlements). Hence, the goal of the first neighbourhood is to create a framework so the inhabitants can fill in the gaps and personalize it until it becomes their homes. The adaptability and modularity of the platforms allow incrementing the foundations of squares, realms and pathways by attaching another one on the side.

The following images showcase two possible ways of incrementing the original dwelling and modules setup. In the first scenario (Figure 48), the family has grown, and there is a demand for another house. Consequently, the owners must extend the realm by adding platform modules. And in the second scenario, the owners decide to increment their vegetable garden fields and add more vertical greenery modules around the dwelling space. With such a vegetable/ fruits production, they could even start their small business.

Figure 48- Dwelling cluster incremented from 3 to 4.

3. Management rules

The local municipality and social workers should develop the rules. However, this thesis proposed specific rules as suggestions for the future community.
· The family clusters should not have more than six dwellings. Other clusters can be attached to this one utilizing narrow pathways.
· The fish farm field should not enter the dwelling space of the neighbour unless the field is shared with this one.
· The width of the greenery space should not exceed specific dimensions depending on the home platform foundation.
· For security reasons, the fish farms and the vegetable gardens should not block the access points from the water (Figure 30).

Figure 49- Incrementality to create a vegetable garden around the realm.

CHAPTER 8

Design Evaluation

Introduction

This chapter evaluates the developed concept from three main perspectives: desirability, affordability, and feasibility. Then, the final design is contrasted with the established requirements in chapter 4 (for the neighbourhood) and 7 (for the module design). Finally, a proposal for a future expansion is presented through a roadmap.
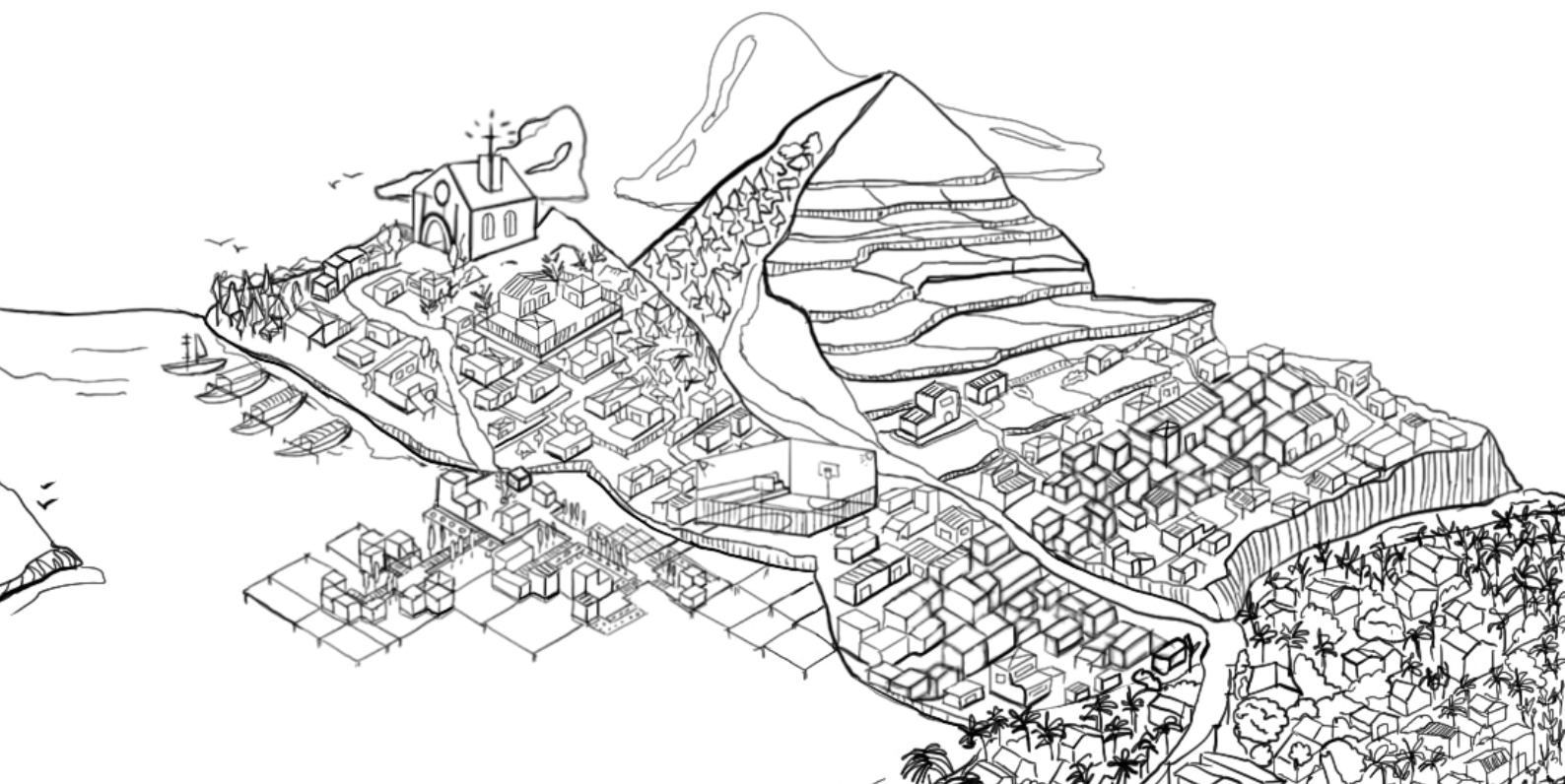
Approach

The design evaluation is divided into different categories. The first three categories follow the pillars of Design Thinking. To arrive at the sweet spot of innovation three main questions should be answered (IDEO Design Thinking, 2018; Kristann Orton, 2017) (Figure 50).

Each of the aspects is evaluated in different ways. The first one, viability, is evaluated from the user perspective. The main question to answer is "How we will live together?", following the topic of La Biennale di Venezia of 2021, co-existing in a new urban layout between inland and floating settlements while becoming resilient against the uprising environmental pressures. Then, the feasibility aspects, pursue the answer of "Can it resist the conditions? Can it be made?" by performing structural and load analysis. The last one is the viability is related to the cost estimation of building one module and the total cost of the foundation of the neighbourhood. Finally, the last section attempts to answer the question, "Can the community afford it?"

Desirability
Do they want it?

Feasibility
Can it resist the conditions?

Viability
Should we make it?

Figure 50- Desirability, Viability and feasibility schema

Desirability

1. Introduction to the evaluation of the living patterns of the Filipino society

This user evaluation aims to determine if the developed persona can maintain their daily/ weekly activities in the hybrid neighbourhood. Performing the activities in the new urban layout is critical to ensure the social acceptance. Therefore, to evaluate it qualitatively, the "A day in the life" exercise performed during the user research is repeated but in the new urban planning. Additionally, the concept is evaluated in a one-on-one meeting to gain insightful feedback and gather reactions.

2. A day in the floating community evaluation

The following procedure is followed to evaluate the hybrid settlement:
1. Create a routine axis for each persona
2. Locate each persona in one different area on the map. The limitation of this evaluation is that the user lives in another part of the vicinity.
3. Trace the activities of each of them on the map.
4. Reflect on the result

2.1. Activities timeline

The developed persona's routine in the user research section is mapped out (Figure 51) to understand the activities, the instant and location of performing them.

Persona Profile

Jose, 27
Fishermen

Angel, 48
Business owner

Rosario, 37
Municipality worker

Wake up 04:30~05:00 — Get ready for work — Go to work — Luch break — Come back home — Have dinner with the family — Play basketball with friends — Hang out with friends — Go to bed
05:00 05:15 12:00 16:30 17:30 19:00 20:30 22:00

Wake up 06:30~07:30 — Go to work — Luch break — Come back home — Have dinner with the family — Go to drink to a friends house — Go to bed
08:30 12:30 17:00 18:00 19:30 23:30

Wake up 06:00~06:30 — Go to the market — Go to work — Luch break — Come back home — Have dinner with the family — Stay home relaxing with the family — Go to bed
07:00 08:00 13:00 17:30 18:00 19:00 23:00

Figure 51-Daily routine of each persona
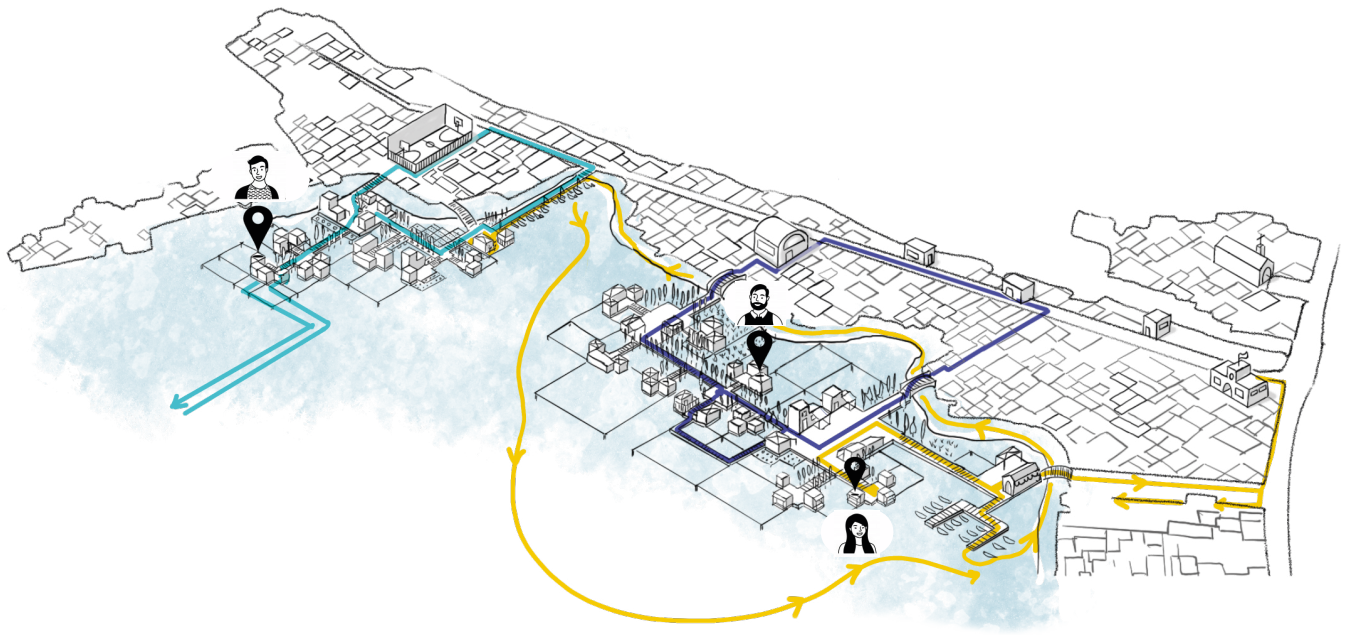
Figure 52- Routine and location of each persona.

2.2. Location of the persona and activity trace in the extension of the Barangay

Each of the persona is located in a dwelling of the neighbourhood. The distribution of them is done following the cluster and existing homes in Mercado. It must be noted that the daily routine scenarios are hypothetical, and the persona's location is just for the sake of the evaluation. According to their daily routine, each persona could have the illustrated route in a typical day of their daily life (Figure 52). The urban planning of the hybrid settlements allows them to carry out the activities in the floating and inland settlements.

Firstly, Jose is located near the fish farms and connected to the canal leading to the seaside fish farms. Then he is also near the basketball court and services to gather with his friends. Secondly, Angel is near a public space where he can meet with the friends of his zone. He is well connected to the mainland, where he owns a business, and he can network and exchange goods and supplies with other businesses. He is well connected to the main road and the hot points of the barangay.

Graduation Report

Lastly, the house of Rosario is located near the marketplace, so she does not have to walk every morning, and she can run errands quickly. Furthermore, she is well connected to the Municipality hall at which she works. Lastly, whenever she has to go to different parts of the Barangay, she can go either by land through the road or by boat through the canal.

Reflection

The hybrid settlement urban planning allows the end-user to perform the activities within 15 -30mins walking distance. Furthermore, accessibility and linkage passages between settlements facilitate the routine for those who work in the mainland and life in the water, and vice-versa.

The canal and the external water access remove the traffic from the main road and distributes it equally throughout the grid.
Lastly, each persona can have their route and run into other stakeholders in the public spaces.

3. Evaluation with participant

The face-to-face meeting aims to gain insights regarding the first impressions of the hybrid neighbourhood, the acceptance of designed functions and features such as the garden containers, pathways and dwellings positioning.

3.1 Interview Structure

The session is structured as an interview where the interviewer presents visualizations of the neighbourhood concept and the interviewee comments on them (Figure 53).

3.2. The outcome of the session

The participant reflected on the possible tension that could be created between the two settlements. The argumentation behind is that the different appearance between the extension and the current community can generate tensions and jealousy, resulting in a lack of safety in the floating settlement. This issue could be fixed by making sure the extension of the city follows, as much as possible, the aesthetical appearance of the existing one and allowing the end-users to personalise their homes.

The second is the container gardeners and the possibility these could offer to the locals. According to the participant, gardening can become the new flourishing business in the neighbourhood. The greenery modules and the possibility of increasing the house can help create new business and generate new job opportunities for the current domestic workers.

Lastly, the participant emphasises the importance of management in the extension of the community. If tension points arise in the ecosystem of the barangay, they impact the livelihood in the neighbourhood. Therefore, it is imperative to manage such tension between settlements and address them from the conceptualization stage of the project and later on through good management and rules establishment.

Figure 53- Evaluation of the neighbourhood with the participants.

Feasibility

Understanding if the concept is feasible to build is vital to continue with further development and production. Therefore, the validation of the design is imperative. This section describes the employed digital tools to simulate the scenarios and analyses the obtained results. A more detailed analysis can be found in the appendices [9].

1.Scenario development

1.1. Theory

A visualization is presented with the fundamental theoretical aspects of the floating behaviour and hydrostatics to introduce the upcoming references and terminology (Figure 54). From the theory (Ham, 2016; Journée & Massie, 2001), the description of the following concepts to understand are obtained. However, it is out of the thesis' scope to dive deep into the theory of hydrostatics; therefore, for further references and details, please check the appendices [9] and previous projects.

D= Depth
B= Width
L= Length
d= draught
M = Meta centre
B = Centre of buoyancy
G= Centre of gravity
y= horizontal distance between centres (Gand B)
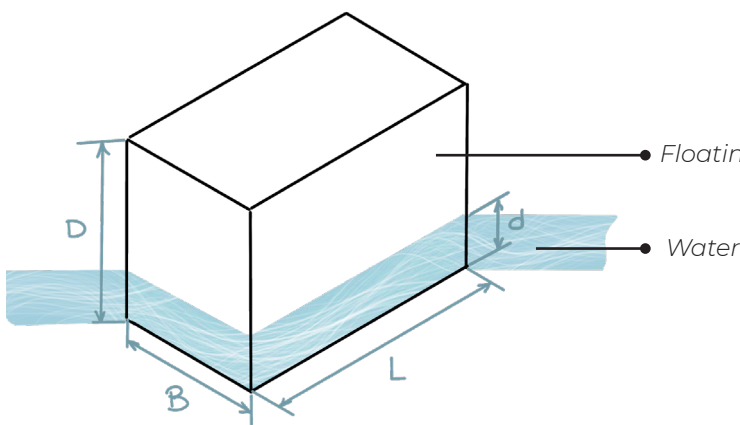
Figure 54- Fundamental signs

Equilibrium cases:

Vertical equilibrium. The result of two vertical forces, Fb (buoyance) and Fg (gravity), act on the centre of each other (Figure 55). Also called as the floating equilibrium.

Figure 55- Gravity force and buoyancy force. Source: (Ham,2016)

Rotational equilibrium. When external (vertical loads, horizontal loads or moments) act on the structure it causes a rotation, a tilt of the structure, around the centre of buoyancy. The heeling moment can be caused by wind or crowding pedestrians and the righting moment is counteracting the Mh (Biran & López-Pulido, 2014). The rotational equilibrium will be achieved when the righting stability moment Mr equals the(external) heeling moment Mh. (Figure 56) (Ham,2016).
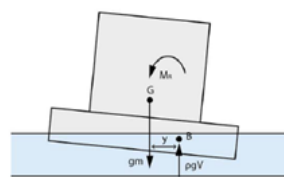
Figure 56- Righting moment Source: (Ham,2016)

$$M_H = M_r = \rho g \nabla \cdot y$$

Equation 1- Heeling moment and righting moment

1.2. Scenarios

As part of the feasibility analysis, different scenarios are studied. Logically, the developed structure should withstand every scenario; however, the calculation is done with the worst-case scenario in this project. The worst-case scenario is considered one detached module. The reasoning behind this is because, in an attached configuration, the modules act on each other, providing more stability to the entire assembly. Within that scope, several scenarios can be generated with different load cases (Figure 57).

1. Dead load: the own weight of the platform (150kg).
2. Live load: citizens standing distributed on top of the platform. (three people per m2).
3. Live load: people disparate (all in one side)
4. Live load: tricycle driving on top. (300kg vehicle plus four people)= 775kg. The reference vehicle is a Ural Gear Sahara 750 tricycle

SCENARIO 1

SCENARIO 2

SCENARIO 3

SCENARIO 4
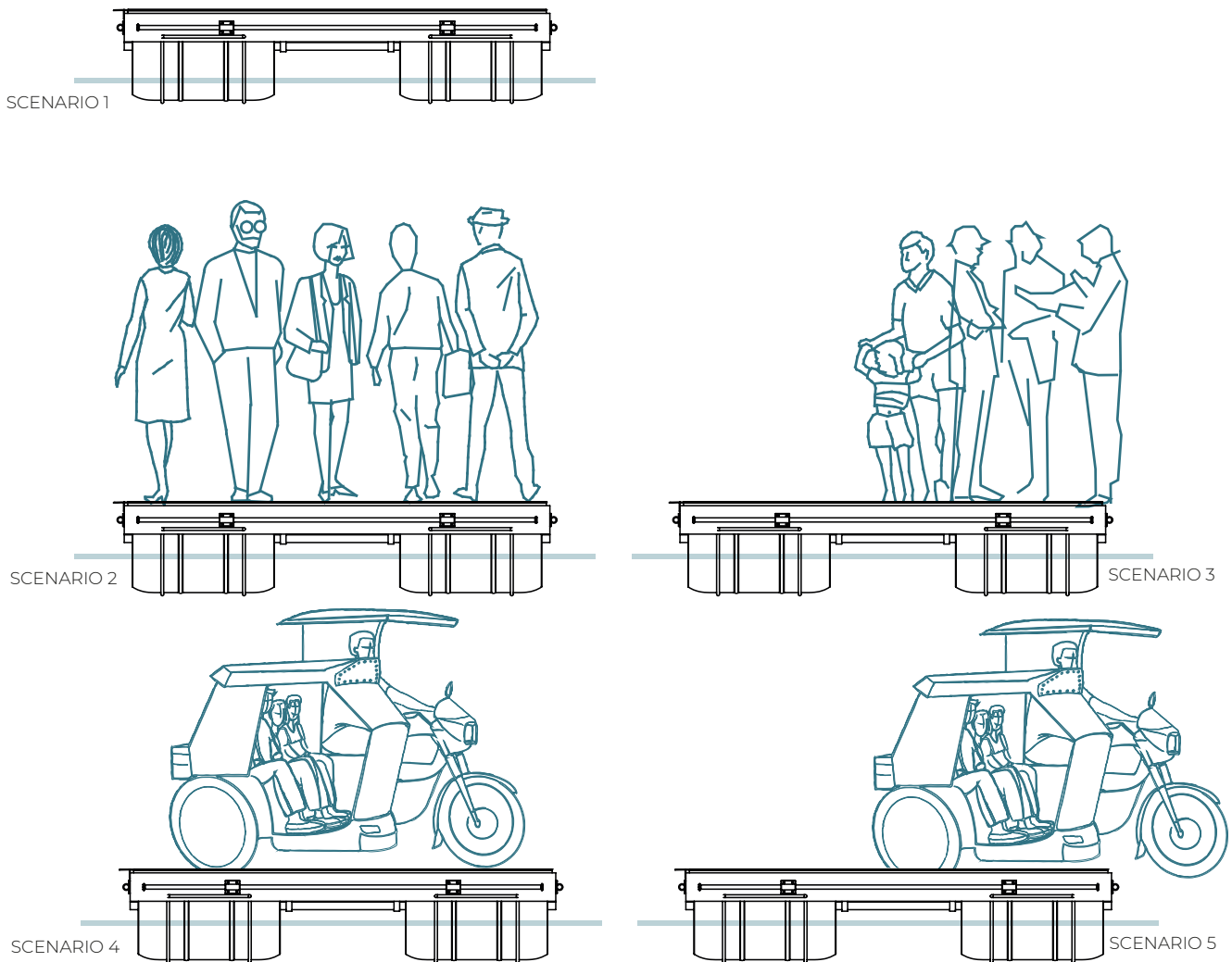
SCENARIO 5

Figure 57- Loaded cases scenarios

2. Structural analysis

2.1. CAD model and method

The program used for the calculation is called Rhinoceros and the plugin RhinoHydro. For the ease of the simulation, a simplified version of the original CAD file is generated.

The force representation in the scenario is introduced into the programme using the following force diagrams. Scenarios 1, 2, and 4 follow the force diagram on the left (Figure 58), and scenarios 3 and 5 follow the diagram on the right (Figure 59).

2.3. Simulation outcomes

When analysing the obtained data from the ran simulations, the critical values for the project are the draught, the maximum righting lever angle and the righting moment. Naturally, more crucial data must also be considered to perform a thorough analysis; however, it is out of the project's scope to dive deeper into them.

In this simulation, the draught (d) value indicates if the waterline touches the wooden structure. Due to the material, the requirement of a 20 cm distance between the waterline and structure is established (Table 6). In order words, the value of d should not be higher than 40 cm because the drums' diameter is 60cm (Appendix 12). Then, the maximum righting lever (GzMAX) indicates the major static heeling moment needed to return the platform module upright. From that angle onwards, the stability of the module decreases drastically. Lastly, according to the regulations the heeling angle (φ) should be around 4 degrees or less.

In this report, only the primary visual outcome is shown with the draught and maximum righting lever values. The source of the presented and discussed values can be found in the appendices [11].
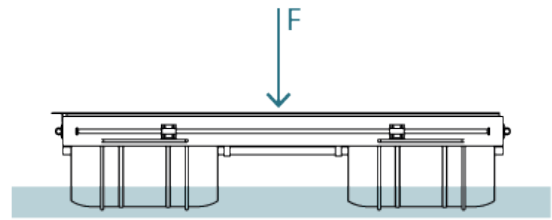
Figure 58- Scenario 1,2 and 4 load location diagram
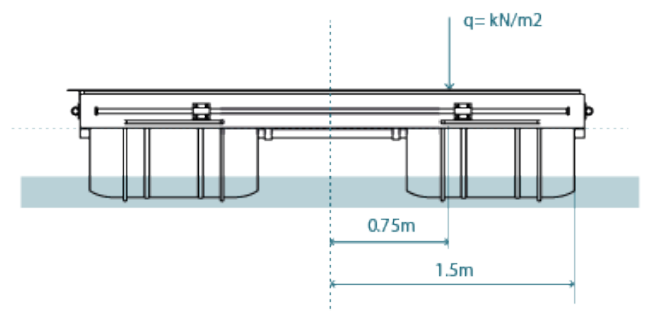
Figure 59- Scenario 3 and 5 load distribution schema

2.3.1 Calculation of the heeling angle

The area where the force is applied is 2.25m2 with a force of 5.25KN (Scenario 3). Then the value of q= 2.33kN/m2, which generates a heeling moment of 1.75kNm at a 0.75m distance from the centre (Figure 59).

According to the obtained result, in the graph (Figure 60), the righting moment has reaches the value of 1.75kNm at heeling angle (φ)of 4.6°.
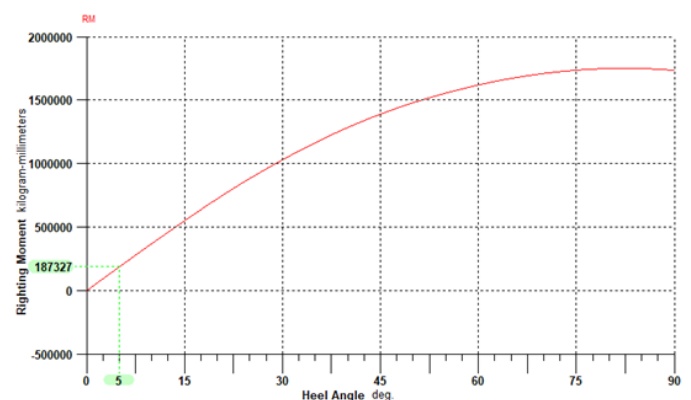
Figure 60- Righting moment/ heel angle graph

Scenario 1:

The result model visualizes the floating equilibrium of the platform in a dead load scenario (Figure 58), where the weight is the module (W=150kg) (Figure 61). The blue line represents the waterline.

Draught	113 millimetres
Gz max	85 degrees

Figure 61- Floating equilibrium dead load scenario

Scenario 2:

Five people (live load) distributed on top of the platform. The total weight is 525 kg, considering that each person has a mass of 75kg.

Draught	279 millimetres
Gz max	80 degrees
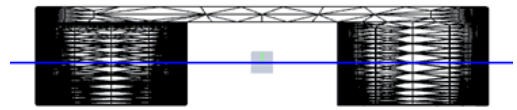
Figure 62- Live load people located on top

Scenario 3:

Live loads with an eccentric distribution (Figure 59): Five people located in one half of the platform. The live loads generate a heeling moment on the right side of the platform. In the simulation, the force is applied in the middle of the half. Due to the heeling moment, there are two different draught heights

Gz max heeling angle	85 degrees
φ	4.6 degrees
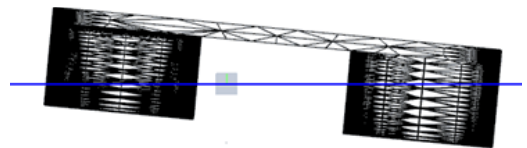
Figure 62- Live load eccentric distribution

Scenario 4:

Live loads with a centralized force. The vehicle is stationed on top of the platform. The loaded vehicle is located on top of the platform when carrying four people, and the total weight is 825kg.

Draught	403 millimetres
Gz max	80 degrees
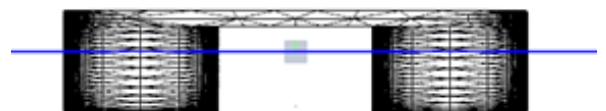
Figure 63 Load case of a vehicle with four people on top

Scenario 5:

Live loads, eccentric distribution. The vehicle is coming from one side. The value of the heeling angle is obtained following the same procedure (2.3.1) as for scenario 3 (appendix 11).

Gz max heeling angle	83 degrees
φ	5.6 degrees
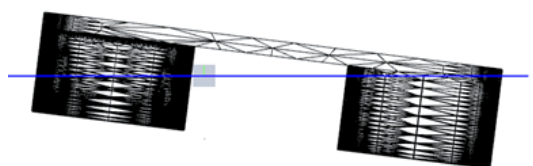
Figure 65- Platform with vehicle driving from one side.

8. Reflection, limitations of the approach and rules development

This section summarises the findings of the feasibility study. Overall, the simulation shows that the module performs well in scenarios 1 to 3, as the distance from the wooden frame to the waterplane is bigger than 20 cm. However, in scenario number, 4 the module is on the edge of not fulfilling the requirements. Lastly, s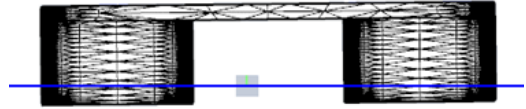cenario 5, does not fulfil the requirement. The figure shows that the moment generated by the live loads would force the frame to touch the water surface.

An apparent limitation of the method is the lack of dynamic studies and the assembly between more modules to study the side forces generated by the attached modules.

From this study, the following guidelines can be generated:
1. The maximum number of people allowed in one module at the same time is five.
2. Tricycles are allowed with a maximum number of two passengers on top.
3. The tricycles are should not to park on top of a type 1 module for safety and material maintenance reasons.

Table 8- Evaluation of the platform requirements

|	Requirements for the platform module	Value	Evaluation
1	*It should stand the weight of four people per module.*	*> 300 kg*	*The platform can stand the maximum weight of seven people.*
2	*The module should have connectors that allow an easy attachment in the X and Y-axis directions.*	*0° and 90°*	*The connection mechanism allows an extension in the X and Y- axes.*
3	*The assembly of the modules should allow movement in the vertical axis (Z-axis). The water line should be at least 20 cm below the wooden frame structure.*	*>20 cm*	*Depending on the scenario, the waterplane is at 20cm.*
4	*The gap in between modules should not be more than 7cm.*	*< 7cm*	*The gap between modules is 5 cm.*
5	*The generated platform design ought to be stable. Do not have a heeling angle higher than 4°.*	*4 °*	*The heeling angle is 4.6°. The requirement is not fulfilled.*
6	*Each module must be replaceable in case of malfunctioning.*		*The assembly mechanism is reversible, and therefore, each module is quickly detachable in case of damage.*
7	*The construction and assembly should be done in the Philippines by the locals.*		*The assembly of the module is done on the site.*
8	*The platform design should be compatible with the current floating homes.*		*The attachment between floating objects can be done by connecting the module to the bamboo pole of the floating home.*
9	*Each module should contain a safety element integrated into the assembly.*		*The bamboo stilts are the safety element of the module.*

Affordability & viability

Affordability determines if the module and the floating neighbourhood can be built in the targeted area and for the target group. Since the targeted end-user are middle and lower-income classes, the cost of the floating module ought to be reasonably cheap. Additionally, the cost estimation strongly depends on the country, suppliers, and target group. For this project, the costs assumptions concern the following factors: material cost (65%), labour cost (30%) and transportation cost (5%)(Ham, 2016). Lastly, the obtained values are an estimation, acknowledging that when the production of the module occurs, local engineers and manufactures may adjust the material selection or the manufacturing method as they know best how to build products in their country.

The estimation of the cost of one platform module would be the reference to assume the final price of the neighbourhood foundation. Next, the obtained value is compared to the existing concrete inland pathway to relativize its cost of the design and viability. Finalising with optimisation options is described to reduce the cost of the neighbourhood design.

1. Cost estimation calculations

The cost of the material is the most significant percentage of the total cost estimation. The listed materials can be found in the country and used previously to produce the pilot home. The cost of each modules is indicated in the table (9) and the entire cost estimation can be found in the appendices [10].

The total number of pathway modules in the neighbourhood is 261, resulting in a total material cost of 46200€ for the pathway grid creation. Then, to this price, it should be added the number of modules used in the public spaces at the entrance of the extension. The total area of those according to the final neighbourhood design is 1952m2. The area of one module is 4.5m2; therefore, approximately 434 modules would be required to build the designed spaces.

2. Cost comparison and optimization

The platform module creation is compared to creating a concrete pathway in the Philippines since this is the current manufacturing method. According to the data provided by stakeholder Pieter Ham, the cost of a concrete pathway of 50 meters is approximately 760€, considering the skilled labourer, transportation, and material costs. To build an equally long pathway, 16 modules should be used, resulting in a total cost of 2830€. After estimating the cost of the platform module, it can be concluded that although the materials and construction methods are more flexible and repairable, the costs are elevated. That leads to the second part of the cost estimation, optimising costs on the module level and the neighbourhood scale.

Cost optimisation

The most expensive materials are the structural wooden elements and the connectors. Consequently, the optimization could be done by replacing the yellow meranti material with cheaper but equally resistant wooden materials such as the bamboo in some elements; inner structure (n°2) and frame assembly (n° 1).
Alternatively, the costs of the neighbourhood can be reduced by:
1. Making the pathways to the neighbourhood narrower from 4.5m width to 3m (7 modules less).
2. Removing pathways around the fishponds (22 modules less).
3. Shortening the distance between dwelling cluster and pathways, one or two modules less per cluster (19 modules less).
4. Combine different building materials in public squares. For instance, use concrete blocks and floating modules to create a solid foundation.

Table 9 - Material cost per module

Material cost estimation per module variant	
Platform module	177€
Vertical greenery module	183€
Horizontal greenery module	144€

Evaluation of concept

1. Evaluation of the requirements

The table 14 evaluates the requirements described on the chapter 4.
The green colour indicates that the requirement is validated with the illustration of the final design, while the yellow indicates that the requirement still needs validation, but it is feasible to do it in the following phases of the project

2. Conclusions of the evaluation

The evaluation shows that the developed concept fulfils most of the requirements. Next, the reflection of the requirements is done in the following chapter (Chapter 9) in the form of future recommendations.

Table 10- Requirements' evaluation

	Requirement	Evaluation
1	The floating community shall not be ought to isolation. Clustering, connectivity, Functional aspect (accessibility)]	The extension of the community has at least three access points per settlement. Additionally, each cluster has a pathway leading to a public space.
2	The solution should be able to accommodate growth when the inhabitants require more space. [incrementality]	The positioning of the dwellings allows incrementality around them.
3	The positioning of the dwellings should encourage face to face interaction. [Familiarity, livelihood]	Approximately 80% of the floating dwellings have a realm space in front of them.
4	The community shall have an accessible central node. [functional and perceptual aspect]	The solution does not have one central node but several smaller open figures distributed around the neighbourhood. The public spaces have at least two entrances.
5	The solution should allow the integration of natural elements. [operational]	The greenery modules facilitate the integration of natural elements in the neighbourhood.
6	The solution shall promote the autonomy of the inhabitants. [operational aspect]	The greenery modules promote autonomy. Furthermore, the available fields around the dwellings offer the opportunity to have a fish farm.
7	The solution must allow the self-expression of the inhabitants. [Perceptual Aspect]	The addition of greenery modules and decoration elements such as plants or tarps under and around the porch promotes self-expression. As a result, the dwelling can reflect the personality of the owners.
8	The solution should allow different levels of privacy according to the desires of the inhabitants. [Functional aspect (public vs private life)]	The dwellings' orientation and location of realm space in the middle of the cluster allows the homes to have privacy on the backside
9	The solution must be implementable within the existing context	The solution is created for the existing context, considering the infrastructures and water access points.
10	Answers living patterns of the community	Citizens can perform the daily activities in the new layout. (Viability and desirability section)
11	A gradual transition between public and private space.	The transitional elements are the natural elements and the variety of pathways' widths.
12	The communal spaces should have good visibility from the pathways.	Public spaces have entrance points and visibility for both settlements (mainland and floating).
13	Position the basic facilities and access points on share roads or paths.	Public spaces have at least two entrance points, one for the inland settlement and one for the floating settlement pathways.

Future neighbourhood expansion

An implementation plan with three phases or horizons is presented in a roadmap format to align the expansion capabilities of Hagonoy with the housing demand and the production power of Finch Floating Homes in the Philippines. This thesis aims to create a framework that allows growth (physical and social) in the coastal rural area of Hagonoy. The implementation steps are supported with present and future trends of natural disasters, population growth and housing backlog. The ultimate goal is to build resilient communities

Horizon 1 | Expansion of the city
Start the extension of the barangay towards the water in a non-invasive way by implementing floating homes and public areas. The new floating expansion for the city of Hagonoy puts the needs of the local community in the centre while embracing their fragile relationship with water.

Horizon 2 | Community Union
The community will increment organically, and more dwellings will be built between the first two settlements. In addition, a nursery for kids and community services will be created. The inhabitants will start expanding their dwelling units and using the fields around, creating their own businesses and resources until becoming one united settlement. This new floating Purok might be attractive also for newcomers.

Horizon 3 | New floating communities
The floating settlements gain popularity and start expanding to other available fishponds in the areas of the city. As a result, the inhabitants are more familiar with the extension of the city into the water. Other cities in the Philippines start introducing floating communities. The floating structures technology is developed, and new architectural elements are implemented into the water, such as basketball courts or churches.

Figure 66- Implementation roadmap

Graduation Report

Horizon 1
| Extension of the city |

Time
Happenings

2023

Market
Trends and community

Population

Climate Change

Target group
Hosted families

39
Families
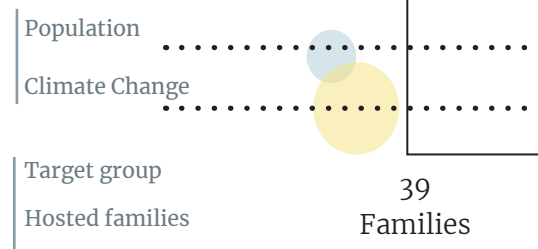
Product
Urban planning and resources

Introduction of architectural elements

Technology

Drum materials

Floating modules types

Plastic

Pathways

Gardeners

Slops

Infrastructure

Piping system

Urban furniture

Open Structures

Tarps

| Extension of the city | Purok |

| Extension of the city | Purok |
| Floating Barangay |

2025

2030
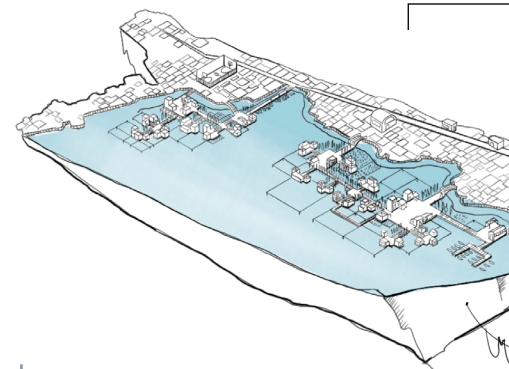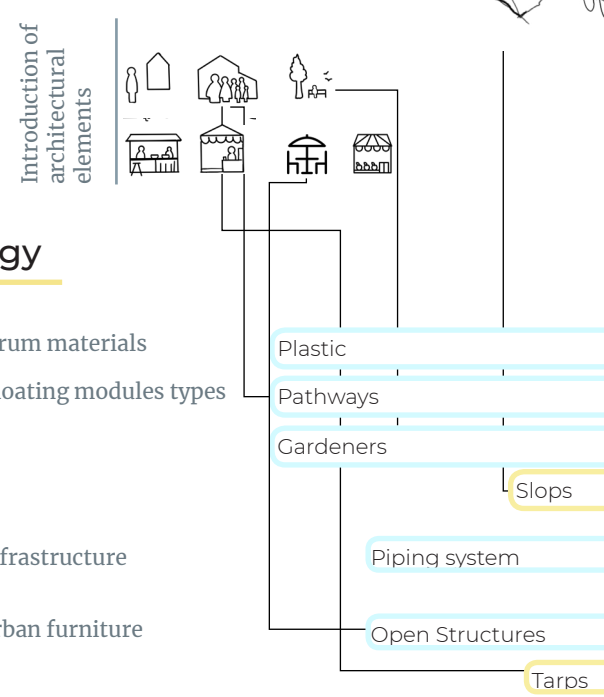
Gradual expansion of
the community

Iteration of design and
improvements of technology and
assembly

Other parts of the world would
also start having floating cities.

Middle and low income families
Fishermen
Farmers
Young adults

Middle and low income families
Fishermen
Farmers
Young adults
Newcomers

All groups of stakeholders
Newcomers

45
Families

65
Families
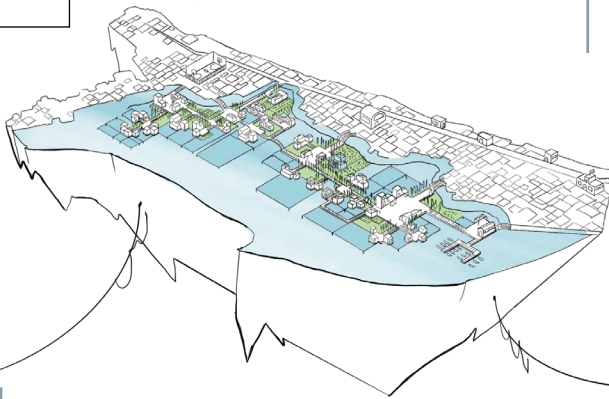
🏫 Kids' nursery

🏛 Community centre
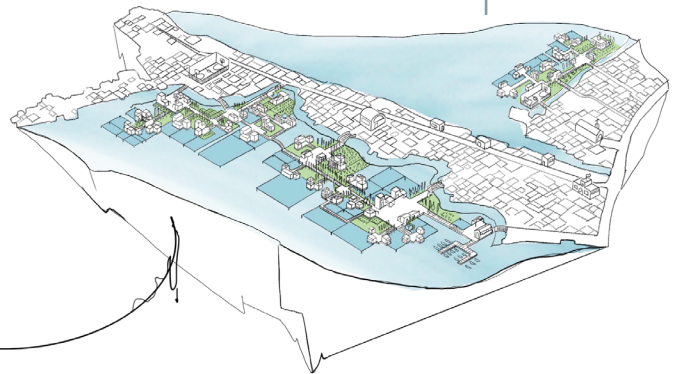
🏫 School

🏀 Sports facilities

Recycled plastics

Parking

Firshfarms

Heavy and crowded space infrastructure

Public benches

The size of the circle represents the amount or impact of those trends.

**Bigger illustrations of the horizons 2 and 3 can be found in the appendix 8.*

D
Desirability

Yes, it is desirable and adapted for to the living pattenrs.
The next step should be gathering more participants.

F
Feasibility

In depth static and dynamic analysis is required. Nonetheless, the performed simulations are quite positive about the feasibility.

V
Viability

The cost of the module is high however in the long term it can payoff.

Figure 67- Conclusions of the evaluation

Chapters conclusions

Chapter 8: Design Evaluation

Desirability

The evaluation of the design is done with the available tools and methods. Unfortunately, the most significant limitation of the desirability study is the incapability of contacting participants due to an unfortunate happening in the Philippines. Nonetheless, the alternative evaluation and one-on-one interview provided enough data to evaluate the concept.

Feasibility

All in all, the neighbourhood concept and platform design show potential to continue developing them. Although further evaluation and tests must be done to certify that the concepts are ready to be implemented into the context. However, due to the housing urge and the pressuring natural disasters, a trial-and-error approach can be taken to start with the extension as soon as possible.

Viability

The first cost estimation proves that the module's initial cost is high; however, the designed module has the advantage that due to its characteristics, it can help to reduce future costs, such as maintenance, repairability, and production time. All in all, the module shows potential to be implemented in the neighbourhood with different functions:

1. Adaptation and extension of the dwellings space.
2. Creation of gardening and farming fields.
3. Temporary and permanent pathways.

Nevertheless, perhaps the module should not be used to create every space or pathway as initially proposed. Consequently, after the cost estimation, it could be said that a mix/hybrid module is the most realistic approach to develop a floating neighbourhood in the Philippines.

Introduction

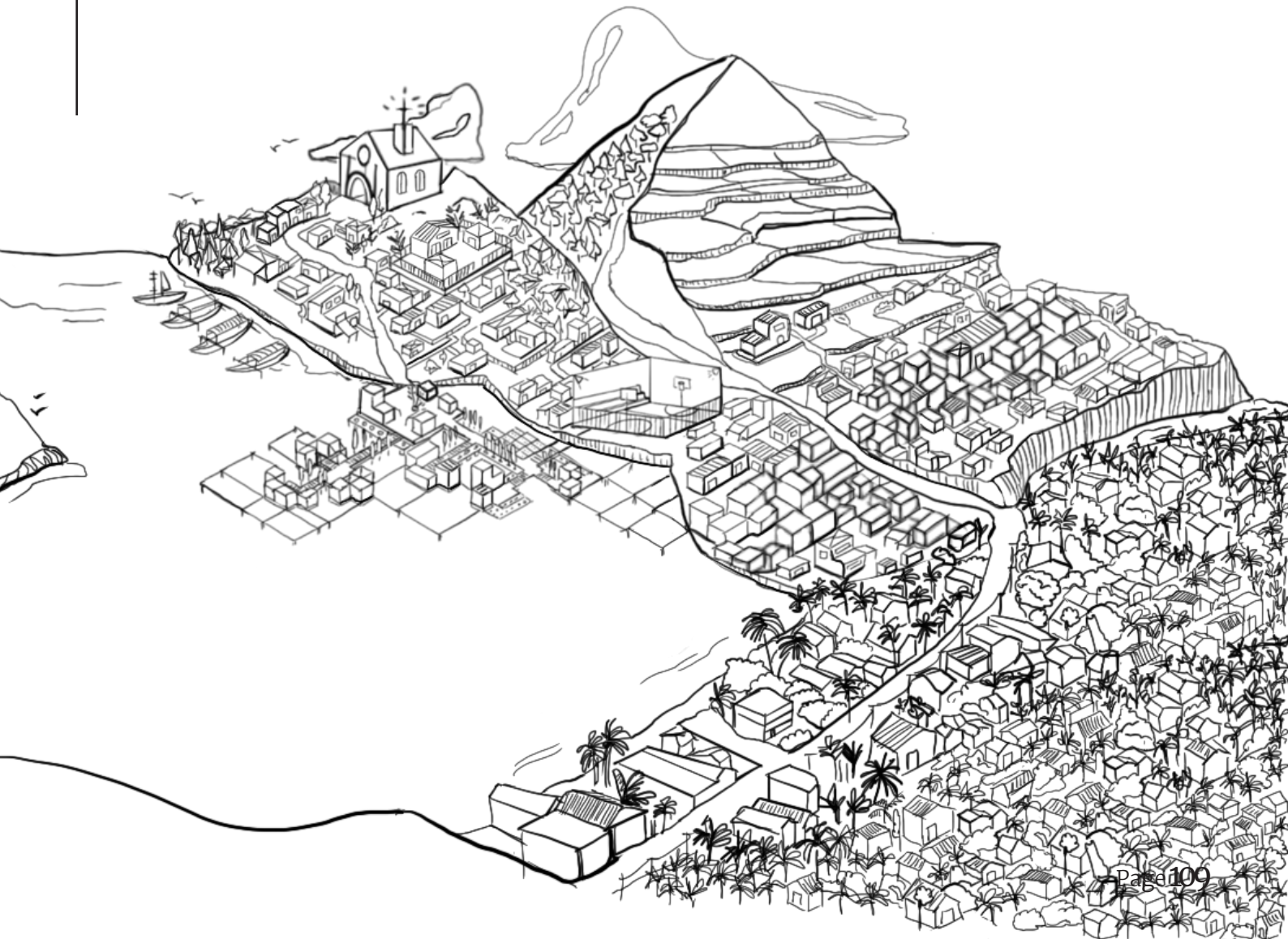This last chapter concludes the project with some future recommendations for those interested in continuing it. Then, it discusses some of the findings and results. Finally, to end with a personal reflection of this thesis author.

Future Advancements

Throughout this thesis, I saw numerous design opportunities for further exploration. In this section, recommendations on different elements, research and development areas in floating neighbourhoods are given.

1. Dive deeper into the module design

During the project, only two functionalities of the floating modules are explored and proven to have the potential in such a context. However, the modular system can have other functions, for example, fish farm structures or dock designs for small boats.

In the final version of the module, there is a rope around the bamboo stilts, creating a fence that protects the pedestrians. Unfortunately, there is no height regulator mechanism in this design, meaning that if an external movement alters the height of the bamboo stilt, the fence does it too. Therefore, it is highly recommended to dive deeper into developing or researching such a mechanism to implement it. The same recommendation goes for the piping system and the lightning of the entire neighbourhood. Concerning the illumination, the selected spots (Figure 34) are placeholders to indicate that there should be around that spot; however, it is not done correctly. Therefore, in the future, the illumination must be designed by experts. Then, the affordability estimation of the one module seems to be high; however, to make it accurate, thorough and detailed calculations should be done considering the maintenance, the life span of the module, and the assembly costs.

Lastly, it is out of the project's scope to provide an accurate and detailed feasibility study during this thesis. Thus, during the following phases of the conceptualization and manufacturing of the module, it is advised to perform a more extensive feasibility analysis in different configurations. .

2.Neighbourhood expansion and improvement of the floating community

Accessibility is one of the core values of the developed concept. These touchpoints between settlements are materialised as bridges. Although the proposed concept relies on them to succeed, the bridge design is currently out of scope.
That is why for the next horizons, bridge design and development must be done to ensure the circulation of citizens entering and exiting the floating community.
Next, inspired by the newest floating community designs, having safe parking outside the floating community for heavy vehicles is necessary. It reduces the number of vehicles near the dwellings making the community safer for the pedestrians and reducing noise pollution.
To finalise, the addition of clear water plants between the corner dwellings purifies the black waters generated by the inhabitants of the dwellings. This practice is already being used in other floating villages, for instance, Cambodia (Tfish fund, 2015).

3. Ground and expansion rules of the community

Although the concept is presented as an extension of the community, this one should have the same rules and management system as the mainland to control and grow in a structured and logical way.
These rules and society-system must be created and regulated by the locals and municipality workers.
As recommended by one participant, each barangay should have a community centre to organize activities and do cultural and educative workshops to improve the livelihood and community feeling of the barangay.

Discussion

This thesis worked towards including the living patterns of Filipino society in the urban planning of a new hybrid community. The goal was to address the community's needs and translate them into tangible elements that can be implemented in the design of the hybrid neighbourhood. The intended outcome was to ensure social acceptance of the community extension and promote the willingness of moving into a floating home. The main research question of the project was "How can we design a floating neighbourhood made with prefabricated homes accepted by the Filipinos'living patterns and allow (social and physical) growth over time?". This discussion will look at the results and contributions made to the ongoing project of Finch Floating homes, followed by an assessment of the limitations and strengths of the employed approach.

1. Results and contributions

The project's outcome includes a hybrid neighbourhood design, which puts the user's needs in the centre of urban planning. Next, it proposes a way of building such a layout through modular floating platforms. This novel neighbourhood combines the positive aspects of the existing floating settlements by offering a non-invasive extension of the barangay towards the water while simultaneously being well connected to the mainland. Thus, this proposal offers the inhabitants new opportunities while maintaining the old connections and habits. The process offers insights into how to facilitate a co-creation session with the end-user in a game form. Furthermore, this uncovered approach involves the end-users in the design process by giving them a tool to communicate with the designers and architects, later considering their urban design and planning requests.

The final result of this thesis is a framework that gives the citizens tools and opportunities to make the floating community their new home.

2. Strengths and limitations

Firstly, the participatory design approach offers individuals to express their wishes and needs for their future community. The advantage of it is understanding the deeper knowledge levels and the reasoning behind their desires. Secondly, the platform's modularity allows the incrementality and adaptation of spaces according to the needs, resulting in a personalised environment.

Although these two tailored and individual approaches show great potential to develop a desired community, it also has limitations. The required time and effort to carry out the individual participatory sessions is extended for the length of the project. Additionally, this approach is common in specific disciplines such as design; however, it might not be as widely used either understood in others. A second limitation is the co-creation session is the designer's subjectivity when executing it, as the involved culture does not tend to express straightforward thoughts this might "force" the facilitator to give a push to kick-off the session.

Personal Reflection

I want to dedicate this section to share my personal experience during this project.

One of my main motivations and challenges in the project was learning about architecture and urban planning from the designer perspective. Through this project, I was able to dive deeply into the complex system of the Filipino culture and learn how to approach this complexity using design principles and techniques to entangle the nodes and design for them. This project and the EDx course of "Global Housing Design" offered me the opportunity to learn the importance of the habitat in the development of the citizens and society. The architectural and urban planning disciplines must put the end-user in the centre and design for the local living patterns and needs. Unfortunately, this is not a common practice due to economic, time issues or other reasons. Therefore, the urban planning I proposed had the mission of designing for the end-user and their needs.

Another personal goal was to broaden my systemic design and user research knowledge which I could achieve when designing the game and synthesizing the information gathered during the co-creation sessions. I must admit that this has not been an easy challenge. On the one hand, I recognize that online tools had made content creation and sharing very easy during the co-creation sessions. On the other hand, I wonder how the created toolkit would have work in a face to face scenario. Each of the sessions with the participants was utterly different. The first ones were more like a personal learning experience on how to ask the questions rather than a project focus interview. I would not dare to say that I became good, but I could say that I managed to get the right amount of information for my project.

In the end, I overcame this phase of the project thanks to the participants. This phase was inspiring, energising and exciting thanks to their attitude towards life, hospitality, and resilience.

After the first diamond, I was flooded with information and new concepts. I needed to analyse all the gathered insights from the user research and translate them into architectural and urban planning features, which I had no previous experience. As industrial designers, we do not learn about the logistics of a neighbourhood; therefore, I started designing a neighbourhood plan based on my intuition, not my best idea. However, thanks to my mentors' guidance, I understood more about the interactions, essentials, and visualization of style I need to achieve to communicate my ideas.

Lastly, if I could go back in time and talk to my past self, I would recommend me this:

- Embrace the chaos and complexity and adjust the initial plan or idea.
- Organize your thoughts from the beginning, write down the research questions I want to answer on paper and keep them visible.
- Start contacting participants sooner; Filipino society does not work well under rush and has its own rhythm.
- Having breakdowns is fine as long as you come back feeling stronger than before.
- Make sure always to keep your friends close.

Bibliography and references

A

Abu-Ghazzeh, T. M. (1999). HOUSING LAYOUT, SOCIAL INTERACTION AND THE PLACE OF CONTACT IN ABU-NUSEIR, JORDAN. In Journal of Environmental Psychology (Vol. 4173). Academic Press Article No. jevp.

Aljazeera America. (2016). Life continues as flooding hits Philippines. Aljazeera.com. http://america.aljazeera.com/multimedia/photo-gallery/2015/7/photos-flooding-philippines.html

B

Bamba, J. C. (2020, September 25). Hábitat Flotante Productivo Refugio del Pescador. ArchDaily Perú. https://www.archdaily.pe/pe/948440/habitat-flotante-de-almacenamiento-y-produccion-refugio-del-pescador-natura-futura-arquitectura-plus-juan-carlos-bamba

Biran, A., & López-Pulido, R. (2014). Simple Models of Stability. Ship Hydrostatics and Stability, 127–169. https://doi.org/10.1016/b978-0-08-098287-8.00006-2

Born, M. (2019, March 12). What It's Like Living in Sausalito, California | neighborhoods.com. Neighborhoods.com. https://www.neighborhoods.com/blog/what-its-like-living-in-sausalito-california

D

de Haan, W. (2020). FLOATING CLASSROOM THE PHILIPPINES.

DelftX. (2021). Global Housing Design. Edx.org. https://learning.edx.org/course/course-v1:DelftX+GHD1x+1T2021/home

Design Council. (2007). Eleven lessons: managing design in eleven global brands. www.designcouncil.org.uk

Diehl, J. (2020). ID 5565 Causal Loop Diagrams Part 1 by Ella Jamsin [YouTube Video]. In YouTube. https://www.youtube.com/watch?v=cIgW78TEnEs&ab_channel=JCDiehl

Doeppers, D. F. (1972). The Development of Philippine Cities Before 1900. The Journal of Asian Studies, 31(4). https://doi.org/10.2307/2052101

E

Ellen MacArthur Foundation. (2019). Systemic Design Toolkit Guide SYSTEMIC DESIGN TOOLKIT. https://www.systemicdesigntoolkit.org/

Emerald Publishing. (2021). Carry out action research. Emeraldgrouppublishing.com. https://www.emeraldgrouppublishing.com/how-to/research-methods/carry-out-action-research

F

Finch Floating Homes. (2021). Finchfloatinghomes.com. https://www.finchfloatinghomes.com/

Floramo, V., & Villadiego, L. (2014, August 10). In Pictures: Cambodia's floating villages. Aljazeera.com; Al Jazeera. https://www.aljazeera.com/gallery/2014/8/10/in-pictures-cambodias-floating-villages

Foraboschi, P. (2017). Specific structural mechanics that underpinned the construction of Venice and dictated Venetian architecture. Engineering Failure Analysis, 78, 169–195. https://doi.org/10.1016/j.engfailanal.2017.03.004

G

Ganvie Lake Village. (2011, November 28). Atlas Obscura. https://www.atlasobscura.com/places/gavie-benin

García, A. (2020). Babahoyo, la antigua "Bodegas" del Ecuador. El Comercio. https://www.elcomercio.com/tendencias/babahoyo-antigua-bodegas-muelles-ecuador.html

Gharai, F. (1999). GENERIC PRINCIPLES OF NEIGHBOURHOOD DESIGN WITH PARTICULAR REFERENCE TO TEHRAN. www.bl.uk

H

Habitat for Humanity. (2020). Philippines The housing need in the Philippines Country profile. Habitat for Humanity. (2021). Philippines | The housing need in the Philippines | Country profile. https://www.habitat.org/sites/default/files/documents/Philippines_FY20.pdf

Halong Hub. (2020, June 2). What's the Story Behind Halong Bay's Floating Villages? - Halong Hub. Halong Hub. https://www.halonghub.com/blog/halong-bay-amazing-floating-villages/

Hagonoy Water District. (2016). Water Safety Plan.

Ham, P. (2016). The design of a modular, amphibious structure for a flood and typhoon-prone municipality.

Ham, P. (2018). Vernacular architecture inspires flood-proof housing. https://flowsplatform.nl/#/vernacular-architecture-inspires-flood-proof-housing-in-the-philippines-1519054933087_____

Herrera-García, G., Ezquerro, P., Tomás, R., Béjar-Pizarro, M., López-Vinielles, J., Rossi, M., Mateos, R. M., Carreón-Freyre, D., Lambert, J., Teatini, P., Cabral-Cano, E., Erkens, G., Galloway, D., Hung, W.-C., Kakar, N., Sneed, M., Tosi, L., Wang, H., & Ye, S. (2020). Mapping the global threat of land subsidence. Science, 371(6524), 34–36. https://doi.org/10.1126/science.abb8549

I

IDEO Design Thinking. (2018). Design Thinking Defined. IDEO | Design Thinking. https://designthinking.ideo.com/

K

Kendall, S. H. (1976). The barangay as community in the Philippines (Vol. 41, Issue 242). https://www.jstor.org/stable/43618621

Keukens, M. (2020). Rhizospheric Gotong Royong. Lorenzo, Ar. C. M. (2016). Filipino Culture of Filling up Space in a Gated Community. Procedia - Social and Behavioral Sciences, 216, 545–551. https://doi.org/10.1016/j.sbspro.2015.12.017

Kristann Orton. (2017, March 28). Desirability, Feasibility, Viability: The Sweet Spot for Innovation. Medium; Innovation Sweet Spot. https://medium.com/innovation-sweet-spot/desirability-feasibility-viability-the-sweet-spot-for-innovation-d7946de2183c

Kurt, D. A. (1984). Experiential learning: experience as the source of learning and development. Educational Technology. https://educationaltechnology.net/kolbs-experiential-learning-theory-learning-styles/

L

Lau-Bignon, A. W. (2015). The Tonle Sap Lake, a birthplace of civilizations. LEspace Geographique, Volume 44(1), 81–88. https://www.cairn-int.info/article-E_EG_441_0081--the-tonle-sap-lake-a-birthplace-of.htm#

M

Macrotrends. (2021). Philippines Population Growth Rate 1950-2021. Macrotrends.net. https://www.macrotrends.net/countries/PHL/philippines/population-growth-rate

Malakova, A., Völker, E., Thi Thu Trang, N., Thi Hong Hanh, V., Stopp, H., & Vukorep, I. (2017). Floating settlements in Mekong Delta. INIK. https://www.researchgate.net/publication/348431834_Floating_Settlements_in_Mekong_Delta

Maslow, A. H. (1943). A theory of human motivation. Psychological Review, 50(4). https://doi.org/10.1037/h0054346

Mauk, B. (2021). A People in Limbo, Many Living Entirely on the Water. The New York Times. https://www.nytimes.com/interactive/2018/03/28/magazine/cambodia-persecuted-minority-water-refuge.html

Maslow, A. H. (1943). A theory of human motivation. Psychological Review, 50(4). https://doi.org/10.1037/h0054346

Meyer, H., Westrik, J., & Jan Hoekstra, M. (2008). Stedenbouwkundige regels voor het bouwen. SUN.

Merriam-Webster. (2021). Merriam-Webster.com. https://www.merriam-webster.com/

MI News Network. (2019, January 16). 10 Floating Villages Across the World. Marine Insight. https://www.marineinsight.com/life-at-sea/10-floating-villages-across-the-world/

McDonnell, S. (2019, November 13). Living on the dock of the bay: The history behind Sausalito's quirky and colorful floating homes. Roadtrippers. https://roadtrippers.com/magazine/sausalito-floating-homes-california/

Municipality of Hagonoy. (2021). Hagonoy, Bulacan, Philippines: Bulacan.gov.ph. https://www.bulacan.gov.ph/hagonoy/index.php

N

National Committee for Human Settlements. (1976). HABITAT BILL OF RIGHTS. https://www.jstor.org/stable/43620469

O

Opray, M. (2020, July 28). Dutch floating community rises to the challenge of climate change. Metabolic. https://www.metabolic.nl/news/dutch-floating-neighborhood-rises-to-the-challenge-of-climate-change/

P

Project for Public Spaces. (2020). What Makes a Successful Place? Pps.org. https://www.pps.org/article/grplacefeat

R

Raffle, E. (2021). The war on drugs in Southeast Asia as 'state vigilantism.' International Journal of Drug Policy. https://doi.org/10.1016/j.drugpo.2021.103114
Rey, A. (2020, December 15). Bulacan airport project to start construction in Q1 2021. Rappler; Rappler. https://www.rappler.com/business/bulacan-airport-project-start-construction-q1-2021

Rey, A. (2020, December 15). Bulacan airport project to start construction in Q1 2021. Rappler; Rappler. https://www.rappler.com/business/bulacan-airport-project-start-construction-q1-2021

Romero, R. (2021). The essence of the Bulacan airport project. Manila Standard. https://www.manilastandard.net/opinion/columns/business-class-by-rudy-romero/350091/the-essence-of-the-bulacan-airport-project.html

S

Schoonship. (2016, April 5). Schoonschip – Amsterdam. Schoonschipamsterdam.org. https://schoonschipamsterdam.org/#wat-is-schoonschip

Service Design Tools. (2021). Personas. Servicedesigntools.org. https://servicedesigntools.org/tools/personas

Sluiter, K. (2019). THE CORRUPTION GAME EXPERIENCE THE BALKAN'S THIRST FOR HYDROPOWER DEVELOPMENT. http://resolver.tudelft.nl/uuid:dc584757-1eaf-42b3-a23a-c3c50bad06ba

T

Tan, E. (2014). Negotiation and Design for the Self-Organizing City Gaming as a method for Urban Design. https://journals.open.tudelft.nl/abe/article/download/tan/pdf_tan

Tfish fund. (2015, Spring 11). Toilets and Hygiene for Cambodian Floating Schools. Transparent Fish Fund. http://www.tfishfund.org/blog/toilets-and-hygiene-for-cambodian-floating-schools

TU Delft Stories. (2021). Floating homes for the Philippines. TU Delft. https://www.tudelft.nl/en/stories/articles/floating-homes-for-the-philippines

U

UN-Habitat for a better urban future. (2016). "Gender perspectives in urban planning" - Ana Falú | UN-Habitat. Unhabitat.org. https://unhabitat.org/gender-perspectives-in-urban-planning-ana-falu

UN-Habitat worldwide. (2014b). Shlomo Angel - Making Room for a Planet of Cities [YouTube Video]. In YouTube. https://www.youtube.com/watch?v=1GknqMC4B2o&ab_channel=UN-Habitatworldwide

UN-Habitat. (2020). "A BETTER QUALITY OF LIFE FOR ALL IN AN URBANIZING WORLD" THE STRATEGIC PLAN "A BETTER QUALITY OF LIFE FOR ALL IN AN URBANIZING WORLD." www.unhabitat.org

V

van Boeijen, A., Daalhuizen, J., Zijlstra, J., & van der Schoor. Roos. (2017). Delft Design Guide (Vol. 165). BIS Publishers.

van Schaik, J. W. J. (2016). An economical prefabricated residence for Hagonoy, a typhoon prone municipality in the Philippines: analysis, design and implementation. https://repository.tudelft.nl/islandora/object/uuid%3A1684d67c-dbe9-4993-b41f-8120336c9bd9

Velez, F. (2020, July 29). Hagonoy is pilot site for flood control mangrove tree planting project. Manila Bulletin. https://mb.com.ph/2020/07/29/hagonoy-is-pilot-site-for-flood-control-mangrove-tree-planting-project/

VOA Learning English. (2014, November 29). Bangladesh Overcomes Flooding with "Floating Farms." VOA; Bangladesh Overcomes Flooding with "Floating Farms." https://learningenglish.voanews.com/a/bangladesh-floating-farms/2535772.html

W

WestDock. (2019, March 5). Candock Modular Floating Dock Systems - West Dock. West Dock. https://www.westdock.ca/candock-modular-docking-systems/

Williams, J. (2005). Designing neighbourhoods for social interaction: The case of cohousing. Journal of Urban Design, 10(2), 195–227. https://doi.org/10.1080/13574800500086998

WoodCulture. (2012). Living with wood in Ganvie [YouTube Video]. In YouTube. https://www.youtube.com/watch?v=HbKxJnKeVHY&ab_channel=WoodCulture

World Economic Forum. (2020). The Global Risks Report 2020.

Y

Yamaguchi, K. (2006). The New American Houses in the colonial Philippines and the rise of the urban Filipino elite. https://www.jstor.org/stable/42633879

Appendices