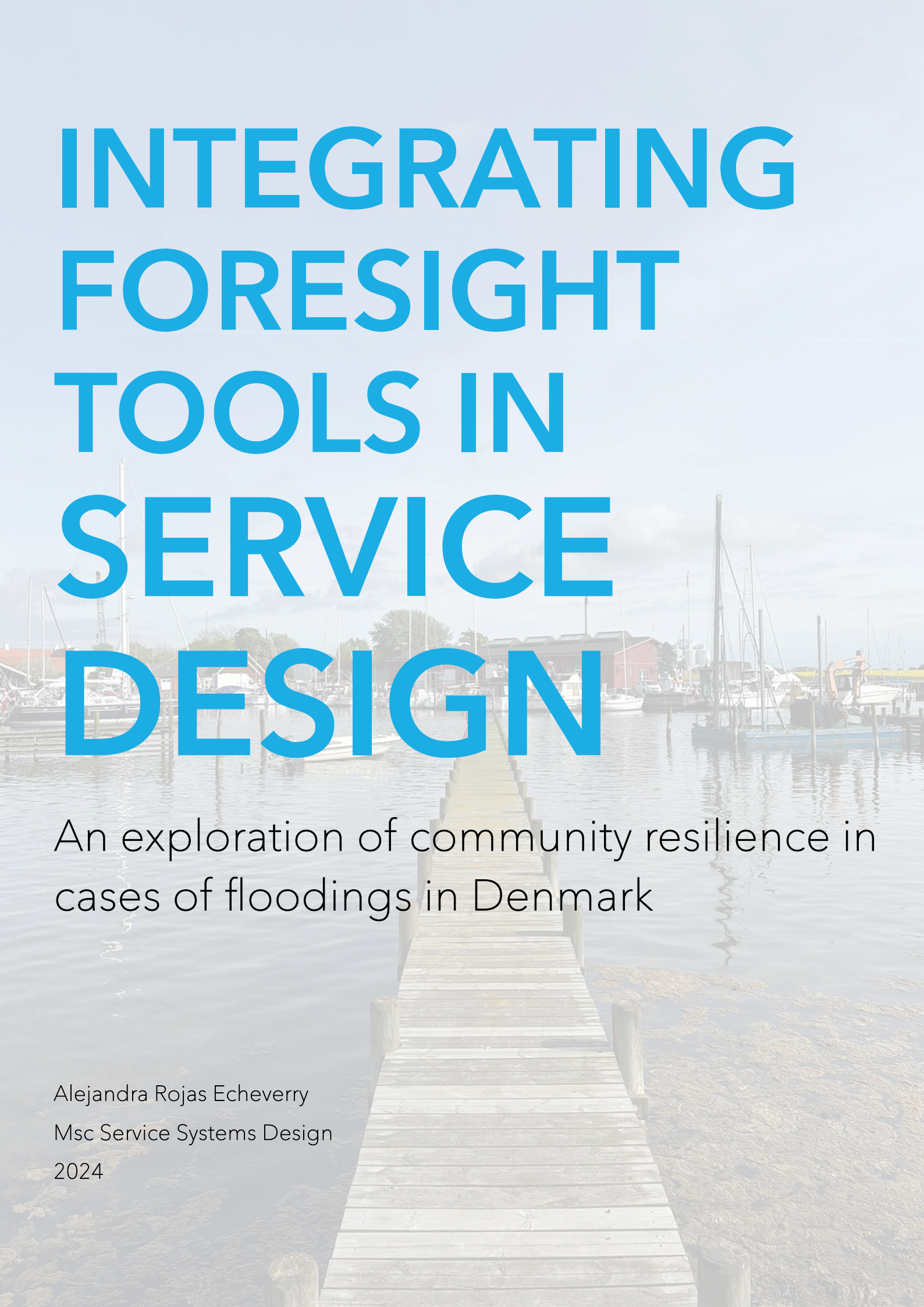

INTEGRATING FORESIGHT TOOLS IN SERVICE DESIGN

An exploration of community resilience in cases of floodings in Denmark

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Abstract

This thesis explores the integration of foresight tools into service design to enhance community resilience in response to flooding events in Denmark. The research investigates how foresight methods can inform service design practices, particularly in addressing climate adaptation challenges. The study employs a case study approach, focusing on flood-prone areas in Denmark, to identify the potential of foresight tools in predicting and preparing for future flooding scenarios.

The methodology includes expert interviews, contextual interviews with residents in flood-affected areas, and surveys to gather data on community experiences and perceptions. Additionally, foresight tools such as PESTLE analysis, trend mapping, and scenario development are utilized to envision alternative futures and inform service design solutions. The findings highlight the importance of effective communication, community collaboration, and proactive planning in enhancing resilience.

The research concludes with the development of a prototype digital platform, FloodGuard, which aims to connect community members, provide real-time flood alerts, and facilitate coordinated response efforts. The study demonstrates that integrating foresight tools into service design can significantly improve community resilience and preparedness for climate-related disasters.

Acknowledgments

A huge thank you to all the people who offered their assistance and took the time to listen and support my work providing feedback, referring me to literature and just allowing theirselves to co-create with me.

I also want to thank my supervisor, Nicola, for his guidance, sharing his extensive knowledge in the different topics that this thesis considers and for his contributions throughout the process.

Furthermore, I want to express my deepest gratitude to my family—my mom Carmen, my dad Juan Carlos, and my brother Sebastian—for their continous support and belief in me and my goals as well as to my danish family Anja, Johs and their children for providing me with space, energy and caring closely about me and my project.

I am grateful as well to my colleague and friend Marie, for the feedback, check ins and encouragement that sustained me and inspired me throughout this entire process.

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Lastly, I want to thank my friends for their support and encouragement.

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1.
INTRODUCTION

1. INTRODUCTION

Introduction and motivation

Service design is both born and enriched by many other fields, making it open to change and evolution. It can be seen as an experimental practice that is influenced by various topics and, in turn, impacts many others. One of the multiple uses of service design is addressing complex global challenges such as climate adaptation. However, climate challenges often do not have short-term impacts, which can challenges service design tools to address the problem fully. This is where foresight comes into play. Foresight, as a field that explores uncertain futures, by utilizing tools to envision alternative scenarios to support decision making can enrich service design, particularly for exploring topics like climate adaptation.

This thesis is structured around three pivotal components: service design, foresight, and community resilience. These components are interconnected to answer the following research question: How can foresight methods be integrated into service design in the context of climate adaptation?

To provide a real context to this research question, climate adaptation will be explored through the specific case of community resilience in cases of floodings in Denmark. Flooding represents a growing threat, particularly in low-lying coastal areas. Denmark is one such country with a substantial portion of its landmass at risk from rising sea levels and increased storm surges. This research connects with global goals, such as Goal 11 of the 17 UN Sustainable Development Goals (United Nations, n.d.), which aims to "make cities and human settlements inclusive, safe, resilient, and sustainable," and Goal 13 (United Nations, n.d.), which emphasizes urgent action to combat climate change and its impacts.

This thesis aims to explore and find ways in which foresight tools can enhance the practice of service design, specifically applied to designing services to address the flooding issue in Denmark. It contributes to the field of service design by exploring tools that can enhance service design practices keeping and nurturing the holistic nature of service design. It provides insights and recommendations on how and when to use these tools within the context of projects focused on community resilience to flooding, specifically addressing climate adaptation challenges.

Learning goals:

Official learning objectives

According to Aalborg University, the following are the knowledge, skills and competences expected to be reached by the completion of the master thesis.

KNOWLEDGE

Students who complete the module will obtain:

- knowledge about the appropriate methodological approaches to specific study areas
- knowledge about design theories and methods that focus on the design of advanced and complex product-service systems
- knowledge about the relevant literature in the Service Design field

With respect to Problem-Based Learning students will be able to:

- account for the scientific foundation, and scientific problem areas
- describe the state of the art of relevant research

SKILLS

Students who complete the module will be able to:

- work independently, to identify major problem areas and adequately address problems and opportunities
- analyse, design and represent innovative solutions
- evaluate and address major organisational and business issues emerging in the design of a product-service system

With respect to Problem-Based Learning students will be able to:

- master the scientific methods and general skills associated with the problem area
- produce a project report according to norms of the area, apply correct terminology, document extensive command over relevant literature, communicate and discuss the research-based foundation, problem and results of the project orally, graphically and in writing in a coherent manner
- critically evaluate the results of the project in relation to relevant literature and established scientific methods and models, evaluate and discuss the project's problem area in a relevant scientific context
- evaluate and discuss the project's potential for further development

COMPETENCES

Students who complete the module will be able to:

- master design and development work in situations that are complex, unpredictable and require new solutions
- independently initiate and implement discipline-specific and interdisciplinary cooperation and assume professional responsibility

With respect to Problem-Based Learning students will be able to:

- participate in, and independently carry out, technological development and research, and apply scientific methods in solving complex problems
- plan, execute and manage complex research and/or development tasks, and assume a professional responsibility for independently carrying out, potentially cross-disciplinary, collaborations
- independently assume responsibility for own scientific development

Personal Goals

The following are my personal goals from developing this master thesis:

- Explore topics that I did not know about from previous semesters or professional/academic background
- Enhance and expand my “design toolbox”
- Identify the right tools to use in the right time, being critical about my performance in the use of those
- Be able to reach out to stakeholders and inmerse myself in different contexts. I would like to be a designer that is able to thrive in different problem environments, such as environmental issues, politics, academy and be able to understand the complexity of the system, research and design in it.
- Be experimental, trying things out for the sake of learning and finding my own style.
- Become confident with foresight which is a topic that interests me.
- Learn, develop and use foresight tools to nurture my service design practice in a topic of relevance.
- Create insights that emerge from the use of said tools and map them in a way that make sense to derive tangible decisions and realizations from them (Smith & Ashby, 2020).
- Contribute to society with my education and passions in a topic that I consider relevant.

2. LITERATURE REVIEW

2. LITERATURE REVIEW

This chapter provides a comprehensive examination of existing literature and definitions on key topics related to the thesis, including service design, foresight, participatory foresight, theory of change, foresight in service design, and community resilience. By critically evaluating these areas, this chapter lays the foundation for the research question that will be presented at the end of the chapter.

Service Design

Literature finds different definitions of Service design. It is described as a mindset, a set of tools, a process, a "cross-disciplinary language," and a management tool (Stickdorn et al., 2018a). Moreover, it can be all of them; as Stickdorn et al. (2018a) suggest, each of these can be true depending on the context. However, aiming to frame some form of definition that is consistent with this project, the definition created by (Mager & Sung, 2011) serves the purpose:

> *"Service design aims at designing services that are useful, usable and desirable from the user perspective, and efficient, effective and different from the provider perspective. It is strategic approach that helps providers to develop clear strategic positioning for their service offerings. Services are systems that involve many different influential factors, so service design takes holistic approach in order to get an understanding of the system and the different actors within the system."*

Service design, a relatively new but rapidly evolving practical activity within the designer's competence, is often traced back to the turn of the millennium (Wetter Edman, 2011) with the emergence of the first service design agencies in England and the integration of service design into IDEO's Design agency. It has emerged from a diverse range of perspectives, both within and outside the design sphere, and continues to expand. However, foundational research in service design can be dated back to the 1990s (Blomkvist et al., 2010), indicating a gradual and consistent evolution.

Despite the various interpretations of service design, the growing academic interest has led to a significant level of maturation. This maturation has generated a substantial amount of knowledge, allowing for the identification of a range of directions and approaches in service design research, thereby enriching the field from a theoretical standpoint.

Contemporary discussions by Morelli et al. (2021) present two perspectives on service design. One perspective, rooted in engineering, highlights the traditional contrast between products and services, focusing on design as a problem-solving activity. In contrast, a 'design-for-services' perspective

advocates for viewing service design as an ongoing process of value creation, engaging multiple stakeholders in a collaborative exploration of complex service-related problems. Another perspective into its maturation grows upon its focus.

Current scholarly efforts in service design research are branching into two primary trajectories: (Blomkvist et al., 2010) delineates the first trajectory as an expansive approach that integrates diverse methodologies and ideas from traditionally separate fields, such as marketing and engineering, enriching the scope and application of service design. The second trajectory represents a critical and introspective direction where scholars question and re-evaluate the foundational principles of service design. This approach encourages a rigorous examination of service design's distinct contributions beyond problem-solving, prompting a consideration of how service design can proactively engage with future service opportunities and challenges.

In other words, service design has been studied and approached by academics from different points of view: It is seen from the act of creating something that is not a tangible product or as an innate interaction of value creation and its research is focused in how to integrate it into other fields or how to look at it critically, starting by its foundations to understand and outline where it is going in the future.

Despite the different paths and perspectives on it, Wetter Edman (2011) proposes 5 characteristics that are part of service design, described in the following points:

Interdisciplinary: There are several practices that inform the service design practice. Often said to be derived from product design, interaction design and marketing (Lindahl & Nordin, 2010) but also because services are inherent to every field in society and therefore the practice is constantly nurtured by the field where service design is applied.

Visualization and Prototyping: In service design the intangible nature of the interactions that form the service again puts a focus on visualization (Wetter Edman, 2011). These are used both as a tool for the designer’s own understanding, as in reflection-in-action (Schön, 1983) and as a tool for communication, for developing ideas and in presentations (Wetter Edman, 2011).

Participation: Service design practice as well as other design practices is described as customer and user-centered by default (Holmlid, 2009; Stickdorn, 2010). Particularly in Service design the role given to the user can be higher, receiving more power to decide or influenced the outcome and it often becomes participatory and co-design.

Transformation: As service design focuses on users and their interactions with a service and value creation in-between, it has an inherent relation to change. This change is viewed from different

perspectives from various authors, such as organizational change (Junginger, 2006) and behavioral change.

Value creation: Designers not only design services but also work to facilitate the emergence of design capabilities that are latent and inherent to communities and individuals. This is confirmed by (Morelli et al., 2021) who claim that service designers design **with** others, for services (or for value creation), and in different logical contexts.

Service design for Social Innovation

As defined by Mulgan et al. (2007), social innovation refers to innovative activities and services driven by the aim of addressing social needs and primarily developed and disseminated through organizations with social missions at their core. This has raised considerable interest among those seeking responses to linked social-environmental challenges (van der Have & Rubalcaba, 2016; van Wijk et al., 2018), such as the case of flooding covered in this thesis.

With this in mind, it becomes imperative to delve into the role of service design in the context of social innovation. Service design for social innovation is a powerful tool for addressing social issues and promoting sustainable solutions (Cipolla, 2016; Sultan, 2020). It involves creating and enabling systems that facilitate social change (Cipolla, 2016). Design thinking, as a key component of service design, can help generate sustainable solutions for various social issues (Sultan, 2020).

Agreeing with Bailey et al. (2023), who applied service design in the public health sector towards social innovation, human-centered service design practices within an organization help navigate complexity by identifying and visualizing patterns and connections to achieve a level of simplicity that can be easily understood and shared.

However, there are challenges in innovating in the service field, and further research is needed to address these (Villari, 2014). Kelly & Kelly (2023) highlight challenges related to social innovation, such as "harmonious bias," which means it is seen as universally positive and non-disruptive, potentially ignoring issues of conflict and power dynamics. Additionally, social innovation relies on developing cultural, social, political, and resource mobilization skills across all social groups, especially marginalized ones. However, societies may not always support or recognize these capacities, seeing marginalized groups as passive rather than active contributors, which hinders the full potential of social innovation. These challenges will be explored further in this document.

Foresight

Foresight, Strategic Foresight, Future Studies, Futures and some other similar names, are terms that most authors use to refer to the same approaches and topic. Despite the fact that some scholars utilize these terms implying differences, for the purpose of this thesis, the term will be used as "Foresight".

According to Solferino Academy, (2023) foresight is a discipline that serves as a tool that involves a methodical evaluation of trends and change drivers to envision multiple potential futures as serves for decision-making. This anticipatory approach is not confined to predictions but extends to a broad spectrum of future possibilities. Echoing this view, (Dan Suteu & Giorgi, 2019) describes foresight as a structured way to examine the long-term implications in science, technology, economics, and society. Given the scope of this thesis, it is pertinent to expand the comprehensiveness of the fields described by the author and incorporate environmental factors into the framework suggested.

The field of foresight has undergone significant evolution since its emergence in Europe in the 1990s. It was in its early use developed to enhance forward-looking opinion formation, it has become a crucial element in decision-making processes for public policies and businesses, reflecting its growing prominence and utility (Havas et al., 2007, Solferino Academy 2023).

Foresight operates through a scientific methodology where questions lead to estimations or forecasts of potential futures, spanning short to long-term perspectives, tailored for specific research areas (Dan Suteu & Giorgi, 2019), this means that it does not aim to predict the future. Rather, its essence lies in opening to a range of possible and futures, and with this providing a strategic advantage in preparing for a variety of potential outcomes.

When addressing the uncertainty of the future, as highlighted by (Dan Suteu & Giorgi, 2019) there are three main approaches: passive acceptance, preparation, or active shaping. This discourse particularly resonates in scenarios like disaster management, where the inevitability of certain events, such as floods, may seem as something not able to change by human acts. Here, the focus often shifts towards preparation rather than the illusion of control, underscoring a pragmatic approach to foresight.

Moreover, the foresight process incorporates a mix of qualitative and quantitative tools, enabling the monitoring of evolving trends and indicators which allow the understanding of the needs and oportunities of the future, thereby facilitating a strategic response to them (Dan Suteu & Giorgi, 2019). This comprehensive methodology allows stakeholders to assess future options, draw conclusions for the present, and make informed decisions (Cuhls, 2000)

As the discipline of foresight continues to evolve, it integrates diverse tools and frameworks designed to address varied objectives regarding future outcomes. This evolution has transformed foresight into a richer and more dynamic field, thereby enhancing its utility in aiding organizations and governments in navigating future complexities.

Despite its growing popularity within the realms of business and strategic thinking, foresight also encounters challenges. It has become increasingly regarded as more of a trend rather than a rigorously applied practice. To this regard, Smith & Ashby (2020) articulate a critical viewpoint, suggesting that

public discourse is often saturated with futures that are imagined, projected, and declared as inevitable outcomes, leading to a dichotomous representation of either utopia or dystopia. This narrative fosters a problematic binary choice in public perception, which could be misleading. Therefore, as a critical insight and precedent for this thesis, it is imperative to critically examine whether any of the ideas generated through foresight might inadvertently fall into these conceptual fallacies.

Participatory foresight

Participatory Foresight, as described by Nikolova (2014), aims for the broad inclusion of experts, citizens, stakeholders, and non-governmental activists in the process of anticipating and planning the future. Traditionally, foresight has predominantly involved experts, often referred to as analysts or futurists. This participatory approach seeks to move beyond the notion that future analysis and decision-making rely solely on a select group of experts. Instead, it is seen as a democratic exercise where various involved stakeholders collaboratively shape the future.

According to Faucheux & Hue (2001), the concept of foresight itself becomes a tool to facilitate social participation. Future studies, or foresight, should encourage the "actors" of society to engage actively in shaping their future. Additionally, this engagement helps the population to better accept the outcomes, having been part of their creation. There is a parallel between participatory foresight and participatory design, including service design, which underscores the significance of including diverse perspectives.

Theory of change and plausible futures

(Kulkarni, 2020) describes Theory of Change as a process where stakeholders plan a progression by using a framework to identify long term goals and unfold the actions needed to be done today in order to achieve that goal. In other words, as described by (Rogers, 2014) A ‘theory of change’ explains how activities are understood to produce a series of results that contribute to achieving the final intended impacts.

So far, the framework has been employed in diverse fields including social innovation, which makes it an appropriate tool to explore in this thesis.

In order to understand better the concept of Theory of Change the example proposed by (Simeone et al., 2023) to explain the framework in practical terms will be adopted to a parallel example, explained similarly, to give the reader a better and more practical understanding.

Let’s say there is a problem that needs solving, closely related to the topic of this thesis. The problem is that flooding is perceived as a distant isue and generally underestimated by many residents of coastal areas in Denmark. With this problem defined, we then need to consider what steps are needed to bring about change. This could be for example by presenting severe cases from other countries

around the world in a more "intense way," or discussing the potential monetary costs of not paying more attention to the issue in the present. The next question then is: what are the immediate effects of these actions? If I provide more information about floodings and its potential severity, the community might become a force to mobilize organized actions to act and protect their area of residence. The final question to ask would be: what change do I expect? Here, the answer could be that if floodings start being taken more seriously, the community will organize themselves better and be more prepared for potential future events.

This example I provide is not necessarily the only way it is. For instance, the problem can be perceived from another angle and therefore the actions and outcomes might also differ; however, the point on the Theory of Change remains that, in any given situation and context, the Theory of Change can provide a number of possible models on how change can be enacted (Simeone, et al., p.5).

A useful tool for designers to understand what the preferable future translate to a expected change and the set of actions to get there is the cone of future. Its first version was introduced by Taylor, C in 1990 but progressively modified by newer academics and practitioners. The cone of plausibility is meant to graphically represent the relationship between the present moment and the certainty of our knowledge about future events.

As the Figure 1 depicts, the further into the future is sought to plan, the greater the number of possible events. The future cone of possible futures, which include anything we can imagine, such as science fiction scenarios and wild card events; plausible futures, which are logical extensions of current trends and understandings; and probable futures, which are a subset of plausible futures, considered likely outcomes based on an assessment of current trends and understanding and lastly preferable futures that are the “desired” to happen based on subjective judgement of the project.

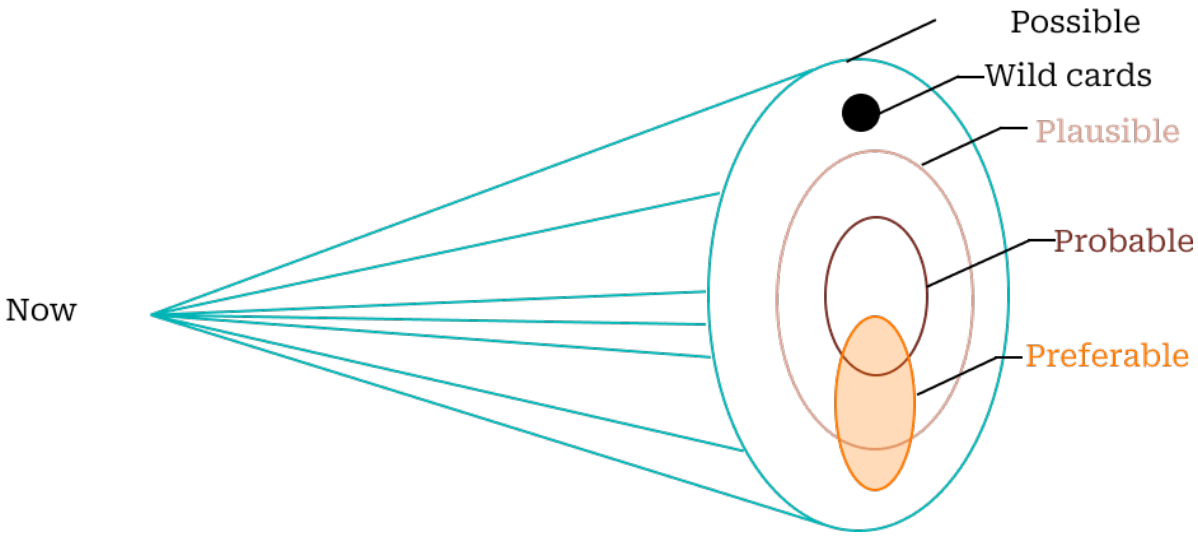


Figure 1. Cone of futures.

Foresight as a tool to inform the design of a service

A range of studies have explored the integration of foresight methods in service design, for instance studies such as Iriarte (2017) extends this by demonstrating how service design can support organizational change and identify new business opportunities. (Løgager et al., 2021) talks about foresight-oriented service design approach, outlining the need for a more integrated between forsight and service desing. These studies collectively underscore the potential of foresight in enhancing the design and delivery of services. One of the focus of implementing foresight tools in service design is the use of it as a core method to foster longer-term thinking and to instill more sustainable ways of thinking (Reitsma et al., 2017). However, (Løgager et al., 2021) emphasize the need for a structured approach, due to as, they mention, current studies do not delve into how foresight methods could reshape the design process or promote a methodical approach to addressing the long-term challenges inherent in complex issues.

According to research, the connection of foresight and service design goes in both ways: foresight uses from service design and service design uses from forsight. For instance (Løgager et al., 2021) exemplify that Meroni & Sangiorgi, (2011) explore considerations on how various service design methods - e.g. journey maps, system maps or scenarios - can be used to imagine future directions of services, whereas (Serio, 2023), proposes a model that seeks how to combine foresight and design thinking methods, by "merging" their respective methods into new integrated methods that can benefit the innovation process.

Being this thesis a service Design Thesis which aims to contribute with new knowledge to the field of service design, the focus will be on understanding and applying into a case, how foresight as a field with its mindset and tools can inform and enrich the service design practice.

In other words there is research and interest in the academic world into how foresight and design nurture each other, however it is not systematic as often is found that service designers do not have the capabilities to use and conduct foresight tools (Løgager et al., 2021).

Community Resilience

Community resilience refers to a dynamic process through which communities adapt and grow in response to environmental challenges. Patel (2022) suggests that building resilience encompasses more than merely returning to a pre-disaster normalcy; it also involves improving the community's overall preparedness and adaptive capacities. This form of resilience enables communities to not only restore their essential structures and functions after a disruption but also to adapt to new circumstances. It is important to note a conceptual contrast with the physical definition of resilience, traditionally described as the ability of a substance or object to spring back into shape, or elasticity, as defined by the Oxford Dictionary.

Many scholars, including (Twigg, 2007), (Cox & Perry, 2011) and (Lowe et al., 2015) typically characterize community resilience by the community's ability to bounce back or quickly return to a functional state following a disaster. However, following Patel's perspective, community resilience should not only be about bouncing back to a previous state but also about adapting and evolving. In other words, it involves building back to a better state than before the disruption. This perspective is particularly crucial in the context of natural disasters because merely returning to the prior state without improvement means that the community remains just as vulnerable to future events. By learning from past events and enhancing resilience, communities can better withstand future challenges.

In the context of floodings, flood resilience as defined by (Karrasch et al., 2021) are an amalgamation of engineering resilience and socio-ecological resilience. Social-ecological resilience goes beyond the that there is a stable state that can be restored, it considers non-linear, complex, and constantly changing environments: all parts of the social-ecological system evolve not only by themselves but also through their interaction with each other.

Research Focus

According to the topics explored and researched in the literature review, foresight is a field with high potential to offer in the service design practice. They both encourage and have developed into participatory practices, they both focus on future actives, despite the natural different timeframes that each one approach, with service design being more focused on the near futures whereas foresight cares about the more distant future.

Foresight introduces a rich, long-term perspective, focusing on the anticipation of possible and probable futures. This can become crucial for service design, as it shifts the design process from reacting to current trends to preparing for future developments, especially in a topic such as climate adaptation where the high impact change is not in the closer future.

The fact that the outcomes of foresight need to be grounded in the present to be useful for service design makes frameworks like the Theory of Change a practical tool for achieving this objective. This approach allows to create a structured plan that not only maps out the desired changes but also outlines the specific steps needed to realize these changes. By using such frameworks, service designers can systematically connect the long-term insights provided by foresight with immediate actionable strategies, ensuring that the services developed are both innovative and directly aligned with future needs and challenges. This integration bridges the temporal gap between future possibilities and current design practices.

Figure 2 presents a basic draft of the connection of service design, tied to the present with foresight which embraces the future and Theory of Change that can connect the envisioned future with the present, subject of design.

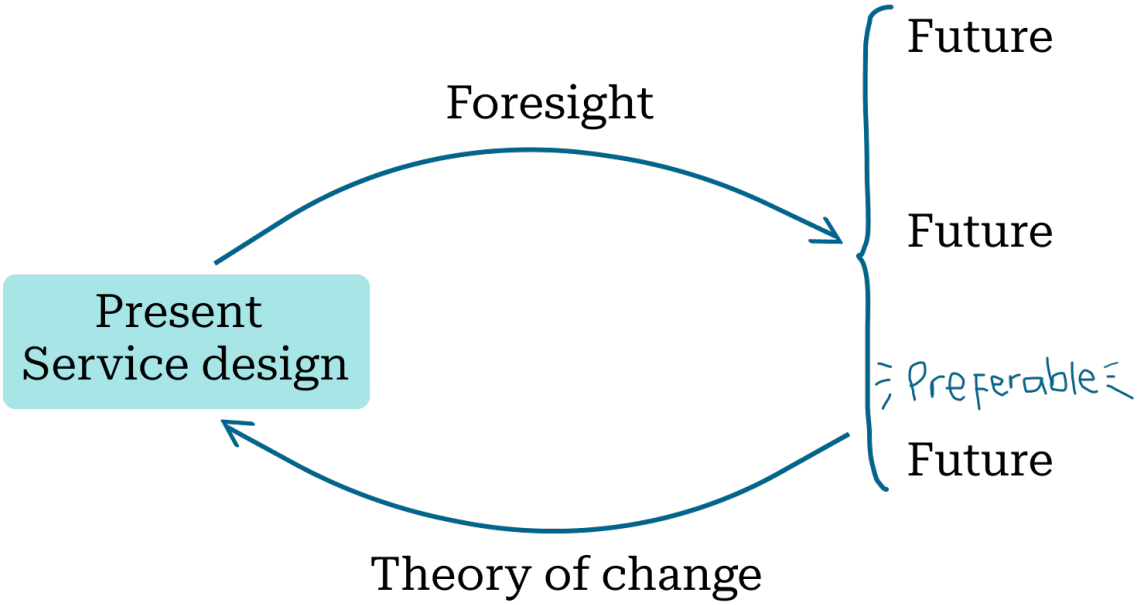
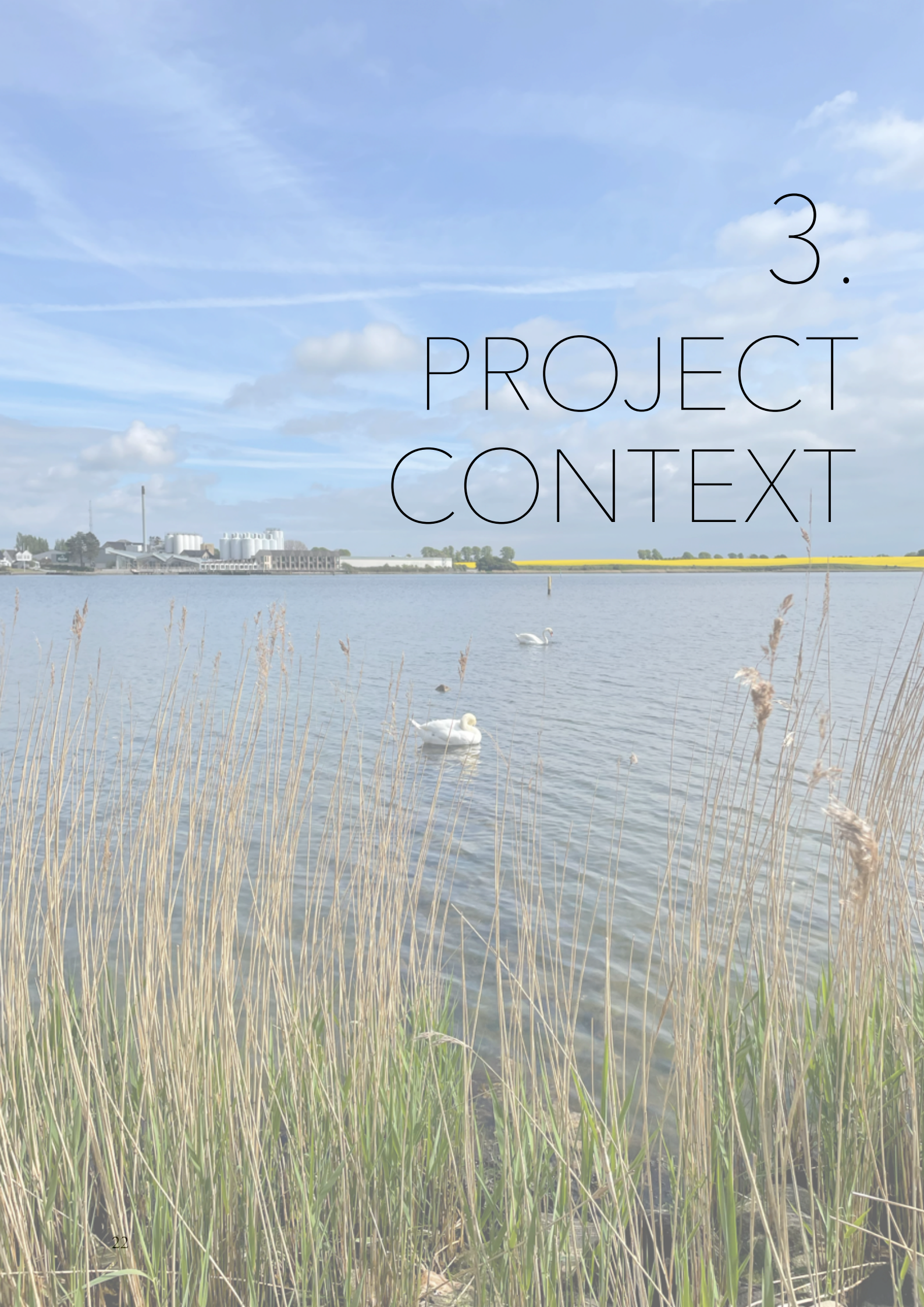


Figure 2

However, integrating foresight into service design also presents challenges. Key issues include ensuring effective participation and maintaining the integrity of foresight activities against the immediate, outcome-focused pressures of service design.



3. PROJECT CONTEXT

PROJECT CONTEXT

This chapter provides a comprehensive overview of the flooding situation in Denmark, setting the stage for exploring the research question within this context. It begins by detailing the status of floodings in Denmark, emphasizing the extent and impact of the problem. This is followed by a discussion on climate adaptation, highlighting ongoing efforts and challenges in mitigating flood risks. The chapter then examines community resilience in the context of floodings, underscoring the importance of adaptive and proactive community measures. Finally, the chapter presents the problem statement for the thesis, outlining the research focus.

Floodings in Denmark

Different sources show that flooding is a natural hazard that is more and more frequent and that has an increasing trend in its likelihood due to climate change and sea level rising. Since 1990, floods have accounted for 44 per cent of disasters worldwide, affecting more than 1.6 billion people and leading to economic losses of at least $651 billion dollars (Centre for Research on the Epidemiology of Disasters (CRED) and United Nations Office for Disaster Risk Reduction (UNDRR), 2021)

Coastal areas are considered especially vulnerable to the different impacts of climate change (McGranahan, Balk, & Anderson, 2007; Nicholls, Hoozemans, & Marchand, 1999; Sorensen et al., 2018) and this is linked with the fact that Denmark is ranked in the top ten countries with the largest share of land in the low elevation coastal zone, with a share of 26% (Pappa, 2019).

One of the examples is, that according to a study carried out by the municipality (Dragør Kommune, 2020), claims that Climate change (climate scenario IPP 8.5) will raise sea levels by approximately 30 cm by 2050, whereby a 100-year storm surge will result in water levels of 2.2 m above mean sea level at Kongelunden, 1.95 m at Søvang and 1.75 m at Dragør town. Towards 2065 and 2100, the water level will rise another 25 cm and 60 cm respectively. In the future, what we see today as a rare event, for example, will statistically occur more frequently, and the probability of large and devastating floods is therefore expected to increase because of expected climate change.

In 2100, the 100-year event is expected to be as extensive as a 500-year event today (NIRAS, 2017). The situation is therefore such that the risk of flooding is expected to increase unless efforts are made to secure the areas at risk.

Flooding can cause significant impacts consistent with harmful security and health outcomes in communities, such as social disruption, economic harm, and psychological impact. (Patel, 2022)

However, and in contrast with the facts just presented in the above-mentioned text, Denmark also has a protection against floodings, there are over 1100 km of dykes which protect against flooding, so people have adapted to storm surges for many years (Miljøstyrelsen Danmark, 2024).

Delving into the community response and the responsibility of the community in cases of floodings, according to the information portal Klimattilpasning (Miljøstyrelsen Danmark, 2024), it is the individual lot owner's own choice and responsibility to protect themselves against flooding. There are no laws or regulations that determine whether protection must be carried out and, if so, to what level the landowner must protect their selves. The municipalities are only responsible for the coastal protection of the land the municipality may own. However, the municipality is responsible for how coastal areas are planned to be used. Municipalities can start joint municipal projects on their own initiative or together with landowners who wish to do so. The main purpose of such projects is to create more coherent and holistic coastal protection. (Miljøstyrelsen Danmark, 2024).

Climate adaptation

Adaptation in a form of risk management, are plans to maintain human health and environment. Humans have a long history adapting to changes in our climate, for instance the use of irrigation in Mesopotamia, 700 years ago is a sign of adaptation. As mentioned as well in the latter section, we are already adapting, through different initiatives such as flood barriers to protect critical infrastructure include levees, dikes, and seawalls. Other forms of adaption becoming more popular are the ones that "give space to nature" withdrawing human activities from flood-prone zones.

Delving into literature on the topic, climate adaptation, as discussed by Scheraga & Grambsch, (1998) p.1adaptation is an important approach for protecting human health, ecosystems, and economic systems, and for maximizing social well-being. It involves understanding the regional effects of climate change and addressing appropriate investments to respond to changes. Some other authors explore that key factors contributing to resilience at both individual and community levels include social connectedness and a strong sense of place, as highlighted by (Boon et al., 2019).

When grounding climate adaptation efforts in the context of Denmark, (Hedensted Lund et al., 2012) explain that network governance and collaboration are necessary for a viable and effective planning and implementation of adaptation measures.

Insights on the project context

According to the UK Climate Impacts Programme technical report, uncertainty is defined as "a condition where we lack certain knowledge that we think may be important to making a decision" (Willows & Connell, 2003, p. 49). This uncertainty adds complexity and strategic dimensions to the risks associated with climate change. Willows and Connell (2003) distinguish between risk and uncertainty: a risk is an event where the probability of occurrence and its impacts are known, but the exact time and place of occurrence are not. Conversely, an event is uncertain when neither its probability of occurrence nor its potential impacts are known, with climate change events being a prime example.

Willows and Connell (2003) also explain that enhancing our knowledge of the probability and consequences of climate change events through vulnerability assessments, historical event studies, and modeling can help reduce uncertainty in decision-making. Additionally, the outcomes of decisions made to address climate change are themselves uncertain, as their effectiveness can only be evaluated over time.

Linking the uncertainty of climate conditions, such as flooding, with the foresight approach, which also addresses uncertainty, underscores the value of exploring foresight tools in the context of flood events.

"What is out there"

As a part of the project context, an initial exploration of "what is out there" in terms of community resilience initiatives projects in other countries somewhat similar to Denmark was carried out, this can be seen in Appendix 1. The initiatives from eight countries (Denmark, Australia, Japan, USA, Germany, Netherland and Bangladesh and England) regarding community resilience were map in order to gather information and gain a deeper understanding of current efforts towards climate adaptation in this specific context. The following paragraphs describe the insights gathered from such exercise:

In England, Flood Action Groups work towards community engagement and local monitoring, leveraging volunteers to keep an eye on conditions and support vulnerable members. Alternatively, Japan's Community-Based Disaster Risk Reduction (CBDRR) focuses on community resilience through education, emergency drills, and volunteer networks, with a strong emphasis on early warning systems. In Bangladesh, the Cyclone Preparedness Programme (CPP) combines volunteer efforts with early warning dissemination and community training, specifically addressing the region's cyclone vulnerability.

In another sort of cluster, Denmark's Klimatilpasning Portal and The German Committee for Disaster Reduction (DKKV) prioritize strategic planning and policy development. Denmark provides tools and information for natural disaster adaptation, while Germany integrates research, policy advice, and international collaboration to enhance global disaster resilience. Australia's Queensland Reconstruction Authority (QRA) also engages in strategic planning but combines this with direct funding and support for local recovery and mitigation projects.

The Netherlands Water Partnership and the United States FEMA Community Rating System (CRS) focus its efforts in the technical expertise and incentive-based approaches. They focu on leveraging its water management expertise through a network of organizations.

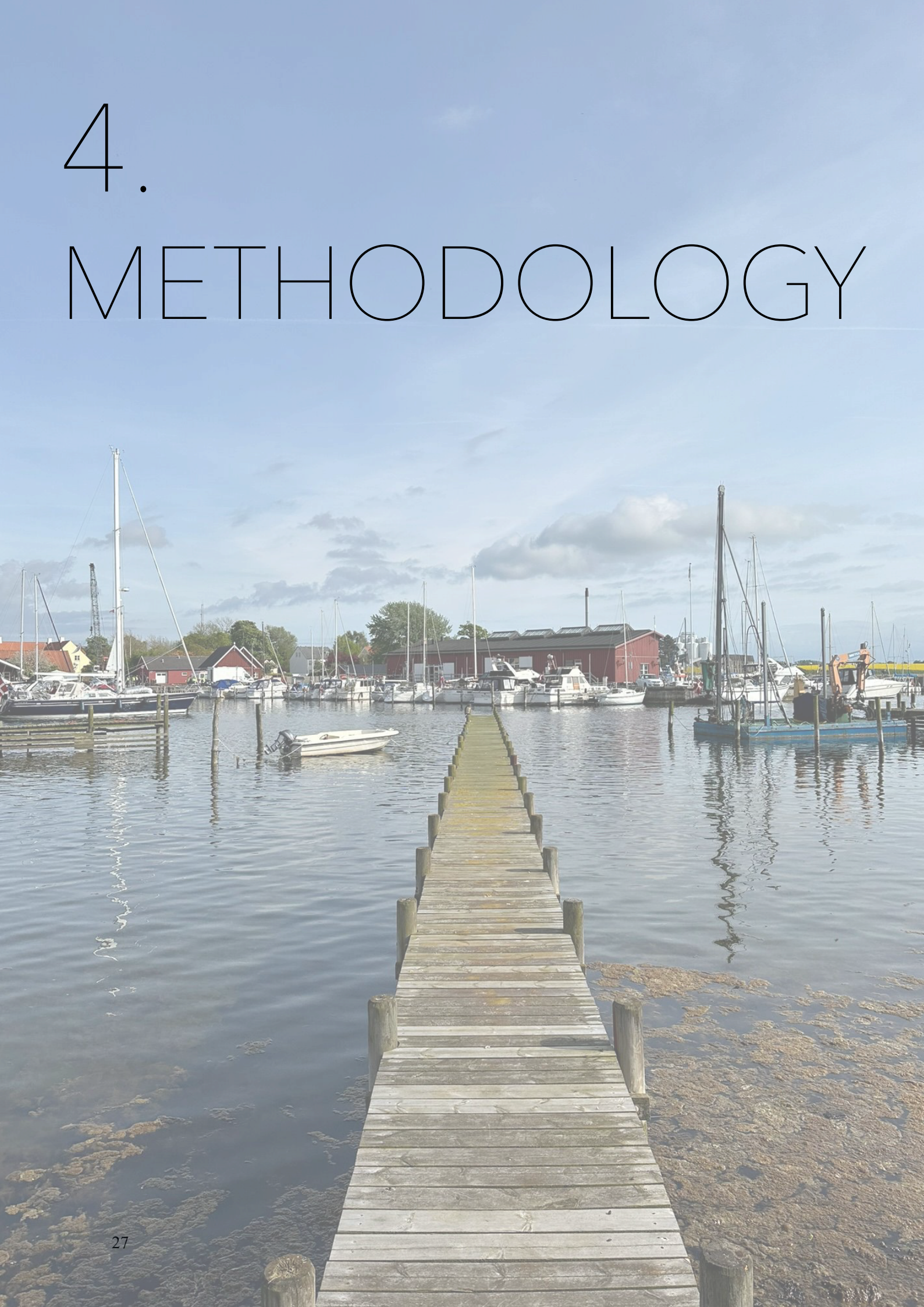
Overall, these initiatives show diverse strategies ranging from community-based actions and volunteer networks, education and strategic planning, policy development, and leveraging technical expertise. It

can argued that each approach reflects the specific environmental, social, and political contexts of the respective regions, showcasing a multifaceted effort in global disaster risk reduction and climate adaptation. In other words, there from what I observed in this excersive there is not a single way in which societies have approac ed community resilience and it is dependant in many local factors.

Research question

How can foresight methods be integrated into service design in the context community resilience for climate adaptation (in flooding context in Denmark)?

4.
METHODOLOGY



4. METHODOLOGY

The aim of this chapter is to characterize the methodologies used seeking an answer to the problem statement and the academic research question. The design thinking methodology enmarked in the double diamond visualisation will be the macro frame where then two subframes, foresight and Theory of change will be utilized in order to navigate and interate between the different phases of the overall design process.

Design thinking framed in double Diamond

The overall thesis project will be framed by the design thinking. As Tim Brown describes, it is a methodology that imbues the full spectrum of innovation activities with a human-centered design ethos (Brown, 2008). According to Brown and Wyatt (2009) design thinking crosses the traditional boundaries between public, for-profit, and nonprofit sectors by working closely with the clients and consumers.

The design thinking process will be applied as described by (Dam, 2023), unfolded in five key stages: Empathize, Define, Ideate, Prototype, and Test. The process begins with the Empathize stage, where the aim is to understand the user's experiences and emotions to gain deep insights into their needs and challenges. Secondly, the Define stage consolidates these insights into a clear problem statement that articulates the user's needs in a concise manner. With a well-defined problem, the Ideate stage encourages free-thinking and creativity to generate a broad set of solutions without constraints. Subsequently, in the Prototype stage, tangible representations of solutions are developed, which are then Tested with users. This testing phase not only validates the solutions but often uncovers additional insights, potentially cycling back through the design thinking stages.

The Design Thinking process will be as well framed in a double Diamond framework, a visual representation created by the UK's Design Council in 2004 that visually describes the ‘opening’/ diverging and ‘closed’/ converging phases of the design process (Ball, 2019). The model helps to actively be aware of what mindset is needed in the different phases: opening up or narrowing down. The Double-Diamond Design Process allows for the participation of stakeholders throughout the process in the form of either feedback loops or more generative participation as co-designers, or active participants (Zyl et al., 2020).

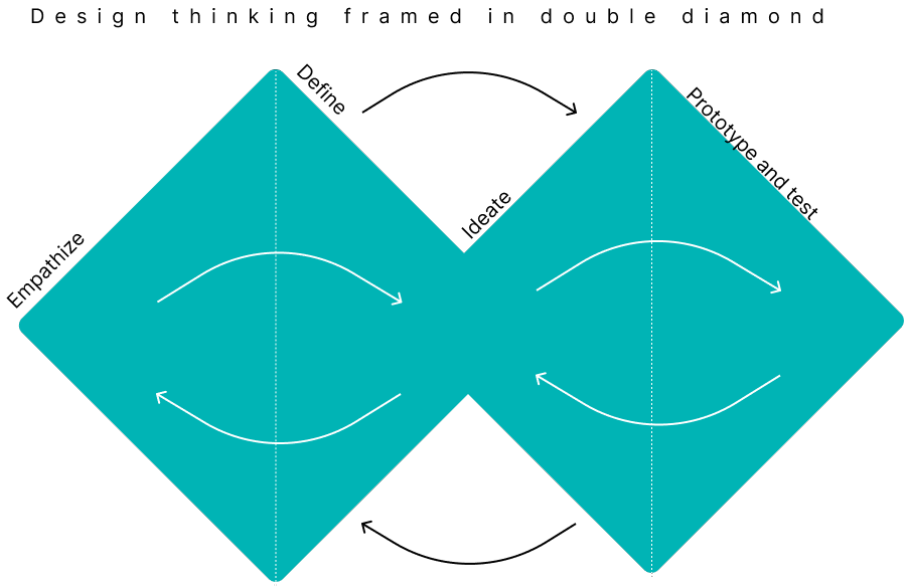


Figure 3. Design Thinking framed in Double Diamond

Foresight tools

Foresight mindset and its tools will be used within the overall Design thinking process. Its tools will be used in the different phases of the design thinking methodology.

Going deeper into the tools, The UNDP for Asia & the Pacific, (2022) categorizes a diverse set of tools into different modules each one with a different purpose. First, Exploring the Future or understanding the Landscape, Creating Alternative Futures, Reimagining the future, Sensemaking, then Transforming the Future to finally expose "Future proofing Strategies" with the goal of stress test the strategies against the multiple scenarios landscape mentioned earlier.

In addition to the perspectives provided by the UNDP, it is also worth exploring the Copenhagen Method, (Copenhagen Institute for Future Studies, n.d.) which outlines the stages of scenario-building for futures studies. This method adapts the double diamond visual representation created by the UK's Design Council in 2004 to the scenario-building exercise as shown in Figure 4. Initially, the process begins with a divergent phase aimed at exploring dynamic changes and understanding high-impact uncertainties. This phase is followed by a convergent stage, where insights are gathered and synthesized. The process then reverts to a divergent mindset to construct various scenarios. Subsequently, it transitions into a convergent mindset again, where these scenarios are analyzed and understood. Finally, the convergent phase continues into the decision-making stage, where strategic options and recommendations are developed. This methodical approach facilitates a comprehensive exploration and synthesis of potential futures, enhancing the strategic planning process.

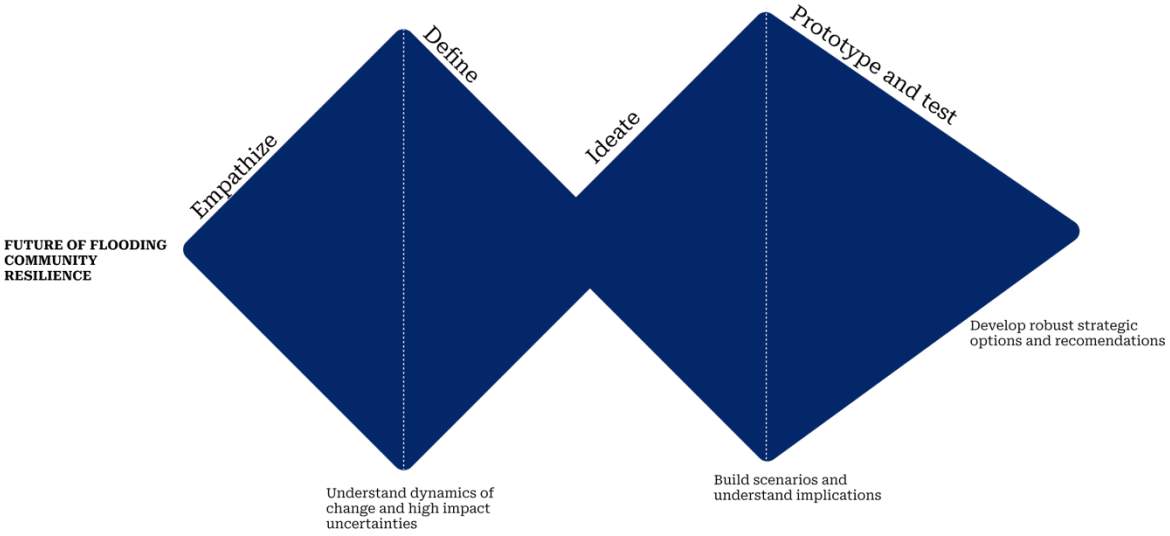


Figure 4. Double diamond applied in foresight methodology

Looking critically at it, it is important to mention that the while process will adopt the divergent or convergent mindset proposed by the latter Figure, however the overall process will be guided by the Design thinking double diamond process depicted in section 4.1.

Theory of change

1. Defining the Problem

The first step in developing a Theory of Change is to clearly define the problem that the project aims to solve. This stage aligns with the "define" phase of the Double Diamond model, which emphasizes understanding the problem space. The following steps describe in a broad way the steps followed.

Identify the Core Problem: The problem is understood through the project context and empathize phase. The problem interdependencies and root causes will be explored through the different tools used in the initial phase of the double diamond.

3. Mapping the Impact, Outcomes, and Outputs

The Theory of Change involves a detailed mapping of the expected impact, outcomes, and outputs of the project. These elements are structured in a hierarchical manner to illustrate the pathway from activities to long-term change.

The impact is the systemic change expected in the long term, which might take several years to materialize. The impact is the goal, reflecting significant and sustainable improvements in the targeted area. Outcomes are the intended and unintended changes experienced by stakeholders as

a result of the project. They are essential for achieving the intended outcomes and serve as tangible evidence of project progress; therefore, they are usually measured with KPIs. The final step involves detailing the specific activities required to achieve the desired outputs. Define Necessary Activities: Clearly outline the activities that need to be executed for each output to materialize. This includes identifying resources, assigning responsibilities, and setting timelines.

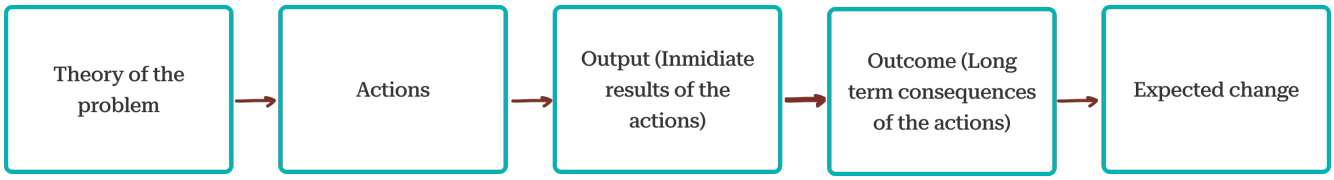


Figure 5. Theory of change

For the scope of the thesis project, incorporating such complex frameworks can present a challenge because they are applied differently in literature and various practices. Considering that the thesis spans only three months, the use of the frameworks is not aimed to be in a rigorous way. Instead, they will serve more as tools, being integrated as appropriate for each phase of the design process. This approach allows for an experimental perspective giving space to exploring different methods and toolsets to be used within service design. Figure 6 aims to illustrate the way in which the design process is intented to work. With the design thinking double diamond are an overall structure that contains foresight and theory of change.

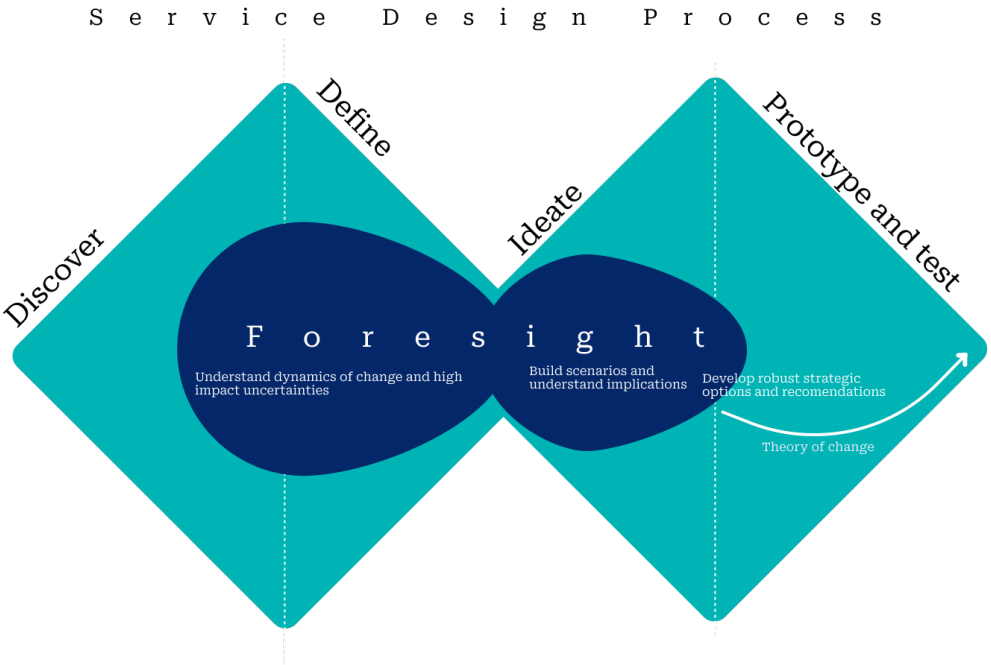


Figure 6. Overall framwork containing foresight and theory of change

5. CASE STUDY

5. CASE STUDY

This section will investigate the research question within the context of community resilience to floodings in Denmark. It is structured using the Double Diamond methodology, which includes four stages: Empathize, Define, Develop, and Deliver. Each stage employs specific tools that generate insights and inform the subsequent phase.

The primary research question of this thesis revolves around the application of foresight in service design. To explore this, various foresight tools will be utilized, providing a foundation for the discussion in Section 7. Additionally, the Theory of Change framework will be integrated, bridging the use of foresight tools with practical service design applications.

Empathize

The objective of this phase is as mentioned in the literature review, understand the user's (members of the communities in coastal areas prone to flooding experiences), aiming to undersdant their behaviours and and emotions to gain deep insights into their needs and challenges. It consists on conducting research and engage with the users for whom the design is intended, fostering a user-centered perspective throughout the project (Stickdorn et al., 2018a). This approach aids in developing a structured understanding of community resilience in the context of floodings in Denmark.

Expert interview

An semi-structured interview was conducted with an expert on climate adaptation. As described by (Galletta & CROSS, 2013), semi-structured interviews typically use varied sets of questions, prompts, and accompanying tools and resources to draw the participant more fully into the topic under study, incorporating both open-ended and more theoretically driven questions, finding data grounded in the experience of the participant as well as in the particular discipline within one is conducting research. The interview was with a professor in Planning for Urban Sustainability at Aalborg University. They have experience working on projects related to climate adaptation and citizen involvement. They are also experienced in projects and classes concerning user participation and social innovation.

The expectation for conducting the interview with the expert was to gain knowledge about the landscape of flooding in Denmark. It is important to mentions that at this point of the process, the desk research was still ongoing, and the one of the golas was to gain insights that would guide further research. The discussion lasted about an hour, beginning with the presentation of the research question of this thesis, followed by an exploration of the expert's knowledge on current initiatives related to flooding in both the Danish and global contexts.

During the discussion, they emphasized the importance of understanding community dynamics as a foundational step in studying resilience and preparedness against flooding. The expert expressed that

in a great portion of literature, resilience in terms of social issues is not seen just about as an act of recovery; rather, it involves the community's capacity to learn and develop from past incidents.

Exploring the concept of community resilience requires being flexible in literature with terms like "preparedness", "resilience", "recovery" and other words of the such because even thoguh they employed different words they can all be talking about community resilience. The expert also pointed out that preparedness in termn of a community involves having a well-informed community that understands the roles each member plays during crises. These conceptions were key points for subsequent research because, as mentioned in the literature review, resilience encompasses both returning to the initial state and improving by learning from experiences. In the context of this project, the interview clarified that the adopted definition of resilience should focus on the community's ability to improve and enhance their situation.

Subsequently, the interview shed light on specific areas of focus for the desk research, suggesting that understanding the local context of floodings is crucial. For instance, the expert exemplified that there is a notable difference in attention and resources provided by the goverment in various areas. Kastrup, for example that hosts a major airport in Denmark, receives more focused state protection agains floodings compared to less prioritized areas, such as Køge or some summerhouse areas located in a more remote place compared to main cities such as Copenhagen or Aarhus.

This disparity opens up avenues for exploring how community-based measures and state involvement differ across regions where they have seen firsthand how coastal protections are often community-initiated with municipalities acting as facilitators. They mentioned the strategy of "Protect and adapt, withdraw and let go" as a way communities respond to flooding threats, suggesting that the present research could explore how communities participate in these strategies.

Further enriching our discussion, the professor introduced the guidebook "Borgere I Beredskabet" (Hoffmann & Baron, 2019) that focuses on enhancing flood management in Denmark through increased collaboration with citizens. The guidebook explores the significant role that citizens can play in managing flood risks before, during, and after incidents. Highlighting challenges and opportunities in citizen engagement, the guidebook provides case studies and examples from various communities to illustrate effective participation. It also proposes strategies for better collaboration, emphasizing the transition from one-way communication to building substantial relationships with the community. The document advocates for a participatory approach in flood risk management, calling for further research and practical developments to strengthen citizen involvement in creating a resilient society.

Overall, the interview with the expert provided valuable insights into the complexities of community resilience and set a robust groundwork for the design proccess in the following steps. Said in other

words it was an initial way to draw definitions for community resilience within my thesis and to keep exploring the context of flooding in Denmark in a more localized way.

Semi structured contextual interviews

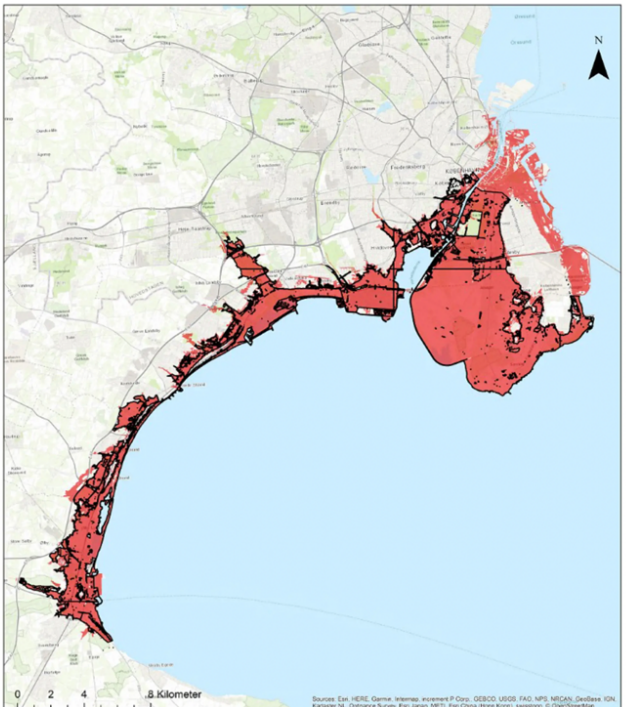


Figure 7. Køge risk areas.

Afgrænsning af Risikoområde Køge Bugt - København

After the in-depth expert interview, and with the aim of understanding the flooding context in a local environment, semi structured contextual interviews were run in Køge municipality. As historical context, Køge, a coastal and low-lying area, is particularly prone to flooding. According to studiesa significant portion of the area is classified as high or very high risk for flooding (Dragør Kommune, 2020). Figure 7 illustrates in red the areas at risk for floodings in Køge.

Contextual interviews are conducted with relevant stakeholders in a situational context relevant to the research question (Stickdorn et al., 2018). In this case it was conducted in the Habour zone of Køge as shown in Figure 8 and Figure 9.

Figure 9. Industrial zone by the harbour of Køge.

Figure 8. Køge flood risk area

Recently, there were two major flooding events, one in October 2023 and another in January 2024, both of which affected in different levels the residents and businesses.

One of the interviews was with a local resident that was around the harbour on the day of the contextual interviews. Key insights were revealed about the community's experiences and challenges with flooding. The interview had the goal of understanding the situation of the community and the efforts perceived by the residents from different stakeholders such as the community itself and the municipality. It was ran as semi structured interview where I asked the participant to describe the events prior, during and after the flooding regarding alerts and actions executed. The interviewee recounted receiving an alert message about the flooding at 8 PM, by which time the area had already been inundated. This delay in communication underscored an issue in the local emergency response system, he got to know about the status of the flooding around the harbour because his dad owns a café in the harbour and kept him updated about it.

The resident detailed the logistical support available during floods, noting that sandbags could be collected from a military-like base. The distribution prioritizes businesses first, followed by private residences where he indicated that is an organized yet sometimes insufficient response to the immediate needs of all residents.

Post-storm recovery efforts appeared to be lacking, as described by the interviewee. He explained that the municipality reportedly did not undertake cleaning operations promptly, leaving seaweed and debris scattered across the area for over a month. He then compared the actions he knows that are taken in Copenhagen, where dikes are installed to mitigate similar risks. Furthermore, the interviewee expressed a sense of lack of trust in the local government's commitment to managing flood risks effectively.

Regarding his role in the community, the lack of involvement in any community group aimed at flood response also highlights a potential area for improvement in community resilience and preparedness.

This conversation sheds light on the significant challenges faced by the residents of Køge in terms of both immediate flood response and long-term risk management strategies.

A second interview was conducted with an employee of a well-known café near the harbor; it took place at the café where she works. The interview transcription can be found in Appendix 2. She is about 20 years old, having recently graduated from high school, and is working there during her gap years before pursuing higher education. She also resides in Køge, but her experience with the flooding occurred at her workplace, as she doesn’t live near the coast and did not suffer any impact at home. The goal of this interview, as with the previous one, was to gain insight into the experiences of Køge residents regarding the recent flooding events. It was a semi-structured interview, where questions about the events before, during, and after the flood were posed. From the perspective of the person interviewed, before the first flooding came, there had already been some discussion within the

community about an approaching. Many, including herself, did not expect it to be as severe as it turned out to be.

She worked normal hours during the day of the flooding as her boss told her that they will be functioning as normal. She explained, that on the day of the flooding when she arrived to work, the water nearly reaching the stairs outside the building. The day of the interview the weather was clear, however Figure 10, shows the stairs that she is talking about.

Figure 10. Café, second contextual interview.

Furthermore, she explains that surprisingly, there was a significant turnout of customers that day, she account almost for a hundred of them, despite warnings from the media advising people to stay indoors, many were drawn out of curiosity, many of them capturing the scene with their cameras.

Questions about preparedness were asked subsequently, where she explained that the most experienced employess had taken precautions like placing sandbags around the premises, however many of the young workers as herself felt unprepared and were not actively involved in the emergency procedures. “We hadn’t received much guidance on what to do if the situation worsened, such as how to handle floodwaters entering the building or the necessary steps to secure the premises.”, she mentioned.

The conversation then went to her own living situation, where she explained that she was secure as she lives on the second floor of an apartment building a couple of kilometers away from the beach. However, the building management advised the residents to minimize water use to prevent overloading the local drainage systems. This was the extent of direct communication they received.

Finalizing the interview, she mentioned that one of her friends wasn't as fortunate; her home near a small lake suffered severe damage from the flood. Despite efforts like placing sandbags, they faced two close successive flooding events that led to extensive renovations.

Insights from the contextual interviews

As a result of the the two contextual interviews, insights were drawn upon the following points:

Underestimation of Floodings: Flooding incidents in Køge have historically been sporadic and only severely affected a limited number of people. This infrequency has contributed to a general underestimation of the potential for more severe damage. Residents do not seem to perceive flooding as a serious threat and there is a lack of urgency in preparing for such events.

Lack of Communication: The interviews highlight a significant communication gap before, during, and after flood events. Participants seem uninformed about the severity of the situations and uncertain about what actions to take if risks materialize. They do not refer to any single, reliable source as the official go-to for emergency information. This lack of communication extends beyond higher entities such as the municipality; it is also prevalent among residents of the community. As the first interviewee mentioned, he was unaware of whether anyone needed help or if his most vulnerable neighbors required assistance prior, during or after the flooding.

Lack of Trust in Local Authorities: A notable distrust in local authorities was evident, coming from perceived inadequacies in handling previous emergencies.

Lack of organized community plans: They also do not have a lot of communication with each other or the muncipality and there neither of the participants was active part of any community led initiative to prepare for floodings.

Survey

After visiting Køge, there was a need to broaden the understanding of the insights and notions gathered from the contextual interview. Consequently, a survey was conducted. Surveys offer valuable insights into individuals' perspectives and experiences and can be administered to large, population-based samples (Alderman & Salem, 2010). They are a unique method for collecting information from a large cohort, providing greater statistical power, the ability to gather substantial amounts of data, and access to validated models (Jones et al., 2013). The questionnaire and results can be found in APPENDIX 3.

Survey was designed for online distribution and posted in 3 different facebook groups for coastal areas Denmark as shown in Figure 9.

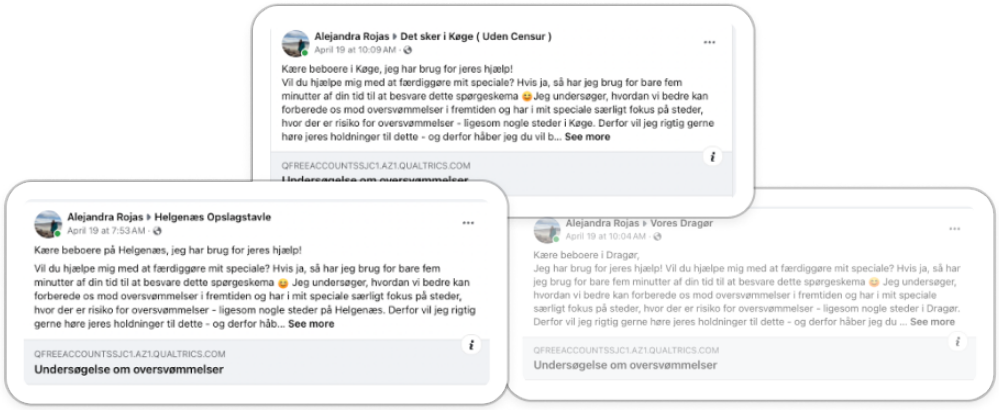


Figure 11. Facebooks posts inviting citizens of 3 different coastal areas to answer the survey

The survey gathered a total of 77 responses from various groups and networks where it was distributed. Considering the diverse flood responses according to different zones, the selected zones for distributing the survey were somewhat similar. Their main similarity is that they are all within a radius of close of proximity to major cities such as Copenhagen and Aarhus, and they lack substantial infrastructure against flooding. The difference is that one of the areas, Helgenæs, is primarily a summerhouse area, whereas the other two are not.

their area before the recent floods in 2023 and 2024, to which around 55.7% of respondents said no, 29.5% said yes, and 14% said they were partially informed. When asked about how they found out information about the flooding, TV/radio and social media were the main sources of information, with 58% and 53% of respondents choosing them, while local authority websites and word-of-mouth communication received 26% and 21% of votes respectively. This might indicate that people use their common sources of information for this purpose as well and that the accessibility of the information can be more important than the source of it.

Moving forward, participants were asked about the impact of the recent flooding on them. The main response, with 47%, was that they were not affected at all, followed by 29% who answered that they were impacted in a minor way. Only 11% of respondents answered that they were affected in a serious or extreme way.

When it comes to flood preparedness, a significant gap was revealed, with 92% of respondents stating that they have not received any form of training or information about flood preparedness. This suggests a broad lack of community education and readiness for dealing with flood risks.

Results indicate a range of perceptions on the effectiveness of local or government responses to flooding. Only a small percentage (2%) of respondents viewed these responses as very effective, while 35% felt they were somewhat effective. The largest group, 39%, remained neutral, neither praising nor criticizing the efforts, but a considerable 18% found the response somewhat ineffective, and 6% rated it as very ineffective.

Regarding community involvement in flood response, the majority (68%) reported no involvement in activities like installing flood barriers, laying sandbags, helping with evacuations, rehousing affected individuals, or volunteering with emergency services. This indicates that while there are some pockets of active participation, overall community engagement in proactive flood response efforts is limited.

As for knowledge of community-led flood prevention initiatives, most respondents are unaware of any such efforts in their areas. However, a few noted local efforts including construction of coastal protections by private landowners, drain cleaning, proposals at the council level for new measures, and infrastructural improvements like separating rainwater from sewage systems.

Insights from online survey

The survey confirms the insights drawn from the contextual interviews described in section 5.1.2, providing information on the reasons behind these issues.

Regarding the underestimation of flooding, the survey notes that most participants did not experience severe impacts from the flooding, which is why it is not considered a serious problem by most respondents.

In terms of communication, it is evident that information is mainly disseminated through TV and social media, with a lack of strong pre-event communication. The community appears to have a passive attitude toward seeking information, as they rely on what they receive rather than actively looking for potential risks. This aligns with a contextual interview where an interviewee mentioned that they "didn't know it was going to get as bad" as it did.

This reactive attitude extends to initiatives to help the community. The survey shows that not many people are actively involved in groups to assist each other. However, this is contrasted by an open-ended response in the survey stating that the only effective solutions have come from community efforts, as government presence has been lacking. This suggests that there is potential to enhance community resilience through community initiatives, but this requires increased awareness and proactive engagement to address the growing issue.

Online observation note taking

Throughout the entire research phase, it became evident that there is a vast amount of information available on various media platforms, including news, social media posts, videos, and comments. This information proved invaluable, offering key points to enrich the research. To make sense of this wealth of information, an online observation board was created. This board explored a wide array of digital content, such as Facebook groups, posts, comments, videos, Instagram posts, TikTok videos, and both local and national news. This exercise provided deep insights into public perception and personal experiences related to flooding.

This approach not only offered a comprehensive overview of the societal impact but also underscored the role of digital platforms as crucial tools for information dissemination and public engagement. By leveraging these online resources, it was possible to capture a more detailed and varied perspective, enriching the research with a blend of qualitative and quantitative data. This method proved particularly effective in identifying trends, common concerns, and differing viewpoints across a wide demographic, ensuring a richer, more nuanced understanding of the subject matter. The Figma board with the observations and notes gathered can be seen in APPENDIX 4.

Key observations included:

- Most posts on social media were made during or after the storm, rather than before and they had the purpose of informing about the status of the flooding.
- News about increasing house insurance prices was a common topic when flooding topics reach the news in times of no-flooding news.
- On social media residents focused on communicating what was happening.
- Facebook groups dedicated to flooding, such as "Oversvømmelser Danmark," were primarily used to show pictures.
- Some posts humorously discussed selling houses protected against flooding.
- There was notable low trust and frustration with local authorities due to a perceived lack of tangible efforts to prevent flooding.
- Some people appreciated the community help, even though it was not well-organized.

Define

As stated in the literature review, define stage consolidates these insights into a clear problem statement that articulates the user's needs in a concise manner.With all the gathered information from the exploratory phase, it was time to understand where to focus.

Synthesis Wall

The synthesis wall is a key support in the moment of debriefing and analysis of the research outcomes (*Service Design Tools*, 2022). Using a physical wall and post-it notes to debrief the research sessions and cluster important insights as depicted in Figure 10.

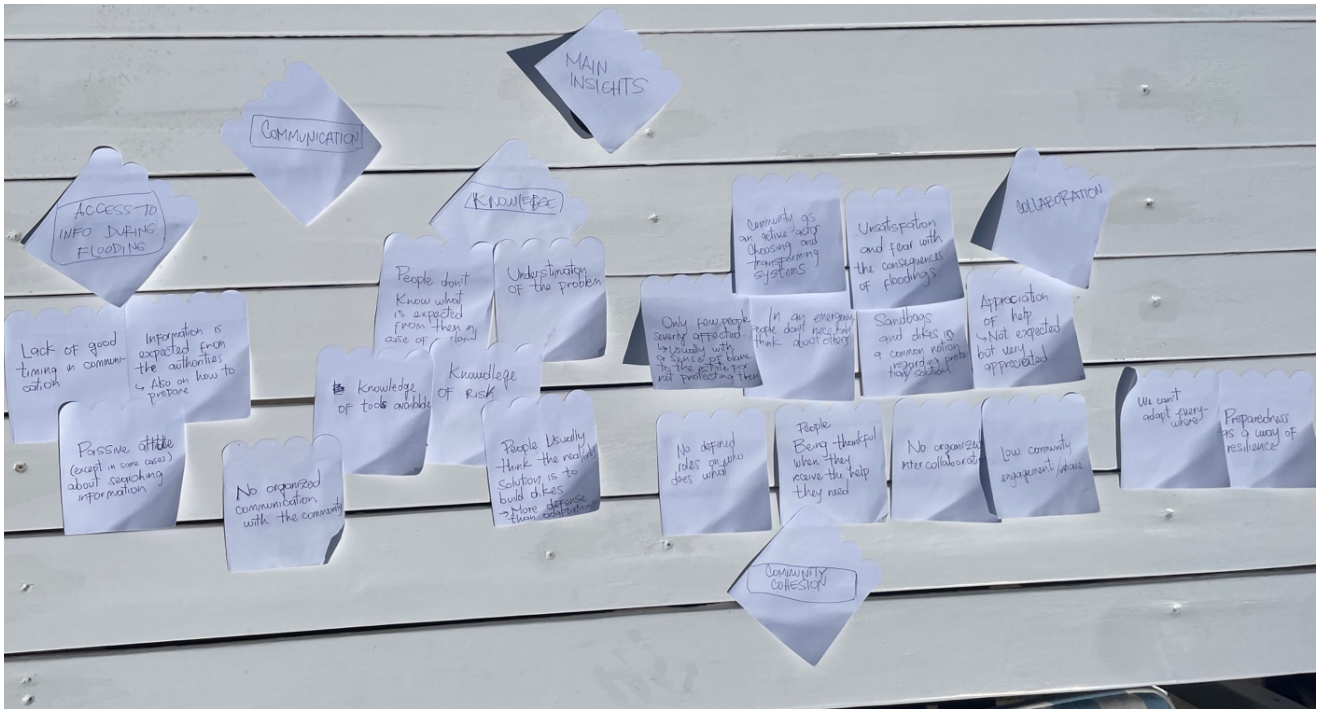


Figure 12. Insights wall

Following a series of discussions and ideation sessions with colleagues, two primary themes emerged from the insights gathered: communication and community cohesiveness.

Communication is divided into two subtopics:

- Access to Information: This focuses on the challenges in the timely and accurate dissemination of information to populations affected by flooding events. Eventhough there is a vast amount of information available, research showed that community members are not accesing it effectively. This happens in all times around a flooding event: prior to it – as they do not really know what their lever of risk is, the insurance schemes that protect them or whose responsibility or role each entity assumes when there is an event.

- Knowledge: This centers on the community's awareness of potential flood risks and the overall level of knowledge regarding preparedness and response. They do not really know what to do neither, their knowledge about what to do is quite limited to the placing of sandbags around their residences.

The other main theme identified was **community cohesiveness**, conected to the lack of collaboration among community members during flooding events. This lack of collaboration is mainly due to the absence of a proactive approach within the community for preparedness, response, and recovery from flooding events. While organized collaboration is often missing, the empathy phase highlighted the value and positive perception of community collaboration when it does occur, even though there is no initiative to formalize it.

The focus of the define phase will be **on community cohesion specified on collaboration**. This decision was based on the existing knowledge of the topic and the insights provided by experts. Research supports this definition as well, because as described in the project context in chapter 3, authors like pHedensted Lund et al., (2012,) affirm that network governance and collaboration are necessary for a viable and effective planning and implementation of adaptation measures.

Additionally, another argument for thi decision it that, although communication is essential and there are many tools aimed at democratizing and making information more accessible, there are fewer projects dedicated to enhancing structured community initiatives. Aligning this with the personal goals of this thesis, which include learning new things and exploring new fields, the topic of community collaboration seemed like a better fit.

Utilizing the "How might we" question framing, the define phase led to a north on upfollowing design phases. The How might we aims to see every problem as an opportunity for design by framing the challenge as a How Might We question.(IDEO, 2024).

How might we use foresight in service design to enhance community collaboration in cases of floodings in Denmark?

Ideate

According to the Design Council, the develop phase encourages people to give different answers to the clearly defined problem, seeking inspiration from elsewhere and co-designing with a range of different people. This phase will explore the way path conducted to find solutions to the How Might We question presented previously.

It utilizes foresight tools as a way to diverge and find alternative ideas and understand how the future might look like to then find a solution aligned with that future. The ideate phase of this thesis brings along a quantity of foresight methods to enhance the divergent mindset inherent to it. Referring to the integrated for foresight and design thinking proposed by (Serio, 2023), this phase navigates future possibilities by imagining various potential futures and creating alternative narratives. The use of scenarios or envisioned future worlds leads to the brainstorm of product or service solutions that address both challenges and opportunities.

PESTLE Analysis

PESTLE analysis, as an established framework in the field of strategic management and foresight, serves as a specific method of driver mapping that focuses on macro-environmental factors (Järvenpää et al., 2020). This approach, which stands for Political, Economic, Social, Technological, Environmental, and Legal aspects, is instrumental in identifying and categorizing the influential forces

Figure 13. PESTLE analysis

that can shape or transform a system.

In the context of foresight, as highlighted by Imaz-Lamadrid et al., (2023) PESTLE analysis provides a comprehensive way to monitor and analyse the external influences that impact systems, thereby assisting strategists in understanding the broader geopolitical, economic, and social trends. As they mention, this method extends beyond simple environmental scanning by offering a structured framework to dissect and prioritize changes in the macro environment, effectively mapping out drivers that are critical to strategic decision-making.

Figure 13 depicts the driver mapping performed in the context of floodings in Denmark. The drivers mapped come because of the diverse literature analysed throughout the empathize phase as well as brainstorming sessions carried out thus far.

The different drivers considered that can drive change in the context of floodings in Denmark are now described:

- Political: This category includes government-led initiatives and laws that focus on flood mitigation and enhancing climate resilience. It highlights Denmark's engagement in international alliances like the EU to facilitate climate adaptation, and the regulatory requirements municipalities must meet concerning flooding.

- Economic: This segment addresses the economic implications of flooding, particularly in agriculture and infrastructure sectors. It details the financial burdens, such as the productivity impacts in agriculture, costs related to infrastructure repair and maintenance, and the economic load on health systems due to floods. It also includes the investments required for flood defense and the insurance costs for properties at risk.

- Social: Here, the focus is on community involvement in flood preparedness programs and the social implications of flooding, including health impacts and public health concerns. This segment also considers the role of insurance and the use of water management systems to mitigate flooding impacts.

- Environmental: This part explores the environmental consequences of flooding on local ecosystems and biodiversity. It also discusses sustainable water resource management, climate change, and sea-level rise.

- Legal: Environmental legislation and land use regulations that govern how areas prone to flooding are managed. It also covers insurance and compensation frameworks that provide financial redress for flood damage.

- Technological: This section looks at the advancements in technology that support flood management, including innovations in flood prediction and monitoring technologies, as well as

sustainable construction, AI development and emerging technologies that we might npt be aware of but that could change the state of the art in flood resilience.

Trend mapping

Two experts were invited to contribute their specialized knowledge to the study: one, an aquatic scientist from DTU working in a Think Tank focused on water management, and the other, a professor in

Figure 14. Trend mapping exercise

environmental studies who completed her master's focusing on the economic impacts of floodings in Denmark and is currently pursuing a PhD focused natural hazards. Both were asked to map trends from their areas of expertise. As explained by FSG, (2016)trend mapping is is a visual representation of relevant trends influencing the system around a given topic. It is developed using the collective knowledge and experience of a group of people familiar with a given domain. Figure 14 illustrates the exercise conducted in a Figjam board.

In the interviews, both experts were explained about the horizon scanning diagram depicting weak signals, emerging issues, trends and Megatrends, depicted in Figure 15. As the UNDP Regional Bureau for Asia and the Pacific, (2022) explains, the diagram has two axis, the horizontal one being time a event has been present and the vertical the number of cases or degree of awareness.

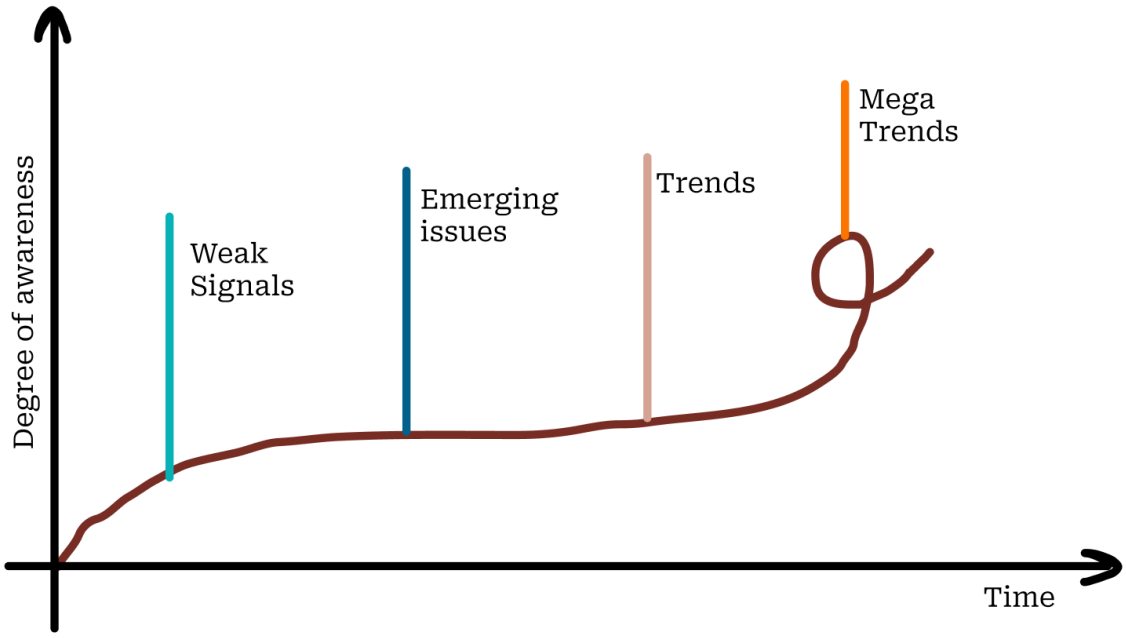


Figure 15. diagram depicting weak signals, emerging issues, trends and Megatrends.

The points on the graphic represent signals, which indicate an event, local trend, or organization that possesses innovative, disruptive, and/or strategically discontinuous potential to expand in scale and geographic reach. As illustrated, the more time a signal has been present, the more cases and increase in degree of awareness. Following this logic, the first represented events, with short time and therefore low degree of awareness are the weak signals, they can be found on social media, value shifts is some populations or companies, futurists, specific communities or interests groups. The weak signals aim to capture the hardly perceptible, unstructured, unplanned and unintended. Hence, incomplete information and uncertainty on a signal's future development trajectory is inherent to this exercise and does not imply that the signal is not worth capturing and monitoring, as weak signals can develop into strong trends in the future. If the weak signal persist on time, and become more spread among wider radious, they become emerging issues, here early adopters of the event start to get ob board. Those are present

among scientist, artists, radicals or mystics. Moreover, developing in time, number of events and geographical areas they can become trends, defined as trend can be a general development or change in a situation or in people's behaviour that has a long-term impact(Future London Academy, 2024).

The goal of presenting the latter explained diagram to the experts was to introduce and familiarize them with the purpose of the trends they were mapping. The aim was to ensure that they did not only focus on the most evident trends, which are easily accessible through other activities such as desk research, but also to encourage them to contribute their knowledge of small-scale, newly emerging initiatives. These initiatives could be part of the weak signals and emerging issues spectrum.

After the trend mapping exercise was concluded, the signals were clustered in a circle containing the same drivers as in the PESTLE framework and the horizons of change, in order to make sense of and categorize the trends mapped. Figure 16 shows the result of this clustering activity.

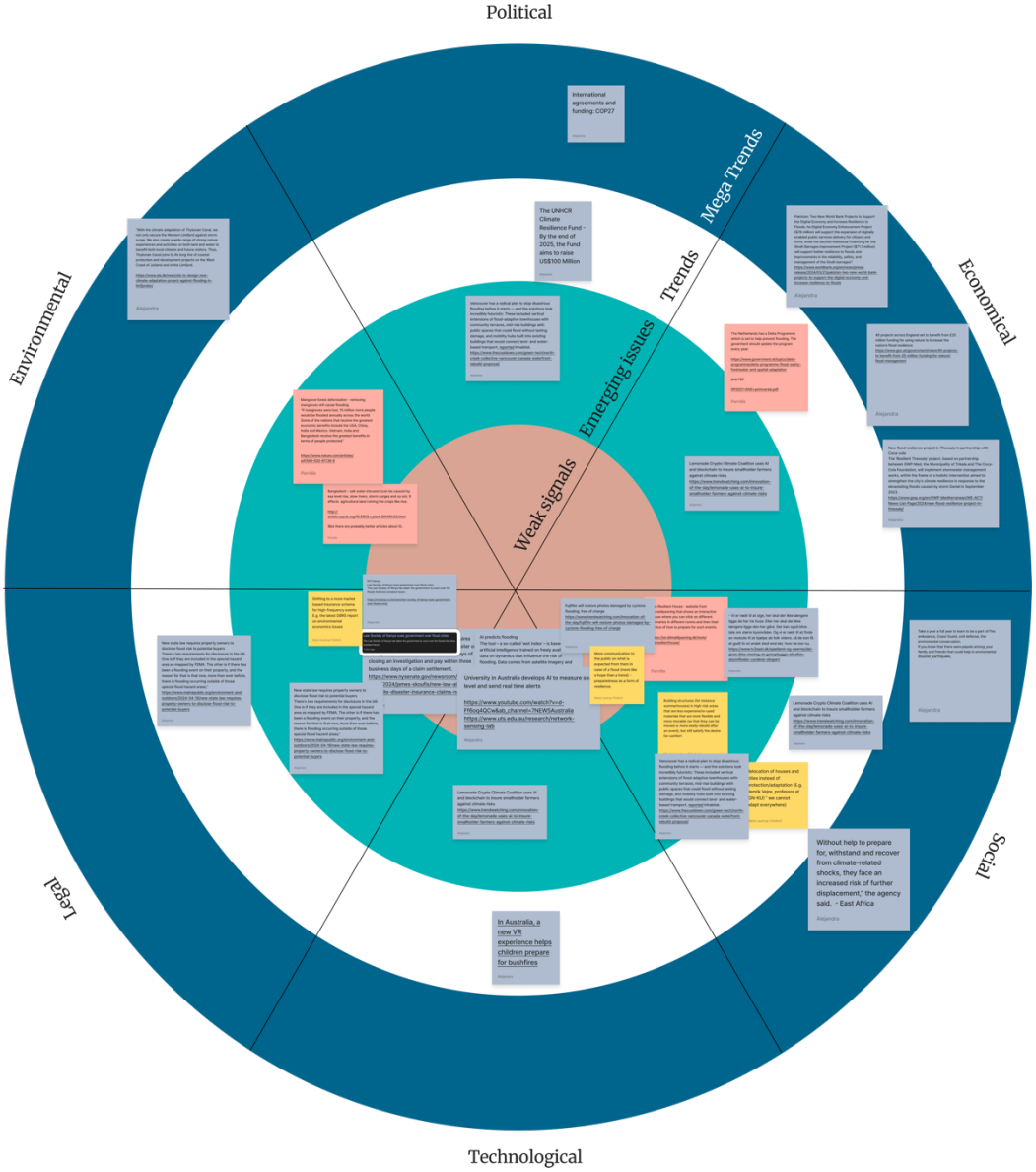


Figure 16. Signal clustering

The following paragraphs intend to give a general overview of the insights gathered from the construction and sense making of Figure 16.

Political

Government Funding and Policy Support: Governments are increasing initiatives and funding to improve flood resilience, integrating flood risk management into national security and urban planning policies.

International Cooperation: Enhanced international cooperation on disaster management includes sharing technologies, strategies, and funding to improve global flood resilience.

Economic

Infrastructure Investment: Significant investments are being made in flood defenses such as sea walls, flood gates, and enhancing the resilience of existing infrastructure to handle floods.

Insurance and Economic Planning: Economic planning now includes better flood risk assessment and adaptation, with adjustments in insurance frameworks to encourage flood risk reduction measures.

Social

Community-Driven Resilience: Emphasis on community-based projects that utilize local knowledge and capacities to develop tailored flood resilience solutions.

Education and Awareness: Increasing efforts to educate the public about flood risks and resilience strategies, ensuring communities are better prepared.

Technological

Advanced Prediction and Monitoring Tools: Utilization of AI, big data, remote sensing, and GIS technologies are advancing flood prediction and monitoring capabilities.

Smart Flood Management Infrastructure: Development of adaptive urban infrastructure that incorporates smart technology, like automated flood defenses and sustainable drainage systems, to better manage flood situations.

Legal

Stricter Regulations: Governments are enforcing stricter urban planning and building codes to ensure new constructions are flood resilient. There is also a greater focus on environmental compliance and the impact assessment of new projects.

Land Use and Building Codes: Enhanced legal frameworks to control land use and ensure new constructions incorporate flood resilience measures.

Environmental

Ecosystem Restoration: Focus on restoring wetlands, rivers, and coastal areas that naturally mitigate flooding.

Climate Change Adaptation: Strategies are being implemented to address the enhanced flood risks associated with climate change, emphasizing sustainability and environmental conservation.

Insights:

As a reflection on this latter method, the recognition of proper weak signals and emerging issues is limited, mainly due to the challenge of encountering new information and for the availability of such information as it is usually experts and niche communities that own this kind of knowledge. This complicates the identification of genuine novelty, either because of the intrinsic newness of it or because I have read extensively about the topic, which may cause the overlook of novel elements. Consequently, what I perceive are likely trends rather than definitive weak signals and emerging issues of future developments. However, given that my current analysis is not intended as a foresight exercise—wherein a more rigorous evaluation of subtle, weak signals would be necessary—my focus on near-future service design justifies the reach and limitations of my present observations.

Regarding the method the trend mapping reflective insights were gathered around the process. The methodology employed in this study proved to be engaging and informative. Allowing participants the space to collaborate and share insights was comparable to conducting expert interviews. However, unlike traditional expert interviews where detailed explanations are provided, this approach enabled participants to offer "hints" or "breadcrumbs" of information, which I, as a researcher, could further investigate and expand upon.

One of the experts is a recent master's graduate, who found the exercise exciting as it allowed her to think beyond her usual scope of work. In contrast, the other expert who was a more experienced professional, appreciated the methodology but expressed some reservations about her suitability for the exercise. As she explained, her expertise in the context of floodings in Denmark lies at a macro level, dealing with stakeholders such as the government, legal entities, and environmental policies, rather than the specific aspects of floodings addressed in this study.

From my perspective as a facilitator, both interviews were highly valuable, providing diverse viewpoints and insights. This methodology, where participants contribute their knowledge or conduct their own research, leaving the primary researcher to synthesize and expand upon the information, proved to be highly enriching. However, for the participants, the distinction between weak signals, emerging issues, trends, and megatrends was not crucial. They simply shared what they knew about the subject matter, providing a broad range of information that could be further analyzed.

Scenario development

Scenario creation is a method that involves constructing and using systematic and internally consistent visions of plausible future states of affairs (Popper, 2008). Scenario planning, recognized as a foresight tool, integrates diverse methods to create alternative visions of the future based on key trends and uncertainties. Scenarios depict plausible and alternative futures, facilitating anticipation and the planning of responses to different but likely future pathways (UNDP Regional Bureau for Asia and the Pacific, 2022), it can help users to consider three different sorts of questions about the future: "what will happen? What can happen? And how can a specific target be reached? (Dhami et al., 2022)

As highlighted by (Dhami et al., 2022) there are several techniques to help the scenario generation. The chosen for this case was the Cone of Plausibility (CoP) technique described by Heuer & Pherson, (2020). This practice consists of 4 steps, which are described below.

1. Establish the question that needs to be addressed.

2. Determine the main factors influencing the issue and hypothesize their future development.

3. Create a standard future scenario by extending the assumptions from the previous step.

4. Develop one to three variant scenarios by modifying one or more of the initial assumptions, ensuring to include at least one scenario that is optimistic or focuses on potential opportunities.

Figure 17 depicts the final process. From among the PESTLE drivers, 6 drivers were chosen: Goverment initiatives on flood mitigation, Infrastructure, Environmental legislation, AI development, Investment on flood defense, Climate migration.

Following the method and after different informal conversations with different stakeholders, mostly residents of Copenhagen, the 3 following scenarios were defined:

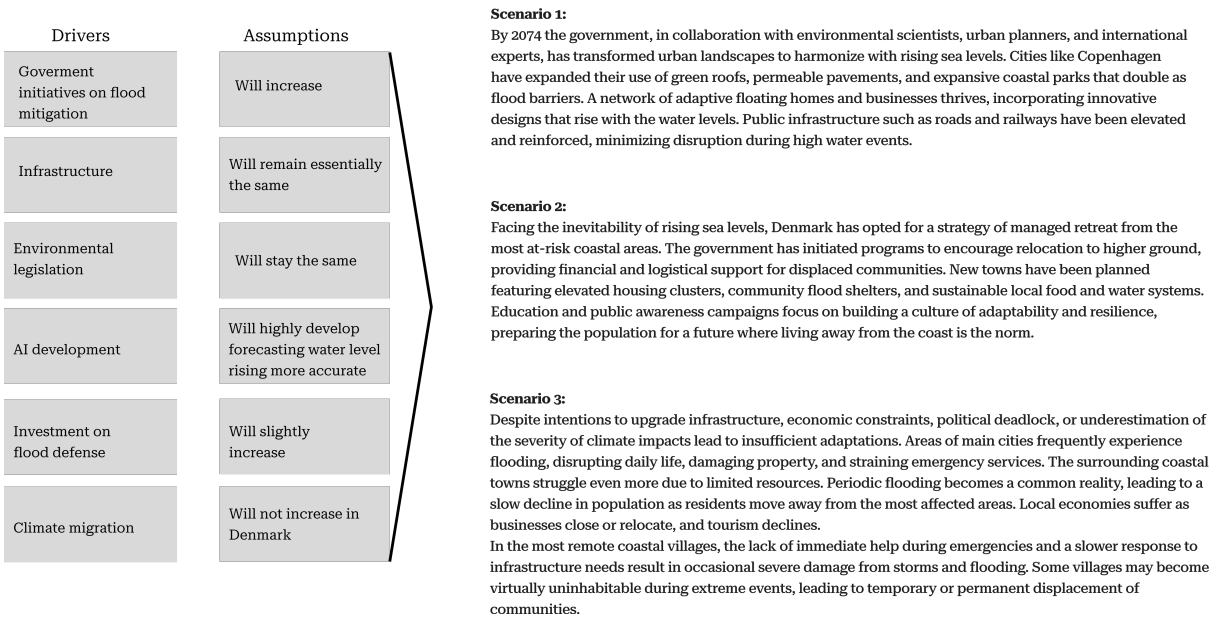


Figure 17. Scenario development with the CoP technique.

Scenario 1: Sustainable Urban Adaptation

By 2074, Denmark's coastal cities have become world leaders in flood resilience. In collaboration with environmental scientists, urban planners, and international experts, the government has transformed urban landscapes to harmonize with rising sea levels. Cities like Copenhagen have expanded their use of green roofs, permeable pavements, and expansive coastal parks that double as flood barriers. A network of adaptive floating homes and businesses thrives, incorporating innovative designs that rise with the water levels. Public infrastructure, such as roads and railways, has been elevated and reinforced to minimize disruption during high water events.

Scenario 2: More Space to Nature, Living Away from the Coast Becomes the Norm

Facing the inevitability of rising sea levels, Denmark has opted for a strategy of managed retreat from the most at-risk coastal areas. The government has initiated programs to encourage relocation to higher ground, providing financial and logistical support for displaced communities. New towns have been planned with resilience at their core, featuring elevated housing clusters, community flood shelters, and sustainable local food and water systems. Education and public awareness campaigns focus on building a culture of adaptability and resilience, preparing the population for a future where living away from the coast is the norm.

Scenario 3: Scenario 3: Inadequate Response and Chronic Flooding

Despite intentions to upgrade infrastructure, economic constraints, political deadlock, or underestimation of the severity of climate impacts lead to insufficient adaptations in major cities. Areas of main cities frequently experience flooding, disrupting daily life, damaging property, and straining emergency services. Surrounding coastal towns struggle even more due to limited resources.

Periodic flooding becomes a common reality, leading to a slow decline in population as residents move away from the most affected areas. Local economies suffer as businesses close or relocate, and tourism declines. In the most remote coastal villages, the lack of immediate help during emergencies and a slower response to infrastructure needs result in occasional severe damage from storms and flooding. Some villages may become virtually uninhabitable during extreme events, leading to temporary or permanent displacement of communities.

Scenario solutions with expert

A workshop was facilitated aiming to engage stakeholders in the participative foresight process, utilizing foresight as a tool to foster social participation and co-create potential futures, this is also consistent with co-design, that, according to Sanders et al. (2008), co- redefines traditional roles by positioning the end-user as the "expert of his/her experience," significantly contributing to knowledge development, idea generation, and concept development.

Facilitation within this context served as a pivotal activity, transforming the designer into a mediator who enhances participants' creative expressions and intrinsic design capabilities (Sanders & Stappers, 2008). A relevant stakeholder, introduced earlier during the scenario mapping phase, was invited to participate in further developing these concepts.

The objective of the session was to present the previously developed scenarios to the expert and discuss potential solutions for each scenario. This exercise was has it's fundament is Backcasting wich as described by (UNDP Regional Bureau for Asia and the Pacific, 2022) is a tool used for creating preferred futures by imagining a future where the goals and strategic objectives have already been achieved and tracing back the steps that got us there. The approach adopted during the online interview, included the employment of a storytelling technique where the participant was asked to imagine traveling to the year 2074 using the DeLorean "Back to the Future" car as depicted in Figure 18. This method not only lightened the atmosphere but also facilitated engagement through playfulness and storytelling. This is backed by Bleeker (2009) that describes design involves materializing reflections on current design and envisioning future designs.Participants were then asked to envision that the travel in time led them into one of the three scenarios and that their mission was to explore and imagine potential community initiatives in the context of floodings that could support these futures. These ideas were captured on virtual post-its, as illustrated in Figure 19, showcasing the creative outcomes from the brainstorming sessions for each scenario. The full digital workshop can be found in APPENDIX 5.

This narrative approach and participative method enabled a comprehensive exploration of future possibilities, fostering a deeper understanding of the interventions needed to achieve desired outcomes in community resilience and innovation. The outcomes of the workshop will be further utilized as an input for the Theory of Change method so they will not be discussed in this section.

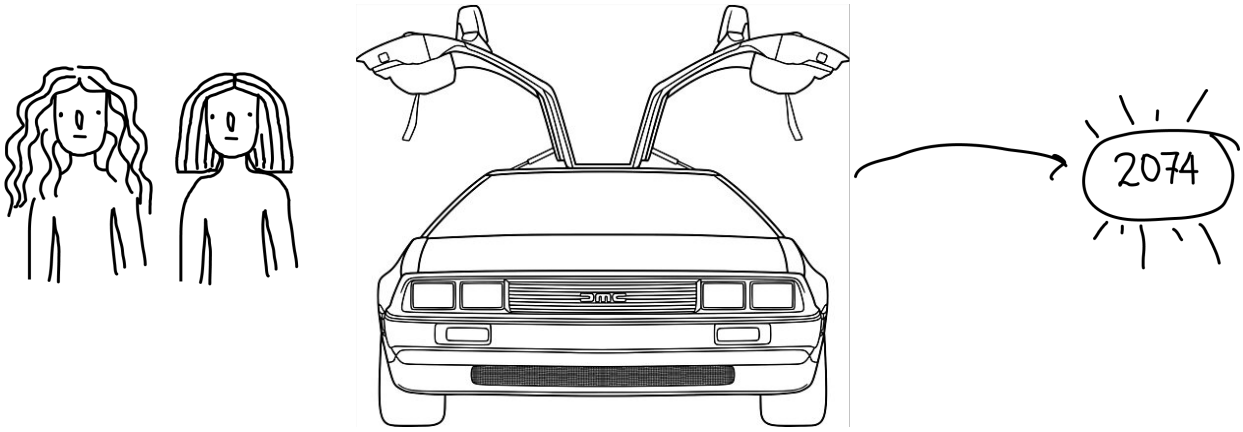


Figure 19. Storytelling visual aid to envision a travel in time fifty years ahead.

Figure 18. Backasting – brainstorming exercise based on future scenarios

Creating a Theory of change

The co-creation sessions with the expert led to the exploration of Theory of change. As described in chapter 2 and chapter 4, Theory of Change serves in this thesis as a tool to bridge the tools and the foresight thinking mindset within the design of a service system. Recapitulating the literature review, A ‘theory of change’ explains how activities are understood to produce a series of results that contribute to achieving the final intended impacts. The theory of change depicted in the following Figure 20, displays a theory of the problem, which is how to enhance resilience, the impact, which in this case is the collaboration.

The theory of change, for this specific application case can be compared to a puzzle, we some of the pieces are in place, and got gathered throughout the process carried out so far, and other are others are subject of new exploration. This is supoorted by Simeone et al., (2023), affirmirng that Theory of Change can integrate tools and frameworks currently in use to articulate strategy. In a first figure, it makes sense to make the pieces that are already in place, and where they came from, at the same time as highlighting the missing pieces of the puzzle.

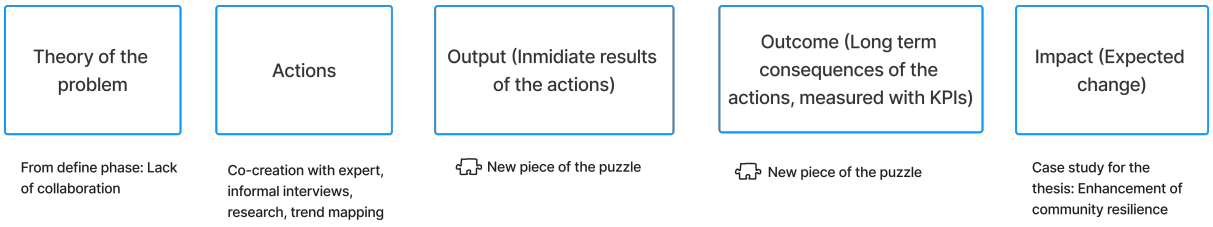


Figure 20. Theory of change connected with the work done thus far

Now, Figure 21 will illustrate the other pieces of the puzzle, aiming to construct a Theory of Change.

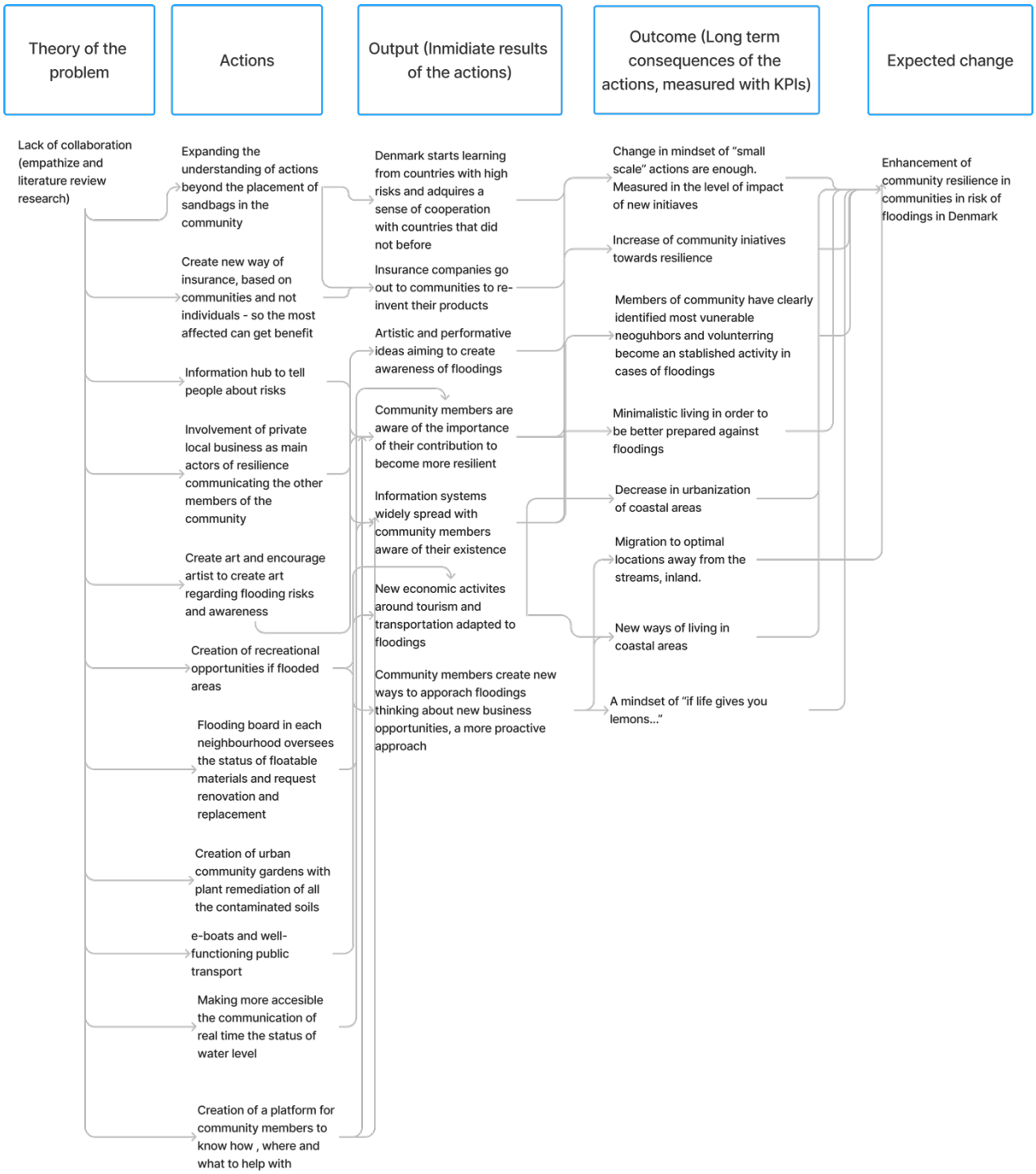


Figure 21. A proposal of Theory of Change

Theory of the problem: This initial node highlights the foundational issue og of lack of collaboration that was found in the Define phase. The literature review and activities carried out throgut empathize phase lead to collaboarion are alre also part of the borader and deeper theory of the problem.

Actions: The actions were inspired by the workshop carried out with the expert. The inputs from the expert do not necessarily are textually as they wrote them but the main concept of it was substrated. This is due to the workshop being focused on the long term future (50 years ahead).

The actions cover the following main points:

- Expanding the understanding of actions: Moving beyond basic measures like sandbag placement to more comprehensive community engagement strategies.
- Denmark starts learning from countries with high-risk of floods and adopt their successful strategies.
- Encouraging insurance companies to invent products that benefit communities, particularly the most flood-prone areas.
- Enhancing community understanding of flood risks and what can be done during such events.
- Utilizing art to raise awareness about flood risks and creating recreational opportunities in areas prone to flooding.
- Focusing on sustainable urban planning like community gardens for contaminated soils and improved public transport adapted to flood risks.
- Making more accesible the communication of real time the status of water level.
- Creating a platform for community members to know how, where and what to help with.

Outputs: The immediate results of the actions; they cover the following points that are immediate consequences:

- Denmark starts learning from countries with high risks and adquires a sense of cooperation with countries that did not before
- Insurance companies go out to communities to re-invent their products
- Artistic and performative ideas aiming to create awareness of floodings
- Information systems widely spread with community members aware of their existence
- New economic activites around tourism and transportation adapted to floodings
- Community members create new ways to apporach floodings thinking about new business opportunities, a more proactive approach
- Community members are aware of the importance of their contribution to become more resilient
- Information systems widely spread with community members aware of their existence

Outcomes are the long term consequences of the actions that can be measured as KPIs in this case, they include

- Increased awareness and preparation within communities, the establishment of flood-specific infrastructures like flood boards in neighborhoods, and new economic activities that adapt to flood conditions.
- Expect to see a shift in economic activities to those adapted to flooding, such as tourism that takes advantage of the altered landscapes and proactive community actions like new ways to approach business during floods.

- Decrease in urbanization in vulnerable coastal areas and migration to safer inland areas, combined with the adoption of a minimalist lifestyle better suited to dealing with floods.

4. Impact

Enhanced Community Resilience: Ultimately, the collective actions and changes in policy and practice aim to enhance the overall resilience of communities against the threat of flooding in Denmark.

Concept development.

Munthe-Kaas and Hoffmann (2016) explain that in the context of urban development, design is viewed as a process of prototyping rather than merely working with prototypes. This means that design is seen as an ongoing, iterative activity. It involves continuously creating, testing, and refining ideas. The focus is on the process of developing and improving designs over time. This contrasts with a more traditional approach where design might be seen as creating a static prototype or a finished product. Applying this to the specific case of this thesis, means that the prototyping exercise that starts in this phase has the goal of create new knowledge within the context of community resilience in the context of floodings and is not a final creation. Each concept and idea just evolve to construct a new one in order to understand better the users and keep developing to meet their needs. Looking retrospectively at the process, this is a key motivation to keep in mind. It means that the concepts and prototypes subsequently described are the product of the knowledge and experimentation gathered thus far and have the aim of keep developing.

Conditions to choose a concept

To identify the most viable concept for further development, specific conditions were established for the prototype. A key criterion focused on the community's relatedness. Insights gathered from interviews and informal discussions with stakeholders highlighted the importance of community connection. It was noted that individuals are more inclined to assist others with whom they share a perceivable bond or connection. For example being boat owners, or living in the same neighbourhood.

In terms of community actions towards resilience, the trend mapping exercise distinguished between two primary types: preparedness and recovery. Preparedness considers proactive measures taken prior to a flooding event to reduce risks, aimed at equipping communities with the necessary knowledge and tools to respond effectively during a flood. Alternatively, recovery is related to those actons that start ones the immediate threat has subsided, with efforts concentrated on restoring affected areas.

To visually represent these conditions, an illustration inspired by "Quattro Stagioni" (Jonas & Morelli, 2008) was created, depicting four different scenarios with the previosly described conditions described for the service. This serves as a way to frame the various brainstormed concepts, providing a strategic tool to select a specific quadrant for prototype development.

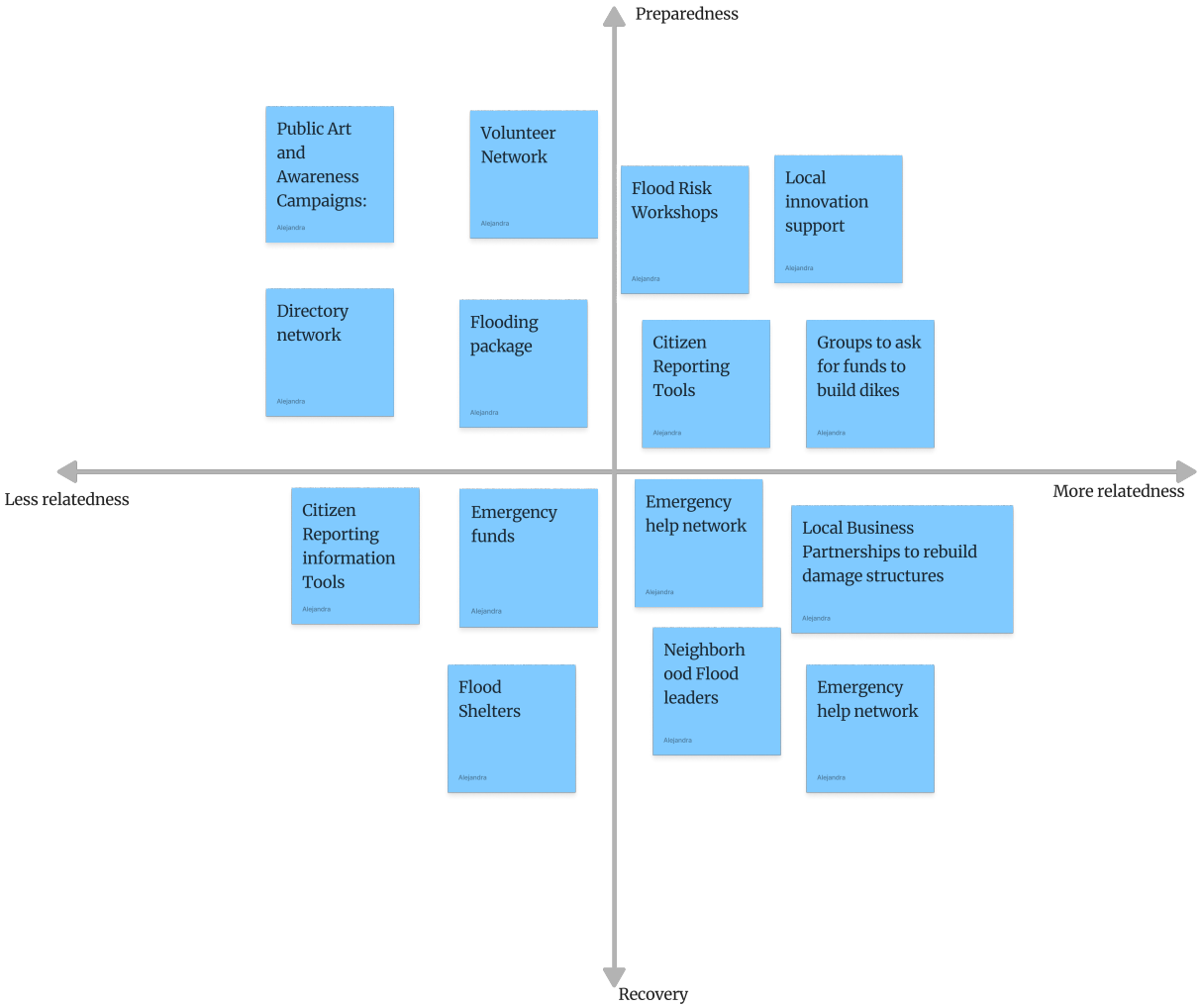


Figure 22. Quadrants with different concept ideas

The quadrant selected for further development was "More Relatedness/Recovery." This decision was grounded in the desire to align the prototype with the themes of empathy through relatedness identified during the research exercises. The focus on recovery was chosen due to its practical approach, providing a broader scope for exploration and creation. This approach was consistent with the personal learning goals described in section 1, aiming to delve into and acquire knowledge in areas previously unfamiliar to me.

Additionally taken the action found on the Theory of change section, “Community members know who, when and what to help with” new conditions appeared as a part of the picture. When referring to “who”, it became a condition that that the community should be connected, regarding the “when” it is referred to “accurate and on time information” and then finally, the “what” refers to having knowledge on risk and opportunities to address it in the community.

The following point sum up the conditions previously described for the prototype:

- It must be a way to connect community members
- It should be based on relatedness among the community members
- It should work towards the recovery after a flooding event
- It should have accurate and on time information
- It should provide knowledge on risks and opportunities to address in the community.

Prototype and test

Prototype stage, include the development of tangible representations which are then Tested with users. This testing phase not only validates the solutions but often uncovers additional insights, potentially cycling back through the design thinking stages. For the specific cae of this thesis, among the different concepts, one prototype was developed and tested and is not considered the final service system of this project. It ha the goal of showcasing a complete prototype – test iteration and is subject of further development in the potential continuation of this thesis.

Running the ideas presented in Figure 22 through a feedback session with colleagues, one idea stood out and was chosen to be explored further as a first step. This idea was the app "Hjeteløber," which is a program that organizes volunteers to respond to nearby cardiac arrests. These volunteers perform CPR and bring defibrillators to the scene. The goal of the Hjeteløber project is to improve survival rates for out-of-hospital cardiac arrests in Denmark (TrygFonden, 2024). The funtioning of the system of hjerteløber is that volunteers sign up to the app with their personal information. They must always allow the use of geolocation on their phone for the app. On the app they can always see where there are defirillators available as points on the a map on their nearby area. In the event of a suspected cardiac arrest, up to 20 nearby volunteers are alerted. They can either accept or reject the alarm. The alert is based on an algorithm where the first four responders who accept the alert are sent to the nearest defibrillator before heading the suspected arrest. The fifth responder is sent directly to the scene of the suspected cardiac arrest to start Cardiopulmonary Resuscitation.

The key factors that made this idea worth exploring further were the fact that it met many of the conditions previously described for the prototype: it connects community members, works towards recovery in an emergency event, and provides accurate and timely information. Agreeing with Stickdorn et al. (2018a), who claim that a good starting point is to examine existing solutions so you are "standing on the shoulders of giants" and acknowledging some of the conditions being met, it became interesting to understand if there was potential for adapting and evolving this concept into the context of flooding events in Denmark. Therefore, referring back to Figure 19, the concept of "**emergency help network**" was explored further.

FloodGuard 1.0

For the initial prototype, the name FloodGuard was assigned to make the concept feel more realistic. The basic idea, inspired by the Hjerteløber app, involves an app that alerts users about an emergency, prompting them to respond and help. A user journey map was utilized to adopt a practical mindset on how the service would function. This map aims to document and visualize the step-by-step experience of a user interacting with the service from start to finish, listing the various actions users take to achieve their goal (Walter, 2022).

In this case, the user journey served as a guide to envision how the experience would unfold, detailing the preconditions, the flow of events during the experience, and the postconditions. Creating and orchestrating the map served as a tool to determine what should come next to develop a comprehensive concept.

Figure 23, envisions the user journey map that a volunteer in the app would do in case they get an alarm. As preconditions, the user must have already signed up for the service. When an official flooding alert is issued, the FloodGuard system receives this alert. The system then asks the user if they are available to help those affected by the flooding. If the user agrees, they are assigned a specific location and task. The user travels to the designated place and receives guidelines on what assistance is needed there. In the postconditions, the user registers the help they provided in the system to gather data for future events. They also report feedback and statuses to keep the community informed.

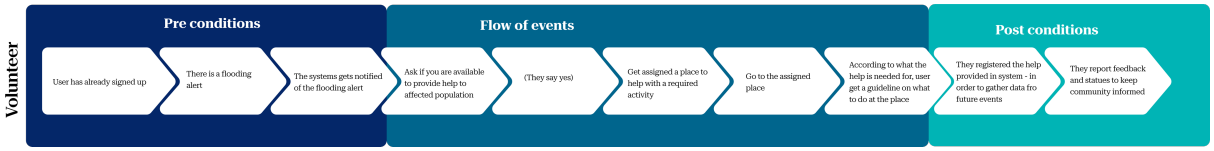


Figure 23. FloodGuard Prototype User Journey

Now from the point of view of the affected, Figure 24, illustrates their user journey.

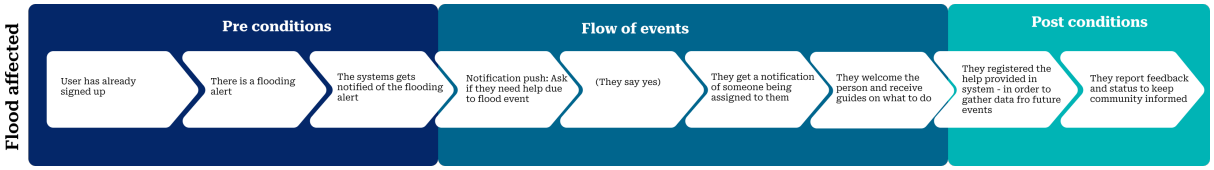


Figure 24. User Journey Flood affected

The preconditions in the case of a flood affected users are the same as for the volunteer, depicted in Figure 23. Following these steps, the system sends a notification to the individual, asking if they require assistance due to the flood event. If the individual confirms that they need help, they proceed to the next stage. In this case, to keep developing the experience, it is an assumption that the user says

– yes- they need help. Upon confirmation, the individual receives a notification informing them that a volunteer has been assigned to assist them. When the volunteer arrives, the individual welcomes them and receives guidance on the steps to follow to manage the situation effectively. In the postconditions phase, the assistance provided to the individual is logged in the system to gather data for future reference and improvements. Additionally, the individual reports feedback and their status to keep the community informed.

The previously described journeys are still in its initial stages and somewhat idealistic, but it serves as a foundation to test and refine the concept, making it more practical and feasible in reality.

There are many systems working together in order to insure the accomplisment of the service. Therefore are service Customer Value Constellation map as depicted in Figure 25 enables designing the service concept. It represents the set of service offerings and respective interrelationships that enable users to cocreate their value constellation experience for a given customer activity. (Patrício et al., 2011).

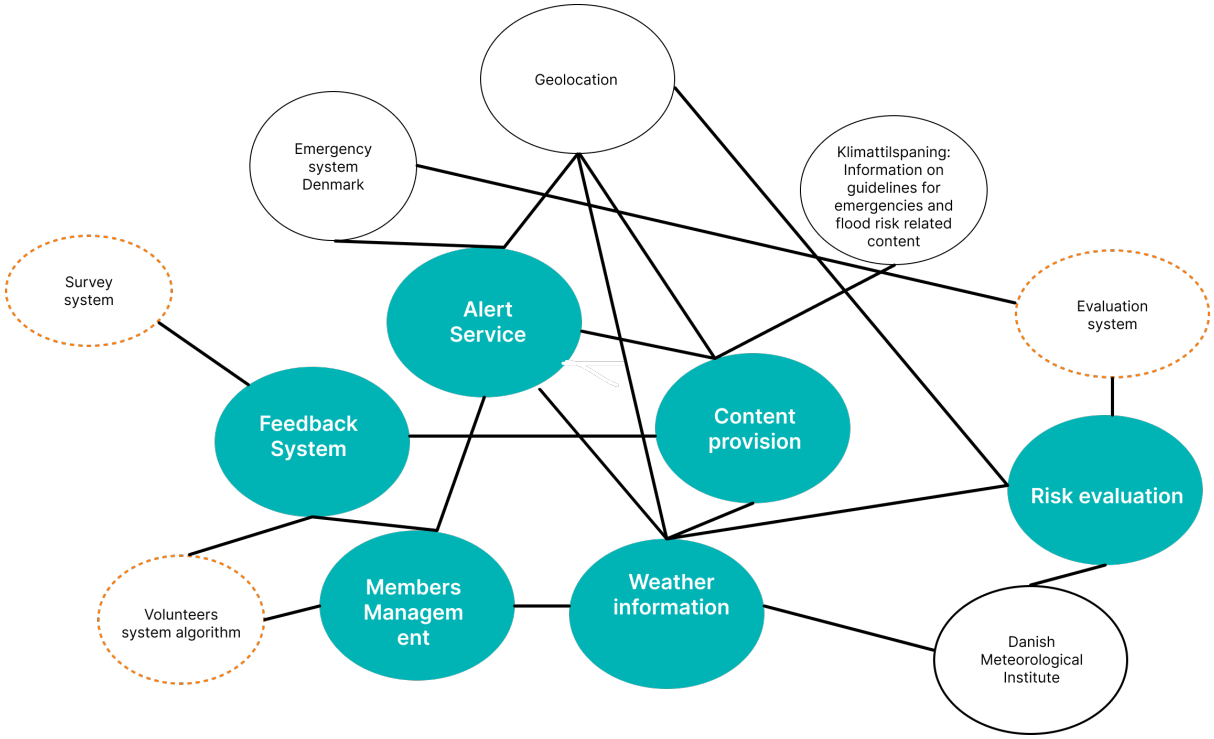


Figure 25. Customer Value Constellation

The alert service, risk evaluation, feedback system, content provision, member management, and weather information are each part of the customer value constellation that supports community collaboration through the FloodGuard app. As supported by Patrício et al. (2011), the customer value constellation map recognizes that value is co-created with a network of organizations beyond the app's boundaries. Therefore, each main service is connected to a stakeholder that provides the service.

For instance, the alert service is provided by the emergency system in Denmark, managed by the Danish Coastal Authority. The feedback system is supported by a survey platform that collects feedback in a

structured manner to improve the overall system. The weather information system is provided by DMI, the Danish Meteorological Institute. Content provision is handled by Klimatilpasning, a portal that offers information and tools to address the impacts of climate change, particularly those related to increased rainfall, higher sea levels, and extreme weather events. The risk evaluation process is managed by a system that assesses and classifies the risk to app members based on their geolocation and information provided by DMI and the emergency system.

The map includes services that already exists and services that need to be in place for the overall service system to work. Those newly created systems are market in dashed orange lines in Figure 22. They are the Survey platform that should be in place in order to gather feedback, the evaluation system to asses the risk in which the user of the service is and the volunteer system algorithm in charge of assigning vulunteers according to they location and availability.

Each of these services is complex on its own and requires a thorough service design process. Acknowledging the limitations of this thesis, these services have been described in terms of their novelty and functionalities. Further development of these services will be addressed in future work if this thesis continues to evolve.

Insights

I am aware of the complexity of the issue and the system and therefore also I am aware that the solutions proposed are still somewhat idealistic and require a longer understanding behind that goes beyond the limits in terms of time, budget and team resources of this thesis. However its main goal is to set a precedent on a solution concept based on collaboration of the community in order to enhance community resilience.

User Scenario

As (*Service Design Tools*, 2022) explain, a user scenario is a narrative that illustrates how a user will engage with the service in a particular everyday situation. Crafting user scenarios involves pinpointing the specific context, characters, and needs that shape the user's behavior. Initially, these scenarios can be written as detailed stories, outlining the experience step-by-step. Figure 24 depicts the user scenario for the prototype FloodGuard 1.0.

John lives in Køge, an area prone to flooding. He has recently downloaded an app that helps community members prepare for and respond to flood situations, called FloodGuards. He heard of it on Køge Uden Censur Facebook group and after the floods experienced last year, he felt that he needed to be better prepared.

After installing the app, John opens it and is prompted to create an account. He inputs his name, contact information, and address. The app uses John's address to assess the flood risk in his area using historical data and geographical location and information from other systems such as Klimatilpasning. It classifies John's location as a moderate-risk area.

A week later, the area's weather forecast predicts heavy rainfall. The national system integrated into the app sends an alert to John's phone about potential flooding. The app provides John with immediate precautions and preparation tips based on his risk level.

As the rain intensifies, John notices water concentration in an unusual way in his neighbourhood. The app later sends an alert of a potential flood condition happening.

During the event, the app sends a notification asking if John has been affected by the flooding to which John responds that he is safe. The app proceeds to ask if he can assist others. John marks himself as safe but indicates that he is available to help others. He gets a notification again where the app says that his help is required at an elderly couple's home two blocks away who need help sandbagging their home. It provides John with directions and safety guidelines for assisting during the flood.

Once he at the elderly couple house, he gets instructions on how to place the sandbags and also fills in a checklist of other items to have into consideration.

After assisting, John uses the app to check in and report the status of the couple and their property. The app updates the community and local authorities about the successful assistance. It also prompts John to share any other observations or further assistance he can provide.
Following the flood, the app continues to be a resource for recovery efforts, providing John with information on community cleaning events post flooding, which he decides to join. The app facilitates coordination of these events and shares recovery resources and tips for flood damage repair and insurance claims.

Figure 26. User scenario FloodGuard

Testing the prototype

Testing out different solutions at small-scale is the overall aim of this part of the process, rejecting those that will not work and improving the ones that will. As mentioned earlier, in the specific case of

this thesis, one selected concept got chosen and tested. Eventhough is not set to be the final solution, it is presented as the first prototype-test interation and sets the precedent for further development.

To test the assumptions underlying the developed concept, two testing sessions were conducted. According to Andreasen and Hein (1987), creating prototypes in the early stages of the design process can help visualize problems and identify incorrect design assumptions. The assumptions to be tested in the following tests are as follows:

- Individuals will be inclined to download and install the app, recognizing flood response.
- Users will perceive their personal skills and resources as valuable contributions to assist others in flood situations.
- There will be an increased awareness among the app users regarding the severity and potential impacts of flooding.
- There will be a strong willingness among users to offer assistance to others during flood events.
- Users will be open to receiving help from others, fostering a supportive community environment.
- After experiencing flood events, users will be motivated to enhance their readiness for future situations, utilizing the app to better prepare themselves.

In order to test assumptions, an interview is carried out. The interviewee provided a different perspective to the ones gathered thus far as a new perspective to floodings in Denmark, particularly because he owns a boat in Rungsted in the northern coastal area from Copenhagen. He explained that although the harbor where his boat is moored is susceptible to flooding, it is generally not a pressing issue. According to him, most harbors in Denmark, including this one, have parking lots designed to rise with the water level, ensuring that boats do not collide and remain stable. Further research is needed to verify these claims. However, he noted that even in harbors with advanced parking facilities, boat owners remain vigilant during flood events. They frequently check on their boats throughout the day to ensure everything is secure. Monitoring methods include personal inspections, organizing groups with other boat owners to take shifts, and using surveillance cameras. Although camera surveillance is convenient, it is also expensive, and not all boat owners can afford it. This highlights the strong community cohesiveness necessary to monitor their boats during flooding. He emphasized the role of the harbor master, who oversees the harbor and its boats. The harbor master utilizes a website and camera surveillance to monitor rising water levels, and boat owners can contact him or visit the website for updates.

During the interview, he was asked about recent flood events and explained that his boat was "off-season," meaning it was onshore and safe from the water, which posed no problem for him. This

response also highlighted that, although flooding is a threatening issue, many boats and some houses at risk are seasonal, hence there's a high probability that no one is present when a storm occurs.

The conversation then shifted to his preparedness for flooding, where he was asked if he knew what to do and who to call in such an event. He paused thoughtfully before admitting that he did not have a clear plan, and would likely consult the harbor master or other boat owners for advice.

Regarding boat insurance and its role in a flooding scenario, he again paused, reflecting his uncertainty about the coverage specifics. He concluded that he would need to review his insurance contract or contact his insurer for clarification if his boat were affected.

This confirms another perspective on the proactive attitude and underestimation of flooding risks.

Moving to the second part of the session, I described a scenario based on the one proposed in a previous section, then asked him several questions about it.

His initial reaction was that while he thought the idea was good, he viewed it as merely a supplementary aid. He emphasized that he wouldn't just rely on app notifications in an actual flood but would proactively check on his nearby neighbors.

When asked how his knowledge and professional background could assist others, he mentioned that he works in the utility industry and advised that the community should switch off their power plants in anticipation of flooding, as it is easier to fix and restore electrical systems if they are turned off before the storm. This insight shed light on an aspect of the prototype I had not considered: using general knowledge as a form of collaboration.

He also remarked that he would be more inclined to assist people he feels a connection with, such as other boat owners or close neighbors, rather than everyone.

Second test

A second test was carried out. Convenience sampling was used for a second test of the concept. This type of sampling aims to find respondents who are easily accessible to the researcher (Edgar & Manz, 2017). According to the interviewee, apps often expect users to perform certain actions, but users do not always comply. The interviewee mentioned that their actions are highly situational; for example, if they noticed a minor flooding, they would not report it themselves.

They emphasized that a sense of connection or belonging is crucial for users to be willing to help. The interviewee also pointed out that people are unlikely to download an app during non-crisis times.

Their willingness to help is based on convenience—they would assist if it was easy to do so but would not go out of their way. The interviewee said, "If I come across something, I want to help. You are helping what you are part of." They concluded by noting that the ideal scenario presented by the app might not always align with real-world behavior.

Connecting with the hypotheses written previously in this section, the following are the insights to answer them:

- Individuals will be inclined to download and install the app, recognizing it as a tool for flood response. This is inconclusive. A notable point is that people may not necessarily download apps supposed to be used in a when there is no immediate crisis. Therefore, exploring other formats for the concept is an opportunity to create more engagement and secure accesibility.
- Users will perceive their personal skills and resources as valuable contributions to assist others in flood situations. People can indeed use their personal skills and professions to help, though there are different formats for this. It doesn't necessarily have to be an app; it could be small tips and light information.
- There will be an increased awareness among users regarding the severity and potential impacts of flooding. This is likely, especially after interviews where participants seemed more aware and conscious of possible scenarios.
- There will be a strong willingness among users to aid others during flood events. Potential users are likely to help mostly if they feel a connection to others. They may not necessarily assist "strangers" but would be more willing if there is a bond or connection with those in need. Another point to add here is that according to the tests carried out, the app or a digital tool is not the only way they would help. As one of them mentioned if the situation is too bad, they would not sit and wait for their phone to get a notification, they would look their surrounding, their neighbourds and close realtives and offer their help.
- Users will be open to receiving help from others, fostering a supportive community environment. According to one of the intervieews, they would accept help if the situation requires it. But they will first approach their close environment.
- After experiencing flood events, users will be motivated to enhance their readiness for future situations, utilizing the app to better prepare themselves. This is inconclusive, as it could not be tested due to being purely hypothetical.

Insights:

After the first testing phase, key insights emerged that determined the path for the progress of the concept. In an iteration of prototyping and testing activities, exploring new formats for the concept became the direction to follow. Despite the willingness to help, further exploration of the app format is needed to effectively reach community members, especially since flooding is a rare event in Danish society. Through brainstorming activities with colleagues, options such as Facebook groups, physical directories, or in-person group meetings were proposed. However, acknowledging the time constraints

of this thesis, these ideas will remain as suggestions and will not be developed further in the present document.

6.
FINAL
CONCEPT

FINAL CONCEPT

As described before, this thesis is not aimed in presenting a final solution due to the limitations on time and resources and the high complexity of the topic. However it will present the prototype developed so far.

OBSERVATION: A visual pitch of the concept which is envisioned as a tool to present to interested stakeholders is included in APPENDIX 6.

Concept Pitch

FloodGuard: A Community-Based Flood Response and Support platform

FloodGuard is a digital platform available as an app that empowers community members to connect, respond, and support each other in times of flooding. By downloading FloodGuard, users can quickly assess their risk level based on their geographic location,

The app is integrated with the national alarm system (The Danish Coastal Authority's), ensuring that all users receive timely and accurate alerts about potential flooding in their residence or business.

When a flood event occurs, FloodGuard becomes an essential tool for communication and coordination. Users will receive a prompt asking if they have been affected by the flooding and whether they need assistance. For those who are safe and able to help, the app provides an opportunity to volunteer their services. Willing volunteers are matched with those in need based on proximity and the type of assistance required.

Volunteers receive precise locations and comprehensive guidelines on how to safely and effectively provide help. This may include rescuing individuals, delivering essential supplies, or assisting with temporary repairs. The app ensures that interactions and interventions are coordinated to secure efficiency and safety.

In the aftermath of the event, FloodGuard continues to support recovery and rebuilding efforts. The envisioned evolution of the app includes providing resources for damage assessment, claims assistance, and information on local clean-up and community rebuilding activities. It also features a feedback system that allows users to share their experiences and suggest improvements, ensuring that FloodGuard evolves to meet the community's needs continually.

With FloodGuard, community members are not only better prepared but also actively part of a supportive network, ready to assist each other in times of crisis, ensuring resilience and recovery are a collective effort.

7. DISCUSSION & REFLECTIONS

7. DISCUSSION

This chapter provides a critical analysis of the research findings, linking them to the study's objectives and theoretical framework. It interprets the results, discusses their implications, and examines the study's limitations. This section also considers the broader context, comparing findings with existing literature and suggesting areas for future research.

Bringing back the research **question how can foresight methods be integrated into service design in the context of climate adaptation?** the following points are part of the discussion:

Service design as a methodology that can embrace and be nurtured by other fields

By incorporating foresight tools into the service design process, it is empirically confirmed that service design is inherently interdisciplinary. This observation aligns with Wetter Edman's (2011b) assertion that various practices contribute to the field of service design.

However, incorporating new fields such as foresight toolsets into the practice, challenges the structure of the service design process as emphasized by Løgager et al., (2021) that talks about the need for a structured approach, as current studies in the topic do not delve into how foresight methods could reshape the design. In this thesis, the challenge of maintaining the structure of a service design project arose due to the overall complexity of the topic, as floodings and in general environmental issues have a huge context that adds complexity to any design process.

It is important to remember that the overall framework is the design thinking process, structured within the double diamond model. As mentioned in the methodology in section 4.1, this framework can encompass the full spectrum of innovation activities with a human-centered design mindset (Brown, 2008). Additionally, the mindset to adopt is determined the divergent/convergent approach suggested by the double diamond model.

Now, let's explore the compatibility between service design and foresight. Some questions to consider are: Are they always compatible? Should the design process always integrate foresight tools to empathize with future scenarios? The compatibility of these approaches can be debated. In this instance, they proved to be compatible, particularly in the context of climate adaptation, where long-term impacts are significant, and tools that help us envision the future are invaluable. This is supported by Wetter Edman (2011b), who notes that service design focuses on users and their interactions with a service, and on value creation, which inherently relates to change.

However, for other complex problems, some foresight tools might not always be the most appropriate choice. As Dan Suteu & Giorgi (2019) mentioned in the literature review, foresight should allow stakeholders to assess future options, draw conclusions for the present, and make informed decisions,

so arguably if the aim of a service design project does not posit in uncertainty of the future, it might not be rather as useful.

To provide an overall view of the relationship between foresight and service design, based on the characterizations made in the literature review and the learnings from the study case, Figure 25 aims to represent the different characteristics of each field and their commonalities. It is important to clarify that the characteristics not shared between the two fields are not opposites or contradictory. Rather, they highlight each field's strengths, indicating how they can serve as complementary tools.

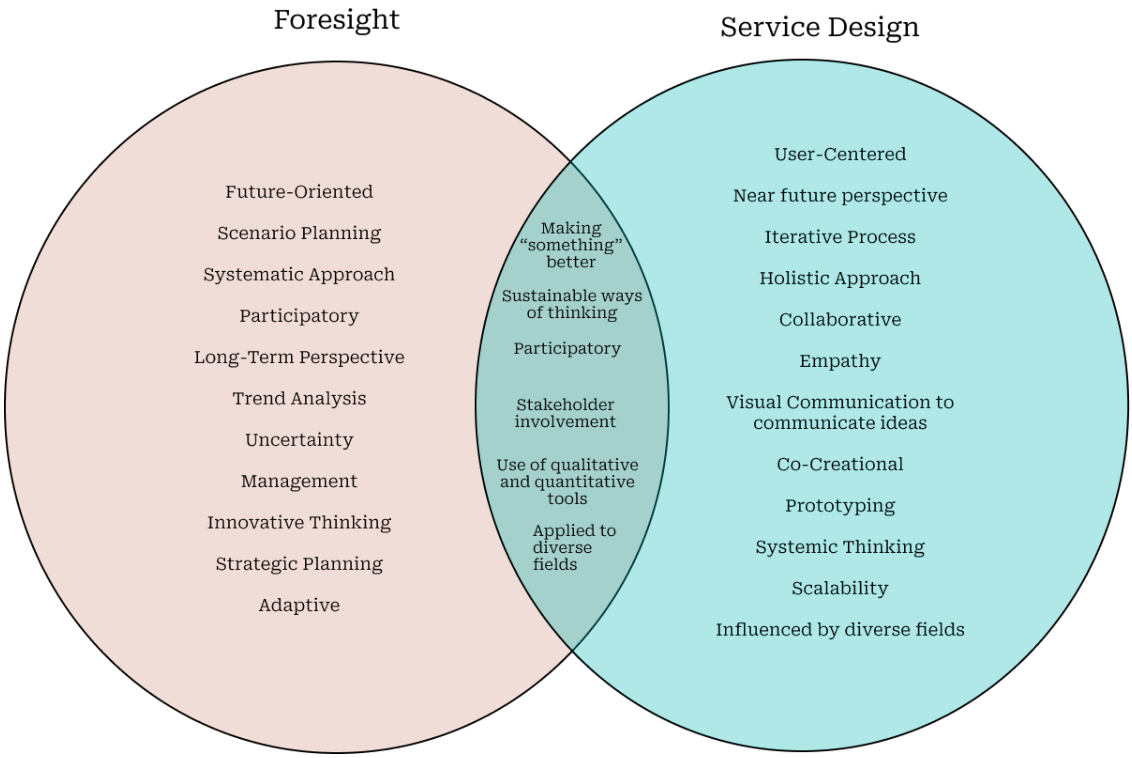


Figure 27. Foresight feat Service Design

As seen in the Figure 25, foresight and service design both aim to make "something better", they both have sustainable ways of thinking, they are both participatory, involve stakeholders use qualitative and quantitative tools and are applied to diverse fields.

Integration of foresight tools? Everywhere in process? Where does it make sense to integrate them?

Foresight methods could indeed be integrated into the design process. However, in this thesis, they were integrated into one specific part of the design process which is Ideate. In this phase, tools such as PESTLE analysis, trend mapping, scenario creating and backcasting were utilized to orchestrate the creation of ideas for the further development of a prototype. In contrast, in Empathize, Prototype and Test, tools "belonging" to service design tools were the protagonists. Looking back at the process this was mostly because the ideate phase was where the problem was already understood, and the

divergent mindset was ready for opening to new alternative scenarios where new solutions could take place.

As described in figure X of the methodology, foresight was indeed utilized to understand dynamics of change and high impact uncertainties and to build scenarios understanding their implications however it was not used to develop robust strategic options and recommendations. After the scenario building, theory of changr came into play as a mediator to get inputs for the design of a service. On a reflective look at it, it did not happen as described in said Figure, but rather in a centralized step of the process. Figure 26 illustrates in a more realistic way the process followed in this specfic case:

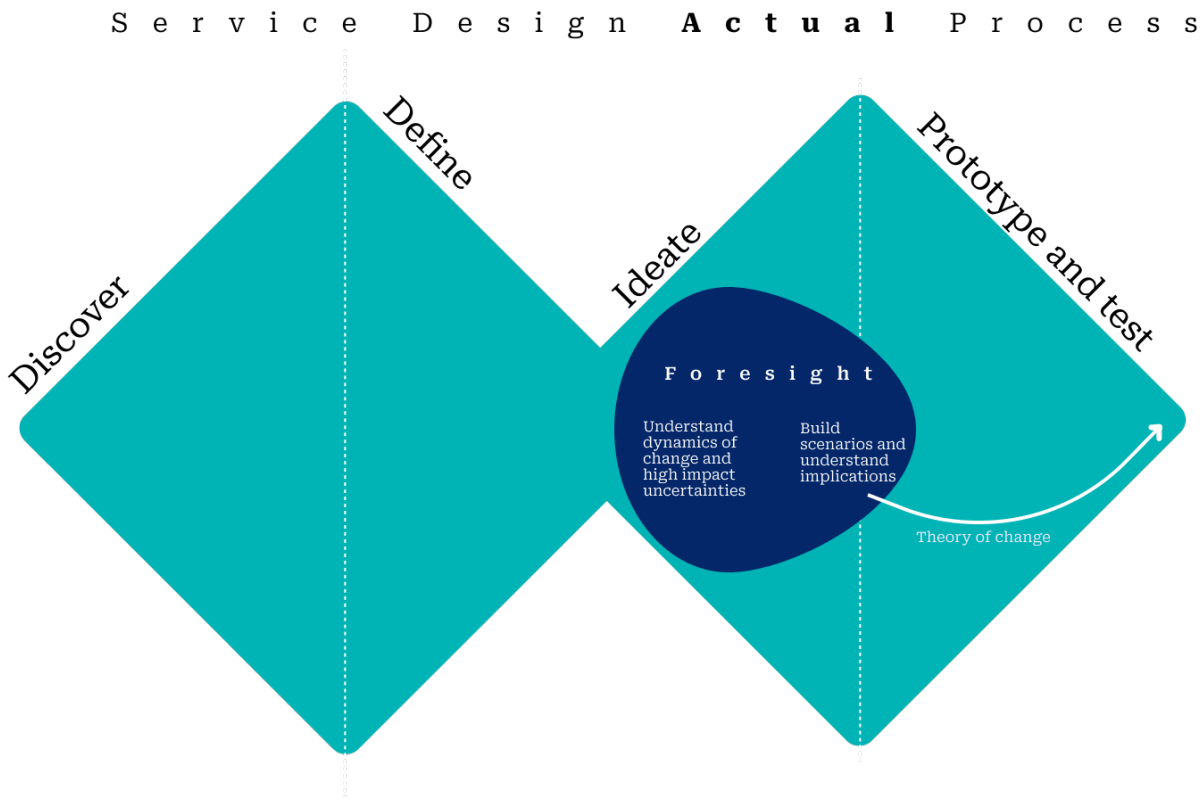


Figure 28. Service design actual process.

Nevertheless, it can be argued that this does not necessarily mean that foresight tools cannot be included in other phases of the design process. For instance, looking retrospectively, a trend mapping exercise during the empathize phase focused on the general signal activities on climate adaptation and not only in floodings could have been beneficial and would have been instrumental to shape the define phase. Knowing where the solutions were going and the trends in different aspects from the beginning the define phase might have looked different.

Following the same rationale, foresight tools could have also been included in the Prototype and Test phase as a way of future proofing the solutions, serving as a “stress” test to ensure that the solutions designed have placed in the envisioned future scenarios. From an overall point of view, “putting the

glasses of the future on" make the designed solution have a higher probability of being sustainable and enduring over time, resulting from informed decision-making.

Leaving the "what if land" and coming back to the facts of how this thesis was built, it is fair to say that the solution creation was based on service design and not much in foresight. Which again shows that foresight can be used in different ways to nurture the service design, in my case it was more informative about how the future would look like and not necessarily a solution that will be useful in that future envisioned.

Connecting foresight outputs to become service design inputs

For service design to effectively utilize inputs from scenario-building foresight methods, it is crucial to employ tools that bring future scenarios into the present. In this case, the Theory of Change was used because the scenarios were not yet suitable as 'digestible' inputs for service design. Therefore, the Theory of Change played a key role in bridging this gap. It was confirmed the way (Simeone, et al., p.5) Theory of Change can provide a number of possible models on how change can be enacted.

Throughout this thesis, I realized that this aspect of the process is more complex than it initially appears. Even thoughtfully constructed imagined futures can differ significantly from reality. This highlights that translating these envisioned futures into practical solutions requires a thoughtful and complex process.

Reflecting on the use of the Theory of Change, it is possible to say that it was applied somewhat superficially, mainly to link foresight to service design without fully leveraging its potential. The prototype developed and tested only addresses two of the actions mapped in the Theory of Change illustrate in Figure 19, which is "Communicating in real time the status of water" and "Creating of a platform for community members to know how, where and what to help with". The rest of the actions with their corresponding outputs and outcomes can be subject of future prototypes or an evolution of the current one.

Therefore, it is argued that when using foresight tools to build scenarios for the design process, a dedicated tool is necessary to effectively translate those scenarios into reality. This adds complexity to the process, making it crucial for designers to set clear boundaries and goals for using such tools to avoid unnecessary complexity.

Challenges of social innovation

The solution develop was within the realm of social innovation, because as said in the literature review, it involves creating enabling systems that facilitate social change (Cipola, 2016). This is achieved by the introduction of a service system which goal is to ehnahce collaboration by introducing an app where community members can help each other acting as actors providing help or seeking help in case of floodings.

However, I concur with the research suggests that there are challenges to it. As mentioned in the literature review, Kelly & Kelly (2023) highlight challenges related to the fact that social innovation relies on developing cultural, social, political, and resource mobilization skills across all social groups. However, societies may not always support or recognize these capacities. This was confirmed by the interviews presented in the testing phase of the case study, where the interviewees expressed that the help they would provide would be potentially conditioned by the level of familiarity the hold with the affected person. This unveils a challenge in the cultural scheme in Denmark and represent a limitation to overcome in the implementation of such solution. This is aligned as well with what. As Adger et al. (2008) have argued, there may be a range of 'limits to adaptation', including not only material and technological limits but also cultural-subjective elements incluidng social-cultural attitudes, knowledge (or not) about climate change, emotions associated with attachment to place and awareness of vulnerability/loss, diverse political and value-based perspectives, and capacity for informed problem-solving.

All of the latter reflection leads to think that in the piotent

A view on participatory foresight

As stated in the literature review, participatory foresight aims to include experts, citizens, stakeholders and non-governmental activists by Nikolova (2014), going beyond the predominantly foresight practice that is led by experts or futurists. Under the light of participatory foreight, this thesis achieved the involvement of two different kind of stakeholders when exploring the foresight exercisises. Both were part of the trend mapping exercise and one of them was part of the scenario backasting exercise. In this context, it's important to note that the term experts is attributed to them because they are experts in diverse fields related to water management and community resilience, and not in the way Nikolova describes experts as futurists. In this sense, one can posit participatory foresight described was part of the process of this thesis. However, being critical at it, it can also be said that it is necessary to broader the participation of stakeholders to include final users such as residents of affected coastal zone, some governmental stakeholders and business for example. In the case of future development of this project, exercises like a participatory intervention in order to co-design future scenarios could be of great potential to as referred in the literature review enhabnce the engagement of the actors in order for to better accept the outcomes, having been part of their creation.

8. PERSONAL REFLECTIONS

Personal reflections involve the introspective analysis of my own experiences and learnings throughout the research process. These reflections provide insights into how the research was conducted, the challenges faced, the skills developed, and the overall personal growth gained through the process.

Complexity and Delimitation

This thesis primarily focused on the research phases rather than the crafting of new solutions. This tendency is also a pattern in my previous semester projects and interests; however, the design aspect involving the crafting and testing of prototypes is still an area I wish to further develop. The emphasis on research was also due to the vast and complex nature of the topic of climate adaptation and community resilience. This topic has many angles and required extensive preparatory research, which may not be fully visible in the thesis.

A significant part of the research involved reading, watching videos, and conversing with various stakeholders to gain a deeper understanding of the subject matter. Tools such as expert interviews and desk research were crucial in understanding the history and future directions of the topic.

Given the three-month timeframe and the fact that I conducted this research alone, it was essential to set realistic goals to achieve a valuable outcome. Therefore, the learning goals of this thesis served as a tool to delimit my approach and the depth of different methods used. The aim was to learn how to apply new tools and gain confidence in the ones I already knew. This experimental mindset was prioritized over the rigorous use of each method, which helped define boundaries but also resulted in a results that are still in their first level of development.

The complexity of the topic led to either oversimplification due to insufficient research or difficulties in balancing the system's boundaries. Consequently, the proposed solution was somewhat oversimplified to complete a full prototype-test iteration. This initial, raw prototype would require more iterations of prototyping, testing, and a more committed participatory approach to become a robust, near-real solution. The app format for presenting the service is just one possibility; alternatives could include a Facebook group, a website, or a combination of these platforms.

Participatory Design Challenges

A significant consequence of the topic's complexity was the limited approach of participatory design. Involving real end users, defined as community members of coastal areas prone to flooding, was challenging due to accessibility issues and the lack of organized entry points. Despite this, I managed to involve diverse stakeholders, including experts, boat owners, and a few community members.

However important decisions were primarily made by me as the "expert designer," for example in the define phase and in the prototypes to go further with. Eventhough I carried out informal brainstorming sessions, the “power of decision” remain in the designer as an expert.

This sheds light in the challenges of the participatory approach as it can be difficult, expensive and consider more resources than the ones available in a certain project. Although I had more decision-making power, I also demonstrated resourcefulness, which is a crucial aspect of being a designer.

The challenge of including Theory of Change

Learning about the Theory of Change was insightful. This concept is more complex than my application, which was practical and simplified due to time constraints and stakeholder availability. Properly developing a Theory of Change requires more stakeholders and time, yet it has been instrumental in further developing my concepts and aligns with my goal of learning and using new tools. It’s important to note that Theory of Change is often represented as linear, which it is not.

This thesis focused more on the research phases than in the crafting new solution phases. It is something that I have done throughout my master’s, and I think it’s due to my background.

It is a complex topic that crave for delimiting the approach. The topic is so big that is challenging to find boundaries and not include everything. For the same reason, some things are complex but some other I just added t can also happen; things of high complexity can be oversimplified due to lack of research of due to not finding the right balance of the boundaries of the system.

Looking critically at my design process, one of the things that was oversimplified was the solution proposed, this was to complete a whole prototype-test iteration, however I had always in mind that it was a first raw prototype and that a strong close to reality solution would need more iterations of prototyping and testing and combined with a bigger and more committed participatory approach. The app is just a format to present the service, but not necessarily the only way to present it. It can also be a Facebook group, or a website, or all of them. After following this process, the conclusion is that when incorporating tools from other fields into the design process, they should be integrated within the service system design framework without altering or introducing a new framework. These additional tools are merely supplementary. When combining different methodologies, such as service design and foresight, it is essential to recognize that one serves as the primary methodology—in this case, service design—while the other serves as a toolbox from which to borrow tools to support the methodology.

The challenge is not to find better ways to “know” the future; rather we need to find ways to embrace the creative novelty that is at the origin of not-knowing the future (Miller, 2011). Overall, the excerpt is advocating for a transformation in how we think about and interact with the future, emphasizing innovation and creativity over predictability and certainty.

9. CONCLUSION

Throughout this work, I have explored how foresight can be integrated into service design for climate adaptation, specifically enhancing community resilience in cases of flooding in Denmark. This exploration was conducted through a service design process based on design thinking, which defined the issue of collaboration among community members.

It can be concluded that the integration of foresight tools into the service design practice in this case nurtured the design exercise, helping to understand issues that are envisioned to materialize in the long term, such as flooding. However, insights from both literature research and empirical work through the case study suggest that the integration of foresight tools requires a structured approach. This approach involves keeping the service design framework as the guiding principle and utilizing foresight as a toolset that fits within this framework.

Throughout the process, it was also demonstrated that using a method, whether within foresight or another field, is essential to connect the futuristic outputs of foresight with the near-future focus of service design. In this case, foresight was the method used.

Limitations for the use of foresight tools stem from the complexity of the topic and the fact that many of the methods were used in a superficial way, deciding not to focus on the rigor of the method as it was believed to be unnecessary.

As an outcome of the case study, a designed service aiming to improve community collaboration in cases of flooding was prototyped.

Furthermore, the research demonstrated the importance of utilizing a method to connect the outputs of the foresight exercise to become inputs for service design—essentially, a way to use future insights in the present. In this case, the Theory of Change was employed as the tool to achieve this integration.

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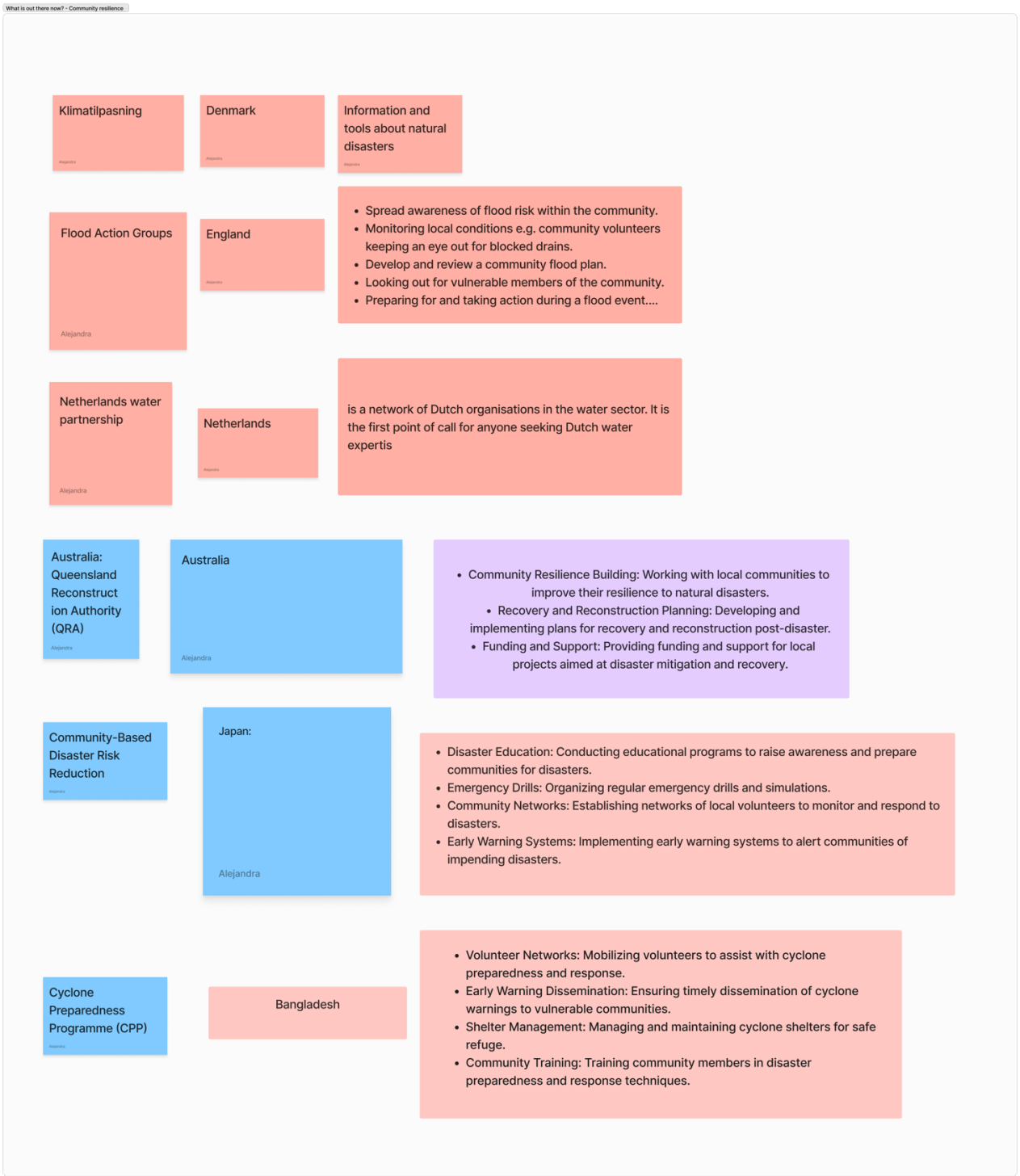
APPENDIX

APPENDIX 1

What is out there brainstorming



APPENDIX 2: Køge Interview transcription

Full interview transcription available in the following link: Køge interview Transcription

APPENDIX 3: Survey Results

Survey questions and results can be found here: Survey results

Section 3

Online safari

Most of the pictures from recent posts (2023 and 2024) show pictures and videos of public spaces such as routes, parks, harbours, fewer are of private houses

Alejandra

There are facebook gropus specially dedicated to Floodings such as the one called "Oversvømmelser Danmark"

Alejandra

Flood Action Groups - UK

Alejandra

Lack of trust on that there will be more risk of floodings

Alejandra

I min optik haster det ikke. Jeg går hver dag langs stranden på syd, og må blot konstatere, der de sidste mange år ikke er kommet så meget som en dråbe mere vand. Og på Dragør Søbad er der nærmest kommet mindre - man skal helt ned på maven for at blive bare lidt våd.

I think that Mother Nature is maybe trying to say something...

Alejandra

Story of success: Community help Faaborg

https://www.instagram.com/p/CysOtNsMPqQ/?img_index=2

Low trust and frustation with current local authorities - due to the lack of "physical work" to prevent community from floods

Alejandra

There was an interview with a guy that had lived in a place with risk for a long time and he explains about the landowner being the responsible for managing the floodings

Alejandra

Vores husforsikring stiger pr 1.8 med godt 100 % pga oversvømmelser

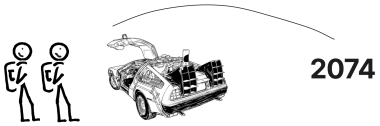
Alejandra

People posting pots supposed to be funny talking about sellings houses protected against floodings

Alejandra

APPENDIX 5:

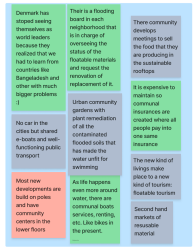
Backcasting Workshop with expert



Scenario 1: Sustainable Urban Adaptation

By 2074, Denmark's coastal cities have become world leaders in flood resilience. The government, in collaboration with environmental scientists, urban planners, and international experts, has transformed urban landscapes to harmonize with rising sea levels. Cities like Copenhagen have expanded their use of green roofs, permeable pavements, and expansive coastal parks that double as flood barriers. A network of adaptive floating homes and businesses thrives, incorporating innovative designs that rise with the water levels. Public infrastructure such as roads and railways have been elevated and reinforced, minimizing disruption during high water events.

What kind of community initiatives are in place in this scenario?

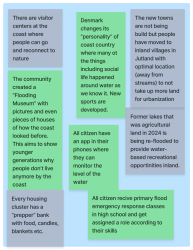


DALL-E CREATED

Scenario 2: More space to nature, living away from the coast is becoming the norm.

Facing the inevitability of rising sea levels, Denmark has opted for a strategy of managed retreat from the most at-risk coastal areas. The government has initiated programs to encourage relocation to higher ground, providing financial and logistical support for displaced communities. New towns have been planned with resilience at their core, featuring elevated housing clusters, community flood shelters, and sustainable local food and water systems. Education and public awareness campaigns focus on building a culture of adaptability and resilience, preparing the population for a future where living away from the coast is the norm.

What kind of community initiatives are in place in this scenario?



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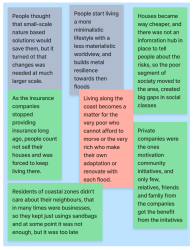
Scenario 3: Inadequate Response and Chronic Flooding

Major Cities: Despite intentions to upgrade infrastructure, economic constraints, political deadlock, or underestimation of the severity of climate impacts lead to insufficient adaptations. Areas of main cities frequently experience flooding, disrupting daily life, damaging property, and straining emergency services. The surrounding coastal towns struggle even more due to limited resources. Periodic flooding becomes a common reality, leading to a slow decline in population as residents move away from the most affected areas. Local economies suffer as businesses close or relocate, and tourism declines.
In the most remote coastal villages, the lack of immediate help during emergencies and a slower response to infrastructure needs result in occasional severe damage from storms and flooding. Some villages may become virtually uninhabitable during extreme events, leading to temporary or permanent displacement of communities.

What kind of community initiatives are in place in this scenario?



DALL-E CREATED

APPENDIX 6:

PRODUCT REPORT:

The product report for the first prototype developed can be found here: product report