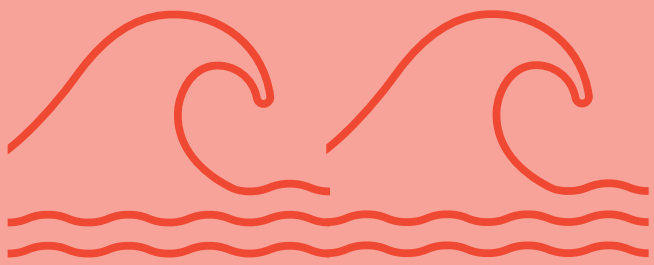
SAFETY ON AALBORG'S WATERFRONT: A STUDY OF USE, RISK, AND RESPONSIBILITY



Signe Nielsen

Aalborg University, Urban Planning and Management

AALBORG UNIVERSITY
STUDENT REPORT

Department of Sustainability and Planning
Rendsurggade 14
DK - 9000 Aalborg
https://www.plan.aau.dk/

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Supervisor:
Lars Bodum

Author:

Signe Korup Nielsen

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Abstract:

This study aims to investigate the current safety conditions at the Aalborg waterfront. In recent years, there has been attention on drowning accidents with fatal outcomes, which has sparked debate about whether the waterfront is safe to move around or whether additional measures are needed. To answer the project's research question: *How is the current safety setup on Aalborg's waterfront adapted to the area's use, and how is the responsibility for safety organized among the involved actors?* The waterfront is analyzed through observations, interviews with relevant stakeholders, and the use of GIS to map safety conditions along the waterfront. This leads to a discussion of the current safety conditions and the distribution of responsibilities among landowners. The study concludes that the current safety setup along Aalborg's waterfront is uneven and dependent on land ownership, leading to gaps in safety infrastructure. To ensure consistent safety for all users, a unified waterfront safety plan is needed, clearly defining responsibilities and setting minimum safety standards across both public and private sections

Preface

This study constitutes the final thesis of the Urban Planning and Management program at Aalborg University and was conducted from February 1, 2025, to May 28, 2025. The focus of this study is the safety of Aalborg's waterfront, with the aim of examining how the waterfront is used and how safety is managed. The interest in investigating this topic arose after several fatal drowning accidents occurred along the waterfront in Aalborg. These accidents have led to frustration over how such accidents can happen and what can be done to prevent them. It is the hope that this study can help shed light on whether certain measures along the waterfront can be improved to make the area feel safer for everyone.

In connection with the preparation of this study, I would like to thank my supervisor, Lars Bodum, for guidance, valuable feedback, and constructive criticism. I would also like to thank those who contributed through interviews. Special thanks go to Christian Birch Smith from Aalborg Municipality and Tommy Johannessen and Lars Krogsgaard Bjørndal from Nordjyllands Beredskab.

Table of contents

1 Motivation

Drowning is a major global public health issue, affecting both coastal and inland areas. While many people associate drowning with the open ocean, statistics show that a significant number of accidents occur in urban environments, where water bodies intersect with the daily life. Understanding the geographical and situational risks of drowning is crucial for improving safety measures and preventing fatalities. According to the WHO (2014), drowning was the third leading cause of unintentional death in 2012, resulting in 372,000 fatalities worldwide. However, the actual number is likely much higher, as many countries are unable to report exact figures for drowning accidents. This is especially true for low-income countries, where such accidents often go unrecorded and therefore, the problem may be even bigger on a global scale. In general, it can be said that there are three common global risk factors for where drowning accidents occur. Many accidents happen inland. Even in high-income countries like Canada and Australia, most drowning accidents occur inland rather than along the coast or at sea. Additionally, the risk of fatal drowning is also higher in less frequented or remote areas because there are no others present to save someone. Finally, most accidents happen in areas where people are close to water, such as places where they live near bodies of water. Examples include cities where people live close to rivers or harbors (WHO, 2014). Many cities are built around water bodies such as rivers, canals, and harbors, which integrate into everyday life. The combination of high population density and recreational activities near the water increases the risk of drowning in these areas.

1.1 Drowning Accidents on an International Scale

To further illustrate the risks of drowning in urban environments, specific case studies provide valuable insights. One such example is Adelaide, Australia, where the interaction between urban infrastructure and water bodies has resulted in a significant number of drowning accidents. In the city Adelaide the Torrens River flows through. The river's length within the city is 2,5 kilometers, and along this part water activities are not permitted in this area. Despite this restriction, there were 34 drowning accidents between 1988 and 2017. Another river in Australia, the Murray River, has a course of approximately 640 kilometers, where water activities are allowed. On the Murray River a total of 57 drowning accidents were recorded over the same period. This means that the Murray River has had 0,1 drowning

accidents per kilometer, whereas the urban section of the Torrens River has had 13,6 drowning accidents per kilometer. This highlights the elevated risk of drowning in urban waterways, even in areas where water activities are officially restricted. In the city, a particularly large number of young men under the influence of alcohol fell into the water. The city of Adelaide serves as an example of the significant risks associated with urban water environments (Stephenson et al., 2020).

Similarly, European cities with proximity to water bodies face comparable challenges with drowning accidents. Amsterdam, the Netherlands, is known for its extensive canal system that extends into the inner city. People tend to fall into the water where there are a high number of people and most people who fall into the water do so during weekends, particularly between midnight and 6:00 AM. The rate of near-drowning accidents is higher in Amsterdam's inner city compared to the rest of the region. However, the number of fatal drownings is lower in the inner city, suggesting that rescue efforts are generally effective. The fatal drowning accidents mostly occur in the outer areas of the city, where there are fewer people and therefore fewer witnesses to help. Nevertheless, people argue that more focus should be placed on preventing people from falling into the water in the first place (Reijnen et al., 2018)

Another European country that also has problems with drowning accidents in cities is the United Kingdom (UK). In the UK, statistics indicate that in 89% of cases between 2010 and 2015, where a young adult man went missing after a night out, they were later found drowned. 96 cases were recorded, with the majority occurring during the winter months when the water was particularly cold. The high number of accidents has sparked debate about how to address and prevent this issue. According to Geoff & Greatbatch (2017) men who went missing after a night out were at a higher risk of drowning than experiencing another type of accident. The same sources conclude that there is a need for further investigation into such accidents in order to prevent them (Geoff & Greatbatch, 2017). In the UK, efforts have been made to prevent drowning accidents by implementing national strategies. In the city of Durham, fatal drowning accidents occurred between 2010 and 2015, all involving men who fell into the city's river after a night out. As a result, key outcomes were developed to prevent and reduce the number of people falling in. These included a focus on better lighting, information about safe walking routes, physical improvements to the

riverbank, safety equipment, surveillance, and ensuring that future construction projects improved water safety (National Water Safety Forum, 2015).

A review of international examples show that drowning accidents often occur where there is a high level of human activity, whether there are rivers, harbors, or canal systems. There is a particular tendency for these accidents to happen close to urban environments, often in connection with nightlife and alcohol consumption. These patterns are also evident in Denmark, where harbor areas in larger cities have proven to be particularly vulnerable to drowning accidents.

1.2 Drowning Accidents in Denmark

The latest figures from TrygFonden (Ahrensberg et. al, 2024) shows that out of the 1.302 drowning accidents in Denmark during the period 2001 to 2022, 300 of the accidents happened in harbors. It states that harbor areas were the places where most accidents occurred, compared to beaches, coasts, and open sea. The development of fatal drowning accidents in harbors in the period of 2001 to 2022 can be se on the following figure 1.

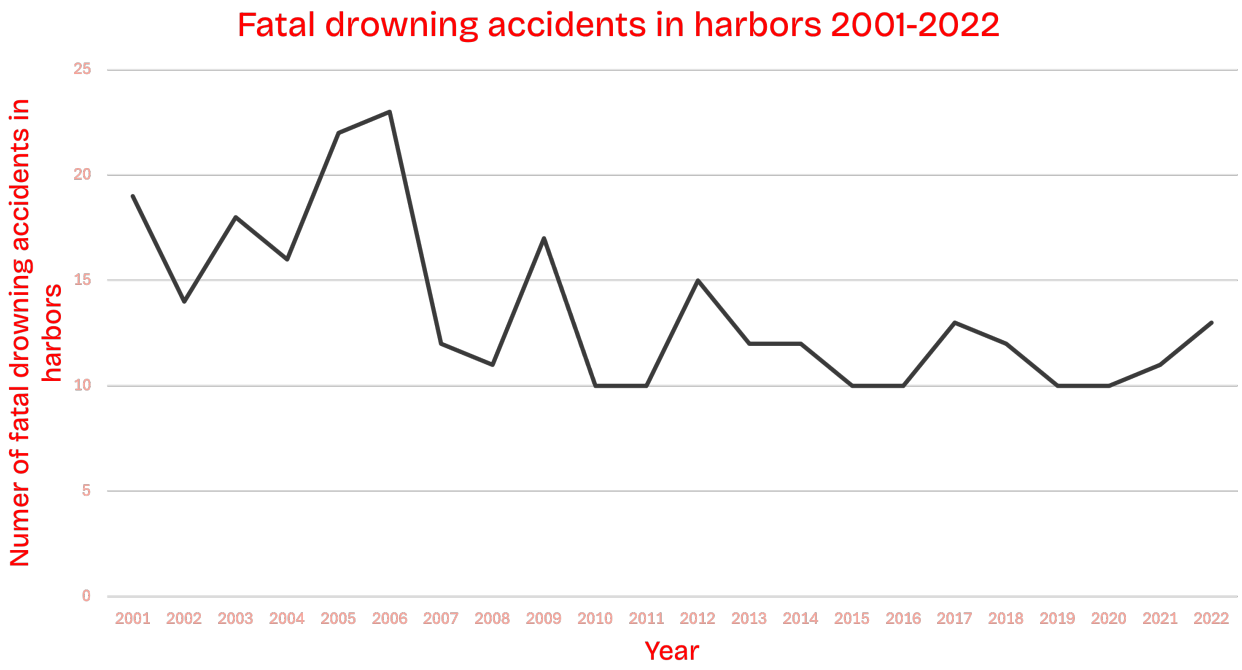

Figure 1- Fatal drowning accidents in Danish harbors from 2001-2022 (Ahrensberg et. al 2024)

The figure shows that the number of drowning accidents in Denmark has generally been decreasing, but it is still necessary to investigate further, as the number of accidents has

been increasing since 2020. The number of drowning accidents has not been under 10 accidents in a year. But what are the reasons for drowning accidents in Denmark? To answer this, it is necessary to examine the parameters underlying harbor accidents in Denmark. The focus is on sociodemographic factors, physical causes, and behavior. The aim is to uncover the existing knowledge on the causes of drowning accidents.

1.2.1 Sociodemographic Factors

There are no concrete similarities between economic differences, educational differences, jobs, and culture, as there are significant global variations, making direct comparisons difficult. There can also be substantial differences in proximity to water, as well as climatic differences that influence these factors (Bierens, 2006). But there is seen differences in other sociodemographic factors such as gender and age.

Gender

When it comes to factors such as gender, more men drown than women. Among all age groups, there are three times as many men who drown as women, according to Bierens (2006). This is also consistent with Danish figures, which show that 85,6% of drowning accidents between 2001 and 2022 involved men. It should also be added that, among accidents in Danish harbors, men were involved in 93% of the accidents in 2001-2022 (Ahrensberg et. al 2024). According to Bierens (2006), some of the explanations for this gender difference are that men may be more exposed to water due to certain professions that take place on or near water, which are more male dominated.

Age

There are also differences in parameters such as age. In Denmark, the age group 45-74 years had the highest number of fatal drowning accidents during the period 2001-2022. However, for drowning accidents in Danish harbors, it is the 15–24 age group that has been involved in the most fatal drowning accidents (Ahrensberg et. al 2024). One of the reasons why individuals over the age of 65 are particularly vulnerable could be due to health conditions, such as cardiovascular diseases, or other factors like poorer swimming abilities (Bierens, 2006).

1.2.2 Environmental Factors

As it is mentioned the environmental factors also have an influence on the risk of drowning. It is the places of occurrence, climatic conditions, and the safety politics in the surroundings.

Place of occurrence

In Denmark, most drowning accidents occur in harbors, with 300 out of 1.302 recorded between 2001 and 2022 happening in harbor areas. The second most common locations were beaches and coasts, followed by the open sea. Regarding the locations of drowning accidents in Denmark, there were also differences between genders. The places where women are most often involved in drowning accidents are along coasts and beaches (26,7%) and in lakes (16%), whereas men are more often involved in drowning accidents in harbors (25%) and in the open sea (23,7%). This reflects the differences in activities that the genders typically engage in. Men are more often present in harbors and are more likely to sail (Ahrensberg et. al 2024). Bierens (2006) suggests that drowning risk is more related to the frequency and proximity to a water environment rather than the specific type of environment itself (Bierens, 2006).

Climatic conditions

Climatic conditions also play a significant role in the risk of fatal drowning accidents. Lower water temperatures contribute to a reduced chance of survival. In colder water, the time before harmful effects occur is significantly shortened (Bierens, 2006). In Denmark, water temperature also affects the risk of experiencing a fatal drowning accident. During the colder winter months, the chance of survival after falling into the water is lower, as the cold-water temperature causes rapid cooling of the body. However, in the summer, the number of drowning accidents also increases, as warmer water temperatures lead to more people swimming at beaches and along the coast, thereby exposing more individuals to the risk of drowning. Another climatic condition that affects the number of drowning accidents is the amount of sun light. Denmark, in particular, is impacted by fewer hours of sunlight during the colder months. This can make it more difficult to navigate, especially in areas with poor artificial lighting, and can also make it harder to locate individuals who have fallen into the water (Ahrensberg et. al 2024).

The time of day also influences when most drowning accidents occur in Denmark. During the period from 2001 to 2022, 55% of drowning accidents occurred during daylight hours. More people are out and near the water during the day, whereas fewer individuals are present near water at night. However, darkness at night plays a role in the drowning accidents that do occur. In 2022, most drowning accidents in harbors happened at night, with movement around the harbor being the most common activity leading up to the accident (Ahrensberg et. al 2024).

When looking at drowning accidents in harbors, marinas, and urban canals, there are monthly variations in when most accidents occur. The highest number of drowning accidents in marinas happen during the summer, as activity increases and more people have their boats in the water throughout summer and autumn. In contrast, during the colder months, boats are brought ashore, which affects the number of accidents. For harbor-related accidents, most drowning accidents occur during the cold winter months, when temperatures are lower and daylight hours are fewer (Ahrensberg et. al 2024).

Safety Equipment and Safety Policies

In the book Handbook of Drowning (Bierens, 2006), it is made clear that safety and safety equipment have a positive impact on the chances of surviving accidents at sea. There is a particular focus on accidents involving ships, where it is shown that accidents with more accessible safety equipment have a higher chance of survival. Additionally, the lack of safety equipment and insufficient maintenance are also risk factors that influence survival in drowning accidents. Prevention plays a significant role in relation to drowning accidents. In particular, providing swimming lessons to children has been shown to have a positive effect in preventing drowning accidents (Bierens, 2006).

1.2.3 Behavioral Risk Factors

Human behavior around water also plays a role in increasing the risk of falling in. Factors such as being alone or having consumed alcohol can contribute to this risk.

Being alone

According to Bierens (2006) parental supervision is a key factor in preventing children from experiencing fatal drowning accidents. However, Ahrensberg et. al (2024) states that it is not just parental supervision that prevents drowning accidents, but rather the general presence of another person, ensuring the victim is not alone. Most fatal drowning accidents occur when the victim is alone, because the chance of being rescued is higher when others are present and can act quickly. In Denmark, 55% of drowning accidents between 2001 and 2022 happened while the victim was alone. The activity with the highest percentage of victims being alone before the accident was drowning in bathtubs, where 88% were alone. The second highest was pedestrian activity at harbors, where the victim was alone in 79,4% of cases.

Alcohol

One of the most widely discussed risk factors in fatal drowning accidents is the consumption of alcohol and/or drugs. These substances impair individuals motor skills and judgment, which can make a person's behavior around water more unpredictable and reduce their ability to rescue themselves (Ahrensberg et. al 2024). In Denmark, during the period from 2001 to 2022, alcohol consumption was involved in 28,3% of fatal drowning accidents. In the following figure 2, the development of the fatal drowning accidents involving alcohol in Denmark in the period 2001 to 2022 can be seen.

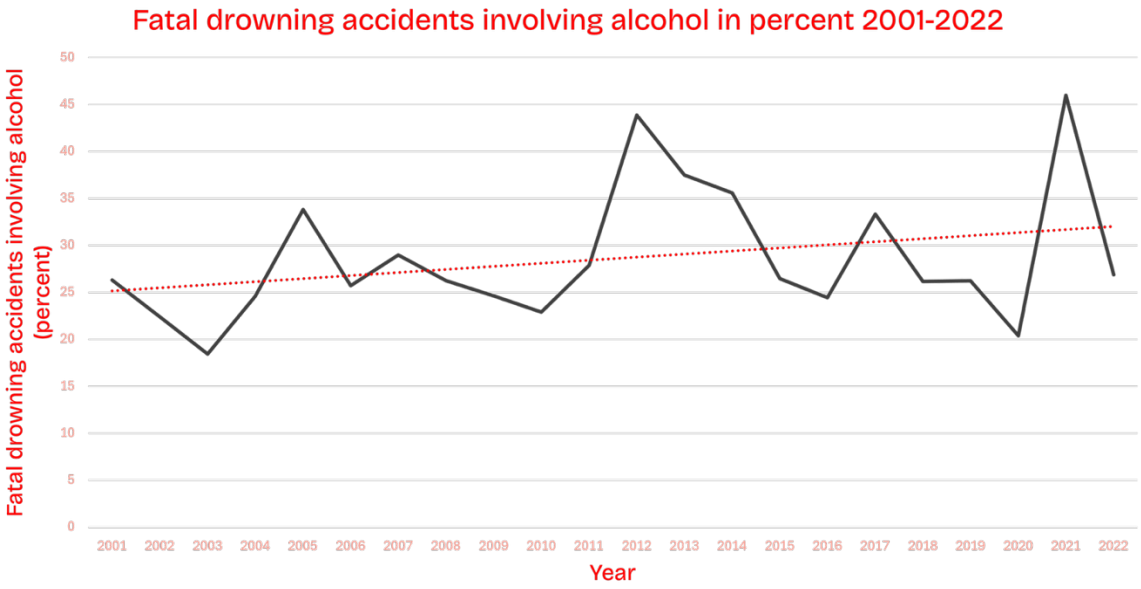

Figure 2 - The development of fatal drowning accidents involving alcohol in Denmark in the period 2001-2022 (Ahrensberg et. al 2024)

On the figure the development can be seen as the dark blue line. The red line represents the linear trend of fatal drowning accidents involving alcohol. It indicates a slight increase in the proportion of fatal drownings where alcohol is a factor. This suggests that a growing share of annual drowning accidents involve alcohol compared to those that do not.

The distribution of men and women who had consumed alcohol prior to a drowning accident shows a significant male majority. Between 2001 and 2022, approximately 89% of alcohol-related drowning victims were men. Additionally, there are noticeable age differences in the distribution. The majority, around 70,4%, of those who had consumed alcohol before drowning were aged 45 or older. In contrast, among young individuals aged 15-29, only 13% had consumed alcohol prior to drowning. Within this age group, men were overwhelmingly overrepresented, accounting for 98% of cases. Furthermore, half of the drowning accidents in this category were linked to social events or nights out, often occurring when individuals were on their way home and decided to urinate in the water or go for a swim (Ahrensberg et. al 2024).

For drowning accidents involving alcohol and/or drugs, most accidents occur in harbors. More than half (55%) of drowning accidents in harbors between 2001 and 2022 involved alcohol or drug consumption prior to the accident. However, the actual number may be higher, as some victims are found long after the accident, or some were alone at the time, and others are therefore unable to recount the events leading up to the accident. The annual average of alcohol-related drowning deaths has fluctuated between 2,8 and 4 per year during this period. Additionally, pedestrian activity is the most common activity leading up to an alcohol-related drowning accident (Ahrensberg et. al 2024).

To understand the underlying causes of drowning accidents, the above has focused on fatal drowning accidents and what can be concluded from them as a collective statistic. However, to delve deeper into the explanations of why such accidents occur, TrygFonden (Goor et al, 2023b) has published a report on near-drowning accidents called "*Nærdruknehændelser I Danmark*", in which individuals who narrowly avoided a fatal drowning have shared the reasons that led to their situations.

1.3 Near Fatal Drowning Accidents

In 2022, TrygFonden (Goor et al, 2023b) began searching for individuals who had survived a near-drowning accidents. Since it is not possible to gather information from those who have been involved in a fatal drowning accident, the focus has been placed on accidents where individuals ended up in situations that could have resulted in a fatal drowning accident. This section aims to clarify the elements that caused the accident in the first place, as well as identify the factors that prevented it from becoming a fatal drowning.

In this study, 269 people participated in a survey covering questions about the events leading up to their accident, their accident itself, and its aftermath. Additionally, 14 in-depth interviews were conducted to gain a deeper understanding of the accidents and provide further insights. Lastly, 1.028 responses from a vox pop conducted in three Danish cities, Copenhagen, Aarhus, and Aalborg, were included to understand behavior around harbors and canals. Of the 269 responses regarding near-drowning accidents, 72% occurred in harbors. There has been an increase in accidents in Danish harbors due to urban development, as recreational and urban areas are moving closer to the harbor environment (Goor et al, 2023b). Therefore, the study asked the individuals involved whether their accident could have been avoided.

Of the 269 respondents, 42% stated that their accident could have been prevented under different circumstances. 24% believed that a barrier, such as a fence or better safety railings, could have made a difference, while 14% pointed to improved lighting in the area as a potential preventive measure. Additionally, 11% stated that better ground markings could have helped avoid the accident, and 9% highlighted the importance of improved urban design. Finally, 6% stated that better signage could have played a role in preventing their accident. Additionally, 48% of respondents either did not know what could have prevented their near-drowning accident or believed that none of the above-mentioned categories could have prevented it. Among those in this category, the majority experienced the accident during the daytime, without the influence of alcohol, and there was presence of others (Goor et al, 2023b).

Some of the factors identified by individuals involved in near-drowning accidents as potentially making a difference included better lighting. However, around half of the accidents occurred between 12:00 and 17:59, during daylight hours. 34% of accidents happened at night between 18:00 and 5:59, while 12% occurred between 6:00 and 11:59. This means that half of the accidents took place in daylight, which may have been a crucial factor in preventing them from becoming fatal drowning accidents. Since lighting appears to have a positive effect, it is relevant to examine how the lighting in dark conditions influences safety. A total of 61% of those who fell into the water during darkness believe that better lighting could have had a beneficial effect in preventing the accident. Further breakdown shows that 68% fell in the water during daytime when there was sunlight, 20% fell into the water, when it was dark, but there was streetlight, and 12% when it was completely dark. This suggests that although sunlight has a beneficial effect in preventing fatal near-drownings, street lighting or good illumination during dark hours also has a positive effect in helping to prevent fatal accidents (Goor et al, 2023b).

Elements highlighted as crucial for rescue include ladders, rescue equipment such as lifebuoys and ropes, as well as tires, stones, and other tools that enable self-rescue. In 21% of accidents, ladders or other rescue equipment made it possible to climb out, and in 12% of cases, ropes, tires, stones, or other objects enabled individuals to rescue themselves. It is therefore highlighted that having equipment for climbing up, as well as ensuring it is visible and accessible, is essential for self-rescue if no one else is present. It is important that the ladders are illuminated so they can be seen from the water. The ladders must be of a length that makes them reachable. Additionally, the tools used for climbing up must not be slippery, as this would make self-rescue impossible (Goor et al, 2023b).

As mentioned earlier a factor often seen in fatal drowning accidents in harbors is the consumption of alcohol prior to the accident. In this study, 23% of respondents indicated that they had consumed alcohol before their near-drowning accident. The problematic aspect of alcohol is that it impairs a person's motor skills and judgment, which can increase the risk of falling into the water. Some of the accidents mentioned in this study include cases where individuals experienced blackouts and only regained consciousness after falling into the water, as well as cases where people were slightly intoxicated, tripped over a curb, and ended up in the water. The study also showed that more men than women were affected by

alcohol when they fell into the water. Furthermore, there is a noticeable pattern among both young and older men, where they are more often alone while being under the influence of alcohol (Goor et al, 2023b). This tendency of being alone is another factor that can contribute to drowning accidents, as the presence of others can help prevent the accident from becoming fatal.

In this study, 61% were with people they knew, and 11% of respondents stated that others were present, although they did not know them. Meanwhile, 27% of respondents answered that they were alone when the accident took place. This suggests that the presence of others may be crucial for surviving a drowning accident. The presence of others plays an important role in helping to get the person out of the water quickly and alerting emergency services. In some cases, it can be difficult for the person in the water to see the rescue equipment, making guidance from others necessary (Goor et al, 2023b).

Among some of the more in-depth interviews conducted in the study, several participants indicated that changes in the layout of the area had caused them to fall. Additionally, the individuals had not been aware of the layout changes, as their attention was focused elsewhere. Since there was nothing drawing attention to the altered layout, this is considered a factor that may contribute to an increased risk of falling (Goor et al, 2023b).

The study highlights three key risk factors that contribute to the drowning accidents: alcohol, darkness, and being alone. Alcohol impairs motor skills and judgment, which increases the risk of falling into the water. The study also found that, especially among men, accidents often occur when individuals are alone and under the influence of alcohol. Additionally, darkness is a significant risk factor, as it increases the likelihood of accidents. It is clear how well-lit areas can play a crucial role in preventing fatal accidents. Finally, the absence of others makes it more difficult to get out of the water quickly or call for help. Therefore, it is important to address these factors, as the presence of these factors can contribute to accident prevention. As mentioned, there are several factors that contribute to the causes of drowning accidents. These involve both human behavior and physical surroundings, which can influence whether a person ends up in a drowning situation. However, it is also important to look at the measures being taken to prevent fatal drowning accidents. This includes the physical safety setup that can help prevent drownings in

marinas, although many of these safety measures can also be applied to other aquatic environments.

1.4 Recommendations of Harbor Safety

The purpose of this section is to outline the current recommendations regarding harbor safety in Danish marinas. At present, there are no official guidelines specifically targeting waterfronts in urban areas. Therefore, this section is based on recommendations from Forening af Lystbådehavn i Danmark (FLID), which has developed a certification scheme to designate Danish harbors as 'Safe Harbors'. Although this scheme is primarily intended for marinas, in this case, the recommendations are considered in relation to safety along urban waterfronts. To achieve certification as a Safe Harbor, certain recommendations must be met. Some of these recommendations are mandatory, while others are considered ideal. The mandatory recommendations must be fulfilled for a harbor to be certified as a Safe Harbor. In addition to certifying Danish marinas, the association also offers a risk assessment of the harbor area, in which the harbor's layout and surroundings are evaluated (FLID, udat).

The risk assessment is based on whether there are areas where the risk of falling into the water is higher, areas with high pedestrian traffic, accessible routes for rescue operations, signage or barriers, whether nearby restaurants and playgrounds are separated from the waterfront edge, the condition and slip resistance of bridges, and whether it is safe to move around the area in the dark. FLID has recommended that Danish harbors have rescue stations, consisting of various life-saving equipment to assist in rescuing individuals from the water. A rescue station should include a fixed ladder, a portable ladder, a rescue hook, an instruction sign for the use of the equipment, and a fire extinguisher. It is recommended that rescue stations are placed at a maximum distance of 75 meters from each other (FLID, udat)

It is recommended that fixed ladders are installed at a maximum distance of 50 meters apart. Ladders should extend 1 meter below the water surface to ensure that individuals can climb out regardless of the water level. Furthermore, it is recommended that fixed ladders are equipped with handrails to allow individuals to pull themselves up. It is also advised that ladders are placed in well-lit areas or have integrated lighting. For ladders without built-in

lighting, it is recommended that they are marked with reflective material to make them easier to spot from the water in low-light conditions. It is also recommended that bollards near ladders are marked with reflective material to ensure they are visible and can be noticed by individuals. It is recommended that ropes are installed between the piers to help individuals who have fallen into the water stay afloat. However, this is considered an ideal recommendation and not a mandatory requirement for obtaining Safe Harbor certification. The rope should be positioned 20–30 centimeters above the water surface to allow individuals to hold onto it. It is recommended that the rope is yellow in color to make it easier to spot for people in the water (FLID, udat).

Other recommended measures include having a defibrillator and a first aid kit available, installing fire extinguishers in areas with a high fire risk, implementing plans for regular equipment inspections, providing guidelines for users on how to use the equipment, overview maps showing the location of safety equipment, an emergency response plan for accidents, and finally, an environmental spill kit for dealing with environmental incidents. However, these latter measures are primarily intended for marinas (FLID, udat)

Although the safety recommendations primarily relate to marinas in Denmark, areas where large numbers of people live close to water are also highly relevant in this context. In general, locations where people are near the water are of particular concern when it comes to drowning accidents. One city that has received significant media attention due to cases of fatal drowning accidents serves as a compelling example. This city is centered around a fjord that plays a vital role in urban life, but which is also known for its strong currents. Alongside the recurring accidents, a broader public debate is currently underway about the most effective preventive measures, such as the controversial proposal to install fencing along the waterfront, to reduce the risk of future drownings.

1.5 Aalborg as a Case

Aalborg is the fourth-largest city in Denmark and ranks among the cities with the highest number of fatal drowning accidents in harbors. In the city the fjord, the Limfjord, divides Aalborg and Nørresundby, which is located in the central area in Aalborg of the city see figure 3.

Figure 3 – The Limfjord, which separates Aalborg (south) and Nørresundby (north)

A waterfront in Aalborg is a recreational meeting point in the city and a boulevard for pedestrians and cyclists that connects the western part with the eastern part. The waterfront offers both areas for relaxation and areas for sports activities. The promenade allows citizens to get very close to the fjord. But before the waterfront became a social gathering place for the city's residents, it was an industrial harbor, an area with almost non recreational activity. The transformation of the area began in 2004 and turned the waterfront into a central place in the city (C.F. Møller Architects, n.d.).

Between 2001 and 2022, seven fatal drowning accidents occurred in Aalborg, where pedestrian traffic at the waterfront preceded the accident. Only Helsingør, Aarhus, and Copenhagen recorded more accidents. In total, there were 202 fatal drowning accidents in Danish harbors during this period, which all involving pedestrian activity prior to the accident. Pedestrian activity includes individuals walking or standing in the harbor area,

being on a boat in the harbor, and boarding or disembarking from a boat (Ahrensberg et. al 2024).

Aalborg is a university city with an active nightlife, attracting many young people. The city is home to Jomfru Ane Gade, a popular street for nightclubs and young people. Jomfru Ane Gade is centrally located and relatively close to the waterfront and the Limfjord. In recent years, there has been increased focus on safety along the waterfront in Aalborg following several fatal drowning accidents involving young men who drowned after a night out (Walsh, 2024).

The two most recent fatal drowning accidents occurred in the fall of 2024. In both cases, the victims were young men, and in one of the accidents, the drowning happened in connection with a night out. These two accidents once again sparked a debate about measures to improve safety along the waterfront. In particular, there has been an increasing demand for fencing (Nordjyllands Politi, 2024) & (Walsh, 2024).

For many years, the arguments against installing fences in Aalborg have been the dominant ones. The arguments against installing fences are that it can create a false sense of security, as a fence is not a 100% effective barrier. Additionally, another argument is that it may encourage further interaction close to the edge of the waterfront, increasing the risk of falling in. People may sit on it or try to climb over a fence. Additionally, the landscape aspect is also an argument against installing a fence. Many believe that setting up a barrier, that could obstruct the view of the Limfjord, would negatively impact the city's aesthetics. A third argument concerns the waterfront's function, as ships need to dock. If a fence is installed along the edge, it could make it more difficult for ships to dock properly (Julsgaard, 2022) & (Bjerre, 2022). But after accidents in recent years, the focus has shifted to seeing fences as a more important solution than the city's aesthetics, as they would contribute positively to safety around the waterfront. Additionally, the argument is that in another Danish city with similar drowning accidents, fences have been installed along the waterfront, which has had positive effects. Aarhus installed fences along a longer stretch of the waterfront in 2022, which later received positive feedback both for the appearance of the waterfront and for improving safety. After the installation of the fences in Aarhus, there has not been a single drowning accident at the harbor in 2022. Therefore, it seems that opinions on fences

in Aalborg have shifted, with many now seeing them as a good solution for improving safety (Thiellesen, 2024) & (Thaysen, 2023). Other measures that have already been implemented at Aalborg waterfront include the installation of ladders, lighting, lifebuoys, and thermal cameras that should prevent drowning accidents (Tryg Aalborg, u.dat). In 2017, thermal cameras were installed at Aalborg waterfront to help reduce the number of drowning accidents. These thermal cameras were designed to monitor activity at the waterfront and alert emergency services if a person was near the water or had fallen in. But despite several measures to improve harbor safety, drowning accidents still occur in Aalborg (Rasmussen & Smorawski, 2024). Each drowning accident is a tragic loss of life that not only affects the individual and their family, but also the surrounding community. This highlights the importance of strengthening preventive measures and underlines the need to prioritize safety setups along waterfronts to reduce future accidents.

2 Research question

This study will examine safety at the Aalborg waterfront, conceptualized as a recreational urban space characterized by its immediate proximity to the water. By analyzing how the waterfront is used, how safety measures are organized, and by mapping the safety setup at the area, the study seeks to uncover the complexity of ensuring safety in this dynamic urban space. This study aims to provide a more detailed basis for assessing safety improvements along the waterfront. The goal is to contribute knowledge that can support preventive measures and inform decisions related to physical planning. This leads to the study's research question, which is as follows:

How is the current safety setup on Aalborg's waterfront adapted to the area's use, and how is the responsibility for safety organized among the involved actors?

To support the research question, this study has three supporting questions that relate to the further analysis of the study.

2.1 Supporting Questions

- *How is Aalborg's waterfront used as a recreational urban space, and how does the level of activity relate to the risk of drowning accidents?*
- *How is responsibility for safety organized among the involved actors, and what strengths and weaknesses can be identified in their collaboration and network?*
- *How is the current physical safety setup distributed along Aalborg's waterfront, and where do high-risk areas emerge in terms of rescue equipment and safety equipment?*

3 Theoretical and Analytical Framework

This section aims to explore the theoretical and the conceptual perspectives relevant to the study of safety at a waterfront. The aim is to establish a framework that can help understand how safety is created and practiced in a complex urban context. The section includes perspectives on how urban spaces are used, as well as theories addressing the network and actors regarding the waterfront safety. First, the section will review how the research design of this study has been shaped.

3.1 Research Design

The research design presents the overall structure of the study and how it investigates safety at Aalborg's waterfront. It includes the initial phases of the research process, from the theoretical framework and data collection to analysis and discussion. The purpose of this research design is to ensure coherence between the study's overall aim, the theoretical perspectives applied, and the methodological approach. The research design of the study can be seen on the following figure 4.

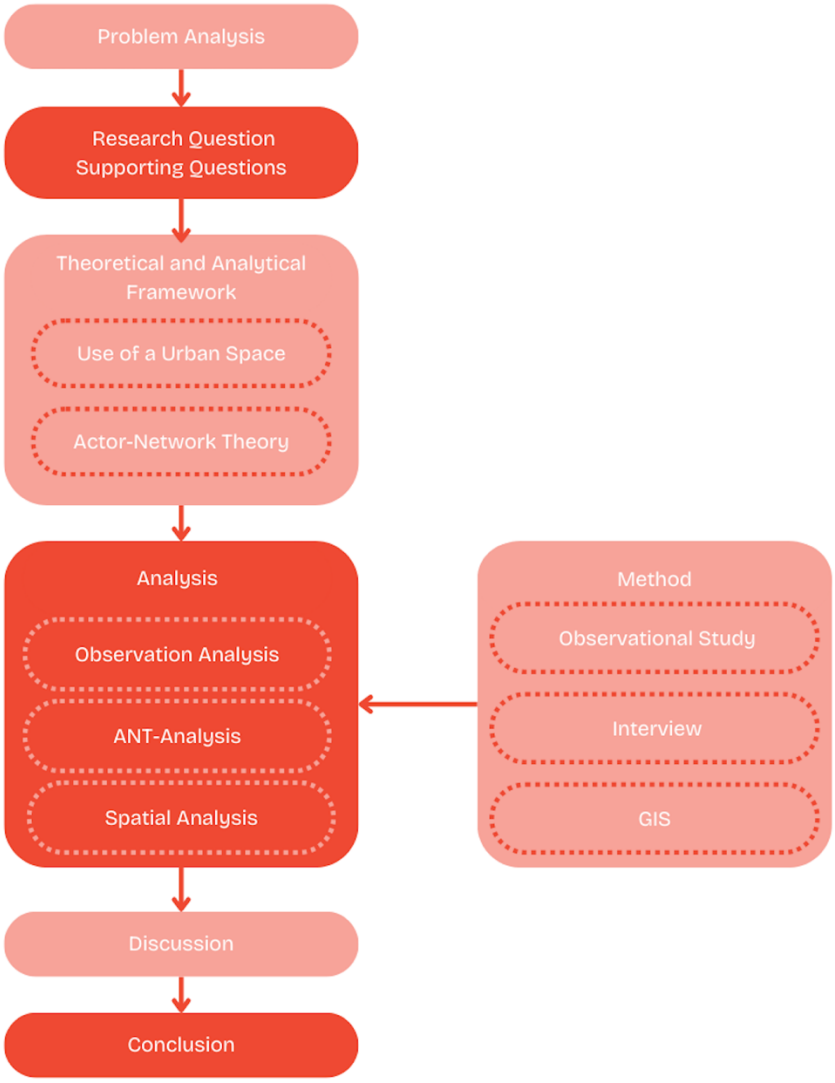

Figure 4 - Research Design

The study begins with the motivation of the study, that also functions as a problem analysis which helps justify the study's relevance and introduces the central issue. Furthermore, it provides insight into how the problem is currently addressed. This leads to the research question, which forms the foundation for how the study is developed and explored. To make the research question more manageable, three additional supporting questions have been formulated to help answer the study's overall research question. Following this, the theoretical and analytical framework of the study is presented. The section includes perspectives on how urban space is utilized, particularly through an analysis of activity levels. In addition, Actor/Network Theory (ANT) provides a theoretical lens for understanding how different actors, both human and non-human, interact and influence safety conditions. This sets the stage for the study's analytical approaches.

Each of the supporting questions is addressed through a corresponding analysis presented in the following section. The first is an observational study of the Aalborg waterfront, which helps answer how the area is used by the public. The second is an ANT analysis, which sheds light on how various actors are involved in shaping safety, and how their strengths and weaknesses influence the overall security of the waterfront. The final analysis involves the spatial mapping of safety setup along the waterfront, aiming to identify areas with deficiencies or potential for improvement. The analyses are supported by an observational study, interviews with Aalborg Municipality and Nordjyllands Beredskab, as well as the use of Geographic Information System (GIS) for spatial mapping. The observational study used in the analysis was not conducted by the author, but by TrygFonden and has helped to answer how Aalborg's waterfront is used. The observational study is using a qualitative and quantitative method, contributing numerical data on how many people use Aalborg's waterfront, as well as focusing on behavior and interactions between people. By using both quantitative and qualitative data, the study takes a mixed-methods approach. Furthermore, the qualitative data is collected through interviews with key actors, offering deeper insight into how safety is perceived, managed, and coordinated in practice. In addition, the quantitative data is used to create maps that provide an overview of the physical safety setup along the waterfront. This combination of methods strengthens the project by providing an understanding of the physical environment, as well as a more nuanced understanding of the human and organizational factors behind safety. The analyses lead to a discussion of the analyses' results, focusing on whether any patterns can be observed in the areas where safety is lower compared to other parts of the waterfront. Additionally, the interplay between key actors is discussed. Finally, the study concludes with a summary that answers the study's research question. This study takes a deductive approach, as the problem analysis focuses on factors that may contribute to drowning accidents, as well as existing knowledge about physical elements that help prevent such accidents and rescue equipment that enhances safety. Subsequently, the study examines whether these elements are present along the waterfront in Aalborg, and to what extent they meet the recommended safety standards.

3.2 Understanding Urban Activity Levels

The way Aalborg waterfront is designed has a significant impact on how people move around near the water. Some areas are designed to attract more people, which affects the number of people being at risk of falling into the water. It is therefore relevant to look at theories on how urban spaces are designed to attract people, to then later examine whether Aalborg's waterfront includes elements that draw citizens to the area. To answer this, Gehl's (2011) has come up with a conceptual tool on what makes an urban space attractive and functional have been chosen as a reference in this case.

According to Gehl (2011), there are certain categories of outdoor activities that contribute to making an outdoor area attractive and well-functioning. There are three categories of outdoor activities: necessary activities, optional activities, and social activities.

- Necessary activities include mandatory tasks such as transportation for errands, going to work, or shopping. These activities are primarily related to daily routines. Necessary activities occur throughout the year and are independent of the surrounding environment (Gehl, 2011).

- Optional activities involve behaviors that only take place when urban conditions are optimal. This could include taking a walk to get fresh air or sitting and enjoying the sun. Most recreational outdoor activities are voluntary. According to Gehl, this is where physical planning plays a significant role. It determines whether people can use the space, ensuring there are proper conditions for sitting or moving around (Gehl, 2011).

- Social activities are activities that depend on the presence of other people in the urban space. These include conversations, play, or sports. Social activities occur when people share the same space to interact, meaning the presence of other activities is necessary for social interaction to emerge (Gehl, 2011).

When these three are present, an area becomes more attractive. The key argument is that the presence of other people using the space makes it more appealing. Seeing that an area is

being used encourages others to want to be there as well. According to Gehl (2011), the design of an urban space has a significant impact on how people move within it. This applies both to where people choose to walk and to the elements present in the space. The surface material of the area plays an important role in ensuring pedestrian safety. If the ground surface is unstable, it can be dangerous, especially for people with mobility impairments. Poor surfaces include "*cobblestones, sand, loose gravel, and an uneven ground surface*" (Gehl, 2011). These can be particularly hazardous when they become slippery due to rain or snow. Another important factor influencing movement in a space is where people prefer to walk. In open areas, there is a tendency for people to walk along the edges. This preference is not only related to how they perceive the space but also to a sense of safety, as walking along the edges can feel more secure (Gehl, 2011).

In this study, Gehl's conceptual tool of activity levels in urban spaces is used to examine and understand the social interactions at the waterfront in Aalborg. The framework is applied through an observational study in two areas of the waterfront. Additionally, Gehl's knowledge of how an urban space functions well is also incorporated into the observational study, examining whether Aalborg waterfront has integrated relevant elements that make it a well-functioning place.

3.3 Actor/Network Theory

To investigate how safety at the waterfront in Aalborg can be organized, Actor/Network Theory (ANT) is applied as a theoretical framework. This theory is particularly well-suited for understanding complex social processes where both human and non-human actors are involved. Safety at the waterfront is not solely a matter of human roles, but importantly a result of the interplay between human and non-human actors. Using Actor-Network Theory, a dynamic network will be analyzed, highlighting how safety emerges as a product of the interactions between actors.

ANT originates from the study of science and technology and positions itself as a social theory focused on the dynamic relationships between actors. The theory was developed through the work of Bruno Latour, Michel Callon, and John Law (Sismondo, 2010). The actors identified in ANT include both human and non-human actors, and all of these actors

contribute to the creation of a network. It is an approach that focuses on understanding how human and non-human actors are formed and how the connections between them create action and change (Rydin, 2021).

According to Latour (2005), ANT identifies five types of sources.

- The nature of groups: There is not just one way to define a social group. Instead, the actors within a group are defined by the context and perspective in which they appear.
- The nature of actions: The actions carried out by actors cannot be expected to unfold as planned, because other actors may intervene and alter the course of events.
- The nature of objects: There is not just one type of agency involved in a situation. Both human and non-human actors, such as technologies, structures, or physical objects, all can influence how situations develop.
- The nature of facts: What normal is consider as facts are not necessarily neutral or objective. Their meanings can be debated and interpreted differently, meaning that facts are not fixed truths but rather starting points for further discussion.
- Finally, the type of studies: ANT questions how the field of social science deals with what is considered empirical. Social phenomena are difficult to measure and explain in simple terms, as they tend to be more complex.

It is argued that non-human actors also influence a network on equal terms with human actors. Non-human actors refer to those that are not alive, such as buildings, infrastructures, and elements from nature. They also impact how the social construction functions, in part by influencing how human actors act based on the actions from non-human actors (Rydin, 2021)

In traditional sociology, agency is usually understood as a capacity that only humans can exercise. However, within the framework of ANT, agency also includes non-human actors such as objects and technologies. This means that agency emerges within a network of actors and is understood as something that is enacted in interaction with others. Another key concept within the ANT framework is translation, which refers to the process by which actors are connected and form a network. It involves shaping interests, creating interplay, and establishing coherence within the network. The aim of this process is to influence others to act in a particular direction (Sismondo, 2010).

In this study, ANT is used to identify the various actors involved in the issue of safety along Aalborg waterfront. The purpose is to map the network of human and non-human actors to understand how waterfront safety is assembled and maintained. ANT allows for an exploration of how these actors operate and interact within the network, how they influence, enable, or constrain each other. By tracing these relations, the theory helps to reveal where the network is most stable and coherent, and where it appears fragile or fragmented.

4 Method

This section outlines the methodological approach of this study, which includes both qualitative and quantitative methods to investigate safety at the Aalborg waterfront. The first supporting question investigates how the waterfront in Aalborg is used. To address this, documents from an observational study conducted by TrygFonden are used. Since the observational study was not carried out by the author, the methodology will not be examined in detail and is not considered a part of this study's chosen methodology. The study applies a qualitative method through interviews to understand how safety is practiced and experienced, providing insight on a more complex level. This will answer the study's second supporting question regarding how the safety is organized. In addition, a quantitative method is used through GIS to examine the current state of the physical safety setup along the waterfront and answer the last supporting question. The combination of these methods allows for an in-depth exploration of safety from multiple perspectives. In the following, the applied methods will be presented and further elaborated in relation to how they are used in this study.

4.1 Method for Interviews

To answer the question of how the safety at Aalborg's waterfront is, this project has chosen to use expert interviews to map out how these accidents occur in practice and what the waterfront looks like. Therefore, an expert interview has been conducted with Lars Krogsgaard Bjørndal and Tommy Johannessen from Nordjyllands Beredskab and another expert interview with Christian Birch Smith from Aalborg Municipality. This section will outline the methodology for both interviews to ensure transparency and understanding of the results.

Interview with Nordjyllands Beredskab

The purpose of the interview with Nordjyllands Beredskab is to gain a better understanding of safety at the waterfront and understand their role in ensuring safety. Their work primarily involves rescuing people who have fallen in the fjord. The interview also intends to help determine whether any trends could be identified in past drowning accidents at Aalborg's

waterfront. Lars Krogsgaard Bjørndal was selected as an informant due to his position as Head of Operations at Nordjyllands Beredskab, as well as his membership in the national expert group on harbor safety. Tommy Johannessen is the Daily Emergency Manager and plays a role in the tactical leadership at the site of the accident.

The interview is a semi-structured interview, as a set of questions is planned beforehand (see Appendix 1), but the order of the questions depends on how the interview unfolds (Brinkmann and Tanggaard, 2010). Additionally, the formulation of the questions may change depending on the flow of the conversation, which is why it is categorized as semi-structured. The interview takes place in person at Nordjyllands Beredskab's station, as this provides an opportunity to observe the equipment and understand how the operations function. Following the interview, the responses are reviewed with the aim of identifying the underlying themes concerning the causes of drowning accidents. In this study, information from this interview will be referenced as either Nordjyllands Beredskab (Appendix 3), Bjørndal (Appendix 3), or Johannessen (Appendix 3).

Interview with Aalborg Municipality

The interview with Nordjyllands Beredskab makes it clear that Aalborg Municipality plays a central role in ensuring safety along the Aalborg waterfront. Therefore, the purpose of conducting an interview with Aalborg Municipality is to understand what is currently being done to prevent accidents on the waterfront. Aalborg Municipality is responsible for a large part of the waterfront, but not all of it. As a result, there are areas along the waterfront where the municipality cannot make decisions regarding safety. The informant from Aalborg Municipality is Christian Birch Smith, who is team leader and is responsible for the safety structure at the waterfront. Prior to the interview, an interview guide is prepared, as this interview is also semi-structured (See Appendix 1). This format allows for follow-up questions based on the informant's responses, and the order of questions is flexible. Additionally, the formulation of questions can be adapted to the flow of the conversation (Brinkmann and Tanggaard, 2010). The interview takes place at the municipality's office, which provides the informant with the opportunity to present data available on-site. The interview with Smith is included in Appendix 2, and references to it are made as (Smith, Appendix 2).

4.2 Method for Data Collection and Processing

This section describes the safety and rescue objects included in the maps and in this study. In this context, an object refers to an element used in the mapping of risk level for falling into the Limfjord and elements that contribute to rescue. Additionally, the relationship between the objects and their specific characteristics will be examined.

In the map assessing the risk of falling into the water, both preventive objects and risk-enhancing objects are included. As a starting point, each object is assigned a score of either 1 or -1. Objects with a preventive effect, which help reduce the risk, are given a score of 1. Objects that represent a risk factor and thus contribute to the possibility of a drowning accident, are assigned a score of -1. Furthermore, if there are distinctions within an object, a weighting is applied. By default, each object has a weighting of 1, If a certain type within an object is considered more effective or safer, it is given a higher weighting, for example, 1,5 or 2. In the end, each object is assigned a total effect, calculated as: score × weighting = max score. This max score is used in the overall assessment.

The same principle applies to the map that illustrates a rescue assessment of the waterfront. Here, too, objects are assigned a baseline score of 1, as they contribute to the rescue of individuals from the water. Objects that include different types are given a weighting on a scale from 1 to 2, depending on how effective their characteristics are. Again, the total effect plays a role in the evaluation. An example of this is ladders, which are categorized as object 1 and object 2. Object 1 refers to ladders without lighting, which are assigned a weighting of 1, while Object 2 refers to ladders with lighting, assigned a weighting of 2 due to their enhanced functionality by being illuminated. It can be shown in table 1.

Table 1 - Example of score and weighting

Object	Score	Weighted	Max Score
Object 1	1	1	1
Object 2	1	2	2

The purpose of this principle is that all objects are initially considered equally important, unless they have a specific feature that provides a clear advantage. This approach also allows

for the visualization of areas where improvements may be needed. It provides a simple yet nuanced model for assessing the area.

There has not been a solid enough foundation to support a more advanced weighting system that compares objects directly against each other. According to both Nordjyllands Beredskab (Appendix 3) and Aalborg Municipality (appendix 2), it is difficult to compare the objects directly, and they should instead be seen as part of an overall assessment. However, variations within individual objects do exist, and these differences are taken into account. Still, it is challenging to compare, for example, a ladder and a lifebuoy directly against each other.

The objects included in the maps are based on interviews with Nordjyllands Beredskab and Aalborg Municipality. It is also based on knowledge from reports on drowning accidents as well as recommendations for Safe Harbor from FLID. They have been assessed based on the equipment designed to prevent accidents, as well as the equipment intended to rescue individuals from the water. Additionally, the selection of the objects that influence the maps is also based on TrygFonden's report on near-drowning accidents (Goor et al, 2023b), where individuals involved in a near-drowning accident provided feedback on the causes of their fall into the water. To assess whether an area along the waterfront edge could be considered a hotspot for drowning accidents, it is necessary to review the objects present in the waterfront environment.

4.2.1 Data: Safety Equipment

Signs – The purpose of the signs is to raise awareness of the waterfront both for drivers, cyclists and pedestrians. A sign should be placed where a road leads directly down to the waterfront. The signs should be lighted enough to be seen in the dark hours. In addition to providing information about the waterfront, signs also act as a kind of barrier that, at that specific spot, prevents people, cyclists, and cars from ending up in the Limfjord. Signs therefore have a positive effect on safety at the waterfront and are given a score of 1. Furthermore, signs also have a weighting of 1, resulting in a total max score of 1.

Bollards – They serve a functional purpose for the ships docked at the waterfront, but they also act as a barrier to prevent vehicles from falling into the water. They are therefore considered to have a preventive effect against falling into the Limfjord. Examples of bollards on the waterfront can be seen on figure 5. As a starting point, bollards are therefore given a score of 1 and a weighting of 1. For them to receive a higher weighting, it would require finding bollards that contribute more to the safety. Bollards have a max score of 1.

Figure 5 - Example of bollards on the waterfront

Lights – Lighting is considered one of the most important objects at the waterfront. Lights help to draw attention to other objects that may pose a tripping hazard and highlights objects intended for the rescue of people who have fallen in. Therefore, lights generally have a positive effect on safety along the waterfront. After an inspection of the waterfront, several different light sources were identified, see figure 6. Each of them contributes in its own way to illuminating the waterfront, and therefore each is given a score of 1. Some small light sources have been found installed near the edge of the waterfront at a height that may pose a tripping hazard, particularly in low visibility. However, despite this, all lights will have a weighting of 1, and therefore a maximum score of 1.

Figure 6 - Example of lights on the waterfront

Fence – A fence on the waterfront is a barrier that helps prevent people from falling into the fjord. It can be placed close to the edge, thereby restricting access to the edge. For a fence to be included in the dataset, it must be high enough that a person cannot step over it. This has a positive impact and results in a score of 1. Furthermore, it carries a weighting of 1, giving a maximum score of 1.

Ground surface – Areas with particularly slippery surfaces pose a greater risk of people falling and ending up in the water. This object is based on experiences mentioned in the near-drowning accident report, where it is stated that icy or slippery waterfront edges contributed to individuals falling into the water (Goor et al, 2023b). Therefore, surfaces that can be slippery will have a negative impact and thus result in a negative score -1 and is given a weighting of 1. This means that a slippery surface receives a max score of -1.

Layout of the waterfront – Changes in the layout of the waterfront can also pose a risk of people falling into the water. This object is based on experiences from the near-drowning accident report, where several individuals mentioned that a sudden recess or the end of the waterfront, which they were not aware of, caused them to fall in (Goor et al, 2023b). Therefore, unlit or unmarked areas where there is a change in the edge of the waterfront are

included as a negative influence indicating a higher risk of falling. This results in a negative score of -1, in addition, they are also given a weighting of 1, resulting in a max score of -1.

Small objects – Objects that pose a tripping hazard. The objects are added because of their size that increase the risk of tripping and then falling into the water especially if there is limit of the lights. Example on small objects can be seen in figure 7. As they pose an increased risk of people falling into the fjord, they are therefore given a negative score of -1. Small objects are also given a weighting of 1, and therefore a maximum score of -1.

Figure 7 - Example of small objects

The overall distribution of the safety objects' points scores, weightings, and maximum scores is shown in Table 2 below. In addition, the overall spatial distribution of the safety objects along the waterfront is illustrated in Figure 8.

Table 2 - Table of safety objects

Safety Object	Score	Weighted	Max Score
Sign	1	1	1
Bollard	1	1	1
Light	1	1	1
Fence	1	1	1
Surface	-1	1	-1
Layout	-1	1	-1
Small Object	-1	1	-1

Figure 8 - Overview of the distribution of points for the safety objects along the waterfront

4.2.2 Data: Rescue Equipment

Ladders – Rescue ladders are important objects for individuals who have fallen into the water, as they enable self-rescue. However, there are different types of rescue ladders along the waterfront. Ladders placed along the waterfront generally have a positive effect on rescue efforts at the waterfront and are therefore given a score of 1. Several ladders have been found on the waterfront with additional features that can contribute more effectively to the rescue

of people who have fallen into the Limfjord. The different ladders can be seen in figure 9. Some ladders have built-in lighting, making them easier to see if someone has fallen into the water. Additionally, some ladders have a handle mounted at the top, which makes it easier for individuals to pull themselves up. These elements increase the chances of a successful rescue and are therefore given a weighting of 2. Ladders that do not have these features are given a weighting of 1. Thus, standard ladders have a max score of 1, while ladders with lighting receive a max score of 2.

Figure 9 – Ladder with light on the left, and ladder on the right

Ropes and tires – Ropes and tires can help individuals who have fallen into the water by allowing them to hold themselves up or, in some cases, pull themselves out. See figure 10 for examples of ropes along the waterfront. Data from TrygFonden shows that in 12% of near-drowning accidents, people managed to rescue themselves using ropes, tires, or stone embankments in the area (Goor et al, 2023b). These objects are therefore considered

Figure 10 - Ropes along the waterfront

important in aiding self-rescue. As a result, they receive a score of 1 due to their positive effect of rescuing. They are also both given a weighting of 1, which gives each a max score of 1.

Boat crane – A boat crane is used by the Nordjyllands Beredskab to launch a boat that can search for individuals who have fallen into the water. This tool is therefore considered very important for enabling a quick rescue response. It is not something the person in the water can use themselves, nor can bystanders at the waterfront make use of it, it is solely for use by emergency services. As such, it receives a score of 1 in relation to the rescue of people who have fallen in. Boat crane is given a weighting of 1, which gives it a max score of 1.

Lifebuoy – A lifebuoy is an important object in the rescue of individuals who have fallen into the water. Its use depends on the presence of bystanders who can assist the person in the water, as it cannot be operated by the individual themselves. In the near-drowning accident report, the lifebuoy is repeatedly mentioned as a crucial factor in successful rescues (Goor et al, 2023b). Lifebuoys are therefore a positive element in a rescue situation and are given a score of 1. No lifebuoys were found along the waterfront with more effective features than others, and therefore all lifebuoys are given a weighting of 1. Thus, each lifebuoy has a total max score of 1.

Surveillance cameras – A tool that is important in rescue operations but cannot be included in this mapping is surveillance cameras. These are vital for the emergency services in locating individuals who have fallen into the Limfjord. Nordjyllands Beredskab (Appendix 3) use both thermal cameras and long-range cameras that assist in locating people. The cameras also help clarify the events leading up to the accident, making them an important tool in understanding the sequence of events. However, the cameras have not been included in this mapping, even though their locations are known, because it has proven difficult to accurately map their range in this project. It has not been possible to obtain a precise picture of what areas the cameras actually cover. According to Smith (Appendix 2) from Aalborg Municipality, there are also differences in how far each camera can reach, whether they can rotate, and whether they are thermal. However, according to Nordjyllands Beredskab (Appendix 3) and Aalborg Municipality (Appendix 2), the cameras are important in light of

technological developments. Therefore, the cameras remain a vital rescue tool when individuals fall into the water, and it is still relevant to include them in this study.

The overall distribution of the rescue objects' points scores, weightings, and max scores is shown in Table 3 below. Furthermore, the overall spatial distribution of the rescue objects along the waterfront is illustrated in Figure 11.

Table 3 - Table of rescue objects

Rescue Object	Score	Weighted	Max Score
Ladder	1	1	1
Ladder with light	1	2	2
Rope	1	1	1
Tire	1	1	1
Boat Crane	1	1	1
Lifebuoy	1	1	1

Figure 11 - Overview of the distribution of points for the rescue objects along the waterfront

4.3 Method in GIS

To answer the question of how the current safety setup is at Aalborg's waterfront this project has produced two maps to illustrate the current situation. One map shows areas with a higher risk of falling into the Limfjord, while the other shows areas with a high likelihood of rescue equipment availability. In other words, the maps illustrate the distribution of safety and rescue equipment along the waterfront providing an overview of the overall safety setup. This section aims to present the method used to create these two maps using a geographic information system (GIS) in the program QGIS.

The dataset is a vector dataset consisting of points. The data was collected through inspection of the waterfront and then plotted using coordinates corresponding to where each object was found. The objects were then divided into two datasets: one for safety equipment intended to prevent people from falling in, and one for rescue equipment designed to help people get out.

The first dataset contains data related to safety, and the objects included are: signs, fences, bollards, lighting, surface, layout, and small objects. In this dataset, each point has been assigned a score, a weighting, and a max score.

The second dataset includes points for rescue objects: ladders, ladders with lights, ropes, lifebuoys, tires, and boat cranes. In this dataset, the points have also been given a score, a weighting, and a max score.

To identify areas with a particularly high risk of falling into the Limfjord, or areas lacking rescue equipment, the tool *Heatmap (kernel density estimation)* was used. The two datasets are each used as input in the tool, where Radius is a parameter. In this case, a radius of 20 meters has been chosen, as Smith (Appendix 2) mentioned that the ladders with lights are placed 20 meters apart. This means that a point, such as in this case, safety and rescue objects, must be reachable within 20 meters. For both datasets, the *Weight from field* parameter has been set to use the field *max score* from both datasets, which is the selected value influencing the result. Thus, it is not the point itself, but the max score, meaning that some points have a higher score, or more value, than others.

4.4 Case Area

This section aims to present the specific case area of the waterfront. The selection of the case area is based on where activity levels are highest and where people can walk along the waterfront. The defined area is shown on Figure 12 below.

Figure 12 - Case area of the waterfront with locations

On the map, the westernmost point is the Cultural Bridge, which is the first area where one can get close to the waterfront. The easternmost point is KMD, which marks the last area actively used by people. Beyond KMD, the area is considered to be a commercial zone, where people without a specific purpose do not typically go. The case area consists of both a municipally owned part and a privately owned part. The privately owned area begins east of Musikkens Hus and includes the areas Østre Havn and KMD. The municipally owned section is approximately 2 kilometers, and the privately owned part of the waterfront is around 1,9 kilometers.

5 Analysis

This analysis section is divided into three parts, where each section will answer a supporting question concerning safety at the Aalborg waterfront. The first analysis aims to examine how the waterfront is used by people, and whether the area functions as a recreational space with human activity. This analysis draws on an observational study conducted by TrygFonden. The second analysis seeks to understand how safety at the Aalborg waterfront is managed by relevant actors and how it is practiced in reality. This is done through an Actor/Network analysis, which identifies the key actors and maps how they are interconnected within a network. Finally, the third analysis focuses on analyzing the current physical safety setup at the waterfront. Using GIS, two maps are created: one highlighting areas where there is a higher risk of falling into the Limfjord, and another map showing the likelihood of finding rescue equipment along the waterfront. The three analyses are based on different methods, including qualitative approaches such as observation of the waterfront and interviews with relevant actors, as well as a quantitative approach to examine safety along the waterfront. Together, these three analyses contribute to a deeper and more complex understanding of safety at the waterfront.

5.1 Observational Study of the Waterfront

This first analysis aims to answer the first supporting question: How is Aalborg's waterfront used as a recreational urban space, and how does the level of activity relate to the risk of drowning accidents? It is relevant to examine whether the waterfront is a place frequently used by many people, as international cities and statistics indicate that areas with high levels of human activity are where there is a greater risk of fatal drowning accidents. As previously mentioned in the report on near-drowning accidents (Goor et al, 2023b), there are also three key factors, that increase the risk of a fatal drowning accident: walking alone, alcohol consumption, and darkness. Therefore, an observational study like this can help assess whether there is a tendency for people in Aalborg to walk alone, and whether the Aalborg waterfront is an area where alcohol is consumed. This analysis is based on an observational study conducted by TrygFonden (Goor et al, 2023a), which included two studies conducted in December 2022 and July 2023. The study was conducted in three major Danish cities,

Copenhagen, Aarhus, and Aalborg, that all face challenges with drowning accidents and have urban spaces close to harbor areas. The purpose of the study was to document how people behave around the harbor areas and how their behavior relates to safety in these environments. This observational study aims to clarify how the Aalborg waterfront is used. It helps to shed light on whether the Aalborg waterfront functions as a recreational urban space that attracts people, and whether this increases the risk of drowning accidents due to the close proximity to the water.

5.1.1 Observational Study of Activity Levels on the Waterfront

Observations were carried out from the afternoon until nighttime, both in summer and winter, to compare behavioral patterns across the two seasons. In Aalborg, the study was conducted at two locations: Jomfru Ane Parken and the Central Waterfront. Jomfru Ane Parken is an area designed for leisure and activities, there are many seating options for visitors to stay and relax, as well as activities such as a sports area where people can play basketball or football. While the Central Waterfront is primarily used for transit, it also offers seating areas for people to stay (Goor et al, 2023a). The observational study assessed how the areas are used based on Gehl's conceptual tool of activities at an urban space. The study categorized activity levels at each location during winter and summer, distinguishing between necessary activities, optional activities, and social activities. Additionally, activity levels were classified as low, medium, or high, depending on how actively the space was utilized (See figure 13) (Goor et al, 2023a).

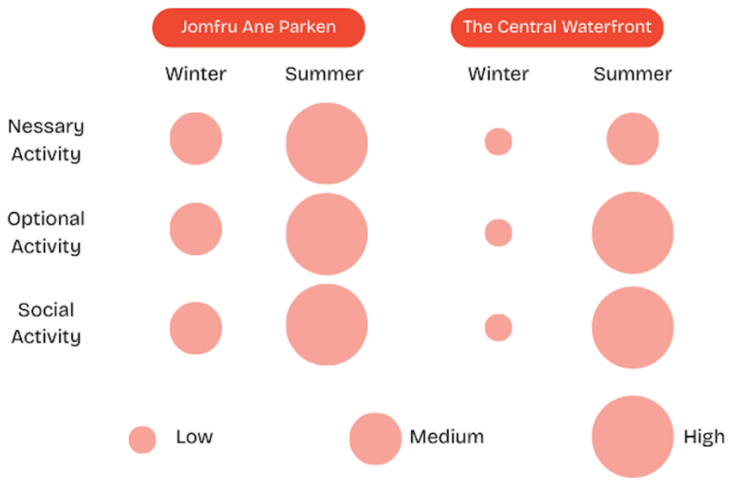

Figure 13 - Activity level of the waterfront (Goor et al, 2023a).

The redevelopment of waterfront has focused on bringing recreational public spaces closer to the Limfjord. As a result, people now spend time and move around near the waterfront, which can be seen on the figure. At Jomfru Ane Parken, all types of activities are at a medium level during winter. In summer, however, activity levels increase significantly, with the area being heavily used. At the Central Waterfront, all activities remain at a low level during winter. In summer, both optional and social activities reach a high level, while necessary activities are at a medium level. This indicates that activity levels are significantly higher in both areas during summer compared to winter. The space naturally invites more use in the summer, leading to increased activity during this season (Goor et al, 2023a). This is further emphasized by two graphs illustrating the total number of people walking along the waterfront, both in summer and winter, see figure 14 below.

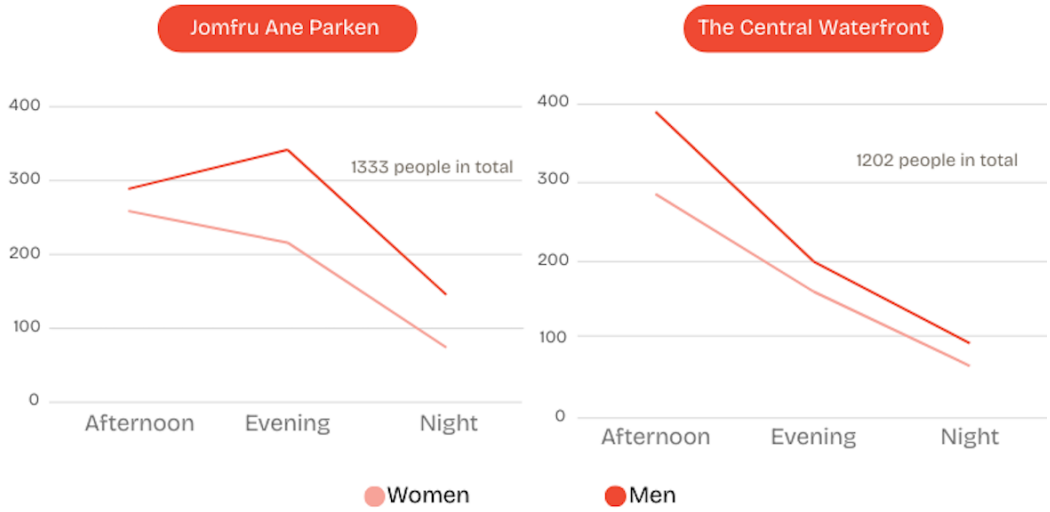

Figure 14 - Graph of the number of pedestrians on the waterfront (Goor et al, 2023a).

The graphs show that the number of people at the waterfront generally decreases from the afternoon to the night. However, there is an increase in the number of men present at Jomfru Ane Park in the evening, indicating that activity in this area is higher in the evening than in the afternoon. At the Central Waterfront, the number of people declines steadily from afternoon to night, suggesting that the area is primarily used for transit rather than as a gathering space, unlike Jomfru Ane Park. The graphs also reveals that men make up the majority of visitors at both locations. The lowest number of people is observed at night, which means that if someone were to fall into the water, there would be fewer people around to help (Goor et al, 2023a).

Observations from all three cities showed that the majority of individuals moving around alone were men. In fact, 63,9% of those walking alone was male. When it came to group movement, however, the distribution was nearly evenly distributed between men and women. Since being alone is a known risk factor for fatal drowning accidents, this suggests that men are at a higher risk, as they are more likely to be alone (Goor et al, 2023a).

5.1.2 Behavioral Observations on the Waterfront

Jomfru Ane Parken is very wide, and with benches and trash cans placed close to the edge, and it prevents people from walking too close to the water, this can be seen on figure 15. The area's lighting is primarily focused on the main waterfront, and there are also smaller lamps placed near the edge, but it can be a tripping hazard if not noticed. There is little activity in the area in the winter, but groups of young men gather there to drink alcohol (Goor et al, 2023a). In the summer there is high activity around Jomfru Ane Parken in the afternoon and evening, especially when music events take place, often accompanied by alcohol consumption. The waterfront's two public toilets are in use, leading to queues, this may lead men to seek out other places. At night, activity decreases, but young men still gather to drink alcohol. Additionally, more people use the area at night as a route to walk home (Goor et al, 2023a).

Figure 15 - The waterfront at Jomfru Ane Parken

Figure 16 - The waterfront close to Musikkens Hus

The area around Musikkens Hus is primarily used by cyclists or pedestrians. Similar to Jomfru Ane Parken, benches and trash bins have been set up, creating a kind of barrier along the edge, see figure 16. The lighting in this area is very poor during the darker hours. It is estimated that most of the people using the waterfront in the nighttime hours are individuals on their way home. Most women walking there are in groups, while it is more often men who are walking alone (Goor et al, 2023a). In the summer the area is primarily used by pedestrians, but more people linger on the benches in the area in the summer than in the winter. In the evening hours, some people use the area to sit and consume alcohol. At night, there is only activity in the form of individuals walking or cycling away from the city center. Again, it is often men who are walking alone (Goor et al, 2023a).

Finally, the focus is on observing specific behavioral factors that may contribute to fatal drowning accidents. In the report "*Druknedødsfald i Danmark i 2022 – og udviklingen fra 1970 til 2022"* (Ahrensberg et al., 2024), it is mentioned, that one of the factors behind half of the drowning accidents in the young men category is that men are standing and urinating by the edge. In this observation study it was found that, on several occasions, intoxicated men had gone to the waterfront to urinate. These incidents occur both in summer and winter. It is also observed that urination takes place near the water, despite the presence of public restrooms nearby. Additionally, it can generally be said that there is a greater risk of ending up in a fatal drowning accident if one is alone, and that it is mostly men who end up in drowning accidents. This trend is also clearly observed in Aalborg, where it is most often men who are seen walking alone by the waterfront late at night. They are therefore at a higher risk of falling in and being unable to get help (Goor et al, 2023a). However, in an interview with Nordjyllands Beredskab it was stated by Bjørndal (Appendix 3) that it is a

myth that accidents in Aalborg are primarily caused by men being near the water to urinate. Based on their experience, it is not the case that men fall into the Limfjord while urinating at the edge of the waterfront. When they have investigated the causes behind the accidents, there has not been a clear indication that this is the main reason. Rather, it has proven difficult to identify one specific cause for the accidents. This is also supported by Smith (Appendix 2), which likewise does not consider public urination to be the typical reason why individuals fall into the water along the Aalborg waterfront.

5.1.3 Summary of the Observational Study

This section will summarize and conclude on the supporting question: How is Aalborg's waterfront used as a recreational urban space, and how does the level of activity relate to the risk of drowning accidents? According to this observational study, Aalborg's waterfront has a high level of activity, which means that large numbers of people gather there. It shows that there is especially high activity during the summer months, with a mix of necessary, optional, and social activities taking place on both areas of the waterfront. This implies that when more people are present, the likelihood of drowning accidents occurring increases. The analysis also shows that activity is lower during the winter, which may mean that the likelihood of someone witnessing and helping a person falling into the Limfjord is reduced. So, while the risk of a drowning accident may be higher in the summer due to increased activity, the chance of a drowning accident becoming fatal may be greater in the winter because fewer people are around to help.

Furthermore, the analysis shows that two of the key factors most commonly associated with drowning accidents are also present at Aalborg waterfront. Observations indicate that several individuals walk home alone along the waterfront, something that statistics identify as a significant cause of fatal drowning accidents. It is also more often men than women who are seen walking alone, which aligns with the fact that more men are involved in fatal drowning accidents. In addition, particularly during the summer, alcohol consumption is observed at the waterfront. In many drowning accidents, alcohol was consumed beforehand, which may have contributed to the accident. Since the waterfront is a place where people who have consumed alcohol tend to gather, they are therefore at risk of ending up in a fatal drowning accident.

5.2 Actor/Network Analysis of the Waterfront

The purpose of this second analysis is to identify the actors involved in ensuring safety along the waterfront in Aalborg, specifically in relation to measures aimed at preventing accidental falls into the Limfjord. Therefore, the next supporting question for this analysis is: How is responsibility for safety organized among the involved actors, and what strengths and weaknesses can be identified in their collaboration and network? Actor/Network Theory (ANT) is applied to map the relevant actors within the safety network and to examine how they interact and collaborate in practice. The analysis explores how safety is created and maintained through these interactions, while also uncovering potential vulnerabilities and strengths within the network. To identify the actors, the analysis is based on the assumption that both human and non-human actors play a role in shaping safety at the waterfront.

5.2.1 The Human Actors Concerning Safety at the Aalborg Waterfront

Aalborg Municipality – Aalborg Municipality is the most prominent actor regarding safety along the waterfront. They own approximately 2 kilometers of the waterfront that serves as the case in this study. According to Smith (Appendix 2), the municipality is responsible for ensuring safety is in place, as well as maintaining the rescue equipment found along the waterfront. The equipment mentioned by Smith (Appendix 2) includes, among other things, life buoys, rescue ladders, rescue ropes, lighting, and the waterfront edge itself. Additionally, they are also responsible for ensuring that technological equipment such as surveillance cameras is functioning properly. Their focus is on maintaining the infrastructure of the waterfront to ensure that it is safe for people to move around in the area. At least once a year, Aalborg Municipality ensures that the equipment available on the waterfront is sufficient through inspection. In addition, they have taken action based on past accidents to assess whether adjustments to current measures are needed in the future to enhance safety (Smith, Appendix 2).

Private Landowners – The waterfront from Østre Havn to KMD is privately owned. The area examined in this case study extends approximately 1,9 kilometers. Like Aalborg Municipality, they are responsible for the installation and maintenance of rescue equipment in the area.

Nordjyllands Beredskab – The emergency service in Nordjylland is responsible for rescuing individuals who have fallen into the Limfjord. In other words, they are responsible for retrieving people from the water once an accident has occurred. According to Smith (Appendix 2), Nordjyllands Beredskab also contribute to the prevention of accidents by investigating the causes of drowning accidents, such as identifying areas lacking in safety measures, including lighting. Additionally, they take part as one of the actors involved in the annual inspection of the waterfront, during which the existing safety equipment along the waterfront is reviewed.

TrygFonden – TrygFonden is an organization that works to improve safety and helps prevent drowning accidents in Danish harbors. They also work more broadly to prevent drowning accidents across Denmark. Each year, they publish a report on drowning accidents in Denmark. In addition, they have released a report on near-drowning accidents in Denmark, as well as a report based on an observational study of three Danish cities where drownings occur. In Aalborg, TrygFonden contributes to assessing the current safety conditions along the waterfront in collaboration with Nordjyllands Beredskab and Aalborg Municipality (Smith, Appendix 2).

The Nightlife stakeholders - Nightlife stakeholders also have an interest in ensuring that the waterfront is a safe place to move around. Following extensive media attention on fatal drowning accidents, the theory has emerged that some of those involved may have fallen into the fjord after a night out. Therefore, club owners with venues near the waterfront have a vested interest in making sure their guests get home safely. Other stakeholders in this group include organizations that contribute to nighttime safety. Smith (Appendix 2) mentions, among others, Natteravne and Midtby Sjakket as actors who help ensure that citizens move safely through the city at night.

Citizens – The citizens are the users of the waterfront. They include both those who arrive from land and those who approach from the water. Citizens play an active role by interacting with the elements of the waterfront. They must relate to the available safety features, such as signage and rescue equipment. According to Smith (Appendix 2), the citizens help with contacting the municipality to report missing lighting or rescue equipment.

5.2.2 Non-Human Actors Related to Safety at the Aalborg Waterfront

The Limfjord – In this case, the Limfjord is a significant actor in relation to safety at the waterfront. The fjord is a dynamic force that cannot be controlled by human actors. It plays a central role in drowning accidents, as it is where people fall in. According to Johannessen (Appendix 3), the dynamic force in the Limfjord is primarily the strong current in the water. The current can carry individuals who have fallen into the water far from the point where they entered, making it more difficult for them to be rescued, especially when the current is particularly strong. The Limfjord is an active space used by both citizens and ships. It consists of physical elements that influence its conditions, including water levels, currents, and waves. The Limfjord also affects other actors, such as the rescue equipment installed along the waterfront. As Smith (Appendix 2) notes, the water wears down the materials of the rescue equipment over time, which means it must be maintained regularly.

The Waterfront – The waterfront plays a central role in safety, as it provides the framework for the many actors involved. The design and layout of the waterfront influence how users of the waterfront move and behave. The waterfront is therefore the central element where several actors are gathered around ensuring safety related to this actor. It is a shared interest that safety here functions effectively and is maintained over time. The waterfront is an area where there is a dynamic between the safety policies that are decided and how they actually function in practice. Furthermore, the waterfront is divided into two parts: a municipal section and a privately owned section, which affects how safety is managed on each part of the waterfront.

Surveillance – Surveillance of the waterfront is a central non-human actor in saving lives. According to Bjørndal (Appendix 3) from Nordjyllands Beredskab, surveillance is an important tool for gaining an overview during a rescue operation and also helps to clarify the events leading up to a drowning accident. This non-human actor requires maintenance and must function optimally to be effective. In this context, the collaboration with Aalborg Municipality is essential, as they are responsible for maintaining the surveillance hardware. Nordjyllands Beredskab also plays a key role in the interaction with the surveillance system, as they manage the operational side of its use.

Barriers – Barriers are a central actor in preventing citizens from falling into the water. They influence how people behave and move. A barrier placed near the edge of the waterfront restricts where people can go, shaping their movement and actions. Barriers depend on human actors for installation and maintenance.

Rescue Equipment – Ladders, life buoys, ropes are all non-human actors involved in enabling people to be rescued from the water. This actor depends on human actors for installation and maintenance. Additionally, it is citizens who actively use this equipment when rescuing themselves or others from the water. The various objects serve different purposes: rescue ladders and ropes are typically used by individuals who have fallen into the water, whereas life buoys are used by people on land to help rescue someone in the water.

Harbor Equipment – This includes bollards and tires. Both serve a function for ships, helping them dock safely. These elements are essential for the waterfront to function as an active and operational harbor. However, they also serve a role in citizen safety. A bollard can act as a barrier, guiding how citizens move along the waterfront. A tire can provide support for someone who has fallen into the water, helping them stay afloat or climb out. Like other equipment, these also rely on human actors for installation and maintenance.

Lighting – Lighting is a central actor in harbor safety. Both Smith (Appendix 2) and Nordjyllands Beredskab (Appendix 3) emphasize that proper lighting along the waterfront is crucial for allowing citizens to see where they are going, as well as to locate various non-human actors such as rescue equipment and barriers. Lighting also supports the actions of other actors, for example, it assists Nordjyllands Beredskab during rescue operations and enables better observation through surveillance. If lighting is lacking, it directly impacts safety, making it difficult for citizens to move safely along the waterfront. Thus, even though it is a technical object, lighting acts as an active actor that influences safety.

Infrastructure – Such as paths and roads around the waterfront are the areas where citizens move and use the space. Signage helps guide people toward safer areas and encourages safe behavior. The infrastructure is an actor that controls the physical framework, determining which boundaries and access points are safe. Additionally, it plays a role in connecting other

actors by contributing to the effective functioning of surveillance in an area and human actors. In relation to cameras, the infrastructure must have the correct placement and connection for the actors to fully utilize their potential.

Ships – a non-human actor, which is a user of the waterfront, yet controlled by humans, thus part of the network. This actor imposes demands on how the waterfront is adapted to it, and therefore also demands on the safety at the area. As Smith (Appendix 2) mentions, ships need space to dock at the waterfront, and therefore, certain rescue and safety equipment must be adapted specifically for this purpose.

5.2.3 The Interaction Between Actors

This section focuses on the interaction between the various actors. As mentioned, the waterfront forms the framework for this interaction, as the aim is to explore the safety at the waterfront. Interactions take place between the mentioned actors, where they influence each other and are dependent on each other's presence. The starting point will be a mapping of these actors and their connections, with the aim of uncovering how the network surrounding the safety of the waterfront is structured and functions in practice. However, not all the relationships between the actors will be covered, as that would be too extensive. The focus will be on the actors and relationships that play a significant role in relation to the safety of the waterfront in this context. This shared network is illustrated in figure 17 below.

Figure 17 - The network of the safety at the Waterfront

As seen, the waterfront is the center of this network, surrounded by both human and non-human actors, with Aalborg Municipality being an active participant. This figure aims to illustrate the presence of actors within the network. Even though the connections between them are not visually represented, the actors remain interconnected, both with each other and with the waterfront as a central element in the network. Aalborg Municipality is not merely a one-sided decision-maker, but an actor that is part of a network of mutual relationships and negotiations with both human and non-human actors. The municipality holds an important position within the network surrounding the waterfront, but its agency arises through interaction with other actors, especially the citizens. Citizens are not just passive participants of municipal decisions, but co-creators of the network, as they use the waterfront, report faults, and thus contribute to shaping how safety is understood and prioritized. The municipality's responsibility for the installation and maintenance of rescue and safety equipment is not solely a top-down task but is shaped in relation to both the citizens' usage patterns and feedback, as well as the physical requirements set by the waterfront infrastructure. For example, the municipality tries to balance the need for safety with the functional requirements of harbor operations. Smith (Appendix 2) points out that ladders with lights are prioritized for citizens' safety, but these cannot be implemented

everywhere, as they cannot withstand the pressure from large cruise ships. Here, a complex negotiation arises between actors, citizens, ships, equipment, and the municipality, where each actor's characteristics and needs shape the solutions that can be established. Decisions regarding safety at the waterfront therefore do not appear as autonomous actions of the municipality but as the result of a long series of interconnected actors' influences. The municipality's decision-making power is linked to citizens' feedback, the physical material, and past accidents, which activate the network and force a reassessment of existing solutions. The stability and development of the network therefore depend on continuous translation, where intentions and needs are converted and negotiated between actors with different roles and characteristics.

In an ANT framework, decisions and changes are not understood as the result of a single powerful actor, but as something that arises through networks of relationships and mutual influence. The collaboration between Aalborg Municipality and Nordjyllands Beredskab can therefore be viewed as an example of a dynamic actor-network, where agency is created in the interaction between different actors. Smith (Appendix 2) emphasizes that "*There we have a close dialogue with the emergency services, where we look into the cause of the accident — 'Is there perhaps a place where lighting was insufficient?*" (Smith, Appendix, line 31-33, author's translation). This illustrates how the municipality does not act in isolation but is constantly engaged in negotiation and coordination with others. Although Aalborg Municipality carries the financial responsibility and formally makes decisions about safety measures at the waterfront this occurs in close cooperation with Nordjyllands Beredskab, who contribute with technical assessments and professional expertise regarding rescue and safety equipment (Bjørndal, Appendix 3). Bjørndal from Nordjyllands Beredskab states "*It's their money. It's their investment. It's their assessment […] but I actually haven't experienced that the things we say are not followed.*" (Bjørndal, Appendix 3, line 647-648 & 667-668, authors translation). This reflects the ANT concept of translation, where ideas and knowledge from one actor are translated and integrated into decisions made by another, creating connections and trust within the network. TrygFonden also participates in this network as an expert actor, providing statistical data on drowning accidents and assessments of safety levels. This data also has a function as non-human actors, which indirectly influence the municipality's decision-making processes. Therefore, the municipality's decisions are not solely expressions of hierarchical power, but rather a product of the collective contributions

of the network, which come from both human actors like Nordjyllands Beredskab and TrygFonden, and non-human actors such as data and equipment.

Although there is no formal power relationship between Aalborg Municipality and the private landowners at the waterfront, their interactions still form a meaningful and influential network. In parts of the waterfront that are privately owned, the municipality does not have decision-making authority regarding the installation of safety measures such as rescue equipment and lighting. Nevertheless, the municipality attempts to apply agency through what ANT refers to as translation, by translating municipal safety principles into recommendations that can be adapted to the private owner's practices and interests. According to Smith (Appendix 2), for example, the municipality has developed concrete proposals for safety equipment and lighting along these stretches. This demonstrates how agency in the ANT sense is not necessarily tied to direct power but can arise through the network's connections and negotiations between the actors. A central actor that connects both parties is the citizens. As users of the waterfront, they form a common interest that influences the network's dynamics. The municipality continuously receives requests from citizens about missing or insufficient safety equipment, further strengthening the municipality's role as a translator of citizens' concerns into concrete recommendations directed at the private owners. In this way, citizens are not only passive users but active co-creators of the network, where both human and non-human actors contribute to shaping the safety at the waterfront.

A relevant non-human actor that influences the network's dynamics is the surveillance system at the waterfront. Surveillance is important for safety because it helps provide an overview of accidents occurring at the waterfront, and it also helps shed light on past events. However, this actor does not operate alone. It is through the interaction with a human actor that the surveillance is influenced. It is Nordjyllands Beredskab that handle the operational side of the cameras, while Aalborg Municipality is responsible for the maintenance of the cameras on-site (Smith, Appendix 2). The surveillance would not function if other actors were not involved. As mentioned earlier, the point of the cameras is to provide alerts about accidents when they occur. However, one of the factors influencing this system is physical changes to the waterfront. This means that when Aalborg Municipality decides to make

physical changes to the waterfront, it affects the surveillance system's ability to analyze the waterfront (Bjørndal, Appendix 3).

Within the network surrounding safety at the waterfront, citizens play an active role as human actors, especially in situations where accidents occur. According to Bjørndal from Nordjyllands Beredskab (Appendix 3) it is often the citizens who call for emergency services in crises. This illustrates a central interaction between human and institutional actors, and the actions of citizens are a necessary condition for the activation of emergency services. There is hope that the surveillance system will take over this role in the future, thereby changing the dynamics of the network by acting more independently as a non-human actor (Johannessen, Appendix). Additionally, Bjørndal from Nordjyllands Beredskab (Appendix 3) points out that citizens often engage directly in rescue efforts, such as using lifebuoys. This highlights a close interaction between citizens and physical safety equipment, where agency is not solely attributed to either humans or technology but arises in the connection between them. Safety at the waterfront is thus not created by individual actors, but through a series of relationships, where citizens, rescue equipment, and emergency services are mutually dependent on each other to enable action.

From an ANT perspective, safety at the waterfront is understood as the result of the interaction between both human and non-human actors. Non-human actors such as rescue equipment, signage, barriers, and lighting actively participate in the network and directly influence citizens' movements and actions at the waterfront. According to Smith (Appendix 2), the signage is strategically placed to guide people away from the waterfront edge to prevent them from falling into the Limfjord. The decision about placement is made by Aalborg Municipality, but once the sign becomes part of the network, it acts, influences, informs, and guides. This also applies to other physical objects: barriers, lighting, and rescue equipment are not passive elements, but actors with agency, whose function arises in the interaction with the people who use the waterfront. Citizens' behavior are shaped by the presence and placement of these actors, and they are assigned meaning based on how they are connected to other elements in the network. Therefore, it is not just the municipality or citizens that govern behavior, it is the network's overall composition, where non-human actors play a central role in creating safety as an effect.

5.2.4 Summary

This summary will follow up on the weaknesses and strengths of this network. This section will therefore answer the supporting question: How is responsibility for safety organized among the involved actors, and what strengths and weaknesses can be identified in their collaboration and network? One of the weaknesses in this network is the dynamics between the owners of the privately owned area and the municipality. The municipality wants to ensure that it is safe for citizens to move around the waterfront, whether the area is privately or municipally owned. However, Aalborg Municipality does not have the authority to make decisions regarding Østre Havn or KMD, which is privately owned. This means that the municipality is not guaranteed any action from the private landowners, which can weaken the network. Another parameter where there is a weakness in the network is the damage to equipment at the waterfront. Citizens, ships, and the fjord itself all contribute to the wear and tear of equipment over time. This means that it cannot always be guaranteed that the safety and rescue equipment is functioning optimally. Another area where there is a weakness in the network is that several non-human actors are dependent on human actors. For example, the surveillance system currently relies on human actors to operate the cameras. Additionally, the emergency services are only activated when citizens initiate the alert. In other words, the surveillance technology is not yet advanced enough to activate emergency services automatically if a person falls into the water, meaning that safety depends on a citizen being present. This indicates that safety is weakened in situations where no other citizens are nearby. A final parameter where a weakness in the network can be identified is that the surveillance system is vulnerable to change. As mentioned, it requires the system to be updated when there are changes in the infrastructure. This makes the system vulnerable, as it requires adaptation in terms of machine learning, adjustments, and a trial period whenever changes occur along the waterfront.

A strength of the network is the close collaboration between key actors. As emphasized, the cooperation between Aalborg Municipality, Nordjyllands Beredskab and TrygFonden is well-coordinated and involves continuous exchange of knowledge and feedback. The annual inspections and evaluations of equipment are translated into and integrated within municipal decision-making processes. Another strength of the collaboration is the inclusion of citizens as active participants. They are not passive actors but have influence over decisions regarding

rescue and safety equipment, and they actively engage in using it. Citizens serve as a link between what the municipality perceives and what the actual needs on the ground are. A third strength is the use of data and technology. Surveillance and data influence how decisions are made within the network. These non-human actors not only collect information but also serve as arguments within the network to guide municipal actions. A fourth and last strength of the network is the use of physical design as non-human actors. Equipment on the waterfront, such as infrastructure, rescue gear, and lighting, is used to shape human behavior along the waterfront. This plays a role in limiting access to dangerous areas, informing about hazards, and improving access to safety equipment.

Based on the network where both human and non-human actors mutually influence each other and create safety as a collective effect, attention is turned to the physical design of the waterfront. The following analysis focuses on where the risk of falling into the water is highest on the waterfront, so-called hotspots. This mapping analysis incorporates several of the non-human actors described earlier, such as barriers, rescue equipment, and lighting, and examines how their placement and absence contribute to creating safer or less safe zones along the waterfront.

5.3 Mapping of the Waterfront

In this section, the third analysis will be presented and aims to answer the last supporting question: How is the current physical safety setup distributed along Aalborg's waterfront, and where do high-risk areas emerge in terms of rescue equipment and safety equipment? As part of the investigation into safety along the waterfront, this analysis examines the current state of the safety setup through two maps. The two maps include objects that contribute to preventing individuals from falling into the Limfjord, as well as ensuring that, if someone does fall in, there are means to get back up. These maps make it possible to identify areas where safety is not optimal and highlight where improvements could be made to enhance safety in those specific locations. The maps are evaluated based on how the safety and rescue elements are weighted, not merely on their presence. An object that helps prevent

a drowning accident is given a positive weighting on the map, whereas an element that could contribute to causing a drowning accident is given a negative weighting.

5.3.1 Risk Assessment of Safety

This section shows a map that highlights potential risk zones where the likelihood of falling into The Limfjord is higher. It is based on safety-related objects along the waterfront that are specifically designed to prevent people from falling in, as well as objects that serve different primary purposes but still contribute to reducing the risk. Additionally, the map includes features that may contribute to accidents and increase the risk of falling into the fjord. This assessment of safety objects is explained in more detail in section 4.2 Method for Data Collection and Processing. The objects in this map that help prevent accidents are: signage, lighting, bollards, and fencing. The objects that may cause or contribute to people falling in are: slippery surfaces, small objects, and sudden changes in layout. The map of the risk level for falling into the Limfjord can be seen on figure 18.

Figure 18 - Heatmap of Risk Level for Falling into the Limfjord at the Aalborg Waterfront

The map above provides an overall view of how the risk of falling into the Limfjord is distributed along the waterfront. The green areas indicate zones where objects that help prevent drowning accidents are more prevalent, where the risk is low. In these areas, there is a greater presence of safety features such as signage, fencing, lighting, or bollards. At the opposite end of the scale, the red areas indicate zones where objects have been identified that may contribute to drowning accidents, where the risk is high. These include features such as slippery surfaces, changes in the layout, or smaller objects that could pose a tripping hazard.

The first area being examined is the western part of the waterfront, namely by the Cultural Bridge. This area is assessed as reddish on the map in terms of the risk of falling into the water, which means that compared to other areas, there is a higher risk of falling in here. What makes this area particularly exposed is that the edge of the waterfront consists of wooden planking. This wooden edge is considered to be very slippery when wet, which can contribute to a drowning accident. The area also shows signs of poor lighting, as it is only lit by tall light poles placed several meters away. Furthermore, there is a lack of signage, fencing, or bollards that could serve as a barrier. On the positive side, the wooden planking is elevated more in this area, meaning one would have to actively step onto it to walk on it. However, it is not considered a sufficient barrier, as it is not high enough to function as a fence. Another positive point is that there are no smaller objects that could pose a tripping hazard. Overall, this area is assessed in the analysis as one with room for improvement.

The next area, which has a higher risk assessment for falling into the fjord, is the area called Between the Bridges. This area is also highlighted because the red color on the scale is clearly visible here. In this area, there are two piers where the risk of a drowning accident is increased. The basis for this assessment is that the area has significant changes in the layout of the waterfront, meaning that if there is poor lighting, lack of signage, and a person is inattentive, there are several places where one could fall into the water. There are many edges in this area that increase the risk of falling. Additionally, the area is characterized by a lack of lighting on the piers, the nearest light source is placed several meters away. There are also no fences to help prevent people from falling in. There are small objects on parts of the piers that pose a tripping hazard. These small objects are, in this case, rings used for docking ships, but they can be difficult to see if lighting is poor or if one is not paying

attention. There are three bollards placed on each pier that serve as a kind of barrier. In addition, there is a row of bollards placed at the entrance to the piers. There is also signage warning of the waterfront edge, which helps prevent drowning accidents. This area is therefore assessed as one where improvements could be made, such as improved lighting.

The third area of focus is Honnørkajen. This area is in the green end of the risk scale, meaning it contains several safety objects that help prevent people from falling into the Limfjord and potentially drowning. The area is assessed as having a good level of safety in terms of preventing falls into the water. Although the area has many changes in layout, bollards and signage have been installed specifically in places where there is a risk of falling, helping to mitigate that risk. In addition, this area has more lighting compared to the two previously mentioned areas, which also contributes to ensuring that people do not accidentally fall in. The lighting also helps increase awareness of the surroundings. This area can therefore serve as a reference point to study which specific safety objects help prevent falls into the water, and how their placement contrasts with objects in other areas that contribute to higher risk.

The fourth area is CREATE, which is also in the green end of the scale, indicating a lower assessed risk of falling into the Limfjord. The area around CREATE is characterized by the presence of sufficient lighting, signage, and bollards that function as barriers. These elements help prevent people from falling in. Furthermore, there are no slippery surfaces or significant changes in layout. Where changes in layout do exist, they are offset by other safety measures, such as signage and barriers. The only drawback of the area is the presence of smaller bollards, which are included as small objects. This area demonstrates that even if certain features could potentially increase the risk of falling, the existing safety elements make a significant difference in the overall assessment. The presence of these safety objects helps compensate and reduce the likelihood of accidents.

The fifth area is Østre Havn, which is characterized as a harbor basin that can be walked around. It is an area with a high level of activity, which is reflected in its appearance. According to Johannessen (Appendix 3), Østre Havn is an area where residential development has increased, and where Nordjyllands Beredskab is experiencing a growing number of emergency calls. On the scale assessing the risk of falling into the water, the area

is generally rated as good. There are several barriers in place that help prevent people from falling into the water. There are multiple bollards in the area, and the first part of the waterfront is well-lit. However, due to the shape of the waterfront, there are several sections with layout changes, which create potential fall risks. There are also various small elements in the area that pose a tripping hazard. What contributes to the overall positive assessment is the presence of many barriers that compensate for the tripping risks. The final part of the area, however, falls into the red end of the scale, meaning the risk of falling into the Limfjord is higher compared to other places. What increases the risk here is the poor lighting, only 1-meter-high light sources are present, and they are spaced relatively far apart. This part of the waterfront also shows signs of a high level of social activity due to equipment from a nearby sports club with water activity. This makes the area difficult to assess clearly, as some of the items provided by the club are not included in the safety evaluation. Some of these elements may act as barriers that limit pedestrian access near the edge of the waterfront, but since they are not actual safety objects, they are not counted in this assessment. Another reason this part of the area ranks in the red zone is that the waterfront edge is made of wood, which is a slippery surface and increases the risk of slipping and falling into the water. In summary, parts of the Østre Havn area include effective barriers and lighting, while other sections have room for improvement. Special attention should be paid to the changing layout of the waterfront in this area, and appropriate measures should be taken to make people aware of these changes.

The final area along the waterfront is KMD. This section falls into the red end of the scale, meaning there is a high risk of falling into the fjord. The area is characterized by having more objects that increase the risk of falling into the water than objects that help prevent it. Along this part, the waterfront edge consists of wood, which is a slippery surface that increases the risk of slipping and falling into the fjord. In addition, lighting is insufficient. The area is only lit by low light sources that are spaced far apart. This part of the waterfront also features several layout changes, meaning that without proper signage, barriers, or lighting, it can be difficult to notice and respond to these changes. There are bollards installed along the stretch, which can act as partial barriers to help prevent people from falling in, this contributes to making the area somewhat safer. The assessment of this area is that greater attention should be paid to safety here. There should be a stronger focus on the type of surface used, as well as improved lighting and the presence of physical barriers.

5.3.2 Evaluation of Rescue Options

This section shows zones where the likelihood of accessing rescue equipment is low and high. The map includes rescue equipment that can be used either by the person who has fallen into the water, by people on the waterfront or by emergency responders from Nordjyllands Beredskab. All rescue equipment found along the waterfront is assessed as having a positive effect on rescue efforts; however, some types of the same equipment are considered to have a better effect than others. For example, ladders with lighting are easier for people in the water to spot compared to ladders without lighting. This assessment of rescue equipment is explained in more detail in the previous section 4.2 Method for Data Collection and Processing. The objects included on this map are: ladders, ladders with lighting, lifebuoys, ropes, tires, and boat crane. The rescue accessibility level for the waterfront can be seen on figure 19.

Figure 19 - Heatmap of Rescue Accessibility Levels on the Aalborg Waterfront

The map shows the areas with the highest likelihood of finding rescue equipment marked in green, while areas with the lowest likelihood are marked in red. Areas not marked on the

heatmap indicate that it is not possible to reach rescue equipment within 20 meters. Essentially, the map illustrates the possibilities for rescuing oneself or the chances for others to help a person. As seen, there are varying opportunities for rescue or self-rescue, as some areas appear more red, others greener and other areas are not included on the scale. This means that there are varying possibilities along the waterfront for accessing rescue equipment within 20 meters. In some areas, it is possible to find multiple types of rescue equipment, while in other areas, only a single type is available along the waterfront, and there are areas where no rescue equipment is available within 20 meters.

The first area is again the western part of the waterfront, near the Cultural Bridge. On this scale, the area falls into the red zone, meaning that only a small amount of rescue equipment was found. This indicates that if a person were to fall into the Limfjord in this area, it could be difficult to be rescued or to climb out on their own. The rescue equipment observed in this area consisted of ladders without lighting. This means it is technically possible to climb out, but the lack of lighting makes it difficult to locate a ladder, especially in low-visibility conditions. No lifebuoys, ropes, tires, or other rescue items were found that could assist in helping oneself or others. In other words, there is a significant lack of rescue equipment in this area. In addition, this area has previously been assessed as having a higher risk of falling into the fjord. So, not only is there a shortage of rescue equipment, but there is also a lack of preventive safety features to help avoid drowning accidents in the first place. This makes the area particularly problematic, people may be at risk of falling into the Limfjord and may also struggle to be rescued. Significant improvements are therefore needed in this area.

The second area is Between the Bridges, which consists of piers and a canal that runs between the buildings. This area is assessed to be in the green zone of the scale. This means there are great opportunities here for a person to be rescued or to climb out of the water on their own. The advantage of this area is the short distance to both sides of the edges of the waterfront, and on both sides, there are ladders and ladders with lighting installed. Additionally, a lifebuoy is centrally placed in the area. Rescue ropes are also available on both sides, making it easier for a person who has fallen into the Limfjord to reach a rescue ladder. Compared to the map highlighting areas with a higher risk of falling into the Limfjord, this area is identified as one with a relatively higher risk. Therefore, it is a positive aspect that this area offers strong rescue possibilities where the risk of falling into the water

is high. Even though this area contains objects that could cause someone to fall in, rescue equipment has been installed to help retrieve people from the water. It can therefore be considered an area that does not require much further attention in terms of rescue equipment, but rather one where more focus could be placed on the causes that lead people to fall into the Limfjord.

The third area is the area Limfjordsbroen. This area falls into the red zone on the scale, indicating a potentially insufficient amount of rescue equipment. There is not a significant amount of rescue equipment here that could help individuals get out of the fjord, either by themselves or with assistance from others. There is a lifebuoy installed on both sides of the Limfjordsbro, and these are positioned close to each other compared to lifebuoys in other areas along the waterfront. Both lifebuoys are also illuminated by direct light sources. However, at the time of observation, no ladders, neither with nor without lighting, were found under the bridge. It is worth noting that this area currently appears to be under construction. The particular absence of rescue ladders is what makes this area especially unsafe in the event of a fall. Thus, this area is considered uncertain for anyone falling into the fjord, as it may be very difficult to climb out due to the lack of ladders. Additionally, other types of rescue equipment, such as rescue ropes and flotation tires, are also missing, items that could assist someone in keeping afloat or climbing out. This area should therefore be prioritized for improvements in self-rescue options, through the installation of rescue ladders, ropes, tires, or other helpful equipment.

The fourth area is the section Stair Area, that consists of a staircase leading directly down to the Limfjord. This area is in the red zone on the scale, meaning that few rescue options have been found in this location. Since this area consists of a staircase descending into the Limfjord, it is difficult to install ladders here, which is the main reason for the lack of coverage. Moreover, there are no other rescue equipment, such as rescue ropes or tires, on the wall surrounding the staircase. As a result, this area must be considered one where the ability to rescue oneself could be difficult. Therefore, special attention should be given to whether it is possible to install rescue equipment that can assist individuals who have fallen in with getting out of the Limfjord.

The fifth area is the waterfront by Musikkens Hus. This area is in the green zone on the scale regarding the availability and placement of rescue equipment. This means that in this area, multiple types of rescue equipment are installed, making it possible for individuals who have fallen into the fjord to rescue themselves, or for people on the waterfront to assist. In this area, ladders with lights are installed along the waterfront, and in addition, there are rescue ropes placed along this section, which make it easier for people who have fallen in the water to reach a ladder with a light. Ladders with lights are easier for people in the water to spot compared to ladders without lighting. Besides ladders with lights and rescue ropes, there is also a lifebuoy in this area, enabling people on the waterfront to help those who have fallen into the Limfjord. Furthermore, this area contains the only boat crane, which allows Nordjyllands Beredskab to quickly access the fjord. This piece of equipment is therefore a particularly important tool for emergency services to rescue individuals from the water. In summary, this area offers multiple means by which people can be rescued, either by themselves or with assistance from others.

The sixth area being highlighted is Østre Havn. As previously mentioned, Østre Havn consists of a harbor basin with a high level of water sports activity. The area is actively used for water-related activities, and this is also reflected in the rescue equipment available in the area. On the scale measuring how the chances are of being rescued from the water, this area is in the green zone, meaning there are great opportunities to be rescued or to rescue oneself. Ladders with lights are installed around almost the entire harbor basin, which makes it easy for individuals who have fallen into the water to spot a ladder and climb out safely. There are also several lifebuoys placed throughout the area, allowing people on the waterfront to assist those who have fallen in. In addition, rescue ropes are installed all the way around the harbor basin, helping individuals reach a ladder with lights. In areas where there are no rescue ropes, tires have been installed, which can also help people stay above the water or move toward a ladder. However, in those parts where tires are present, the ladders do not have lights. It would be more optimal to install ladders with lighting in these areas to make them easier to locate for individuals in the water. Compared to the map showing the risk of falling in, this area is also considered exposed, due to low lighting and a slippery surface. This lack of lighting is especially problematic where ladders without lights are installed, as it becomes even more difficult to spot them from the water. This is therefore a point of concern that should be addressed.

The final and seventh area is the area KMD. This area is assessed as being in the red zone on the scale, and parts of the area have not been assessed at all due to the absence of relevant rescue equipment. Therefore, this area is particularly problematic in terms of the ability to be rescued from the fjord or to rescue oneself. The only rescue equipment noted in the area consists of ladders without lights and a lifebuoy. It would be advantageous to install ladders with lights, as they are easier to spot for individuals who have fallen into the water. As previously mentioned, this area also lacks proper lighting, which makes it even harder for people to see the ladders. On the stretch from Østre Havn to KMD, no lifebuoys have been observed, which would otherwise enable people on the waterfront to assist individuals in the water. The only lifebuoy on this part of the waterfront is located at the far end, which means there is a long distance between this sort of rescue equipment. Nor have any rescue ropes or rubber tires been found that could help someone in the water reach a ladder. This area is also considered to have a high risk of falling into the Limfjord, due to the layout of the waterfront, slippery surfaces, and insufficient lighting. For this reason, it is especially important that individuals can be rescued from this area. It is therefore recommended that this area receive special attention to improve the available rescue options.

5.3.3 Summary

This section will highlight the answers to the supporting question: How is the current physical safety setup distributed along Aalborg's waterfront, and where do high-risk areas emerge in terms of rescue equipment and safety equipment? In an overall assessment of the safety and rescue equipment available along the waterfront, it is considered that it is well distributed, and there are good opportunities over longer parts of the waterfront to prevent falls into the Limfjord and to ensure successful rescue. There are several areas where safety could be improved, and among them, one large area stands out where the risk of falling into the Limfjord is significantly high. This mainly applies to areas that are privately owned or overlooked by the municipality, located in the outer part of the case area. In the larger parts of the waterfront where safety is good, it has been assessed that several elements contribute to this level of safety. There is thus a strength in viewing the safety objects as a whole, rather than attributing safety to any single object alone.

The amount of rescue equipment along the waterfront is also assessed to be sufficient. According to Smith (Appendix 2), ladders with lights have been installed approximately every 20 meters, even though the recommendations suggests a spacing of around 30–40 meters. This indicates that along this part of the waterfront, there are good opportunities for rescue, and that especially in the municipal areas, there are strong rescue provisions across large parts of the case area. Again, there is a larger area where the rescue equipment is insufficient, and otherwise only a few smaller areas where improvements could be made. As before, it is particularly in the outer parts of the case area that both the quantity and quality of the rescue equipment could be improved. There is therefore room for improvement in several areas along the waterfront, both in terms of safety and rescue options. The next section will discuss the significance of the current safety setup and explore whether changes can be made to the waterfront to enhance safety in areas where it could be more effective.

6 Discussion

This discussion explores the current state of the safety setup along the waterfront in Aalborg, with a focus on areas where the risk of falling into the fjord is elevated and where rescue options are limited. It further investigates whether these high-risk areas share certain characteristics that might explain why they stand out in terms of safety concerns. Additionally, the discussion examines the extent to which ownership structures influence the presence and quality of safety objects. Finally, it assesses whether concrete recommendations can be made to improve overall safety standards along the waterfront.

6.1 Factors Contributing to Increased Risk Along the Waterfront

Firstly, this discussion will examine the areas where there is a particularly high risk of falling into the Limfjord, or where rescue options are insufficient. As mentioned, some areas present a higher risk of falling into the Limfjord and potentially drowning, due to the presence of certain objects that may contribute to such accidents. Some of these objects include slippery surfaces, such as a wooden surface that can become slippery when wet, changes in layout, which may come as a surprise if one is not paying attention, and the last object is small objects that could easily be tripped over. This raises the question of whether these factors can be altered so they no longer pose a safety risk. First, it is relevant to assess whether these objects serve a necessary function in making the waterfront usable. For instance, a wooden surface might be required for aesthetic or structural reasons, and smaller objects, despite being tripping hazards, may still serve a practical purpose. The first recommendation is therefore to remove any object that poses a risk unless it serves an essential function. If removal is not possible, steps should be taken to make these objects more visible. Lighting has been shown to improve visibility and draw attention to potential hazards, making it an effective tool in improving safety. Therefore, it is recommended to make slippery surfaces and small objects visible through sufficient lighting. Additionally, FLID (The Danish Marina Association) recommends marking such objects with reflective material to make them more noticeable. This could be applied to smaller objects that present a tripping hazard. At present, there is no observation of reflective markers in place on such objects along Aalborg's waterfront, highlighting a missed opportunity to implement a relatively simple and low-cost

improvement that could significantly enhance public safety. In slippery areas, signage could also be introduced to warn users of the hazard and discourage them from walking on dangerous surfaces. Again, this is a low-effort and cost-effective intervention that can contribute meaningfully to a safer waterfront environment. It should be noted, however, that despite improvements such as increased lighting, reflective markings, and signage, this does not guarantee that individuals will follow the signs or behave cautiously. A more general recommendation regarding the rescue equipment available along the waterfront is to optimize the existing equipment, ensure that it is clearly visible, and make sure it can be accessed within a reasonable distance. However, these measures do not ensure that drowning accidents will be fully prevented. Ultimately, it is important to consider whether the factors that may contribute to drowning accidents are necessary, whether they can be removed, or whether they can be modified to become safer.

In addition to examining the factors that contribute to the areas being high-risk for falling into the Limfjord or having low accessibility to rescue equipment, it is also important to consider what these areas have in common. By examining the commonalities between these places, it may be possible to explain why these particular areas stand out. The first noticeable aspect of these locations is their placement. The areas with a significantly poorer safety setup are situated on the outer edges of the waterfront in the selected case area. These outer edges are characterized by having lower levels of activity compared to the rest of the waterfront. There is only limited residential construction nearby, which contributes to a lower activity level, this may also be a contributing factor to why a more effective safety setup has not been prioritized in these areas. The lack of activity in these areas can be seen as both a strength and a weakness. On one hand, as previously mentioned, drowning accidents typically occur in areas with high levels of human activity. This could mean that areas with less activity are at lower risk of fatal drowning accidents, and that this lower risk is the reason why these areas are given lower priority in terms of safety at the waterfront. On the other hand, it could also mean that the risk is actually higher in these areas because there may be no one present to help if an accident occurs. This raises the question of why such areas are not given higher priority in order to ensure greater safety, and why better rescue options are not available there. This suggests that the balance of where to focus on safety and rescue equipment should not necessarily be based solely on the number of people frequenting an area, but also on how exposed the area is in terms of the likelihood that no

one will be nearby to assist in case of an emergency. If the likelihood of others being present is low, and the area also poses a higher risk of falling into the Limfjord, should there not at the very least be a focus on ensuring that more rescue options, such as ladders, are available in these areas?

6.2 The Role of Ownership and Responsibility in Waterfront Safety

This questioning of how waterfront safety should be prioritized also raises important questions about how responsibility is distributed. By examining the differences between municipally owned areas and privately owned areas such as Østre Havn and KMD, it becomes clear that safety standards vary depending on who holds the responsibility. Østre Havn and KMD stand out particularly because the risk of falling into the Limfjord is higher here, and the availability of rescue equipment within 20 meters is low. Currently, there is no legislation regulating the number or quality of ladders or other rescue equipment at harbors in an urban environment. As a result, it is up to each individual landowner to decide how they prioritize safety and rescue equipment. Therefore, Aalborg Municipality does not have the authority to manage safety along the waterfront in areas that are privately owned. This means that the division of responsibility creates challenges, as it leads to significant variations in the level of safety provided. However, should citizens not be afforded the same level of safety in both public and private areas? Since the privately owned areas are also accessible to the public, there should be a responsibility to ensure that people are protected from falling into the water and can quickly get out again if such an accident occurs. The mapping clearly highlights the lack of a unified safety plan for areas along the waterfront where human activity takes place, given that there are such large differences between the areas. The absence of a shared plan creates an unclear and inconsistent approach to citizen safety. Even though people are able to walk through publicly accessible spaces, their safety is not necessarily being prioritized.

Similar challenges can also be seen in relation to climate plans. Without a common climate strategy and shared goals, effective solutions cannot be fully implemented. For example, in relation to climate adaptation for rising sea levels, if one area is protected against flooding while another is not, the problem is simply displaced to the unprotected area. This is emphasized by the initiative "*Together for a Green Transition*" published by FH (2022)

(Fagbevægelsens Hovedorganisation), which focuses on raising awareness about the consequences of rising water levels due to climate change, and how best to protect against these challenges through collective action. The initiative highlights several obstacles that hinder the implementation of a joint climate adaptation plan. One key issue mentioned is the lack of knowledge among private landowners. Often, they are unaware of the flood risks affecting their properties and mistakenly believe that it is the responsibility of public authorities to secure the area. In addition, private landowners often find it difficult to coordinate large-scale climate adaptation efforts. It is also pointed out that while some climate measures may benefit certain areas, they can create problems for others, which further complicates coordination among private owners (FH, 2022). Climate adaptation in cities also illustrates the need for uniform regulations when multiple stakeholders are involved. If the stakeholders do not cooperate on equal terms and share common goals and opportunities, the problem may simply be displaced to another area

The same applies to the safety setup along waterfronts where people are present. Even if one area has a sufficient safety setup, another nearby area may have minimal precautions, increasing the risk of drowning accidents there. A possible solution to this issue could be the development of a joint waterfront plan regarding the safety for urban areas. A waterfront plan helps ensure that areas where safety is currently not prioritized are also brought up to a consistent safety standard. It aims to minimize the risk of falling into the water and to ensure that, if someone does fall in, it is possible to get back out regarding the landowner.

It is relevant to clarify how ownership and responsibility are distributed in the waterfront plan. If an area allows public access to the waterfront, the owner is then responsible for ensuring that the area meets established safety requirements. Some of these requirements could include the type of rescue equipment to be installed, the quality of that equipment, how accessible rescue equipment needs be, and the maximum allowed distance between each unit. Other safety aspects that could be regulated include lighting, such as the minimum level of illumination required in an area, as well as signage, which is essential for informing people about the risk of walking near the water. These safety requirements help to standardize safety across all publicly accessible areas, regardless of who owns the land. But, this would require national legislation if a waterfront plan were to apply to privately owned areas. Another option is for municipalities or the state to enter voluntary partnerships with

privately owned areas to ensure a consistent safety standard. However, the risk with this approach is that areas not included in such cooperative agreements may fail to meet the same standards, once again creating an imbalance in safety for the public. With a waterfront safety plan in place, it is possible to tailor safety measures to address the specific factors that may contribute to drowning accidents. These include socio-demographic factors, environmental conditions, and behavior. As mentioned earlier, men are statistically involved in the majority of drowning accidents, and individuals in the 15–24 age group are particularly at risk. Thus, the statistics show that the planning and the management of waterfronts can be adapted specifically to this demographic group, to minimize the risk of fatal drowning accidents among them. Targeted planning may include campaigns aimed at young people to raise awareness about the risks associated with being near waterfronts. In addition, increased collaboration with other actors, such as the nightlife sector, commonly used by young people, and educational institutions, can support campaigns specifically directed at young men regarding safety around waterfront areas. Actors in the nightlife sector are particularly important when it comes to campaigning, as two of the previously mentioned risk factors, alcohol consumption and walking alone, are closely related to nightlife activities. Walking home alone at night after drinking increases the risk of falling into the water. Therefore, nightlife actors serve as an important channel for communicating the dangers associated with being near waterfronts. Finally, it can be discussed how a waterfront plan should function in practice in terms of financing. Clarification is needed on whether private actors are expected to cover the costs of installing safety and rescue equipment themselves, or if there should be opportunities to apply for funding to support such installations. Since a waterfront plan is intended to function as a collective planning strategy for the area, it is important to consider how all stakeholders can be involved. If private actors are required to pay on their own, it may result in actors with fewer resources being unable to participate in the plan. This could, in turn, lead to a lack of uniformity in safety standards along waterfronts, where only better-funded areas are sufficient secured. To avoid this, a co-financing model could be introduced, in which public authorities provide financial support for safety measures. Another solution could be to seek assistance from foundations, such as TrygFonden, where both public and private stakeholders contribute to ensuring that minimum safety standards are met across all waterfront areas. Ensuring fairness in the financial model is essential to achieving a coherent and effective safety strategy.

This discussion has shown that safety along the waterfront in Aalborg varies depending on the level of activity in the area and ownership. To ensure a more uniform safety standard across the waterfront, a joint waterfront plan is necessary. At a minimum, it should include a clear distribution of responsibilities, defined safety standards, and financing options. A key argument for prioritizing such a waterfront plan is that the lack of safety measures can cost lives if not properly addressed. This argument highlights the necessity of treating safety as a shared responsibility that should not depend on ownership or activity level. Everyone has the right to feel safe when walking along a waterfront, and to achieve this, common safety standards are essential. Human life must come first and recognizing this is the first step toward implementing an effective and fair waterfront safety strategy.

7 Conclusion

This study aims to answer the research question: How is the current safety setup on Aalborg's waterfront adapted to the area's use, and how is the responsibility for safety organized among the involved actors? The current safety setup along Aalborg's waterfront reveals an unequal setup in terms of both how the waterfront is used and how ownership of the waterfront areas is distributed. The study found that the Aalborg waterfront is a frequently used recreational urban space, particularly during the summer months. This high level of activity underscores the importance of ensuring safety in the area. While the uneven distribution of safety and responsibility is a key concern, the study also identified behavioral factors, such as walking alone or consumption of alcohol, that increase the risk of accidents along the waterfront. In particular, men were found to exhibit a higher incidence of this type of risky behavior. This finding aligns with national statistics, from TrygFonden, indicating that young men are overrepresented in drowning accidents at Danish harbors. As a result, the study highlights the potential need to target safety campaigns specifically toward this demographic group, with the aim of raising awareness about risky behaviors in and around the waterfront.

Given the waterfront's popularity and high foot traffic, maintaining a safe environment is essential. Therefore, this study examined whether current safety measures are sufficient to protect users of the space. It assessed both safety objects that help prevent accidents and objects that might contribute to risk. The findings show that in the most frequently visited parts of the waterfront, there are appropriate safety measures in place that can help prevent fatal drowning accidents. However, in less frequented areas, safety provisions are noticeably lacking. A similar pattern was observed regarding the availability of rescue equipment, where areas with higher foot traffic tend to have more rescue equipment, while less populated sections are lacking necessary equipment. This suggests a correlation between the level of human activity and the degree of attention given to safety setup. However, this creates a problem in areas with fewer people, which may carry a higher risk due to the lack of sufficient help in case of an accident, and therefore, these areas should in fact be provided with the necessary rescue equipment.

This issue was further highlighted by the fact that safety structures varied significantly between areas, depending on their ownership. While Aalborg Municipality is responsible for the public areas of the waterfront, there are sections that are privately owned, such as Østre Havn and KMD. In these areas, this study found that safety measures were particularly lacking compared to municipally owned areas. There are no official safety requirements that landowners must follow regarding access to waterfront areas. As a result, an imbalance in safety arises for citizens moving along the waterfront. This approach often leads to a situation where people cannot distinguish between public and private ownership when moving through the area. This study therefore suggests that a unified approach to waterfront safety is necessary. A common waterfront plan should apply to all landowners with publicly accessible areas and should ensure that citizens can move safely along the waterfront. Such a plan must clearly define the distribution of responsibility and outline the required safety standards to protect those who use the area. Ensuring safety for all should be a shared obligation, because no matter where one walks, feeling safe should be a given, not a privilege.

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