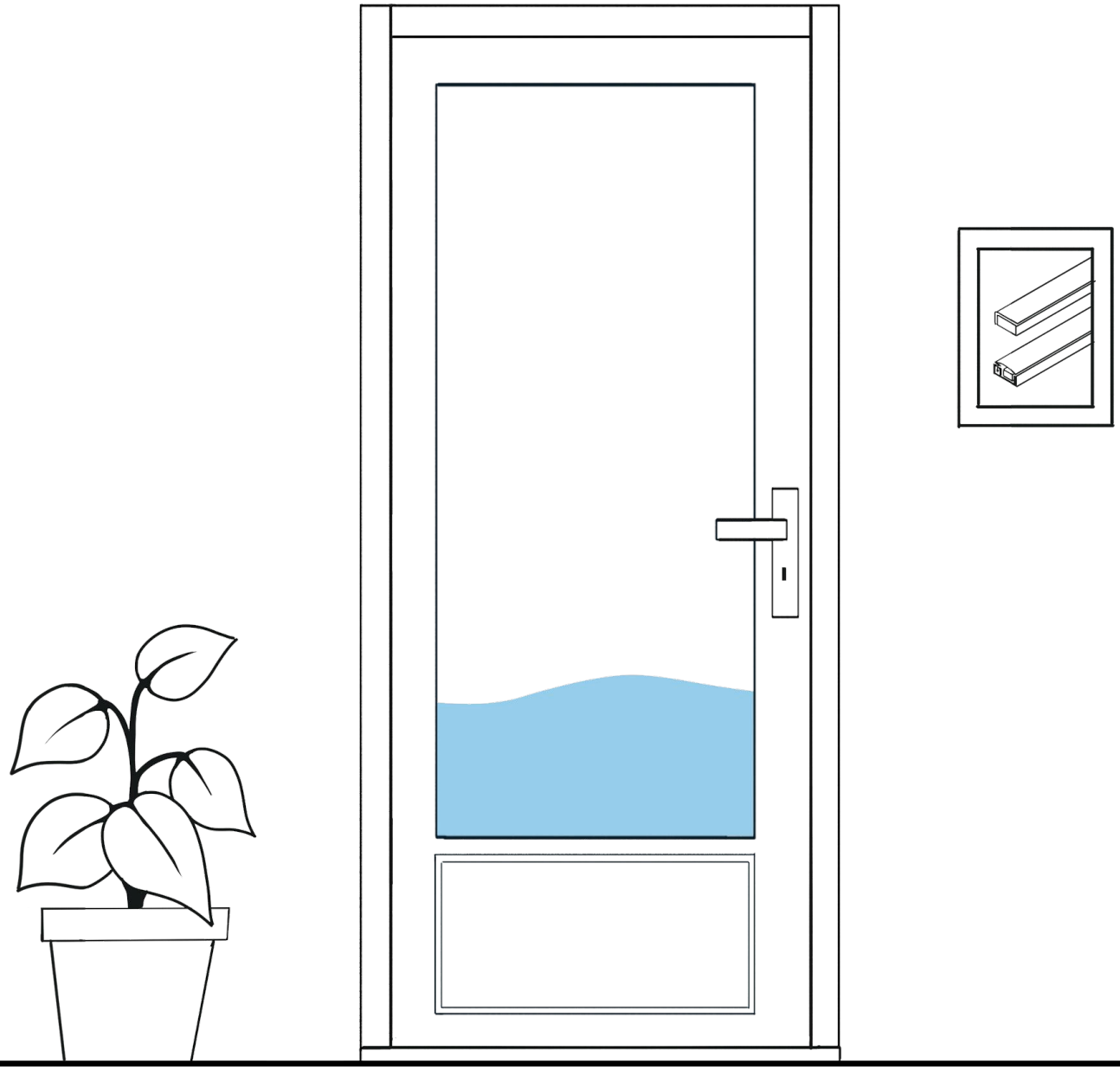
Sealing the Gap: Designing a Flood-Protection Solution for Outward-Opening Doors.

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MSc thesis
Integrated Product Design
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ALPROKON.

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Abstract

This project originated from Alprokon's search for new consumer products aligned with their mission of making “every space safe”. In an extensive research phase, combining consumer and professional interviews with a literature study, nine potential problem scopes related to unsafe situations in the home were identified. Further analysis of trends, market availability, and strategic fit led to flood prevention being selected as the project focus, given its growing relevance and the lack of consumer awareness and suitable products for outward-opening doors.

Climate change is driving rising sea levels and increasingly intense rainfall, making floods more frequent and severe across the Netherlands. The consequences of floods can be significant: dangerous situations, structural damage and costly repairs. With floodwater entering through doors being a primary cause of damage. While various protective flood solutions exist, such as barriers and sandbags, most are bulky, heavy, expensive and time-consuming to set up. Critically, none of the currently available solutions are suitable for outward-opening doors, which are standard for most Dutch back doors. This represents a clear gap in the market. To fill this gap Floud is created.

Through iterative ideation, testing and material research, Floud was developed as a flood protection concept in two versions: the Floud Add-on and the Floud Draft Strip. Both are compact additions to existing outward-opening doors, built around a water-activated expanding material that automatically seals all gaps around the door when floodwater rises, requiring no setup and protecting the home even when no one is there.

The Floud Add-on is easy to install and compatible with almost any door type but more prone to wear and tear over time. The Floud Draft Strip integrates flood protection into a traditional draft strip, delivering a faster, longer lasting and more reliable seal at a higher installation effort and cost. Both concepts present a strong business case for Alprokon, and first contact with potential production partners has been made, demonstrating clear potential to develop Floud further and bring it to market.

Glossary and Abbreviations

In this document, specific terms are used. An overview:

- Safe: a situation or state of being, where the (mental) health of a person is not at stake. It is not likely to be harmed or get lost.
- Unsafe: immediate situation or, when exposed for a longer time, where health of the person is endangered, resulting in immediate life-threatening situations, injuries or (long-term) (mental) health risks.
- Space: In the goal of Alprokon “every space safe”, space means a place of being and its surroundings. For instance, a home, a bedroom, a car or an office.
- Astragal: An (aluminium) profile that is attached between two double doors. This closes the gap, creates a clean finish and could make the door fire, smoke proof and/or soundproof, see figure 1. This is the main selling product of Alprokon.
- Elkeruimteveilig.nl: Alprokon is launching a webshop for safety products, as will be explained in the project brief. Although this is a separate B.V., it is financially supported and operated by Alprokon. These two names will be mentioned side by side.

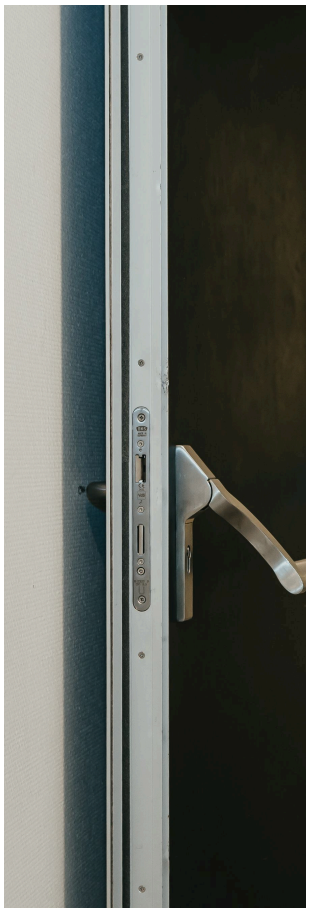


Figure 1: door with an Alprokon astragal

- Flood: an overflow of water that submerges land or enters buildings that are normally dry, typically caused by heavy rainfall, rising river levels or failure of water defences such as dikes.
- SAP: Super Absorbent Polymers are synthetic materials that can absorb large amounts of water relative to their own weight. They are commonly used in products such as diapers, agricultural applications and in this project.
- WAEM: Water Activated Expanding Material; An abbreviation created for this report as an umbrella term for all types of materials that expand when activated by water. This could be SAPs, but also mixes of SAPs with binders or other materials.
- (door)Jamb: the vertical the vertical side frame of a door, forming the inner surface of the door frame against which the door closes and hinges are attached.
- Rebate (door stop): the stepped recess in the door frame against which the door closes, and where draft strips are typically installed to seal the gap between the door and frame.
- Threshold: is the horizontal strip at the bottom of the door frame, forming the transition between the floor and the doorway, against which the bottom of the door closes.

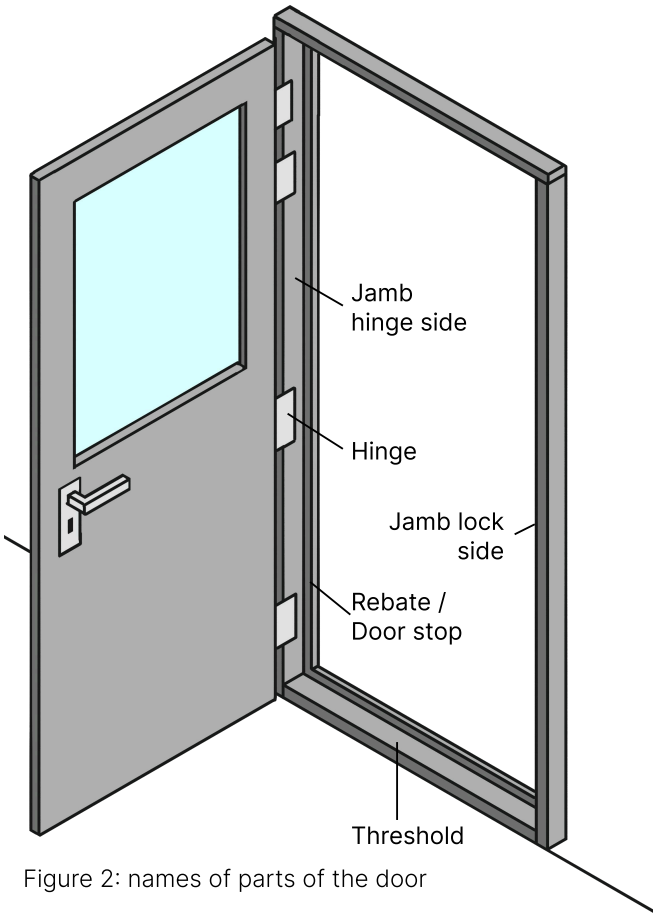


Figure 2: names of parts of the door

Aknowledgement

I would like to express my sincere gratitude to my mentors, without whom this project would not have taken the shape it did. I want to thank Bart Bluemink for stepping in at a crucial moment and helping me to stay grounded throughout the project, to view the project from new perspectives and encouraging me to push my boundaries. I want to thank Arno van Leeuwen for his creativity, enthusiasm, valuable conversations and the extra support he provided when it was needed most. I also want to thank Erik Tempelman, my initial chair, who unfortunately could not continue due to circumstances beyond his control. The tips on project-approach and things we discussed at the start of the project guided me throughout and have helped me a lot.

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Introduction

Alprokon

Alprokon was founded in 1967 by Fred van Herpen under the name Alkoni, initially supplying aluminium sheet solutions. Among its early product developments, the astragal proved particularly successful. By 2026, Alprokon has grown into the market leader in double-door fire safety solutions in the Netherlands, supplying products to nearly all public buildings and many offices, and producing over 12 kilometres of astragals annually. The wide range of configurable properties makes these astragals suitable for diverse building types and requirements, enabling functionalities such as fire and smoke sealing, as well as sound and burglary resistance. While many products are standardized, a significant portion is customized for specific projects, reflecting the company's flexibility and solution-oriented approach.

The company is characterized by a strong focus on continuous improvement and innovation, both within and beyond its core product range. A clear example is *Dakreling*, a modular and removable roof fall-protection system for roofers and maintenance workers. Although relatively new within the portfolio, it has rapidly gained traction. Despite being outside Alprokon's traditional focus on door solutions, *Dakreling* demonstrates the company's ability to leverage its design and engineering capabilities to successfully enter new markets and their drive to expand.

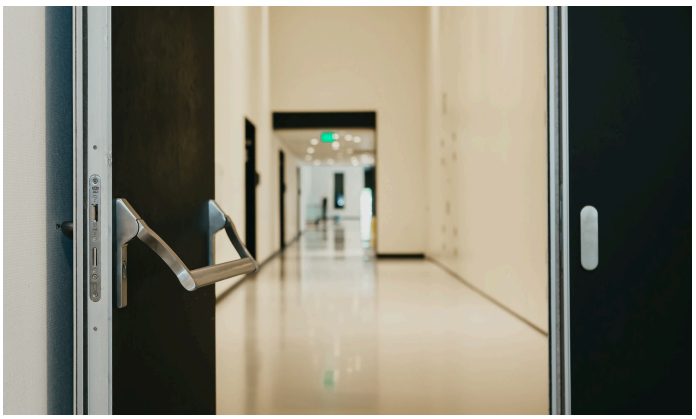




Figure 3 & 4: door with an Alprokon astragal (above) and a roof with Dakreling (below)

Project brief

Although many people regularly encounter an Alprokon astragal almost daily, brand recognition remains low, and consumers are often unaware of the company's role in safety solutions.

In its 2020 BHAG, Alprokon set the ambition that by 2030 every person in the Netherlands will recognize its name and associates it with safety. In line with the vision "every space safe," the company plans to launch a consumer platform, Elkeruimteveilig.nl, offering a wide range of high quality home safety products such as smoke alarms, security cameras, fire extinguishers, stair gates and emergency kits. The goal is to establish a central platform for home safety products and position the brand as a leading authority in this domain.



Figure 5: Elkeruimteveilig.nl

In addition to reselling existing products, Alprokon aims to introduce innovative, proprietary products exclusively available on the platform. These products should enhance home safety while attracting consumers and increasing brand visibility.

Accordingly, the design brief for this project was formulated broadly: develop a product that improves the safety of people at home. While few constraints were set regarding focus, theme or implementation, there was a clear preference for physical, marketable products aimed at individual consumers. This served as the starting point of the project.

Project Approach

In this project, the Double Diamond model was applied to structure the design process. Its use ensured that sufficient time, effort and focus were dedicated to each phase of the project, resulting in thorough research into the problem, potential solutions, and guidance during periods of uncertainty. The model supported decision-making, preventing the process from becoming too broad and ensuring that all choices made were evidence-based.

The Double Diamond shows the iterative movement between exploring broadly (diverging) and narrowing down options (converging). While it provides a clear sequence of phases (Discover, Define, Develop, and Deliver) the process in practice was not strictly linear. Regular movement between phases happened, with feedback loops, enabling continuous adjustments and improvements throughout the project. Each phase included different methods and activities, which together led to the final design and prototype.

Methods

During this project, various methods were used to collect, structure, and analyse information, as well as to generate, refine, and evaluate ideas and make informed decisions. The following chapter provides an overview of these methods used in the course of the project

Discover; Diverging

In and around the home, numerous potentially dangerous situations occur, often without immediate or severe consequences. However, a significant proportion of these incidents result in injuries, property damage or, in extreme cases, deaths. To better understand these risks, an extensive study was conducted, combining interviews with professionals, interviews with residents and a review of relevant literature. This approach provides an overview of where and how unsafe situations occur within the residential environment.

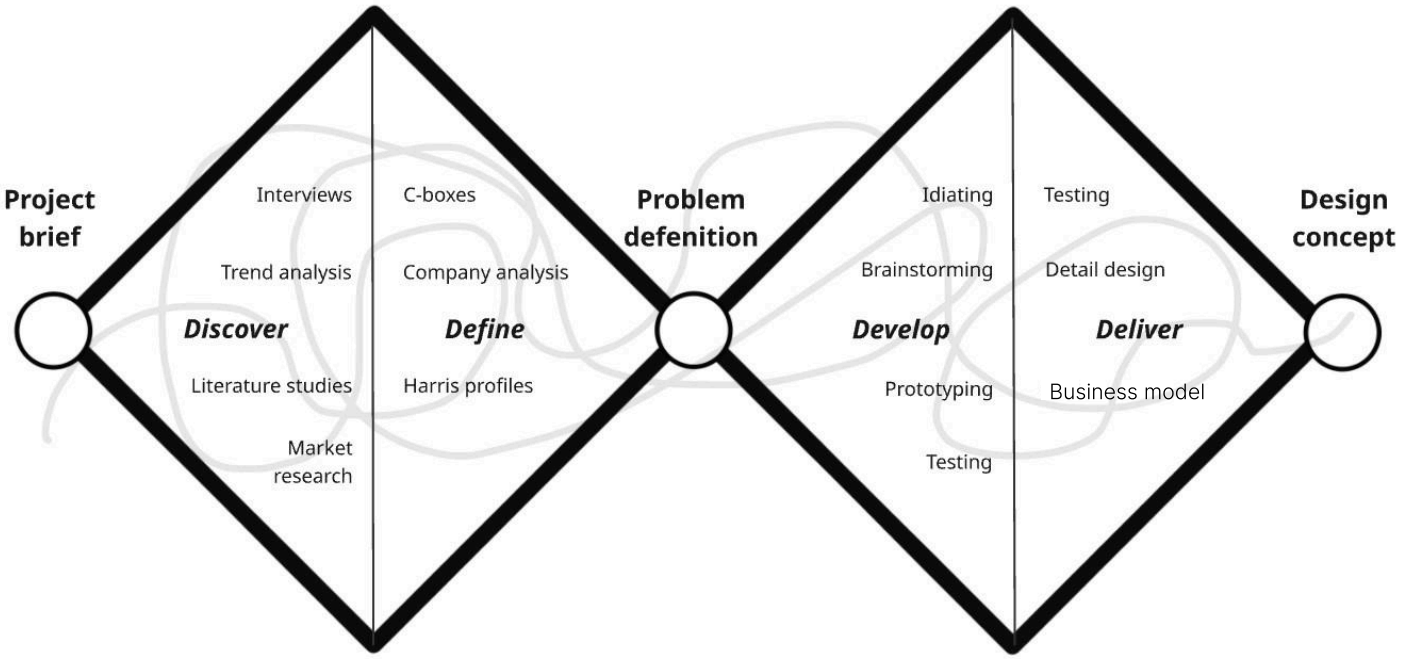


Figure 6: Schematic picture of the double diamond model applied in this project with corresponding activities.

To structure and interpret the collected data, two methods were applied. First, visual-mapping was used to group and project the identified risks onto a schematic map of a house, enabling the identification of high-risk areas and their associated hazards. Second, the clustering method was applied to cluster the data based on underlying causes, revealing patterns and themes across different situations. Based on these analyses, nine potential problem scopes were identified.

Subsequently, market research and trend analysis were conducted for each of these problem scopes. This provided further insight into existing solutions, current market opportunities and potential future developments and requirements.

Define: Converging

With all information gathered, several methods were applied to select the most suitable problem scope with the highest potential. To ensure alignment with the Alprokon, further analysis into this company was conducted using tools such as the Hedgehog Model, a SWOT analysis and mood boards. These methods provided a clearer understanding of the company and their strategic fit towards the identified design directions.

Subsequently, C-boxes and Harris profiles were used to evaluate and compare the identified opportunities, ultimately leading to the selection of the final project scope; protecting your home against floods.

Develop: Diverging

After defining the final project scope, additional research was conducted to develop a deeper understanding of the problem. This included interviews with professionals specializing in water management and flooding. Literature research focused on the causes and consequences of floods, with particular attention to cases in the Netherlands. Furthermore, detailed market analysis was carried out to identify gaps and potential unique selling points, alongside an investigation into how water enters homes during flood events. Stakeholder mapping and a set of requirements were also developed to structure the problem context.

Based on these insights, concept generation was started using methods such as the HKJ method, brain-writing, analogies, the lotus blossom method and SCAMPER. This resulted in 13 preliminary concepts, which were elaborated in more detail.

Deliver: Converging

Out of the initial 13 product ideas, four promising concepts were selected and further developed and tested using low-fidelity prototypes. Feedback from professional designers, colleagues and experts in water management and flooding prevention informed in the selection of the most suitable concept.

In the detailing phase, a parallel and iterative approach was taken. Material feasibility was explored through literature research, supplier consultations, including contact and a visit to Bekina BeSealed, and hands-on testing of available materials. Simultaneously, the product's form, application, and user experience were developed through sketching, prototyping and stakeholder feedback sessions. These two streams were closely interrelated; findings from material research directly influenced design decisions, and vice versa. Given the early stage of development and the unavailability of the final material, several decisions were based on informed assumptions, which will require validation through further testing.

The resulting concepts were subsequently evaluated through different methods, including a cost price analysis and the development of a supporting business case and supply chain.
This complete process resulted in an feasible and well-substantiated product concept that makes the home more safe during floods.

Use of AI

Throughout this project, artificial intelligence (AI) was used as a supportive tool. Primarily to refine and rewrite text into academic English and occasionally as a brainstorming aid. In both cases, all input was provided by me and all output was critically reviewed and assessed. AI was not used to generate data or draw conclusions. Full responsibility for all content and outcomes therefore remains with me as the author. Additionally, five figures (figure 26, 29, 30, 36 and 42) were modified using AI to support their statement.



Figure 6: image of a burglar

1. Problem Definition

“Every space safe” is a big and broad goal. What does safety mean? When are spaces not safe? What spaces? An extensive research is done to answer these and more questions to find the problem scope for the rest of the project. What unsafe situation in what space can be improved by creating a new product?

1.1. Research

What is safety and when is a home not safe? Researching this wicked problem was done in different ways; interviews with professionals, interviews with consumers and an extensive literature research.

1.1.1. Interviews with professionals

Why

In unsafe situations at home, professional assistance is often required. For example, firefighters respond to fires, police intervene after burglaries or accidents, or individuals seek help from a medical professional after an accident. To gain insight into home safety from different professional perspectives, semi-structured interviews were conducted with experts who regularly deal with such incidents.

How

In total, four interviews were conducted with five professionals: three firefighters, one emergency department physician, and one construction specialist from Vereniging Eigen Huis. Participants were asked about their personal experiences within their field, the key safety issues they encounter in the home-contexts, existing forms of information and guidance, and their perspectives on potential areas for improvement. All questions were tailored to the interviewee and follow-up questions were asked based on the responses. The information was structured and analysed. Deeper analysis of all found data will be explained in chapter 1.2. Detailed summaries of the interview questions and outcomes of each interview can be found in Appendix 1.1.

Findings:

The professionals pinpointed different focus points about unsafe situations happening often in the home context, the most important ones being:

Firefighters primarily emphasised fire-related hazards caused by handling electrical appliances in a way they are not supposed to. Particularly unsafe battery charging practices like mobile devices, e-bikes and e-scooters. Improper handling and placement of home batteries were also identified as emerging risks, a concern shared by Vereniging Eigen Huis. In addition, incorrect responses to stovetop fires, such as improper extinguishing or moving burning pans, were highlighted as factors that can escalate otherwise manageable incidents.

Both firefighters and the ER Doctor identified messy living spaces and stairways as significant hazards, as they increase the risk of tripping and can obstruct safe evacuation. The medical professional further emphasised the severity of the number of nighttime falls among elderly, often caused by fainting or loose rugs, noting that these incidents constitute a substantial proportion of emergency room visits.

Outdated electrical infrastructure, including canvas-insulated wiring and insufficient fuse boxes, was also identified by both firefighters and Vereniging Eigen Huis as a key fire risk. Finally, structural deficiencies, such as failing foundations, wall damage and poorly executed construction, were recognised as contributors to unsafe living conditions.

Overall these interviews conclude that unsafe situations are a result of the behaviour or the absence of this proactive behaviour towards a situation. During emergency situations, but mostly in advance of those. An overview of the thindings can be found in Table 1. For the complete overview of all findings, see Appendix 1.1.4.

Category	Unsafe Situation	Identified by
Fire-related hazards	Unsafe charging of mobile devices (phones, tablets)	Firefighters; Vereniging Eigen Huis
	Unsafe charging of e-bike and e-scooter batteries	Firefighters; Vereniging Eigen Huis
	Unsafe placement and handling of home batteries	Firefighters; Vereniging Eigen Huis
Cooking-related risks	Incorrect handling of stovetop fires	Firefighters
	Unsafe responses (e.g., improper extinguishing, moving burning pans)	Firefighters
Trip and evacuation hazards	Cluttered stairways	Firefighters; Medical professional
	Rugs and steps	Medical professional
Falls and medical risks	Tripping indoors among elderly	Medical professional
	Nighttime fainting and falling among elderly	Medical professional
	drunk individuals tripping	Medical professional
Electrical hazards	Outdated wiring (e.g., canvas-insulated wiring)	Firefighters; Vereniging Eigen Huis
	Obsolete fuse boxes	Firefighters; Vereniging Eigen Huis
Structural safety issues	Poorly executed construction work	Vereniging Eigen Huis
	Wall damage or openings	Vereniging Eigen Huis
	Failing foundations	Vereniging Eigen Huis

Table 1: overview of named dangerous situations by professionals

1.1.2. Interviews with consumers

Why

How do people perceive and approach safety in the home? Interviews were conducted with consumers to create an insight in this. These interviews explored individuals' definitions of safety, the factors that motivate them to take measures or invest in safety-related products and the barriers that may limit such actions. Additionally, the interviews aimed to identify underlying needs in relation to safety products.

How

Short individual interviews were conducted with 5 consumers. All participants live in either rented or owned homes, with a range of houses, apartments and souterrains. They all have a say in the safety measures and equipment used in their households.

Participants were asked what came to mind when thinking about safety, which provided insight into common focus areas. They were also asked which safety products they currently have at home and why and which ones not. Discussing products they do not own revealed both their level of awareness and their initial interests. Follow-up questions about why certain products were not present helped identify underlying barriers, such as practical limitations, perceived necessity or cost considerations. All questions and structure can be found in Appendix 1.1.5.

Findings:

The consumer interviews indicate that consumers' behaviour towards safety is largely shaped by social norms, perceived necessity and ease of implementation. Safety measures that are standardised or required, such as smoke alarms and fire extinguishers, are widely used. This suggests that external regulation and social norms play a role in investing in safety-products. In addition, many respondents reported incorporating basic safety-oriented behaviours into their daily routines, such as maintaining clear escape routes, avoiding unattended charging and locking their homes.

In general, the term "safety" is for people quite small. Most participants only named fire safety, ability to flee and burglary safety when asked "what is safety to you?". Other domains like air-quality, storms, cyber security, floods, mental safety and war are less named. The focus of safety knowledge seems more to be about wider known and immediately visible safety risks and less about long-term risks that appear less frequently.

Investing in safety products is mainly influenced by psychological factors. Respondents indicated that the products they invest in, provide a sense of safety and control. Perceived effort (e.g., the need for research), low prioritisation, lack of perceived necessity and, in some cases, not wanting to feel as if they have to invest, are barriers to investing in safety products. Furthermore, even when safety products are present, improper installation or placement reduces their effectiveness, potentially limiting their usability in emergency situations. Multiple consumers indicated that they are aware of the improper placement of their safety products but feel uncertain or unmotivated to correct this.

Overall, consumers do take action about their safety, particularly in familiar domains, there is limited proactive knowledge and behaviour toward broader or less immediate risks, and practical implementation of safety measures is often incomplete.

1.1.3. Literature research

Why

A literature review on residential safety was conducted to develop a broader and more comprehensive understanding of unsafe situations in and around the home. Including findings from sources based on data, referrals from professionals, focusgroups and other types of research gave a more evidence based findings. The findings from the literature review were used in the analysis of all found information, which supported the identification of a suitable problem scope.

How

An extensive literature review on residential safety was conducted across multiple academic and professional databases, including Google Scholar, as well as general search engines such as Google, Ecosia, and Bing. Sources consulted included academic studies, institutional reports, legal documents, news articles and professional publications. Additional sources were identified through referrals from interviewed professionals, ensuring both breadth and depth of the literature gathered.

Search terms were varied and iteratively refined to ensure broad and relevant coverage. Sources were evaluated based on both reliability and relevance. A source was considered suitable if it met the following criteria: it was authored or published by a credible individual or organization; it was published within the past 15 years (with limited exceptions for foundational works); it addressed safety in or around the house or its consequences; and it was focused on the Netherlands or on countries with comparable contexts.

Findings:
The findings from the literature review largely align with the findings of the conducted interviews. The most frequently identified and high-impact risks include residential fires, domestic accidents (such as falls, choking, poisoning, and cuts), burglaries and water damage. In addition, several less frequently discussed but substantiated risks were identified, including poor indoor air quality and natural disasters.

More detailed findings are presented in the following chapters.

1.2. Findings

After collecting all information with the interviews and literature research, this information was processed and analyzed in two different ways: visualizing it in a schematic overview of the house and by context mapping. The outcomes of both ways are shown in this chapter.

1.2.1. Visualising the data: dangerous places in the home

The insights gathered during all interviews and literature review, were reviewed and visualised onto a schematic layout of a house. This way, a visual overview was created of all potentially dangerous situations and its places in and around the house. Out of these situations, a selection based on most frequently mentioned situations, considered most dangerous, expected to become more relevant in the future and situations that are often overlooked was made and researched more in depth. See Appendix 1.2. for the complete list of dangerous situations per room. This chapter elaborates on the six most relevant ones.

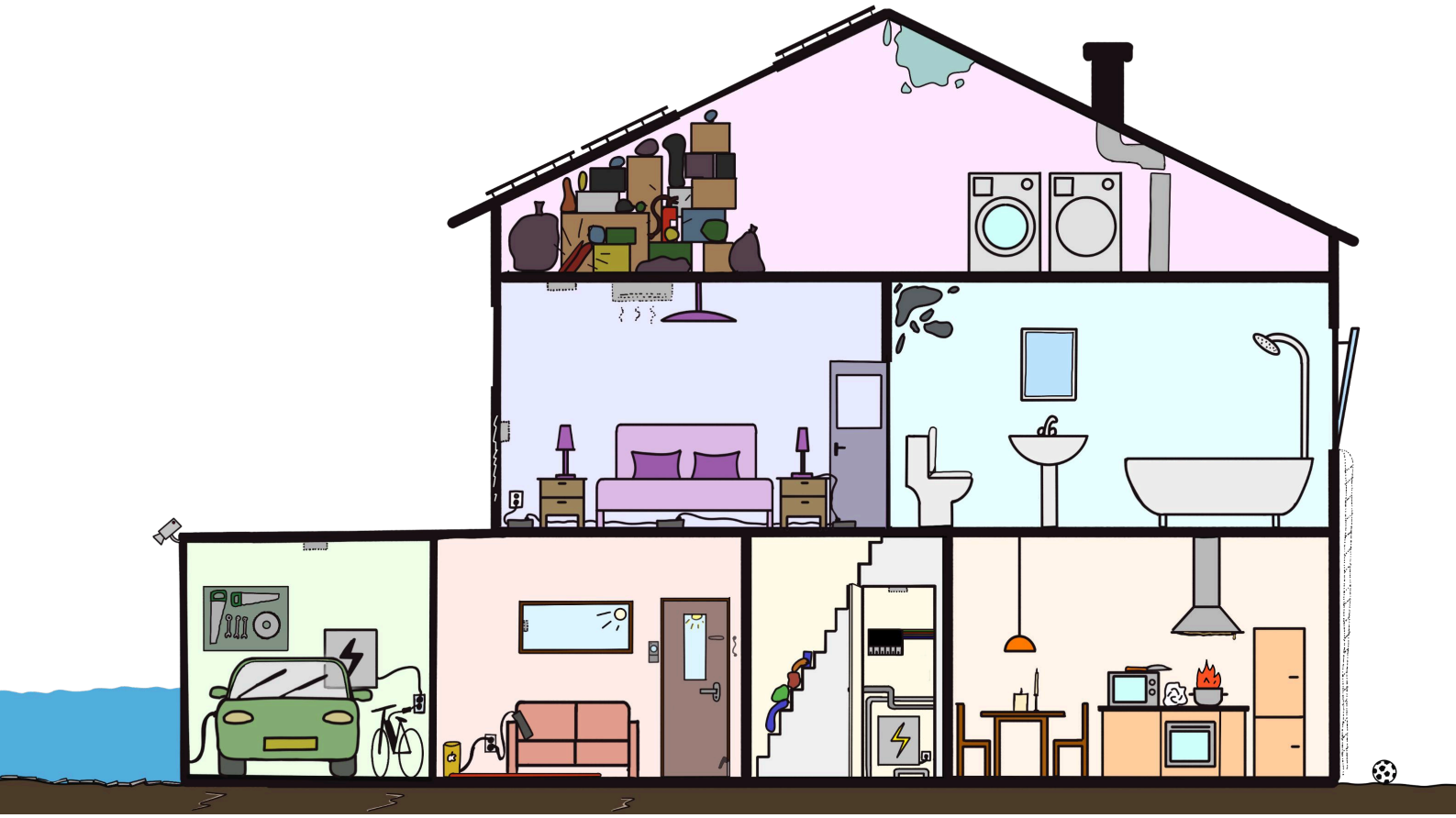
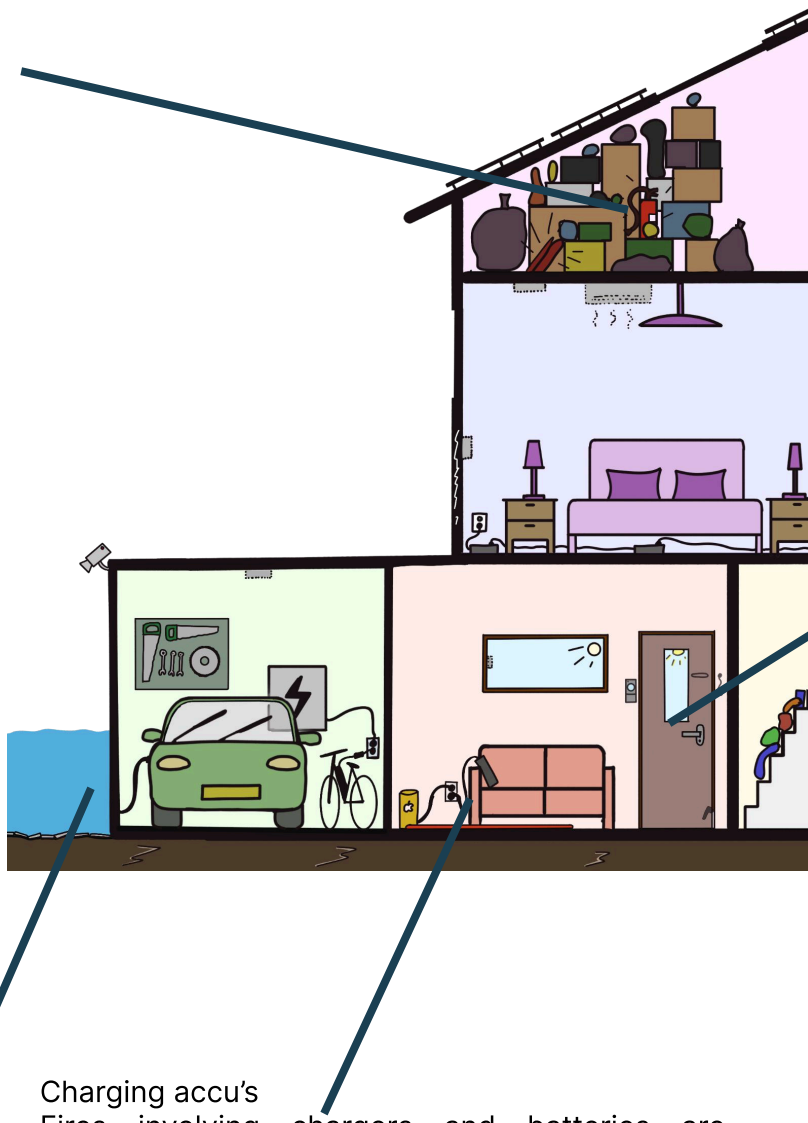


Figure 7: schematic overview of found dangerous situations in the house

Missing safety products

During the interviews, multiple participants indicated that safety products were not always stored or placed appropriately. One interviewee could not remember where their escape ladder was stored, while another interviewee noted they stored fire extinguishers in hard-to-reach locations. This suggests that owning safety products does not necessarily translate into effective usability in an emergency.

Limited research exists on how consumers place and use safety products at home. However, interview findings combined with emerging trends towards more aesthetically pleasing safety product designs (Jalo Helsinki, n.d.; Fire Art, n.d.; Nordic Flame, n.d.) suggest that users may be reluctant to hang large or visually intrusive products in their homes. This reluctance may contribute to improper placement, underuse, or misuse.



Floods

Due to climate change, the likelihood and severity of floods is increasing, as seen in the 2021 Limburg floods (Noorlander & Noorlander, 2025; Kennisportaal Klimaatadaptatie, n.d.) and similar events abroad (NOS Nieuws, 2026b; Nu.nl, 2026; TU Delft, 2025; Nu.nl, 2018; Trouw, 2021). A Rijkswaterstaat-commissioned calculation estimated that 10.6 million Dutch residents are at risk (Nijholt, 2026). However research by the Dutch Red Cross shows that most people are not prepared for floods, with many believing their home has little chance of flooding (Rode Kruis Nederland, 2024). This lack of awareness was reflected in the consumer interviews, where flood safety was rarely mentioned. One participant acknowledged the risk of a nearby river flooding but quickly dismissed it, feeling there was nothing they could do.

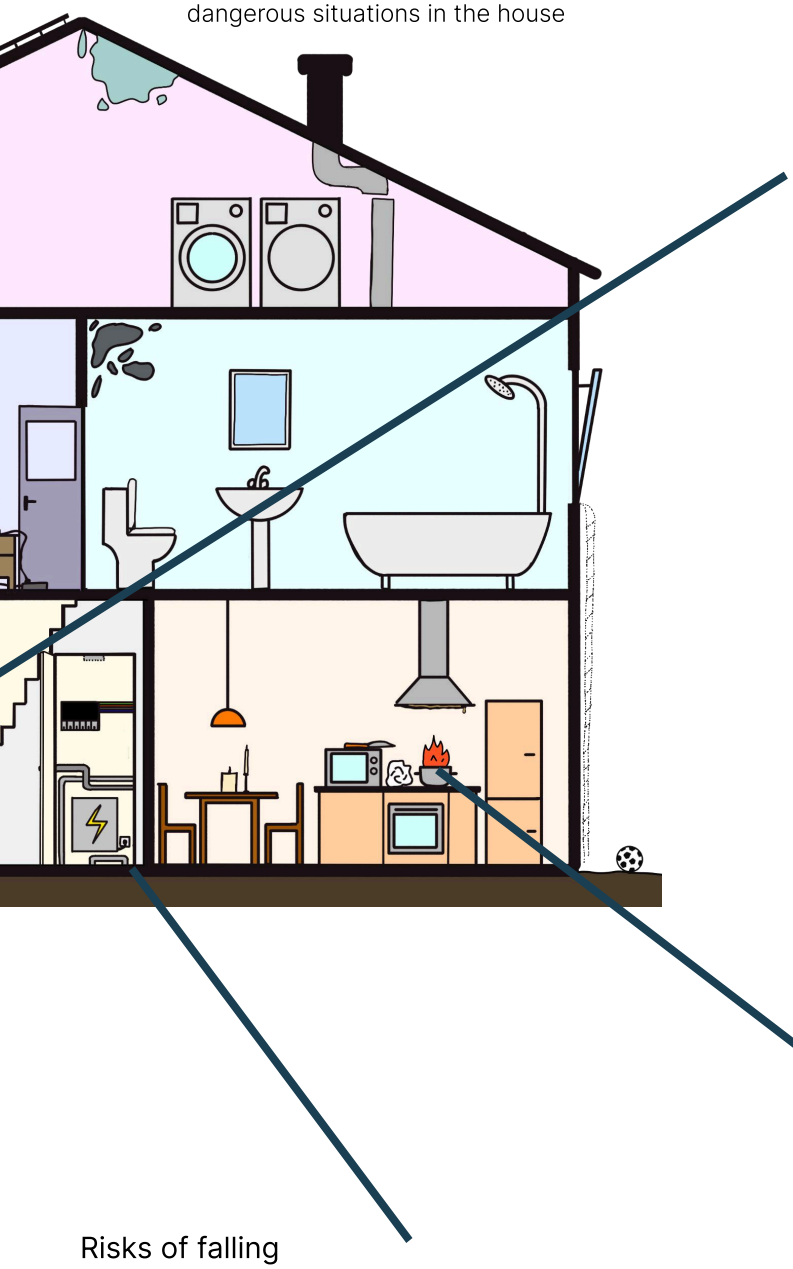
Existing tips for floods, from organisations such as the Red Cross, focuses primarily on during and post-flood response, like evacuation plans, emergency kits, and turning off electricity, with little attention given to preventing water from entering the home with barriers, sandbags or other protective measures (Denk Vooruit, 2025; Rode Kruis Nederland, 2025; Leven met water, 2025; Waterschap AA en Maas, n.d.; Veiligheidsregio Noord-Holland Noord, n.d.). Investing in such preventive measures could significantly reduce damage, financial loss and dangerous situations.

Charging accu's

Fires involving chargers and batteries are increasing, having overtaken fuse box fires as the most common type of electrical fire (Netbeheer Nederland, 2025), partly driven by the growing use of e-bikes (Brandweer, 2025d). While charging itself is not directly dangerous, unsafe charging, such as using damaged batteries, low-quality chargers, overcharging, or charging without smoke detection, significantly increases fire risk. Lithium-ion battery fires are particularly hazardous, being difficult to extinguish and produce toxic smoke (Van Wijk, 2025; Brandweer, 2025a; Heijnen, 2023).

Many consumers lack knowledge of safe charging behaviour (Van Wijk, 2025), and the growing adoption of home batteries is expected to increase the risk of such fires further (Agnew & Dargusch, 2016; Brandweer, 2025b; Haaglanden Veilig, 2026). As a solution various campaigns with guidance on safe charging are created (Ik Laad Accuraat, 2025).

Figure 8: schematic overview of found dangerous situations in the house



Burglaries

IIn the Netherlands, over 20,000 burglaries occur annually, though numbers have declined significantly in recent years (Politie, 2026; Van den Berg, 2022). Recommended measures to prevent break-ins include certified locks, door chains, outdoor lighting, and securing doors and windows when leaving (Politiekeurmerk Veilig Wonen, 2025b; Nationale Nederlanden, 2026). Combining multiple interventions offers the greatest protection, with external lighting and deadbolt locks among the most effective individual measures (Tseloni et al., 2014). Nevertheless, a significant share of Dutch residents still fail to consistently lock up when leaving home (Univé & MarketResponse, 2022).

Interviews confirm burglary as a prominent concern, with most participants having implemented measures such as three-point locks, door chains, alarms, and cameras. While participants were generally proactive, some expressed reluctance toward more intrusive solutions like cameras, preferring not to feel dependent on such measures for their sense of safety. This contradicting feeling creates room for innovative solutions.

Risks of falling

Falls are a leading cause of injury and death in the home. In the Netherlands, they are the primary cause of accidental death (National Safety Council, 2025b; Centraal Bureau voor de Statistiek, 2025b). In the United States, stairs, chairs, and beds are among the most common sources of fall-related injuries requiring emergency care (National Safety Council, 2025a; Stam, 2023). A large proportion of the emergency department visits are elderly that have fallen and often suffer various fractures or head injuries (Stam, 2023; Centraal Bureau voor de Statistiek, 2025b). The interviewed emergency physician confirmed this pattern, noting that a significant part of their patients are elderly people who fell at home, particularly at night, due to factors such as dizziness, loose rugs, slippery footwear, stairs, and reluctance to use walking aids.

Kitchen fires

Kitchen fires account for the majority of residential fires. In England, 68–76% of residential fires start in the kitchen, most frequently between 4:00 p.m. and 8:00 p.m. (Spearpoint & Hopkin, 2019), while in the United States this amount ranges from 30–68% depending on housing type, both with cooking as the primary cause (Hall & McGree, 2025). Key risks are unattended cooking, distraction, and combustible materials placed near heat sources (Xiong et al., 2016). Although these findings cannot be directly applied to the Netherlands, similar living conditions suggest comparable patterns. This is supported by firefighter interviews conducted in this study, which confirm that, despite the decline in fires, unsafe cooking remains a significant cause of house fires.

1.2.2. Cluster outcomes: dangerous themes in the home

To discover underlying themes and patterns and connections of the findings, the context-mapping method (Stappers et al., 2023) was applied. By analysing on a more thematic level the deeper factors are unraveled, which is crucial for identifying project opportunities and designing effective interventions.

The information found in the literature and interviews was stated into 209 statement cards. A cluster session where each card was individually assessed and linked to the other cards revealed 24 clusters covering 6 themes. Some clusters were already known. Others opened up new insights. The most surprising, new or important clusters are elaborated below. All clusters and their statement cards can be found in Appendix 1.3.



Figure 9: all statement cards printed and cut

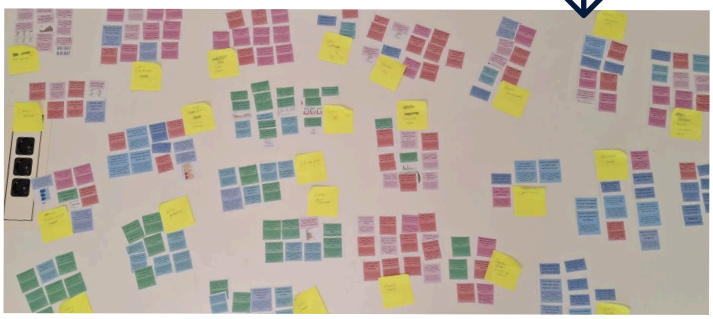


Figure 10: all statement cards in their clusters

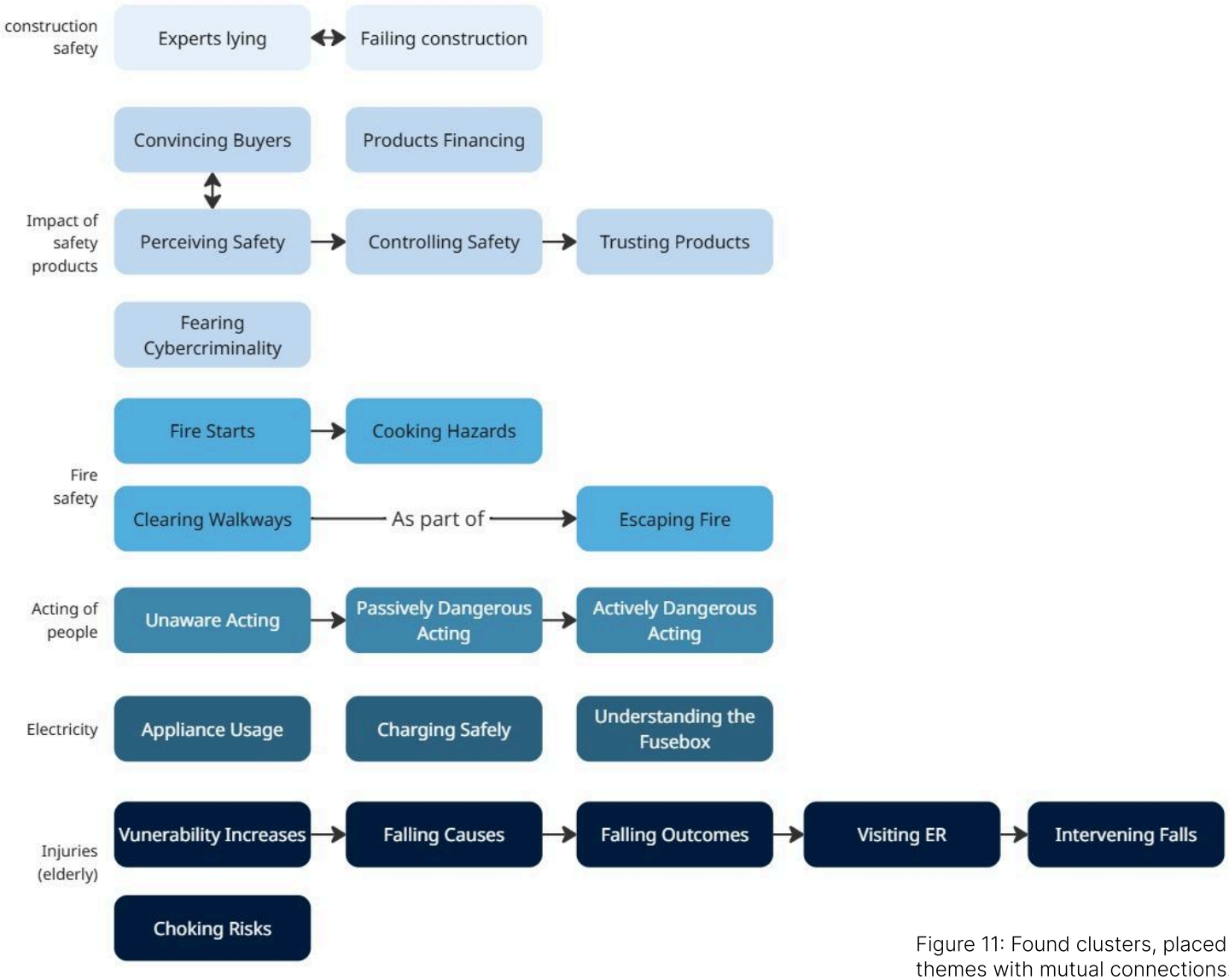


Figure 11: Found clusters, placed in themes with mutual connections.

Theme: acting of people

Analysis of the interviews and literature revealed four different types of behaviour consumers can show that can lead to unsafe situations. To prevent these unsafe situations from happening, the specific behaviour type shown by consumers is important for selecting the best fitting (design) strategies and interventions. These four behaviour types are shown in figure 12 and are:

1. Being Unaware: When people **don't do something** which might result in a dangerous situation, because they **did not know** it might be dangerous.
2. Being Naive: When people **actively do something** which might result in a dangerous situation, because they **did not know** it might be dangerous.
3. Being Negligent: When people **don't do something** which might result in a dangerous situation, even though they **know** it might be dangerous
4. Being Stubborn: When people **actively do something** which might result in a dangerous situation, even though they **know** it might be dangerous

Individuals do not fit neatly into a single behaviour type; their knowledge and actions vary across situations. For example, a person may charge their phone on the couch, aware of the risk (situation 4) (Brandweer, 2025a), while simultaneously neglecting to clean an old toaster because they are unaware of the fire hazard (situation 1) (Xiong et al., 2016).

In conclusion, behaviour change strategies should be tailored to the type of behaviour exhibited. For those who are unaware of the risk (types 1 & 2), informing and educating may be effective. For negligent behaviour (type 3), solutions that facilitate and motivate safe actions are appropriate and inform people on the consequences. For stubborn or resistant behaviour (type 4), interventions that prevent or redirect the behaviour can reduce risk. As well as keep informing them on the consequences. Recognizing these distinctions is essential when designing safety products.

Use of (old) appliances

A proportion of residential fires is caused by electrical appliances, typically due to short circuits or overheating (Grijpma et al., 2023). The risk increases with misuse, insufficient cleaning, and lack of maintenance. Appliances that generate significant heat or accumulate dirt easily, such as ovens, microwaves, deep fryers, dryers, and heating equipment, pose higher risks (Xiong et al., 2016; Grijpma et al., 2023). In particular, the misuse of older heating equipment is identified as a significant hazard (Xiong et al., 2016).

Encouraging regular maintenance or developing solutions that prevent short-circuiting could therefore reduce the fire risk associated with electrical appliances.

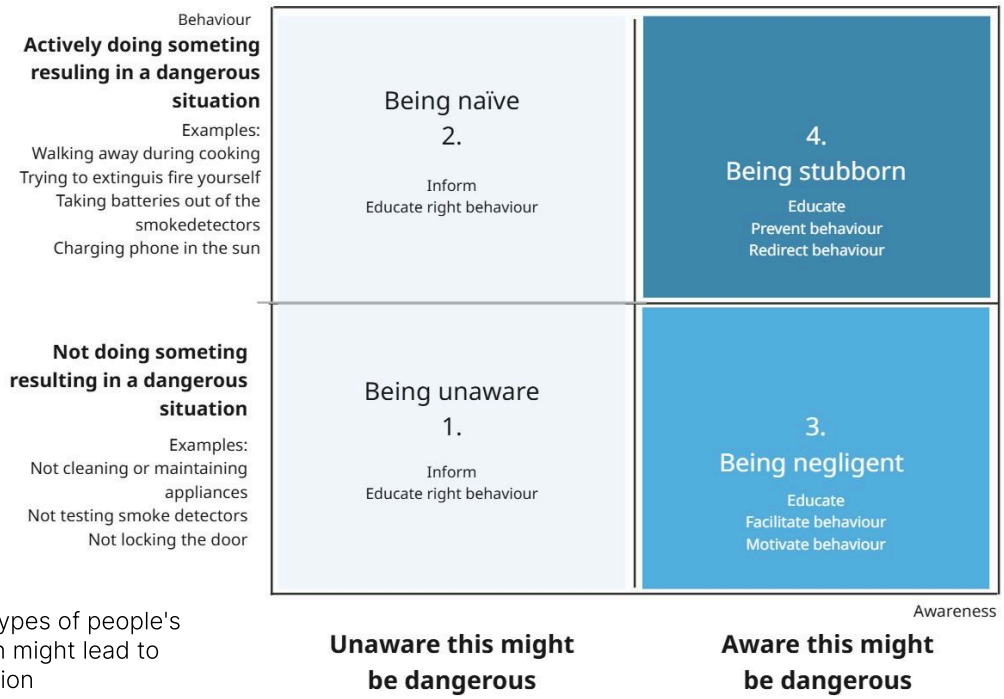
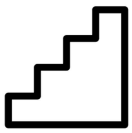


Figure 12: four types of people's behaviour which might lead to an unsafe situation



Cluster: Perceiving safety

The use of doorbell cameras has grown rapidly in recent years (Politiekeurmerk Veilig Wonen, 2025), driven primarily by the desire of customers to feel safer at home (Buccieri, 2025). However, evidence shows that they do not necessarily prevent burglaries and may in some cases increase risk (Politiekeurmerk Veilig Wonen, 2025; Tseloni et al., 2014; Farivar, 2020). This highlights a broader phenomenon: consumers are willing to invest in products that offer a sense of control, such as remote monitoring, even without objective safety benefits. However, this perceived control can also increase anxiety for some users (Buccieri, 2025). Solutions that enhance the consumer's sense of control may therefore be both effective and well received.



Free walkways & escaping fires

Hall and McGree (2025) found that 37% of fire-related deaths and 31% of injuries occur during escape attempts, making clear escape routes critical. The fire brigade advises keeping these free of clutter (Brandweer, 2025c; Brandweer Amsterdam-Amstelland, 2024), with regulations enforcing this in shared buildings (Overheid, 2026). The interviewed firefighters echoed this, also noting the importance for their own work. Cluttered floors additionally raise fall risk (National Safety Council, 2025).

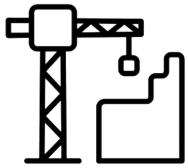
Despite widely available tips on escape planning (Brandweer, 2025c; Nationale Nederlanden, 2026b), few interview participants had created a plan, shared this with cohabitants or installed escape equipment, revealing a clear gap between awareness and action.



Cluster: Convincing buyers

Convincing consumers to buy safety products is challenging, as people are reluctant to invest in items they may never need. Consumer interviews confirmed that purchases are often driven less by objective safety, but by the feeling of being prepared and the peace of mind this provides. Making perceived security a key factor in purchasing decisions (Gabriele, 2026), as also seen with doorbell cameras.

Financial motivation also plays a role: consumers are more willing to invest in products that save money in the long term. Interviewees reported greater willingness to purchase safety products for family members than for their own use, aligning with the concept of prosocial spending, the idea that spending on others generates greater personal happiness (Dunn et al., 2008). Although based on limited qualitative data, this suggests an opportunity to design products that benefit a specific target group while also benefiting the purchaser, increasing both usability and market potential.



Failing construction

Construction failures can create dangerous situations. The construction specialist from Vereniging Eigen Huis identified two main issues: foundation problems, where droughts and groundwater depletion put nearly half a million Dutch homes at risk of subsidence and structural instability (VEH, n.d.); and poor-quality workmanship, where unskilled or negligent contractors ignore safety regulations, overcharge, or miscalculate structural changes (Vogels, 2023). As a result, VEH offers a specialist check service to give homeowners a piece of mind about the quality of the construction done (Vereniging Eigen Huis, n.d.-b). Firefighters also note that using a home in unintended ways can increase hazards.

New construction homes are bound to strict, regularly updated safety regulations. Older homes, however, need only comply with their original "legally acquired level" (Informatiepunt Leefomgeving, n.d.), making them more prone to structural and safety risks. Updating these homes to modern standards is time consuming and expensive and is oftentimes not done, leaving them a significant and persistent hazard.

1.3. Potential problem scopes

What dangerous situation should be prevented? By combining the findings on dangerous locations within the home (chapter 1.2.1.) with the identified clusters (chapter 1.2.2.), nine relevant problem scopes were identified. This selection enabled a more focused analysis to determine the problem scope with the greatest potential.

This selection was based on a multi-criteria assessment, including: the increasing importance of the issue over time, frequency of occurrence, level of public awareness, degree of preventability and the potential for alternative or innovative perspectives on the problem. Although a lot of information on these factors was found during the research, some assumptions had to be made.

The nine problem scopes are:

1. Changing people's behaviour toward safety
- Many people have a “this won’t happen to me” mindset regarding safety.
- They are often aware their behavior is unsafe but continue anyway.
- Although people value safety, they face practical barriers (time, knowledge, priority), causing safety to rank low on their to-do list.
- Products, campaigns, measurements, etc. could be used to adjust consumers behaviour.

2. Esthetics of safety products
- Safety products are often perceived as unattractive and visually intrusive.
- As a result, they are not always placed correctly or accessibly.
- Attractive design may improve visibility and likelihood of use.
- This also creates an opportunity to increase Alprokons brand recognition.

3. Kitchen fires
- Most house fires start in the kitchen, often during cooking.
- These fires are frequently caused by human behaviour or negligence.
- Many existing kitchen fire products limit damage but focus on consequence control rather than fire prevention.
- The rise of induction cooking does not eliminate the risks of stovetop fires

4. Floods
- The risk of flooding is increasing, both near rivers and lakes and due to heavy rainfall or overflowing sewers.
- Many people are unaware of these flood risks.
- Preparing homes for floods is not yet a priority for most.
- Guidance mainly covers what to do after flooding, not how to prevent it.
- There is no central place to purchase flood protection products and are often expensive.

5. Elderly falling
- Falls among the elderly account for the majority of First Aid visits.
- The elderly population is growing, and more will live at home longer in the coming years.
- Many products already exist to prevent falls among the elderly.
- The target group is significant but very specific.

6. Increasing the safety of old houses
- New houses are built under strict safety regulations, older houses have less requirements.
- Many homes have structural problems that create unsafe situations.
- Some homeowners are aware of risks but feel unable or unmotivated to improve safety.
- Unskilled or untrustworthy contractors contribute to unsafe construction practices.

7. Charging safely
- Unsafe charging of batteries is a major cause of house fires.
- The growing number of rechargeable products at home increases this risk.
- Fires are mainly caused by unsafe behaviour and poor-quality batteries or chargers.
- Battery fires are difficult to extinguish.
- It is hard to change consumers behaviour towards safe charging.

8. Feeling of being in control of your safety
- People want to feel in control of their safety.
- Products that provide a sense of control are more likely to be purchased.
- Some popular safety products, like doorbell cameras, may not increase actual safety but make users feel safer.

9. Safely escaping the home
- Being unable to escape during for instance a fire or burglary could be a major hazard.
- Many homes have cluttered hallways, which also hinders first responders.
- Escape ladders are expensive, hard to store, and often perceived as unsafe.

1.4. Researching the potential problem scopes

To find the scope with the highest potential for this project, more research was done about the existing markets, ongoing trends and the connection with Alprokon.

1.4.1. Market research

What are the current solutions available on the market for the nine defined problem scopes? A market research was done to gain an insight of the products available, the price, ability to store, effectiveness and their limits. This information can later be used to identify potential gaps in the market.

Products included in the market analysis were identified by entering search terms aligned with the defined problem scopes into multiple search engines, including Google, Ecosia and Bing. Both general search results and the “products” tabs were used to identify relevant solutions.

Each product was assessed based on several criteria: market presence (e.g., availability across multiple vendors), level of customizability, required quantity per household (to estimate total cost), and ease of storage. In addition, an indicative evaluation was made of the product’s expected effectiveness and its limitations. This assessment provides insight into existing market gaps and informs the requirements for potential future solutions.

The market analysis highlights several gaps in residential safety products for each potential scope.

Scope 1: Changing people's behaviour toward safety
Physical products that actively influence and encourage safe behaviour are largely absent. This is mostly done in campaigns and initiatives. This presents a potential area for innovation of physical solutions, although it is doubted if consumers are willing to invest in such solutions.

Scope 2: Esthetics of safety products
While more aesthetically designed safety products are emerging, regulatory constraints in the Netherlands limit the range of available options. Innovation between these rules and regulation with a focus on visually appealing designs could be a product development potential.

Scope 3: Kitchen fires
There are few solutions specifically targeting kitchen fires, despite their high occurrence. Besides, most fire safety products are reactive, focusing on detection and extinguishing rather than prevention. Suggesting an opportunity in preventing kitchen fires rather than extinguishing them.

Scope 4: Floods
Flood prevention solutions are currently limited in versatility, ease of storage, ease of setting up and accessibility. Highlighting a potential opportunity for more practical and versitile solutions.

Scope 5: Falling elderly
The market for (elderly)) fall prevention is well-developed. However, effectiveness often dependents on correct usage and the level of support required by the elderly, indicating that product performance alone may not be sufficient but creating a form of convincing people to use them is required.

Scope 6: Increasing the safety of old houses
Building safety domains appear largely unsuitable for product-based solutions, as they require professional assessment and intervention to fully solve the unsafe situation.

Scope 7: Charging safely
Products aimed at improving charging safety compete directly with the option of replacing existing chargers or batteries, which may limit consumer adoption.

Scope 8: Feeling of being in control of your safety
While some products aim to increase the perceived feeling of safety, successful examples are mostly found in the domain of burglary prevention and assessment, they often involve complex systems such as camera surveillance. Opportunities arise to expand this sense of control and security into other domains, for example fire safety.

Scope 9: Safely escaping the home
Some range of evacuation-related products exists already, but many are perceived as bulky, unattractive and expensive, which may reduce their appeal and willingness to invest in, store or use properly.

The complete list of the market research can be found in Appendix 1.4.

1.4.2. Trends

Understanding both current and future trends supports companies in positioning themselves effectively and anticipating future developments, ultimately contributing to the design of more suitable and successful solutions. Therefore both current and emerging trends were analysed.

1.4.2.1. Future trends

Although the future is uncertain, future trends can already be identified. Anticipating these developments enables companies to prepare strategies and respond to changing customer needs, making an understanding of future trends essential for long-term positioning. Like choosing what type of product to develop to fit the future needs of consumers.

Leads for potential future trends were identified throughout the research process, including during interviews with consumers and professionals, discussions with supervisors and colleagues and the literature review. These leads often emerged as subtle signals, but showed great relevance when further researched. The leads that showed the strongest relevance and potential impact for the project were investigated more through targeted literature research and follow-up discussions with domain experts. Three interesting topics were identified.



Cybercriminality

Concerns about cybercrime were raised in multiple interviews, with respondents expressing reluctance to invest in smart home products due to fears of hacking, surveillance and fraud. This aligns with research showing an increase in both the frequency and sophistication of cybercrime (MIND Young, 2025; Centraal Bureau voor de Statistiek, 2025a; Jager, 2026), a trend expected to continue alongside the technological development (Kaspersky, 2025). Combined with limited consumer understanding of digital threats and solutions, this highlights an opportunity for solutions that integrate digital security with a tangible sense of safety.



Climate change

An interview with the structural engineer of Vereniging Eigen Huis highlighted foundation problems affecting over half a million Dutch homes, caused by climate change-induced shifts in groundwater levels (Vereniging Eigen Huis, n.d.-a). More broadly the rising temperatures due to climate change are increasing the frequency of droughts, wildfires, extreme heat, heavy rainfall and flooding (ESPAS, n.d.; United Nations, n.d.), resulting in growing flood risks across the Netherlands and a higher likelihood of forest fires (Deltares, 2025; Schaap & Ajrovic, 2025).

These developments have direct impact on household safety, requiring context-specific measures such as wildfire prevention, water storage and flood protection. Notably, despite general climate awareness, none of these concrete risks were raised during consumer interviews, suggesting a gap between awareness and action, and a need for accessible solutions that address climate-related risks at the household level.



Elderly living at home

The first aid physician highlighted the high number of elderly patients treated daily for injuries sustained at home. This proportion is expected to grow significantly, as confirmed by literature. Ageing population policies encourage older adults to live independently for longer. However, many of their homes are not adapted to accommodate age-related physical decline, leading to more falls and therefore hospital visits (Lagendijk, 2024; Ministerie van Algemene Zaken, 2025). This places extra pressure on healthcare systems already facing shortages in beds and personnel (TNO, 2025). This situation is expected to worsen, as the elderly population is growing, while the healthcare workforce shrinks (Toekomst Nederland 2040, 2023). Creating solutions that adapt the living environments to the needs of the elderly residents could improve the home safety and reduce healthcare pressure, creating an interesting opportunity for Alprokon.

1.4.2.2. Ongoing trends

Understanding current developments enables more effective strategic positioning and future planning. Trends shape public awareness and influence individuals' willingness to act, often signalling future directions. Google Trends data can provide an indication of topics currently capturing public attention by showing the relative frequency of search terms used over time. While this data does not reveal precise motivations, it offers a useful general indication of relative interest across the subjects.

For this analysis, the terms "Brandblusser", "Zandzak", "Rookmelder", "Rollator", "Aannemer", "Brandladder", "Oplader", and "Ring deurbel" were compared over the period March 2025 to March 2026. This data should be treated as an indicative signal rather than hard data, with various limitations outlined in Appendix 1.5. Nevertheless, the analysis provides useful indications of topics currently trending, which can support the selection of a project scope with strong future potential.

The term “opladen” was “googled” significantly more often than the other safety-related terms, as showed in figure 13. However, this does not necessarily mean that people are more concerned about charging safety than, for example, fire extinguishers. Rather, it suggests that charging is a more frequent and visible activity in daily life and terms including the word “oplader” are therefore used more. This could be explained by the rise of E-bikes and Electric cars that need charging. This high focus on charging could be used by Alprokon to introduce a solution to the dangers of charging, since it is a widely used and searched for phenomenon.

Figure 14 presents the same search term analysis, excluding charging-related terms and focusing on products. The results show that smoke detectors, fire extinguishers, contractors, and walkers are searched more frequently than sandbags or escape ladders, suggesting greater consumer interest in these product categories. This presents Alprokon with a strategic choice: either enter product ranges with already proven consumer demand, or develop a product in a category with, at the moment, limited consumer attention, but potentially less products already available.

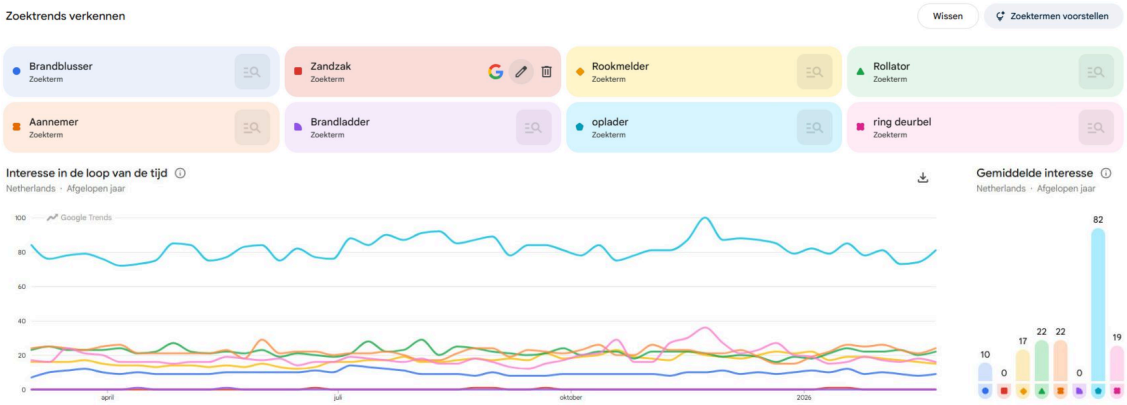


Figure 13: trend analysis of google search terms based on products of the potential problem scopes based on the market research.

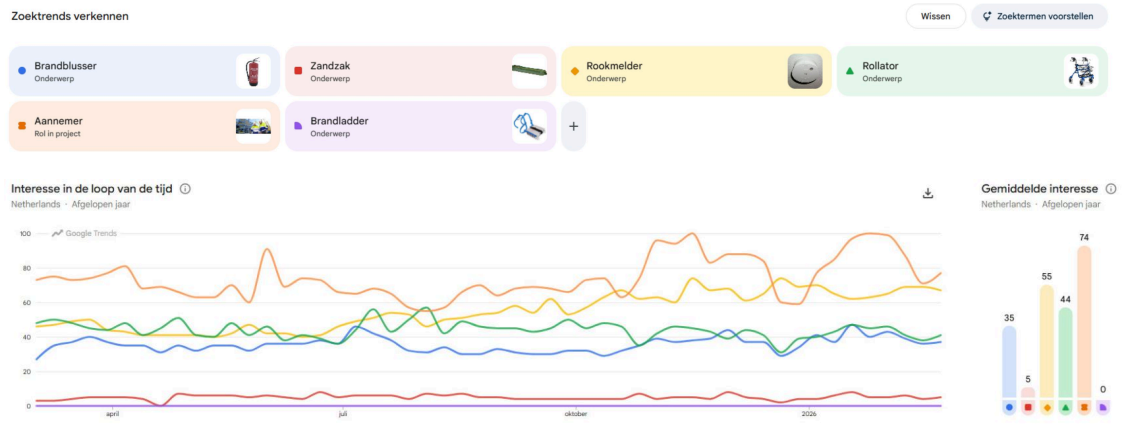


Figure 14: trend analysis of google search terms based on products of the potential problem scopes based on the market research, without “opladen”.

1.4.3. Alprokon's fit

Although Alprokon is open to exploring new markets, product groups and manufacturing ways, launching a new product is easier when the strengths and competencies of the company can be used. By using different models, the core competences, strengths, weaknesses, opportunities, threats, and mood of Alprokon are explored.

1.4.3.1. Hedgehog model

In his book, Good to Great, Jim Collins (2001) introduces the Hedgehog model as a framework for identifying a company's core competence, which can then guide business activities to position themself and create market opportunities. A brief application of this model was carried out for Alprokon, based on conversations with colleagues and observation. The model was applied twice, once for Alprokon in its current form, and once for the envisioned Elkeruimteveilig brand, as these represent two distinct companies with different goals. The detailed outcomes are presented in Appendix 1.6.1.

The core competence of the current Alprokon is:

Designing and manufacturing high-quality, neatly integrated door closing and safety systems where provable safety and appearance are key. Driving profit through premium positioning and margin in products.

The core competence of Elkeruimteveilig.nl is:

Offering a complete range of affordable and high-quality safety products that improve the personal safety of consumers, driven by margin per product sold.

Although both companies share a similar foundation, improving people's safety, their approaches differ. Alprokon focuses on a limited range of specific and high-quality products for businesses, while Elkeruimteveilig focuses on a broader range of products aimed at personal safety. These distinctions opportunities should be kept in mind when selecting the project scope and designing new solutions.

1.4.3.2. SWOT

By applying a SWOT analysis, the strengths, weaknesses, opportunities and threats of Alprokon are discovered (Zijlstra et al., 2020). This information can be used to position the new B2C model to use the strengths of Alprokon, improve around its weaknesses, seize the opportunities identified and protect itself for possible threats.

This analysis was done through objective observations, conversations and literature research of the company's activities and positioning. Table 2 shows an abridged version of the SWOT analysis done. The complete analysis and how this was done can be found in Appendix 1.6.2.

Alprokon excels at creating elegant, fire-safe door solutions, supported by strong technical knowledge, skills and facilities. However, its current product range offers limited customer reach and growth potential. Their expertise and reputation in fire safety provide a strong foundation, and their proven ability to enter new market segments, combined with a team that embraces innovation, positions them well for expansion.

With growing consumer interest in safety and peace of mind, Alprokon has significant opportunities to pursue, whether through affordable and aesthetic solutions or an all-in-one safety service. At the same time, evolving government regulations, construction goals, and sustainability requirements should be considered when defining a new strategic direction.

Strengths	Weaknesses
• Lots of technical knowledge (extrusion, door specifications, manufacturing, etc.) • Strong brand identity • Strong ties with resellers • Drive for high-quality products • Elegant and clean products • Provable safe products • Products fit different customer needs; fireproof, soundproof, etc.	• One main source of income: astragals • No sales to private end-consumers (B2C) • Limited direct sales to customers (mostly through retail) • Barely any name-fame to customers • Only focus on fire and smoke safety, no other unsafe situations • Products are barely applicable in a standard house
Opportunities	**Threats**
• Rise in safety-awareness consumers • Create a solution that focuses on other safety issues than fire safety; Like falling, water protection, charging safely, burglaries, etc. • Create a solution that is made for things other than doors • Low-cost safety solutions • Create a solution that gives people a sense of control • Offer complete packages with all needed for safety and installation services • Create a solution that will have a high cost-benefit outcome for the consumer. • Grow in IOT solutions and opportunities	• Customers have a limited amount of money they want to invest • Limited amount of astragals to be sold • Competitors are creating similar products • Rising material costs • Tight labour supply • New upcomming safety-risks, like floods, charging fires and war • Changing focus to remodelling buildings instead of building new ones, resulting in fewer double doors • Shift in how people perceive safety • More focus on sustainability and the life cycles of products

Table 2. The most interesting findings in the SWOT analysis of Alprokon.

1.4.3.3. Moodboard

What is the visual style of Alprkon and how does this reflect on (future) products? Alprokon was founded in 1967. Since then, many innovations, product changes and company styles have passed and its appearance towards its customers has changed. Lately, this appearance has been settled, and products and style are intertwined. A moodboard would capture this style. A new product would preferably fit within this image.

The images used for the mood board were collected through three approaches:

- Searching the term “Alprokon” via Google Images and Ecosia images.
- Reviewing visual content on the official media channels of Alprokon, including the website, LinkedIn, Instagram, and Facebook.
- Exploring websites of partners and resellers.

The collected images were evaluated based on the following criteria:

- Whether the image was created or commissioned by the company
- Whether the image was deliberately published by Alprokon
- Whether the image reflects the core business and intended brand identity of Alprokon

Images that met these criteria were considered representative of the desired look and feel of the company and were therefore included in the mood board.

In addition to static images, several videos met the same criteria. Relevant still frames were extracted from these videos and incorporated into the mood board.

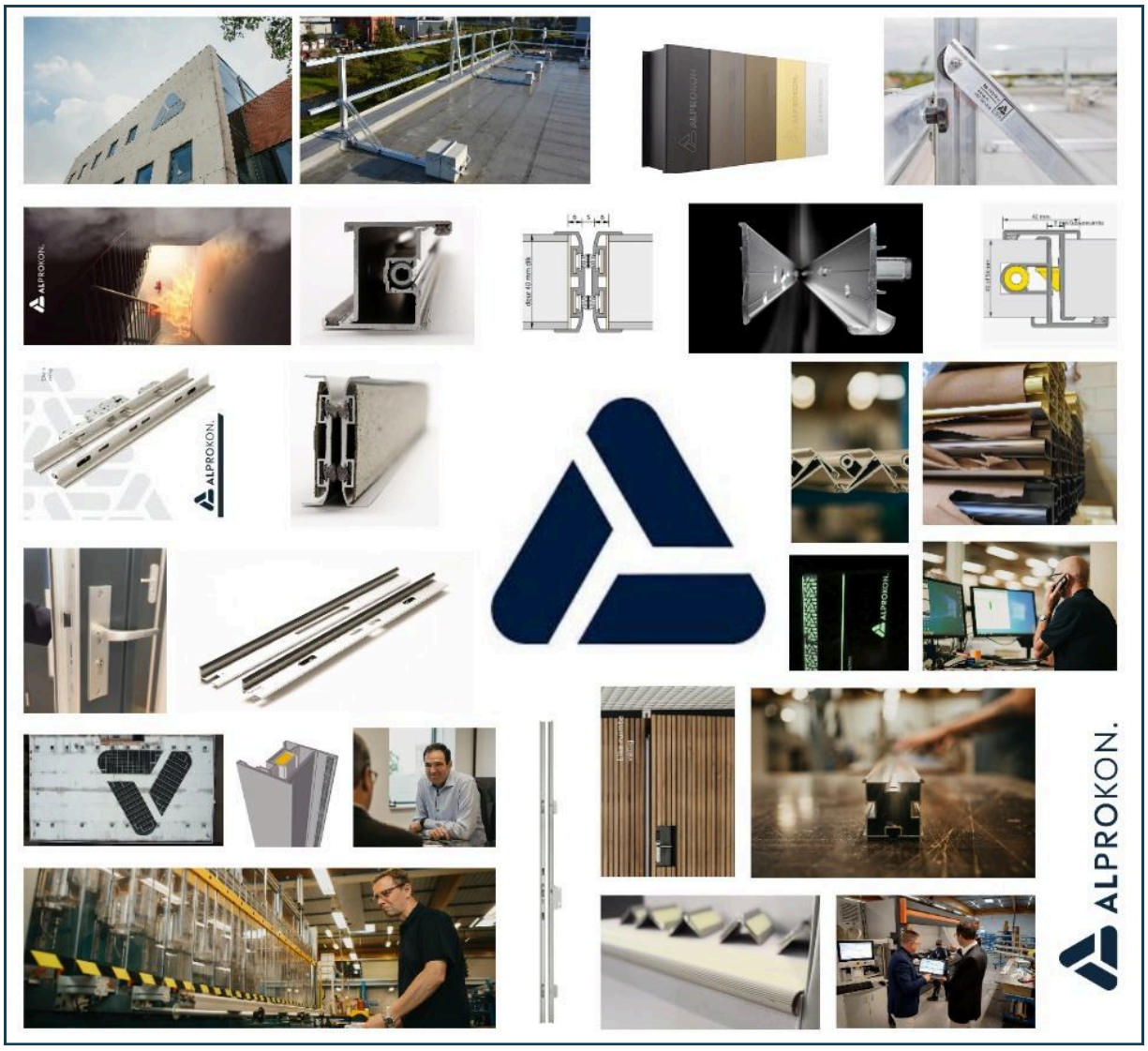


Figure 15: moodboard capturing Alprokons style and image.

As can be seen in figure 15, Alprokon maintains a sleek and professional visual identity that is carefully considered and consistently applied. Products and imago are presented in a uniform manner, using standard colours and clear visuals that highlight technical quality in a simple way. There is a preference for showing technical details and features of the product, showing the focus on selling to businesses and craftsman, rather than consumers or end-users. A limited amound of images are focused on the intended environment of the product, weakening the understanding of the practical application and context.

The style of Alprokon is shaped based on its intended customers: mainly businesses in the door, building, construction and renovation sector. However, focussing on consumers and end-users requires a different approach and style. To discover the possibilities of this style, a new moodboard is created, see figure 16. The future, consumer focused, product would preferably fit within this style.

This proposed communication style for Alprokon places greater emphasis on the consumer and the benefits they experience, positioning the user as the central focus. It incorporates more visual representations of consequences and protection, such as fire safety, to make the value of the product more tangible.

In contrast to the current company image, which emphasizes technical specifications and craftsmanship, this approach shifts towards highlighting the sense of safety provided and the practical application of the product in everyday contexts. Themes such as family, children, and a feeling of security form the core of this visual and communicative direction to persuade consumers to invest in the product.



Figure 16: moodboard capturing a possible style and image of the B2C focus of Alprokon.

1.5. Selecting the problem scope

Which problem scope fits this project the best? To make an educated and carefully considered selection of the problem scope, various methods were used. Applying these methods were done informally discussing with different stakeholders of the project.

1.5.1. C-boxes

C-boxes visualise the relative positioning of the identified problem scopes, making it easier to compare their strengths, weaknesses, and hierarchies. All nine scopes were evaluated against criteria including market opportunities, future trend relevance, strategic fit within Alprokon and consumer willingness to invest. This was done based on collected data and informal conversations. For each C-box, a green zone indicates the ideal high-potential area. As exact placement of a scope may vary by perspective, these zones are intentionally broad, providing a comparative overview rather than a precise measurement.

The problems scopes are:
1. Changing people's behaviour toward safety
2. Aesthetics of safety products
3. Kitchen fires
4. Floods
5. Falling elderly
6. Increasing the safety of old houses
7. Charging safely
8. Feeling of being in control of your safety
9. Safely escaping the home

C-box 1 evaluates scopes on market opportunities and their fit within Alprokon. Scopes in the upper-right quadrant, where market opportunity aligns with company capabilities, score highest, with scopes 2, 3, 4 and 9 performing best.

C-box 2 evaluates future relevance of each scope against the current consumer action. The highest-potential scopes sit in the upper-left quadrant, where future importance is high but consumer action remains limited. For example, fall prevention for the elderly (scope 5) is growing in importance but already sees considerable attention, placing it outside this zone. Scopes 3, 4, 6 and 7 emerge as the most promising.

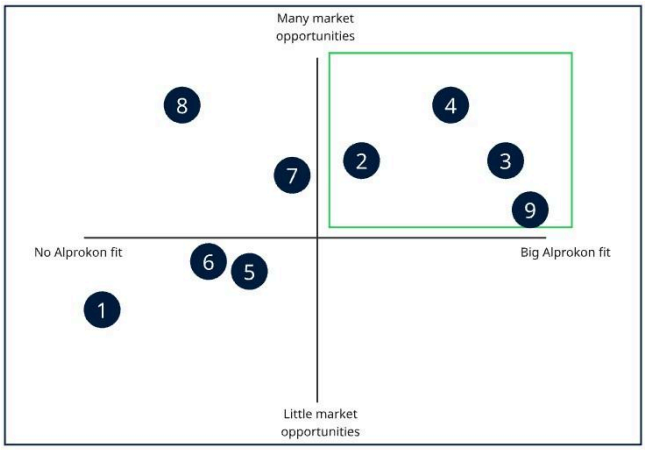


Figure 17: C-Box 1 2 3 4 9

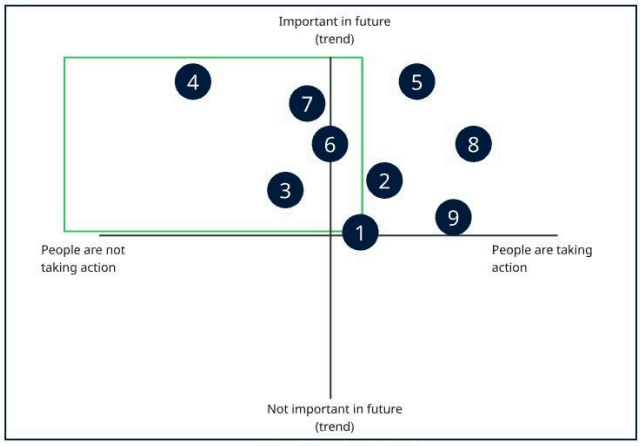


Figure 18: C-Box 2 3 4 6 7

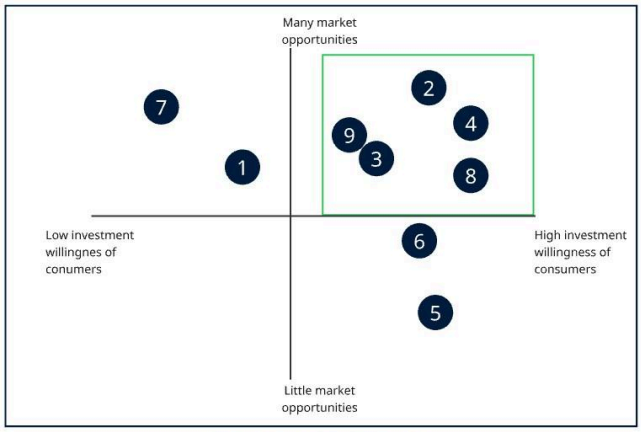


Figure 19: C-Box 3 2 3 4 8 9

C-box 3 evaluates market opportunities against consumer willingness to invest, as low willingness to invest reduces the likelihood of a successful marketable product. For example, consumers appear less willing to invest in higher-quality chargers to prevent fires than in fire extinguishers. Willingness to invest is influenced by the perceived balance between cost, potential damage and likelihood of occurrence, a generalised estimation was done based on research insights and informal consumer discussions. Scopes 2, 4, 6, 8 and 9 perform best in this analysis.

The C-Boxes show the four often returning, and therefore high-potential, problem definitions;

2. **Esthetics of safety products**
3. **Kitchen fires**
4. **Floods**
9. **Escaping fire**

These four are examined in more detail and accessed through Harris Profiles.

1.5.2. Harris profiles

Using Harrisprofiles, the four high-potential problem definitions are be more extensive assessed to choose the one with the highest potential.This approach provides a structured visual overview of the relative performance of each problem scope (Zijlstra et al., 2020).

Multiple criteria were used to evaluate the problem scopes. These are based on the current market situation (existing solutions and opportunities for differentiation), emerging trends and their urgency, strategic fit with Alprokon (alignment with the B2C vision, scalability, and compatibility with company strengths), the target customer (size of the target group, willingness to invest, and ease of conversion), and potential threats such as changing or strict regulations.

Figure 20 presents the Harris profiles of the four selected problem scopes. While all profiles are generally positive and show similarities, problem scope 4 (flooding) shows the highest overall potential. This is due to its strong future relevance and market opportunities, clear possibilities for differentiation, a relatively limited number of competitors and a high willingness among consumers to invest.

Based on the outcomes of the Harris Profiles, preparing for flooding is the problem scope with the highest potential and best fit for this project. More research, scoping and brainstorming was done to create a fitting solution. This is elaborated in chapter 2.

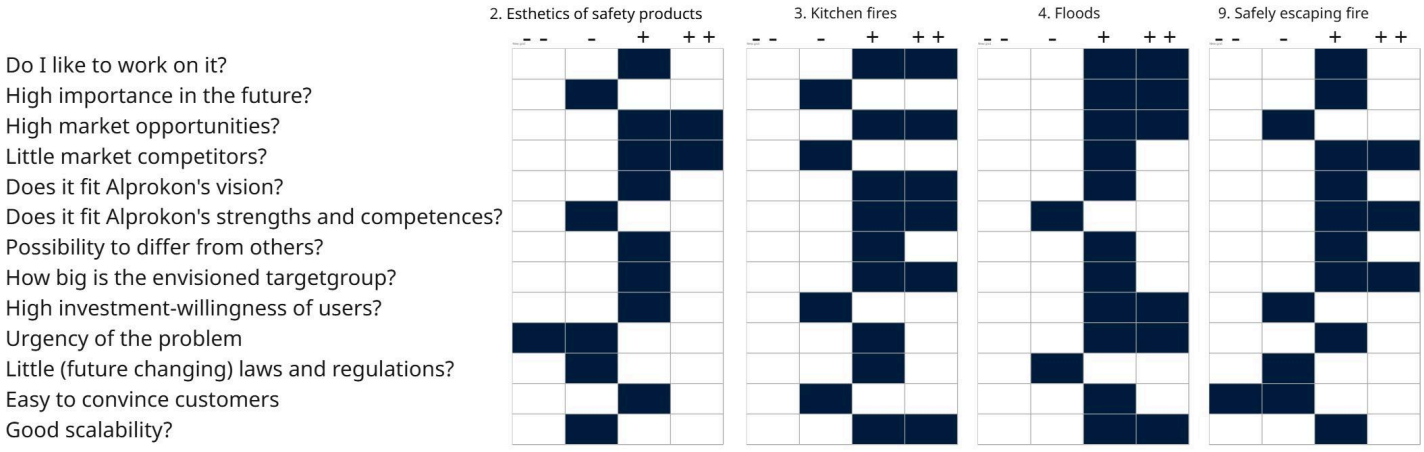


Figure 20: Harris profiles of the four high potential problem scopes



Figure 21: Flooded street (Rode Kruis, 2023)

2. Problem Scope

With an initial problem scope chosen, more dedicated research was conducted to deepen the understanding of challenges and opportunities around protection against floods. This research results in a defined problem scope, ultimately guiding the development of a unique solution that genuinely fits the needs of future consumers.

2.1. Background information

The flood research was focused on understanding how and where floods occur, existing prevention measures, and their consequences. It was conducted through online research, contact with Wacht niet op Water, and the municipality of Valkenburg (see Chapter 2.1.1.). All findings are combined and concluded in Chapter 2.1.2, forming the basis for a well-defined problem scope that will guide the rest of the project.

2.1.1. Information gathering

2.1.1.1. Interview Wacht niet op Water

Wacht niet op Water is an initiative by the Limburg municipalities, the Province of Limburg, and the Dutch government under the program Waterveiligheid en Ruimte Limburg (WRL), established after the floods of 2021. In addition to flood prevention, the initiative focuses on increasing awareness among residents by providing information about flood risks and preparation options. Their gathered insights offer valuable information about current flood-prevention behaviour, consumer perceptions, and existing market solutions. Appendix 2.1.1. shows the conclusions from the interview done.

2.1.1.2. Contact with municipality of Valkenburg

In July 2021, extreme rainfall caused severe flooding in parts of Limburg, Belgium, and Germany, with Valkenburg being one of the most heavily affected municipalities. Contact with the municipality was set up to gain insight into the causes, impact, and consequences of this flood. The individual conclusions of this correspondence can be found in Appendix 2.1.2.

2.1.1.3. Online research

While initial research provided relevant insights, particularly through interviews, a deeper understanding was needed to develop a suitable solution. Online literature research was therefore conducted to build a comprehensive overview of flood causes, consequences, prevention measures, available market solutions and future relevance. This research aimed to identify opportunities for innovation, with more detailed information available in Appendix 2.1.3.

2.1.2. Conclusion of the research

2.1.2.1. How do floods happen?

Climate change is increasing the likelihood and severity of floods. Rising sea levels put greater pressure on coastal and river dikes, while also reducing rivers' ability to discharge into the sea (H2O Drones, 2021). Rainfall is also intensifying: where in 2018, 70 mm in 2 hours was considered a once-in-a-100-years event, current calculations already use 70 mm in 1 hour, sometimes 90 mm (Kennisportaal Klimaatadaptatie, 2026). Alongside these intense downpours in the summer months, the winter months will have longer periods of rainfall (KNMI, n.d.).

Existing water management systems struggle to cope with these volumes of water. Sewage systems drain roughly 20 mm per hour on average (Slager, 2018), making overflow increasingly likely. This is especially problematic in urban areas, where large paved surfaces and limited green space reduce natural and fast water absorption (Dirven-van Breemen et al., 2011).

2.1.2.2. Where did floods happen?

The Netherlands has experienced several major floods throughout history. The 1953 North Sea flood caused 1,836 deaths and billions euros in damage through multiple dike failures (Ministerie van Infrastructuur en Waterstaat, 2026). In 2021, extreme rainfall caused rivers in Limburg, Belgium, and Germany to overflow, flooding entire villages, causing severe damage (KNMI, 2025; Asselman et al., 2022). In 2024, over 60 mm of rain in half an hour overwhelmed Enschede's drainage systems, flooding and damaging dozens of homes with rainwater and sewage (NOS Nieuws, 2025; Perree, 2026). Cities like Rotterdam and Dordrecht regularly face high-water situations outside the quays during storms or extreme rainfall (Gemeente Rotterdam, n.d.). But flooding is a global issue. Recent examples in Valencia (2024), Morocco (2025), and Texas (2025) illustrate how extreme weather, overflowing rivers, and inadequate drainage can rapidly cause major damage and dangerous situations everywhere in the world (Gilliver, 2026; BBC News, 2025; Columbia Climate School, 2025).



Figure 22: Flooded street during the floods of Valkenburg in 2021 (Kievit, 2021).

2.1.2.3. Where will floods happen?

Around 60% of the Netherlands lies below sea level (Deltares, n.d.), making flood risk a widespread and serious concern. If national flood defenses were to fail, approximately 10.7 million residents would be at risk (Nijholt, 2026). Even without such a scenario, at least 39,000 homes, mainly near rivers and coastal areas, already face a high flood risk once every ten years (Zicht op Nederland, 2024). Beyond these vulnerable areas, extreme rainfall poses an additional and growing threat. Arcadis estimated that around 140,000 homes are at risk during rainfall of 70 mm within two hours (De Regt & Bunskoek, 2019), this threat is becoming more serious, given that projections of heavy rainfall have since increased to 70 mm within one hour (Kennisportaal Klimaatadaptatie, 2026). This risk is not limited to low-lying regions. Extreme rainfall can cause flooding anywhere in the country, particularly in cities where large paved surfaces leave water nowhere to go (Kuijper, 2025).

2.1.2.4. What measurements are taken?

Flood protection has long been a Dutch priority, particularly after the 1953 North Sea flood, which prompted major investment in defenses such as the Delta Works, consisting of dikes, dams, storm barriers, and water storage systems (Ministerie van Infrastructuur en Waterstaat, n.d.). In recent years, attention has expanded to preventing urban flooding from extreme rainfall. Many cities are working towards "Sponge City" principles, using green roofs, wadis, infiltration systems, and underground water storage to better absorb and manage rainwater (Dirven-van Breemen et al., 2011; Hamidi et al., 2021; Van Der Heijden, 2025).

Despite these advances, floods still occur due to system failures, extreme weather, or insufficient drainage capacity, as seen in Amsterdam (2023) and Enschede (2024) (Hilgers, 2024; Perree, 2026). Household-level flood protection therefore remains an important last line of defense.

2.1.2.5. How does water enter the home?

During a flood, water can enter the home in various ways:

- The most common entry point is through gaps around doors, particularly front, back and garage doors.
- Basements and crawlspaces are also highly vulnerable, as water tends to accumulate in these lowest parts of the house. Floodwater may enter basements through stairs, windows and “koekoeks” (sunken ventilation/ window structures), ventilation openings, or slowly through walls under high water pressure.
- Lower placed ventilation openings in the walls.
- Overloaded sewage systems can cause water to enter through toilets and drains.

2.1.2.6. What damage do floods cause?

Floods can create various dangerous situations. During floods, rainwater may mix with sewage, creating contaminated water that poses health risks to humans and animals. Even after the water recedes, harmful bacteria can remain (Gezondheid.be, 2019). Severe floods may also involve strong currents and floating debris, increasing the risk of injury or death.

In addition to safety risks, floods can severely damage homes and buildings (Kennisportaal Klimaatadaptatie, n.d.). Even small amounts of water can ruin floors, furniture, (stored) belongings, and walls due to moisture and mould growth. Research by the Centraal Plan Bureau shows that the financial flood risk in high-risk areas can cost up to 1.1% of a property’s value. Although some costs are covered by insurance, households can still face repair costs ranging from thousands to tens of thousands of euros (Deelen et al., 2025).


Figure 23: damage of floors, walls and belongings after a flood (Kessel, n.d.).

2.1.2.7. Existing products and their limits

Various flood-protection solutions are already available (see Appendix 2.3.) on the market. They however have various advantages and disadvantages during use. These solutions can be roughly divided into four categories:

- Sandbags: Effective, affordable, and widely available, but heavy, bulky, and slow to install. They also perform poorly with outward-opening doors. Sandless alternatives are lighter and easier to store, but share similar placement limits and can be costly.
- Solid barriers: Rigid partitions in wood, aluminum or plastic can effectively block water, but are often large, heavy, difficult to store, expensive and generally unsuitable for outward-opening doors.
- Alternative barriers: Include water-filled tubes, pressure-stabilized barriers, and silicone sealing systems. Effectiveness varies, and many remain bulky and incompatible with outward-opening doors.
- Watertight doors: Fully watertight doors offer effective protection but are expensive and require replacing the full door.

Overall, existing flood-prevention solutions can effectively reduce flood damage, but most are heavy, bulky, expensive or difficult to install, particularly for people with limited mobility. Moreover, few are widely available in large construction stores such as Praxis or Gamma, and barely any are compatible outward-opening doors.



Figure 24: Different flood protection products available

2.2. Defining the scope

These findings are combined to formulate a focused problem scope that defines the design challenge for this project, forming the basis by with a list of (possible) unique selling points, requirements and a stakeholder map.

2.2.1. Unique selling points

Several market gaps and improvement opportunities were identified within existing flood-prevention products. Addressing these weaknesses in a product design could create strong unique selling points:

- Outward-opening doors: Current solutions rarely work for doors that open outward. Most back doors in the Netherlands are outward opening doors.
- Lightweight design: Existing barriers are often large and heavy, limiting usability for people with reduced mobility.
- Easy (or no) storage: Many products are bulky and difficult to store or access quickly in emergencies.
- No setup required: Floods can occur unexpectedly or when people are away from home, showing the wish for a solution that is always active or quickly operational.
- Affordable pricing: Many user-friendly flood-protection systems are expensive, limiting accessibility for a broader consumer group.
- Add-on to existing doors: Many new buildings already incorporate some sort of flood-protection measures. A solution that can be added to existing homes increases accessibility and broadens the potential target group.

2.2.2. List of requirements

Based on the gathered information, a list of requirements was created (see Table 3 for a summary and Appendix 2.4. for the complete list), defining the goals and boundaries for the ideation phase.

Multiple stated requirements directly reflect the shortcomings of existing flood solutions and can be seen as unique selling points. For example, the requirement that the product must work for outward-opening doors addresses the lack of suitable solutions for back doors, while a maximum weight of 5 kg responds to the impracticality of current heavy and bulky solutions.

Other requirements were concluded from research findings. The requirement of a minimum lifespan of 10 years ensures the product remains functional for the 39,000 homes that face a flooding risk once per decade, avoiding premature replacement of an unused item. The wish for automatic sealing without consumer intervention was inspired by the 2021 Valkenburg floods, where many residents were on holiday, automatic protection could have prevented significant damage. Further requirements regarding maximum cost price, flood type compatibility, storage dimensions, and protection effectiveness were similarly based on the research.

Theme	Requirement	Theme	Wish
Lifespan	The product must have a shelf life of at least 10 years	Lifespan	The shef life of the product should be as long as possible
Application	The product must stop water from entering through the backdoor	Application	The product should be able to be used for different types of doors
	The product must work for floods due to rivers flooding and heavy rainfall		
Cost	The product should not cost more than €1.000	Cost	The product should be as cheap as possible
Installing	The product must be able to be installed in different sizes of doors	Installing	The product should be able to be installed with a basic toolset
	The product must be able to be added to already existing doors		There should be as little as possible permanent changes to the house
Setting up	The product must be able to be activated/set up within 15 minutes	Setting up	The door should automatically be sealed when floods happen, without any setup from the onsumer required
	Setting up the product must be intuitive		Setting up should be as quick as possible
			The product should be able to be set up by people with limted abilities
During floods	Maximum 1 L per hour can get get into the house	During floods	There should not be any water getting into the house
Properties	The product must not weigh more than 5 kilos	Properties	The product should weigh as little as possible
	The product must be smaller than a moving box (30x40x58 cm) when stored		The product should be as small as possible when stored
	The production must give people a feeling of safety		The product should be able to be stored close to the door
Production	The product must carry the "Elke ruimte veilig" name	Production	The product should be able to be made or assembled at Alprokon

Table 3: Concise version of the first list of requirements

2.2.3. Stakeholdermap

Multiple stakeholders are involved in this project. Homeowners, businesses, distributors, and resellers form the core stakeholder group that is directly involved and shapes the outcome of the project. Governments, municipalities, investors, and water-safety informing companies, as Wacht niet op Water, are also important stakeholders, as they can support implementation, promotion, and further development of the product, but play a less central roll. Other parties, such as media, water safety experts, banks and research institutes, are less directly involved but may play a role in specific future activities including financing, research and communication. See Appendix 2.5. for the complete stakeholder map.

2.3. Final scope

With all the knowledge gathered, the final project scope is defined:

Due to climate change, sea levels will rise and rainfall wil increasingly intensify. While the government and municipalities are working to improve water infrastructure, these measures will not be sufficient to handle future water volumes. Therefore, floods will happen more frequently. Homeowners will therefore need to take preventative measures to protect their own homes against the dangerous situations and costly damage caused by water entering.

During floods, most water enters through doors. Various solutions exist for front doors, which typically open inwards, although most are large, heavy and costly. Critically, no solutions currently exist for outward opening doors, which are often back doors. This shows a clear market gap for Alprokon.

The aim of this project is to develop a product that stops water intrusion through outward-opening doors of existing residential homes, thereby limiting damage, costs and dangerous situations. To meet consumer needs, the solution must be effective, compact, lightweight, easy to use and affordable. Functioning as an Add-on to the existing door rather than a full replacement of the door, in order to reach a broad consumer market.

Alprokon has a strong preference for a tangible, sellable product. Its exact form will be shaped throughout the ideation and prototyping phases, guided by factors such as cost price, consumer preferences, test outcomes and available materials.

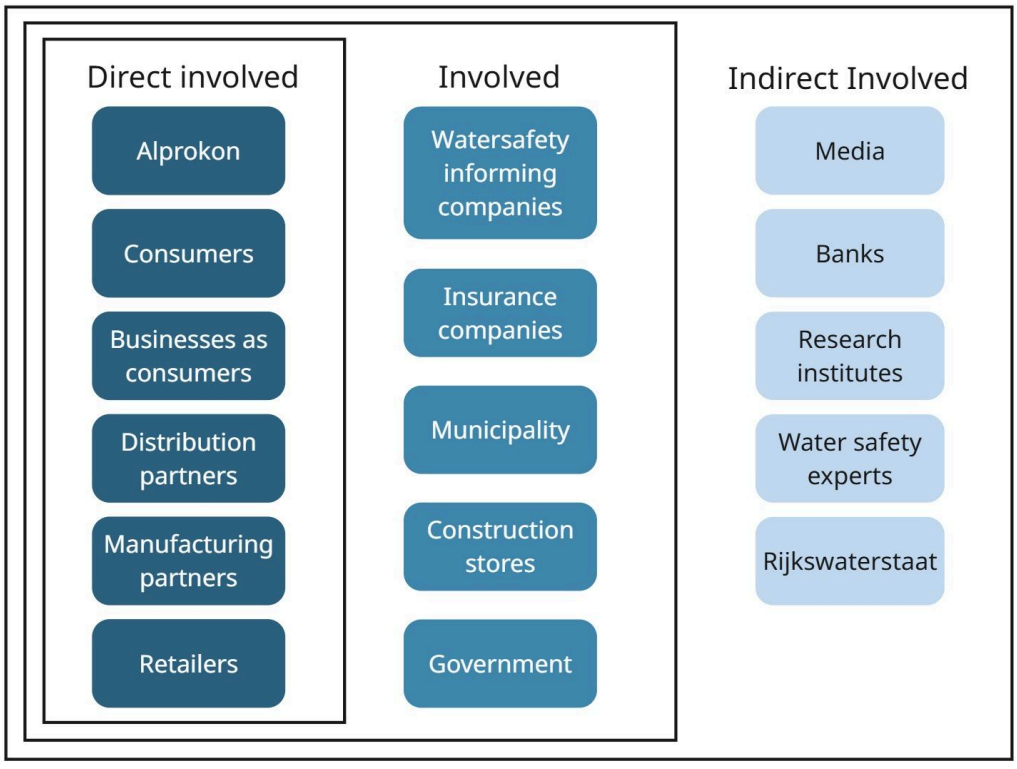


Figure 25: simplified stakeholder map



Figure 26: visual example how Floud can keep floods out of the door

3. Floud

In response to the identified problem, two product concepts have been developed: the Floud Add-on and the Floud Draft Strip. Both are based on the same core principle: a special material that automatically expands upon contact with water, sealing the gaps around the door without any action required from the user. Both concepts are elaborated in this chapter.

Floud

Keep Floods out of The Door

3. Floud

Floud is a flood protection product, with two versions available; the Floud Add on and the Floud Draft Strip, designed for outward-opening doors, such as back doors, but compatible with many other door types too. Simply install Floud in your door frame and your home is always protected against flooding. No setup, no activation, no heavy barriers when floods are rising. Floud is small, unobtrusive and always ready to keep the water out of the house. Even when you are not home.

Floud works using a Water Activated Expanding Material (WAEM), a specially designed material that is small and solid when dry, but absorbs water and swells up to four times its original size when in contact with water. When a flood occurs, the rising water automatically activates Floud, causing it to expand and seal all gaps around the door. Keeping floodwater out and your home dry, potentially saving thousands of euros in damage.

Installation is easy and can be done independently, without special tools or a specialist needed. After installing, the Floud product waits in your door frame until a floods comes. Then it is automatically activated by the rising water and seals the gaps around the door. No action required.

Floud has multiple advantages:

Fits outward-opening doors
Floud is specifically designed for outward-opening doors (back doors), which most existing flood protection solutions cannot accommodate. It also fits a wide range of other door types, including front doors, double doors, sliding doors and windows.

Always protected
Knowing your home is protected against floods, even when you are not there, is exactly what Floud provides. Once installed, no setup or action is required. Floud is automatically activated by rising water, swelling to seal all gaps around the door without any intervention. Simply close the door, and your home is protected.

Easy storage
Because Floud is permanently installed in the door frame, no accessible storage space is needed for the product itself, unlike most current flood prevention solutions. Spare strips are compact and easy to store for quick replacement after a flood.

Floud
Keep Floods out of The Door

Figure 27: Floud logo and solgan

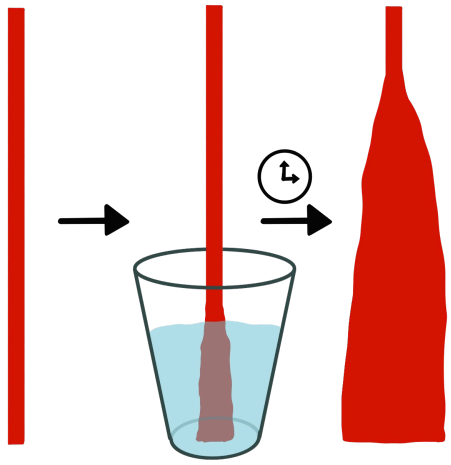


Figure 28: Visual example of how the WAEM swells

Cost effective
Floods may only happen once every few decades, but when they do, the damage can reach thousands of euros easily. Compared to most other flood protection solutions, Floud is significantly more affordable. A small investment that could save you a lot of money.

Minimally visible
Floud sits discreetly in the door frame, barely noticeable in everyday use. Available in multiple colours, it blends seamlessly into any door. A simple, unobtrusive addition to your home's safety.

Growing market potential
Safety regulations for new buildings are becoming increasingly stringent and flood protection may become a future requirement. This positions both Floud versions well for a growing market, while adding meaningful value to the buildings in which it is installed.

Two versions available
Floud is available in two versions: the Floud Add-on and the Floud Draft Strip. Both are installed in the door frame and provide automatic flood protection, but differ in ease of installation, visibility and sealing speed. A solution available for everyone!

The two Floud versions are:

Floud Add-on

The Floud Add-on is a thin, flexible strip that sticks directly onto the door frame, no tools or specialist knowledge required. Once installed, it sits discreetly in place for years, ready to automatically seal the gaps between the door and frame the moment floodwater arrives. It fits both sides and the threshold of virtually any door size and type, adapts around locks and hinges and can be replaced quickly and easily after a flood. Unobtrusive, affordable and low-impact; a simple way to make any door flood-proof.



Figure 29: Floud Add-on strip in the door



Figure 30: Floud Draft Strip in the door

Floud Draft Strip

The Floud Draft Strip combines the sealing capabilities of Floud with the appearance of a draft strip. This makes it less visible than the Floud Add-on while also providing better protection and improved sealing performance of the gaps around the door.

Although the installation of the Floud Draft Strip is more intricate and the concept is not usable for every door type, this version has a better and longer-lasting flood protection.

The concept is also similar to products already included in Alprokon's product range, making it a logical addition with commercial potential.

Altough both Floud Add-on and Floud Draft Strip are strong concepts, there are various disadvantages to both of them:

Single use
Floud is a single-use product. During a flood, the WAEM absorbs water that may be contaminated with bacteria and sewage. Although the material eventually unswells and could be reused, the absorbed contaminants create a health hazard, meaning the strip must be discarded and replaced after each flood.

Activation time
The WAEM requires a few minutes to swell and seal the door upon contact with floodwater. In the case of a rapidly rising flood, a small amount of water may enter through the door gaps before the seal is complete. However, this will be a minimal amount and once activated, Floud will keep the remainder of the flood out.

Responds to rain
Floud's fast swelling response to water is also a limitation. Accidental contact with water, such as rain entering through an open door or window washing, may accidentally trigger unwanted swelling. Design choices have been made to minimise this risk, but it cannot be fully excluded. Further development is needed to address this.

Development of the WAEM
Floud's concept and the working of the WAEM is grounded in material research and testing. However, the specific WAEM required does not exist yet. First steps towards its development have been taken, but the final material properties may influence the product's performance and require further design adjustments.

3.1. Floud Add-on

The Floud Add-on is a thin, flexible strip that is applied directly to the door frame along the hinge jamb, lock jamb and threshold of the frame. It is compatible with many door types and sizes. Here it swells, sealing the gaps and creating a barrier for the flood water, keeping the water out of the house. Its placement does not interfere with normal door use. Once in place, it is barely visible.

The strip consists of three layers: an adhesive backing for easy installation, a WAEM core that swells upon contact with water and an outer rubber layer that protects the WAEM against sunlight, accidental water exposure and everyday impact. The user can choose how high to apply the strip on the frame, anywhere from 20 cm high to the full door length.

During a flood, the WAEM in the Floud automatically responds to rising water, swelling up to four times its original size and sealing all gaps around the door, requiring no action from the user and keeping the home dry.*
*Provided no other unprotected entry points for floodwater exist in the home.

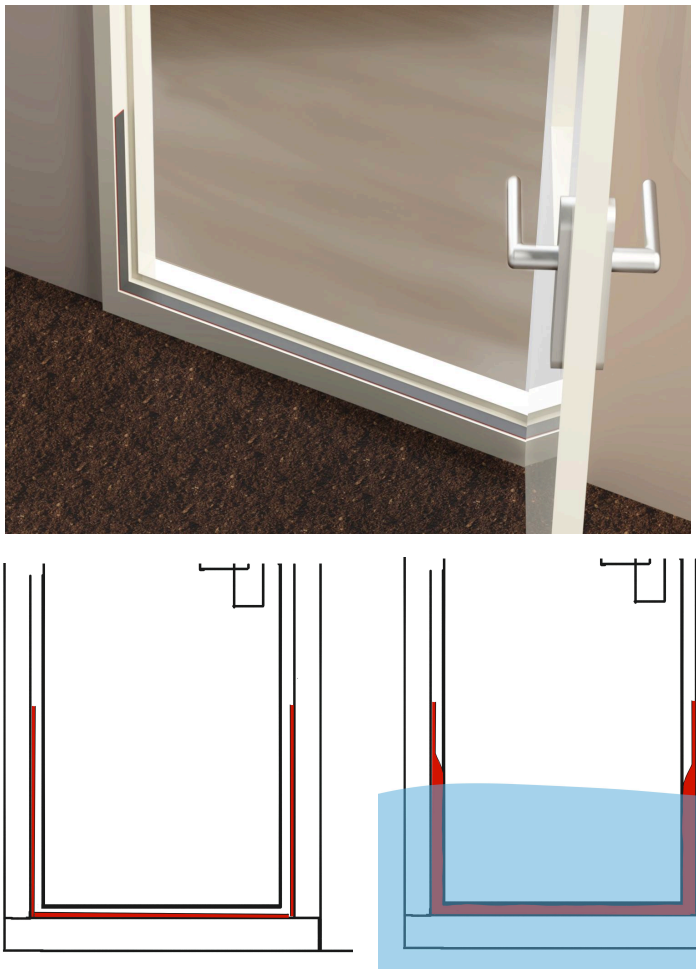


Figure 32 & 33: the Floud Add-on placed in the door (upper) and the strip swelling in a door (lower)

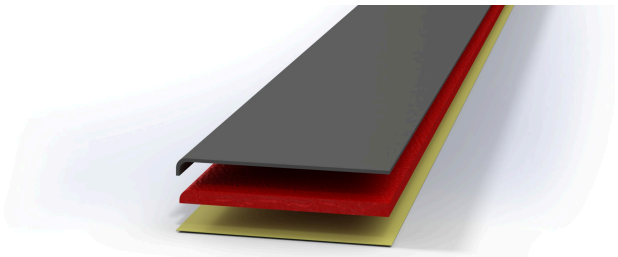


Figure 31: the three layers of Floud Add-on: a rubber cover, piece of WAEM and an adhesive layer

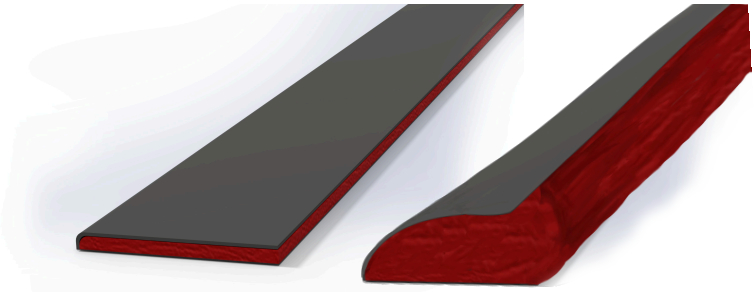


Figure 34: the Floud Add-on in normal, dry state (left) and in swollen, wet state (right)

Advantages of the Floud Add-on:

Easy to install and replace
Installing or replacing Floud Add-on takes no more than 20 minutes. Simply clean, stick, cut and press. No tools or specialist skills required.

Suitable for all doors
Thanks to its slim design and strong expanding capabilities, Floud Add-on fits virtually any size and type of door: front and back doors, sliding doors, double doors and even windows.

Easy to store
It is advisable to keep a spare strip on hand so your home can be re-protected quickly after a flood. Thanks to its flexible nature, Floud Add-on can be rolled up and stored compactly and easily, so a replacement is always within reach.

Returning business case
As a single-use product, Floud requires replacement after each flood, creating a reliable stream of returning customers and a stable recurring revenue model for Alprokon.

Visible reminder
The subtle visibility of the Floud Add-on serves an important purpose beyond protection. Each time a user passes through the door, the strip acts as a quiet reminder that their home is protected for floods, reinforcing the feeling of safety and providing a lasting sense of peace of mind.

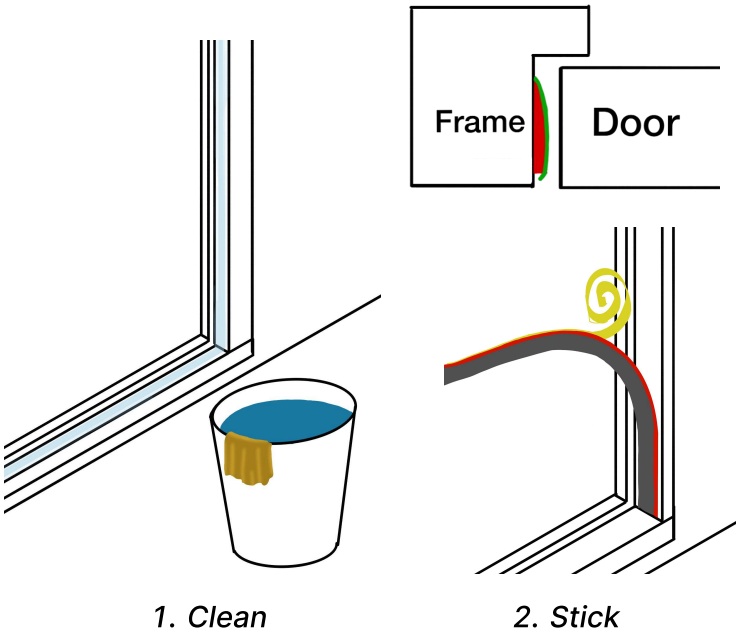


Figure 35: visual installation steps of Floud Add-on: cleaning, sticking, cutting to size, repeat, cutting the holes for the locks and doing this for all sides of the door.

Installation

The Floud Add-on is applied to the door frame in the gap between the door and frame, along the hinge jamb, lock jamb and threshold. Installation is straightforward, easy to do, takes less than 20 minutes and follows six simple steps:

1. **Clean** the surface to remove any dirt or debris that could affect the adhesion of the strip.
2. **Peel and stick** the strip onto the frame with the rubber flap opening facing outward.
3. **Cut** to the desired height using a utility knife.
4. **Repeat** on both sides of the door and along the threshold.
5. **Cut holes** with a knife where the strip covers locks, hinges or other fixtures. Make sure the strip remains present on both sides of each fixture for continuous protection.
6. **Close the door**. When a flood arrives, the Floud is ready to seal the gaps around the door and keep the water out.



Figure 36: A packaged Floud Add-on strip

After a flood

Once the flood subsides, the door can be opened normally. The swollen WAEM is removed and discarded in the general waste. A new strip of Floud can be installed immediately. The door is ready for the next flood.

Target market

The Add-on version of Floud is designed for consumers to purchase and install themselves, without special tools or specialist knowledge needed, making it well-suited for direct sales through Elkeruimteveilig.nl and a broad audience. It is sold in packets sized for one door, around 3 m of strip, enough to seal up to 1 m high, allowing consumers to protect as many doors as needed.

It is a relatively simple and easy to use product. However, its main limitation is the high chance of accidental exposure to damage or unintended activation through everyday use. For a less visible and more durable alternative, the Floud Draft Strip was developed.

3.2. Floud Draft Strip

The Floud Draft Strip is an adapted draft strip applied directly to the rebate of the door, where a standard draft strip normally is placed, serving a dual purpose of draught sealing and flood protection, figure 39. It is compatible with many door sizes and works for most inward and outward-opening doors. The result is an invisible flood protection solution, seamlessly integrated into a functional and familiar draft strip.

The strip consists of three components, see figure 41: an aluminium frame, a WAEM core that swells upon contact with water and an outer rubber layer that acts as a draught barrier while protecting the WAEM against sunlight, accidental water exposure and everyday impact.

While the installation is slightly more complicated than the Add-on, the end result is a clean, barely visible addition to the door that provides draught sealing and flood protection in one.

During a flood, water reaching the sides of the door activates the WAEM automatically. The aluminium frame and rubber layer are designed shorter than standard draft strips, allowing water to quickly reach and activate the WAEM, sealing the gap between the door and frame rapidly, as can be seen in figure 38, with no action required from the user.



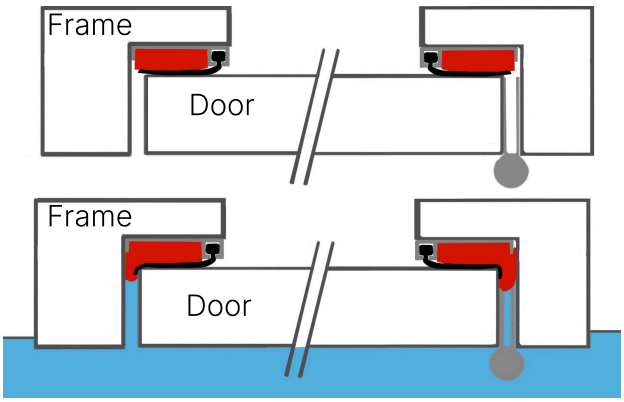


Figure 37 & 38: The Floud Draft Strip installed on the rebate of the door (above) and a cross section of the placement of the Floud Draft Strip in the door normally and during a flood (below)

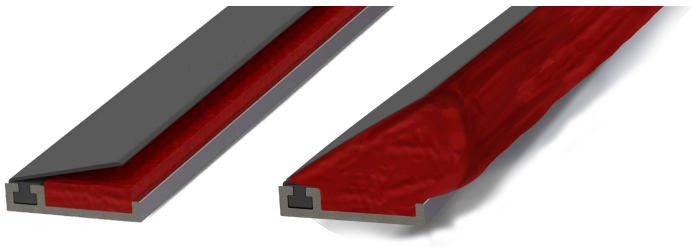


Figure 39: The Floud Draft Strip in normal, dry state (left) and in swollen, wet state (right)

Advantages of the Floud Draft Strip:

Invisible

By integrating the flood prevention properties of Floud into the existing draft strip, Floud is virtually invisible, making it an attractive option for consumers who are reluctant to alter the look of their house for flood protection.

Better protected

Tucked further into the door and shielded by the rubber flap, the WAEM in the Floud Draft Strip is better protected against accidental activation, sunlight, and everyday wear and tear. Extending its lifespan compared to the Add-on.

Faster and more consistent seal

Because the WAEM sits closer to the door, it needs to swell less to seal the gap, activating faster and creating a more reliable seal. Its placement also avoids interference with locks and hinges, reducing weak points and ensuring more consistent protection across the full door.

Close to Alprokon's current business

The Floud Draft Strip closely resembles products already in Alprokon's existing range, adapted for flood protection rather than fire protection. This allows Alprokon to use existing knowledge, intellectual property and customer relationships to bring this concept to market efficiently.

B2B market opportunity

Beyond individual consumers, the Floud Draft Strip is well-suited for the B2B market. Door companies can offer it as a flood-protective upgrade in new-build projects for a small additional cost.

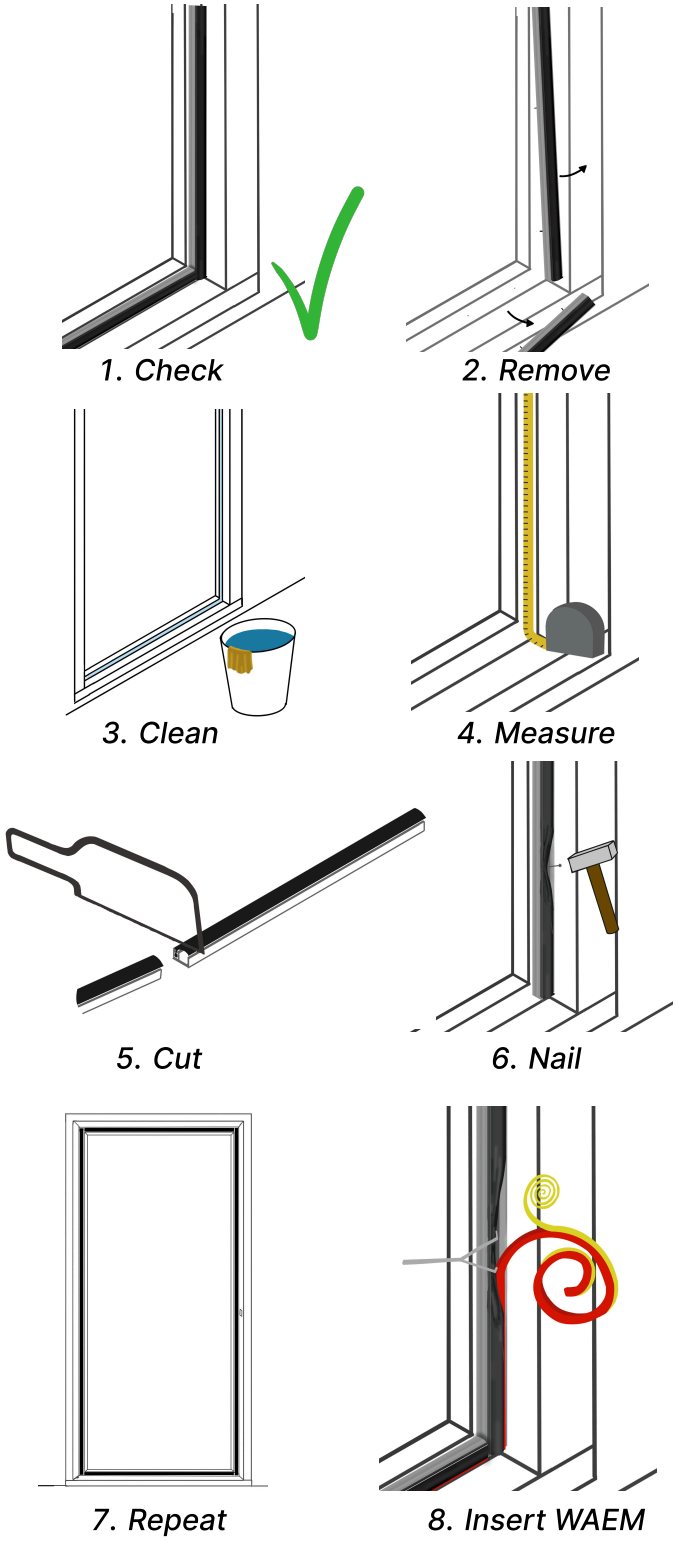


Figure 40: Installing the Floud Draft Strip

Installation

Installing the Floud Draft Strip is somewhat more involved than the Add-on, but remains achievable without specialist tools or knowledge. Installation follows these nine steps:

1. **Check compatibility.** Verify that the door currently uses a similar draft strip system and/or that sufficient space is available to fit the Floud Draft Strip.
2. **Remove** the existing draft strip.
3. **Clean** the surface of the door.
4. **Measure** the door to determine the required strip length.
5. **Cut** the Floud Draft Strip to size using a metal saw.
6. **Nail** the draft strip into place using the included small nails through the pre-drilled holes.
7. **Repeat** for all four sides of the door.
8. **Insert the WAEM** into the slot in the draft strip with the included tool.
9. **Close the door.** The Floud Draft Strip is now ready. When a flood arrives, it will automatically seal the gaps and keep the water out.

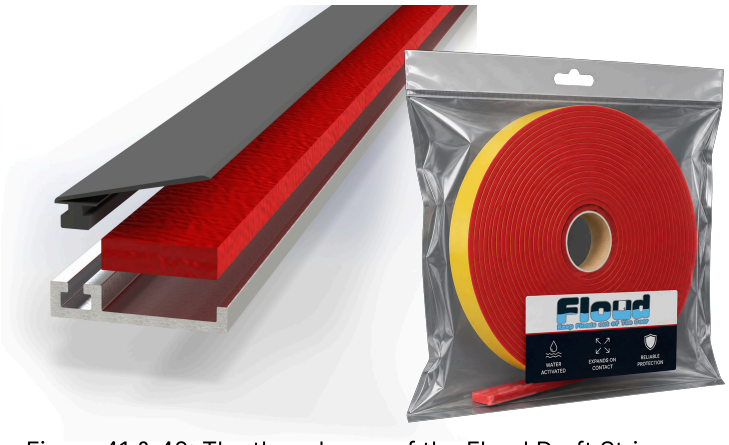


Figure 41 & 42: The three layers of the Floud Draft Strip (left) and and the refillable WAEM (right)

After a flood

Once the flood subsides, the door can be opened normally. The swollen WAEM is removed from the draft strip and discarded, and a new WAEM strip is inserted into the aluminium slot. The door is then immediately ready for the next flood.

Target market

While the Floud Draft Strip offers more integrated and reliable protection than the Add-on, its installation is more complex. Although it is still relatively simple, the higher investment in both time and cost make the Floud Draft Strip less appealing in the direct consumer market, where ease and accessibility are important purchasing drivers, and positions it more as a product for the motivated, hands-on homeowner rather than the average consumer.

However, the Floud Draft Strip presents a strong opportunity in the B2B market. Door frame companies and contractors can offer integrated flood protection as an additional option in new-build projects, with minimal extra work on the installer's part. This creates a scalable and stable revenue stream for Alprokon.

3.3. Final list of requirements

Throughout the project, research, iteration cycles, feedback rounds and testing generated an extensive list of requirements and wishes for the final product, covering installation, physical performance, manufacturing, user perception and more. The complete list can be found in Appendix 3.1., while Table 4 highlights the ones that had the highest influence in this project. The requirements and wishes are categorised according to three themes: why people want the product (desirable, light blue), how it works (feasible, middle blue) and how it will be sold (viable, dark blue).

These requirements and wishes capture what makes Floud both unique and effective. Some are straightforward, such as compatibility with different door sizes, affordability and the ability to completely seal a door, yet meeting them is essential for a strong product and business case. Others are more specific to the product's working principle and details, such as the requirement that the WAEM activates without any input from the consumer and that activation is visible during a flood. These requirements ensure the final product performs as intended, meets the expectations of its users and differentiates itself from other flood prevention solutions.

	Requirements		Wishes
Lifespan	The product must only by activated by floods	Lifespan	The looks, feel and working of the product should not change over 10 years when applied to the door
	The product must not respond to humidity in the air, rain or mist		Parts of the product should be easily replaceable when broken
Application	The product must stop water from entering through the gaps around the door	Application	The product should be able to be used for front doors, double doors, sliding doors, garage doors and windows too
	The product must work for all types of single outward-opening doors		The product should also be able to be used by businesses
	The product must be able to be applied to existing doors (no matter the age of the house)		The product should also be applicable for houses outside of the Netherlands
	The product must be applicable for houses all over the Netherlands		The product should protect against all hights of floods
	The product must be able fit different sizes of doors		
	The product must be able to be applied to new build houses	Buying	The product should be as cheap as possible
	The product must protect against floods up to 50 cm high		The working of the product should be effectively explained to conusmers
Installing	The installation of the product must be able to be done by consumers themselves	Installing	The product should be able to be installed with a basic toolset: hammer, drill, screws, nails, screwdriver
			The installation of the product should be as quick as possible
Activating (setting up)	The product must completely seal the door within 30 minutes after first contact with water		Installing the product should require as few permanent changes to the house as possible
	The product must seal all corners, hinges and locks completely		The door should not have to be replaced or adapted to fit the product
	The activation of the WAEM must not require any influence of the consumers		The consumer should be able to decide up to how high the product will be placed
			The product should be able to be installed during bad wheater conditions
During floods	The door must be able to be opened when the product is activated (in case of an emergency)		
	The product must withstand the pressure and moving streams of the flood	Activating (setting up)	The product should let as little water into the house as possible when it is still setting up
			The product should be completely activated as quickly as possible
After floods	The product must be easy to remove from the door		The contents of the water should not have any impact on the working of the product
			The product should be able to be "pre-activated" when floods are comming
Properties	The production must give consumers a feeling of safety		
	The product must be available in different sizes for different sizes of gaps	During floods	It should be visible for the consumer that the product is activated during a flood
	The product must fit between the door and the frame		Additional (traditional) flood protection products should not interfere with the working of the product
	The product must be able to resist impact by use of the door		
	The product must not be toxic for the environment	Properties	One size of product should fit for all sides of the door

Desirable, from chapter 4

Feasible, from chapter 5

Viable, from chapter 6

Table 4: Concise version of the final list of requirements

The coming chapters show how Floud was developed. Chapter 4 covers the ideation, selection and refinement process that shaped Floud to meet consumer needs, creating a desirable product. Chapter 5 details the testing and material research that established its feasibility and effectiveness. Chapter 6 presents the business case of Floud, including the first cost price, business model and supply chain analysis. Demonstrating its commercial viability. Together, these chapters show how Floud was developed into two desirable, feasible and viable product concepts.



Figure 43: man standing close to flooded house during the floods of 2021 (ANP, 2021)

4. Why people want Floud

This chapter describes the development process of the final product concepts. It covers the generation of ideas, the collection of feedback and the selection and detailed exploration of design options. Creating concepts that fit the consumers needs, making them desirable products.

4.1. Ideation

Starting with the information found in chapter 2, extensive ideation process using carious ideation methods, was started, resulting in a wide range of product ideas. From these ideas, 12 promising ideas were developed in greater detail, which were refined and detailed into four product concepts. This process will be elaborated in this chapter.

4.1.1. Ideation methods

While the project scope was still being refined, the ideation phase was started to explore potential solutions within flood prevention. Various methods were used to generate product ideas, which are described below. A more detailed explanation of each method can be found in Appendix 4.1.

Brainwriting and brainstorming

Exploring the problem scope in depth creates opportunities for diverse solution directions. By combining elements of brainwriting and brainstorming (Lucid Software, 2025), a wide range of ideas was generated, discussed and written down.

HKJ'tjes

Due to the broad project scope, dividing the problem into smaller sub-problems enabled focused research and ideation on specific aspects of the challenge rather than the complete solution at once (Zijlstra et al., 2020). Creating new and original product ideas.

Lotus Blossom method

The Lotus Blossom method (Guthrie, 2024) encouraged the development of a wider variety of design directions. This method was applied twice in the ideation process. The method was valuable in expanding small opportunities into broader and more developed solution ideas otherwise abandoned.

Analogies

Analogies were used to explore alternative ways of understanding and solving the problem (Zijlstra et al., 2020). This approach enabled new perspectives on the problem and inspired new and unique solution principles.

Other applications

Already existing solutions from comparable contexts provided valuable inspiration for product ideas for this new application. The most promising inspiration came from sealing systems used in ships and yachts.

SCAMPER

After several promising concepts were developed, the SCAMPER method was applied to systematically explore, improve and adapt these ideas (Zijlstra et al., 2020). This method supported exploring alternative configurations and identifying opportunities for optimization.

All ideas generated using these methods were combined and evaluated to identify the most promising solution directions.

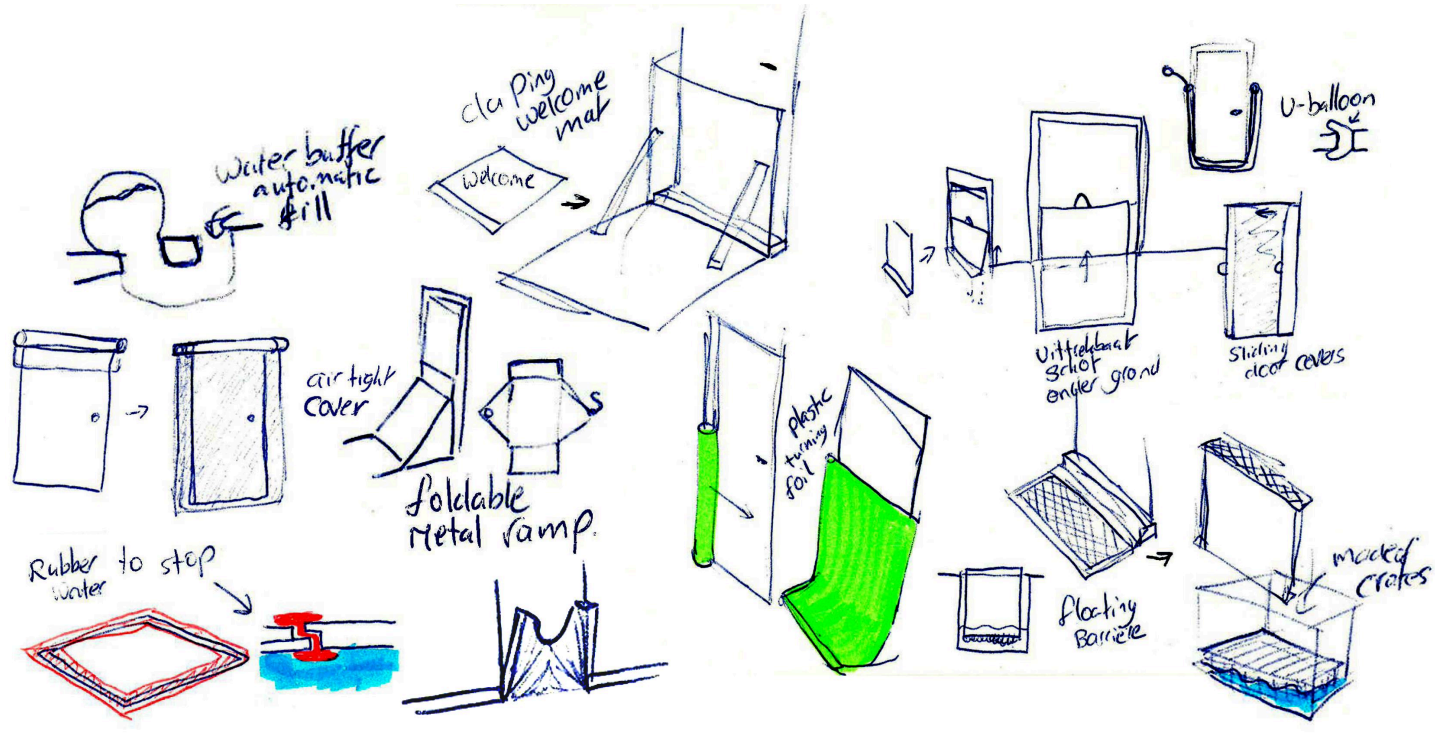


Figure 44: various sketches made during the application of the different methods

4.1.2. Selecting high potential ideas

Out of all created ideas, the most promising, unique and conceptually strong ideas were selected and slightly further developed on a single A4 sheet. The focus of this step was on the appearance of the solution, its working principle, installation and use and its unique selling points. All 12 detailed ideas can be found in Appendix 4.2.

4.1.2.1. The 12 concepts

The 12 chosen concepts can be categorized in 3 groups: Foldable barriers, rollable barriers and solutions in the frame.

Foldable barriers

These solutions are focused on improving the ease to storage the product, compared to existing flood protection products.], using folding rigid panels, connected with interlocking hinges and plastic sheets. This way, compact, strong and water-resistant systems were created.

However, several of these concepts created cannot be used with outward-opening doors. Other versions remain compatible but are still relatively bulky when folded. In addition, all foldable solutions require a certain level of time and effort for installation.

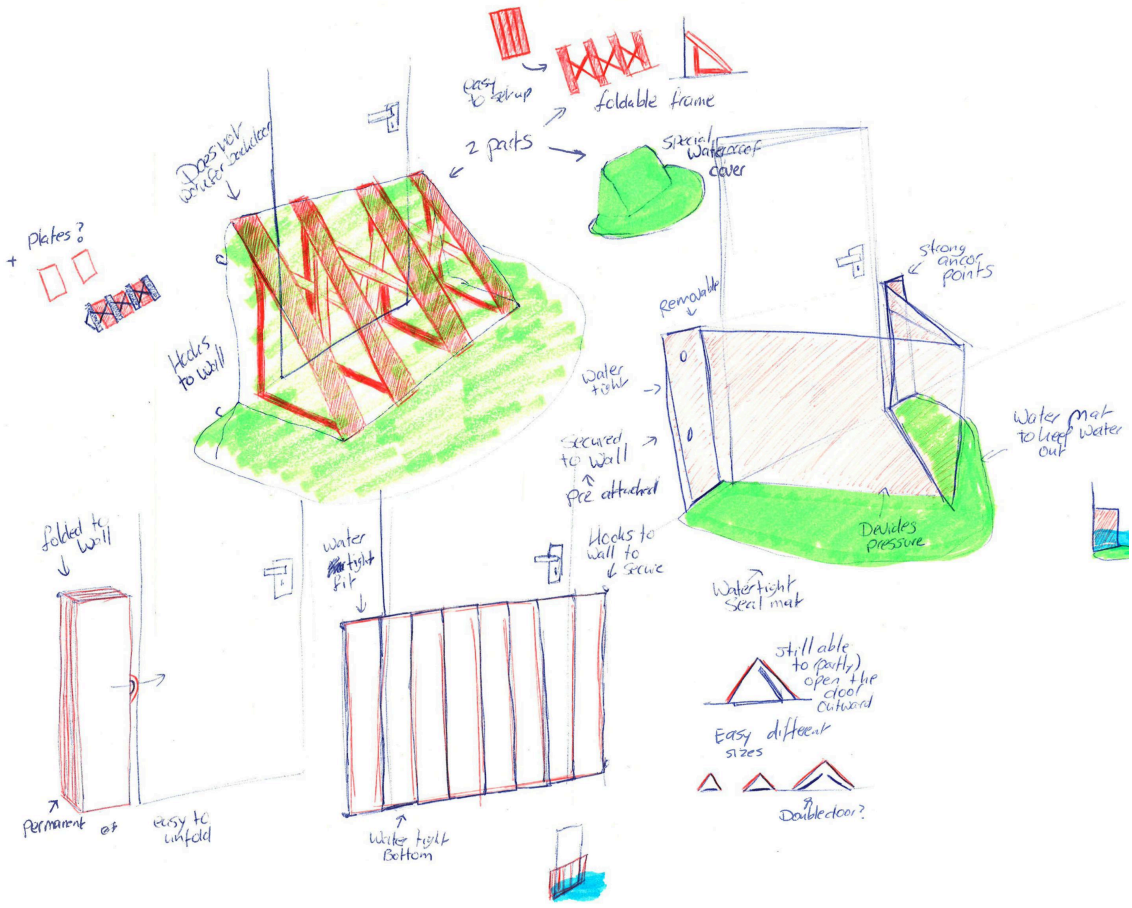


Figure 45: Sketches of the foldable barrier ideas

Rollable barriers

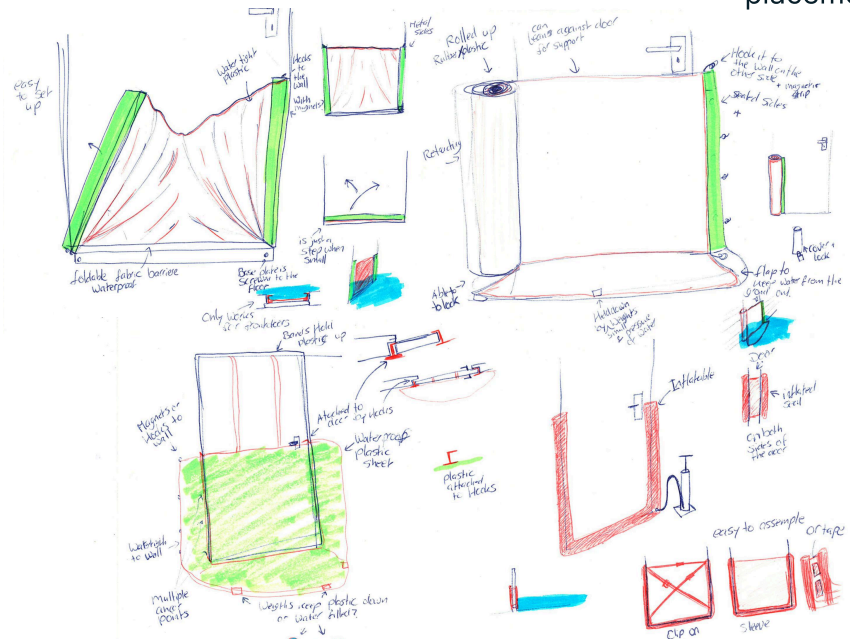
By removing the rigid components of traditional flood barriers, more compact solutions can be achieved. In these concepts, a flexible waterproof sheet is directly applied to the door to create a seal against water ingress. Different configurations were explored, with varying levels of required setup.

A key challenge of these ideas are ensuring a fully watertight seal along all edges. In many cases, achieving this seal requires some modifications to the building itself, if applicable at all. Although these solutions are easy to store and transport, setup requires time and effort and complex systems.

Solutions in the door

This solution direction moves away from traditional barrier systems and instead focuses on sealing the door itself. Doors already function as partial barriers, but contain gaps around the edges between the door and the frame. Solutions targeting these gaps could prevent water ingress. Concepts include inflatable seals, folding rubber trims and various sealing profiles integrated between the door and frame.

However, within these concepts challenges arise: limited space within the door frame, the need for door movement of the door and potential interference with locks and hinges. As a result, more research is required regarding placement and options of sealing.



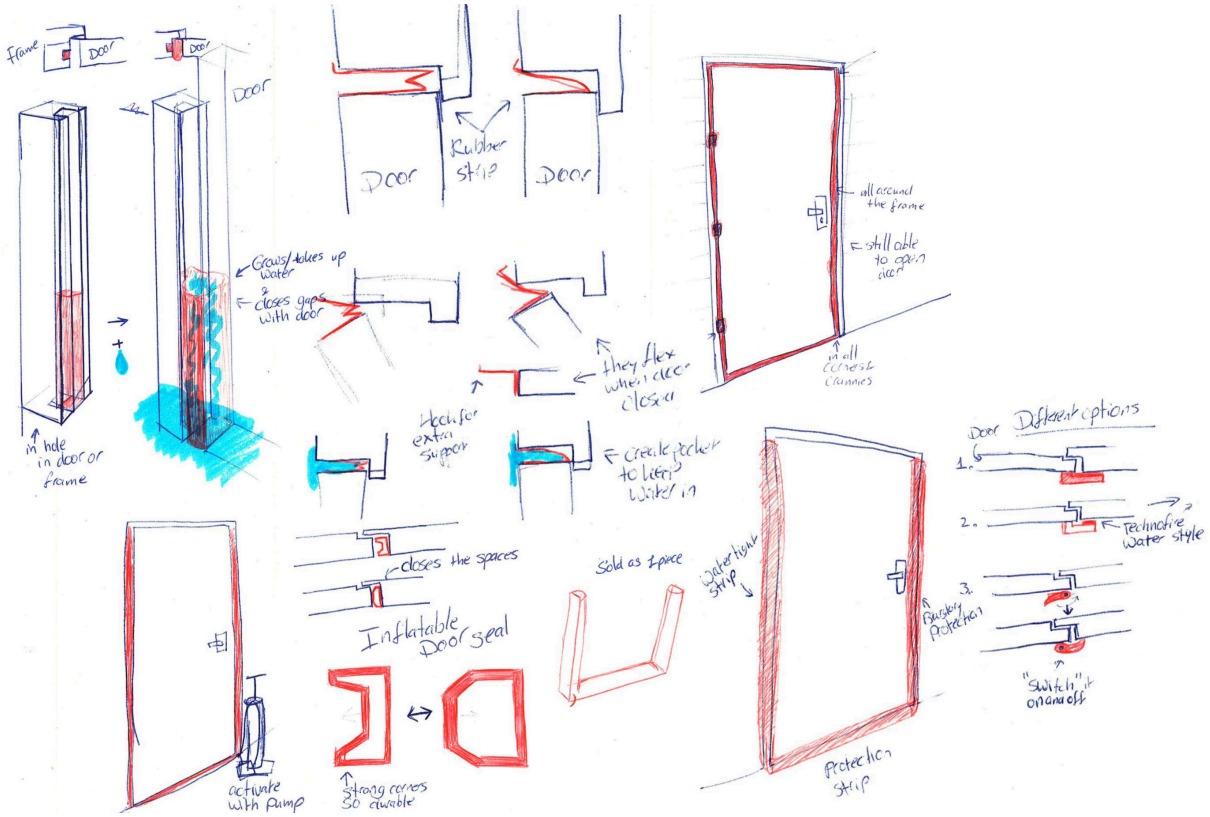


Figure 46 & 47: Sketches of the rollable barrier ideas (left) and sketches of the ideas in the door (below)

4.1.2.2. Selecting the 4 high potential ideas

Through several meetings and informal feedback sessions with various stakeholders, including the supervisors of this project and Alprokon Staff, key evaluation criteria were determined. The 12 concept ideas were then assessed against these criteria to identify the most promising candidates for further development. An overview of the advantages and limitations of each concept is provided in Appendix 4.2. The leading criteria were:

Evolutionary v.s. revolutionary
While all concepts improve on existing solutions, they differ in their level of innovation. The foldable and rollable barriers are evolutionary developments of existing flood protection systems, whereas the concepts integrated between the door and frame take a more revolutionary approach. Despite differences in innovativeness, preference is given to the latter direction.

Ease of use
Existing flood barriers often require multiple steps, physical effort or heavy components. Feedback from users, including elderly residents, highlights difficulties in setting them up. Therefore, simplicity of use is critical. Concepts requiring minimal and intuitive setup and low physical effort are preferred.

Versatility
Although the focus is on outward opening doors, solutions that can be applied to multiple door types are preferred. Some ideas are broadly applicable, while others are limited to specific applications.

Storage
Most current flood protection products are bulky and difficult to store. Solutions that are compact or permanently integrated into the door system have a clear advantage, since there is no need to store them at all.

Feasibility
Technical feasibility was not used as a selection constraint at this stage. Some created ideas are relatively easy to implement, while others require further development. Given the exploratory nature of the project, all directions were considered regardless of current feasibility.

The four concepts that best meet these requirements and/or show the highest potential were selected and further developed. These are elaborated in Chapter 4.3.

4.2. The four concepts

Assessing the product ideas on the defined criteria resulted in the selection of four ideas. These were researched and detailed further. After multiple iteration cycles, the following concepts were created. See Appendix 4.3. for the concepts in greater detail.

4.2.1. Folding barrier

How it works: This concept consists of a foldable barrier mounted next to the door. When flooding is expected, the barrier can quickly be unfolded and secured in front of the door. Sheets attached to the frame make the barrier waterproof. Its V-shaped geometry allows the outward-opening door to remain functional and distributes the water pressure.

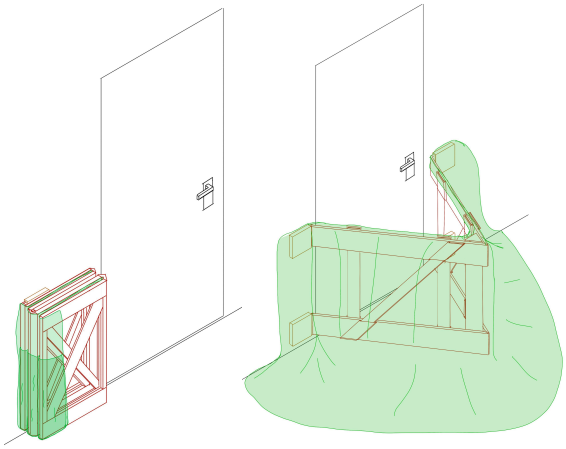


Figure 48: The folding barrier unfolds into a watertight V-shaped barrier.

Material: The structural components are made from a lightweight and durable material such as aluminium, combined with waterproof plastic sheets.

Placement: The folded barrier is mounted beside the door on the hinge-side and can quickly be opened and attached to the other side of the door. Small attachment points on both sides of the door are required to secure the barrier. A removable version for indoor storage was also considered.

Advantages
- Familiar barrier principle increases user trust
- Applicable to various door types, including front, sliding and double doors
- More compact storage compared to traditional barriers

Limitations
- Objects around the door may hinder use, like bushes, furniture and steps.
- Manual setup still requires time and effort
- Visible modifications to the house are required

4.2.2. Inflatable trim

How it works: The inflatable trim is based on inflatable sealing systems currently used in yachts, but adapted for residential doors. A rubber inflatable seal is integrated into the door and connected to a pump and exterior water sensors. When flooding is detected, the system automatically inflates the seal, closing the gaps around the door and creating a watertight barrier.

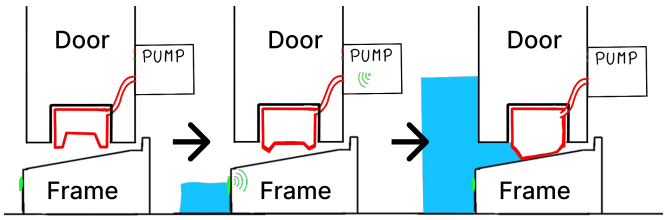


Figure 49: The rubber seal is activated by a detection of a flood and inflates to seal the gaps, side cross section.

Material: The seal is made from a flexible and durable material such as EPDM or NBR. The system includes a pump and electronics, which can operate wired or wireless using a battery-powered setup. Integration with smart-home systems or mobile applications is possible.

Placement: To protect the system from damage and create enough space, the rubber seal is recessed into the door or frame through a milled channel.

Advantages
- Automatic activation during floods
- Ability to connect with app creates an increased feeling of control and safety
- Minimal visible impact on the home
- Suitable for multiple door types, including front, sliding and garage doors

Limitations
- Installation is invasive and requires specialized tools
- Damage to the inflatable seal decreases functionality
- Space is needed for the pump and electronics
- Higher complexity may increase costs

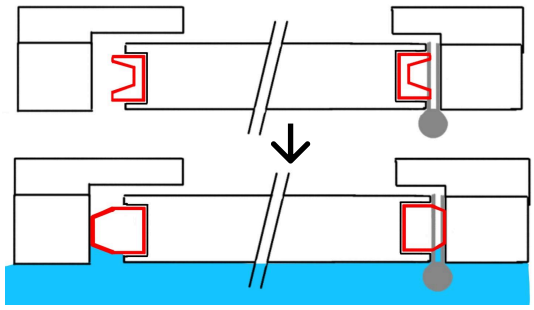


Figure 50: Top-view cross section of the inflating trim sealing the sides of the door

4.2.3. Folding trim

How it works: The rubber folding trim (shown in red) is attached to the sides and bottom of the door. When the door closes, the flexible L-shaped trim folds between the door and frame, creating a watertight seal. The water pressure pushes the trim further into place, increasing the sealing effect.

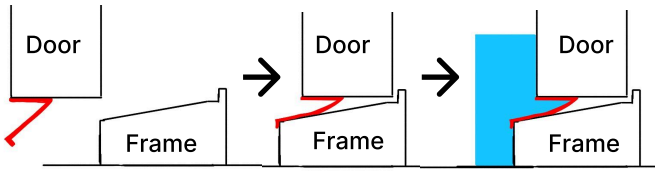


Figure 51: schematic side cross-section of the bottom of the door and threshold (frame). The folding trim (red) seals the gap between the door and frame, sealing the door.

Material: The trim is made from a flexible and durable rubber, such as EPDM or butyl rubber, suitable for frequent bending and outdoor exposure. The profile is likely produced through extrusion.

Placement: The trim is mounted along the sides and bottom of the door, with the fold facing indoors. It can be attached to the door via adhesive or screws.

Advantages
- Low-cost production through rubber extrusion
- Easy installation with limited tools required
- Automatically active when the door is closed
- Minimal visual impact on the home
- Additional thermal and acoustic insulation

Limitations:
- Challenges around hinges, locks, and corners
- Unsure about durability due to repeated folding
- Requires sufficient space between door and frame
- Irregularities in the frame or door can reduce sealing performance
- Not directly suitable for front or sliding doors without adaptation

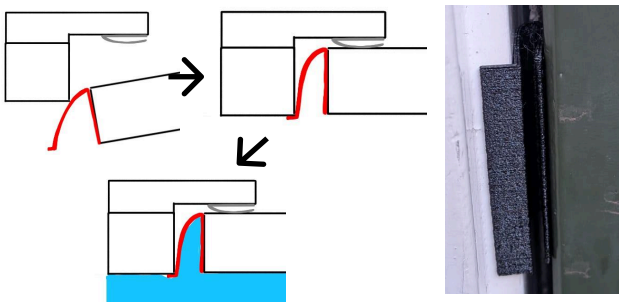


Figure 52 & 53: Top-view cross section of the folding trim sealing the side of the door (left) and prototype of the folding trim between a door (right)

4.2.4. Sealing trim

How it works: The Sealing trim uses a Water Activated Expanding Material (WAEM) integrated into a protective anti-burglary trim mounted around the outer sides of the door. When water reaches the material, it expands and seals the gaps between the door and frame, creating a watertight barrier.

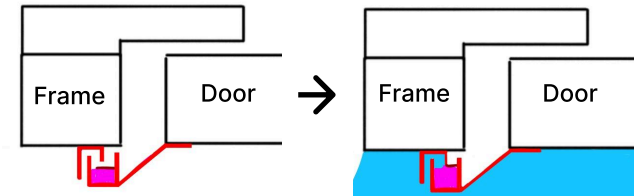


Figure 54: schematic top cross section of the WAEM (pink material) that expands in contact with water and seals the gaps in the strips (red material)

Material: The trim is made from a durable material such as aluminum or steel. The WAEM consists of Super Absorbent Polymers (SAPs), such as sodium polyacrylate with a binder or in a small bag.

Placement: The product is mounted on the outside of the door and frame along the sides and bottom, creating an interlocking seal. This external placement avoids interference with locks and limited spacing between the door and frame.

Advantages
- Automatically active when flooding occurs
- Suitable for multiple door types
- Requires small modifications to the door
- Limited visual impact on the house
- Adds burglary protection
- Refillable WAEM system offers recurring business opportunities

Limitations
- Corners and hinges require additional attention
- Environmental impact of the WAEM is unclear
- The WAEM requires replacement after activation
- SAP materials are sensitive to humidity

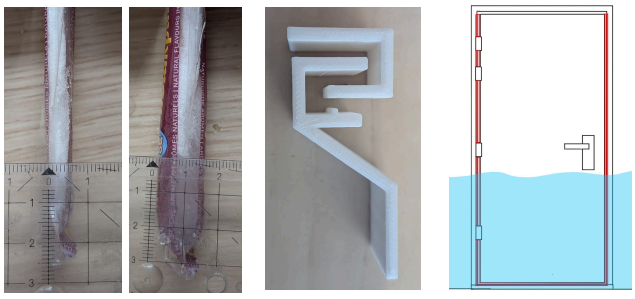


Figure 55, 56 & 57: Test done with WAEM (left), prototype of possible shape for the adapted anti-burglary trim (left) and placement along the outer sides of the door (right).

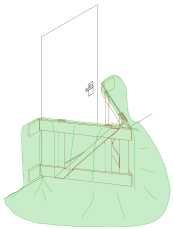
4.3. Selecting the concept

Feedback on the four concepts was acquired from different stakeholders and professionals. This feedback was used to select the concept with the highest potential to protect the house of flooding and fit the consumers needs.

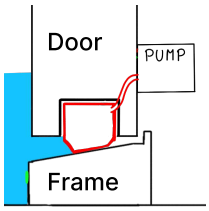
4.3.1. Collected feedback

Feedback of six people was acquired; the two academic mentors of this project and professionals in design, the company mentor and colleague of this project, a professional about flood protection and a lecturer in urban design. They were all asked to give feedback on the concepts out of the perspective of their profession and their personal view as home-owners. All feedback can be found in Appendix 4.4.

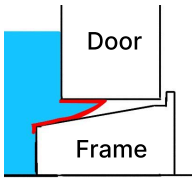
Concept 1: The foldable barrier was seen as a familiar solution that improves on existing flood barriers and was appreciated for its compatibility with different door types and ease of setup. However, it was also perceived as bulky, visually intrusive and still requiring considerable time and effort to install.



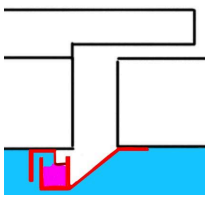
Concept 2: The inflating trim was praised for its automatic activation, limited visual impact on the house, and the sense of security offered by the app. However, concerns were raised about installation complexity, reliance on electronics and long-term reliability.



Concept 3: The folding trim was appreciated for its elegant and logical design, affordability and ease of installation. Concerns included wear from repeated use, difficulty sealing corners, compatibility with all door types and the need for proactive maintenance or replacement.



Concept 4: The expanding trim was seen as innovative and attractive for being compact and integrated to the door and added anti-burglary functionality, it was appreciated for its ease of installation and strong business potential. However, its novelty raised concerns around user trust, environmental impact and the replacement or reuse of the expanding material.



Figures 58 to 61: sketches of the four concepts

4.3.2. Selecting the concept

During an extensive meeting with all project supervisors, the concepts and collected feedback were evaluated. The discussion concluded that concepts 2, 3, and 4, which are integrated between the door and frame, offered clear advantages over traditional external barriers, like concept 1, including automatic availability, no setup time and minimal visual impact on the house.

Concepts 2 and 3 were considered innovative and promising, although both are based on existing techniques adapted to a new flood-prevention application. Questions remained regarding their ability to fit between the door, their long-term reliability and the consistency of the seal.

Concept 4 was identified as the most promising direction. The use of water-activated expanding material (WAEM) to automatically seal a door showed strong potential, while its simple and elegant functionality and use aligned well with the project goals. Although the integrated anti-burglary feature added value, discussions revealed a preference for a simpler solution focused solely on the expanding material strip. Further research into the feasibility and application of this approach was therefore the logical next step.

A significant part of the development of this product concerns the selection of the most suitable water activated expanding material, which is covered in depth in chapter 5.2 and 5.3. Alongside this, the broader product concept, including form, placement, installation and use required research and development, shown in chapter 4.4. Once the final material was selected, the final product form was decided, based on the research done in chapter 4.4.. The final product designs are outlined in Chapter 5.4.

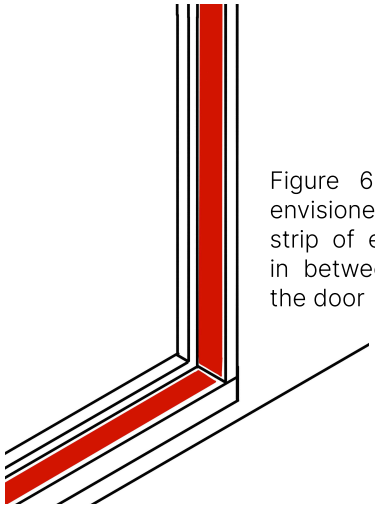


Figure 62: sketch of the envisioned final product; a strip of expanding material in between the frame and the door

4.4. The envisioned concept options

With the most promising concept selected, the use of a water-activated expanding material to seal a door, the focus shifts to optimization, detailing and testing, to work towards a complete and desirable product concept.

The product's final functionality, and therefore its form and use, is largely determined by the properties of the selected water-activated expanding material (WAEM). The search for this material is outlined in Chapters 5.2 and 5.3. The various options for this material started an exploration of multiple options for the product's form, appearance and mechanics, which are outlined in this chapter. Once the final WAEM is selected, its specific properties will determine which of these options is most suitable, forming the basis for the final product design.

4.4.1. Placement of the strip

Depending on the swelling capacity and structure of the material, the WAEM can be integrated into different parts of the door system. These placements are investigated and shown in Table 5. A full overview of placement options is provided in Appendix 4.5.

Strip placement depends on the available space between the door and frame. Where sufficient space exists, the strip can be attached directly to either the door or frame. This is the simplest solution, requiring minimal installation work. Where space is insufficient, a groove can be milled into the door to place the WAEM, though this increases complexity and may require professional installation. Hinges, locks and non-wooden frames can further complicate this approach.

Overall, direct placement between the door and frame is preferred, as it simplifies installation and avoids issues related to hinges and locks. The

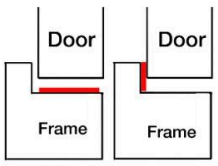
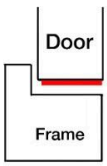
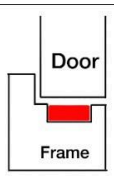
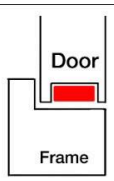
	Frame	Door	notes
Stuck between frame and door *- If there is enough space*			- Easy and quick installation
Milled in frame or door *- If there is not enough space*			- Complex installation - interfere with hinges and locks - not possible with plastic or metal frames and doors
notes	- Higher wear and tear - Easier to be affected by rain	- Flood water activates the material later	

Table 5: an overview of the possible placements of the material in the door and frame.

4.4.2. Physical properties of the strip

The physical properties of the selected WAEM strongly influences the final product design and how the WAEM can be applied. The material could be a flexible solid strip that can be attached along the door, similar to an anti-draft strip. Its flexibility would allow easy transport, storage and installation.



Figure 63: Flexable strip, just like a draft strip (Eneco, 2025).

If the material is solid but rigid, the product would function more like a skirting board attached around the door. Although less compact and slightly harder to install, it would still provide a practical solution.

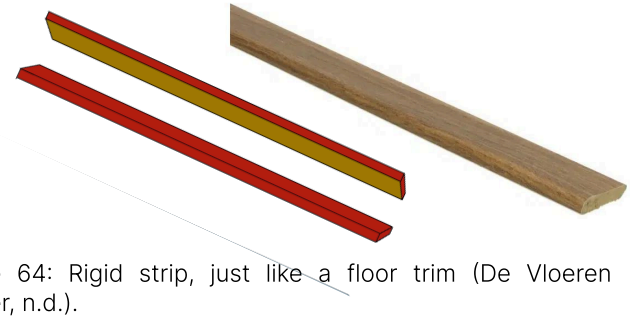


Figure 64: Rigid strip, just like a floor trim (De Vloeren Kenner, n.d.).

If the WAEM is only usable in powder or granular form, the powder could be integrated into a flexible fabric strip containing multiple small compartments filled with SAP parts, like sachets. This would allow the particles to remain distributed over the strip evenly while still being able to expand effectively.



Figure 65: rollable strip with powder in small bags, like sachets (Break Free From Plastic, 2021).

All proposed variations create modularity and adaptability to apply the product to different door sizes and types. A complete overview of the advantages and limitations of these solutions can be found in Appendix 4.5.2.

4.4.3. Shape of the strip

The shape of the WAEM influences swelling speed, sealing effectiveness and compatibility with the door's operation. Several options were explored, varying in thickness, surface area and placement. Due to the unavailability of the final material, physical testing of these options was not possible, and assumptions were made to inform the selection. The following assumptions are made: greater surface area accelerates swelling; positioning the material closer to the door, without interfering with its operation, reduces the required expansion and therefore speeds up sealing; and the shape must be compatible with any protective cover without compromising sealing performance.

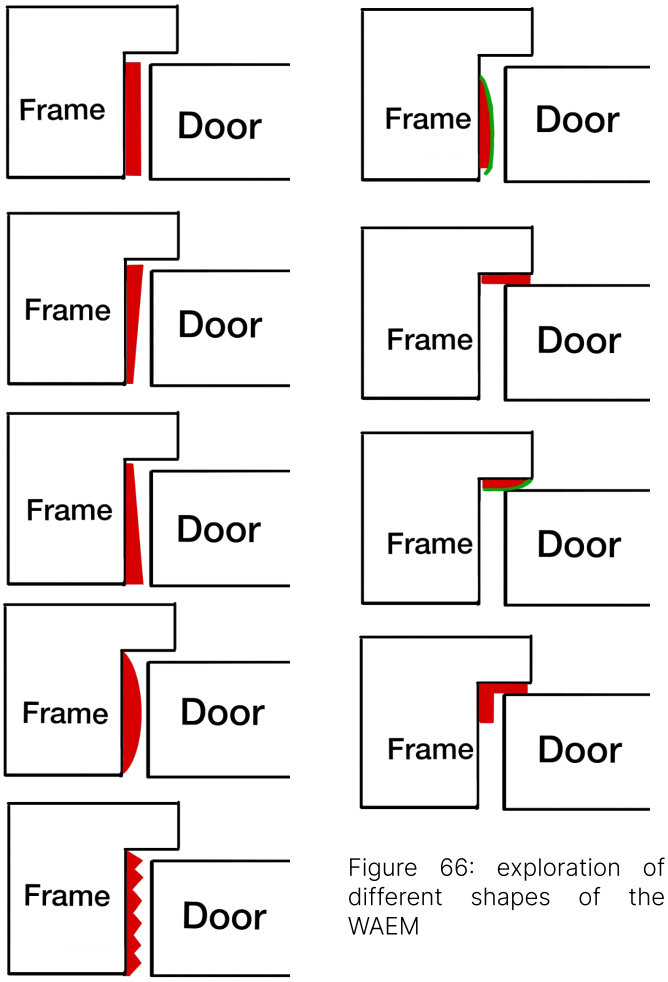


Figure 66: exploration of different shapes of the WAEM

4.4.4. Coverage of the strip

Ideally, the product will be fully modular, allowing users to adapt it to their specific door and expected flood risk. Users could decide themselves how high the product is applied, for example based on the flood-risk information from Overstroomik.nl (Overstroomik.nl, n.d.). If desired, the product could also be installed along the full height of the door.

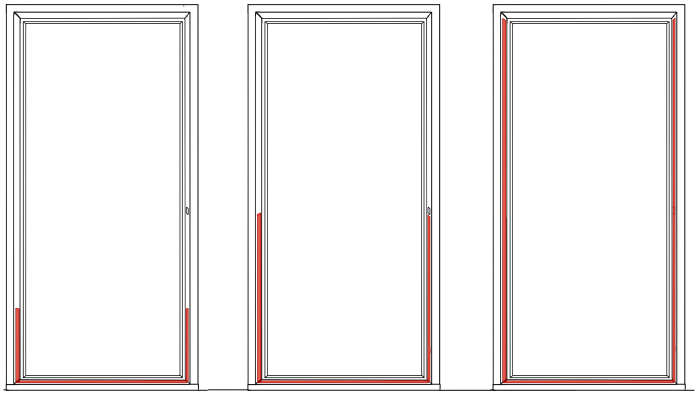


Figure 67: different options of heights the product can be applied.

4.4.5. Corners, hinges and locks

The corners of the door are critical points within the sealing system. Further testing is required to determine the most effective sealing method, including whether dedicated corner pieces are necessary or if the swelling behaviour of the material can seal these areas automatically, see figure 68.

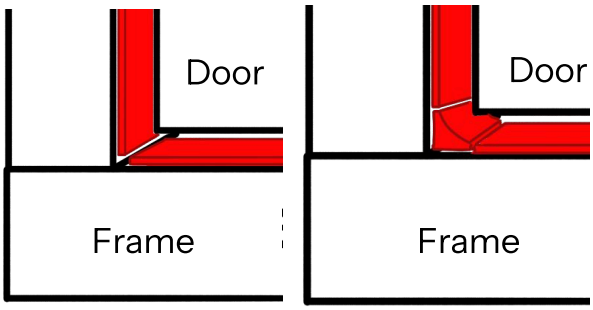


Figure 68: two situations of sealing the corners, sticking it to the edge (up), or with a special corner piece (down)

The placement and height of the WAEM influences how the hinges and locks of the door are integrated in the design. Initial concepts for handling these obstacles have been explored.

Observations suggest that most backdoors use a single lock, rather than a three-point locking system, see Appendix 4.5.3. This lock is positioned around 100 cm high on the door (Sleiderink, 2026). As a result, applying the product below this height will often avoid interference with the lock mechanism. For doors where interference with a lock still occurs, several possible solutions were explored, see figure 69.

Hinges may also create challenges for the sealing system. Most backdoors contain three or four hinges positioned at approximately 20 cm, 100 cm, 170 cm, and 190 cm height, depending on the size of the door (KTV Online, 2026). In most cases, the bottom hinge will have to be covered to create a continuous seal. Since hinge designs vary greatly, like being recessed, internal or externally mounted, different solutions were explored for different hinge types, see figure 69.

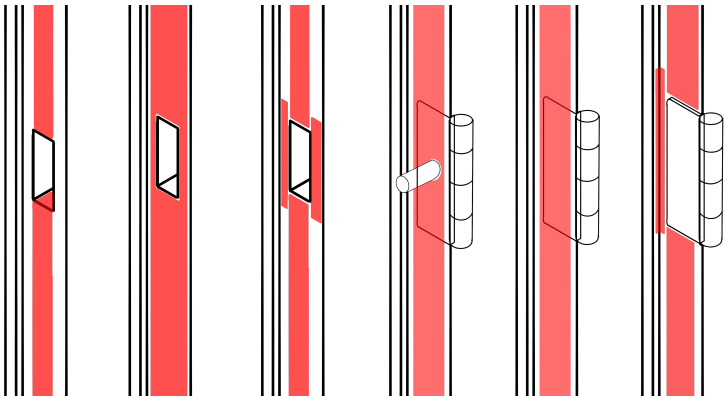


Figure 69: Different options to place the material to make a waterproof seal around locks and hinges.

These concepts are based on a standard configuration in which the expanding material is attached to the frame along the short side of the door. Similar solutions are expected to work when the material is attached to the door itself. For solutions in which the product is milled into the frame or door, larger adjustments will be needed to retain the normal working of the door.

4.4.6. Avoiding unintended activation

The properties of the final WAEM will also determine how it responds to everyday humidity and rainfall, with the goal of preventing unintended expansion outside of flood conditions. Different solutions are analysed, figure 70.

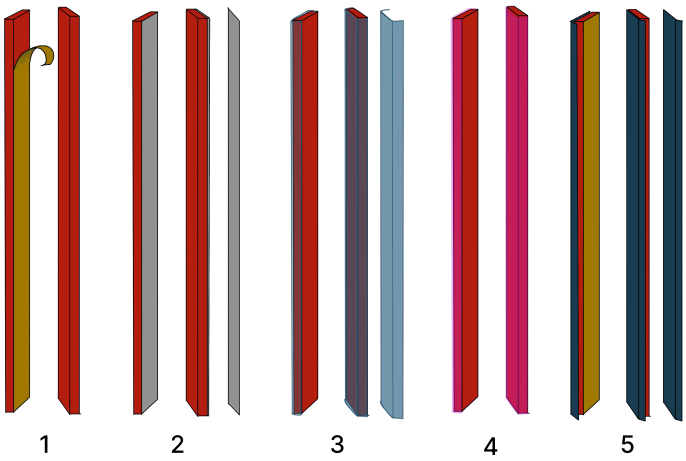


Figure 70: different options for use of the product. With tape (1), with magnets (2), with a watertight cover (3), with a chemical coating (4) and with a rain cover (5)

If the chosen WAEM responds to both humidity and rain, the simplest solution is to store the product indoors and only install it when flooding is expected. Quick installation could be supported with systems such as adhesive strips (1) or pre-attached magnets (2). Although this solution prevents unwanted activation, it removes the advantage of the product always being ready for use without setting up needed.

Another option is to have the strip installed but protected with a plastic layer (3). When flooding is expected, the protective layer can be removed, allowing the material to activate when exposed to water. This approach reduces setup time during a flood, but still requires user action prior to a flood.

A more advanced solution would involve applying a chemical coating that delays activation (4). Such a coating could prevent the material from activating due to humidity or rain, while still allowing activation after prolonged contact with floodwater. This would maintain the advantage of the product always being ready, although rapid flooding situations could pose challenges.

If the WAEM is resistant to humidity but sensitive to rain, a protective rain cover could be added (5). This cover would block rain from above and the side while still allowing rising floodwater to activate the material from below. This solution preserves the “always ready” functionality, but requires additional space between the door and frame.

4.4.7. Combining functionalities

Although it is not a requirement, combining the flood prevention capabilities with other functionalities could increase the desirability of the product. Some exploration was done combining it with an anti-burglary strip and two versions of an anti-draft strip, as can be seen in figure 71.

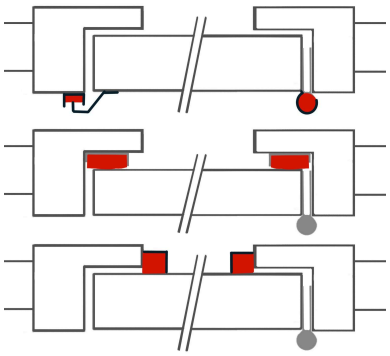


Figure 71: different options for integration with other functionalities: anti-burglary trim (top), a traditional draft strip (middle) and new type of draft strip (bottom).

The options explored in this chapter form the basis for creating the most effective product concept, some user stories and leaflet of an explored final product can be found in Appendix 4.6 and 4.7. However, the material's properties directly influence the form and use of the product, and so which options work best. Chapter 5 therefore explores the material options and properties. Combining those findings with the options explored in previous chapter leads to the development of the final product concept, which is presented in Chapter 5.4.



Figure 72: Man checking the water levels from his home (Boon, 2012)

5. Why Floud works

This chapter demonstrates the feasibility of Floud. Throughout the project various prototypes were made and tests were conducted to verify the concept's feasibility. Alongside this, extensive material research was carried out to identify the most suitable water-activated expanding material for this application. This information was combines with all knowledge from previous chapters and two product concepts created, which will be explained in more detail in this chapter.

5.1. The first tests

To make sure the final product would work as expected, tests with early prototypes were conducted since the early stages of ideation. The outcomes of these tests helped selecting the right solution.

5.1.1. First tests with the three concepts

Three of the developed concepts differed significantly from conventional flood barriers: the inflating trim (chapter 4.2.2.), folding trim (chapter 4.2.3.) and expanding trim (chapter 4.2.4.). Simplified prototypes were made and tested in simple setups to evaluate their ability to block water. The complete test setup and procedures can be found in Appendix 5.1.

All three concepts successfully delayed water penetration and demonstrated the potential of their working principles. Although small amounts of water still passed through with all prototypes. This was mainly caused by the low-fidelity setup, which did not fully seal the bottom edges and the use of non-final materials. Nevertheless, the tests proved that the underlying mechanisms of all of these concepts can effectively contribute to flood protection.



Figure 73: pictures of initial tests of the three concepts: Inflating trim (upper left), folding trim (upper right), expanding trip (lower left) and the test-setup (lower right).

5.1.2. Testing SAP with different mixer materials

Initial tests with the expanding trim showed potential for flood-sealing applications. However, the material used, sodium polyacrylate, a super absorbing polymer (SAP), is mainly available in powder form. Therefore binding materials were tested to explore possibilities for creating a solid but swelling material, see Appendix 5.2..

Although no suitable mixture was found, the tests provided valuable insight into the behaviour of the SAP. Loose SAP inside a permeable “bag” showed the highest water absorption, while mixed samples absorbed significantly less water. These findings indicate that further professional material research is required to develop a viable solid application, if this concept is chosen.



Figure 74: different bags and material mixes to examine the capabilities of the SAP.

5.1.3. Other tests performed

Several additional exploratory tests were conducted with the SAP material. A humidity test showed that SAP stored in a permeable bag absorbed a significant amount of moisture from the air, making this form unsuitable for long-term exposure to humid environments, see Appendix 5.3.1.

In another test, activated SAP wrapped in a towel was evaluated as a water barrier, see Appendix 5.3.2. Although similar materials are used in sandless sandbags, small streams of water still passed through the setup. While the low-fidelity prototype and materials used likely influenced the results, the test raised concerns about the ability of a small SAP-based strip to withstand higher water pressures effectively.





Figure 75 & 76: a humidity test (left) and “sandbag” test (right)

5.2. Water Activated Expanding Material (WAEM) research

After the selection of the water-activated expanding trim as the final concept, as explained in chapter 4.3.2. research was initiated to identify the most suitable material for this application. The material used in initial tests, sodium polyacrylate, proved unsuitable in several ways; Its powdery form makes it difficult to apply as a continuous strip along the door, compromising reliable sealing, uncertainty remained whether the material can withstand higher water pressures, and its high sensitivity to humidity posed a risk of unintended expansion under normal conditions. An extensive research to find or create a material that suits the intended application was started.

5.2.1. Research done to different materials

Several potential materials for the water-activated expanding material in the intended concept were investigated. Sodium polyacrylate, the material used in earlier tests, was mainly available in powder form, and has multiple other disadvantages, making it less suitable for the envisioned application (Sodium Polyacrylate, 2025). An other option, polyacrylamide gel, can be produced in solid form and is already used in various applications. However, its absorbs speed is low and it will turn soft when activated, which may reduce its mechanical strength needed to seal a door (Ataman Chemicals, n.d.).

Another promising direction was bentonite clay, a natural swelling material commonly used in water filtration and construction (Feick, n.d.). While bentonite itself is usually applied in powder form, products such as bentonite liners and swelling strips, combining bentonite powder with fabrics or mixing materials, showing interesting application possibilities. However, the intended use of these products, concrete construction, requires an expansion speed of several days and when activated, the clay will lose cohesion. This limits its suitability for rapid flood sealing around doors.

More promising were materials combining SAPs with rubber binders. Products such as Polybar+ use this principle to create solid swelling strips for construction applications. Although the standard Polybar+ has a low swelling speed, the Polybar+ Superswell, created by Bekina BeSealed, has a large and fast expansion capacity and demonstrates the potential of this material used in rapid flood sealing (Bekina BeSealed, 2021). More research towards this material was conduted.



Figure 77: Different swelling materials researched: sodium polyacrilate (upper left) (Amazon, n.d.), Polyacrylamide (upper right) (Gel Watergun, 2024), Bentonite liner (lower left) (Wennian, n.d.) and Bentonite swelling bars (Tradewheel, n.d.)

5.2.2. Meetings with suppliers

Literature research and a meeting with Bekina BeSealed provided additional insight into the potential of swelling materials for flood sealing applications.

The Polybar+ Superswell was originally developed for use in concrete construction in highly saline environments and consists of a Super Absorbent Polymer (SAP) combined with a TPE binder. It can expand up to 2000% in rainwater and withstand water pressures up to 8 bar. After drying, the material shrinks back to its original size, enabling repeated use (Bekina BeSealed, 2021).

Current Polybar+ products are primarily developed for concrete construction applications, meaning limited research and development has been conducted on properties such as quick swelling speed, see figure 78, and drying behaviour. Additional testing is therefore required to evaluate its suitability for flood-protection applications and, if found unsuccessful, to explore the potential of new material compositions that might fit this application. Since Bekina BeSealed develops and manufactures these materials in-house, customized compositions and a wide range of forms can be produced through extrusion and injection moulding. Bekina BeSealed expressed strong interest in further collaboration to explore these possibilities.

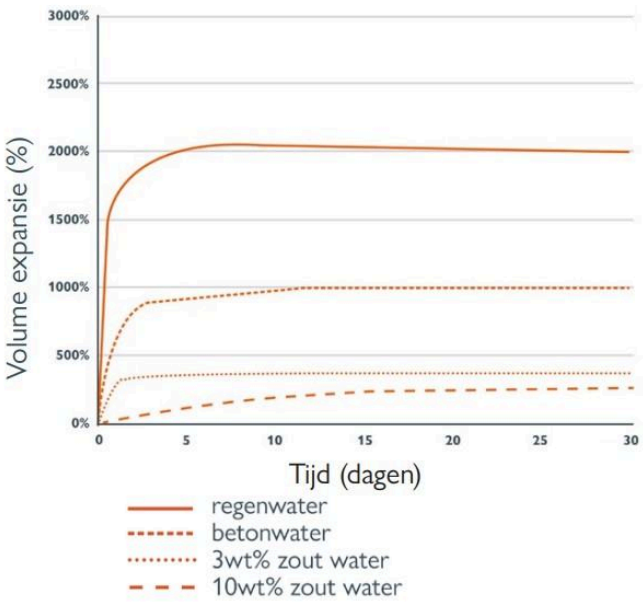


Figure 78: graph of swelling Polybar+ Superswell (Bekina BeSealed, 2021).

5.2.3. Tests with different polybars

The research analysing the swelling behaviour concluded three potential materials to be tested:

1. Bentonite bar
2. Polybar+ from Bekina BeSealed
3. Polybar+ superswell from Bekina BeSealed

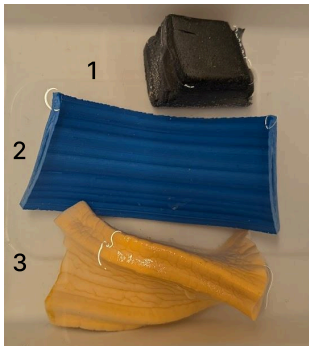


Figure 79: test setup comparing the swelling speed and volume of a Bentonite bar (1), Polybar+ (2), and Polybar+ Superswell (3).

The first test measured swelling speed and volume, with full results in Appendix 5.4. The Bentonite bar barely increased in size and became crumbly after a while. The Polybar+ swelled only slightly, growing from 2 mm to 4 mm over several hours, too little and too slow. The Polybar+ Superswell grew from 5 mm in thickness to 13 mm in four hours, which is promising in terms of volume, but still too slow for practical use. During a flood, swelling within 30 minutes is preferred, ideally within 5 minutes.

The Polybar+ Superswell was identified as the most promising material and was selected for further research and testing to better understand its properties and applications.

5.2.4. Prototype material

Polybar+ Superswell was used for prototypes and material tests. It consists of a mix of Super Absorbent Polymers (SAPs) and a binder material. SAP particles are capable of absorbing large amounts of water and can expand up to 300 times their original volume when exposed to moisture, giving the material its swelling properties (Edana, n.d.).

The SAP particles are held together by Styrene-Ethylene-Butylene-Styrene (SEBS), a thermoplastic elastomer. SEBS is a flexible, non toxic and durable rubber-like material that does not react to water (Technirub, n.d.). The SEBS binds the small SAP particles into a solid strip. When the SAP particles absorb water and expand, the elastic SEBS matrix stretches, allowing the material to swell while maintaining its structural integrity as a single product (see figure 80).

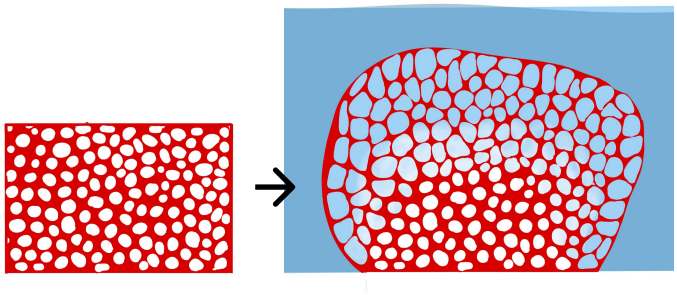


Figure 80: The Polybar+ Superswell in two states: “dry” with the particles SAP (white) bounded by the binder (red) (left). And the material while it is absorbing water in the particles (blue and white) and therefore expanding (right).

5.2.5. Tests with Polybar+ Superswell

Although the swelling speed of the Polybar+ Superswell was insufficient for the intended application, further tests were done to better understand its properties, limits, and possible applications, see Appendix 5.5. It should be noted that all tests were carried out in a home environment and should be treated as indicative. More testing under controlled conditions is required before final conclusions can be drawn.

Long-term test

A small strip left in water for 72 hours swelled from approximately 60 × 20 × 5 mm to 130 × 55 × 20 mm. This is a significant increase that demonstrates strong potential for starting small but swelling greatly, being able to seal big gaps.

Surface area test

Increasing the surface area exposed to water appears to accelerate swelling. A simple comparative test with three pieces of varying surface area supported this. With the sample with greater surface area swelling faster and larger.

Rain test

The material responded quickly to raindrops, showing signs of swelling, showing that it is sensitive to rain but does not swell severely. This indicates a need for protection against rain exposure during normal use.

Humidity test

After several weeks in a 95% humidity environment, the material showed no signs of swelling or degradation, suggesting it is resistant to ambient humidity and suitable for use in damp conditions.

Pressure test
When swollen, the material generated enough pressure to slightly bend two ice lolly sticks without it tearing or breaking. This suggests it can create sufficient force to hold itself firmly between the door and frame. Notably, the material swelled laterally when constrained, indicating it will adapt to uneven surfaces and fill irregular gaps in the door and frame.

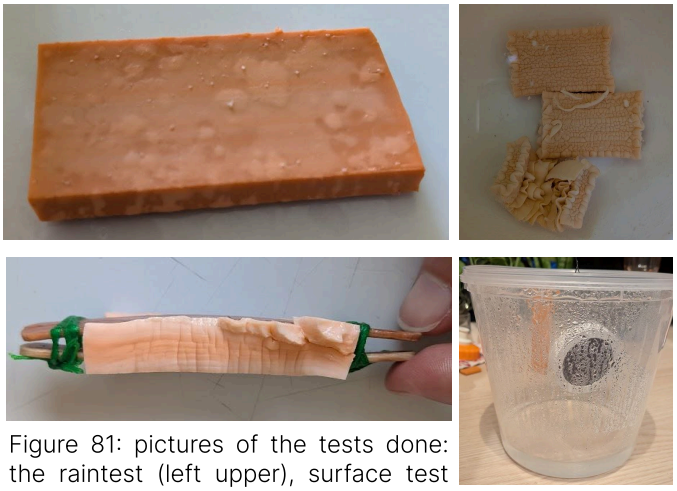


Figure 81: pictures of the tests done: the raintest (left upper), surface test (right upper), pressure test (lest lower) and humidity test (right lower)

The test outcomes demonstrate a strong potential for the Polybar+ Superswell as a door-sealing solution. Its significant swell volume means a small strip can seal a large gap, its humidity resistance allows it to remain in place long-term and the pressure it can create suggests it can withstand the forces of floodwater. However, the swelling speed remains the critical challenge. If the material takes four hours to fully expand, floodwater will likely have already entered the home, making the product useless. A new material with similar properties, will need to be developed to fit this application.

5.3. Final material

The development of a custom material falls outside the scope of this project. However, first steps have been taken towards enabling this through a collaboration with Bekina, which has also provided a better understanding of the material and its potential properties.

5.3.1. Creating the best fitting material

Following the tests, contact and a visit was established with Bekina to discuss the findings and the need for a faster-expanding material. Bekina showed strong interest in the possibilities of such a material and committed considerable time and effort to developing a custom material suited to this application.

Several approaches to increase the swelling speed of the Polybar+ Superswell were explored, including increasing the SAP content, adjusting the SEBS configuration, for example by increasing styrene and reducing ethylene to improve elasticity, and replacing the SEBS binder with an alternative such as rubber. Initial tests of these configurations produced a soft, clay-like material that fell apart in the water, falling short of the requirements. While potential was identified, further research, testing, and prototyping are needed to find a suitable formulation.

The target is to create a material that swells at least 300% within 30 minutes, but preferably within 5 minutes, while generating sufficient pressure to seal door gaps. For the remainder of this project, the assumption is made that such a material can be developed and will behave similarly to the Polybar+ Superswell, but with the required swelling speed.

5.3.2. Manufacturing of the material

Bekina has an extensive production facility. Once the final material formulation is established, Bekina can manufacture it in-house through a process involving mixing, extruding, anti-sticking treatment, drying, stamping, adding an adhesive layer and cutting, producing the material in the required shape and colour. Injection moulding is an possibility too. It can be supplied as long strips of many meters or as pre-cut, individually packed spools, shipped in batches. Further assembly into the final product would have take place elsewhere.

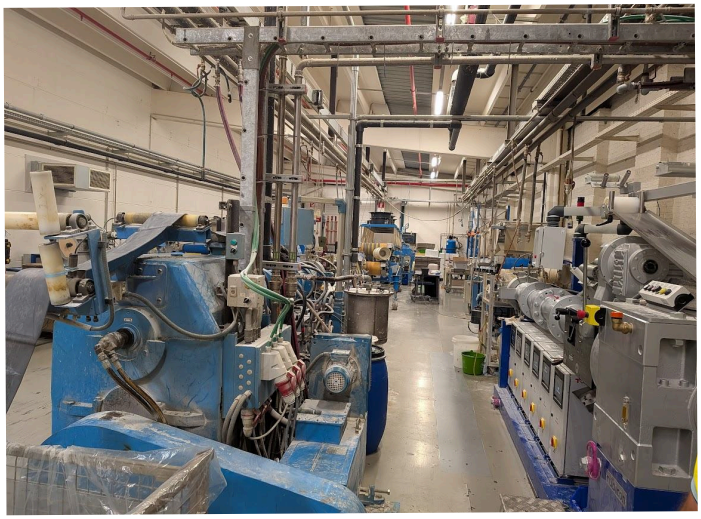


Figure 82: Production facility of Bekina

5.4. The concepts

After extensive ideation, evaluation and refinement (Chapter 4), combined with material research and testing (Chapter 5), two high-potential product concepts have been developed: the Floud Add-on and the Floud Draft Strip. Both are detailed in this chapter. While all design decisions are grounded in the findings of the research and ideation done in previous chapters, both concepts require further detailing and testing before they can be brought to market. Particularly given that the WAEM is still under development. This, however, falls outside the scope of this project.

5.4.1. Floud

Floud is a product concept built around the working principle of automatically sealing the gaps around doors during a flood using a Water Activated Expanding Material (WAEM). This WAEM swells upon contact with water, sealing all gaps, and prevents water from passing through. This principle can be applied to the door in various ways. In this project, two product concepts have been developed: the Floud Add-on, designed for easy and quick installation at a low investment, and the Floud Draft Strip, a more permanent solution that creates a faster and more reliable flood barrier.

The name Floud is derived from the phrase "Flood Out", but it is also an abbreviation of “Flood Locked Out of Unattended Door”, capturing exactly what the product does: keeping floodwater out of the door without the need for setting anything up.

Floud

Keep Floods out of The Door

Figure 83: a logo for Floud

5.4.2. Floud Add-on

The Floud Add-on is designed for easy installation, low investment and constant flood protection, suitable for a broad consumer market. Its slim, flexible form makes it compatible with many door types and sizes, while keeping installation simple and accessible.



Figure 84: Floud Add-on installed on a back door

Location and shape of the product

The Floud Add-on consists of three layers, see figure 85; a 2 mm thick WAEM core forms the active flood protection layer of the strip, swelling up to four times its size upon contact with water. This can be stuck to the doorframe due to the 0.1 mm adhesive backing layer, allowing quick and tool-free installation. The WAEM is protected against sunlight, accidental water exposure and impact by an outer flexible rubber layer of 0.4 mm. This rubber covers most of the WAEM, but leaves a small gap for floodwater to reach and activate the WAEM. The rubber flap opening faces outward so that rising water can contact the WAEM as quickly as possible. It does not interfere with the swelling.

The total strip thickness of 2.5 mm is deliberately chosen to fit within the typical door gap of 2–6 mm without affecting normal door operation. The strip is 30 mm wide and made entirely of flexible materials, allowing it to be rolled compactly for storage.

The high-quality materials and protective design are expected to give the Floud Add-on a lifespan of at least 10 years without flood activation, though further testing is needed to confirm this.

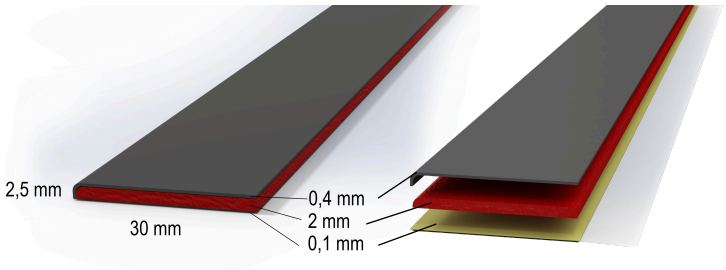


Figure 85: layers and thickness of the Floud Add-on

Application

The strip is applied to the hinge jamb, lock jamb, and threshold of the door frame, not the door itself. This placement is deliberate: the frame is better protected from everyday wear and weather, and positioning the strip lower, on the frame instead of the door, means floodwater reaches the WAEM sooner, reducing the amount of water that enters the house before activation.

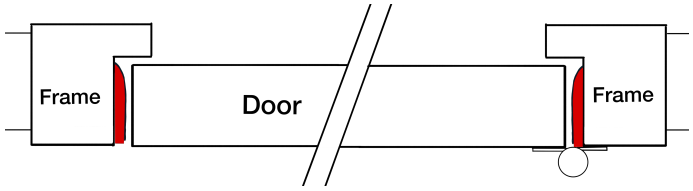


Figure 86: Top-view cross section of Floud Add-on placed in a door frame

The consumer can decide themselves how high to place the strip. While 1 metre is advised, users with knowledge of their local flood risk can paste it accordingly. For example, applying it only 30 cm high if water levels are unlikely to exceed 20 cm. Customers could also decide to cover the full door height for maximum protection. It can simply be cut to size with a utility knife. This flexibility makes Floud Add-on adaptable without requiring different product sizes. Although further testing is needed, the strip is expected to withstand water pressures of at least 1,5 metre in height.

Due to the swelling capabilities of the WAEM, no special corner pieces are needed. As long as the strip is applied against each other without gaps, the WAEM will swell to fill and seal corners and small holes completely.

The strip is wide enough to cover most holes for locks and hinges. Just apply the strip over the hole and cut it out with a utility knife, ensuring some WAEM remains on both sides of the hole. While this still creates a seal, these points are weaker and more prone to leakage than the rest of the strip.



Figure 87: The strip placed around a lock hole with the hole cut out

Installation is straightforward, easy to do, takes less than 20 minutes and follows six simple steps:

1. **Clean** the surface to remove any dirt or debris that could affect the adhesion of the strip.
2. **Peel and stick** the strip onto the frame with the rubber flap opening facing outward.
3. **Cut** to the desired height using a utility knife.

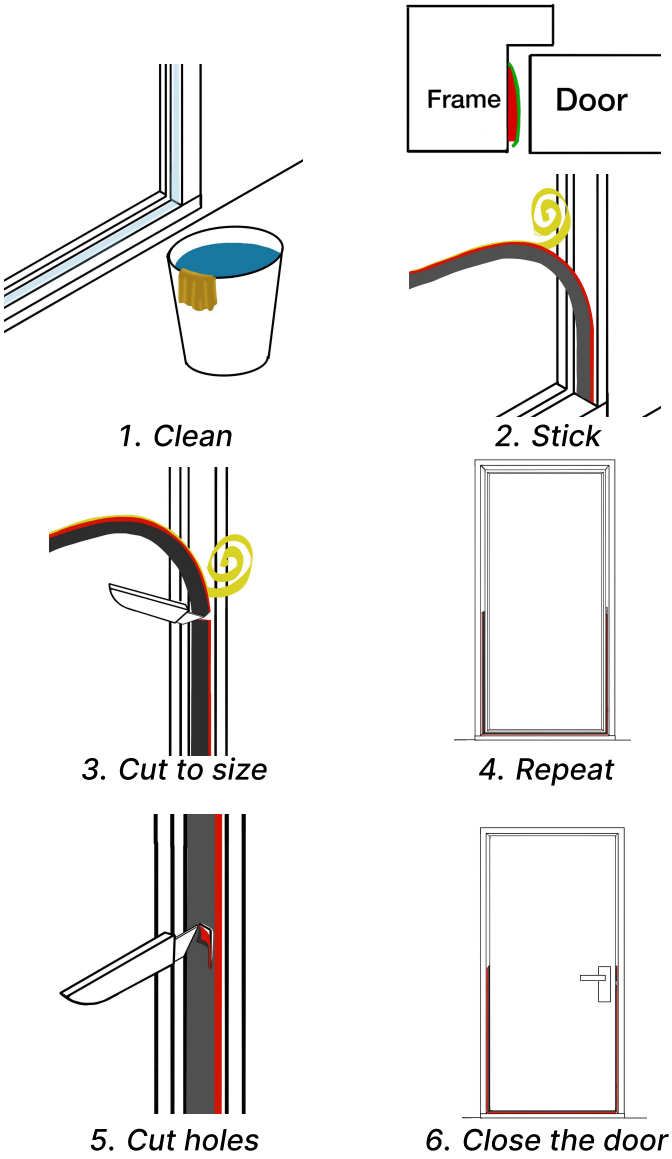


Figure 88: visual installation steps of Floud Add-on: cleaning, sticking, cutting to size, repeat, cutting the holes for the locks and doing this for all sides of the door.

4. **Repeat** on both sides of the door and along the threshold.
5. **Cut holes** with a knife where the strip covers locks, hinges or other fixtures. Make sure the strip remains present on both sides of each fixture for continuous protection.
6. **Close the door**. When a flood arrives, the Floud is ready to seal the gaps around the door and keep the water out.

During a flood

When in contact with water, the outer surface of the WAEM swells first, closing most of the gap within approximately 10 minutes. Swelling then continues inward, creating a firm and stable seal in all directions. The force generated holds the seal in place without preventing the door from being opened in an emergency. The seal remains active for as long as water is present, from a few hours to several days.

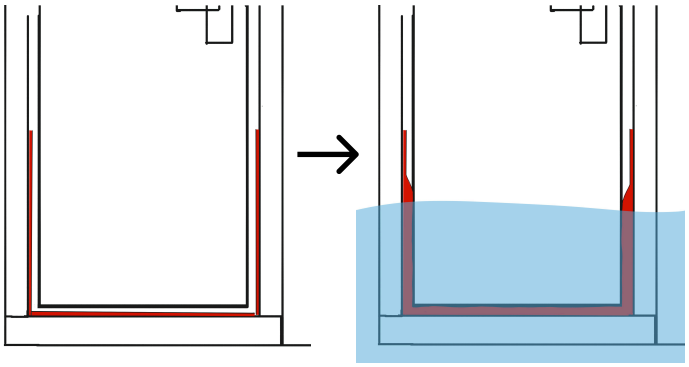


Figure 89: Floud Add-on placed in a door frame (left) and swelling, sealing the gaps around the door during a flood (right).

After a flood

Once the flood subsides, the door can be opened normally. The WAEM must be discarded and replaced, as it has absorbed potentially contaminated floodwater. Removal is straightforward and easy to do. Reinstallation follows the same steps as installing: clean, paste, cut and press, and can be done within 20 minutes. A spare strip kept in storage ensures the door can be re-protected immediately.

Storage

Floud Add-on is sold in packets sized for one door, three meter, allowing consumers to purchase as many as doors needed to protect. No storage near the door is required, as no setup is needed when a flood approaches. Storing the product in its original watertight packaging prevents accidental activation and extends shelf life. A target shelf life of at least 10 years has been set.



Figure 90: A packed strip of Floud add-on

Customisation

Floud Add-on can be produced in multiple colours to match different door frame finishes, reducing the likelihood of users painting over it and reducing its working. However, a more visible colour also has its advantages. It could act as a subtle daily reminder that the door is protected for floods, reinforcing the user's sense of safety and peace of mind. Different thicknesses and widths can also be offered to accommodate varying gap sizes, ensuring compatibility across a wide range of doors.

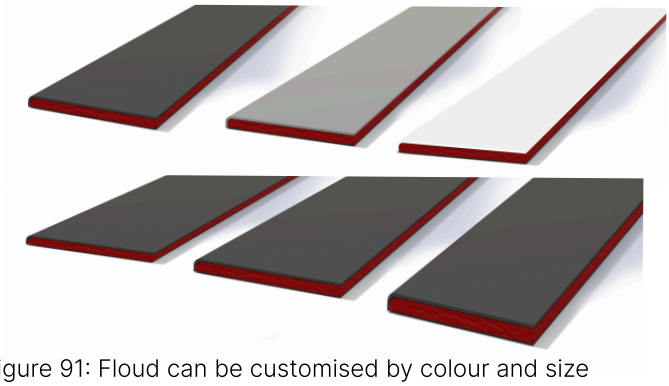


Figure 91: Floud can be customised by colour and size

Other applications

While designed primarily for outward-opening (back) doors, Floud Add-on has potential for wider application. However dedicated research is needed to confirm this.

- Front doors: can be applied with the opening facing outward.
- Double doors: applied similar as with back doors, with an additional strip where the two doors meet.
- Sliding doors: most mechanisms have sufficient space to fit the strip, but further research is needed.
- Garage doors: feasibility depends on available space within the rolling mechanism.
- Windows: applicable to lower windows where space between frame and opening allows.

The Floud Add-on has multiple advantages and disadvantages:

Advantages

- Easy to install and replace in under 20 minutes, without tools or specialist knowledge
- Suitable for a wide range of door types and sizes due to its flexible and slim design
- Compact and easy to store
- No permanent changes to the door or frame required
- Remains subtly visible on the door frame, acting as a daily reminder of flood protection and reinforcing peace of mind

Disadvantages

- More susceptible to wear and tear due to its exposed placement on the door frame
- Risk of accidental activation through rain or incidental water contact
- May not fit doors with very small gaps between door and frame
- Single-use. Must be fully replaced after each flood to avoid health hazards from contaminated floodwater
- Longer activation time due to the greater swell distance required to seal the gap
- Locks and hinges create weak points in the seal where leakage is more likely

5.4.3. Floud Draft Strip

The Floud Draft Strip is a more permanent and integrated flood protection solution than the Floud Add-on. It is less visible, faster to seal and creates a stronger seal, but requires a more involved installation. Its close resemblance to Alprokon's existing product range makes it a commercially strong concept with clear B2B potential too.

What it is made of
The Floud Draft Strip consists of four components: a 17 mm wide, 4 mm high and 1 mm thick aluminium profile holds the strip together and mounts it to the door frame, providing a rigid, durable structure. A 4 mm thick, 11 mm wide WAEM core sits in the larger slot of the aluminium profile, forming the active flood protection layer, secured in the strip with a 0.1 mm adhesive backing. A 1 mm flexible rubber layer covers the WAEM, protecting it against sunlight, accidental water exposure and everyday impact, while simultaneously functioning as a draught seal, giving the product dual functionality. After activation, only the WAEM core needs to be removed and replaced with a new strip of the same dimensions, leaving the aluminium profile and rubber layer permanently in place.

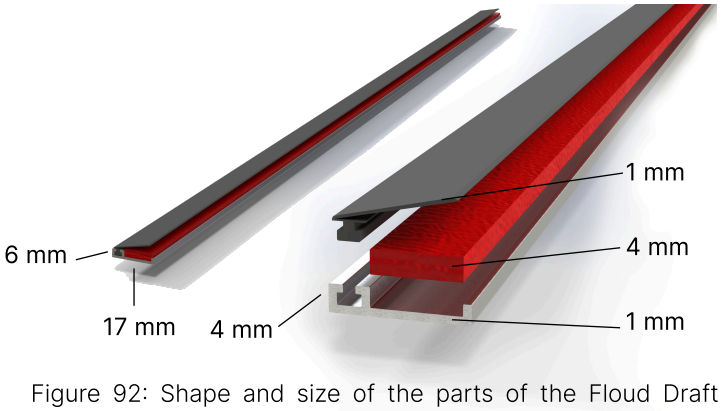


Figure 92: Shape and size of the parts of the Floud Draft Strip

The outer dimensions, 17 mm wide and 6 mm thick, match those of a standard draft strip, allowing it to fit directly where an existing draft strip would sit, without requiring modifications to the door. It is sold in long strips so consumers can cut it to the required door length themselves.

The high-quality materials and protective placement within the aluminium profile are expected to give the Floud Draft Strip a lifespan of at least 10 years without flood activation, potentially longer than the Add-on due to its better-protected position. Further testing is needed to confirm this.

Application
The Floud Draft Strip is installed on the rebate of the door, the same location as a standard draft strip, running along all four sides of the door. Here the WAEM is placed closer to the door than in the Add-on, meaning less swelling is required to seal the gap. This results in faster activation and a more consistent, uniform seal. This placement simultaneously avoids locks and hinges entirely, eliminating the weak points present in the Add-on and ensuring a continuous seal.

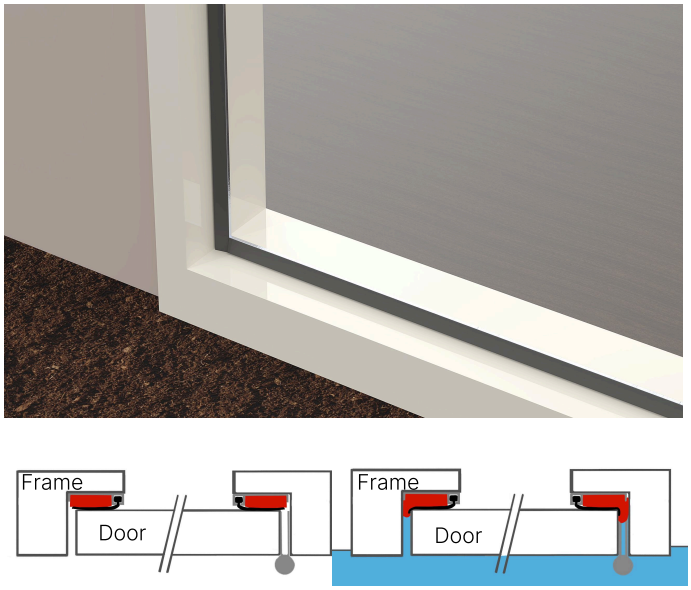


Figure 93 & 94: Placement and form of the Floud Draft Strip in door (upper) and cross section (lower)

As shown in figure 95, installation requires checking compatibility (1), removing the existing draft strip (2), cleaning (3) and measuring (4) the door, cutting the aluminium profile to size with a metal saw (5), nailing it to the frame using small nails (6), repeating this to all sides of the door (7) and inserting the WAEM into the dedicated slot (8). While no specialist knowledge or tools are required, this process is significantly more involved than the Add-on, but similar to applying a normal draft strip. This is a deliberate trade-off: more complex installation delivers better, longer-lasting and more reliable protection.

As with the Add-on, no special corner pieces are needed, it is expected that the swelling capabilities of the WAEM fill corners and small gaps completely, as long as the strips are placed without gaps between them. The Floud Draft Strip is designed to withstand water pressures equivalent to at least 1,5 metre of water height, though further testing is needed to confirm and potentially exceed this figure.

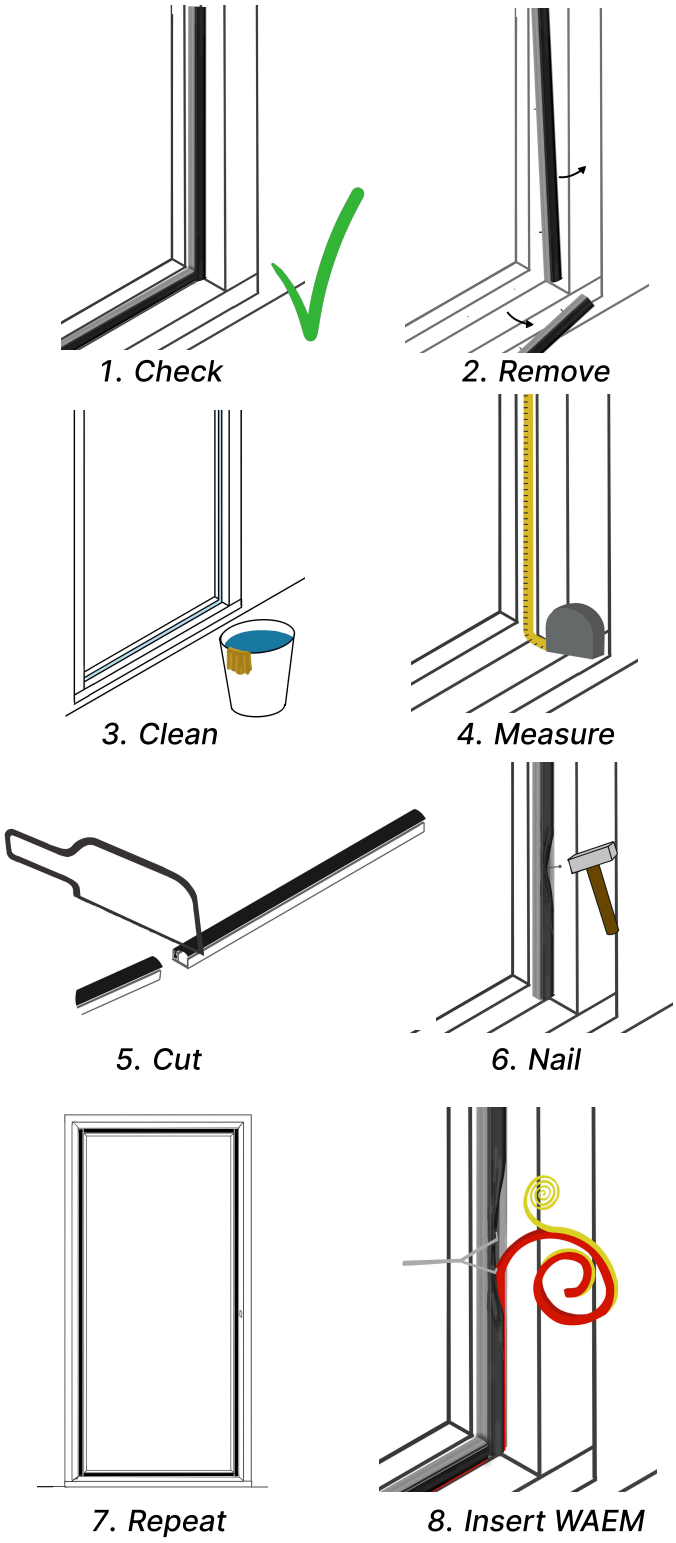


Figure 95: Installing the Floud Draft Strip

One important limitation of the Floud Draft Strip is compatibility: this system requires a specific amount of space between the door and frame. While many doors already accommodate this, not all back doors use this type of draft strip system. The exact proportion of compatible doors is currently unknown and requires further research.

During a flood

Both the aluminium profile and rubber layer are deliberately shortened compared to standard draft strips, allowing water to reach the WAEM faster. this difference can be seen in figure 98. Upon contact with water, the WAEM swells and seals the door within approximately 5 minutes, faster than the Add-on. The pressure generated holds the seal firmly in place while still allowing the door to be opened in case of an emergency. The seal remains active for as long as water is present, from a few hours to several days.

After a flood

Once the flood subsides, the door can be opened normally. The WAEM is removed from the aluminium slot, discarded and replaced with a new strip. The aluminium profile remains in place permanently, meaning only the WAEM insert needs replacing. A special tool is developed to make this replacing easier. This makes post-flood recovery quicker and less costly than replacing the full Add-on strip. It is advised to keep a spare WAEM refill in storage at all times.



Figure 96 & 97: Installing the WAEM in the Floud Draft strip (left) and the packaged refill strip (right).

Fit with Alprokon's current products

The Floud Draft Strip is closely modelled on Alprokon's existing "rebate profile 350" that uses Technofire, a heat-activated expanding material, to delay smoke and fire transmission during a fire. The Floud Draft Strip follows the exact same principle, replacing Technofire with the WAEM and making targeted adjustments to the aluminium and rubber components. This means Alprokon can directly leverage existing manufacturing knowledge, intellectual property and supplier relationships, significantly reducing development time and go-to-market effort.

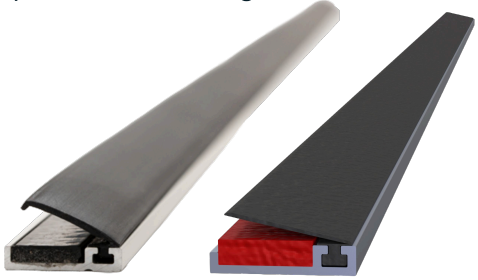


Figure 98: the Alprokon Rebate profile 350 (left) and the Floud Draft strip (right).

B2B market
The permanent but familiar nature of the Floud Draft Strip makes it an ideal fit for door and frame companies offering the Floud Draft Strip for new-build projects. By incorporating the Floud Draft Strip as a standard or optional upgrade, these companies can offer flood-resistant doors for a small additional cost, with minimal extra effort, as installation is nearly identical to a standard draft strip. Alprokon's existing relationships with door companies provide a strong starting position for this channel, creating a scalable and semi-stable revenue stream.

Other applications
Due to its size required placement, the Floud Draft Strip is less versatile than the Floud Add-on. Further research is needed to discover if the Floud Draft Strip fits in these applications:

- Front doors: feasible where a similar draft strip system is already used; others may lack sufficient space.
- Double doors: applicable where the door meets the frame, but unlikely to fit the gap between two doors without further adjustments.
- Windows: compatibility depends on window type and whether a similar draft strip system is present.

A combination between the Floud Draft Strip and Floud add-on could open up possibilities.

The Floud Draft Strip has multiple advantages and disadvantages:
Advantages:

- Faster and more consistent sealing due to closer placement to the door
- Virtually invisible with no impact on the appearance of the door or home
- Dual functionality, flood protection and draught sealing in one product
- Close to Alprokon's existing product range
- Strong B2B market opportunity, supported by Alprokon's existing industry relationships
- Familiar form factor: consumers recognise it as a draft strip, potentially increasing trust and willingness to invest
- Only the WAEM insert needs replacing after a flood, not the full product

Disadvantages:

- More complex and invasive installation
- Not compatible with all back doors due to space requirements
- More difficult to distribute due to the longer lengths required and the rigid bodies
- Less versatile across different door types
- Less visible to the user, reducing the daily reminder effect and potentially diminishing the sense of peace of mind

5.4.4. Prototypes

Due to the unavailability of the final WAEM material, no fully functional prototypes or definitive tests could be conducted. However, first samples were made to visualise the concepts and perform initial tests.

Sealing test
Using a similar setup to the tests in Chapter 5.1, the sealing capability of the current WAEM in a door context was tested, see Appendix 5.5.5. The results confirm that the WAEM effectively seals the door and generates considerable pressure when doing so.

Prototypes
A prototype of the Floud Add-on was created using the current WAEM, with a bicycle tire used to approximate the specific rubber profile, see figure 99. While the dimensions are not fully accurate, the prototype gives a clear and tangible representation of the concept and a first idea how it will behave during a flood.



Figure 99: Prototype of the Floud Add-on with Polybar+ used as WAEM dry (left) and activated (right).

A prototype of the Floud Draft Strip was built using the aluminium profile of Alprokon's existing rebate profile 350, combined with the current WAEM, see Figure 100. Although dimensions are not fully accurate and time constraints prevented it from being built into a door, the prototype makes it tangible, displays its final form and demonstrates that the draft strip functionality remains unchanged. Both prototypes provide a valuable tangible insight into the final product.



Figure 100: Prototype of the Floud Draft strip with Polybar+ Superswell used as WAEM dry (left) and activated (right)



Figure 101: man cleaning its house of flood water that came in despite the sandbags placed (Waterschappen, n.d.)

6. How Floud sells

This chapter examines the business viability of Floud from Alprokons perspective. It covers the cost price, business model, ways to market and supply chain, each of which has been researched and given an initial setup, although much more research is needed to make solid conclusions.

6.1. Cost analysis

To determine an estimated retail price for Floud Add-on and Floud Draft Strip, deeper research is needed into production costs, ways of selling, competitor pricing and the consumer willingness to pay. These factors combined will form the basis for a price point that is both commercially viable and acceptable to the target market.

6.1.1. Production costs

Firstly, a rough estimation of the production cost is made. The cost of the final material is unknown, as it is still under development and will depend on order volumes. Marketing, labour, transport and R&D costs are similarly uncertain at this stage. Therefore the outcome of this calculation is an indication, rather than a guide.

The following assumptions were made:

- Per concept, 10,000 units are produced and sold per year in the first few years
- One unit seals one door. The Add-on contains 3 m of material (sufficient for sides to 1 m and bottom), the draft strip contains 6.2 m of material (sufficient for both sides, bottom and top)
- R&D, transport, storage, labour, and marketing are estimated at €100,000 per year together for the first few years

A more detailed breakdown is provided in Appendix 6.1.1.

Add-on		**Price per unit**
Material cost:	Corst price Polybar	€ 30,00
	Cost rubber	€ 2,66
	Cost glue	€ 0,87
	Total material cost:	**€ 32,66**
Additional cost	Labour, transport, storage, distribution, R&D	€ 10,00
Product cost:		**€ 42,66**

Draft strip		**Price per unit**
Material cost:	Corst price Polybar	€ 62,00
	Cost aluminium	€ 4,35
	Cost rubber	€ 5,50
	Total material cost:	**€ 71,85**
Additional cost	Labour, transport, storage, distribution, R&D	€ 10,00
Product cost:		**€ 81,85**

Table 6: cost price estimation of the Floud Add-on (upper) and Floud Draft Strip (lower)

Based on these assumptions, the material cost per unit Floud Add-on is €32,66, resulting in a production cost price of €42,66. The dominant cost is the WAEM, which is highly speculative. If the price per metre were to drop from €10 to €5, the cost price would decrease significantly.

The material cost for the Floud Draft Strip per unit is €71,85, resulting in a total cost price of €81,85. Here too, the dominant cost is the WAEM. The material cost of the refill WAEM is estimated at approximately €62 per unit.

6.1.2. How to buy Floud

The sales channels through which consumers can purchase Floud will influence customer interaction with the product, sales volume, margins and final pricing.

6.1.2.1. Elkeruimteveilig.nl

Both Floud products are designed to be sold trough Elkreruimteveilig.nl. By selling these products here, more attention is brought to the website, resulting in more sales and revenue. And, likewise, Floud can profit from the consumers already visiting this webshop. Alprokon has complete control of the margins added and final price.

6.1.2.2. Resellers

Selling Floud through resellers, like hardware stores as Hornbach, Praxis and Gamma increases accessibility and visibility for customers, lowering the threshold for purchase. Physical retail also allows customers to see the product in person and obtain it immediately. While this may reduce direct traffic to Elkeruimteveilig.nl, the increased exposure and potential sales increase are likely to outweigh this drawback. Resellers typically apply high margins over their products sold. Meaning that when selling at the same end price, a smaller share of the revenue reaches Alprokon.

6.1.2.3. Special projects

While Floud primarily targets homeowners, it is also relevant for landlords seeking to avoid costly flood repairs, a group often best approached through direct B2B channels rather than online platforms. Additionally, the Floud Draft Strip holds a great potential for integration into new construction projects. As Alprokon already supplies door manufacturers and construction companies, offering Floud alongside their current products available, will increase the number of Floud sales, using direct B2B channels.

6.1.3. Cost of competitors

Pricing is partly determined by the retail prices of competitors. A retail price that is higher than competitors may discourage consumers to purchase, while a retail price that is much lower can reduce margins or raise concerns about product quality. Therefore, analysing similar solutions is essential. How this is done is explained in Appendix 6.1.2.

Retail prices of flood protection products range between €16 for sandbags, up to €6,000 for self-floating barriers, with most solutions priced between €100 and €300 per door. Commonly recommended flood barriers typically range between €500 and €1,000 (Wacht niet op Water, n.d.). Based on this comparison and the unique advantages of the Floud products, such as being always present, easy to use and suitability for outward-opening doors, a retail price between €200 and €400 is considered appropriate. This positions the product between low-cost, labour-intensive and bulky solutions and the more advanced, easy to use and expensive barrier systems.

6.1.4. Payment willingness of consumers

Consumer willingness to pay is an important factor in determining the retail price. Since Floud ultimately sells a feeling of safety and peace of mind, this will vary between individuals and should be carefully considered.

A short test with 3 participants assessed willingness to pay for three flood protection products, including the Floud Add-on, see Appendix 6.1.3. Existing barriers were priced significantly higher than participants expected or were willing to pay, highlighting a gap between market pricing and consumer expectations. For Floud, the average willingness to pay came to approximately €60 per door, influenced by its single-use nature and simple appearance, summarised by one participant as: "It looks like a piece of tape. I'm not paying more than €100 for a piece of tape."

This test provides an initial indication of consumer willingness to pay and highlights how product appearance can influence perceived value. However, the test had limitations: a very limited number of participants was used, participants had limited background information about floods beforehand and the emotional value of feeling safe and protected, a key selling point of Floud, was not sufficiently captured. This may have led to an underestimation of what consumers would ultimately be willing to pay.

6.1.5. Estimated sales price

Combining all findings and including (reseller) margins, the estimated retail price comes to approximately €206.47 (including tax) for the Floud Add-on and €396.15 for the draft strip, see table 7. The majority of this price is driven by margins added by Alprokon and resellers or Elkeruimteveilig.nl. These are estimates based on current market margins.

Price per unit		Add-on	Draft strip
Material cost:	Corst price Polybar	€ 30,00	€ 62,00
	Cost aluminium		€ 4,35
	Cost rubber	€ 2,66	€ 5,50
	Cost glue	€ 0,87	
	Total material cost:	**€ 32,66**	**€ 71,85**
Additional cost	Labour, transport, storage, distribution, R&D	€ 10,00	€ 10,00
Product cost:		**€ 42,66**	**€ 81,85**
Margins	Alprokon (x2)	€ 42,66	€ 81,85
	Margin reseller or Elkeruimteveilig.nl (x2)	€ 85,32	€ 163,70
Final cost price exl. tax		**€ 170,64**	**€ 327,40**
Tax 21%		€ 35,83	€ 68,75
Final cost price incl. tax		**€ 206,47**	**€ 396,15**

Table 7: cost price estimation of the Floud Add-on (left) and Floud Draft Strip (right)

Compared to competitors, these prices are reasonable, particularly given Floud's advantages of always-on protection, compact design and easy installation. The main drawback is its single-use nature, which adds recurring costs each time the product is activated.

Compared to consumer willingness to pay, the price is high. The product's simple appearance limits perceived value. However, effective communication of flood risks and potential damage costs, as well as targeting consumers in high-risk or flood-affected areas, could significantly increase willingness to pay.

Given the many assumptions used in these calculations the actual retail price could be vastly different, therefore the prices should be treated as indicative rather than fixed. Small changes in the cost price of the WAEM or margins can have a significant impact on the final retail price. Design changes could reduce costs further. It is also worth noting that a lower selling price would likely result in higher sales volumes, lowering the fixed costs.

6.2. Ways to market

Creating a complete marketing strategy for Floud falls beyond the scope of this project and should be done by a marketing professional. However, based on the research conducted, some general marketing directions can be outlined.

6.2.1. General marketing opportunities

Flood awareness varies greatly between regions and individuals, requiring tailored marketing approaches. A key focus of the marketing strategy should be on raising general awareness of the increasing flood risks across the Netherlands, as awareness is the primary driver of consumer action. Alongside this, emphasising the potential costs and disruption of flooding, and how Floud can prevent these, provides a strong financial incentive for purchase.

Building consumer trust is equally important. As the working principle of Floud is new and unfamiliar, some consumers may doubt its effectiveness. Trust could be built through try-it-yourself kits, real-life demonstrations, pictures of the Floud products during a real flood and third-party testing or recommendations, like Wacht Niet op Water.

Across all marketing efforts, the unique selling points of Floud should be central: broad compatibility with different door types, automatic activation without any setup required, easy installation, minimal visual impact and significant cost savings compared to flood damage. These are the qualities that set Floud apart from existing solutions and are likely to be decisive in the purchasing process.

6.2.2. Required by insurance

The financial impact of floods can be gigantic. Following the floods in Limburg in July 2021, approximately 25,000 insurance claims were filed, amounting to at least €211 million in damages. Most insurance policies cover damage caused by extreme weather, dyke breaches or overflowing smaller rivers or lakes (Verbond van Verzekeraars, n.d.). Covering these claims can get very expensive for insurance companies, especially with the rising likelihood of these events happening.

In various other safety domains, insurers already incentivize preventive measures. For example, homes with a PKVW certificate, indicating meeting specific security standards and using products such as SKG+++ locks, may receive premium discounts (Pereira, 2025). A similar approach could be applied to flood prevention. If Floud were implemented as a certified protective measure, homeowners could be rewarded with insurance discounts if applied to their homes. This would reduce potential flood-damage claims for insurers, lower insurance costs for homeowners and support wider adoption of both Floud products.

6.2.3. Businesses

In comparison to consumers, many companies are not insured against flood damage, as coverage is often assessed on a case-by-case basis and can require significant time and effort to arrange. Some solutions exist within the insurance sector (Verbond van Verzekeraars, n.d.), but preventing flood damage is generally more effective than relying on compensation afterwards.

This positions businesses as a relevant target group. Commercial buildings often contain assets worth thousands to millions of euros, including materials, products and equipment. Protecting these from water damage can therefore result in substantial cost savings. As such, businesses represent a big and promising focus group and will require a dedicated focus in the marketing and sales activities of Elkeruimteveilig.

6.2.4. International opportunities

Flood risks are increasing globally, not only in the Netherlands (Environmental Defense Fund, 2021). Although building styles and door dimensions vary across regions, especially the Floud Add-on has the potential to be used in a wide range of contexts. Homes with similar building styles as the Netherlands could benefit from both Floud products. This is especially relevant in flood-prone regions of countries such as the United States, Australia, Italy, and Spain.

Offering the Floud Add-on in different sizes and forms could accommodate the sealing of even larger gaps between doors or less precise carpentry. This enables less precisely constructed homes to be made more water-resistant, provided that other parts of the building are also adequately protected against water intrusion.

6.3. Business case

Based on the information about the production and distribution of Floud available now, combined with the envisioned goals of Elkeruimteveilig.nl, a first business case was developed. This is done by filling in the business model canvas by Strategyzer (2024). These insights, mostly based on the research done, complemented with assumptions, outline the key aspects of bringing Floud to market. See Appendix 6.2. for more detail.

Value proposition and target market: The unique selling points of Floud translate into a strong value proposition for a broad target audience. Since flooding can affect anyone, the product targets the mass market, regardless of home ownership status or location. Sales will primarily occur through retail stores and the company website. With advertisements via different social media platforms and information centres. Given its relatively simple installation, Floud is designed as an install-it-yourself product, requiring minimal dedicated customer support, except for larger commercial projects.

Key partnerships include suppliers, distribution companies, and resellers, as well as promotional partners such as “Wacht niet op Water” and “Vereniging Eigen Huis”, who can help raise flood awareness and reach potential customers

Key activities beyond production, packing, and distribution include product development and flood awareness campaigns. Awareness directly drives demand, while continuous improvement is essential to meet evolving consumer needs. Particularly given the increasing effects of climate change.

Costs and revenue are relatively straightforward, with production, wages, distribution, and marketing as the main cost drivers, financed entirely through product sales. Initial investment by Alprokon is anticipated until break-even is reached.

Overall, the business case is not overly complex. Beyond manufacturing and distribution, the main focus should be on raising flood awareness, securing larger projects, and continuing product development.

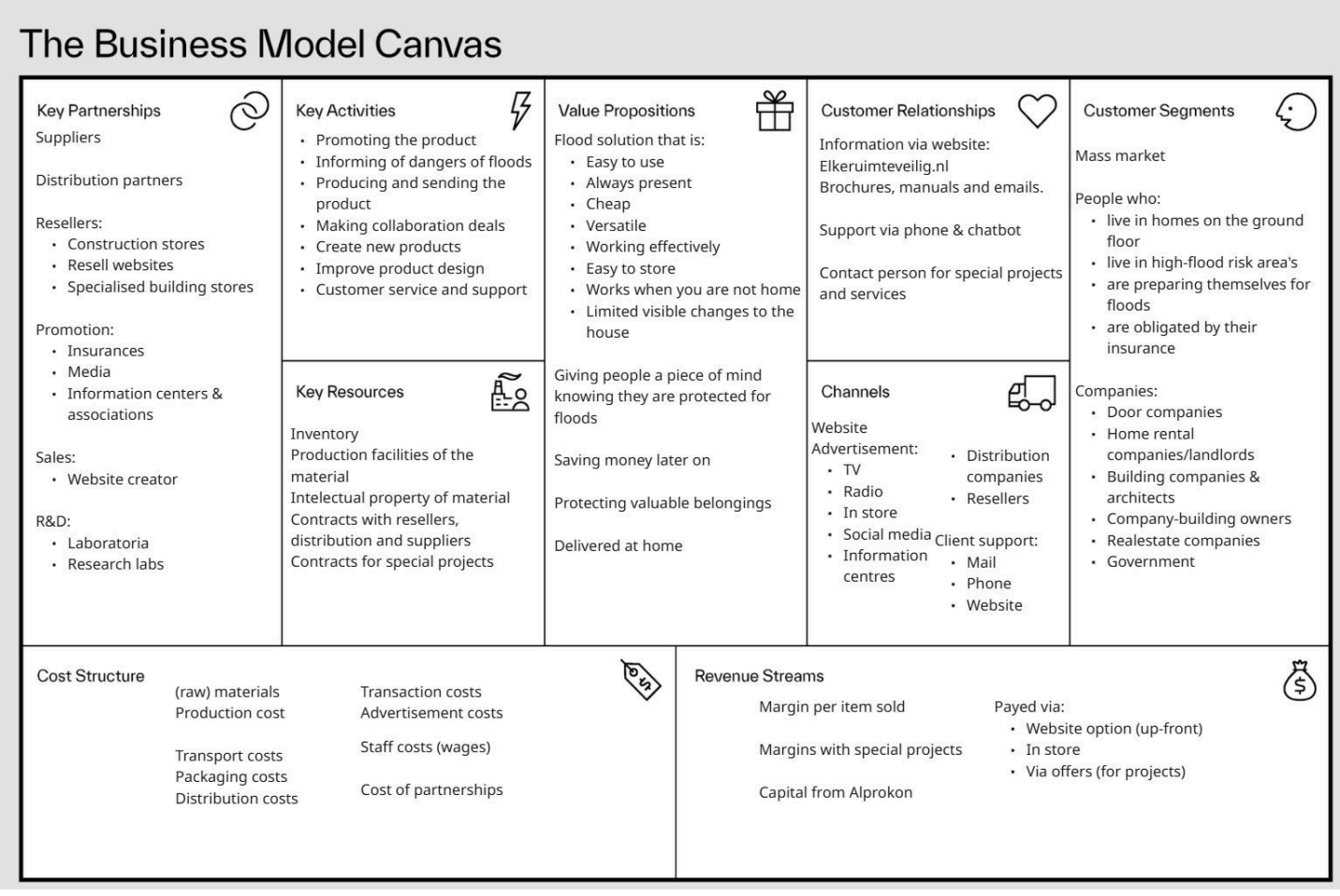


Figure 102: A fist setup for a business model, using the businessmodelcanvas (Strategyzer, 2024).

6.4. Supply chain

Mapping the supply chain of Floud provides insight into the activities required to produce and deliver the product from raw materials to flood protection at the customers door. This overview presents a concise supply chain based on assumptions regarding the envisioned materials and parts sourcing process, production process, distribution system and Alprokon's in-house capabilities, informed by online research and colleague discussions.

Individual components are manufactured by various suppliers, delivered to Alprokon, stored, assembled, packed and prepared for shipment. A relatively simple process that could (partially) be outsourced depending on Alprokon's available space, facilities, and manpower.

Distribution pathways vary depending on the sales model: products may flow through distribution centres to customers or retailers and their distribution centres and stores, or be supplied directly to construction or housing projects. Further research and optimization of the distribution structure falls outside the scope of this project.

6.5. Existing patents

The principle behind Floud is not entirely novel, as both water-activated expanding materials and door-sealing systems have been used in existing products and patented applications. Therefore, a patent review was conducted to identify potential conflicts with existing intellectual property.

One relevant patent is WO2012138205A2 – Sealing Packing Member Using a Water-Expandable Material (Gyeongsang National University GNU, 2013), which describes a water-expandable gasket integrated into a door or window frame. Although the underlying principle is similar to Floud, the patent focuses on a different composition that is applied to the frame differently. Another relevant patent is US9297134B1 – Self-Expanding Barrier for Control of Surface Water Flow (Dancer, 2016), which uses water-absorbing materials to create an automatically expanding flood barrier. This barrier is placed in front of a door rather than integrated into the frame. Both applications differ significantly from Floud.

Several additional patents related to water sealing and SAPs were identified, but none closely matched the working principle and application of Floud. Based on this initial review, no direct conflicts were identified. However, a more comprehensive analysis would be required before commercialization.

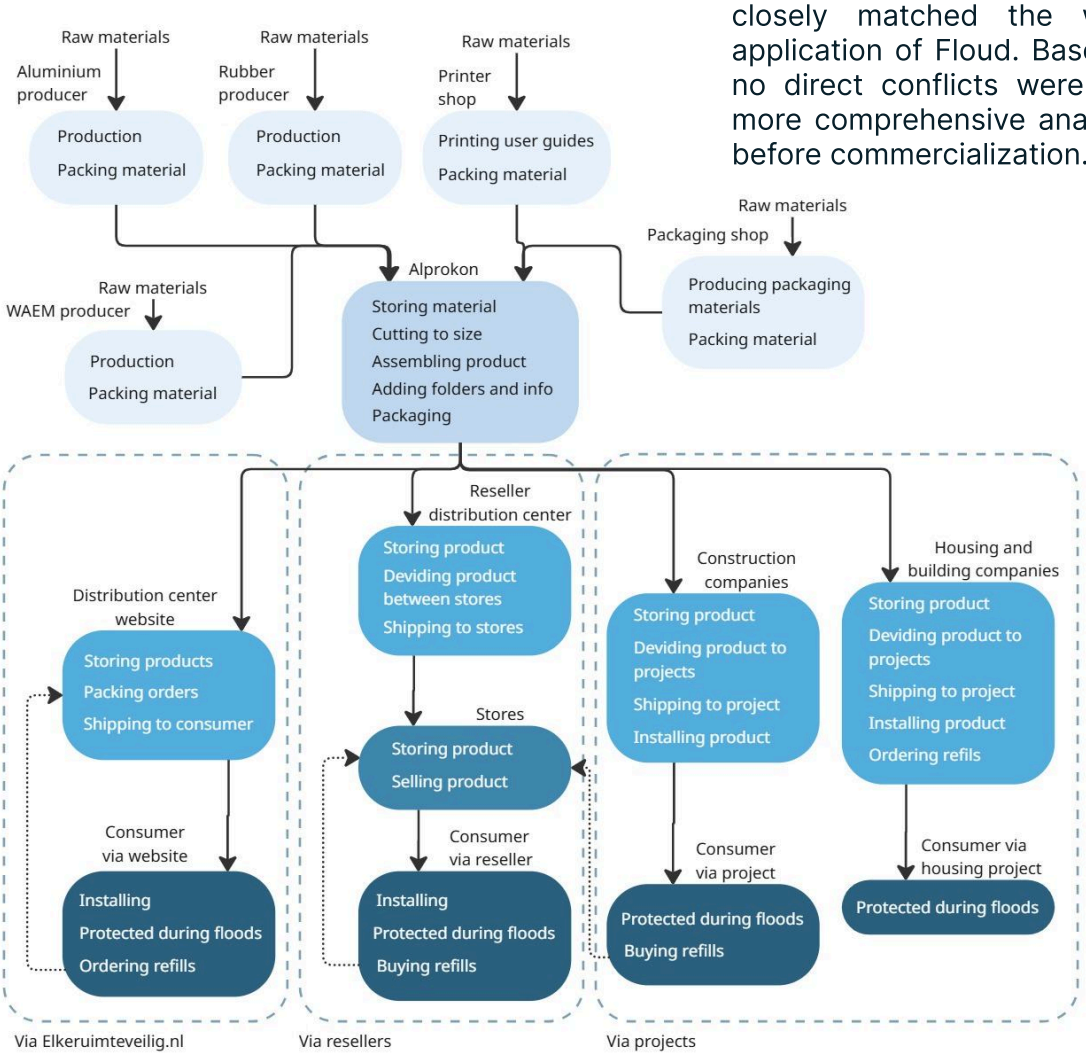


Figure 103: A concise visualization of the envisioned supply chain.



Figure 104: two people in flooded street during the floods of Limburg in 2021(Van Hoorn, 2021)

7. Conclusion

This chapter reflects on the development process of the Floud Add-on and Floud Draft Strip, elaborated in the previous chapters, and outlines prospective directions for both products. It compares the advantages and disadvantages of both concepts, considers their potential relevance, discusses the limitations of the current project and the steps required to advance both concepts towards commercialization.

7.1. The development of Floud

In this report, two strong concepts and their development are explained. Through extensive research, including literature review and interviews with professionals and consumers, flood preparedness was identified as a promising problem scope. It was found that despite rising flood risks across the Netherlands, many consumers remain unprepared for such risks, although preventing water intrusion can save thousands of euros in damage costs. It was also found that no suitable solutions exist for protecting outward-opening doors during floods. A clear market gap was identified: a small and lightweight flood protection product that works automatically, without any setup required from the user, making it effective even when no one is home.

Through multiple ideation cycles, concept development, stakeholder feedback, prototyping and testing, the concept of a water-activated expanding material emerged as the most innovative and fitting solution. Material research led to the discovery of the Polybar+ Superswell by Bekina BeSealed, a material that meets most requirements needed in this product, with the exception of swelling speed. Development of a faster-swelling version has been initiated in collaboration with Bekina.

Two product concepts were developed: the Floud Add-on and the Floud Draft Strip. Both automatically seal outward-opening doors upon contact with floodwater, require no setup when a flood approaches and can be added to existing doors. The Add-on offers easier installation and a lower cost, while the Draft Strip provides faster sealing, better protection and stronger B2B potential. A first business case was established for both concepts, covering cost price, sales channels, business model and supply chain.
All research and development done indicates that both products are desirable by consumers, feasible, for the exception of the WAEM being in development and viable based on the first business case. Table 8 below shows differences in advantages and disadvantages between the two concepts. The complete list can be found in Appendix 7.1.

Table 8: short list of the pros and cons of the Floud Add-on and Floud Draft Strip.

Pro (+) or Con (-)	Pros and cons	Floud Add-on	Floud Draft Strip
+	Fits outward opening doors (back doors)	x	x
+	Fits inward opening doors (front doors)	x	x
+	Always protects the door, even when no-one is home	x	x
+	Fits many other types of doors	x	
+	Visual reminder the door is protected	x	
+	Quick installing	x	
+	Minimally visible		x
+	Close to current product range		x
+	B2B opportunity		x
+	Easy distribution	x	
+	Protected against wear and tear		x
-	Single use product	x	x
-	Unsure about the working abilities due to unfinished WAEM development	x	x
-	Hard to convince people to invest	x	x
-	Risk of accidental activation	x	
-	Might get in the way with additions to the door, like locks, hinges, etc.	x	
-	Might not fit all doors	x	x
-	Less suitable for temporairy living situations		x

7.2. Social relevance

If successfully developed and adopted, Floud could provide social benefits at multiple levels of society.

At the individual level, the product can help prevent floodwater from entering residential homes, potentially saving homeowners thousands of euros in repair and replacement costs. In addition to reducing financial losses, it can increase the feeling of safety and security during extreme weather events and reduce the likelihood of dangerous situations caused by flooding.

At the regional level, widespread use of Floud could improve community resilience to flooding. By reducing damage to homes and businesses, recovery times after floods may be shortened, being able to resume normal-day operations more quickly, limiting economic disruption. Also the need for temporary housing can be reduced in a tight housing market. Furthermore, increased awareness of flood risks and available measures can help communities become better prepared for future flood events.

At the national level, improved household flood protection could contribute to a reduction in overall flood damage costs. This may lower the financial burden on insurers, governments and emergency response organizations and decrease the number of dangerous situations happening. By increasing awareness and encouraging individual preventive action, products such as Floud can complement existing flood protection infrastructure and contribute to a more flood-resilient society.

7.3. Limits

Despite the potential benefits of Floud, the development and effectiveness of the product have several limitations and uncertainties. The concept relies on a material that is still being developed. A material with the required properties, such as sufficient swelling speed, strength, durability and sealing performance, does not currently exist. As a result, no tests have been conducted with fully functional prototypes, and it remains uncertain whether the material can be developed and whether the product will perform as intended.

In addition, no full-scale prototypes have been tested under realistic flood conditions. Consequently, the actual effectiveness of both Floud products in preventing flood damage have not yet been validated. Further research and testing is required to develop the material, evaluate its performance and determine the extent to which the product can reduce damage in real-world situations. The design will need to be adjusted based on these outcomes.

Several assumptions were also made regarding the user interaction, market adoption and demand. The exact number of suitable doors, consumers' willingness to invest in flood protection and the effectiveness of the concept on real doors have not been fully investigated. Also limited user test and focus groups were performed. Incorporating these insights will increase the desirability of the product. Furthermore, aspects such as production methods, supply chains, manufacturing costs and large-scale implementation are briefly addressed but have a significant impact in the ability to continue this project. However, in depth research remains outside the scope of this project and require further development before commercialization.

In conclusion, although Floud shows significant potential, a critical perspective must be maintained regarding both its effectiveness and current stage of development. Further research and development are required to validate the concept, optimize the material and assess real-world performance before the product can be brought to market.

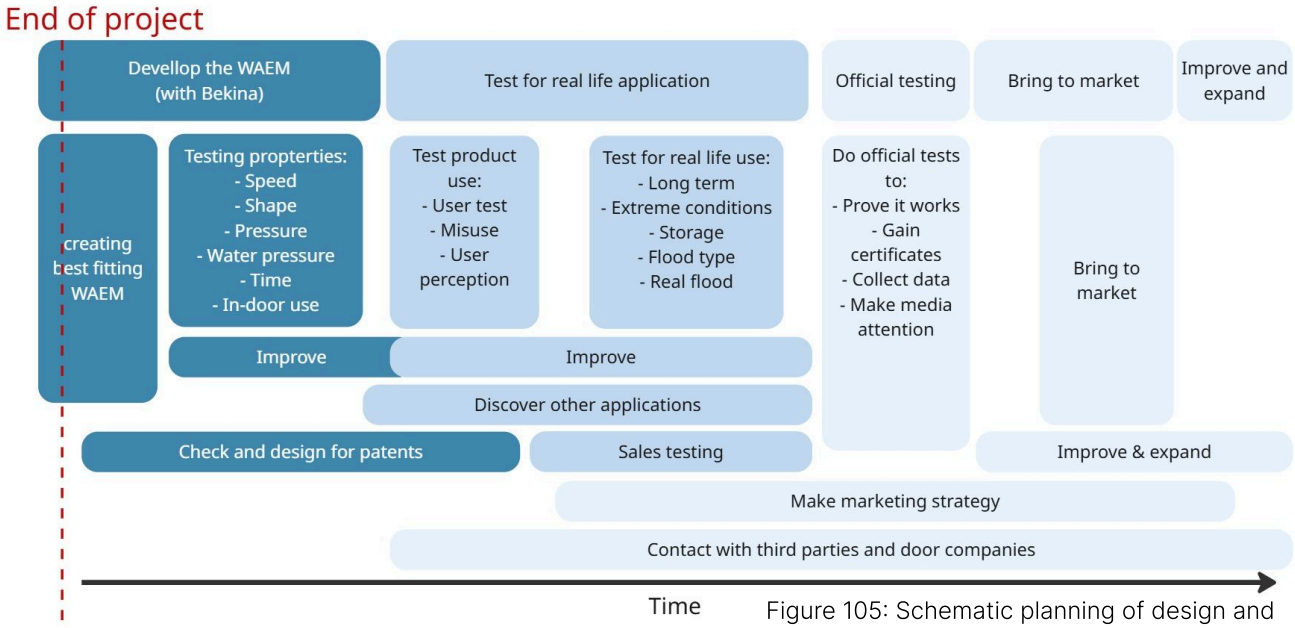


Figure 105: Schematic planning of design and testing steps that need to be taken to bring Floud to market.

7.4. Next steps: Test plans

At the end of this project, two credible product concepts are presented, developed through extensive research and multiple iteration cycles. However, bringing either concept to market will require considerable more testing, decision-making and refinement. The indicative timeline of figure 105 shows the expected steps needed to take these concepts from their current stage to a market-ready product.

This process can be divided into three phases, each consisting of multiple rounds of testing and design improvements. The duration of each phase is hard to estimate, as it depends on material performance, the number of ideation cycles required, available time and resources and other unforeseen factors. The key activities per phase are outlined below, with further detail on the tests and test plans provided in Appendix 7.2. The red line in figure 105 indicates where this graduation project ends.

It should be noted that the phases are presented here as a linear process for clarity. In reality, the process will involve multiple feedback loops, overlapping tests, and revisiting of earlier decisions, rarely following the exact order shown.

Phase 1: Developing the WAEM
The first phase focuses on developing and validating the water-activated expanding material, as the product's performance is entirely dependent and influenced on how well this material works. The material must succeed in the following tests:

1. Speed test: The expansion speed determines whether the material is feasible for flood protection and will influence the product's form and application.
2. Shape test: The current shape of the product is partly based on assumptions made during the development of the concepts, like best shape to seal the gap and increase the speed of swelling. These need to be validated through testing. The outcomes will support the design of the optimal shape for a functional product.
3. Pressure test: The pressure generated by the swollen WAEM determines how well it stays in place between the door and frame and how it behaves during floods, water currents and waves. Testing across different door sizes will reveal whether further ideation is needed.
4. Water pressure test: Floud is designed to withstand approximately 1,5 metre of water. As floods may exceed this and consumers could decide to seal the complete door, the material's resistance to higher water pressures must be tested and improved upon where necessary.
5. Time test: Floods can last hours or even days. The material's ability to maintain a watertight seal over time must be tested, and if insufficient, the material or product design should be adapted accordingly.
6. In-door testing: Even before the material properties are established, the product should be integrated into real back doors to identify practical challenges and refine the design.

Phase 2: Optimising the application
With the WAEM developed and the product(s) designed accordingly, the focus shifts to real-world performance and user experience. The following tests are required:

Product use:

1. User test: Dedicated user tests will reveal pain points during installation and use of the product, which can then be addressed in the design.
2. Misuse test: Consumers will use the product in unintended ways, for example, painting over it, pressure washing nearby surfaces or taking it while moving houses. Testing these scenarios will set the limits of acceptable use or redesigns will adapt the product.
3. User perception test: Beyond functional performance, understanding how users feel about the product, whether they trust it and feel safe, is essential. Insights from this test can inform improvements to the product's appearance, feel and usability.

Product in real-world conditions:

4. Long-term test: The product must be tested after an extended period installed in a door to confirm it remains fully functional when needed after a period of time.
5. Extreme conditions test: The product may be exposed to extreme heat, heavy rain, cold or storms. Testing these extremes will reveal the product's limits and highlight where design adjustments are needed to do so.
6. Storage test: The product's shelf life in storage must be established to inform consumers with purchasing advice, replacement recommendations and for stock management for Alprokon.
7. Flood type test: Different causes of floods influence and vary greatly in speed, severity and water composition. Testing against different flood types will establish which scenarios Floud can protect against and where design adjustments may be needed.
8. Real flood test: Controlled tests cannot fully replicate the unpredictable nature of real floods. Testing in real flood conditions may reveal additional limitations that can then be addressed.

Phase 3: Bringing Floud to market
With the product(s) fully developed, the final phase focuses on market introduction and continued growth. Before launch, official testing will be required to formally demonstrate Flouds flood protection performance. The specific tests and certifications needed will depend on the target market and desired certificates. These tests can also serve as a source of marketing material and media attention.

Once on the market, development does not stop. Continuous improvement to meet evolving consumer needs, as well as exploration of new applications for the product's working principle, will be essential to keep the business growing.

Throughout the project:
The following additional steps should also be considered throughout the project:

1. Patents: As outlined in chapter 6.5., several patents exist for similar products. These must be carefully reviewed to avoid overlap and the possibility of filing a patent for Floud should be explored.
2. Alternative applications: The working principle of Floud has potential beyond the back door. Research and testing are needed to determine what adaptations are required to make it suitable for front doors, double doors, sliding doors and windows.
3. Consumer testing: To support an effective marketing strategy, additional tests can be conducted to understand what consumers value, how the product is best explained and what drives purchase decisions.

7.5. Design recommendations

Beyond the testing and development needed to bring Floud to market, as explained in chapter 7.4., several promising research and design directions are worth exploring for future growth of Floud:

Product line
In this report, two Floud products were created, both with different strong points and consumer focusses. Developing Floud into a complete product line with more automatically sealing flood prevention versions, covering every door type and size, would significantly strengthen its market position. While a single universal size may not be feasible, dedicated versions for different door types would ensure no door is left unprotected. Making Floud the standard for always-ready flood protection.

Flood and fire protection combined
The Floud Draft Strip closely resembles Alprokon's existing rebate profile, which provides fire and smoke protection. Combining both functions into a single product, offering fire, smoke and flood protection, could create significant added value. Particularly for specialised indoor spaces such as labs, kitchens, laundromats and more. Further research is needed to determine the demand for such a product, the optimal dimensions for both materials and how this can be applied. The same could be done with an Alprokon astregal; creating a product for fire and flood safe double doors.

Alternative applications
Besides residential doors, the principle of Floud, automatically sealing when in contact with water, could be adapted for various consumer and commercial applications. For example, it could be used on internal doors of ships to limit water damage when exterior compartments flood. In data centres, a modified version could provide an additional layer of protection against leaks from cooling systems or fire-suppression systems. The technology could also be integrated into household appliances such as washing machines and dishwashers or fuse boxes to contain water leaks and reduce damage to surrounding areas. These examples demonstrate the broader potential of the concept beyond flood protection for homes.

Flood protection as a service
Rather than selling Floud as a standalone product, Alprokon could explore offering flood protection as a subscription service, including installation, maintenance and periodic check-ups. This would transfer responsibility for keeping the door flood-proof from the consumer to Alprokon, building trust and removing any uncertainty about the product's effectiveness. While this represents a significant shift from Alprokon's current business model and would require considerable organisational investment, it could generate a stable recurring revenue stream, foster strong customer loyalty, and position Alprokon as a pioneer in home safety services.

8. Personal reflection

This project has been a roller-coaster, but one I am very proud of. I learned a lot these past months, professionally and personally, about research, ideation, stakeholder management, setting boundaries, corporate life and concept and material development.

The broad scope of the initial research phase was my biggest challenge. I frequently lost overview of the project and struggled to set boundaries. I have learned that working backwards helped me significantly: setting a clear end goal and planning the steps needed to get there. Creating a visual, even if it was just for me, of the envisioned end product helped me identify what still needed to be researched and which decisions had to be made, even though the final product changed considerably.

Reaching out to people was something I consistently struggled with. I often postponed sending interview requests and felt nervous before the interviews, yet everyone I interviewed was genuinely happy to help. This taught me that the fear of reaching out is almost always worse than the reality. The same applied to phone calls which I avoided. However I repeatedly found that a call achieved in minutes what an email could not do in days. I now push myself to reach out earlier and more directly, knowing it is more effective. This would have helped me in involving my stakeholders earlier and more consistently throughout the project. Keeping short lines would have led to more and quicker feedback to ideate and base choices on.

I also learned to navigate professional relationships more confidently. Where in previous meetings with businesses I felt inferior or more like a student-interview rather than a meeting, I learned to position myself as an equal, asking the right questions and not revealing everything at once, leading to far more productive and interesting conversations.

I experienced material research as one of the most challenging parts of the project. This was due to limited but complex available information online about the working and contents of Water activated expanding materials, my limited chemical knowledge and the fact that the envisioned material did not exist yet. Therefore I found selecting the best concept hard and I had to partly based this on assumptions and small-scale tests. Learning to make educated choices and trust my own judgement, rather than waiting for certainty, was one of the most important lessons of this project. Something I still strugle with, but are improving.

Over all, this project has strengthened my analytical thinking, my ability to make structured and educated decisions and my confidence in myself and knowledge after my studies at TU Delft. I am proud of the result and pleased with how well it fits within Alprokon's business and with the enthusiasm they have shown for it. Overall a great way to finalise my studies at the TU Delft.

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Appendix

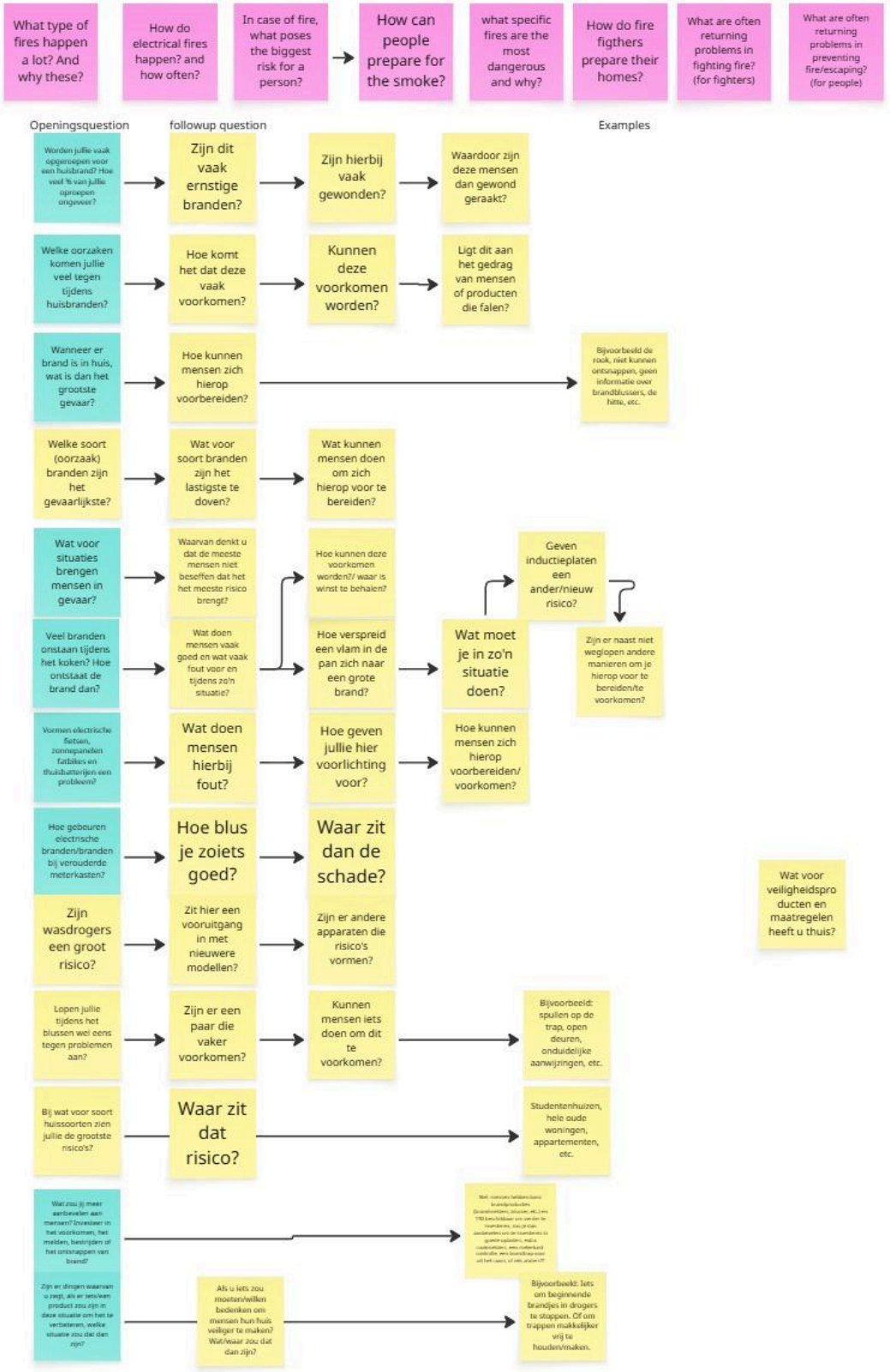
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Appendix 1: Chapter 1

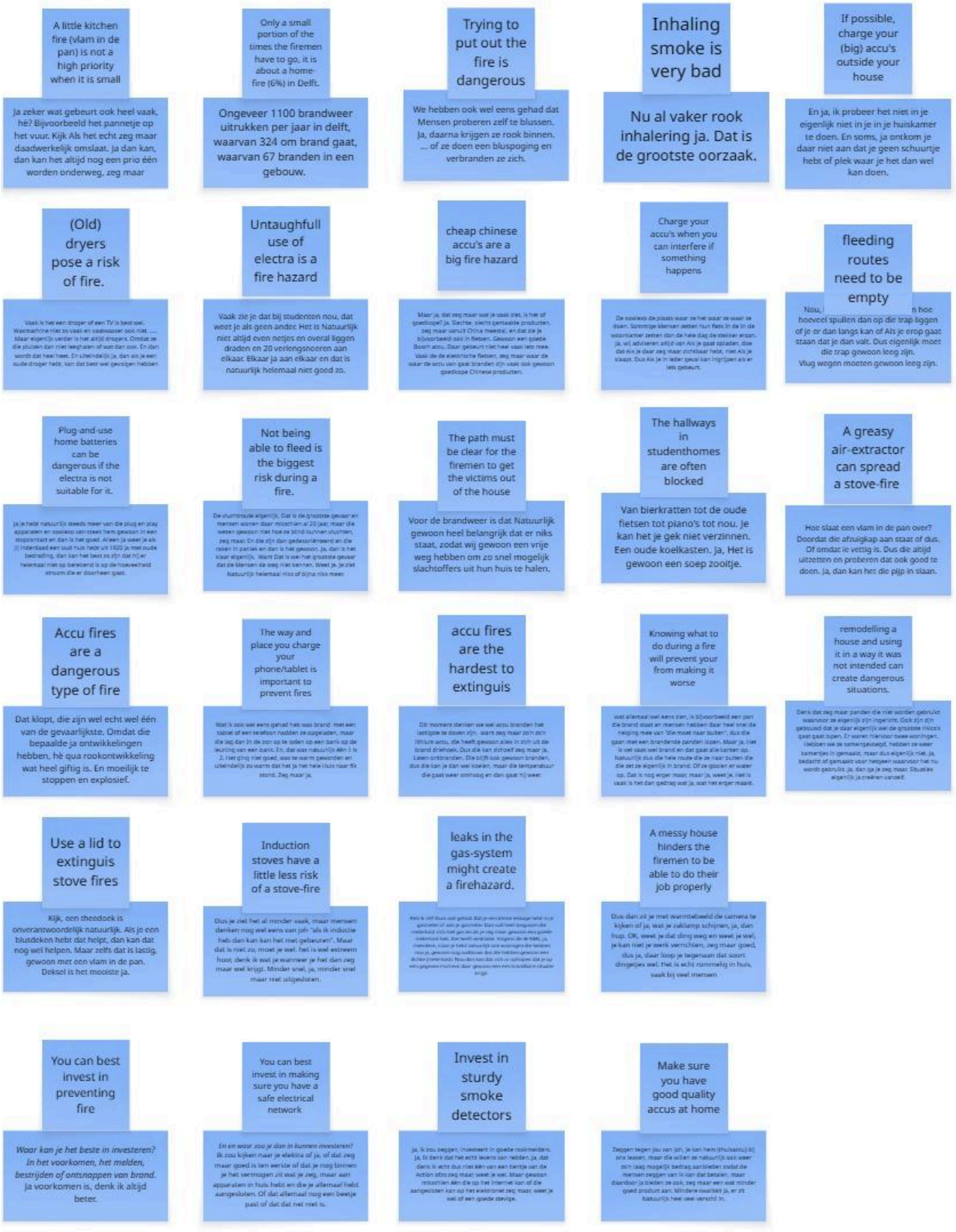
1.1. Interviews

1.1.1. Firefighters

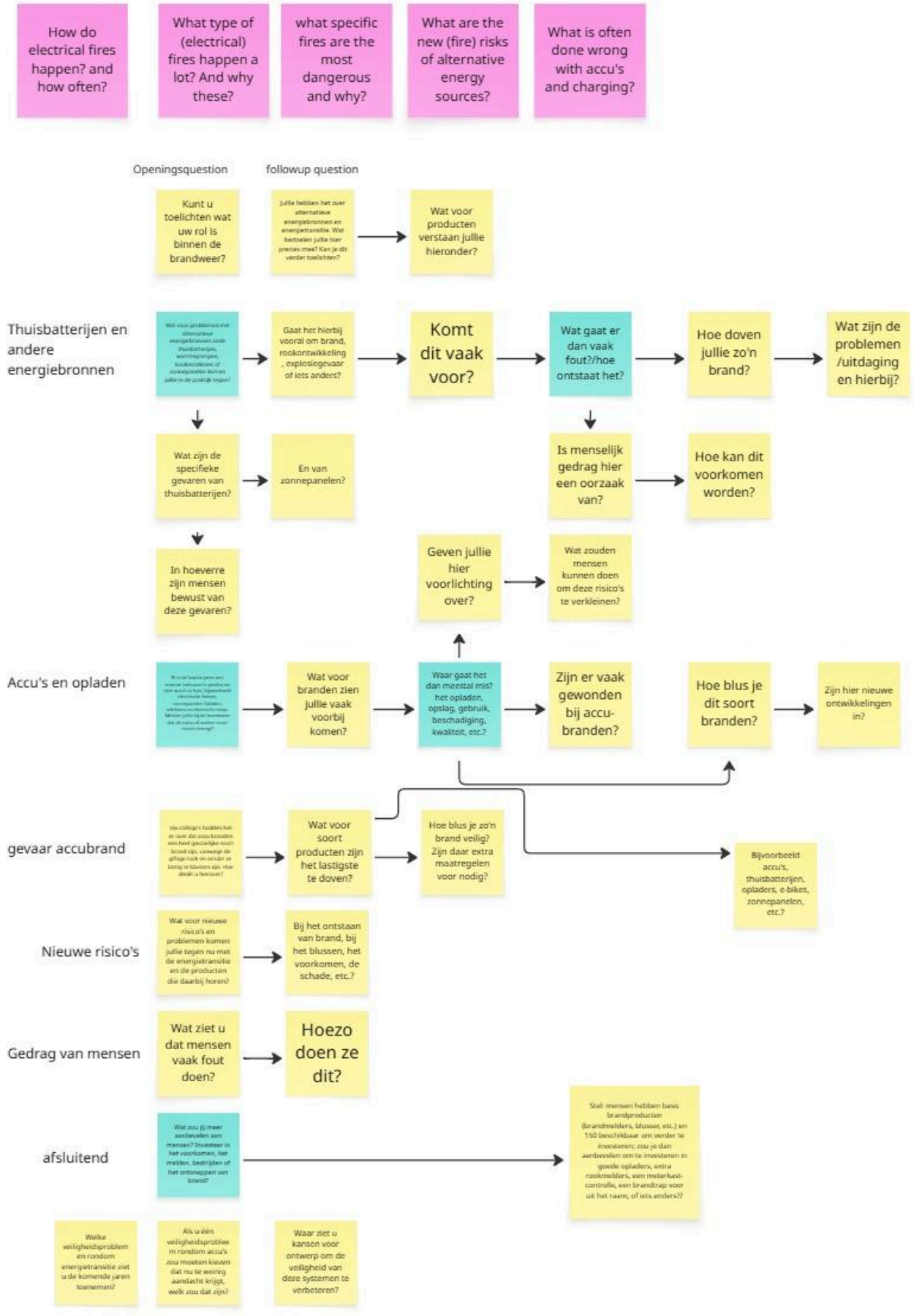
Interview questions firefighters interview 1



Interviewfindings (statementcards) firefighters interview 1



Interview questions firefighters interview 2


How do electrical fires happen? and how often?
What type of (electrical) fires happen a lot? And why these?
what specific fires are the most dangerous and why?
What are the new (fire) risks of alternative energy sources?
What is often done wrong with accu's and charging?
Openingsquestion
followup question
Kunt u toelichten wat uw rol is binnen de brandweer?
Jullie hebben het over alternatieve energiebronnen en energietransitie. Wat bedoelen jullie hier precies mee? Kan je dit verder toelichten?
Wat voor producten verstaan jullie hieronder?
Thuisbatterijen en andere energiebronnen
Gaat het hierbij vooral om brand, rookontwikkeling, explosiegevaar of iets anders?
Komt dit vaak voor?
Wat gaat er dan vaak fout?/hoe ontstaat het?
Hoe doven jullie zo'n brand?
Wat zijn de problemen /uitdaging en hierbij?
Wat zijn de specifieke gevaren van thuisbatterijen?
En van zonnepanelen?
Is menselijk gedrag hier een oorzaak van?
Hoe kan dit voorkomen worden?
In hoeverre zijn mensen bewust van deze gevaren?
Geven jullie hier voorlichting over?
Wat zouden mensen kunnen doen om deze risico's te verkleinen?
Accu's en opladen
Wat voor branden zien jullie vaak voorbij komen?
Waar gaat het dan meestal mis? het opladen, opslag, gebruik, beschadiging, kwaliteit, etc.?
Zijn er vaak gewonden bij accu-branden?
Hoe blus je dit soort branden?
Zijn hier nieuwe ontwikkelingen in?
gevaar accubrand
Wat voor soort producten zijn het lastigste te doven?
Hoe blus je zo'n brand veilig? Zijn daar extra maatregelen voor nodig?
Bijvoorbeeld accu's, thuisbatterijen, opladers, e-bikes, zonnepanelen, etc.?
Nieuwe risico's
Wat voor nieuwe risico's en problemen komen jullie tegen nu met de energietransitie en de producten die daarbij horen?
Bij het ontstaan van brand, bij het blussen, het voorkomen, de schade, etc.?
Gedrag van mensen
Wat ziet u dat mensen vaak fout doen?
Hoezo doen ze dit?
afsluitend
Wat zou jij meer aanbevelen aan mensen? Investeer in het voorkomen, het melden, bestrijden of het ontsnappen van brand?
Stel: mensen hebben basic brandproducten (brandmelders, blusser, etc.) en 150 beschikbaar om verder te investeren; zou je dan aanbevelen om te investeren in goede opladers, extra rookmelders, een motorkast-controlle, een brandkrag voor uit het raam, of iets anders??
Welke veiligheidsproblemen rondom energietransitie ziet u de komende jaren toenemen?
Als u één veiligheidsprobleem rondom accu's zou moeten kiezen dat nu te weinig aandacht krijgt, welk zou dat zijn?
Waar ziet u kansen voor ontwerp om de veiligheid van deze systemen te verbeteren?

Interviewfindings (statementcards) firefighters interview 2



1.1.2. Doctor first aid

Interview questions doctor first aid

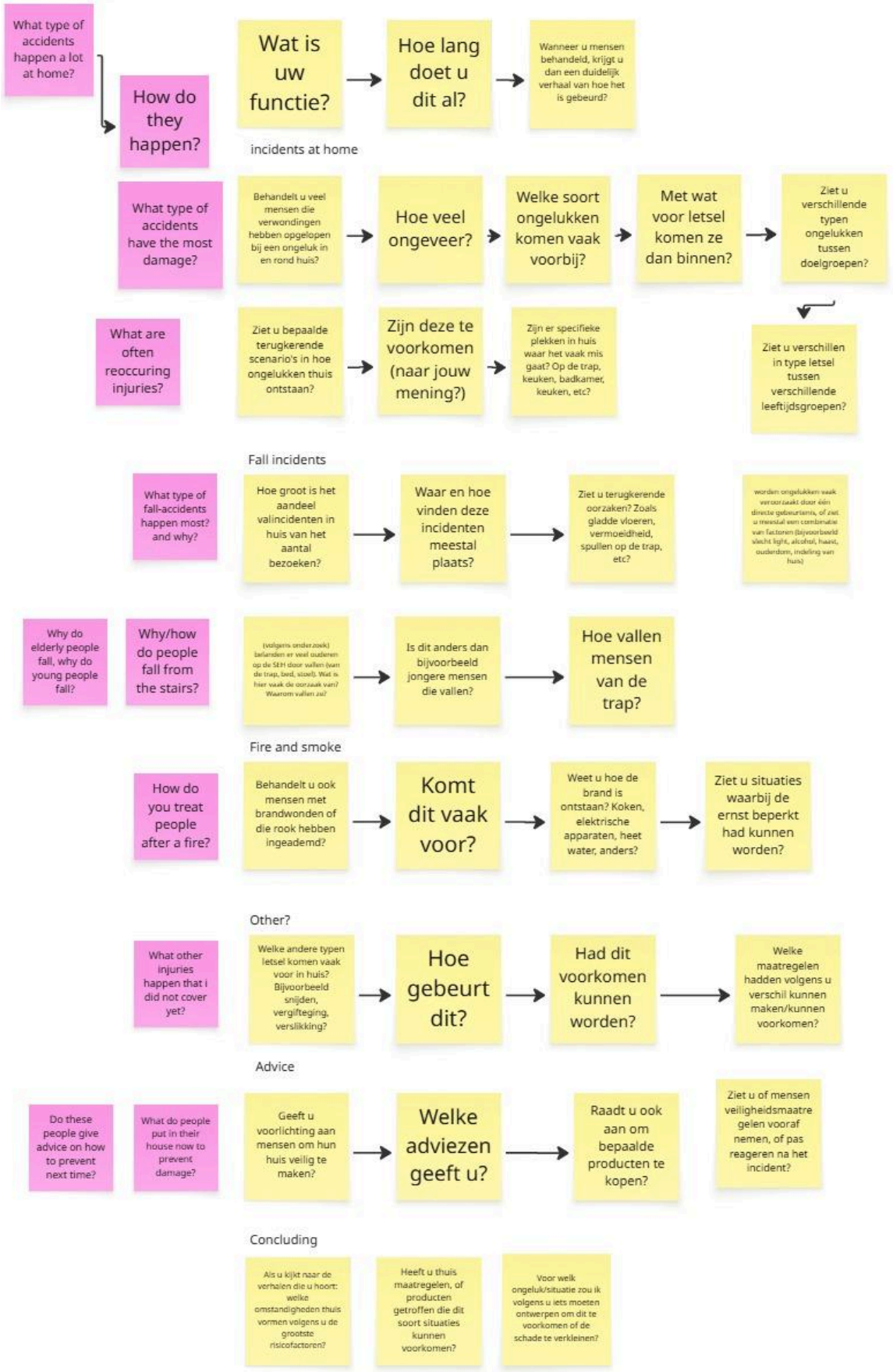


Figure #: Visual overview of interview questions asked

Interviewfindings (statementcards) doctor



1.1.3. Construction specialist VEH

Interview questions construction specialist VEH

Vereniging Eigen Huis en veiligheid (organisatieperspectief)

1. Vereniging Eigen Huis biedt veel verschillende diensten en producten aan. Welke daarvan worden het meest gebruikt, en wat zegt dat volgens u over waar huiseigenaren zich zorgen over maken op het gebied van veiligheid?
2. Jullie bieden ook verzekeringen aan. Welke soorten schades komen daarin het vaakst terug? In hoeverre zijn dit situaties die volgens u te voorkomen waren met andere keuzes, onderhoud of maatregelen?
3. Zijn er specifieke producten of diensten waarvan u merkt dat leden er bijzonder veel baat bij hebben als het gaat om veiligheid in en rondom de woning?

Bouwkundige veiligheid en keuringen

1. Waar wordt tijdens een bouwtechnische keuring vooral op gelet vanuit veiligheidsperspectief? Welke gebreken of risico's komen jullie het vaakst tegen bij woningen?
2. In hoeverre maken brandveiligheid, elektrische installaties en de meterkast standaard onderdeel uit van zo'n keuring? Ziet u daar vaak problemen?

6. Welke veiligheidsproblemen ziet u vooral bij oudere woningen vs. nieuwbouw?

Verbouwen, verduurzamen en nieuwe risico's

1. Door de groei van zonnepanelen, warmtepompen en thuisaccu's worden veel bestaande woningen aangepast. Ziet u dat woningen hier altijd geschikt voor zijn, of ontstaan er nieuwe veiligheidsrisico's?
2. In hoeverre geeft Vereniging Eigen Huis advies over veiligheid bij verduurzaming, bijvoorbeeld rond elektra, isolatiematerialen of bereikbaarheid voor hulpdiensten? Merkt u dat dit onderwerp voldoende aandacht krijgt bij consumenten?
3. Welke veiligheidsrisico's worden bij verbouwingen of renovaties door bewoners of aannemers volgens u het vaakst onderschat of vergeten? Ziet u verschillen tussen wat bewoners dénken dat veilig is en wat dat bouwkundig gezien echt is?

Preventie, advies en doelgroepen

1. Vereniging Eigen Huis biedt onder andere veiligheidschecklists en adviezen. In hoeverre wordt er ook maatwerkadvies gegeven om woningen veiliger te maken? Verschilt dit bijvoorbeeld voor ouderen of gezinnen?
2. Valincidenten, met name op trappen, vormen een groot deel van de ongelukken in huis. Ziet u hierin een rol voor Vereniging Eigen Huis, bijvoorbeeld in voorlichting, bouwkundig advies of productkeuze?

Reflectie en kansen (voor ontwerp)

1. Zijn er veiligheidsgerelateerde producten of diensten die u vanuit Vereniging Eigen Huis graag zou willen aanbieden, maar die nu ontbreken of lastig realiseerbaar zijn?
2. Tot slot (optioneel): als u kijkt naar veiligheid in woningen, waar ziet u persoonlijk de grootste blinde vlek of gemiste kans?

Interviewfindings (statementcards) construction specialists VEH

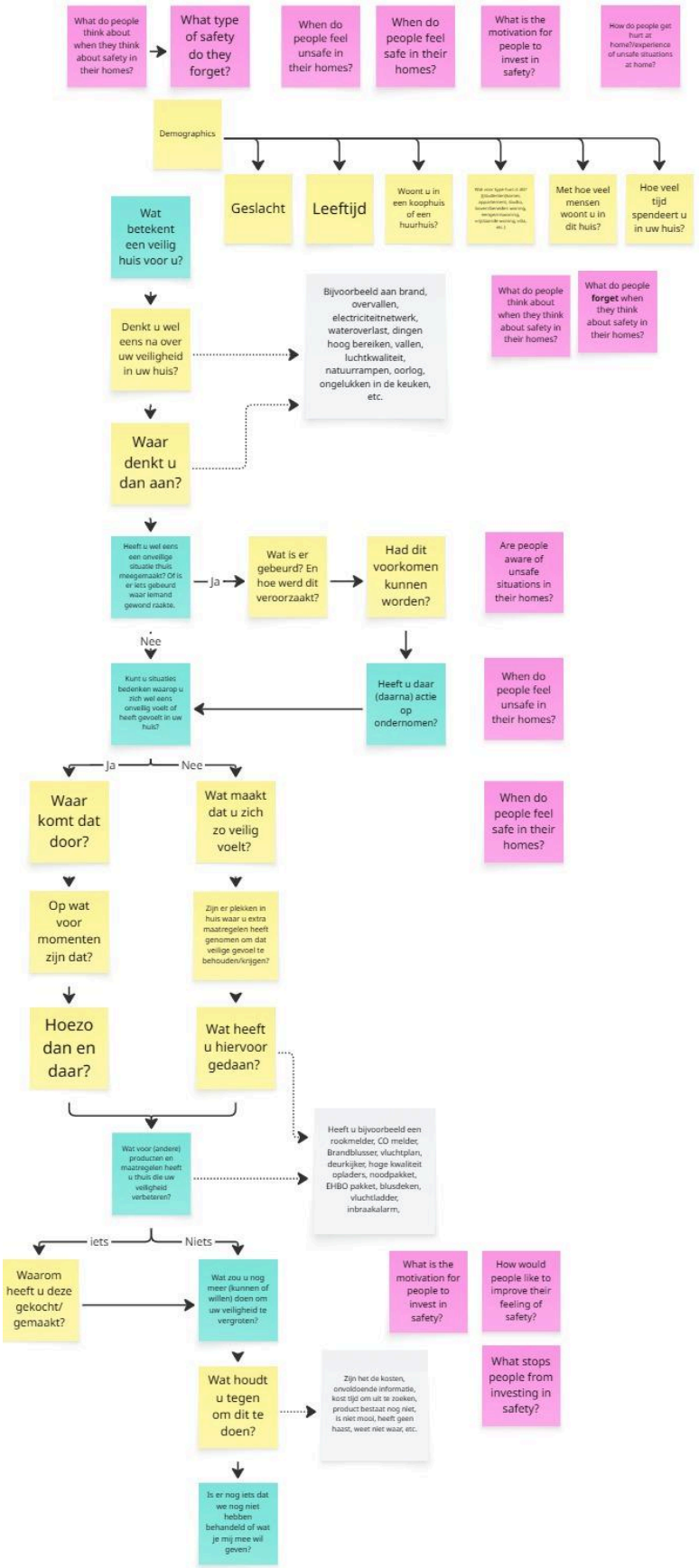

People want to know what costs they can expect in the upcomming years
People want a professional second opinion to judge the construction of the house they buy
People want professional opinions and backup during conflicts with a contractor
There are websites (like watermerconl) that inform people what the damage to your house might be during floods
Bigger constructive problems can impact the safety of its inhabitants
Even though people know its dangerous, they still do dangerous actions
Unskilled people work as constructor and create unsafe solutions
Some constructors want to earn money over the knowledgeless of people
Constructors try to get away with unsafe situations
Betonrot is ook wel een probleem. Dat er haarscheurtjes ontstaan en het instort.
To predict leaks or fires, you should look out for signals
There are certain things you can do to prevent fire in the meterkast
Houses from different ages have different safety issues
hire hazardus building materials can injure you when on fire
Specific constructions in the house need to be safe to be able to fleed.
En vooral het plafond tussen de woonkamer en de slaapkamer, die is bijvoorbeeld cruciaal. Nee, want er staat brand ontstaat. We hebben hier niet op gelijk. Al boven is. je moet wel Natuurlijk veilig kunnen kunnen vluchten.
Smoke detectors need to be tested
Maintainance of gas pipes is needed to protect safety
People can have good safety equipment, but still get robed if not used correctly
Keeping your escape route clear is important
Plug in home batteries don't work with fuses and create a fire hazard.
People are scared of asbest
En waar mensen echt paniekerig geworden is asbest
Experts disconnect the chargers when leaving to minimise fire risks.
Op werk heb ik ook zo'n zo'n draadloze (telefoon oplader). Maar als ik naar huis ga, trek ik toch even de stekker eruit voor de zekerheid. Weet je wel. Dus dat hij niet aan blijft staan
Insulation on the outside of the house pose a high risk if its not fire-safe
Even though people see something is wrong with the construction of the house, people ignore it and keep living there
Soms kunnen ze hand insteken en twee weken later even het geregend. Gaat het pand hier omhoog en dan wordt gaat de schuur weer dicht en denkt, hé, Het is weer good, dus ja, Ik vind het toch wel een dingetje. Ik weet niet of ik lekker zal slapen, zeg maar dus.
dus die kopen gewoon een tekening over je. Zet er een ander adres onder, wordt er ingediend en klaar is allemaal niet berekend voor hun woning. (over bouwtekeningen voor aan- of verbouwingen)
The amount of burgleries goes down
Sinds de metingen van de inbraken het laagste jaar vorig jaar ooit was. Hè dus 800 minder, dus daar gaat de hele goede kant op,
The cybercriminality is growing
People need someone trustable to advise in big spendings
(small) checks by professionals get costly quickly
People think "that does not happen to me"
Dat omdat mensen vaak wel denken dat dat mij niks gebeurt, hè? En dat ze een blinde vlek en dat gebeurt hier ook hoor,
The need for professional opinion and confirmation of quality of house bouwtechnische keuring
the construction of houses need to be strong
The extraction of CO needs to work properly

1.1.4. Overview of findings from interviews with professionals

Question	Fireman 1	Fireman 2	Fireman 3 - Energy specialist	First Aid doctor	Construction specialist
What is the biggest problem in terms of people's safety at home?	Non smoke alarm, or smokealarms that do not work	Unsafe charging of devices. Using old or cheap chargers, but also leaving them on the sofa in the sun while charging.	Incorrect charging of devices. Using incorrect or low-quality chargers.	Falling, especially elderly and intoxicated individuals	The structural safety of the house; of old houses but also after renovation by a contractor
What makes your work difficult to do?		Crammed and cluttered houses with blocked hallways. It is difficult to escape and difficult to get people out of the house.	Lithium-ion batteries have everything the fire triangle needs. This makes extinguishing them extremely difficult, especially larger devices with batteries. These must be completely submerged in water.	When people don't know the whole story of how an accident could have happened. And when people don't listen to our advice on how to live more safely.	High costs for providing people with tailored advice. People are often unwilling to pay for this.
Where are the major hazards when it comes to fire?	The electrical system in your home. If it cannot handle the appliances or is old, this can pose a hazard.	The toxicity of battery fires and their potential to explode.	Batteries are often safe. Once they are damaged, they become dangerous. It is therefore a question of how (home) batteries are used.		Plug-and-play home batteries, canvas electrical wiring, safe charging and fire-resistant building materials.
Where are the greatest dangers when it comes to falling?		The clutter in the hallways and on the stairs.		Stairs, rugs and the unsafe use of ladders and step ladders. It is also important to lift your feet properly when walking, especially for elderly.	
Where else are there major dangers?	People who renovate their homes and use them in ways that were not intended. For example, creating extra rooms that make escaping difficult.	Battery fires are difficult to extinguish. Charge large batteries in a safe environment. Preferably outside the house where you can keep an eye on them.	People often know how to charge (or do anything else) safely, but still do it wrong	The consequences of falling due to fainting. People and hobbyists who rush to do something and therefore do not act safely. Not using walking aids.	Hiring unskilled contractors, neglecting home maintenance, not using anti-burglary systems properly.
What are some things people don't think about when it comes to safety?	A stove fire is not dangerous, but it becomes dangerous when people extinguish it incorrectly or, for example, start walking around with it. Or if the fire spreads to a greasy extractor hood or kitchen cabinets. Even with an induction hob, there is a risk of flames in the pan.	Extinguishing fires yourself is not advisable or safe. It is harmful to inhale smoke. It can even be toxic. Escape, go outside as quickly as possible and call 112.	When installing a home battery, do so in a place where it will not be in the way if, for example, you need to evacuate. Also add extra safety measures to that space, such as a fire extinguisher and fire-retardant material.	The layout of your home is important. Can you walk around with walking aids? Is there somewhere you can lean on while walking if necessary? Are there any trip hazards, such as rugs or uneven tiles? What could you bump into if you faint? But also, how can you prevent fainting by adjusting your behaviour slightly? And how you behave at home when you are drunk can also be dangerous.	Small cracks in the walls of a house can have major consequences. A large group of contractors are not performing their tasks properly, resulting in extremely unsafe houses. Houses built in different years have different common problems. The number of burglaries is falling, but cybercrime is on the rise.
What could people invest in to have a safe home?	Invest in fire prevention: a good electrical network, appliances and safe charging.	Good quality appliyances, smoke alarms and chargers	High quality chargers and protecting your (home) batteries and accu's	Use sufficient walking aids and take out all those little rugs!	Choose a good and reliable contractor. Carry out maintenance on time. Keep a good overview of all the maintenance you will need to do soon and all the costs you can expect.

1.1.5. Consumers

Interview questions for consumers



Interviewfindings (statementcards) consumers



1.1.6. Overview of findings from consumer interviews

What is a safe house for you:	How often named
Firesafe	5
Buglary safe	3
Ability to escape	2
Not getting injured	1
No need to worry	1
Air quality	1

Experienced an unsafe situation	How often named
Water leackage	2
Buglary	2
Gass leackage	1
Fire in the flat	1

Measurements taken	How often named
Lock the door every night	4
Keep walkways clear of clutter and shoes	2
Don't charge when I'm not around	3
Clean dirty places and appliances	1
Replace cables when broken	1
Do not use dryer when not home or aslee	1
Closing windows when not home	1
Replaced old appliances	1

Why invested in these products?	How often named
Gives a feeling of safety	2
Gives a feeling of controll	1
Is alreay present in the house	1
Gives an overview of what happens at home	1
Feels bad when something happens and I did not prepare/could have been avoided	1
It is obligatory	1
It has happened to me before and I do not want it to happen again	1

Why invested in these products?	How often named
Gives a feeling of safety	2
Gives a feeling of controll	1
Is alreay present in the house	1
Gives an overview of what happens at home	1
Feels bad when something happens and I did not prepare/could have been avoided	1
It is obligatory	1
It has happened to me before and I do not want it to happen again	1

Why no extra safety products?	v often named
It is a big hussle to improve/install	3
Never experienced an unsafe situation	2
Don't want to feel it is needed	2
It takes time and effort to research and do	2
Do not know where I can store them	2
Afraid of cybercriminality	2
there is not a lot of valuables to damage or take	2
Not aware of the available products	1
I do not feel the need	1
It will probably not happen to me	1
Don't think it will work	1
Feels like i'm fit enough to climb if needed	1
House is too small	1
Do not feellike i'm in controll of that	1

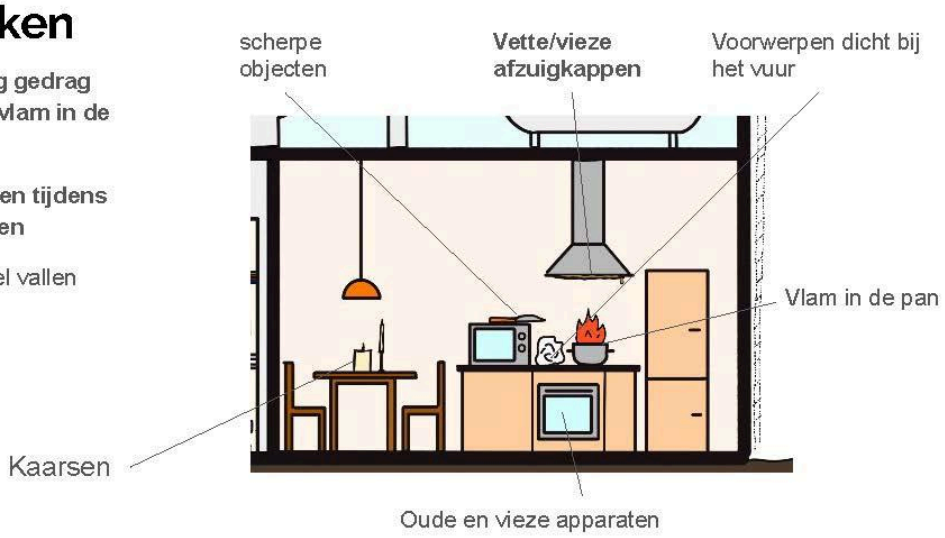
1.2. Dangerous situations in and around the house per room

Keuken

Onveilig gedrag tijdens vlam in de pan

Weglopen tijdens het koken

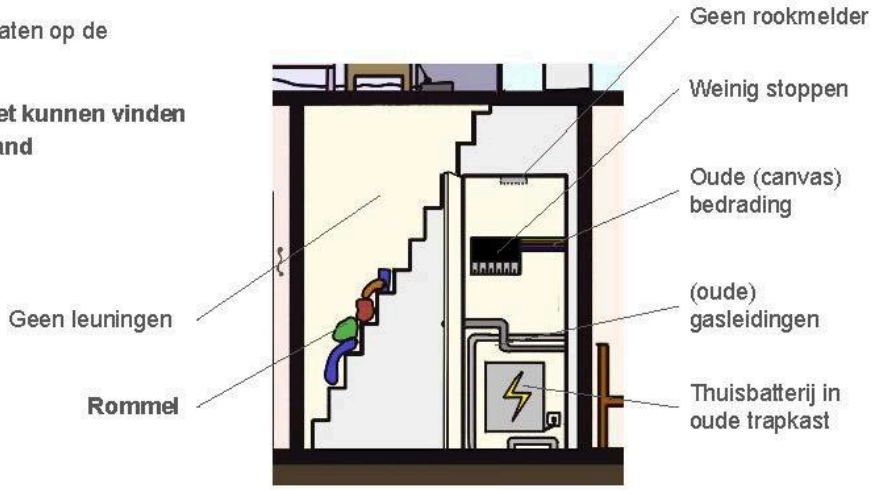
Van stoel vallen



Trap en meterkast

Veel apparaten op de stoppen

De weg niet kunnen vinden tijdens brand



Voordeur

Vergeten op slot te doen

Niet te zien vanuit de straat



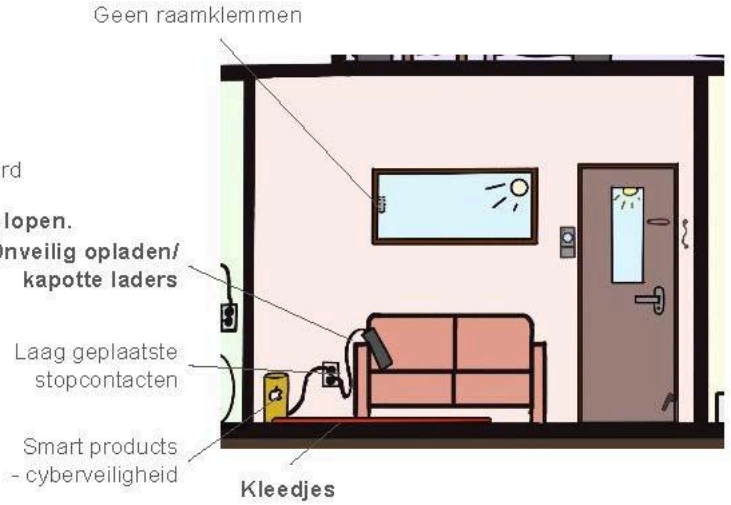
Woonkamer

Plug-in thuisbatterij

Kinderen spelen met vuur

Slecht onderhouden openhaard

Krap om met een rollator te lopen.



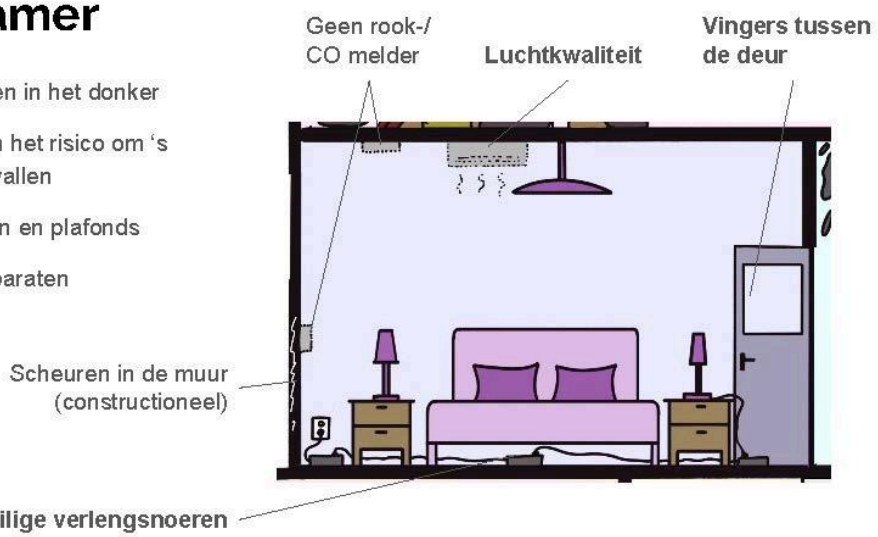
Slaapkamer

kans op struikelen in het donker

Ouderen hebben het risico om 's nachts flauw te vallen

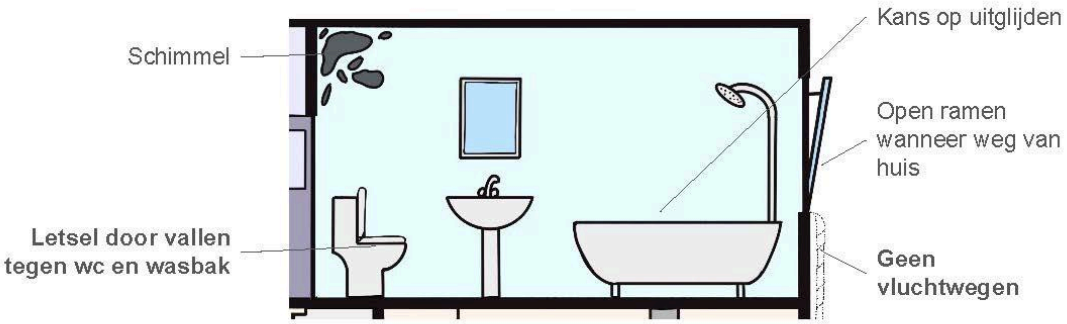
Vlambare vloeren en plafonds

Verwarmingsapparaten

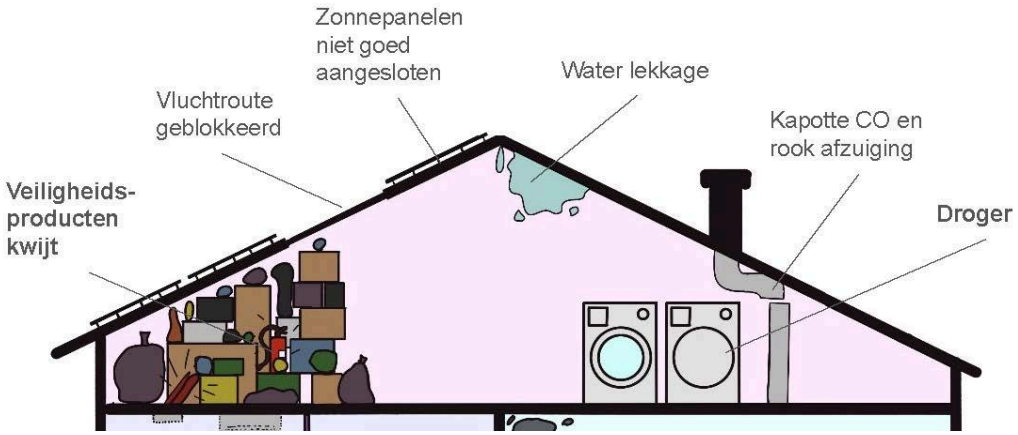


Badkamer/toilet

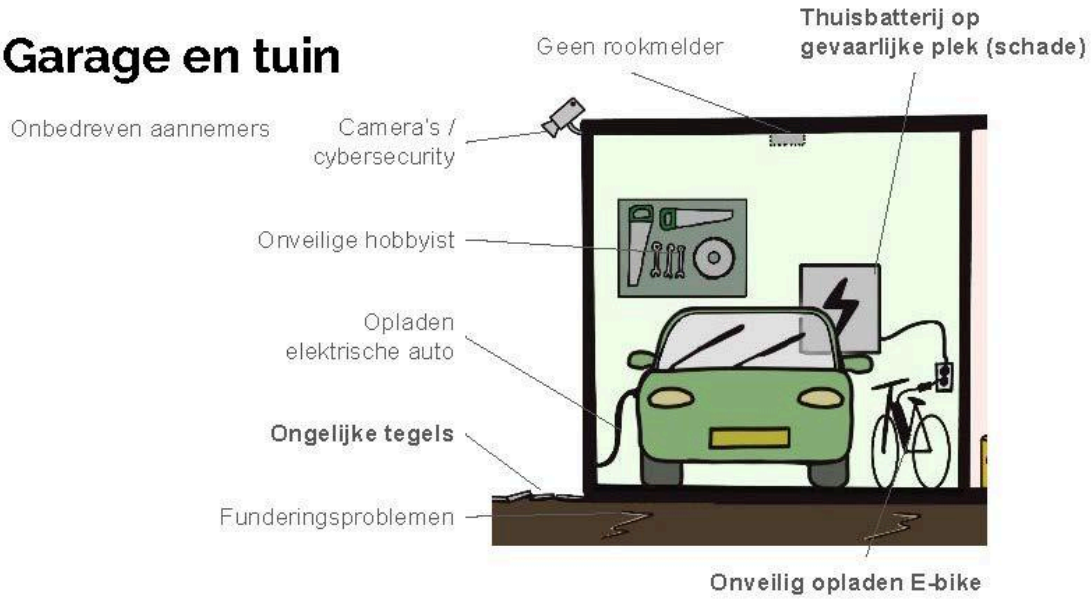
Niet op kunnen staan wanneer gevallen



Zolder/washok



Garage en tuin

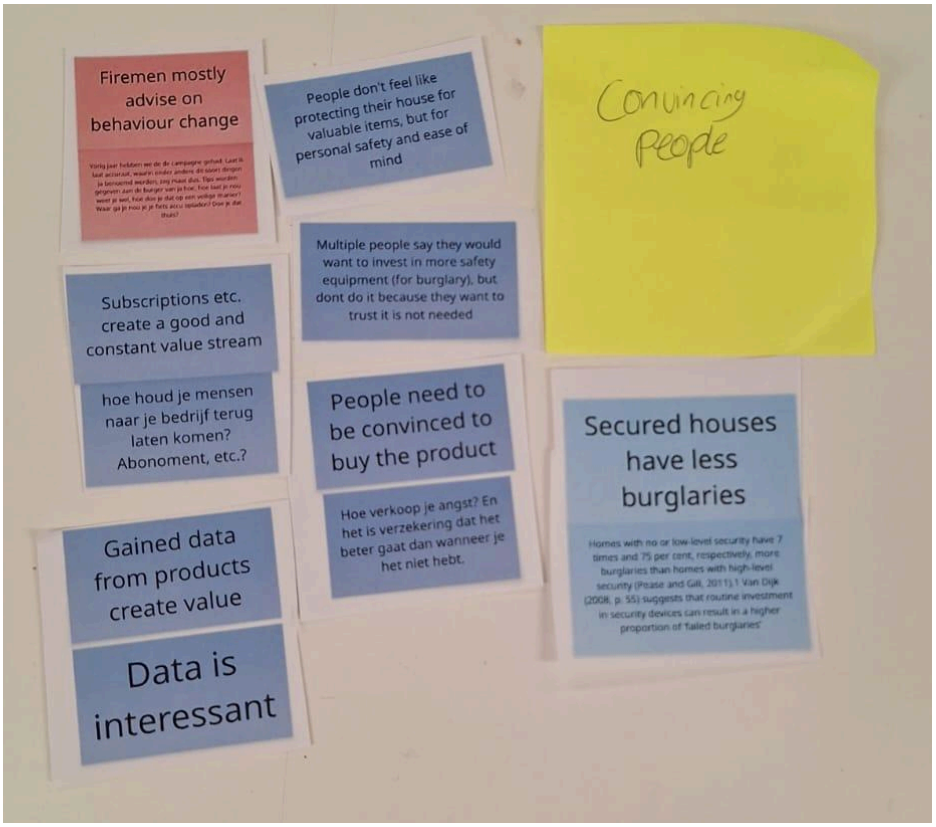


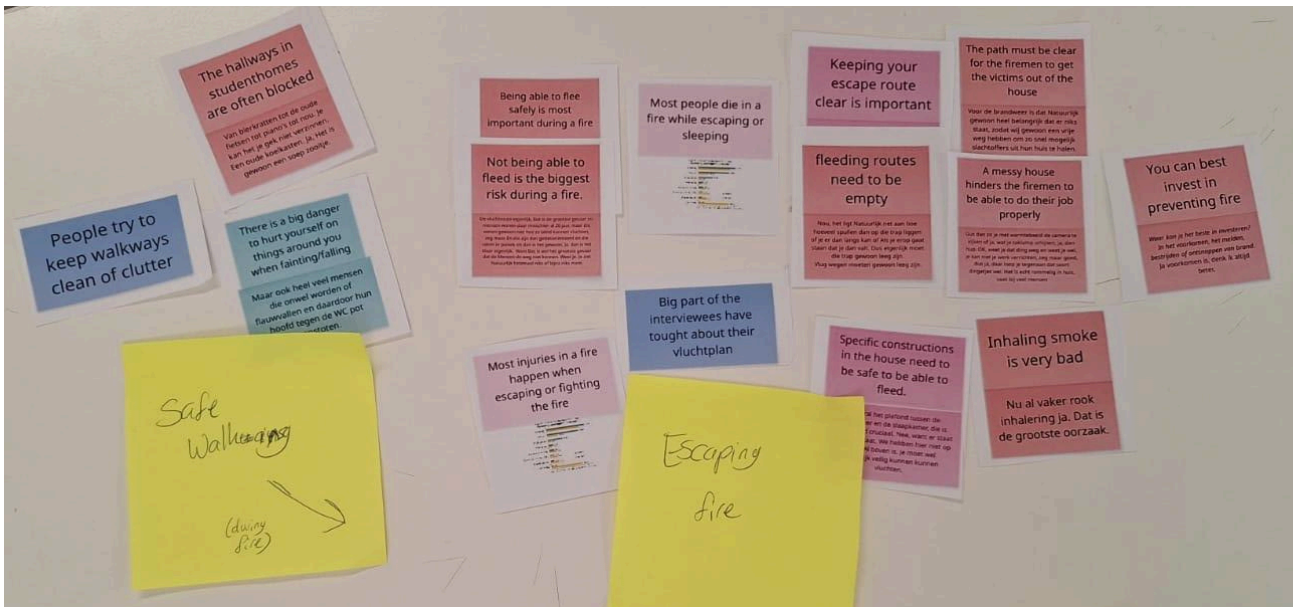
1.3. Clusters

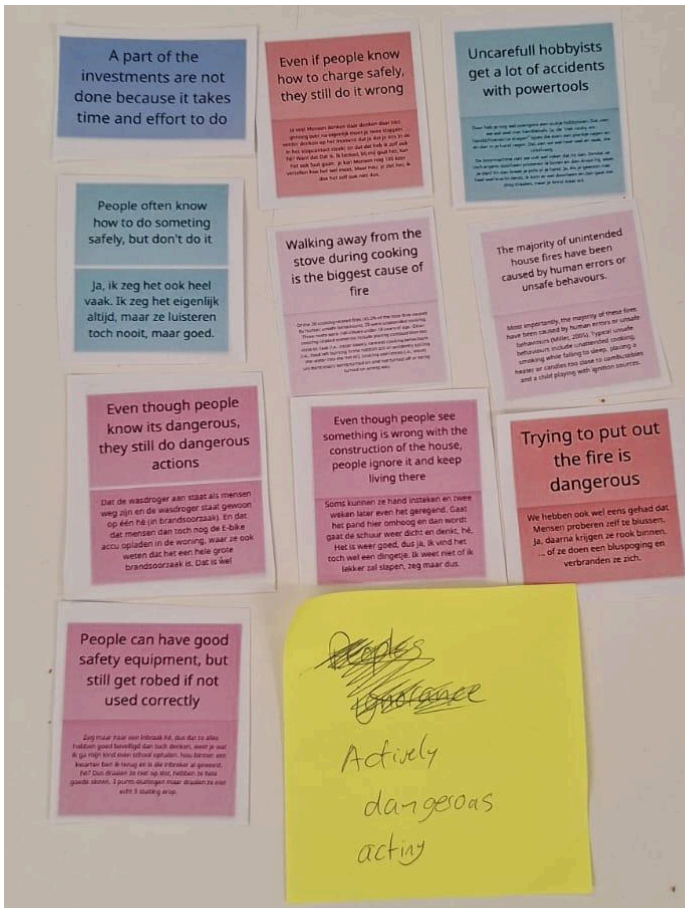
How

The information found in the literature and interviews was stated into 209 statementcards. A cluster session where each card was randomly individually assessed and linked to the other cards revealed 24 clusters covering 6 themes. Some clusters were already known/guessed. Others opened up new interesting approaches towards the problem. The most surprising, new or important clusters are elaborated in chapter #. A complete overview of the clusters can be found in appendix %.

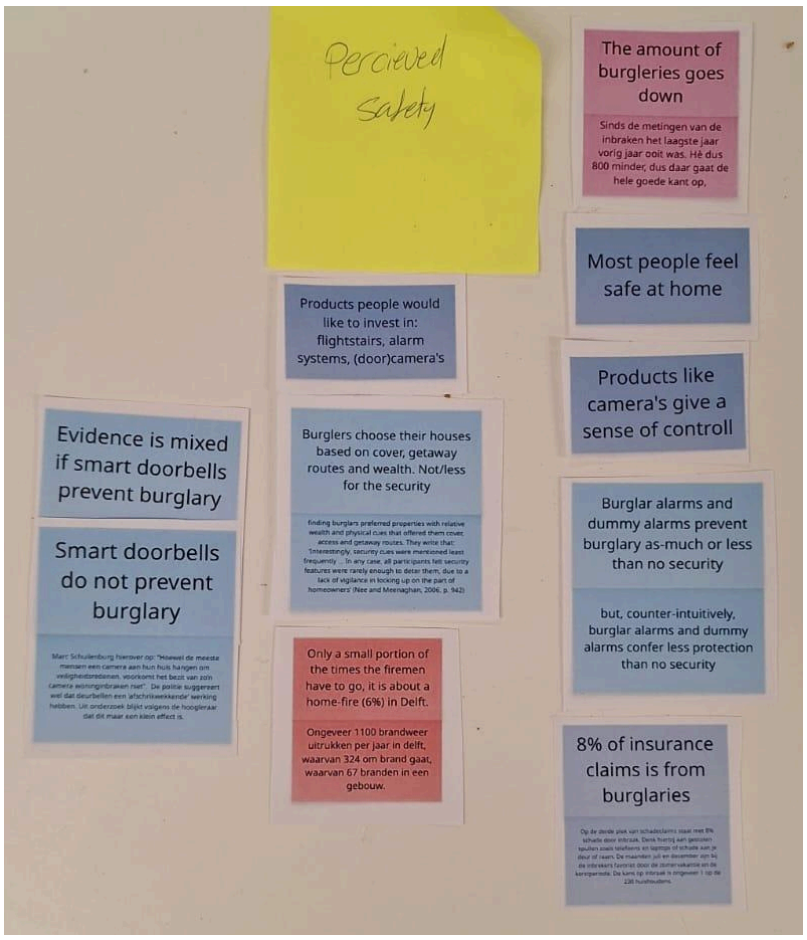
Clusters found:

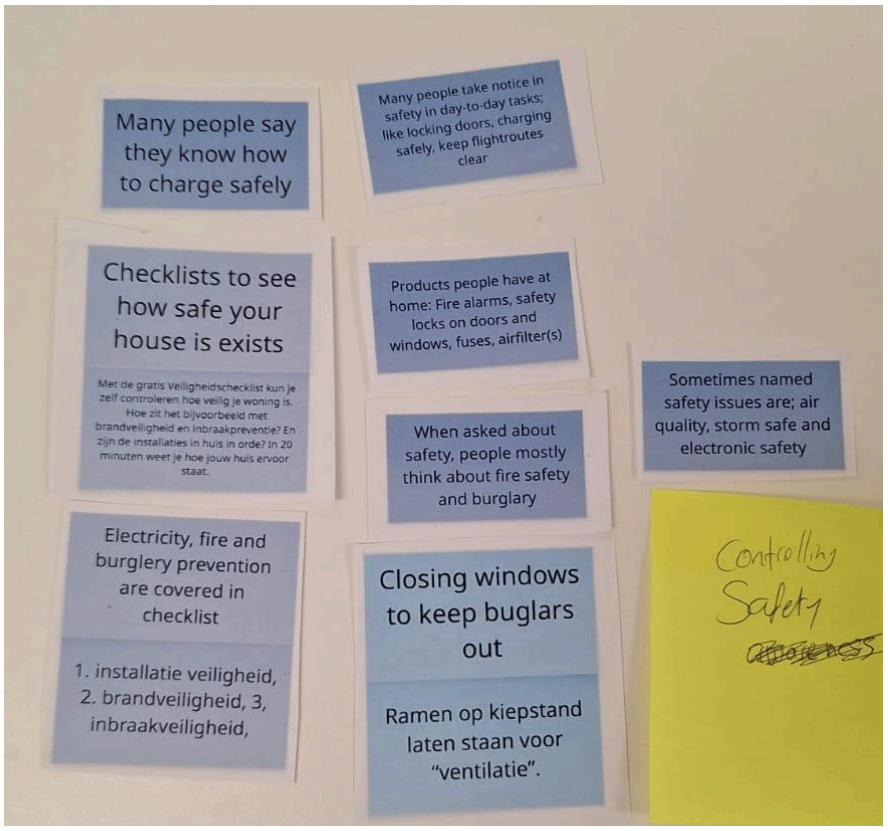


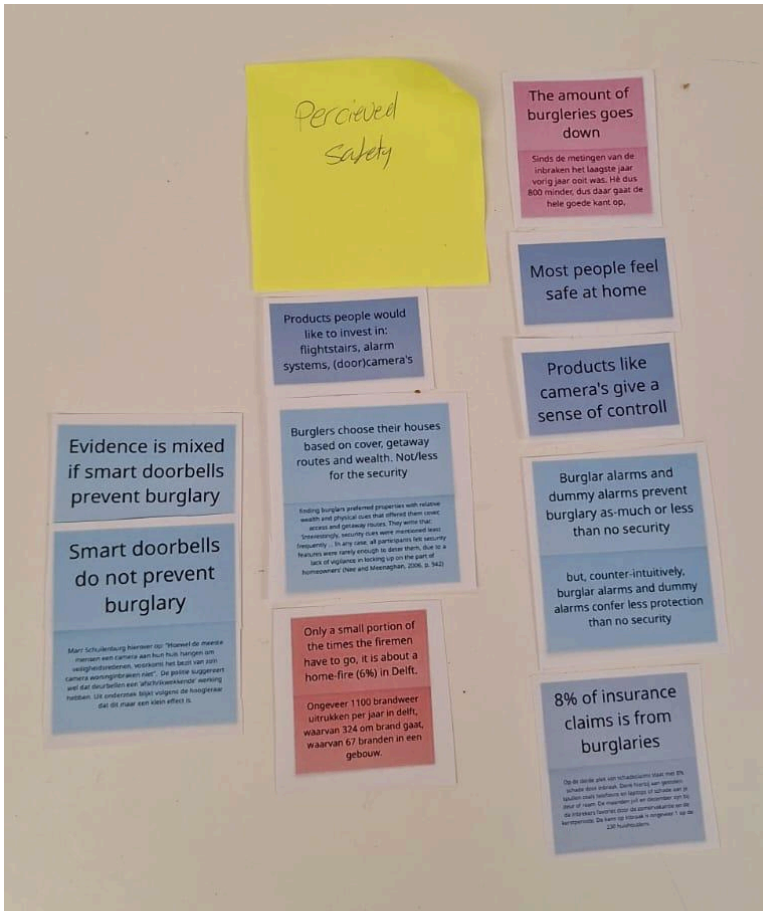

The hallways in studenthomes are often blocked
Van klerkraten tot de oude hetzen tot pand's tot nou je kan het je gek niet verzinnen. Een oude koekaten. Ja. Het is gewoon een zoop zooitje.
People try to keep walkways clean of clutter
There is a big danger to hurt yourself on things around you when fainting/falling
Maar ook heel veel mensen die onwel worden of flauwvallen en daardoor hun hoofd tegen de WC pot
Being able to flee safely is most important during a fire
Not being able to fleed is the biggest risk during a fire.
Most people die in a fire while escaping or sleeping
Keeping your escape route clear is important
The path must be clear for the firemen to get the victims out of the house
fleeding routes need to be empty
A messy house hinders the firemen to be able to do their job properly
You can best invest in preventing fire
Big part of the interviewees have tought about their vluchtplan
Most injuries in a fire happen when escaping or fighting the fire
Specific constructions in the house need to be safe to be able to fleed.
Inhaling smoke is very bad
Nu al vaker rook inhalering ja. Dat is de grootste oorzaak.
Safe Walkways
(during fire)
Escaping fire

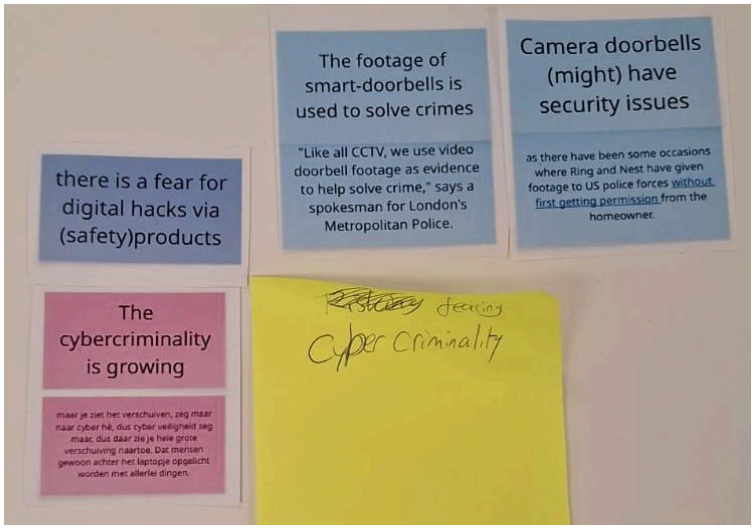

A part of the investments are not done because it takes time and effort to do
Even if people know how to charge safely, they still do it wrong
Uncarefull hobbyists get a lot of accidents with powertools
People often know how to do someting safely, but don't do it
Ja, ik zeg het ook heel vaak. Ik zeg het eigenlijk altijd, maar ze luisteren toch nooit, maar goed.
Walking away from the stove during cooking is the biggest cause of fire
The majority of unintended house fires have been caused by human errors or unsafe behavours.
Even though people know its dangerous, they still do dangerous actions
Dat de wasdroger aan staat als mensen weg zijn en de wasdroger staat gewoon op één hé (in brandsoorzaak). En dat dat mensen dan toch nog de E-bike accu opladen in de woning, waar ze ook weten dat het een hele grote brandsoorzaak is. Dat is wel
Even though people see something is wrong with the construction of the house, people ignore it and keep living there
Soms kunnen ze hand instekken en twee weken later even het gereageerd. Gaat het pand hier omhoog en dan wordt gaat de schuur weer dicht en denkt, hé. Het is weer goed, dus ja, ik vind het toch wel een dingetje. Ik weet niet of ik lekker zal slapen, zeg maar dus.
Trying to put out the fire is dangerous
We hebben ook wel eens gehad dat Mensen proberen zelf te blussen, Ja. Daarna krijgen ze rook binnen. of ze doen een bluspoging en verbranden ze zich.
People can have good safety equipment, but still get robed if not used correctly
Zeg maar naar een inbraak hé, dus dat ze alles hebben goed beveiligd dan toch denken, weet je wat ik ga mijn kind even school ophalen. Nou binnen een kwartier ben ik terug en is die inbreker al gewoon, he? Dus draaien ze niet op dat, hebben ze hele goede sloten, 3 punts-duimgen maar draaien ze niet echt 3 sluiting erop.
Actively dangerous acting

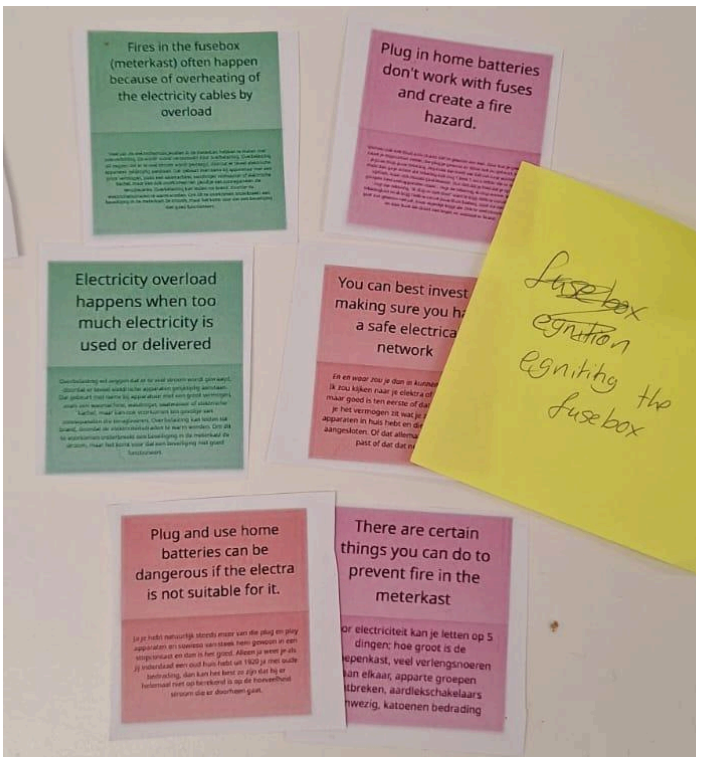

Passively dangerous acting
Security products fail due to virgilance of homeowners
In any case, all participants felt security features were rarely enough to deter them, due to a lack of vigilance in locking up on the part of homeowners' (Nee and
Untaughfull use of electra is a fire hazard
Vaak zie je dat bij studenten nou, dat weet je als geen ander. Het is Natuurlijk niet altijd even netjes en overal liggen draden en 20 verlengsnoeren aan elkaar. Elkaar ja aan elkaar en dat is natuurlijk helemaal niet goed zo
Sometimes, people have security measures, but these are not easily available, up-to-date, checked or even lost
People feel safe at home, because they have lived there for a while and everything went well
Smoke detectors need to be tested
Problems in home batteries happen because of the surroundings
Many people charge their e-bike accu in a room without a smoke detector
51% laadt accu op in ruimte zonder rookmelder
People think "that does not happen to me"
Dat omdat mensen vaak wel denken dat dat mij niks gebeurt, hè? En dat ze een blinde vlek en dat gebeurt hier ook hoor,

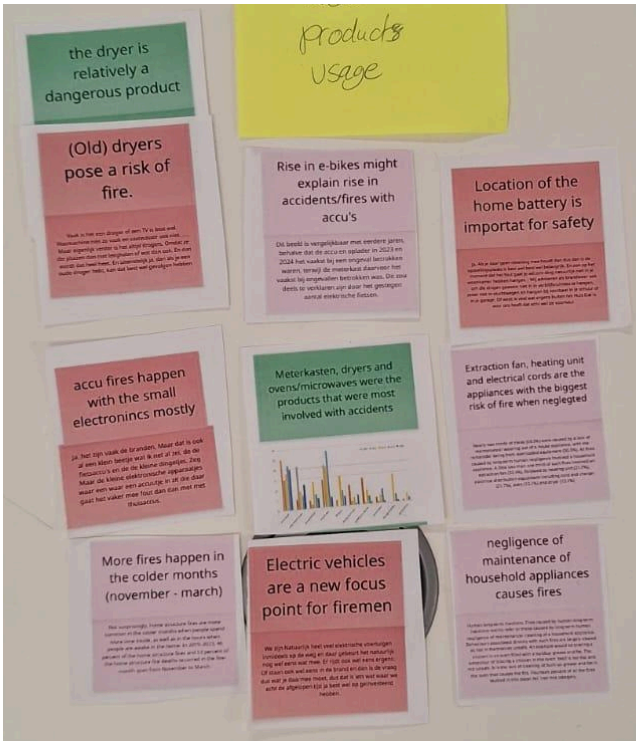

Perceived safety
The amount of burgleries goes down
Sinds de metingen van de inbraken het laagste jaar vorig jaar ooit was. Hè dus 800 minder, dus daar gaat de hele goede kant op,
Most people feel safe at home
Products people would like to invest in: flightstairs, alarm systems, (door)camera's
Products like camera's give a sense of controll
Evidence is mixed if smart doorbells prevent burglary
Burglers choose their houses based on cover, getaway routes and wealth. Not/less for the security
finding burglars preferred properties with relative wealth and physical cues that offered them cover, access and getaway routes. They write that: "Interestingly, security cues were mentioned least frequently ... In any case, all participants felt security features were rarely enough to detar them, due to a lack of vigilance in locking up on the part of homeowners' (Nee and Meenaghan, 2006: p. 942)
Burglar alarms and dummy alarms prevent burglary as-much or less than no security
but, counter-intuitively, burglar alarms and dummy alarms confer less protection than no security
Smart doorbells do not prevent burglary
Marc Schuilenburg hierover op: "Hoewel de meeste mensen een camera aan hun huis hangen om veiligheidsredenen, voorkomt het bezit van zo'n camera woninginbraken niet". De politie suggereert wel dat deurbellen een 'afschrikwekkende' werking hebben. Uit onderzoek blijkt volgens de hoogleraar dat dit maar een klein effect is.
Only a small portion of the times the firemen have to go, it is about a home-fire (6%) in Delft.
Ongeveer 1100 brandweer uitrukken per jaar in delft, waarvan 324 om brand gaat, waarvan 67 branden in een gebouw.
8% of insurance claims is from burglaries

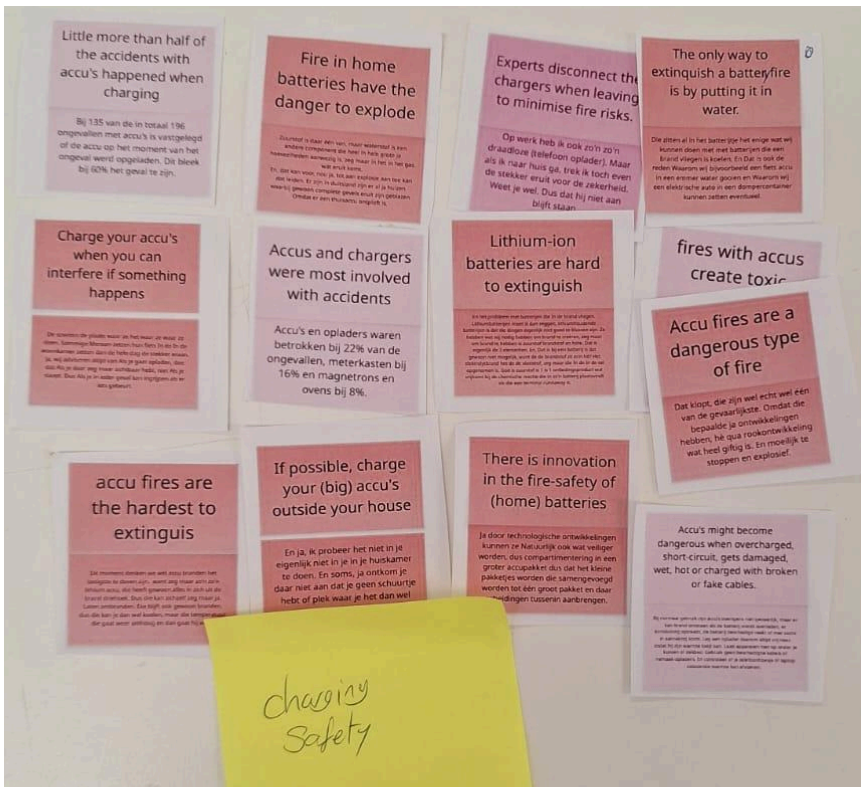

Many people say they know how to charge safely
Many people take notice in safety in day-to-day tasks; like locking doors, charging safely, keep flightroutes clear
Checklists to see how safe your house is exists
Met de gratis Veiligheidschecklist kun je zelf controleren hoe veilig je woning is. Hoe zit het bijvoorbeeld met brandveiligheid en inbraakpreventie? En zijn de installaties in huis in orde? In 20 minuten weet je hoe jouw huis ervoor staat.
Products people have at home: Fire alarms, safety locks on doors and windows, fuses, airfilter(s)
Sometimes named safety issues are; air quality, storm safe and electronic safety
When asked about safety, people mostly think about fire safety and burglary
Electricity, fire and burglery prevention are covered in checklist
1. installatie veiligheid, 2. brandveiligheid, 3, inbraakveiligheid,
Closing windows to keep buglars out
Ramen op kiepstand laten staan voor "ventilatie".
Controlling Safety

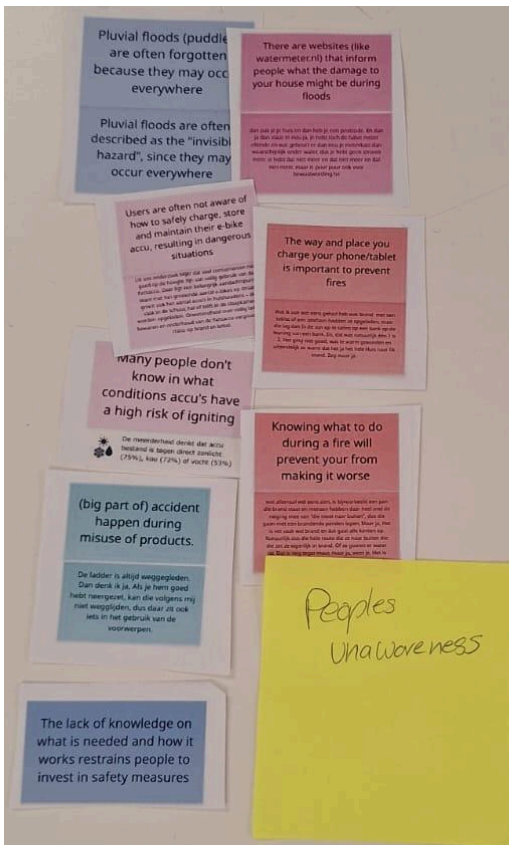

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Op de derde plek van schadeclaims staat met 8% schade door inbraak. Dank hierbij van gestolen spullen zoals laptops en laptops of schade aan je deur of ruim. De meesten zijn van december om te de inbrekers besmet door de zomervakantie en de kerstperiode. De kans op inbraak is ongeveer 1 op de 130 huishouden.

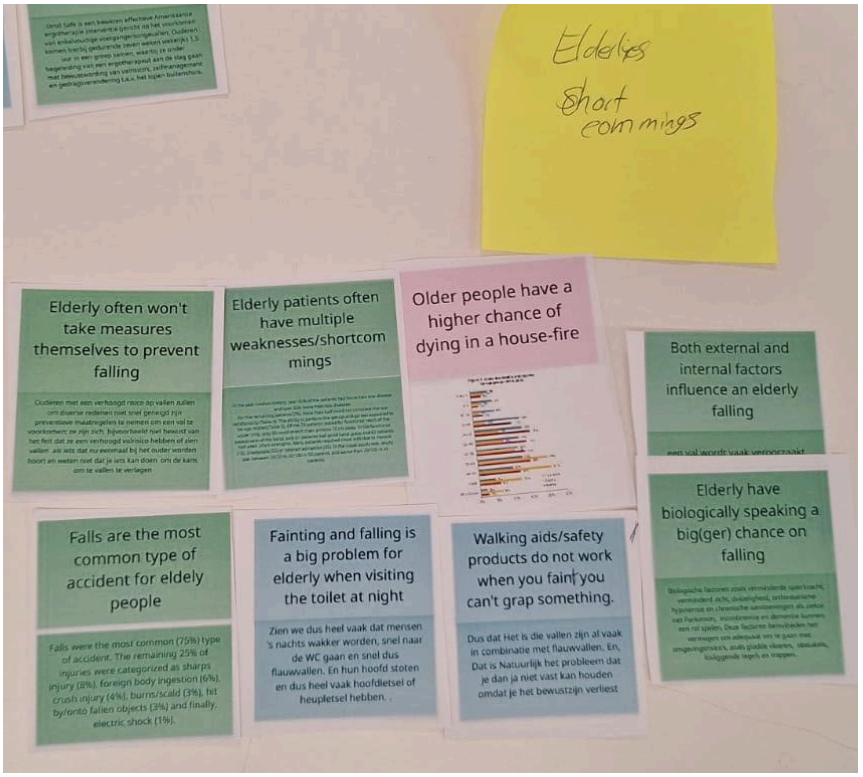

The footage of smart-doorbells is used to solve crimes
"Like all CCTV, we use video doorbell footage as evidence to help solve crime," says a spokesman for London's Metropolitan Police.
Camera doorbells (might) have security issues
as there have been some occasions where Ring and Nest have given footage to US police forces without first getting permission from the homeowner.
there is a fear for digital hacks via (safety)products
The cybercriminality is growing
maar je ziet het verschuiven, zeg maar naar cyber hè, dus cyber veiligheid zeg maar, dus daar zie je hele grote verschuiving naartoe. Dat mensen gewoon achter het laptopje opgelicht worden met allerlei dingen.
Cyber Criminality

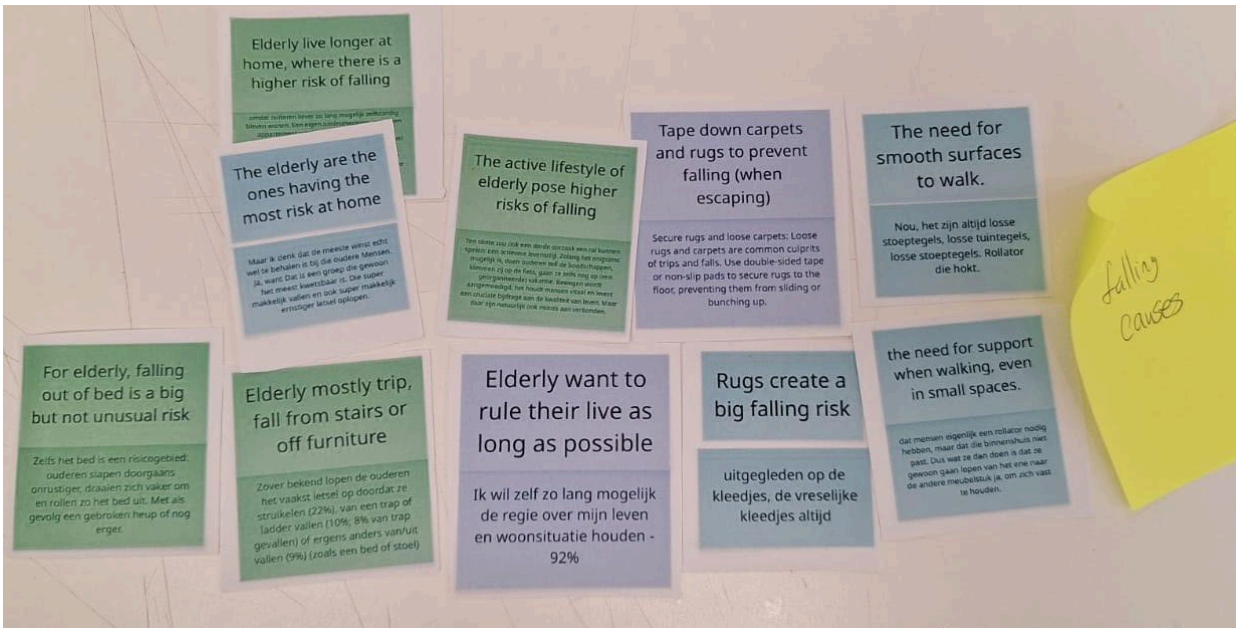

Fires in the fusebox (meterkast) often happen because of overheating of the electricity cables by overload
Plug in home batteries don't work with fuses and create a fire hazard.
Electricity overload happens when too much electricity is used or delivered
You can best invest
making sure you h
a safe electrica
network
Fusebox
egnition
egniting the
fusebox
Plug and use home batteries can be dangerous if the electra is not suitable for it.
There are certain things you can do to prevent fire in the meterkast

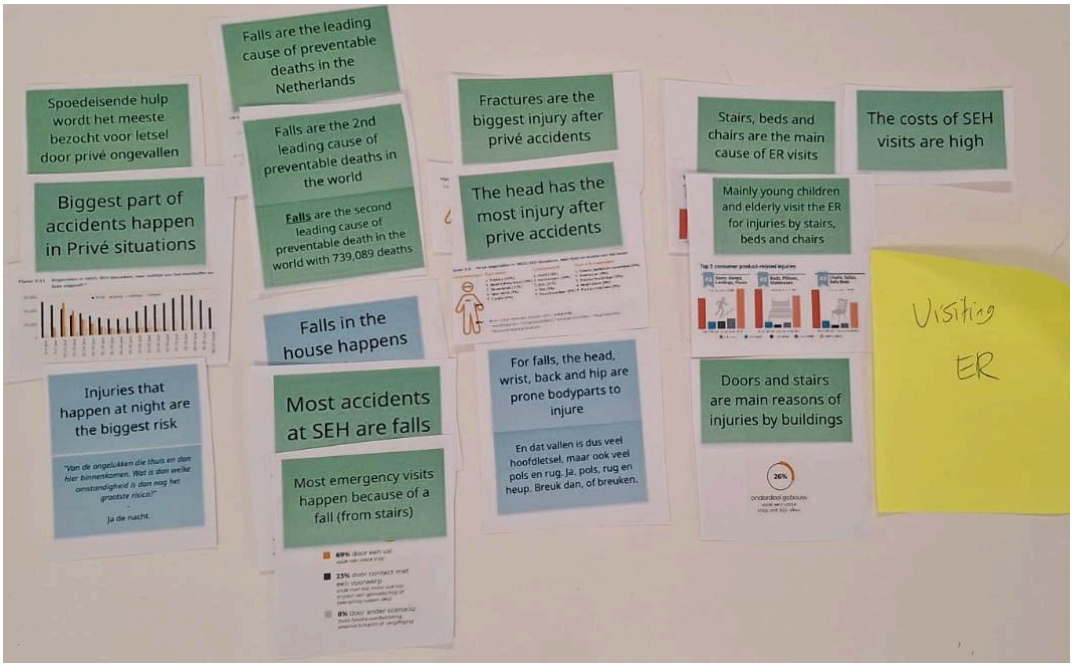

the dryer is relatively a dangerous product
products
usage
(Old) dryers pose a risk of fire.
Rise in e-bikes might explain rise in accidents/fires with accu's
Location of the home battery is importat for safety
accu fires happen with the small electroincs mostly
Meterkasten, dryers and ovens/microwaves were the products that were most involved with accidents
Extraction fan, heating unit and electrical cords are the appliances with the biggest risk of fire when neglegted
More fires happen in the colder months (november - march)
Electric vehicles are a new focus point for firemen
negligence of maintenance of household appliances causes fires

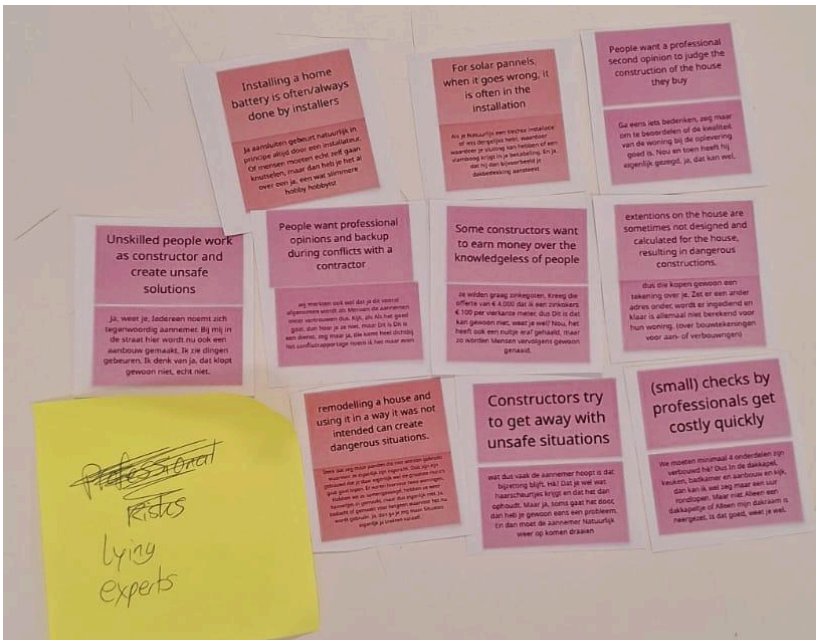

Little more than half of the accidents with accu's happened when charging
Bij 135 van de in totaal 196 ongevallen met accu's is vastgelegd of de accu op het moment van het ongeval werd opgeladen. Dit bleek bij 60% het geval te zijn.
Fire in home batteries have the danger to explode
Experts disconnect the chargers when leaving to minimise fire risks.
Op werk heb ik ook zo'n draadloze (telefoon oplader). Maar als ik naar huis ga, trek ik toch even de stekker eruit voor de zekerheid. Weet je wel. Dus dat hij niet aan blijft staan
The only way to extinquish a battery fire is by putting it in water.
Charge your accu's when you can interfere if something happens
Accus and chargers were most involved with accidents
Accu's en opladers waren betrokken bij 22% van de ongevallen, meterkasten bij 16% en magnetrons en ovens bij 8%.
Lithium-ion batteries are hard to extinguish
fires with accus create toxic
Accu fires are a dangerous type of fire
Dat klopt, die zijn wel echt wel één van de gevaarlijkste. Omdat die bepaalde ja ontwikkelingen hebben, hè qua rookontwikkeling wat heel giftig is. En moeilijk te stoppen en explosief.
accu fires are the hardest to extinguis
If possible, charge your (big) accu's outside your house
En ja, ik probeer het niet in je eigenlijk niet in je in je huiskamer te doen. En soms, ja ontkom je daar niet aan dat je geen schuurtje hebt of plek waar je het dan wel
There is innovation in the fire-safety of (home) batteries
Ja door technologische ontwikkelingen kunnen ze Natuurlijk ook wat veiliger worden, dus compartimentering in een groter accupakket dus dat het kleine pakketjes worden die samengevoegd worden tot één groot pakket en daar
Accu's might become dangerous when overcharged, short-circuit, gets damaged, wet, hot or charged with broken or fake cables.
Charging Safety

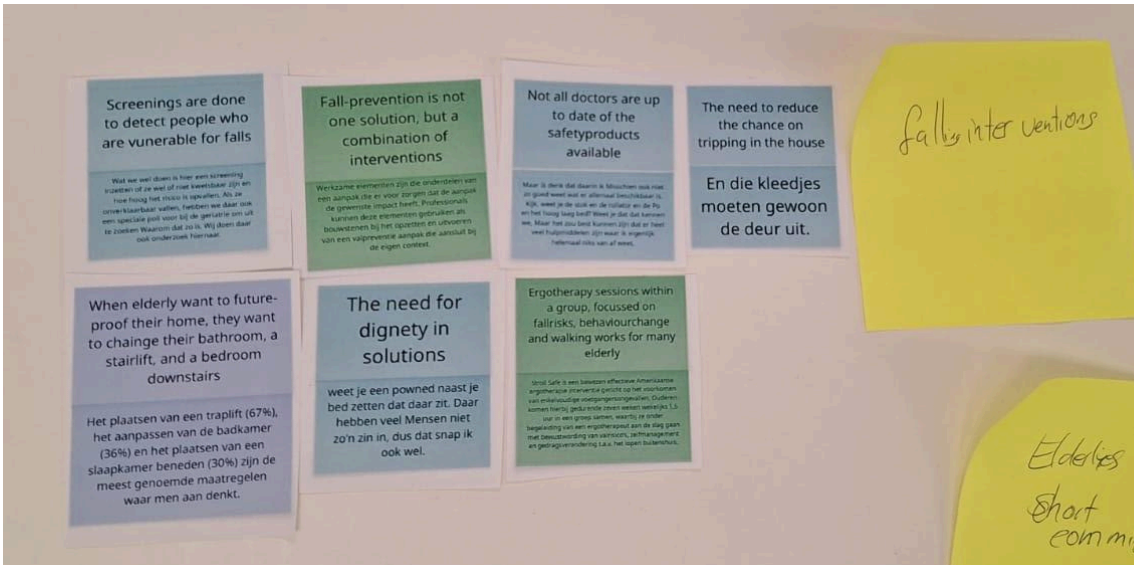

Pluvial floods (puddle
are often forgotten because they may occ everywhere
Pluvial floods are often described as the "invisibl hazard", since they may occur everywhere
There are websites (like watermeter.nl) that inform people what the damage to your house might be during floods
Users are often not aware of how to safely charge, store and maintain their e-bike accu, resulting in dangerous situations
The way and place you charge your phone/tablet is important to prevent fires
Many people don't know in what conditions accu's have a high risk of igniting
Knowing what to do during a fire will prevent your from making it worse
(big part of) accident happen during misuse of products.
De ladder is altijd weggegleden. Dan denk ik ja. Als je hem goed hebt nagekeken, kan die volgens mij niet weggliden, dus daar zit ook iets in het gebruik van de voorwerpen.
The lack of knowledge on what is needed and how it works restrains people to invest in safety measures
Peoples Unawoveness

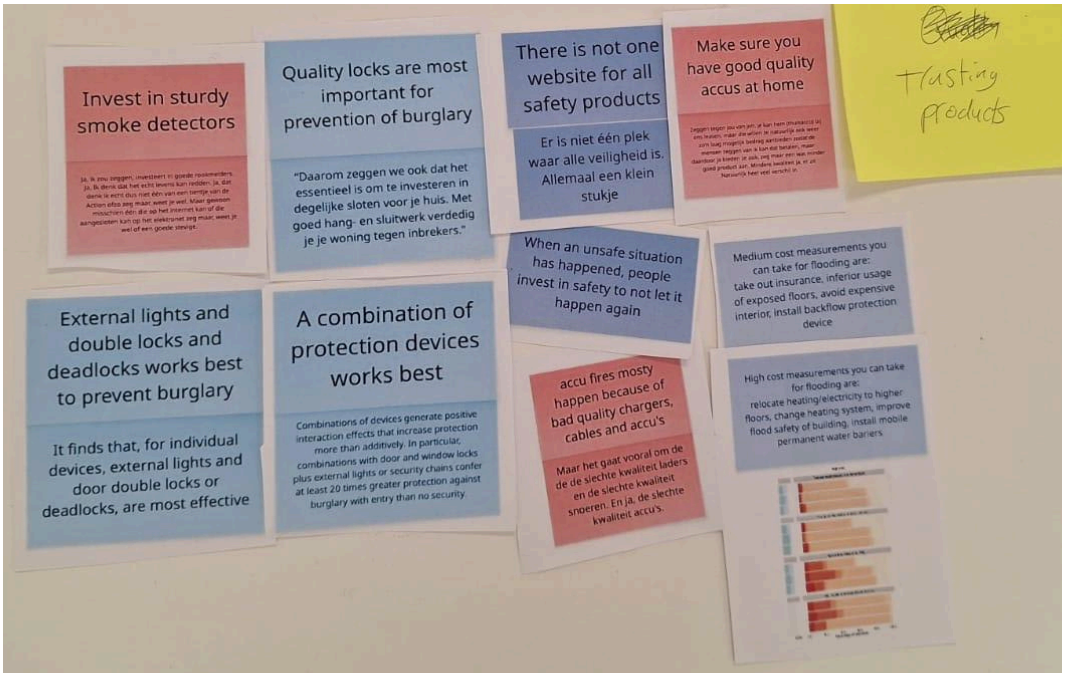

Elderlies
short comings
Elderly often won't take measures themselves to prevent falling
Elderly patients often have multiple weaknesses/shortcom mings
Older people have a higher chance of dying in a house-fire
Both external and internal factors influence an elderly falling
Elderly have biologically speaking a big(ger) chance on falling
Falls are the most common type of accident for eldely people
Falls were the most common (75%) type of accident. The remaining 25% of injuries were categorized as sharps injury (8%), foreign body ingestion (6%), crush injury (4%), burns/scald (3%), hit by/onto fallen objects (3%) and finally, electric shock (1%).
Fainting and falling is a big problem for elderly when visiting the toilet at night
Zien we dus heel vaak dat mensen 's nachts wakker worden, snel naar de WC gaan en snel dus flauwvallen. En hun hoofd stoten en dus heel vaak hoofdletsel of heupletsel hebben.
Walking aids/safety products do not work when you faint you can't grap something.
Dus dat Het is die vallen zijn al vaak in combinatie met flauwvallen. En, Dat is Natuurlijk het probleem dat je dan ja niet vast kan houden omdat je het bewustzijn verliest

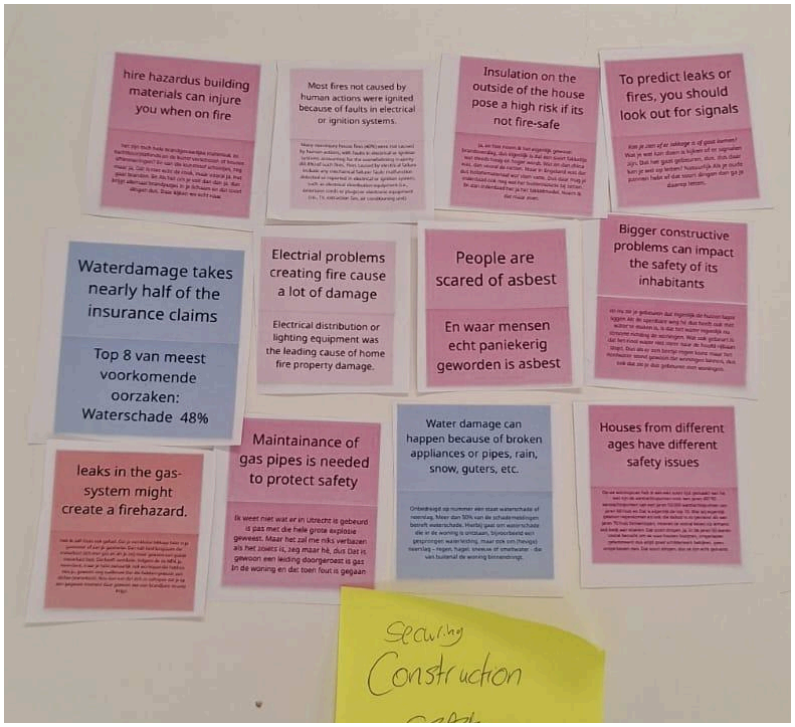

Elderly live longer at home, where there is a higher risk of falling
The elderly are the ones having the most risk at home
Maar ik denk dat de meeste winst echt wel te behalen is bij die oudere Mensen, ja, want Dat is een groep die gewoon het meest kwetsbaar is. Die super makkelijk vallen en ook super makkelijk ernstiger letsel oplopen.
The active lifestyle of elderly pose higher risks of falling
Tape down carpets and rugs to prevent falling (when escaping)
Secure rugs and loose carpets: Loose rugs and carpets are common culprits of trips and falls. Use double-sided tape or non-slip pads to secure rugs to the floor, preventing them from sliding or bunching up.
The need for smooth surfaces to walk.
Nou, het zijn altijd losse stoeptegels, losse tuintegels, losse stoeptegels. Rollator die hokt.
falling causes
For elderly, falling out of bed is a big but not unusual risk
Zelfs het bed is een risicogebied: ouderen slapen doorgaans onrustiger, draaien zich vaker om en rollen zo het bed uit. Met als gevolg een gebroken heup of nog erger.
Elderly mostly trip, fall from stairs or off furniture
Zover bekend lopen de ouderen het vaakst letsel op doordat ze struikelen (22%), van een trap of ladder vallen (10%; 8% van trap gevallen) of ergens anders van/uit vallen (9%) (zoals een bed of stoel)
Elderly want to rule their live as long as possible
Ik wil zelf zo lang mogelijk de regie over mijn leven en woonsituatie houden - 92%
Rugs create a big falling risk
uitgegleden op de kleedjes, de vreselijke kleedjes altijd
the need for support when walking, even in small spaces.
dat mensen eigenlijk een rollator nodig hebben, maar dat die binnenshuis niet past. Dus wat ze dan doen is dat ze gewoon gaan lopen van het ene naar de andere meubelstuk ja, om zich vast te houden.

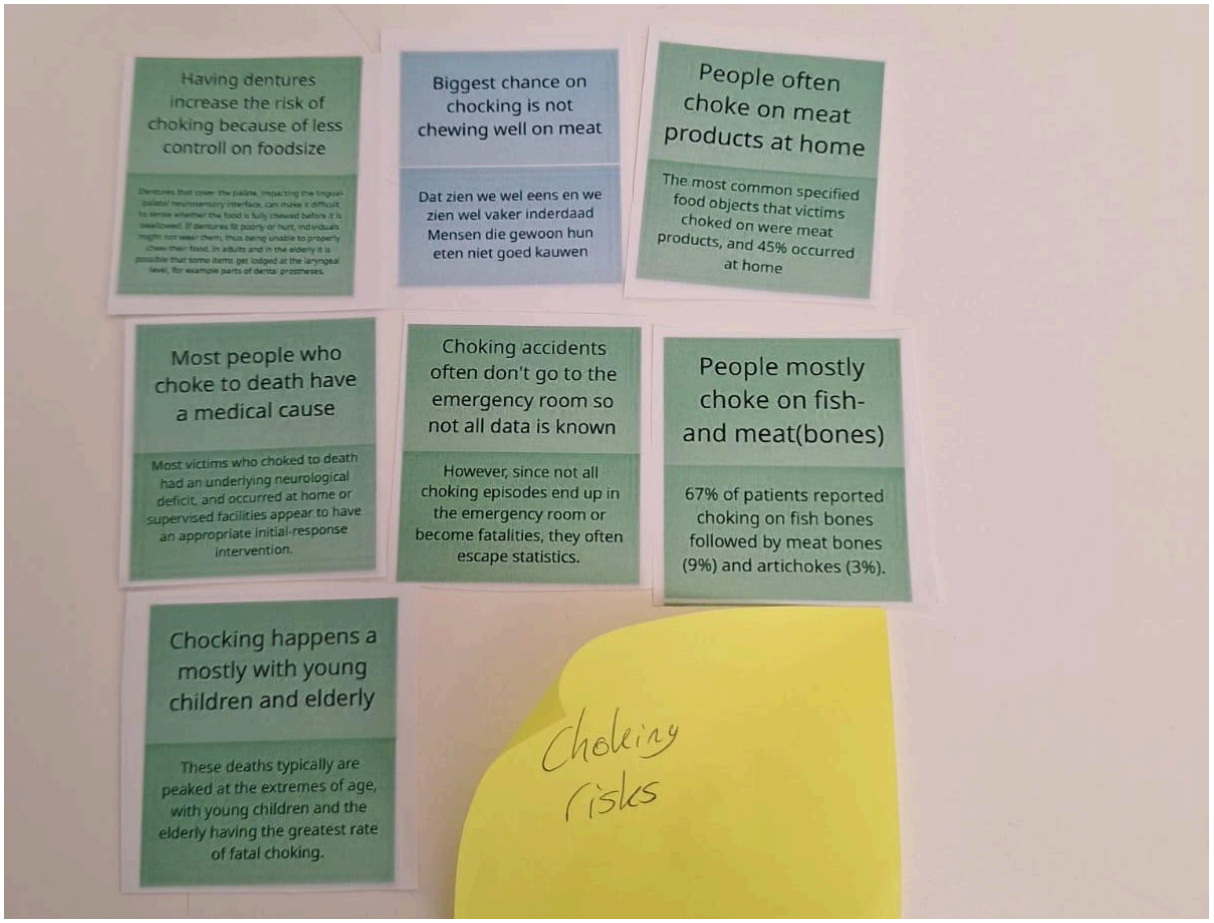

Falls are the leading cause of preventable deaths in the Netherlands
Spoedeisende hulp wordt het meeste bezocht voor letsel door privé ongevallen
Fractures are the biggest injury after privé accidents
Stairs, beds and chairs are the main cause of ER visits
The costs of SEH visits are high
Falls are the 2nd leading cause of preventable deaths in the world
Falls are the second leading cause of preventable death in the world with 739,089 deaths
The head has the most injury after prive accidents
Biggest part of accidents happen in Privé situations
Mainly young children and elderly visit the ER for injuries by stairs, beds and chairs
Visiting ER
Falls in the house happens
Most accidents at SEH are falls
For falls, the head, wrist, back and hip are prone bodyparts to injure
Injuries that happen at night are the biggest risk
Doors and stairs are main reasons of injuries by buildings
Most emergency visits happen because of a fall (from stairs)

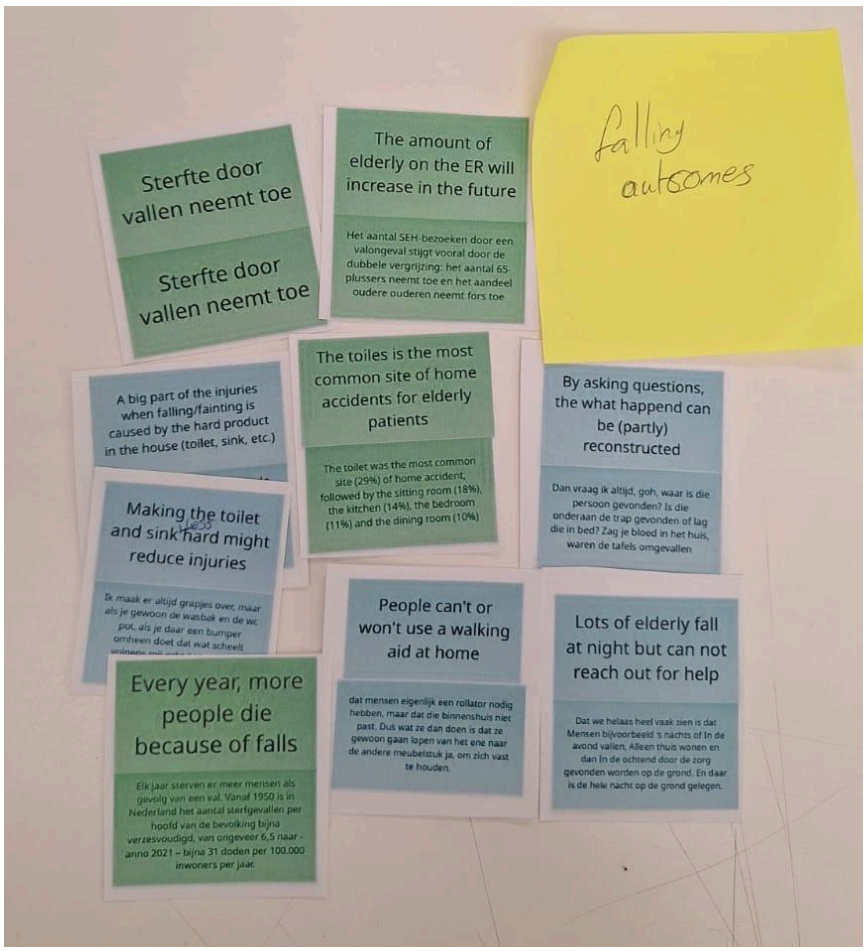

Installing a home battery is often/always done by installers
For solar panels, when it goes wrong, it is often in the installation
People want a professional second opinion to judge the construction of the house they buy
Unskilled people work as constructor and create unsafe solutions
People want professional opinions and backup during conflicts with a contractor
Some constructors want to earn money over the knowledgeless of people
extentions on the house are sometimes not designed and calculated for the house, resulting in dangerous constructions.
remodelling a house and using it in a way it was not intended can create dangerous situations.
Constructors try to get away with unsafe situations
(small) checks by professionals get costly quickly
Professional risks
lying experts

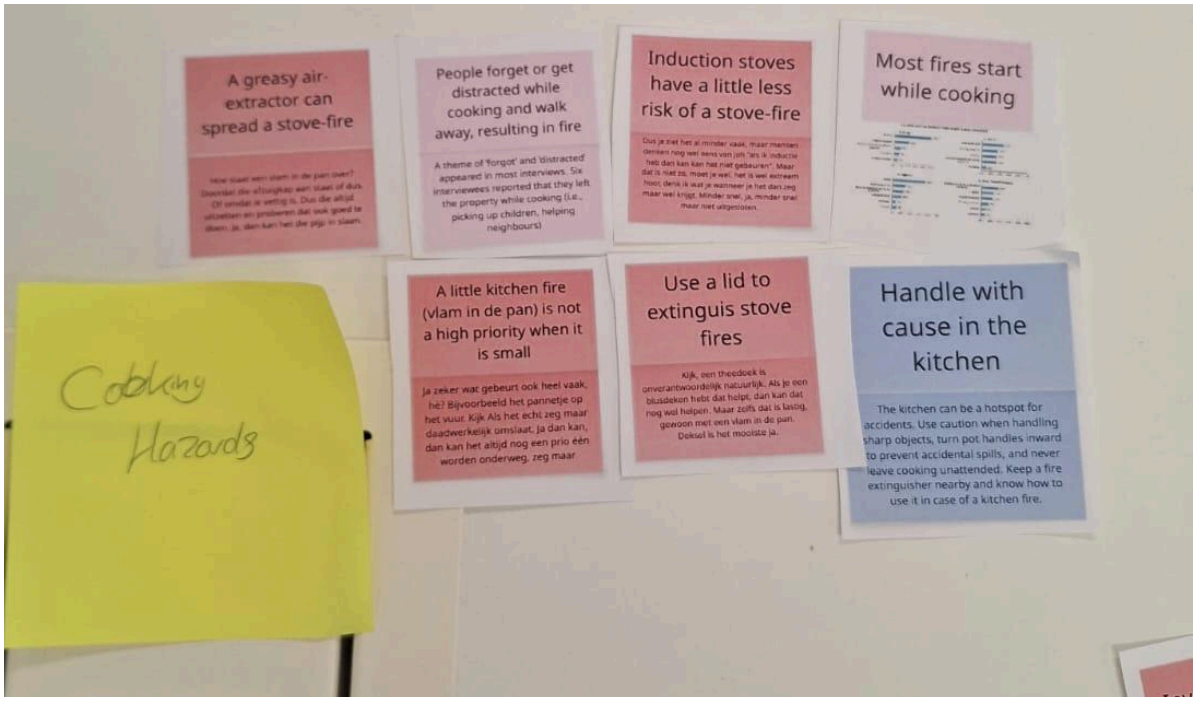

Screenings are done to detect people who are vunerable for falls
Fall-prevention is not one solution, but a combination of interventions
Not all doctors are up to date of the safetyproducts available
The need to reduce the chance on tripping in the house
En die kleedjes moeten gewoon de deur uit.
When elderly want to future-proof their home, they want to chainge their bathroom, a stairlift, and a bedroom downstairs
Het plaatsen van een traplift (67%), het aanpassen van de badkamer (36%) en het plaatsen van een slaapkamer beneden (30%) zijn de meest genoemde maatregelen waar men aan denkt.
The need for dignety in solutions
weet je een powned naast je bed zetten dat daar zit. Daar hebben veel Mensen niet zo'n zin in, dus dat snap ik ook wel.
Ergotherapy sessions within a group, focussed on fallrisks, behaviourchange and walking works for many elderly

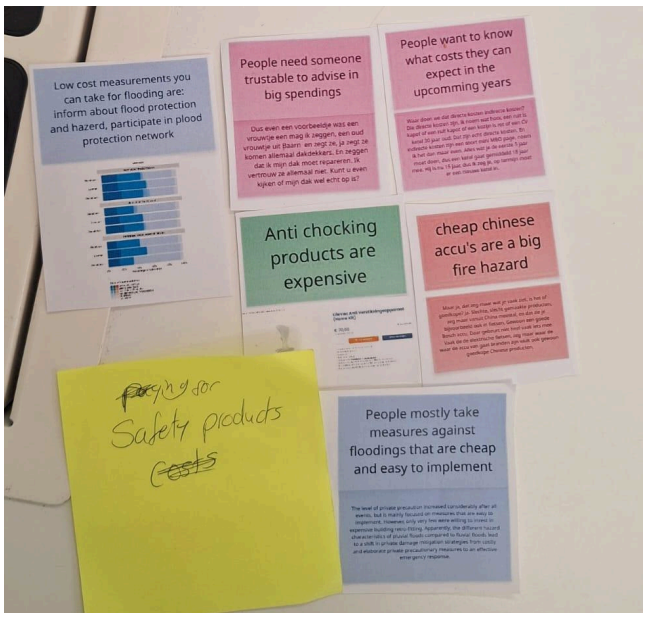

Invest in sturdy smoke detectors
Quality locks are most important for prevention of burglary
"Daarom zeggen we ook dat het essentieel is om te investeren in degelijke sloten voor je huis. Met goed hang- en sluitwerk verdedig je je woning tegen inbrekers."
There is not one website for all safety products
Er is niet één plek waar alle veiligheid is. Allemaal een klein stukje
Make sure you have good quality accus at home
External lights and double locks and deadlocks works best to prevent burglary
It finds that, for individual devices, external lights and door double locks or deadlocks, are most effective
A combination of protection devices works best
Combinations of devices generate positive interaction effects that increase protection more than additively. In particular, combinations with door and window locks plus external lights or security chains confer at least 20 times greater protection against burglary with entry than no security.
When an unsafe situation has happened, people invest in safety to not let it happen again
accu fires mosty happen because of bad quality chargers, cables and accu's
Maar het gaat vooral om de de de slechte kwaliteit laders en de slechte kwaliteit snoeren. En ja, de slechte kwaliteit accu's.
Medium cost measurements you can take for flooding are: take out insurance, inferior usage of exposed floors, avoid expensive interior, install backflow protection device
High cost measurements you can take for flooding are: relocate heating/electricity to higher floors, change heating system, improve flood safety of building, install mobile permanent water barriers

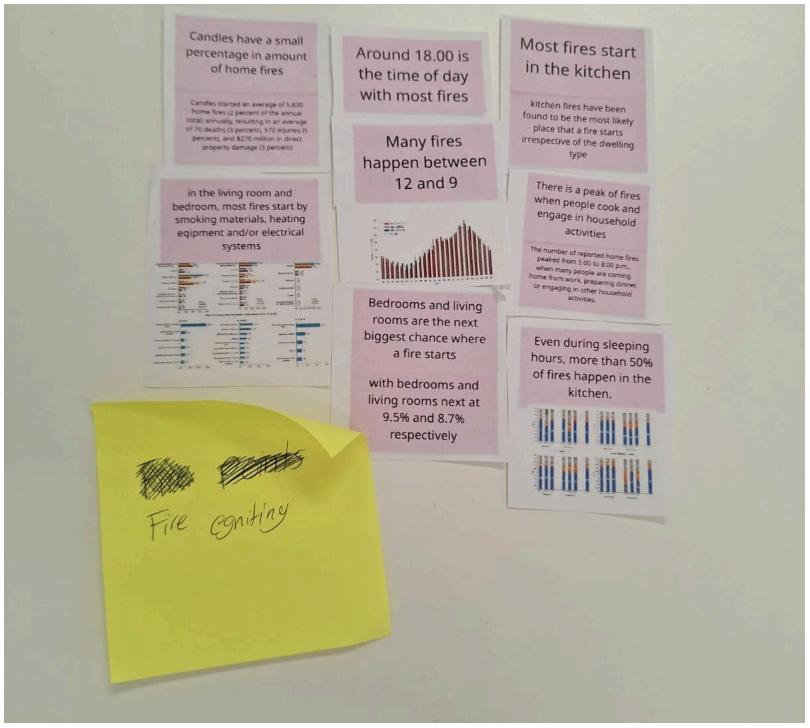

hire hazardus building materials can injure you when on fire
Most fires not caused by human actions were ignited because of faults in electrical or ignition systems.
Insulation on the outside of the house pose a high risk if its not fire-safe
To predict leaks or fires, you should look out for signals
Waterdamage takes nearly half of the insurance claims
Top 8 van meest voorkomende oorzaken: Waterschade 48%
Electrial problems creating fire cause a lot of damage
Electrical distribution or lighting equipment was the leading cause of home fire property damage.
People are scared of asbest
En waar mensen echt paniekerig geworden is asbest
Bigger constructive problems can impact the safety of its inhabitants
leaks in the gas-system might create a firehazard.
Maintainance of gas pipes is needed to protect safety
Water damage can happen because of broken appliances or pipes, rain, snow, guters, etc.
Houses from different ages have different safety issues
Sewing
Construction


Having dentures increase the risk of choking because of less controll on foodsize
Biggest chance on chocking is not chewing well on meat
Dat zien we wel eens en we zien wel vaker inderdaad Mensen die gewoon hun eten niet goed kauwen
People often choke on meat products at home
The most common specified food objects that victims choked on were meat products, and 45% occurred at home
Most people who choke to death have a medical cause
Most victims who choked to death had an underlying neurological deficit, and occurred at home or supervised facilities appear to have an appropriate initial-response intervention.
Choking accidents often don't go to the emergency room so not all data is known
However, since not all choking episodes end up in the emergency room or become fatalities, they often escape statistics.
People mostly choke on fish- and meat(bones)
67% of patients reported choking on fish bones followed by meat bones (9%) and artichokes (3%).
Chocking happens a mostly with young children and elderly
These deaths typically are peaked at the extremes of age, with young children and the elderly having the greatest rate of fatal choking.
Choking
risks


Sterfte door vallen neemt toe
Sterfte door vallen neemt toe
The amount of elderly on the ER will increase in the future
Het aantal SEH-bezoeken door een valongeval stijgt vooral door de dubbele vergrijzing: het aantal 65-plussers neemt toe en het aandeel oudere ouderen neemt fors toe
falling outcomes
A big part of the injuries when falling/fainting is caused by the hard product in the house (toilet, sink, etc.)
The toiles is the most common site of home accidents for elderly patients
The toilet was the most common site (29%) of home accident, followed by the sitting room (18%), the kitchen (14%), the bedroom (11%) and the dining room (10%)
By asking questions, the what happend can be (partly) reconstructed
Dan vraag ik altijd, goh, waar is die persoon gevonden? Is die onderaan de trap gevonden of lag die in bed? Zag je bloed in het huis, waren de tafels omgevallen
Making the toilet and sink less hard might reduce injuries
Ik maak er altijd grapjes over, maar als je gewoon de wasbak en de wc pot, als je daar een bumper omheen doet dat wat scheelt
People can't or won't use a walking aid at home
dat mensen eigenlijk een rollator nodig hebben, maar dat die binnenshuis niet past. Dus wat ze dan doen is dat ze gewoon gaan lopen van het ene naar de andere meubelstuk ja, om zich vast te houden.
Lots of elderly fall at night but can not reach out for help
Dat we helaas heel vaak zien is dat Mensen bijvoorbeeld 's nachts of In de avond vallen, Alleen thuis wonen en dan In de ochtend door de zorg gevonden worden op de grond. En daar is de hele nacht op de grond gelegen.
Every year, more people die because of falls
Elk jaar sterven er meer mensen als gevolg van een val. Vanaf 1950 is in Nederland het aantal sterfgevallen per hoofd van de bevolking bijna verzesvoudigd, van ongeveer 6,5 naar - anno 2021 – bijna 31 doden per 100.000 inwoners per jaar.


A greasy air-extractor can spread a stove-fire
People forget or get distracted while cooking and walk away, resulting in fire
A theme of 'forgot' and 'distracted' appeared in most interviews. Six interviewees reported that they left the property while cooking (i.e., picking up children, helping neighbours)
Induction stoves have a little less risk of a stove-fire
Most fires start while cooking
Cooking Hazards
A little kitchen fire (vlam in de pan) is not a high priority when it is small
Ja zeker wat gebeurt ook heel vaak, he? Bijvoorbeeld het pannetje op het vuur. Kijk Als het echt zeg maar daadwerkelijk omslaat, ja dan kan, dan kan het altijd nog een prio één worden onderweg, zeg maar
Use a lid to extinguis stove fires
Kijk, een theedoek is onverantwoordelijk natuurlijk. Als je een blusdeken hebt dat helpt, dan kan dat nog wel helpen. Maar zelfs dat is lastig, gewoon met een vlam in de pan. Deksel is het mooiste ja.
Handle with cause in the kitchen
The kitchen can be a hotspot for accidents. Use caution when handling sharp objects, turn pot handles inward to prevent accidental spills, and never leave cooking unattended. Keep a fire extinguisher nearby and know how to use it in case of a kitchen fire.





1.4. Market Research

Category	Product	Description	Costprice inc t	Where to use?	Number needed aprox.	Widely used?	Customizable	Link	Easy to store?	Mulitple versions / sellers	Efficiency	Limitations
2. Esthetics/storing safely products	fire blanket coffeetable book	Fireblanked discuised as coffeetable book	€ 56,16	Living room	1	No	Yes, different colours	https://itssafly.c	N.A	?	medium	rules and regulations, hard to access when needed, where to place it?
2. Esthetics/storing safely products	Aesthetic fire extinguiser	Aesthetic fire extinguiser	€ 102,66	Indoors	2+	No	Yes, different colours	https://itssafly.c	N.A		Low	rules and regulations, still ugly
2. Esthetics/storing safely products	chrome cover fire extinguisher	Cover for a big and round mounted fire extinguiser (company one) in chrome colour	€ 674,75	On fire extinguisher	1	Yes	Yes, different colours	https://www.bra	N.A	Yes	Low	Not often in homes, still limited options, still very visible, does not fit many styles
2. Esthetics/storing safely products, 3. K	Easthetic smoke alarms	Smoke alarms with simple, sleek model	€ 39,90	Indoors	2+	Yes	Yes, different options	https://jalohelsi	N.A	Yes	High	Still visible, hard to install, Limited colours and styles
2. Esthetics/storing safely products, 9. S	Smoke alarm in lightbulb	Smoke alarm that can be mounted in a lighbulbsockle and an lightbulb can be screwed in		Indoors	2+	No	No	https://www.yar	N.A	No	Medium	Does not work if the light is turned off for a longer period of time, still ugly, not able to use in all lamps
2. Esthetics/storing safely products, 9. S	Rainpipe ladder	Flight stairs mounted to the outside of the house that looks like a rainpipe	€ 995,00	outdoors on house	1 or 2	No	No	https://www.bra	N.A		High	Hard to install, ugly on the outside, short, hard to reach from window
2. Esthetics/storing safely products, 9. S	Flightstairs in box	Standard flight stairs stored in a box that can be mounted on a wall	€ 429,55	Indoors, next to windo	1	Yes	Yes, different sizes	https://www.bra	Yes	Yes	High	Not for people with limited abilities, ugly to store, expensive, in the walkway, scary and unstable
3. Kitchen fires	Fire extinguiser	Simple fire extinguisher to hang in your house		Indoors	2+	Yes	Yes, different sizes		No	Yes	High	Advice is not to try to to fight fire, chance of injuries, many different types, ugly, big, hard to store but easy to reach
3. Kitchen fires	fire blanket	Blanket that can be used to extinguish fires on the body		Indoors, kitchen	1+	Yes	No		Yes	Yes	Medium	Limited use, misconceptions on use, ugly, hard to store where reachable
3. Kitchen fires	Kitchen fire system	Complete systems that detect fire and extinguish them imidiately	Expensive	Indoors, kitchen	1	No	Yes, made to fit	https://www.sa	N.A	Yes	High	Expensive, specialised designed, professional kitchens only, big damage if used, takes a lot of space
3. Kitchen fires	Fire extinguiser ball	Ball that can be thrown at the fire, explodes and shares extinguisher fluid	€ 40,00	Indoors, in garden	1+	No	No	https://www.ebz	No		Medium	What if thrown wrong? Hard to store, limited effect, small fires only, what if dropped? One time use, no relakes
3. Kitchen fires	Mini fire extinguiser pen	Mini device in the shape of a big pen	€ 129,95	Indoors, in garden	1+	No	No	https://www.joo	Yes		Medium	Need to be close to the fire, small fires only, new to use,
3. Kitchen fires	Mini fire extinguiser square	Mini device you can hang above your stove (i think) that will explode when smoke detected and shares extinguisher fluid	€ 39,00	Indoors, in kitchen	1+	No	No	https://www.am	N.A		Medium	High temperature before it explodes, what if false alarm? ugly to see, hard to install, only extinguishes small fires
3. Kitchen fires, 9. Safely escaping fire	Smoke alarms	Devices that detect smoke		Indoors	2+	Yes	Yes, different options		N.A	Yes	High	Hard to install, ugly, do not prevent fire, need battery check, false alarm,
4. Floods	Door barrier	A removable barrier you can place in front of your door to keep the water out. Change size to fit all doors.	€ 749,00	Front door, backdoor	2	nda, most known soluti	Different sizes, but wide range within one size	https://www.dar	No	No	High	Does not fit all doors? Need to set up when needed, hard to store
4. Floods	Hydro Snake	Long sand-free sack that creates a temporary barrier for low water or to change direction of water	€ 28,99	Garden or doors. Doe	4	No	Yes, used in many different configuraütons. Does not work for salt water	https://www.dar	Yes	Yes	Middle high	Only for low waters, one time use
4. Floods	Snorckle Vent	Permanent cover to cover your air vents. Stops water from coming in but keeps ventillating	€ 65,00	Air vents	Depends on the number of vents	No	Yes, can be modified to right size	https://www.dar	Yes	Yes	High, if it works	Looks ugly and cheap, durable?
4. Floods	Patch strip	Rubber strip to cover disposal holes etc. During floods	€ 8,99	Disposal pipes	5?	No	Yes, can be modified to right size	https://www.dar	Yes		Middle	Where to use it? Will it work? Ugly to leave on
4. Floods	Toilet dam	Stops water comming up trough the toilet during a flood	€ 139,98	Toilet	2?	Dont know	Fits most models	https://www.dar	Yes	Yes	High	Can not use the toilet
4. Floods	Shower Dam	Protects shower and bath agains upcomming water during a flood	€ 139,98	Bathroom first floor	1	No	fits most models	https://www.dar	Yes		Middle?	Will it fit all baths? Only to be used for the bath?
4. Floods	Aluminium protection barriers	aluminium sheets that stack together to create a removable dam	€ 749,00	Front and backdoor	2	Yes	Standard sizes, but not modifiable	https://www.fru	Yes	Yes	High	Need to put on when water rises, where to store it? still fit at the bottom? Will it fit all doors?
4. Floods	High water turners	Plastic L Shaped plates that can be used to change the direction of the water or keep parts dry	€ 163,35	Outdoor, garden, stree	10+	Yes	Yes modular, but hard to use in smaller spaces	https://www.kai	No	Yes	Middle high	Big and expensive. Many needed. Used to change water direction, not to block water or keep it out. big to store
4. Floods	Water filled flood barrier	Barrier that can be filled with water to keep flood water out	€ 59,00	Outdoor, garden, stree	2	Kinda	No, one size	https://www.bol	Yes	Yes	Middle high	Uses lots of water, hard to move, how to use as barrier to keep water out
4. Floods	Plastic water blocker	Plastic shape you can use as a barrier against the water	€ 564,73	Door	2	No	Could cut to size, but sold in one size	https://en.raptor	No	Yes	Middle	Big to store, low water, will it stay?
4. Floods	Water activated dam	Small dam that is activated by water to stop larger quantities	€ 15,76	Ouside, door	2	Yes	No, one size	https://www.am	Yes	Yes	middle	one-time use, low waters, multiple needed, water gets still through?
4. Floods	Plastic dam	Plastic tarp that catches water to stop it	2.465,72	Outside, garden, stree	2	yes	No, one size	https://en.raptor	No	Yes	High	Big to store, big product needed, does not work when water can get past
4. Floods	Plastic water blocker for drain	Plastic shape to put around the drains to stop water	€ 445,05	Outside, street	1	Yes	No, one size	https://hermeq.u	No	Yes	low	Low water only, big to store, limited use
4. Floods	Flood proof doors	Doors that can withstand floods	Unknown	Doors	2	No	Yes	https://apexfloo	N.A	Yes	High	Expensive, custom-built, limited styles
4. Floods	Barriers	different types of barriers in front of your door	Unknon	doors, garden	2	No	Yes	https://apexfloo	No	Yes	High	Expensive, limited sizes, hard to store, ugly, still have to put on when rain starts
4. Floods	Flood tape	Tape to put on your house where cracks might be to keep the water out	25,37	Ouside of house	2	Yes	Yes	https://www.ebz	Yes	Yes	Middle	Will never work completely, might damage properly, still have to put it up when storm starts, never all cracks, how to get in afterwards?
4. Floods	Water activated dam sacks	Smaller sacks that activate by water and can be used as dam	€ 17,50	Outside of house, doc	10+	Yes	Yes	https://www.bol	Yes	Yes	Middle	One-time use, multiple needed, water gets still through, how to get in afterwards, put up when flood has started
5. Falling elderly	Helmet for eldelry	Soft helmet to protect the head of elderly when falling	€ 19,59	Inside of the house	1	No	Yes	Agad_source=1	Yes	Yes	Low	Ugly, only protects head, nobody wants to wear this, still have headdamage
5. Falling elderly	Airbag vest	Vest with airbag	€ 879,00	Inside of the house	1	no	Yes, different sizes	https://www.der	Yes	Yes	Low	Expensive, ugly, nobody wants to wear it, does not prevent fall, arms still exposed, might not work
5. Falling elderly	Hip protector	Underpants with hip cushions	€ 69,15	Inside of the house	2	no	Yes, different sizes	https://senso-cs	Yes	Yes	Low	Ugly, people do not want to wear it, still big part of the body is in danger
5. Falling elderly	Bed rail	Rail on side of bed to prevent elderly from falling	€ 330,00	Bed	1	Yes	Yes, different sizes	https://senso-cs	N.A	Yes	Low-middle	Prevents worse elderly, not the independed ones, prevent people to go to the toilet at night
5. Falling elderly	Bed trapresium	Handlebar to grab when getting in and out of bed	€ 99,53	Bed	1	Yes	No, one size	https://www.am	N.A	Yes	Low	Helps to get up out of bed, not during walkig or getting up
5. Falling elderly	Power walking aid	Aid to help lift legs when walking	€ 219,00	Indoors and outdoors	2	No	No, one size	https://www.fru	Yes	Yes	Middle-high	People do not want to wear this, only used during the day, people will lose their strength more quickly
5. Falling elderly	Standing help	Help to stand up from the couch	€ 69,99	Couch	1	Yes	No, one size	https://www.am	N.A	Yes	Middle	will not help during walking, big product, hard to remove, takes big place on the couch, ugly
5. Falling elderly	Standing help foldable	Foldable help to stand up and lean	€ 78,99	Bed, closet, etc.	1 (or more)	No	No, one size	https://www.am	N.A	Yes	Middle	Might be dangerous if not attached or used correctly, People start leaning more and walking badly
5. Falling elderly	Rollator	Walking aid with wheels	50+	Indoors and outdoors	1	Yes	Yes, different sizes		No	Yes	High	Big, represents old age, people do not want to use it, hard to manage sometimes
5. Falling elderly	Walking stick	Stick to help elderly walk	50+	Indoors and outdoors	1	Yes	Yes, different sizes		Yes	Yes	High	Makes people walk badly, losing it, hard to pick up, represents old age
5. Falling elderly	Rug tape	Tape to prevent rugs from slipping	€ 8,00	In house	1	Yes	Yes, can be modified to right size	https://www.am	Yes	Yes	Low	Does not prevent tripping from not lifting up feet, does not smooth out bumbs

Category	Product	Description	Costprice inc t	Where to use?	Number needed aprox.	Widely used?	Customizable	Link	Easy to store?	Multiple versions / sellers	Efficiency	Limitations
5. Falling elderly	Stairs stick	Stick to help elderly walk up the stairs	€ 165,00	Stairs	1	No	Yes, different sizes	https://www.gor	N.A.	Yes	Medium	Only used at stairs, hard to use in small stairs or with turn, unstable when not used correctly
5. Falling elderly	Shower handle	Handle to be mounted on the wall in the shower to offer extra support		Bathroom	2	Yes	Yes, different options		N.A.	Yes	Medium	Not useful when fainting, can break, ugly, hard to install, shows old age
5. Falling elderly	Grip strips in shower	Strips on the floor of the bathroom that create more grip to prevent falling		Bathroom	1	Yes	Yes, different options		N.A.	Yes	Low	Hard to clean, does not help with losing balance, limited use, feel uncomfortable, limited use
5. Falling elderly	Bath stool	Stool to sit on in the shower to prevent slipping and help people who can not stand for longer periods of time		Bathroom	1	Yes	Yes, different options		No	Yes	Low	Shows old age, people refuse to use, not how they like it, standing up is difficult and dangerous
6. Making old houses safe	fixed by contractor	Hiring contractor to fix problems	5000+	Everywhere in the hou	1	Yes	Yes, completely to your problems		N.A.	Yes	High	Very expensive, takes time and effort, unskilled contractors, might change a lot at the house, uncomfortable living for a while
6. Making old houses safe, 4. Floods	Waterappealing paint	Paint so water does not come in/get through	€ 10,00	Everywhere in the hou	2	Yes	Yes, different colours		Yes	Yes	medium	Might build up behind the paint layer, not everywhere applicable, chemicals,
7. Charging safely	High quality chargers	Use high quality chargers	20+	Indoors	1+	Yes	Yes, different options		Yes	Yes	High	More expensive than the cheap ones, not delivered with the product anymore (phones), still needs to be charged correctly, need to be thrown when damaged
7. Charging safely	Wireless charger	Wireless charger	15+	Indoors	1+	Yes	Yes, different options		Yes	Yes	High	Makes it harder to use products while charging, cheap versions available, still need to charge safely
7. Charging safely	Charging locker	Locker to safely charge and lock your products	€ 1.000,00	Indoors	1	yes	Yes, different options	https://www.bra	N.A.	Yes	High	Big, expensive, ugly, need space, permanent, target for burglars, used in one place, not able to use product during charging
7. Charging safely	Mobile power hub	Movable hub that can be used to charge products	€ 4.000,00	Indoors	1+	No	No	https://www.sec	No	Yes	Medium	Big, expensive, ugly, needs space, barely any added value
7. Charging safely	Charging cable hook	Hook and arm to hang charging cable to not get it damaged	€ 100,00	Indoors and outdoors	1	No	Yes	https://www.am	N.A.	Yes	Medium	Big, ugly, actually needed?, for car chargers and big cables only
7. Charging safely	Smart Home charger	Smart home charger	€ 650,00	Indoors and outdoors	1	Yes	Yes, different colours	https://www.blu	N.A.	Yes	Medium	Big, little added value, what if damaged
7. Charging safely	Charging dock	Stationairy charging dock to charge powerbanks	€ 180,00	Indoors	1	Yes	Yes, different options	https://www.am	Yes	Yes	High	Chance of overheating, not wanting to charge with powerbanks, chance of damaging powerbanks, chance of overcharging
7. Charging safely	Multiple output charger	Charger with multiple output points	€ 70,00	Indoors	1	Yes	Yes, different options	https://sharge.c	Yes	Yes	High	Chance of overheating, chance of damaging, chance of overcharging, still needing to safe charging behaviour
7. Charging safely	fire safe battery bag	Bag to store and charge e-bike battery, fire resistant	€ 26,00	Indoors	1	No	Yes, different options	https://www.am	No	yes	Medium	Big, ugly, not greatly ventilated, does not prevent overcharging
7. Charging safely	Accu protection cover	Cover to protect the battery of the E-bike for cold and/or damage	€ 24,90	Indoor and outdoor	1	No	Yes, different options	https://www.am	Yes	Yes	Medium	Might overheat the battery
7. Charging safely, 8. Feeling of controlli	Electricity meters/fuses	Extra fuses and measuring on electricity	€ 300,00	fusebox	1	Yes	Yes, different options	https://www.eib	N.A.	Yes	Medium	Hard to install, limited protection for small devices
7. Charging safely, 8. Feeling of controlli	Tijdschakelaar	Select time how long electricity works	€ 16,50	Indoors	1+	Yes	Yes, different options	https://nl.bauha	N.A.	Yes	Medium	Still needs to be charged safelly, ugly, big
7. Charging safely	Charger case	Case to transport chargers	€ 5,00	Outdoors	1+	Yes	Yes, different options	https://nl.bauha	Yes	Yes	Medium	Does noting else than protect against damage while transporting
7. Charging safely	High quality extention cords	High quality extension cord	€ 15,00	Indoor	1+	Yes	Yes, different options	https://nl.bauha	Yes	Yes	Medium	What if multiple pluged in each other. Still safe charcing behaviour needed
7. Charging safely	Smart plug	Plug for in your own plugs to make it a smart product	€ 22,30	Indoor and outdoor	1+	Yes	Yes, different options	https://nl.bauha	N.A.	Yes	Medium	Limited protection, chance of hacks
7. Charging safely, 8. Feeling of controlli	Electricity measuring device	A device that measures the elecitricity used by the device pluged in to get more insight	€ 10,00	Indoor	1+	Yes	Yes, different options	https://nl.bauha	N.A.	Yes	Low	Get insight, barely protection,
8. Feeling of controlling your safety	Home camera's	cameras to survaillance your home	30+	Indoors and outdoors	1+	Yes	Yes, different options and placements	https://tweakerr	N.A.	Yes	Medium	Does barely to not protect against burglary. Might make people more scared. Privacy sensitive
8. Feeling of controlling your safety	Home security system	System to alarm your house during burglaries	€ 200,00	Indoors and outdoors	1	Yes	Yes, different options and placements	https://www.cor	N.A.	Yes	Medium	Does barely to not protect against burglary. Might make people more scared. false alarms
8. Feeling of controlling your safety	Doorbell camera	Cameradoorbel	120+	Outdoors	1	Yes	Yes, different options	https://www.pra	N.A.	Yes	Medium	Does barely to not protect against burglary. Might make people more scared. Privacy sensitive. Not made for security purposes
9. Safely escaping fire	EvaCord	Cord with special handles to easily and safe guide children out of a building	€ 28,80	In building with many	1+	Yes	Yes, different options	https://bhvlolaa	Yes	Yes	Medium	Use in case of big number of (small) childen, does not do anything to secure safety
9. Safely escaping fire	Evaccuation sheet	Sheet to evacuate people who are not able to walk on their own	€ 125,24	Indoors	1+	Yes	Yes, different options	https://bhvlolaa	Yes	Yes	High	Might hurt the patient, hard to drag, needs to be put undereath the matress
9. Safely escaping fire	Window hammer (car?)	A hammer that can safely break the (car) window when needing to escape and cut through seatbelts	€ 17,97	Car, indoors?	1+	In car, yes, not in house	Yes, different options	https://bhvlolaa	Yes	Yes	High	Glass might injure, needs to be stored close to window/easy to reach, What if it does not work?
9. Safely escaping fire	Evacuation chair	Special chair that allows people to evacuate people who can not walk themselves along the chairs	€ 1.076,90	Indoors	1+	Yes	Yes, different options	https://bhvlolaa	No	Yes	High	Only one patient at a time, needs someone to push, might be heavy to push,
9. Safely escaping fire	Evacuation braincard	Braincard to evacuate bedridden people	€ 798,60	Indoors	1	Yes	Yes, different options	https://bhvlolaa	No	Yes	Medium	Only one patient at a time, needs multiple people to use, might be heavy to use, might be hard to put someone on it
9. Safely escaping fire	Rescueseat	Band to connect between 2 people to let a child who can not walk sit there	€ 118,58	Indoors and outdoors	1	No		https://bhvlolaa	Yes		Medium	Hard for the two people to walk, chance of falling of, how to get up,
9. Safely escaping fire	Blindmask	Mask that limits the sight to practice how smoke limits the sight. During fire drills	€ 15,49	Indoors	1+	No	Yes, different options	https://bhvlolaa	Yes	Yes	Medium	Will people use it, not likely in reallife
9. Safely escaping fire	Flashlight	Flashlight to enable sight during fire/blackout	€ 23,96	Indoors and outdoors	1+	Yes	Yes, different options	https://bhvlolaa	Yes	Yes	Medium	Will not work with a lot of smoke, needs to be found during fire,
9. Safely escaping fire	Canvas flight stairs	Flight stairs made from canvas	€ 140,00	outdoors on house	1+	No	Yes, different sizes	https://icbrindle	Yes	Yes	Medium	Hard to climb, needs to be secured really well, made to be used on boats,
9. Safely escaping fire	SOS balloon	Balloon to let up to sign you need help	€ 200,00	outdoors	1+	No	Yes, different options	https://www.spr	Yes	Yes	Medium	Only when visible, not quick enough during fires
9. Safely escaping fire	Fire escape shutes	Shutes/slide to escape the building during fire	Expensive	Outdoors on house	1+	No	Yes, different sizes	https://www.the	Yes	Yes	High	expensive, mightb be scary, big and hard to store and mount
9. Safely escaping fire	Self rescue device	Catrol/abseil product that lets you go down the building safely	ittle expensive	Indoors and outdoors	1	No	Yes, different sizes	https://www.the	Yes	Yes	High	Only be used once, only one person at a time, expensive, make sure you do not fall, no children and parents together option
9. Safely escaping fire	Safety air cushion	Cushion to jump from high buildings	Expensive	Outdoors	1	Yes	Yes, different options	https://www.the	No	Yes	High	Needs to be setup outside, scary, fast enough during a fire? scary, expensive, place in garden needed
9. Safely escaping fire	Permanent escape slides	Escape slides that are permanently mounted to the house	Expensive	Outdoors	1	No	Yes, made to fit	https://www.wir	N.A.	Yes	High	Big, expensive, ugly, need space, permanent, target for burglars
9. Safely escaping fire	Emergency handles	Handles that quickly open the door	€ 100,00	Indoors, on doors	1+	Yes	Yes, different options	https://www.saf	N.A.	Yes	High	Ugly, needs to be installed before, hard to install, specific type of door,
9. Safely escaping fire	Key guards	Place to store the key/other stuff. Break in case of emergency	€ 10,00	Indoors	1+	Yes	Yes, different options	https://www.saf	N.A.	Yes	High	Easy for intruders to grab, ugly, visible for everyone where keys are
9. Safely escaping fire, 7. Charging safet	Temporary firemask	Mask that filters the air on toxins for 10 minutes, enough to escape the fire	€ 44,63	Indoors	1+	No	Yes, different options	https://bhvlolaa	Yes	Yes	High medium	What if there is not enough air? Need one for everyone, not too effective, does not filter CO2
8. Feeling of controlling your safety	Air quality measurement device	Device that measures the air quality of its surroundings	€ 27,54	Indoors	1+	No	No	https://www.bol	Yes	Yes	medium	Gives insight but does not propose or show what actions to take next/improve.

1.5. Trends

1.5.1. Future trends

Why

Although the future is uncertain, emerging trends can already be identified. Anticipating these developments enables companies to prepare strategically and respond to evolving customer needs, making an understanding of future trends essential for long-term positioning. Based on these insights, potential solution directions were identified.

How done:

Leads for potential future trends were identified throughout the research process, including during interviews with consumers and professionals, discussions with supervisors and colleagues, and the literature review. These leads often emerged as subtle signals, such as participants expressing concerns about increasing occurrences, references in academic sources to an “increasing risk” or “growing likelihood,” or professionals indicating possible future developments.

Leads that demonstrated the strongest relevance and potential impact for the project were investigated in greater depth. This was done through targeted literature research and follow-up discussions with domain experts.

1.5.2. Ongoing trends

Limits:

Using Google Trends, specific search terms were compares on how often selected terms were used in the Netherlands over the past year compared, March 2025 until March 2026, to each other. The terms “Brandblusser”, “Zandzak”, “Rookmelder”, “Rollator”, “Aannemer”, “Brandladder”, “Oplader” and “Ring deurbel” were compared in the analysis. Although this data does not provide precise insights into motivations, it does offer a general indication of relative interest.

However, this approach to identifying trends provides only limited insight into actual developments. The use of search terms restricts the analysis to the exact wording entered, meaning that variations or related terms may be excluded. For example, searching for “overstroomd” does not capture results for “overstromingen” and searching for “brand” may yield unrelated results, such as company names (“Brand new day”) or general news articles, rather than specifically fire-related content. Similarly, for products such as a doorbell camera, users may employ a variety of search terms (e.g., “doorbell camera,” “Ring doorbell,” or similar variations), which are not automatically aggregated.

In addition, Google Trends presents data in relative terms rather than absolute search volumes. The highest search interest within a given dataset is assigned a value of 100, with all other data points scaled accordingly. As a result, it is not possible to determine the actual number of searches, nor to directly compare different search terms in absolute terms, as each is normalized within the selected dataset.

Given these limitations, the results of this analysis should not be interpreted as precise measurements of trends, but rather as indicative signals or insights into current areas of public interest. Nevertheless, they will provide useful indications of topics that are receiving increased attention at the moment and can be used for selecting a project scope with high potential in the future.

1.6. Alprokons Identity

1.6.1. Hedgehog model

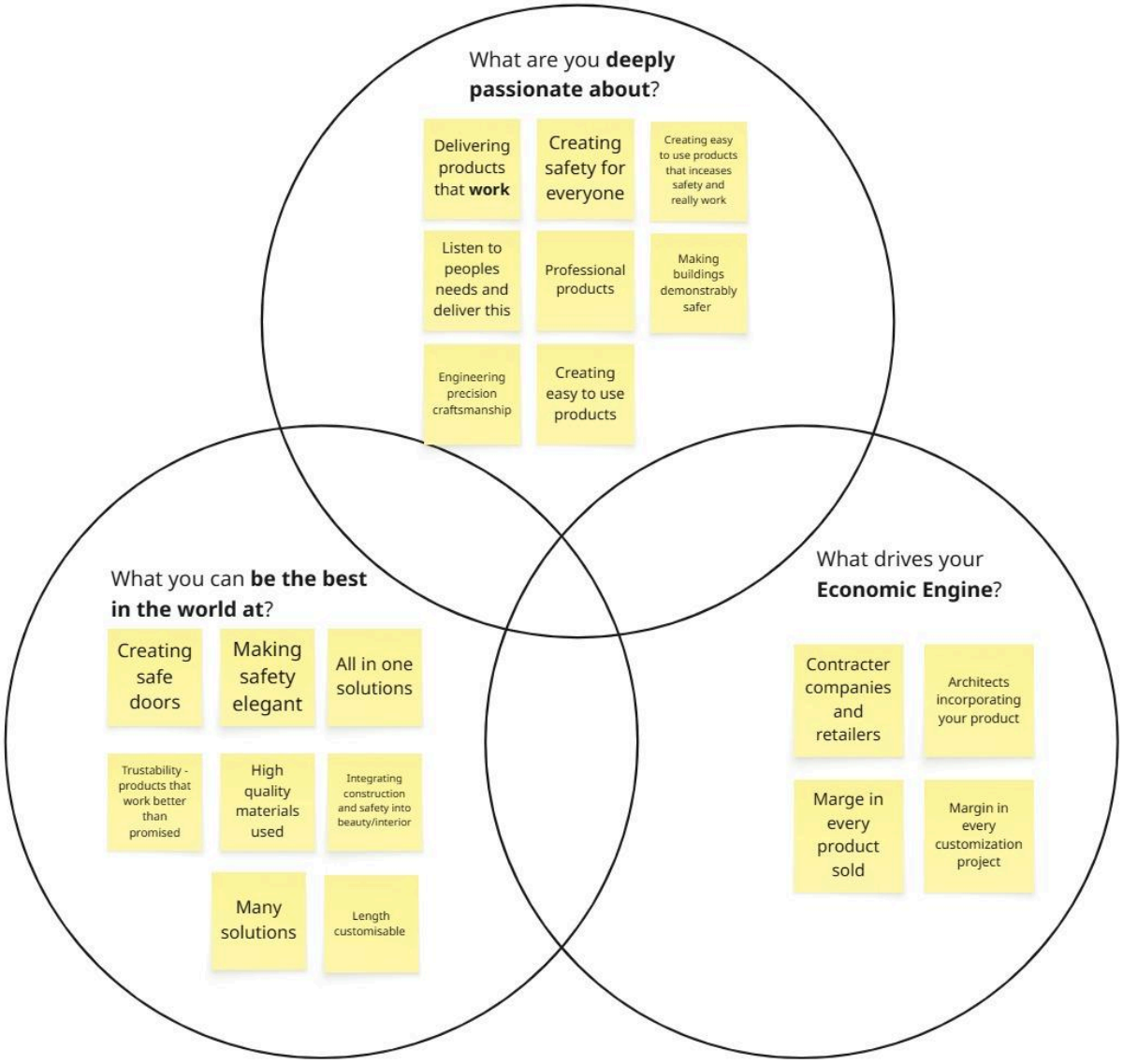
Why
In his book, Good to Great, Jim Collins (Collins, 2001) introduces the Hedgehog model. A way to find the core competence of a business; what is the company truly good at. When found, this is something to build on. Applying the model to what Alprokon does now, is different than what Alprokon is trying to achieve. Therefore the hedgehog model was also applied to the new focus.

How

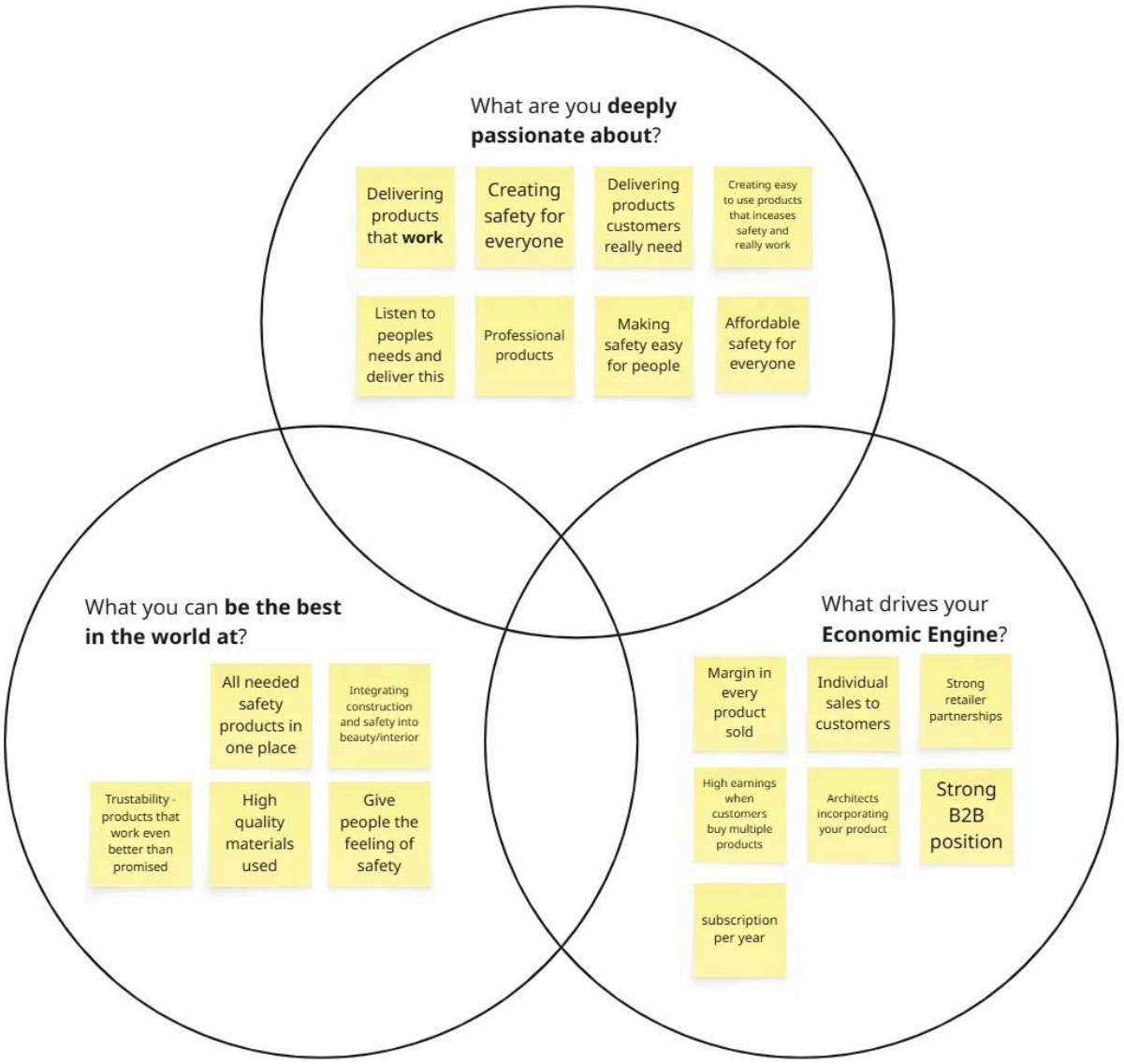
The Hedgehog Model was applied by assessing Alprokon against its three core questions: what the company is deeply passionate about, what it can be the best in the world at, and what drives its economic engine. Insights to inform these questions were primarily derived from multiple informal conversations with employees.

The outcome of this analysis provides an initial, basic-level objective for the company. While a more in-depth, multi-layered investigation could yield a more precise result, this level of analysis was considered sufficient for the scope of the current project.

Conclusion
Applying the Hedgehog model on Alprokon, as seen in figure #, the following core competence is found: *Designing and manufacturing high-quality, neatly integrated double-door closing and safety systems where provable safety and appearance are key - driving profit through premium positioning and margin in products.*



Hedgehog model of Aplrokon currently



Hedgehog model of Aplrokons envisioned project “elkeruimteveilig.nl”

1.6.2. SWOT analysis

How done:

An assessment of Alprokon was done through objective observation and analysis of the company’s activities and positioning. This assessment focused on identifying strengths, weaknesses, opportunities, and threats (SWOT).

Insights were further enriched through multiple informal conversations with employees of the company, as well as professionals with experience in the building sector. In addition, findings from the previously done literature review and trend analysis were incorporated into the assessment.

Complete conclusion:

Strengths

- **Lots of technical knowledge (extrusion, door specifications, manufacturing, etc.)**
- Lots of knowledge on rules and regulations (Safety, building and contractors, certificates, etc.)
- Extensive aluminium workshop

- **Strong brand identity**
- Unique communication to possible customers (marketing and fairs)
- Strong market position in doorneedles
- **Strong ties with resellers**
- Some collaborations and all-in-one projects (Centerparcs)
- Ability to join new market segments (valbeveiliging)

- Drive for high quality products
- Drive for higher efficiency
- Innovative menality trougout company
- Mentality to experiment with new things
- Strong sales team
- Motivated team
- Stable revenue stream

- Patents on doorneedles
- Clear product focus; aluminium safety products
- One clear main product, with multiple side products

- **Elegant and clean products**
- **Provable safe products**
- Many different versions on the product
- Possibility to customise products
- **Products fit different customer needs; fire proof, sound proof, etc.**

Weaknesses

- Expensive products
- (long) waiting times on deliverables
- **One main source of income; doorneedles**

- **No sales to private end-consumers (B2C)**
- Limited direct sales to customer (mostly trough retail)
- Limited contact with end-user/end customer
- **Barely any name-fame to customers**
- Can not grow unlimitedly; Limited amount of new buildings to be build and renovated each year
- Company immage will not work for consumers
- Many competitors

- Limited different types of products sold
- Not a complete product; needs to be attached to other products to work (not complete doors sold)
- Does not prevent disaster (like prevent fire) but limits problematic outcomes (smoke inhallation, spreading, etc.)
- **Only focus on fire and smoke safety, no other unsafe situations**
- **Products are barely applicable in a standard house**

- Not too efficient production process/workshop
- Not a dedicated R&D department
- Workshopworkers with a low optimisaion mentality

- Limited amounts of all-in one projects
- Lots of advice to be given before sale

- Use of virin materials in product
- No/limited recycle program

Opportunities

- **Rise in safety-awareness consumers**
- Go to customer market/private sector
- Become the place to buy all types of safety products
- Offer safety knowledge to end-customers
- Sell directly to customers, not trough retail

- Multiple material and colour products
- Solutions for different types of doors (materials, type, etc.)
- **Create a solution that focus on other safety than fire safety; Like falling, water protection, charging safely, burglaries, etc.**
- **Create a solution that are made for other things than doors**
- **Low-cost safety solutions**
- Create a solution that will become statementpieces in peoples homes
- Create a solution that has multiple purposes
- Create a solution that changes a persons opinion about safety
- Create a solution that gives people a sense of controll

- Manufacture new product out-house

- Offer installation services
- **Offer complete packages with all needed for safety and installation services**
- Create a solution that can be sold by playing in on the fears of people
- Create a solution that will have a high cost-benefit outcome.

- Government changing and sharpning fire-safety regulations
- General shift of focust to building safer buildings
- Governmental focus on building more buildings
- create product that will be obligatory to have in your house

- **Grow in IOT solutions and opportunities**
- Rise in sustainability and lifecycles of products

Threats

- Customers have a limited amount of money they want to invest
- Alprokon has a limited amount of money to invest
- Limited willingness of consumers to change behaviour

- Limited amount of doorneedles to be sold
- Increase in glass (and other material) doors
- Competitors creating similar products

- Rising material costs
- Tight labour supply
- Supply chain problems
- Rising electricity costs

- Changes in willingness of consumers to invest in fire-safety
- **New upcomming safety-risks, like floods, charging fires and war**

- Government changing laws and regulations
- **Changing focust to remoddelling buildings instead of building new ones, resulting in fewer double doors**
- Ending focus and innovation on safe building (trend)

- Shift in how people perceive safety
- More focus on sustainability and life-cycles of products
- Consumers are more focused on the aesthetic of their homes
- There is less of a I-will-fix-it-myself and more of a I-will-call-a-contractor type of mentality
- (rise in) cybercriminality

1.7. C-boxes

How it was done:
The identified problem scopes were evaluated against the findings from the market, trend, and company analyses. Criteria such as market opportunities, relevance to future trends, strategic fit within Alprokon, and consumers' willingness to invest were used to establish a comparative hierarchy among the problem scopes.
The positioning of each scope is based on all collected research data as well as insights from informal conversations. While the exact placement may vary depending on the perspective applied, the C-boxes are intended to provide a general comparative overview rather than a precise measurement. To account for potential uncertainty in positioning, the "highest potential" zones are deliberately defined with broader boundaries.

Appendix 2: Chapter 2

2.1. Additional research done

2.1.1. Interview Wacht niet op Water

Why
Wacht niet op Water is an initiative by the Limburg municipalities, the Province of Limburg, and the Dutch government under the program Waterveiligheid en Ruimte Limburg (WRL), established after the floods of 2021. In addition to flood prevention, the initiative focuses on increasing awareness among residents by providing information about flood risks, preparation and response. Their gathered insights offer valuable information about current flood-prevention behavior, consumer perceptions, and existing market solutions.

How
An online interview of approximately one hour was conducted with an advisor from WRL. During this interview, questions and follow-up discussions were held regarding flood risks, consumer behavior, and current preventive measures. The questions asked can be found in appendix #.

Interview questions

Over Wacht niet op Water

- Kunt u iets vertellen over *Wacht niet op Water*? Wat is de missie van het initiatief en hoe proberen jullie die te bereiken?
- Wat is uw rol binnen het project?
- Waar zijn jullie nu veel mee bezig?

Overstromingen en risico's

- Op wat voor soort overstromingen richten jullie je vooral? En op wat voor "oplossingen" daarvoor?
- Hoe en hoe snel kunnen dit soort overstromingen ontstaan?
- Waar zit volgens jullie het grootste gevaar wanneer een huis overstroomt?
- Waar komt het water het huis binnen? Wat is het grootste probleem daarbij?
- Komen kleinere overstromingen vaak voor?

Ervaringen van inwoners

- Jullie delen verschillende verhalen van mensen die een overstroming hebben meegemaakt. Komen inwoners ook zelf bij jullie met hun ervaringen? Wat speelt er dan veel bij mensen?
- Welke problemen of zorgen horen jullie het meest van mensen die een overstroming hebben meegemaakt? Wat voor advies kunnen jullie dan bieden?
- Waar zijn mensen het meeste bang voor?
- Waar is de meeste schade?

Bescherming van woningen

- Met wat voor maatregelen zijn jullie veel bezig?
- Welke adviezen geven jullie inwoners om hun huis beter te beschermen?
- Op welke plekken komt water meestal een huis binnen? En hoe snel kan dat gaan?
- Hoe bereiden mensen zich momenteel voor op mogelijke overstromingen?
- Tegen welke problemen lopen mensen aan wanneer ze hun woning willen voorbereiden op wateroverlast? En welke eisen of verwachtingen hebben ze bij oplossingen of producten?
- Waarom zouden mensen hun huizen niet voorbereiden op water? Wat houdt mensen tegen?

Toekomst en beleid

- Wacht niet op Water is gericht op de provincie Limburg. Denkt u dat vergelijkbare initiatieven ook in andere provincies waardevol zouden zijn?
- Waar zijn volgens jou nog punten om op te verbeteren? Wat missen mensen voor mogelijkheden om hun huis te kunnen beschermen?

Conclusion

The interview revealed that water most commonly enters homes through doors, basements, and crawlspaces, often via basement windows, ventilation openings, and drainage systems. Basements were identified as particularly dangerous areas during flooding events.

Responses to flood-prevention campaigns run by Wacht niet op Water vary. Negative reactions are often linked to the belief that flood protection is solely the government's responsibility or that flooding is unlikely to happen personally. Positive responses mainly come from people seeking preparedness, safety, and financial protection.

Existing flood-prevention products are frequently perceived as large, heavy, difficult to store, and time-consuming to install, especially for elderly or less mobile users. In the 2021 floods, many residents were unable to deploy barriers because they were away from home.

The interview also emphasized the severe financial consequences of flooding. Even limited water ingress can result in major damage to floors, walls, furniture, and electrical systems, often leading to repair costs of thousands of euros.

2.1.2. Municipality of Valkenburg

Why
In July 2021, extreme rainfall caused severe flooding in parts of Limburg, Belgium, and Germany, with Valkenburg being one of the most heavily affected municipalities. Contact with the municipality was established to gain insight into the causes, impact, and consequences of the floods.

How

Through email contact, a municipal staff member from Valkenburg provided answers to several questions and shared additional information regarding the impact and aftermath of the flooding.

Conclusion

The floods had a major impact on Valkenburg and its residents. Businesses in the touristic city center were particularly affected, with extensive damage to buildings, inventory, and especially basement storage. Long insurance processes and drying periods delayed reconstruction, resulting in prolonged business closures and financial losses.

Although the floods were exceptional, the municipality recognizes the possibility of future events. As a result, several preventive measures have been implemented, including raised pavements, improved drainage systems, measures against mudflows, and information and subsidy programs to help residents better prepare for flood risks.

2.1.3. Literature research

Why
Initial research already revealed several relevant insights regarding flooding. However, to develop a suitable product solution, a deeper understanding of floods, their causes, consequences, existing preventive measures, what and how information is provided, future relevance and current market solutions was required. Literature research was conducted to create a comprehensive overview of the flood-prevention landscape and identify opportunities for innovation.

How
A broad range of reliable sources was used to answer the different research questions. Scientific papers, reports, news articles, podcasts, brochures, and online publications were analyzed to investigate topics such as flood causes, future relevance, damage consequences, existing solutions, and public awareness. In addition, insights and starting points from interviews and conversations were further explored through online research.

Conclusion
The findings from the literature research aligned closely with the insights gathered during interviews. Together, these results provided a comprehensive understanding of flooding, current preventive measures, and existing gaps in the market. The combined findings are elaborated in Chapter 2.1.2.

2.2. Extra information floods in the past

The Netherlands has experienced several major floods, most notably the North Sea flood of 1953. A severe storm and spring tide caused multiple dike failures, resulting in 1,836 deaths and approximately €5.4 billion in damage. Since then, flood protection has become a major priority in the Netherlands (Ministerie van Infrastructuur en Waterstaat, 2026).

More recently, in the summer of 2021, extreme rainfall caused severe flooding in parts of Limburg, Belgium, and Germany. In some areas, up to 150 mm of rain fell within 48 hours. Local rivers overflowed, flooding villages and causing extensive damage. Evaluations showed that part of the impact could have been reduced through better preparation and infrastructure. Since then, the Province of Limburg and the Dutch government have implemented additional flood-prevention measures (KNMI, 2025; Asselman et al., 2022).

On July 21st, 2024, extreme rainfall caused flooding in Enschede, with some areas receiving over 60 mm of rain within half an hour. Although the city's drainage systems were technically designed to handle such rainfall, earlier heavy showers that day combined with the city's low elevation led to flooding in multiple neighborhoods. Dozens of homes were flooded by both rainwater and sewage water and were later declared uninhabitable due to contamination and water damage (NOS Nieuws, 2025; Perree, 2026).

Cities such as Rotterdam and Dordrecht regularly face high water levels, especially in areas outside the dikes ("buitendijks gebied"). In Rotterdam alone, around 40,000 residents live in these risk areas (Gemeente Rotterdam, n.d.). Measures such as sandbags and removing cars from quays are regularly required, as water overtopping the quays is not uncommon (NOS Nieuws, 2026a; AD, 2018; RTL, 2013). Although these areas are designed with flood risks in mind, additional household flood protection could still be valuable.

Flooding is not only a problem in the Netherlands, but worldwide. While some regions naturally face higher flood risks, climate change is increasing both the frequency and severity of floods globally. In many countries, flood-prevention infrastructure and preparedness are less developed than in the Netherlands. Recent examples include severe floods in Valencia in 2024, Morocco in 2025, and Texas in 2025 (Gilliver, 2026; BBC News, 2025; Columbia Climate School, 2025).

2.3. Current flood protection products available

Expandable door barrier



+ Fits many sizes of doorways
+ High efficiency
+ sturdy
+ simple steps to set up
+ Quick to set up
+ Nothing that needs to be attach beforehand

- Big and bulky
- Hard to set up for people with limited abilities
- Hard (and ugly) to store
- Need to be home to set up
- Need a place on the door to set up (not fit backdoor)
- Pricy

Water activated hydro snake



+ packages small
+ Big area that is covered
+ different ways and locations to use
+ Fits all types of doors
+ Easily stored
+ Can be used in other places than doors

- Limited hight can be reached
- Not 100% efficiency
- One time use
- Need to be home to setup
- Can be heavy to remove

Air vent cover



+ One time effort to install
+ always protected

- Limited amount of water gets in this way
- Many other solutions

Aluminium flood barrier



+ High efficiency
+ Easier for people to install
+ Exact fit
+ Multiple solutions

- Hard to store
- Needs to fit exact: Custom size
- Big parts that need to be mounted beforehand
- Need to be home to setup
- Might be still hard to set up for people with limited mobility
- Pricy

L shaped water barriers



+ High efficiency
+ Easier for people to install
+ Can be used in different ways
+ Customable size

- Hard to store
- Does not fit all doors
- Need to be home to setup
- Might still have gaps letten water trough
- Pricy

Water filled Dam



+ Easy to store
+ Can be easy for people to install
+ Can be used in different places
+ Most people have a water connection
+ Reusable

- Might not fit door etc. exactly
- Need to be home to setup
- Might still let water through (Not 100% effective)
- Might be hard to move once full

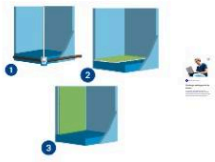
Drain cover tape



+ quick and easy solution
+ Everybody can do this
+ could stay on for long?

- will it work 100%?
- Not the biggest way water gets in
- Looks ulgy
- Not a professional solution

Catch water in the basement



+ Solves problem outside of floods
+ Multiple places/locations solution
+ Works for long

- will not work 100%, water still gets in
- Will it work efficient enough during floods?
- Big investment/assembly
- Need a professionals opinion
- Will not work everywhere
- Electricity/pump needed

Waterproofing the basement



+ Solves problem outside of floods
+ Big problem of many people
+ Works for long

- Needs to be judged/done by a professional
- Needs regular maintainance
- Big investment
- Will not work for all basements
- Might create more problems (mold, etc.)

Silecone dam



+ Can be easy for people to install
+ Can be used in different places
+ Reusable

- Might not fit door etc. exactly
- Might still let water through (Not 100% effective)
- Hard to store
- Not for high floods
- Pricy

Higher koekoek



+ Big impact/improvement
+ solves way water gets in easily
+ Professional solution

- Big investment
- Needs to be done by professionals
- Impact on appearance of the house
- Impact on working of the de basement (light, air, etc.)

Sewage Anti-Backing



+ Solves the problem with sewage water/floods
+ Works automatically
+ One time investment
+ Still able to use the sewage

- Big investment
- Needs to be installed by professionals
- Big and complicated installing
- Rainwater needs to be disassembled of sewage
- Need to be always reachable (by put o.i.d.)

Water activated dam



+ Easy to store
+ Can be easy for people to install
+ Can be used in different places
+

- One time use
- Might still let water through (Not 100% effective)
- Might be hard to move once full
- Limited how high flood can be
- Need to be home to setup
- Not used for salt water

Tarp dam



+ Easy to store
+ Can be easy for people to set up
+ Can be used in different places
+ Strong and effective

- Limited how high flood can be
- Can it be used in front of doors and houses?
- Water might go through the sides
- Need to be home to setup
- Pricy

Silecone dam



+ Can be easy for people to install
+ Can be used in different places
+ Reusable

- Might not fit door etc. exactly
- Might still let water through (Not 100% effective)
- Flood can be limited height
- Hard to store
- Pricy

Plastic water barrier

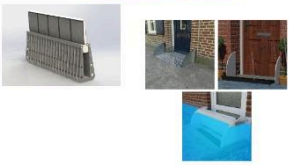


+ High efficiency
+ Easier for people to install
+ Exact fit
+ Multiple solutions

- Hard to store
- Custom size
- Big parts that need to be mounted beforehand
- Need to be home to setup
- Might be still hard to set up for people with limited mobility
- How to get in the house after putting it up?
- Pricy

Self rising water barrier

https://apexflood.com/products/



+ High efficiency
+ Self activating
+ Always ready
+ Barely any noticable things when not in use

- Big investment
- Big installment needed
- Limited hight of flood
- How are the sides arranged?
- Pricy

Waterproof gate

https://apexflood.com/products/



+ High efficiency
+ Different options available
+ Will always work
+ No need to set anything up
+ Not noticable it is for floods

- Big investment
- Might not work if damaged
- Limited companies provide this
- Limited locations to be used
- Pricy

Waterproof door



+ High efficiency
+ Different options available
+ Will always work
+ For high floods too

- Big investment
- Might not work if damaged
- Limited companies provide this
- Pricy

Sand bags



+ Widely available
+ Different ways and locations to use
+ Fits all types and sizes of doors
+ Can be used in other places than doors
+ Widely known
+ Cheap solution

- Need a lot of bags to cover a small space
- Limited hight can be reached
- Not 100% efficiency
- Need to be home to setup
- Heavy work
- Where to get sand?

Water filtration crates



+ Stores a lot of water
+ Benefits all year around
+ Will always work
+ Will lead water directly to the ground

- Big investment
- Big and professional assembly needed
- Does not work for big floods
- Inreases the ground-water-level
- Hard to fix when broken/full
- Pricy

Tape to waterproof



+ quick and easy solution
+ Everybody can do this
+ Temporary
+ Easy to store
+ low investment

- Will it stay during a flood?
- Small chance it will work 100%
- Not a professional solution
- How to get in the home after taping?

Water activated sandbags



+ different ways and locations to use
+ Fits all types of doors
+ Easily stored
+ Can be used in other places than doors

- Limited hight can be reached
- Not 100% efficiency
- One time use
- Need to be home to setup
- Can be heavy to remove
- Need multiple



+ Gets water out of the house
+ Fits all types of spaces
+ Easily stored
+ Often used

- Water is already in the house
- Limited amount of water able to move per minute
- Need to be home to setup
- Can be heavy to replace
- Needs electricity to work

Temporary covering windows/doors with wood



+ Low cost
+ Removable

- Limited efficiency
- Takes hard work
- Might damage house

Building a dam



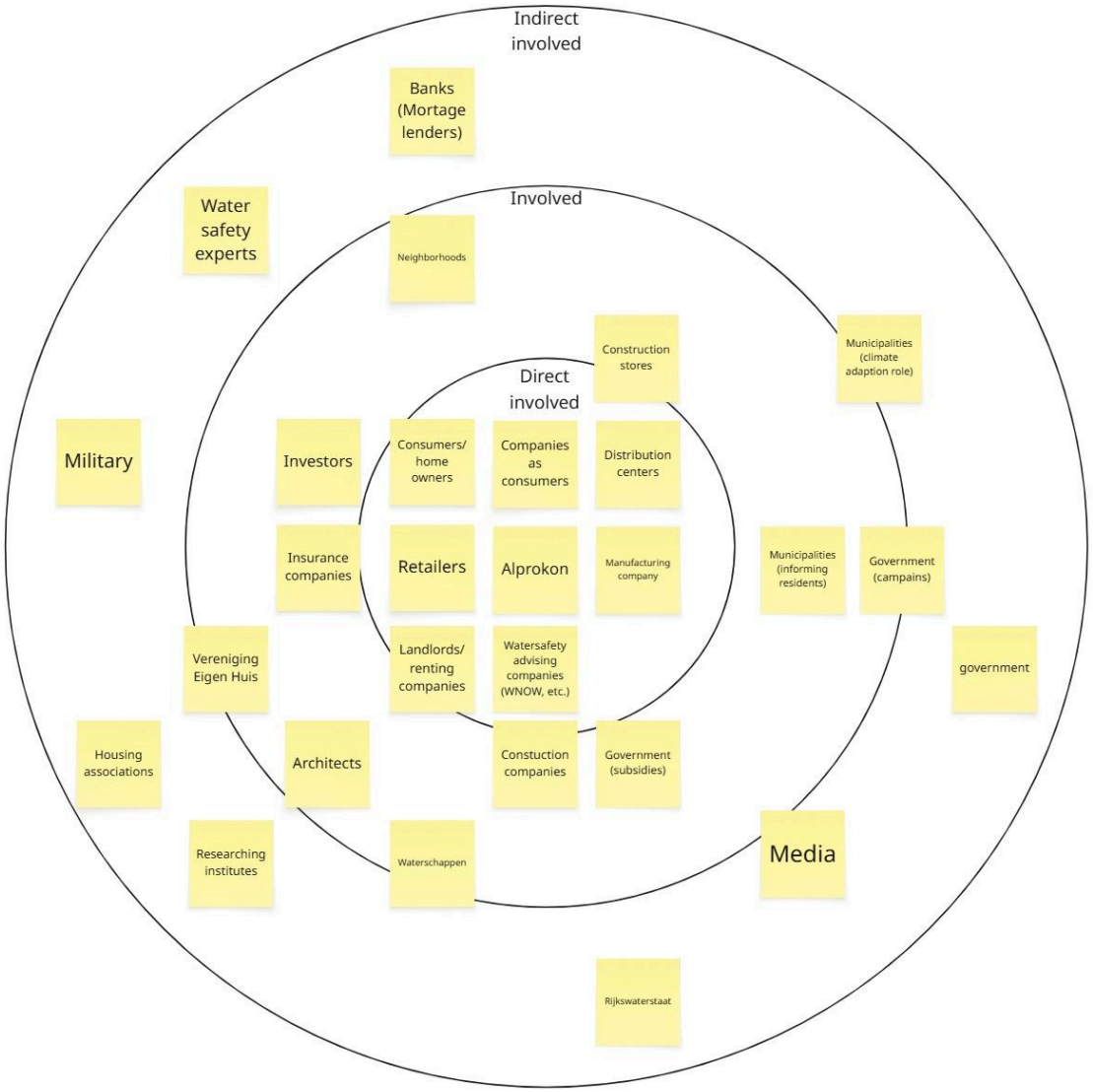
+ Permanent solution
+ Oftentimes effective
+ can be integrated in the apperance of the house

- Changes landscape of the house
- Limited hight of floods
- Probably needs to be done by professionals
- Does not fit all houses
- Might become pricy

2.4. List of wishes and requirements

Theme	Requirement	Theme	Wish
Lifespan	The product must have a shelf life of at least 10 years	Lifespan	The shef life of the product should be as long as possible
Application	The product must stop water from entering through the backdoor	Application	The product should be able to be used for different types of doors
	The product must be applicable for houses all over the Netherlands		The product should also be applicable for windows
	The product must work for floods due to rivers flooding and heavy rainfall		The product should also be applicable for businesses
	The product must not create any dangerous situation due to bacteria from the contaminated water that could stay behind		The product should also be applicable for houses outside of the Netherlands
			The product should also work for floods due to sea floodings
Cost	The product should not cost more than €1.000	Cost	The product should be as cheap as possible
Installing	The product must work for all types of single outward-opening doors	Installing	The product should be able to be installed with a basic toolset
	The product must be able to be installed in different sizes of doors		The product should be able to be installed without the help of professionals
	The door must be able to work normally when the product is installed		There should be as little as possible permanent changes to the house
	The product must be able to be added to already existing doors		The product should change the looks of the house as little as possible
	The installation must be able to be done within 1 day		The door should not have to be adapted to fit the product
			Normal use of the door should not have an impact on the working of the product
Setting up	The product must be able to be activated/set up within 15 minutes	Setting up	The door should automatically be sealed when floods happen, without any setup from the onsumer required
	No specialised tools must be needed to set up the product		Setting up should be as quick as possible
	Setting up the product must be intuitive		Setting up should be intuitive
	Setting up the product must be perceived as easy to do		Setting up should require as little tools as possible
			The product should be able to be set up by people with limted abilities
During floods	The product must work for at least 2 days	During floods	There should not be any water getting into the house
	Maximum 1 L per hour can get get into the house		There should not be any water entering the home when the door is opened.
	In case of an emergency, the door must be able to be opened when the product is activated		The working of the product should be able to be tested
Properties	The product can not contaminate the floodwater	Properties	The product should be environmentally friendly
	The product must be able to be thrown away in the regular waste facilities		The product should be recyclable
	The product must not weigh more than 5 kilos		The product should weigh as little as possible
	The product must be smaller than a moving box (30x40x58 cm) when stored		The product should be as small as possible when stored
	The production must give people a feeling of safety		The product should be able to be stored close to the door
			The product should always be ready to use
Production	The product must be able to be sold trough a website	Production	The product should be able to be made or assembled at Alprokon
	The product must be able to be shipped to consumers		The product should be able to be sold through resellers
	The product must carry the "Elke ruimte veilig" name		

2.5. Stakeholder Map



Appendix 3: Chapter 3

3.1. Complete list of requirement and wishes

Desirable, from chapter 4
Feasible, from chapter 5
Viable, from chapter 6

Theme	Requirement	Theme	Wish
Lifespan	The product must have a shelf life of at least 10 years	Lifespan	The shef life of the product should be as long as possible
	The product must stay in the door and work for at least 10 years without being used		The looks and feel of the product should not change over 10 years when stored
	The working of the product must not be affected by wear and tear of normal use of the door over 10 years		The looks and feel of the product should not change over 10 years when applied to the door
	The product must work in all types of weather conditions and temperatures		The product should still work effectively when there are small cracks in the product
	The working of the product must not be affected by (simple) construction done to the house (washing windows, dust, paint splatters, etc.)		Parts of the product should be easily replaceable when broken
	The application of the prodcut to the door (for example glue) must stay active for at least 10 years		The product should still work after it has been painted over
	The product must only by activated by floods		The product should be able to be taken off and reapplied to other doors (when for example moved)
	The product must not respond to humidity in the air or mist		The product should not be impacted by small amounts of water getting stuck between the door
	The product must not respond to rainfalls		The door should be able to be kept open during a (small) rainfall without the product activating
	The product must not respond to water comming from washing the doors/house/windows		Normal use of the door should not have an impact on the working of the product
			The working of the product should be able to be tested
Application	The product must stop water from entering through the gaps around the door	Application	The product should be able to be used for front doors
	The product must work for all types of single outward-opening doors		The product should be able to be used for double doors
	The product must be able fit different sizes of doors		The product should be able to be used for sliding doors
	The product must work for "the average western house"		The product should be able to be used for garage doors
	The product must be applicable for houses all over the Netherlands		The product should be able to be used for windows
	The product must be applicable for houses all over Europe		The product should also be able to be used by businesses
	The product must work for floods due to rivers flooding and heavy rainfall		The product should also be applicable for houses outside of europe
	The product must not create any dangerous situation due to bacteria from the contaminated water that could stay behind		The product should also work for floods due to sea floodings (high salt aounts)
	The product must be able to be applied during an upcomming flood		The product should also be able to be applied to public buildings
	The product must be able to be applied to existing houses and doors (no matter the age of the house)		The product should also be able to be applied to glass doors
	The product must be able to be applied to new build houses		The product should aslo be able to be applied to different types of doors in public buildings: revolving doors, automatic sliding doors, etc.
	The product must protect against floods up to 50 cm high		The product should protect against all hights of floods
Buying	The product should not cost more than €500 per door	Buying	The product should be as cheap as possible
	The product must be able to be send to the consumer with standard package services		The product should be shiped as efficiently as possible
	The product must be able to be purchased online		The product should be able to be bought in construct stores
	This product must be able to be shipped through distribution centres		The working of the product should be effectively explained to conusmers
	Consumers must be able to understand how the product works		
	The product must carry the "Elke ruimte veilig" name		
Installing	The installation of the product must be able to be done within 1 day	Installing	The product should be able to be installed with a basic toolset: hammer, drill, screws, nails, screwdriver
	The installation of the product must be able to be done by consumers themselves		The installation of the product should be as quick as possible
	The installation of the product must not require specialised tools		The product should be able to be installed without the help of professionals
	The installation of the product must be perceived as intuitive		Installing the product should require as few permanent changes to the house as possible
	Clear guides must help the consumer to install the product		The product should change the locks of the house as little as possible
	The product must be able to be installed without removing the door		The door should not have to be replaced to fit the product
	The door must be able to work normally when the product is installed		The product should still work if it is not installed correctly
	Installing the product must not mean activating the product imideately		The product should be able to be installed during bad wheater conditions
	The product must be able to be installed around hinges		The product should be able to be removed and reinstalled when not installed correctly
	The product must be able to be installed around locks		An installation service should install the product for the people who are unable to do so

	The product must be able to be installed in corners		The consumer should be able to decide up to how high the product will be placed
	The product must facilitate installation around the whole door		
Activating (setting up)	The product must be automatically activated (by the floodwater)	Activating (setting up)	The product should be completely activated as quickly as possible
	The WAEM must grow 300% within 30 minutes		The door should automatically be sealed when floods happen, without any setup from the consumer required
	The product must completely seal the door within 30 minutes after first contact with water		The product should work if the consumers are not home
	The product must work when the door is closed properly		The product should be able to be "pre-activated" when floods are arriving
	The product must be activated up to a bit above the current waterline of the flood		The product should not interfere with locks, hinges and corners
	The activation of WAEM must not require any influence of the consumers		The product should be reusable after an accidental activation
	When activated by accident, the product must return to its origional size within 2 days		The door should still be able to be opened and closed when the product is activated by accident
	The activated material must not "press" the door out of its frame due to its activation		Closing the door should be easy if the product is activated
	The activated material must seal all holes and irregularlies in the door and frame		The product should let as little water into the house as possible when it is still setting up
	The product must seal all corners completely		The product should not let any water in when the flood is rising
	The product must seal all hinges completely		The contents of the water should not have any impact on the working of the product
	The product must seal all locks completely		
	The door must be able to be closed after the product is activated and the door opened		
	The product must be able to be activated normally with dirty water		
During floods	The product must seal the door for at least 2 days	During floods	The product should seal the door for as long as possible
	Maximum 1 litre of water per hour can get get into the house per door		The product should not let any water into the house
	The door must be able to be opened when the product is activated (in case of an emergency)		it should be visible for the consumer that the product is activated during a flood
	The product must withstand the pressure and moving streams of the flood		Additional (traditional) flood protection products should not interfere with the working of the product
	The product must withstand the dirt and substances in the water		
After floods	The product must be easy to remove from the door	After floods	The product should be reusable
	The product must not leave any damage to the door when removed		The product should be recyclable
	The product must be able to be discarded in the normal waste		
	The product must be able to be replaced immediately after the previous product/strip is removed		
Properties	The product must not weigh more than 5 kilos	Properties	The product should be environmentally friendly
	The product must be smaller than a moving box (30x40x58 cm) when stored		The product should not stand out in the door
	The production must give consumers a feeling of safety		The product should weigh as little as possible
	The product must convince people it can be trusted		The product should be as small as possible when stored
	The product must be available in different sizes for different sizes of gaps		The product should always be ready to use
	The sproduct must fit between the door and the frame		One size of product should fit for all sides of the door
	The product must be at least 2 mm thin		The product should be as thin as possible without losing its properties
	The product must be easy to cut to size		The product should be robust
	The product must be able to resist impact by use of the door		
	The product must not be toxic for the environment		
Production	The product must be able to be made by Alprokon or a partner	Production	The product should be able to be made or assembled at Alprokon
	The product must be made in the width and height of the final strip		The product should be packed per door
	The intelectual property of the product must be owned by Alprokon		The product should be produced as effectively as possible
	The consumer must be able to buy the product per door		

	The product must be stored and send sealed		

Appendix 4: Chapter 4

4.1. Ideation methods

A detailed description of the methods applied in the ideation process can be found below.

Brainwriting and brainstorming

Why

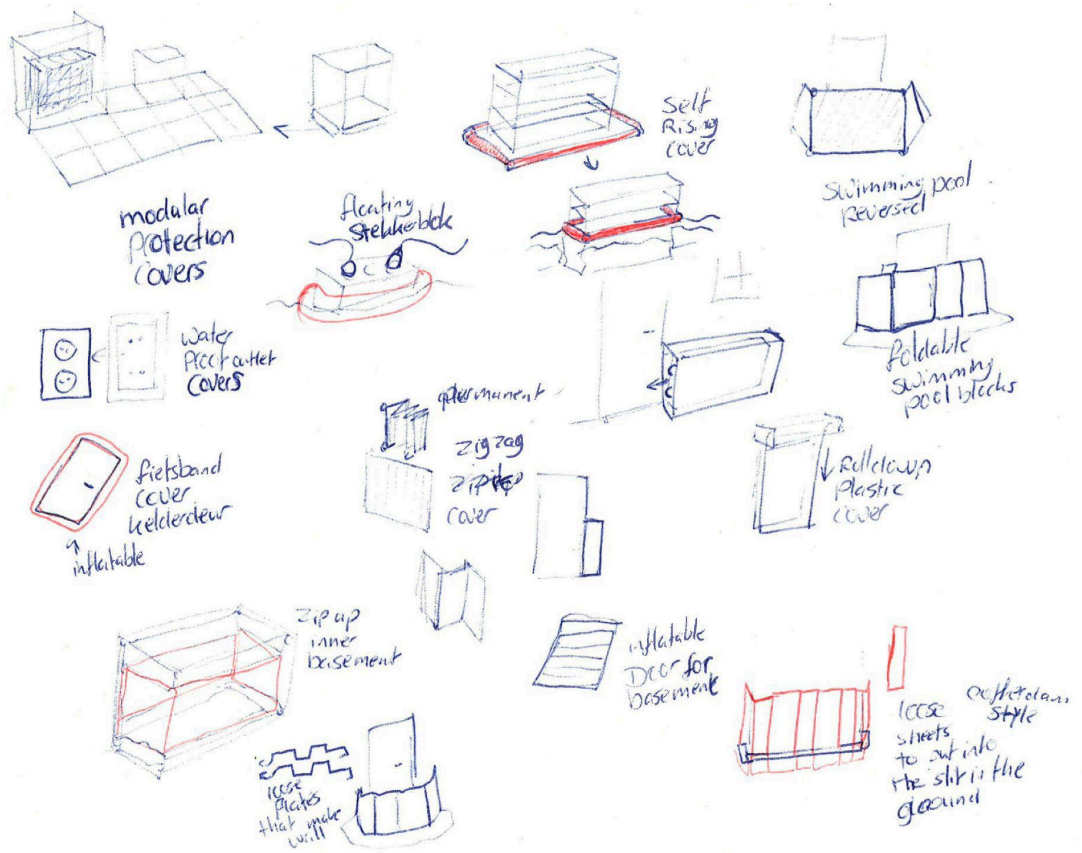
Exploring the problem scope in depth creates opportunities for diverse solution directions. By combining elements of brainwriting and brainstorming (Lucid Software, 2025), a wide range of ideas could be generated, discussed, and further developed.

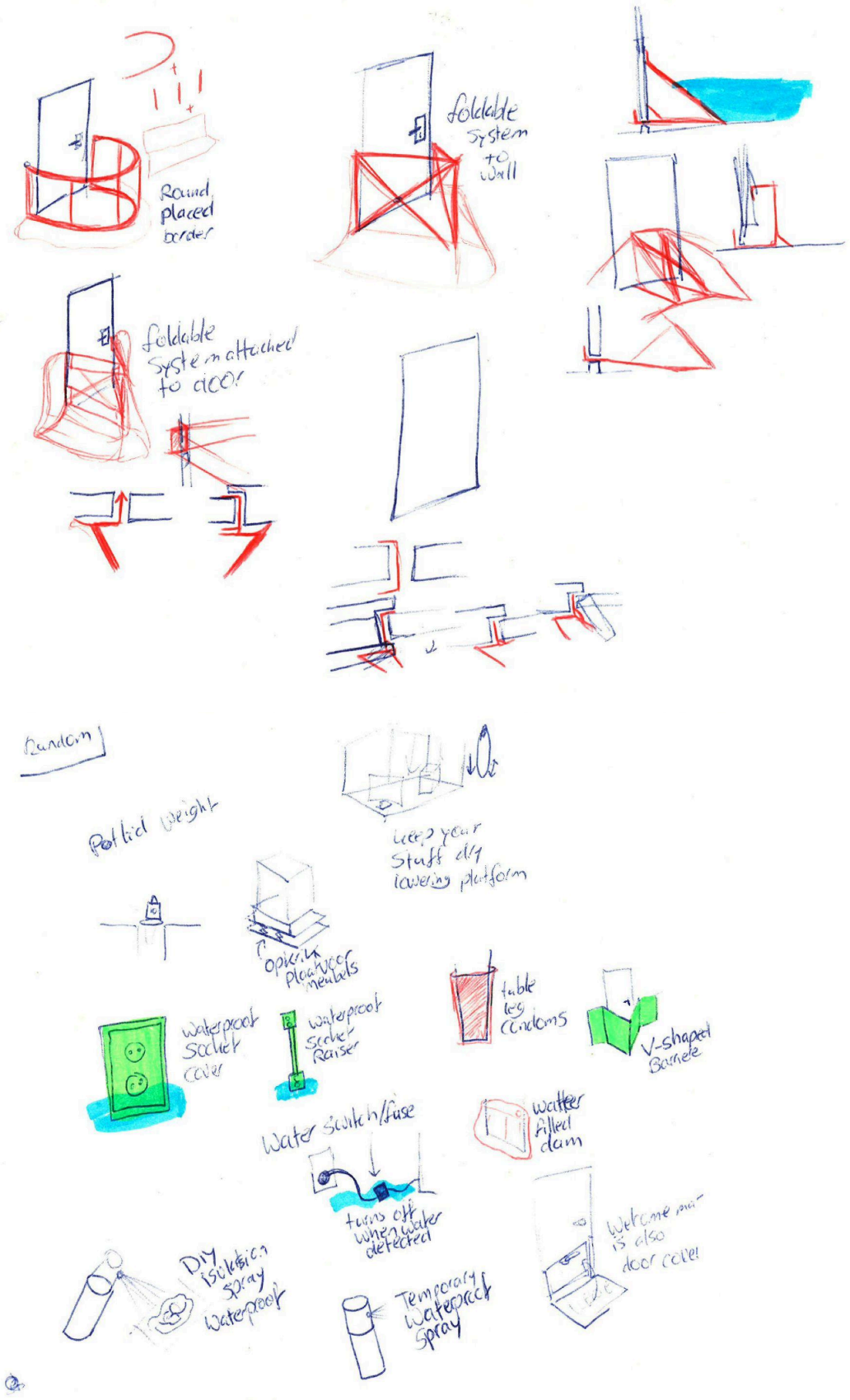
How

A flexible combination of brainwriting and brainstorming methods was applied over several weeks. Rather than working with a fixed group or session format, ideas were created through ongoing discussions with colleagues, fellow students, and other participants. Concepts were documented, evaluated, and iteratively expanded to different levels of detail.

Conclusion

These methods resulted in a broad variety of promising concepts, differing in application, functionality, and level of innovation. The continuous exchange of ideas with others helped to approach the problem scope from multiple perspectives and supported the development of diverse solution directions. These ideas were combined with concepts generated through the other ideation methods and evaluated to identify the most promising solution directions.




Round placed border
foldable System to wall
foldable System attached to door
Random
Bottle weight
Keep your Stuff dry lowering platform
Optional Plaatjes metalen
Waterproof Socket cover
Waterproof Socket Raiser
table leg Condoms
V-shaped Barriere
Water Switch/fuse
turns off when water detected
Weather filled dam
Welcome mat is also door cover
DIY Isolation spray Waterproof
Temporary Waterproof Spray

HKJ'tjes

Why

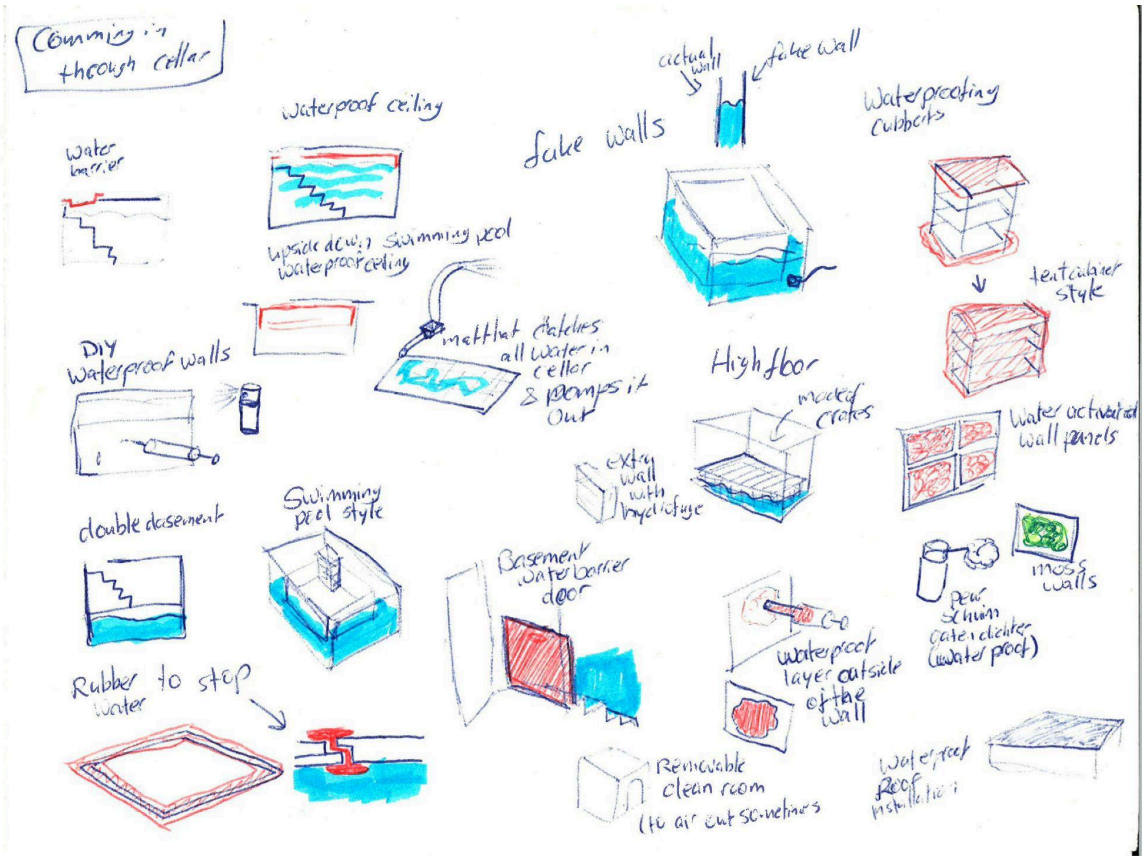
Due to the broad project scope, preventing water from entering the home during floods, and the limited technical restrictions, the problem was divided into smaller subproblems. This approach enabled focused research and ideation on specific aspects of the challenge rather than the complete solution at once (Zijlstra et al., 2020), leading to new insights and concept directions that could later be applied to other product ideas.

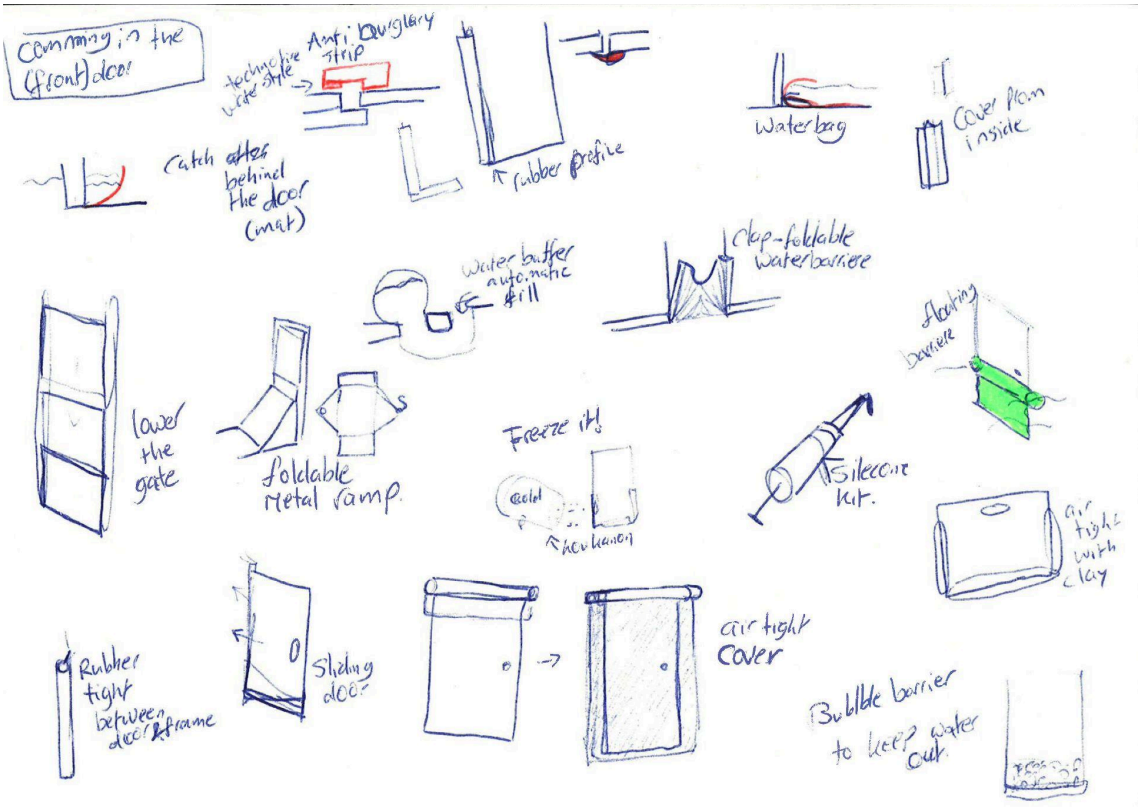
How

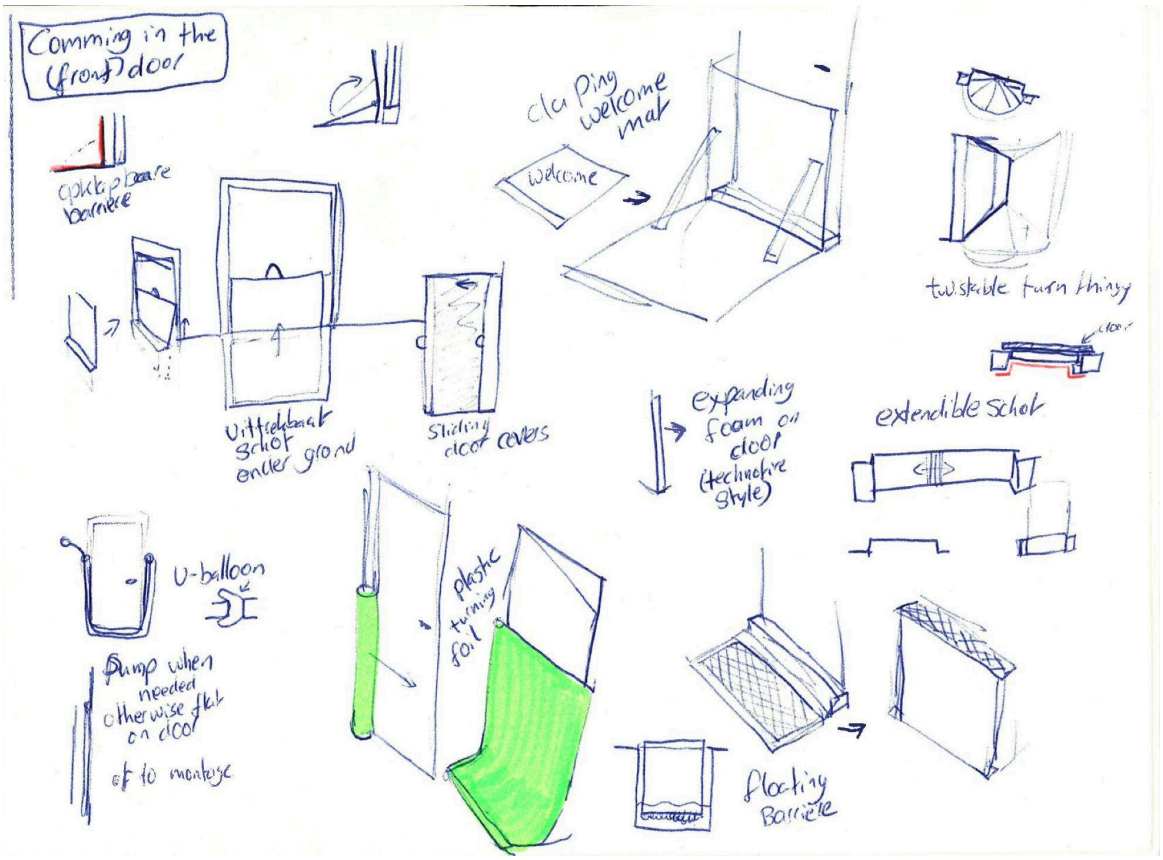
Multiple HKJ exercises were conducted, each focused on a specific aspect of the problem, like "how to prevent water from entering the house through the door" or "how to prevent water from entering the house through the basement". For each HKJ, at least two 15-minute ideation sessions were carried out on separate days to stimulate a broad range of ideas. Several outcomes were also informally discussed with colleagues and fellow design students.

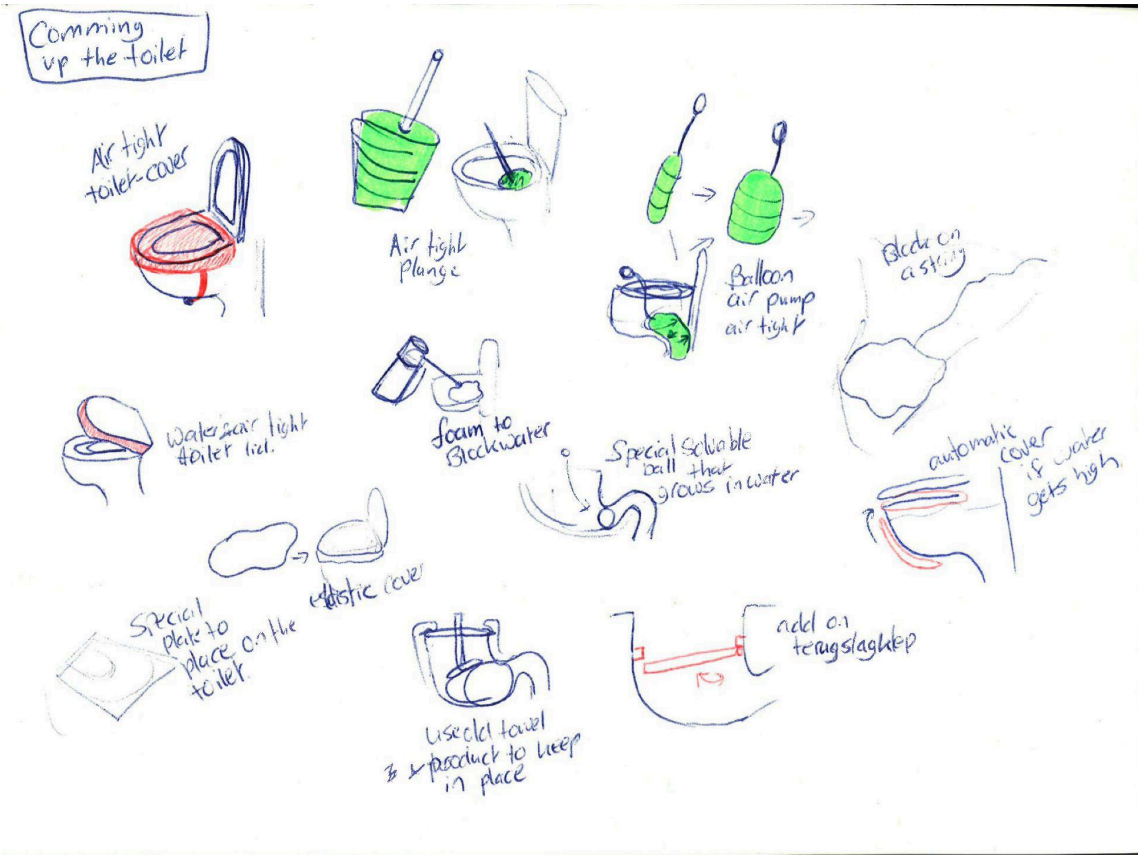
Conclusion

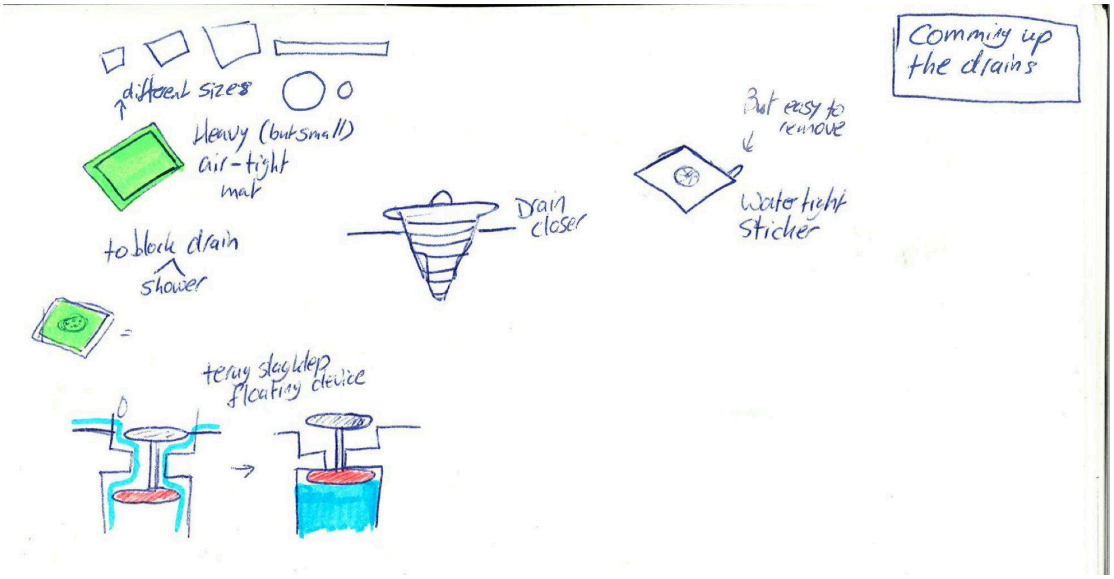
The HKJ method resulted in several promising ideas and helped identify new solution directions by focusing on individual parts of the problem. These ideas could later be combined or further developed into broader concepts. The method also contributed to identifying back doors as the most relevant focus area, as this context offered the greatest opportunity for innovative solutions beyond existing products.

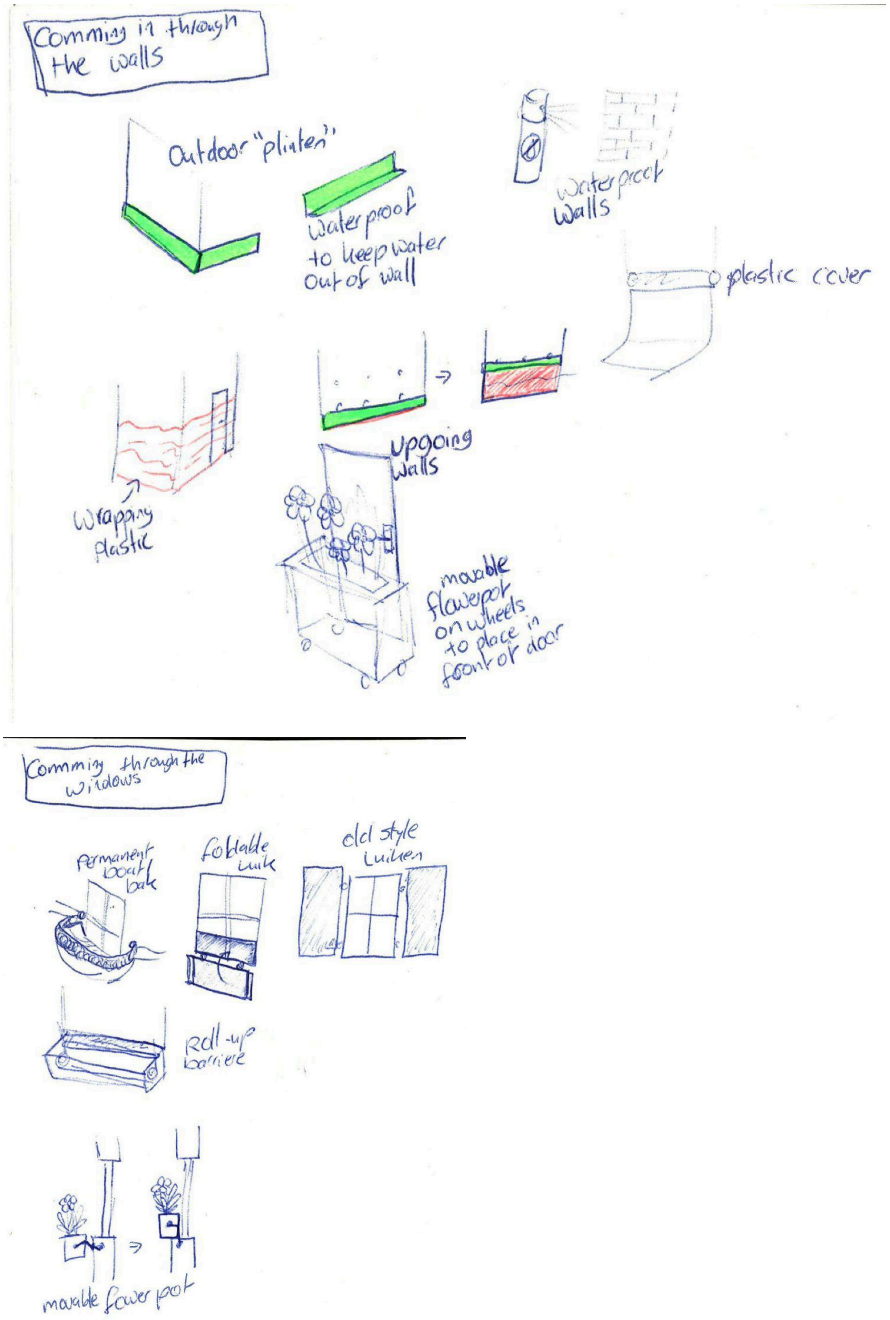



Comming in the (front) door
Anti burglary strip
Catch after behind the door (mat)
Water bag
Cover from inside
Rubber profile
Water buffer automatic fill
Clap-foldable water barriere
Floating barriere
lower the gate
foldable metal ramp
Freeze it!
cold
heat/warm
Silecone kit.
air tight with clay
Rubber tight between door & frame
Sliding door
air tight Cover
Bubble barrier to keep water out


Comming in the (front) door
clapping welcome mat
welcome
twistable turn thingy
door
Sliding door covers
expanding foam on door (technique style)
extendible schot
U-balloon
Pump when needed otherwise flat on door
plastic turning foil
floating Barriere


Comming up the toilet
Air tight toilet-cover
Air tight Plunge
Balloon air pump air tight
Blocks on a string
Water/gear tight toilet lid.
foam to Blockwater
Special Soluble ball that grows in water
automatic cover if water gets high
elastic cover
Special plate to place on the toilet
used cat towel to product to keep in place
add on terugslagklep


Comming up the drains
different sizes
Heavy (but small) air-tight mat
to block drain shower
Drain closer
But easy to remove
Water tight Sticker
terug slagklep floating device



Lotus Blossom method

Why

The Lotus Blossom method (Guthrie, 2024) is a structured ideation technique that stimulates deeper exploration of a problem by systematically generating variations on initial ideas. Compared to simpler brainstorming methods, it encourages the development of multiple design directions and uncovering new insights. This method was applied twice in the ideation process.

How

The Lotus Blossom method was applied twice during the ideation phase using the questions: “How to make the back door waterproof during a flood?” and “How to make a door waterproof by working with the door frame?”. Each question was placed in the center of a 3×3 grid, surrounded by eight initial solution directions. For each of these directions, an additional 3×3 grid was created to further expand and vary the ideas. The objective was to fill at least 70% of all fields, with a minimum of four variations per solution direction.

Conclusion

This method supported a deeper exploration of different solution approaches rather than remaining at a superficial level. For each design direction, multiple variations were generated, resulting in several promising concepts. The method proved valuable in expanding small opportunities into broader and more developed solution ideas otherwise discarded.

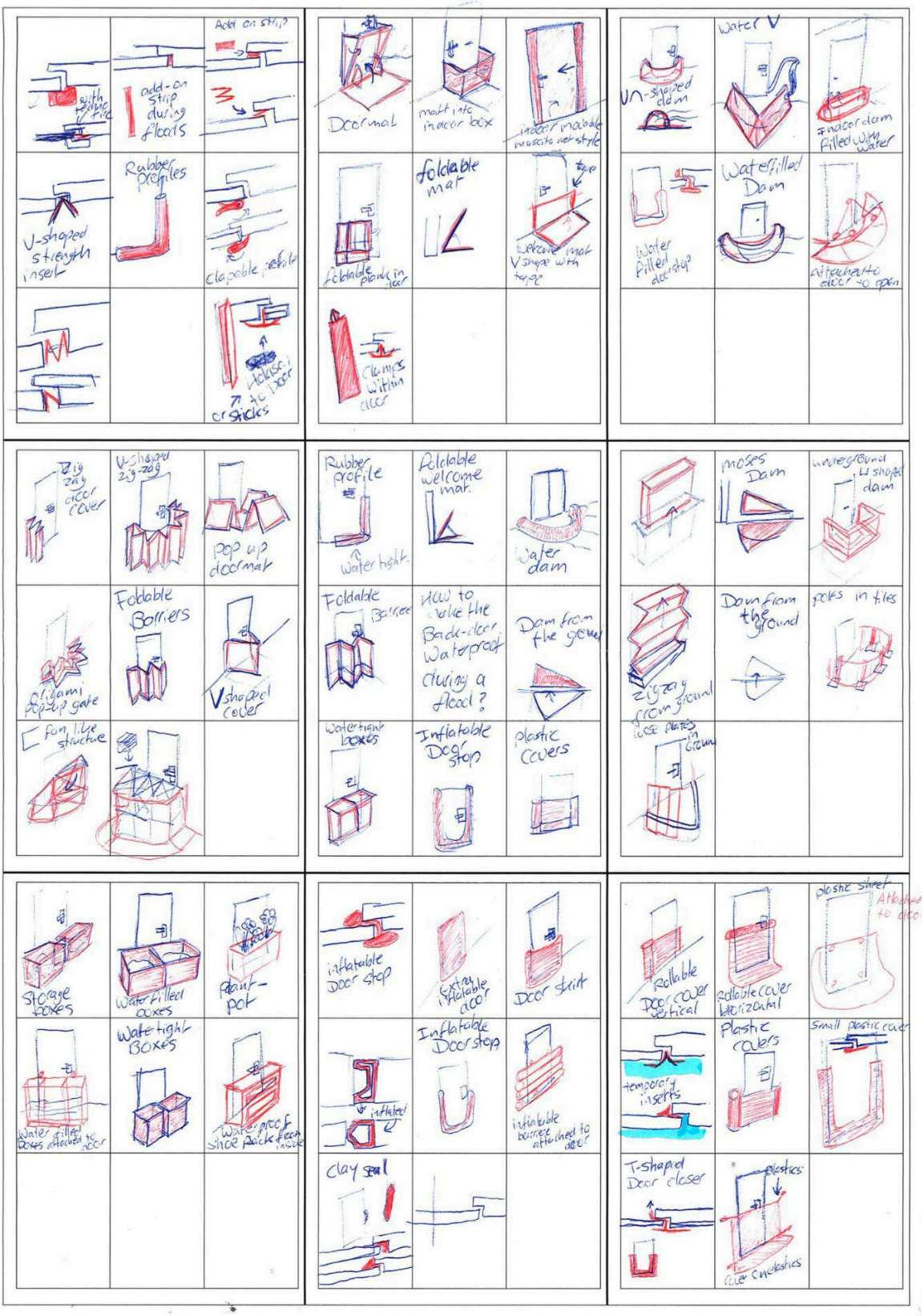


Figure #: Lotus Blossom method done 1

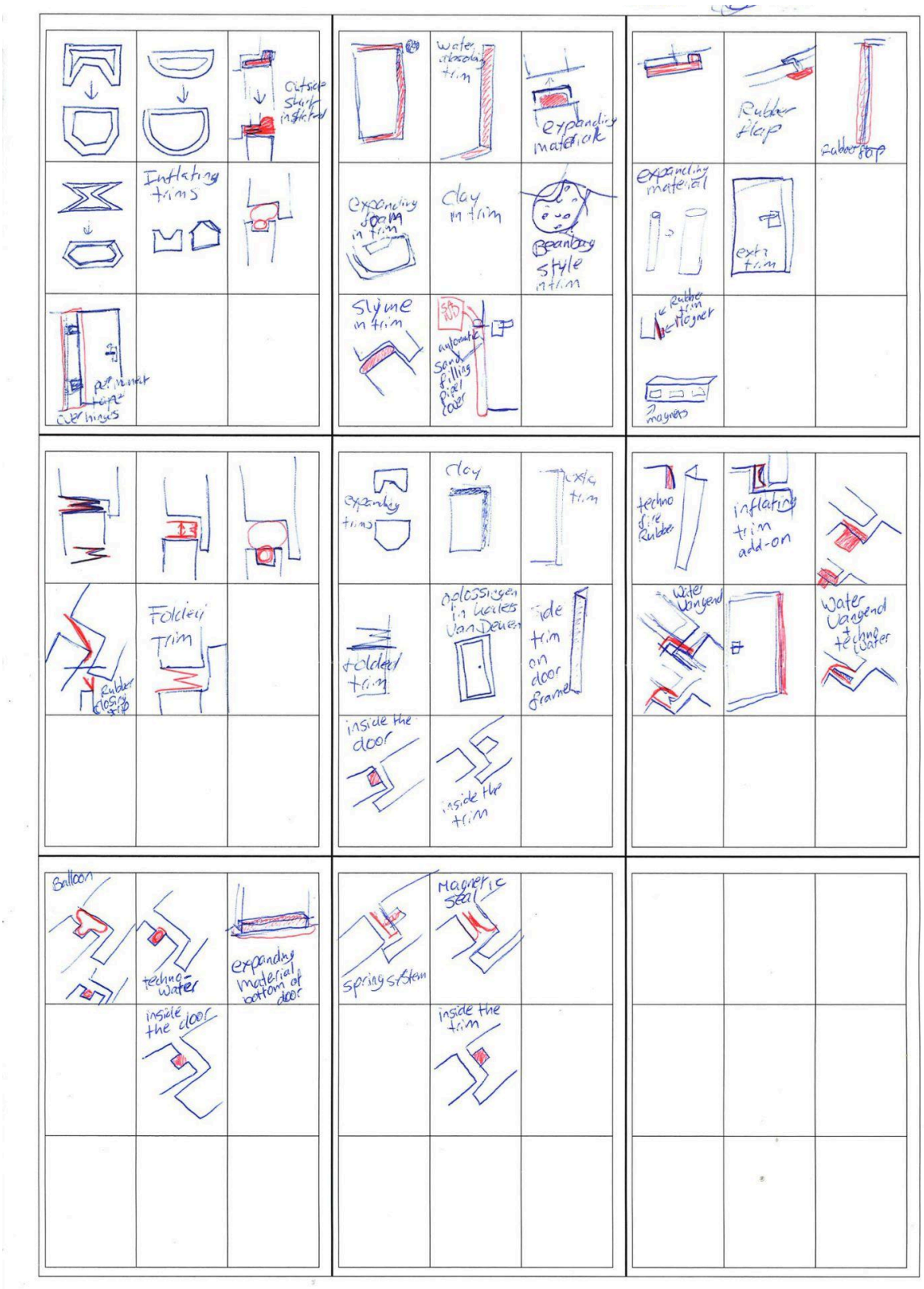


Figure #: Lotus Blossom method done 2

Analogies

Why

Analogies were used to explore alternative ways of understanding and solving the problem by identifying situations in which comparable challenges are addressed differently (Zijlstra et al., 2020). This approach enabled new perspectives on the problem and inspired new solution principles.

How

Analogies related to water containment, sealing, and protection were explored. These included applications involving water, such as dams and boats, as well as systems related to air and smoke sealing. Each analogy was analyzed to understand its underlying principles and assess its relevance to the project scope. The most promising analogies were further explored and translated into potential product concepts.

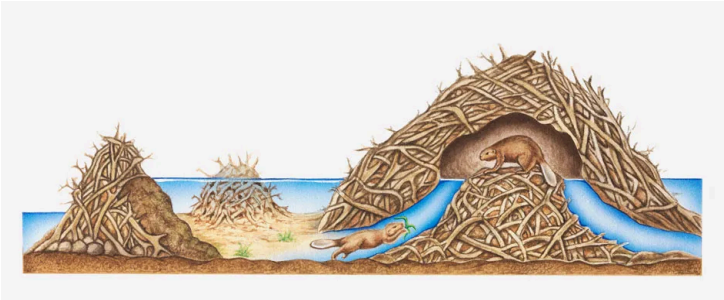
Conclusion

The use of analogies contributed to several new solution directions. For example, swimming pools inspired lightweight inflatable barrier concepts, draft strips led to ideas for integrated watertight door seals, and the operation of Technofire, currently used in many Alprokon products, inspired the use of expanding materials to seal gaps. A complete overview of the explored analogies is provided below.

All analogies analysed:

Beaver dam

Beavers make dams and lodges using the properties of water and dams. By creating an airpocket as home with underwater entree, a safe and dry home is created. This way of thinking could be used for flooding solutions.



Technofire

Keeping smoke and air from getting through the door by the material expanding by contact with heat. The same could be done with water.



Building a bridge: Cofferdam
For building a bridge in water, a cofferdam is used to make the base of the pillars. The technique of creating this cofferdam could be used for a flooding solution



Venice
The city that is build on water is fighting for ages against floods. They recently installed the mose dam and other percussions to protect their buildings. It is an interesting city to learn from. Venice (left) and Mose Dam (right)





Dam
A dam is basically a permanent water barrier. A lot of engineering has gone in making is strong and long lasting. This engineering could be simplified used for a temporary flood barrier.



Draft strips
Creating a flexible "bumper" that will close the gaps to let air in. The same can be done with water. Using the door as a barrier.



Closable air vents
A build-in mechanical system that is build to be able to leave air trough, but easily close if needed.



Swimming pool
Swimming pools are doing the exact opposite of what we want: they keep water in. So essentially, they are doing the same: Keeping water where you want it to be. The swimmingpool technology could be used in a flooding solution. Inflatable pool (left) and foldable pool (right)





Extractor fan
Take away of the unwanted smoke to keep the air clean. Use this technique to keep the water out?



Sea of people during a festival
Controlling the croud of people to keep out of specific places and out of others. This is done by redirecting, barriers and employees.



Other applications

Why

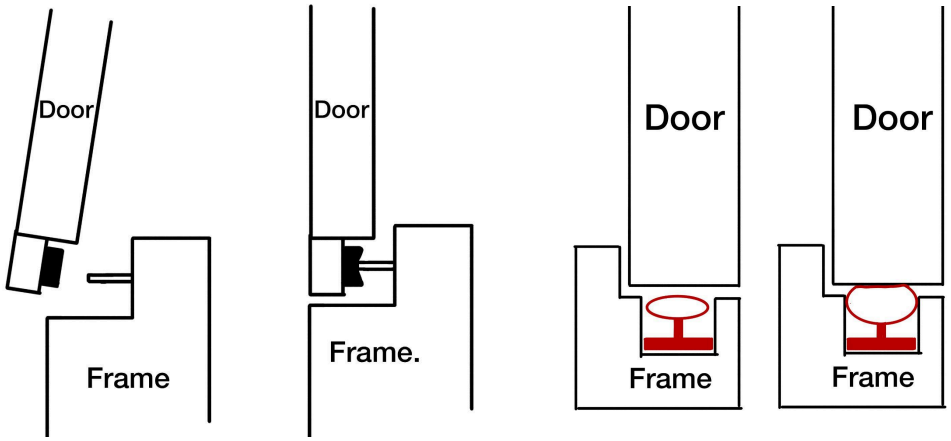
Existing solutions from comparable contexts can provide valuable inspiration for new applications. By identifying situations in which similar problems are already effectively solved, these principles can be adapted to the project context instead of developing entirely new solutions from scratch.

How

Different contexts were explored in which preventing water ingress is a key challenge, like how this problem is handled in other parts of the world or industries. The identified solutions were analyzed to understand their working principles and assess their applicability to the project scope. These principles were then translated and adapted into new product concepts for residential flood protection.

Conclusion

Several relevant analogies and solution principles were identified, including flood-adaptive housing in monsoon regions and floating structures. The most promising inspiration came from sealing systems used in ships and yachts, where doors must remain fully watertight to prevent flooding and protect interiors. Two common approaches were identified: compression seals using inflatable rubber seals that expand to close all gaps around a door. These mechanisms provided valuable inspiration for the development of residential flood-protection concepts.



Approach with compression seals (left) and approach with inflatable rubber seals (right).

Other applications found:
Boats



Floating houses





Houses on stilts



SCAMPER

Why

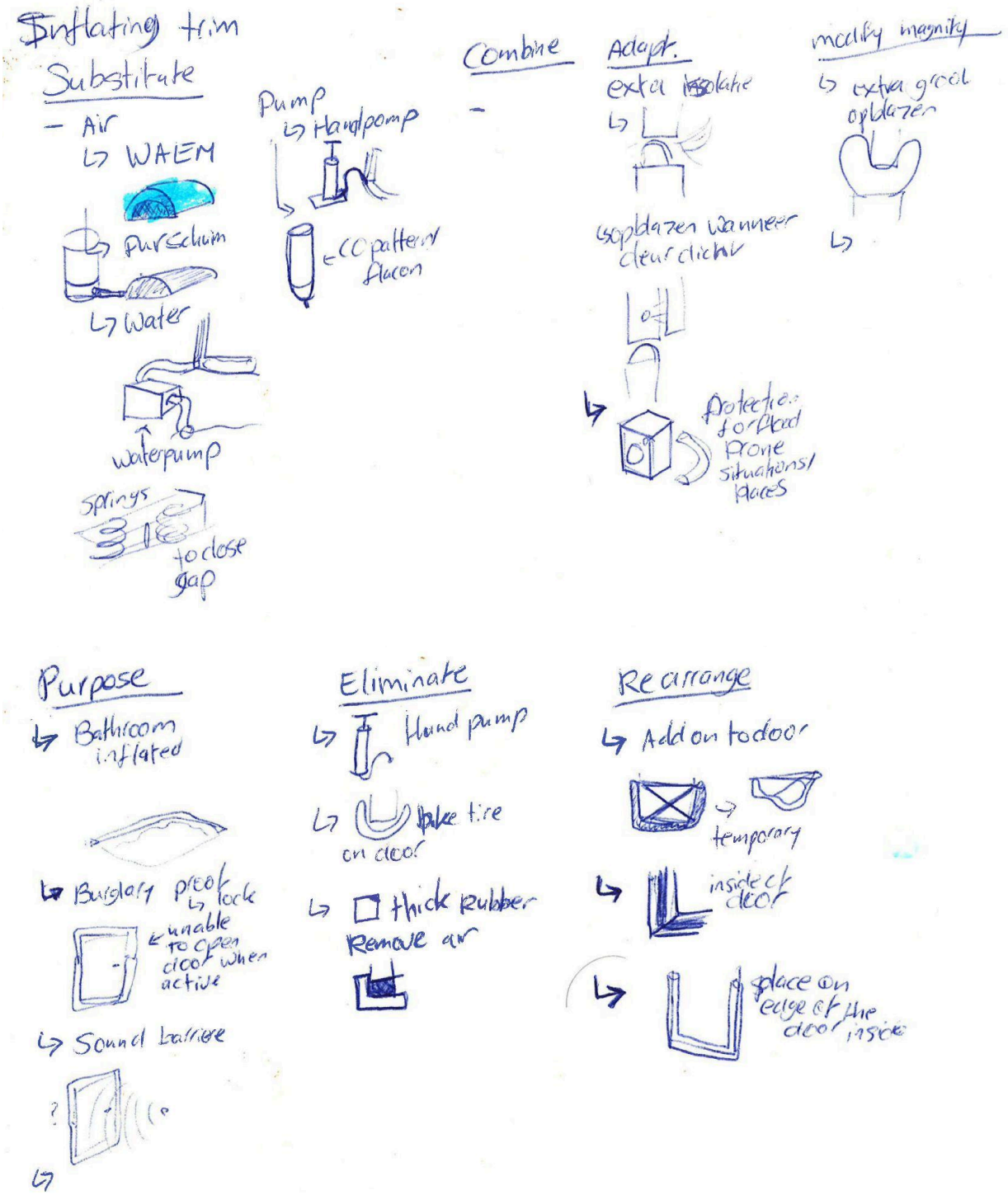
After several promising concepts had been developed, the SCAMPER method was applied to systematically improve and adapt these ideas (Zijlstra et al., 2020). The method supports exploring alternative configurations and identifying opportunities for optimization.

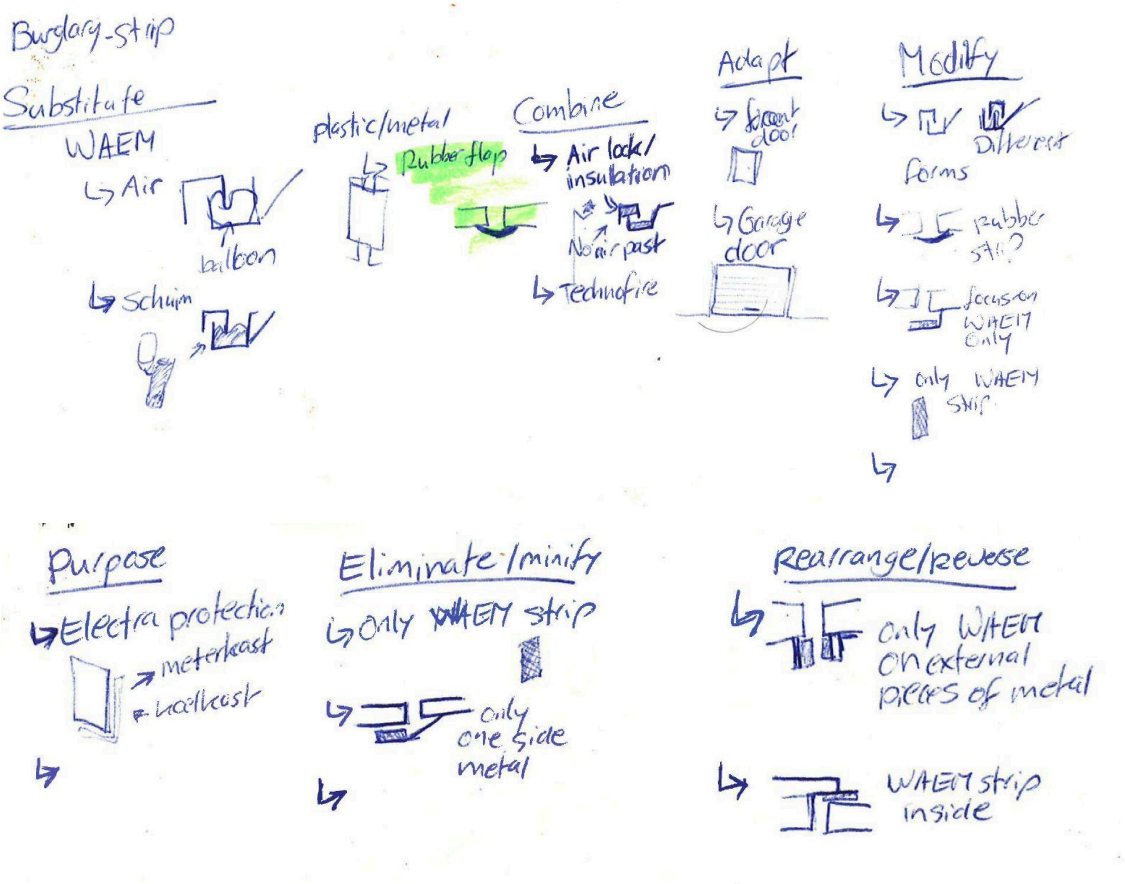
How

The SCAMPER method was applied to three selected concepts by systematically evaluating them through the steps: Substitute, Combine, Adapt, Modify, Put to another use, Eliminate/Minify, and Rearrange/Reverse. This process led to multiple modifications and refinements of the original concepts. The Burglary Strip and Inflating Trim concepts were analyzed using this method, while the Folding Trim was not assessed due to time constraints.

Conclusion

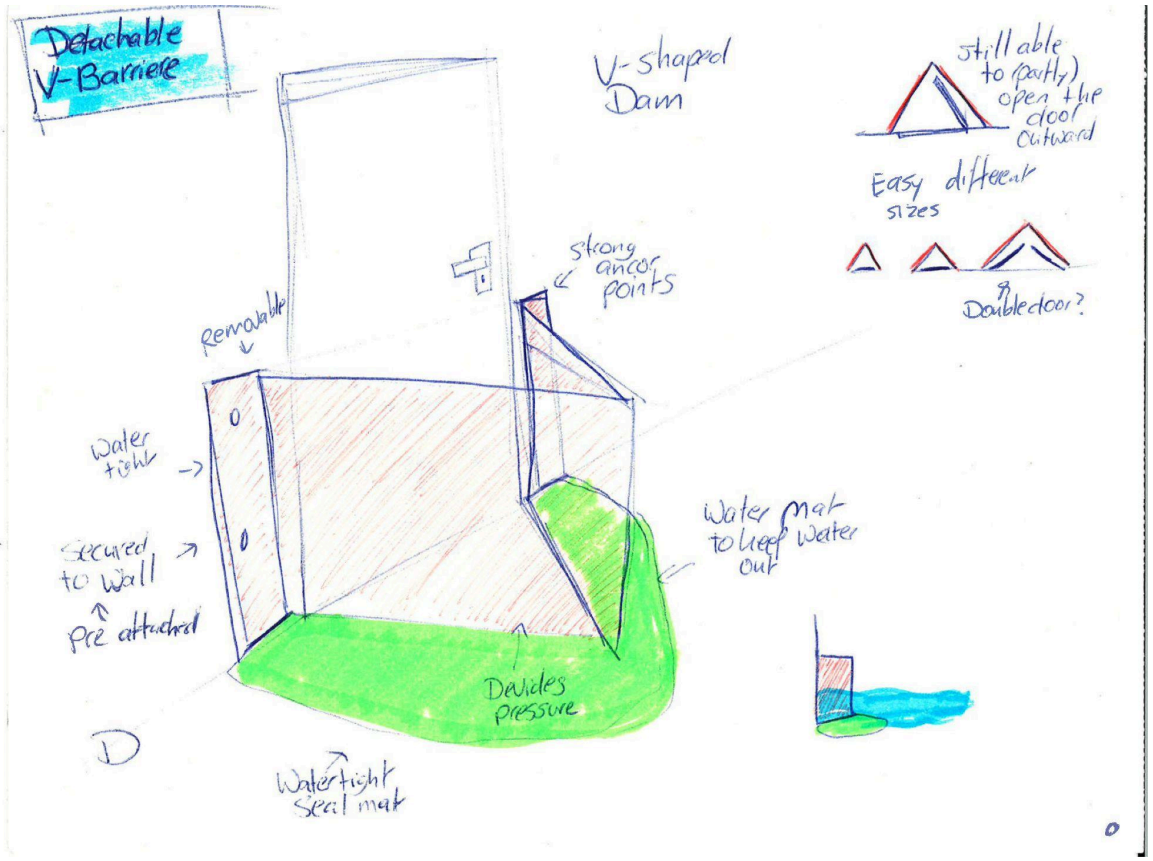
The method resulted in several promising adaptations. For example, the Burglary Strip evolved through concepts such as replacing the expanding material with an inflatable seal and removing the anti-burglary function to focus solely on flood protection. For the Inflating Trim, valuable improvements were identified regarding placement and attachment to the door. Overall, the SCAMPER method encouraged evaluation from multiple perspectives and led to improved and more refined product concepts.


$nflating trim
Substitute
- Air
↳ WARM
↳ Purschum
↳ Water
waterpump
springs
to close gap
Pump
↳ Handpomp
↳ CO patteren flacon
Combine
-
Adapt.
extra isolatie
↳
opblazen wanneer deur dicht
↳
Protection for flood prone situations/ places
modify magnify
↳ extra groot opblazen
↳
Purpose
↳ Bathroom inflated
↳ Burglary proof
↳ lock
← unable to open door when active
↳ Sound barriere
?
↳
Eliminate
↳ Hand pump
↳ take tire on door
↳ thick Rubber
Remove air
Rearrange
↳ Add on to door
↳ temporary
↳ inside ck door
↳
place on edge of the door inside


Burglary-Strip
Substitute
WAEM
Air
balloon
Schuim
plastic/metal
Rubber flap
Combine
Air lock/ insulation
No air past
Technofire
Adapt
Garage door
Modify
Different forms
rubber strip?
focus on WAEM only
only WAEM strip
Purpose
Electra protection
meterkast
Eliminate/minify
only WAEM strip
only one side metal
Rearrange/Reverse
only WAEM on external pieces of metal
WAEM strip inside

4.2. The 12 concept ideas

Foldable barriers



<u>Detachable V-barriere idea</u>

Advantages:

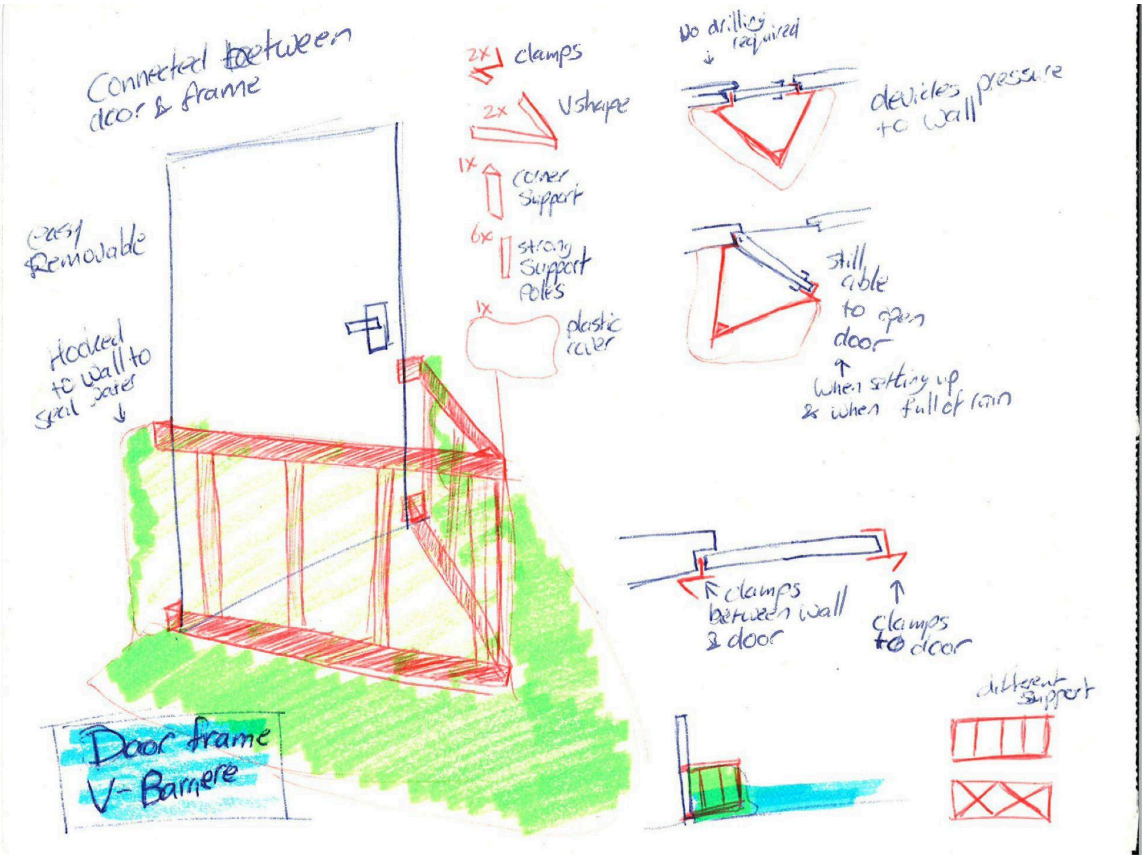
- Works for different types of doors
- Devides pressure of the water
- Still able to open the door

Limits:

- Big to store
- Some changes on the house needed
- Not revolutionair

Unique:

- Limited dependable on size of the door



Completely foldable V-barriere idea

Advantages:

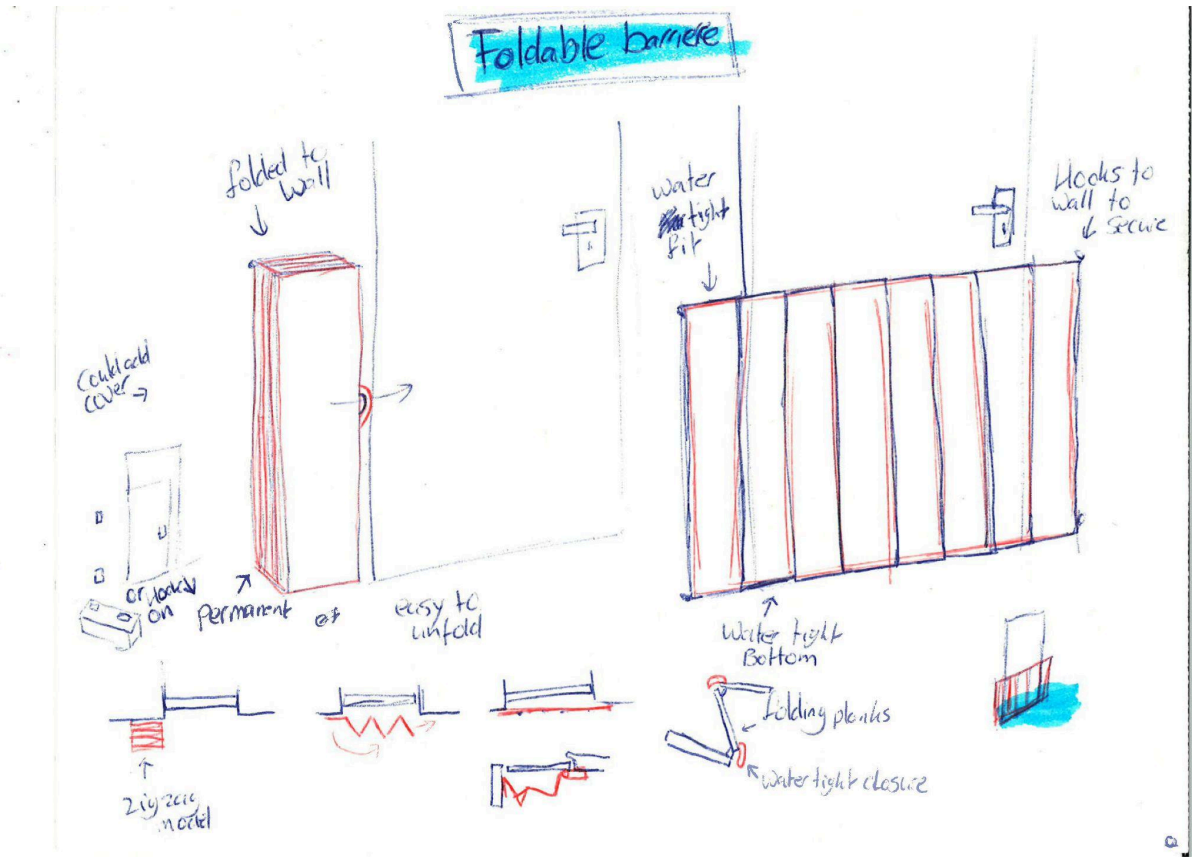
- Works for different types of doors
- Devides pressure of the water
- Still able to open the door
- foldable design
- Can be made really easy to use

Limits:

- Small changes to the house needed
- Takes some time and effort to set up
- Not revolutionair

Unique:

- Limited dependable on size of the door



Foldable barrière idea

Advantages:

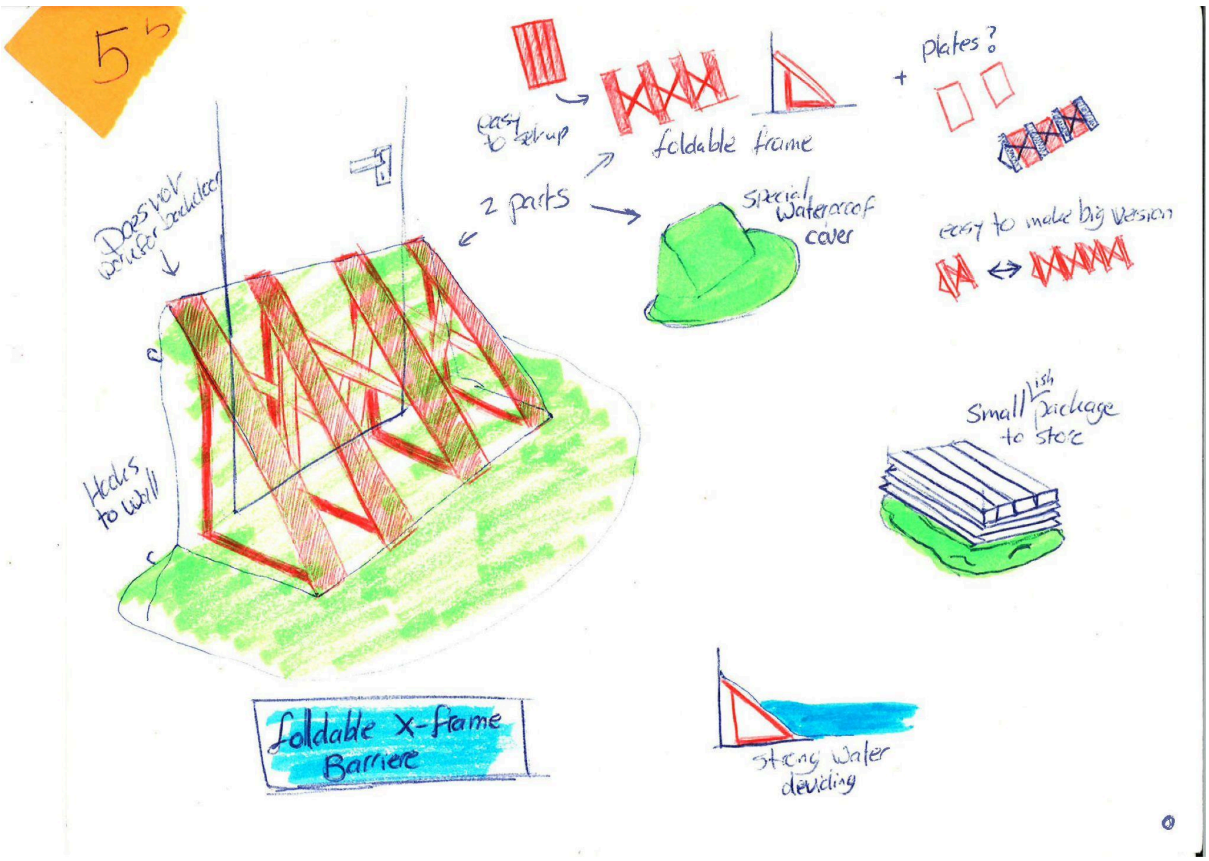
- Always present
- Easy for neighbours to set up
- Option to remove and store somewhere else
- Light/easy to set up
- Works for different types of doors

Limits:

- Change/attachment needed to work on an outward opening door
- Big visable object at the outside of the house
- Somewhat revolutionair, not evolutionair

Unique:

- compact foldable design
- Already attached to house



Foldable x-frame barrière idea

Advantages:

- Will not work for backdoors
- Strong setup
- Compact storing
- Usable in different types/withs of doors
- No need for external changes on the house

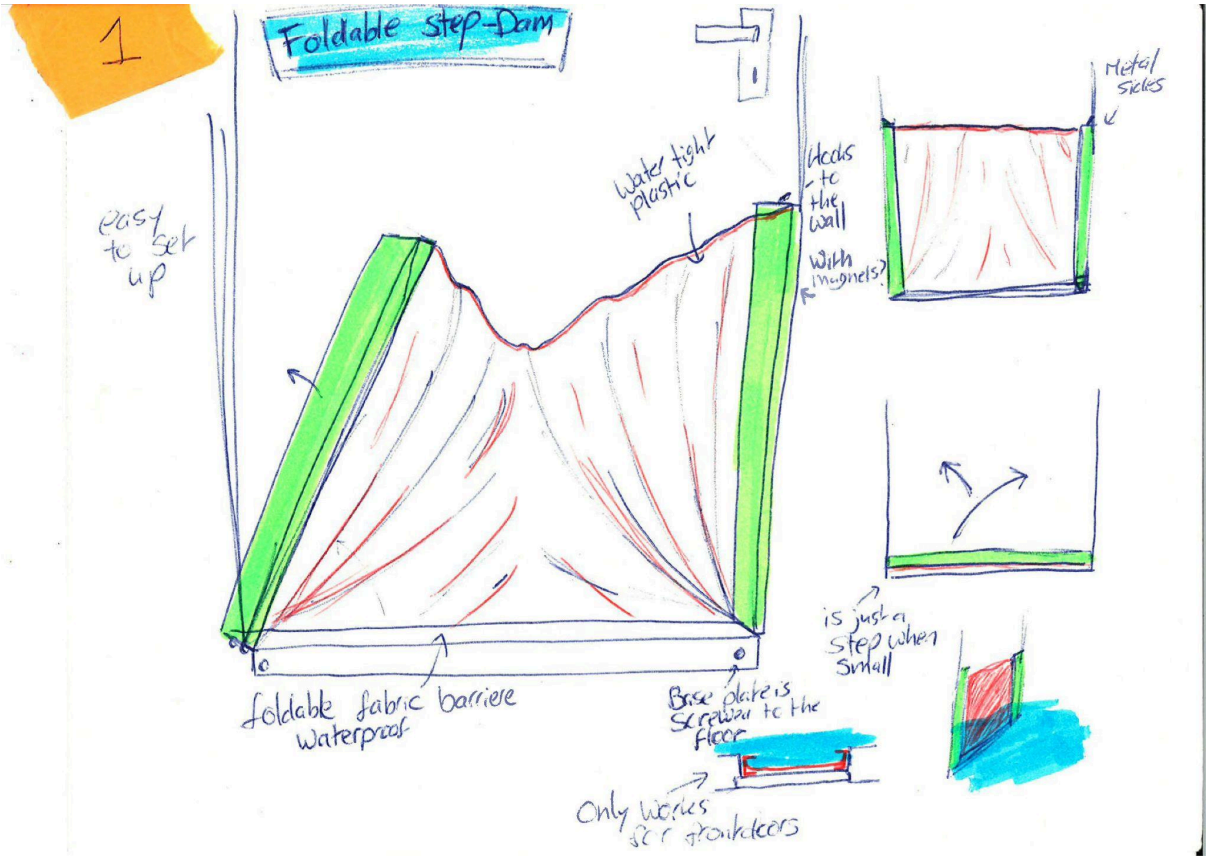
Limits:

- Does not work on an outward opening door
- Big/heavy to set up
- Not revolutionair

Unique:

- Foldable design

Rollable solutions



Foldable step-dam idea

Advantages:

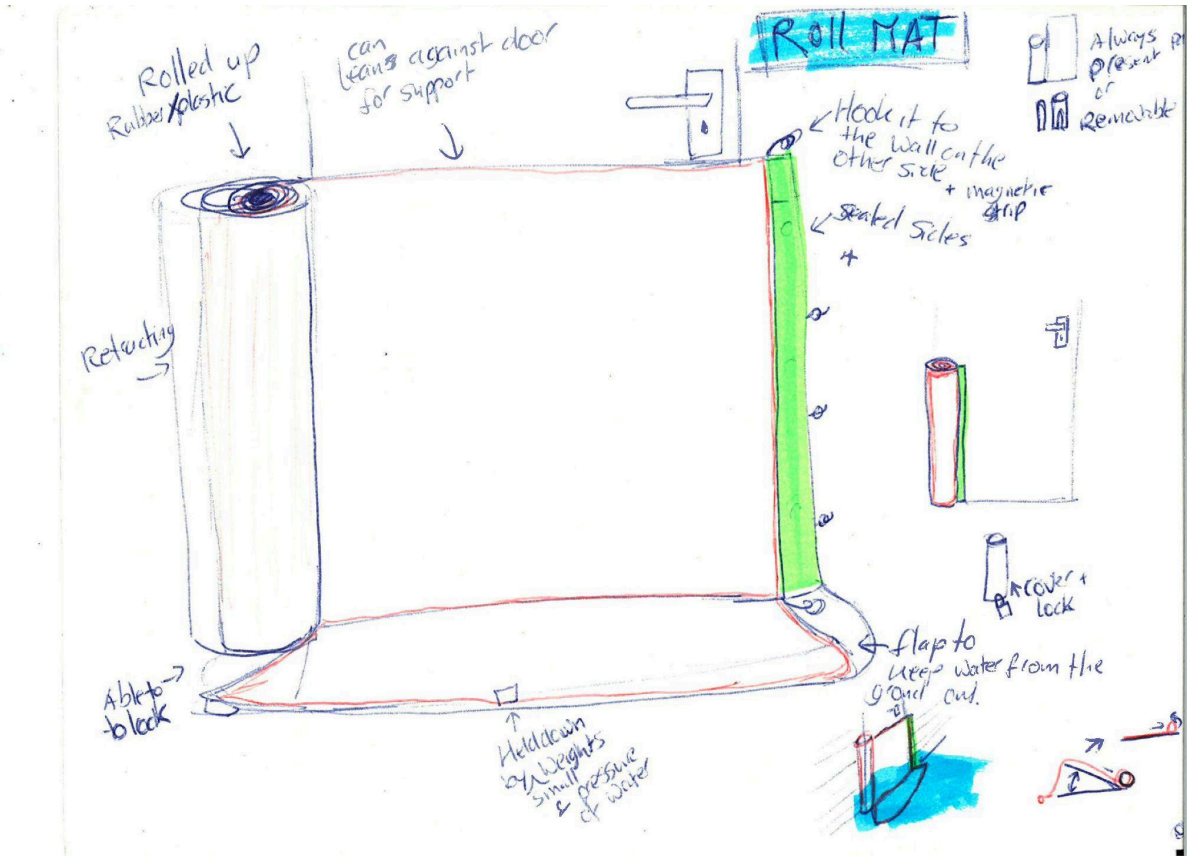
- Will not work for backdoor
- Always present
- Easy to set up
- Easy to install
- Easy for others to set it up

Limits:

- Needs walls on the side
- Does not work for an outward opening door
- Creates a step in front of the door
- Somewhat revolutionair

Unique:

- Foldable design
- Does not stand out in the design of the house



Roll mat idea

Advantages:

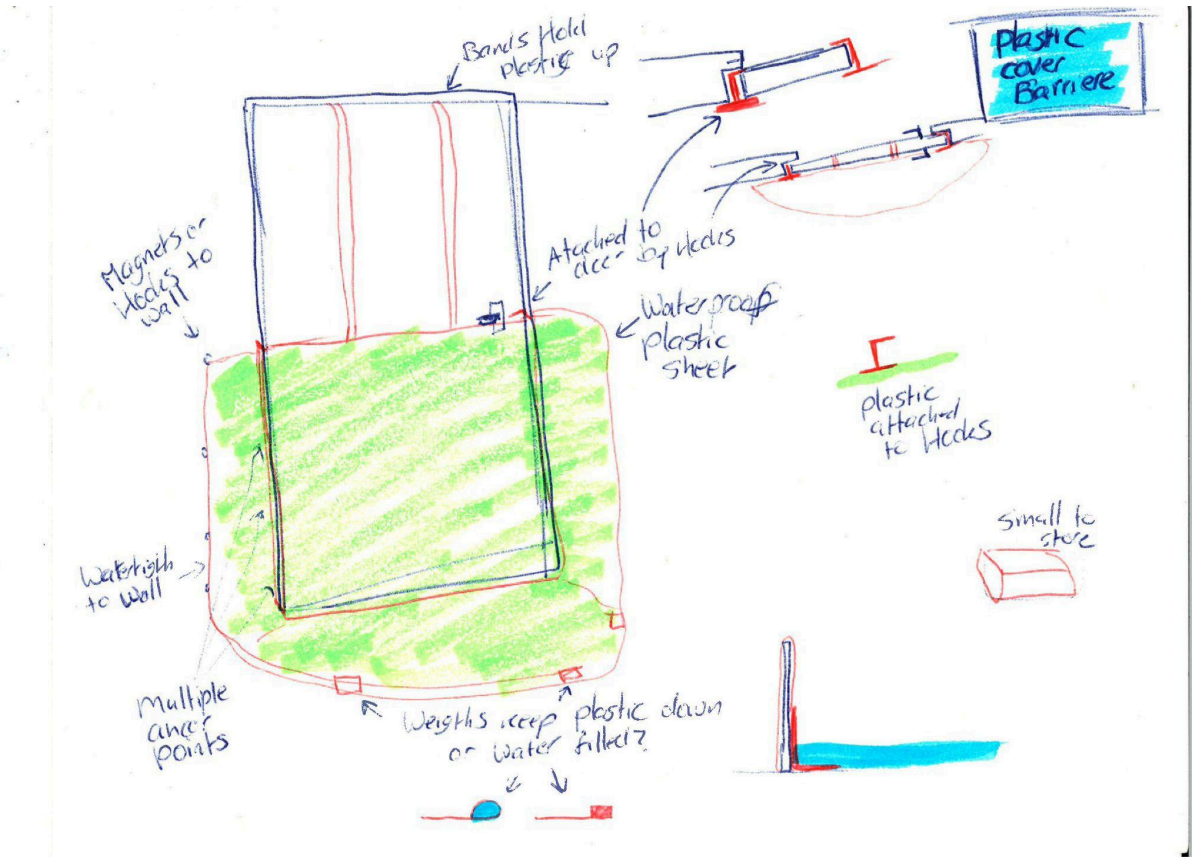
- Always present
- Easy to set up
- Limited force required
- Easy for others to set up

Limits:

- Bit more complicated for an outward opening door
- Big visable object at the outside of the house
- Need to find a way to make the side watertight
- Enough space on the side needed
- Somewhat revolutionair

Unique:

- Retractable design



Plastic cover barrier idea

Advantages:

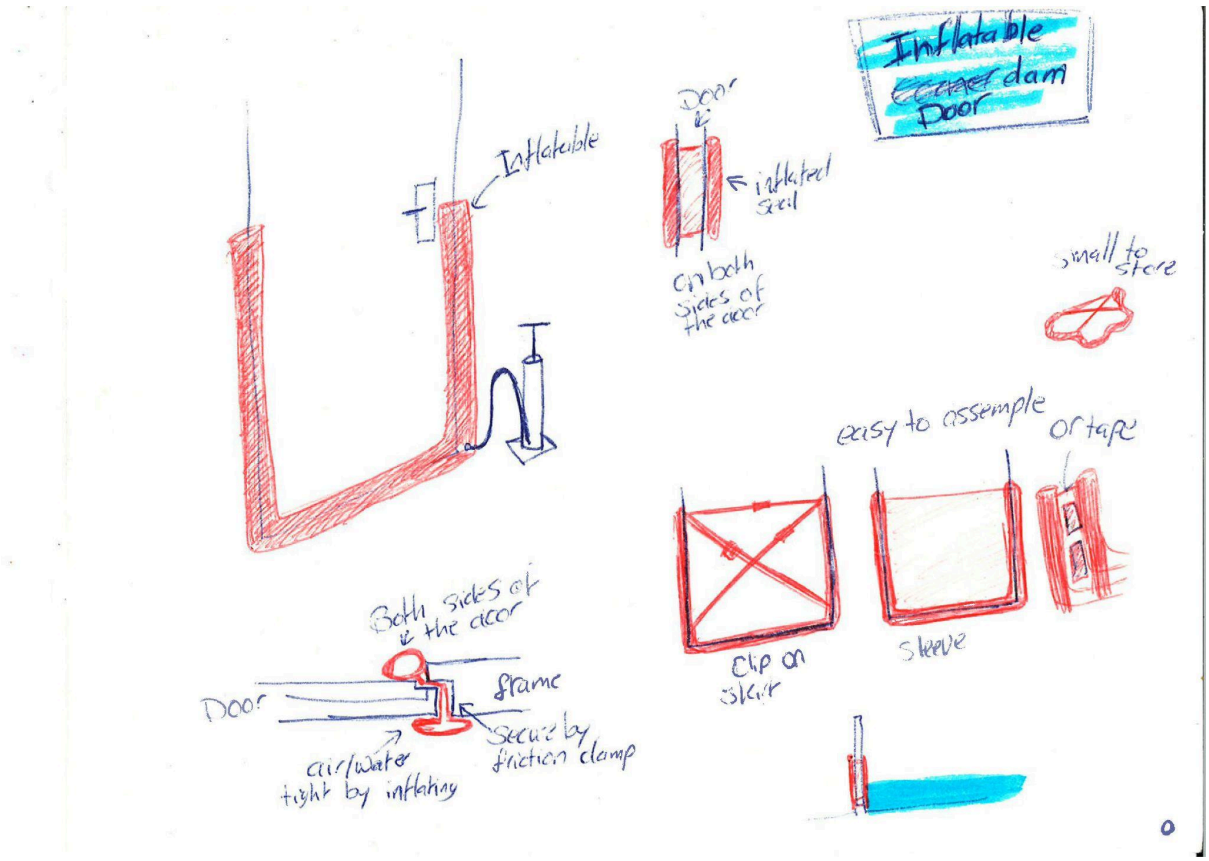
- Works for different types of doors
- Small to store
- Light to set up
- Neighbours mostly able to set up

Limits:

- some small changes on the house needed
- Can not open the door when in use
- Somewhat revolutionary

Unique:

- clamp between the doorframe to let it stay



Inflatable door dam idea

Advantages:

- Small to store
- Nothing big to carry/set up
- Works on all types of doors
- Seal on both sides of the door: double protection
- No installation beforehand needed
- Somewhat evolutionair

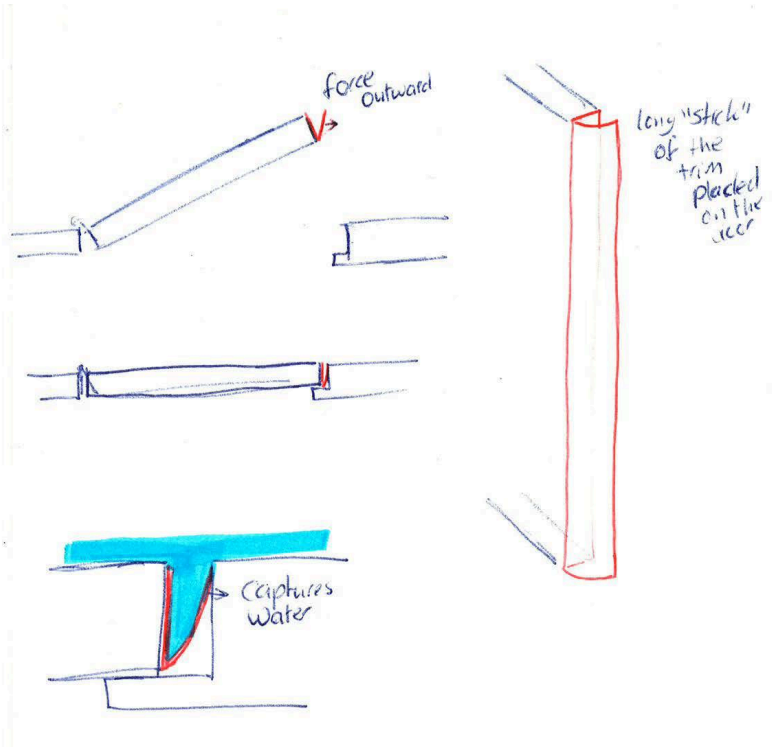
Limits:

- Harder to assemble around hinges
- Chance on deflating
- Door needs to open to assemble: neighbors need to get in to assemble

Unique:

- Cover-style add-on to the door
- Using inflation to seal the door

Solutions between the door



<u>V-shaped trim idea</u>

Advantages:

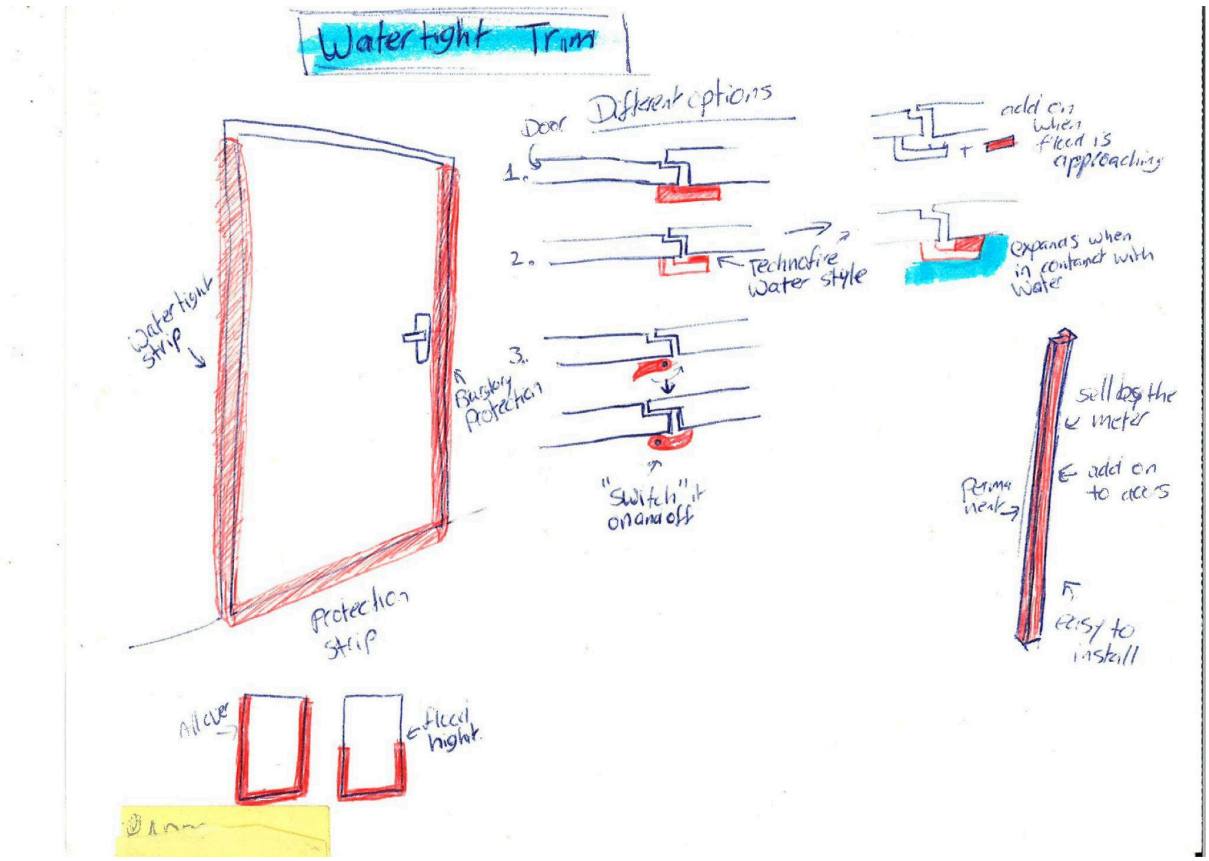
- Easy to set up
- Works for all types of doors
- No need to store
- Works always
- Somewhat evolutionair

Limits:

- Might not fit all doors

Unique:

- Use properties of rubber to seal the door
- Works always when door is closed



<u>Watertight trim idea</u>

Advantages:

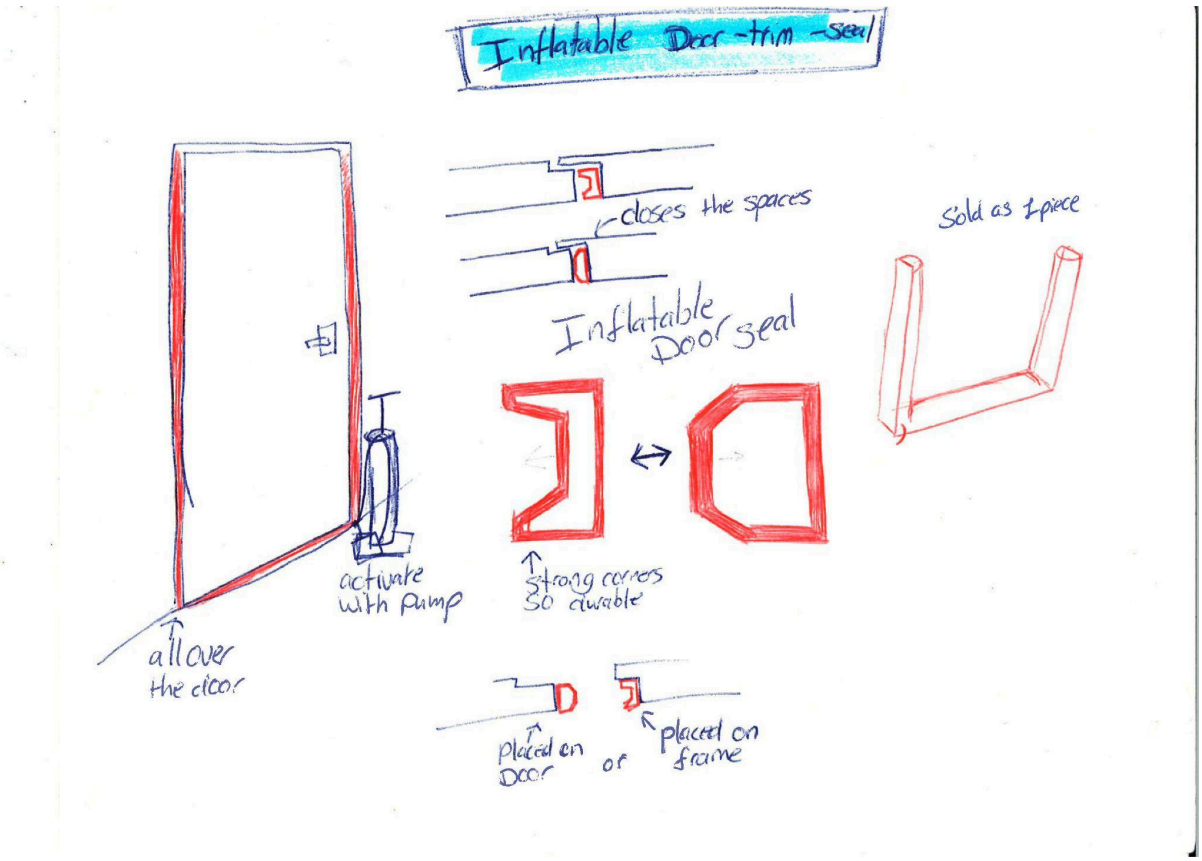
- Always present
- Nothing/barely needed to set up during flood
- Minimally visible
- Different ways of executing
- Somewhat evolutionair

Limits:

- Harder to assemble around hinges
- Does not/less work on an outward opening door

Unique:

- Anti-burglary attachment
- Close to current product line



Inflatabe door-trim-seal idea

Advantages:

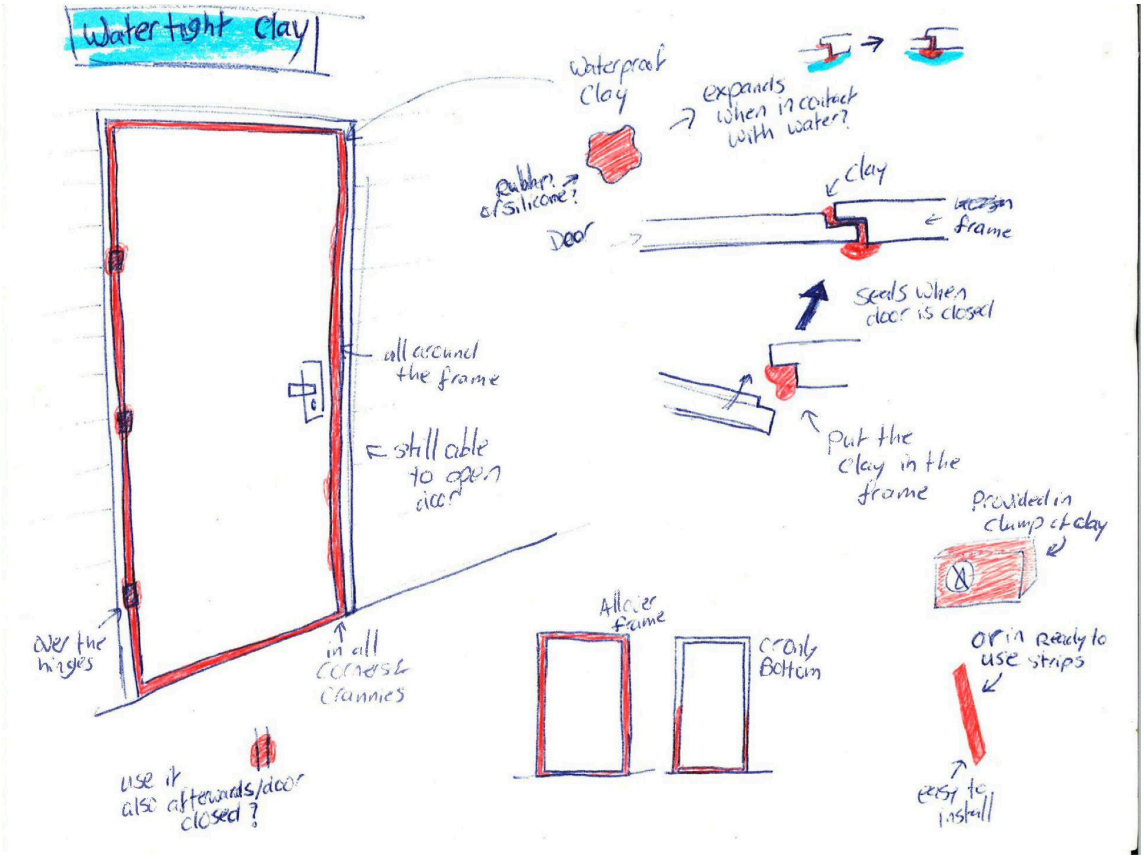
- Always present
- Easy to set up/activate
- Works for different types of doors
- Not visible from outside
- Somewhat evolutionair

Limits:

- Chance on breakdown and therefore failing
- Beforehand installing needed

Unique:

- Use air to close gaps
- Already existing product/people use it but not in this form
- Also adds insulation properties



Waterproof-clay idea

Advantages:

- Easy to set up
- Works for all types of doors
- Easy to store
- Use when needed

Limits:

- Need to open the door to activate
- Working depends on properties of the material

Unique:

- Completely seal all the gaps

4.3. The 4 concepts in greater detail

4.3.1. Folding barrier

How it works
This concept consists of a foldable flood barrier mounted next to the door. When flooding is expected, the barrier can be unfolded and secured in front of the door. Waterproof sheets close the gaps and create a watertight seal. Its V-shaped geometry allows the outward-opening door to remain partially functional while distributing water pressure.

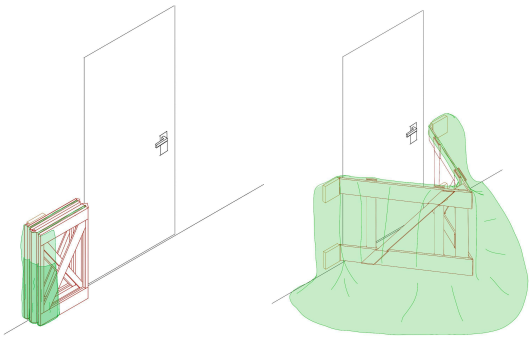


Figure: The folding barrier unfolds into a watertight V-shaped barrier.

Details
Form: The barrier folds into a compact package when not in use. Once unfolded, the V-shape improves stability and door accessibility. A waterproof sheet is attached to the sides on the wall and weighted at the bottom to seal against water ingress.

Material: The structural components are made from lightweight and durable materials such as aluminium, combined with waterproof plastic sheets.

Placement: The folded barrier is mounted beside the door on the opening side for quick deployment. Small attachment points are required on the house to secure the barrier and sheet. A removable version for separate storage was also considered.

Advantages
- Easy to trust: looks like and works in a way that is already known to people, so it makes it easier to trust
- Works for different types of doors: all types of doors can be protected with this concepts: front and back doors, sliding doors, garage doors, etc. A bigger version can be made for double doors.
- Small(er) storage: Foldable design makes it a small package to store than traditional flood barriers.

Limitations
- Surroundings in the way: the space around an outward opening door, oftentimes the backdoor, varies greatly among people and things stored or placed aroutd the door, like benches, plants, flowers or toys could interfere with the placing and folding of the barrier.

- Time and effort needed: setting up this barrier is easy and intuitive, setting it up still takes effort and some time to do so.
- Changes to the house needed: Some visible changes to the house are needed to connect the barrier. Also having the barrier in sight all times might be perceived as an disadvantage.

Variations
Several configurations were explored, including removable systems, solid panel constructions, and alternative mounting methods. The presented concept showed the highest potential due to its ease of use and versatility.

4.3.2. Inflatable trim

How it works
This concept is based on inflatable sealing systems currently used in yachts and ships, adapted for outward-opening residential doors. A rubber inflatable seal is integrated into the door and connected to a pump and exterior water sensors. When flooding is detected, the system automatically inflates the seal, closing the gaps around the door and creating a watertight barrier.

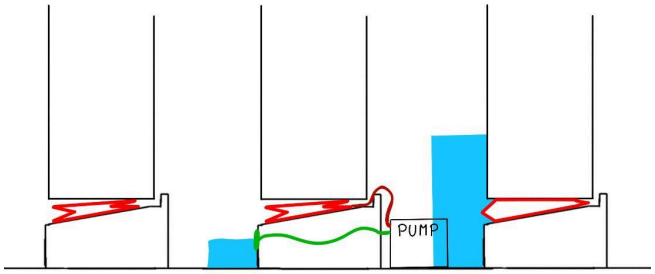


Figure: The rubber seal is activated by a detection of a flood and inflates to seal the gaps.

Details
Different seal geometries are possible, depending on the required expansion and sealing performance. Picture # shows a few possibilities.

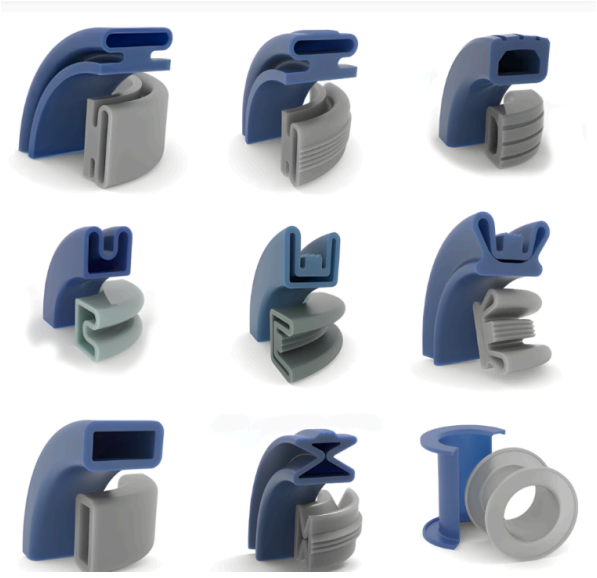
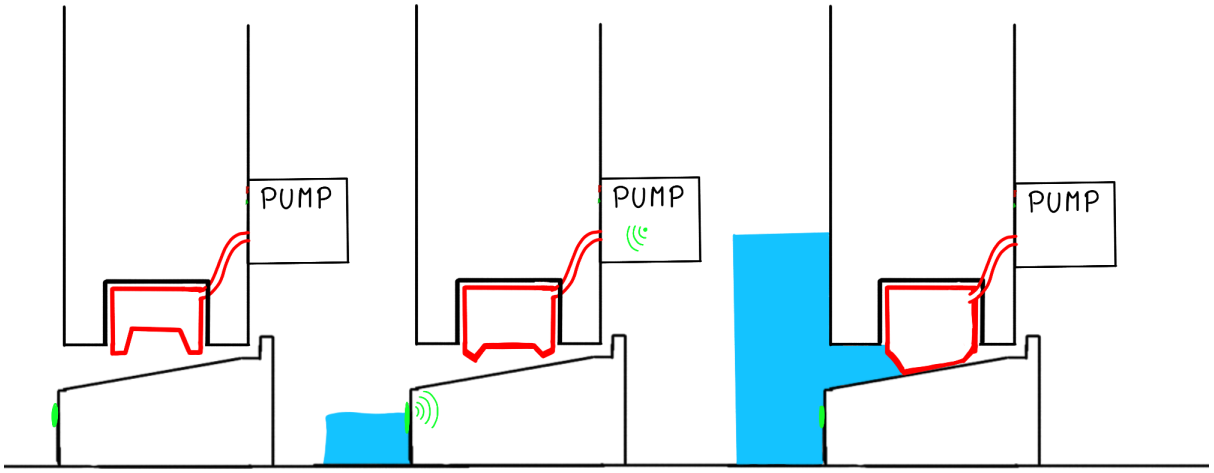


Figure: variation of forms of rubber seals created by (Advanced Sealing Technology, 2024)

Material: The seal is made from flexible and durable rubber materials such as EPDM or NBR. The system includes a pump and electronics, which can operate wired or wirelessly using a battery-powered setup. Integration with smart-home systems or mobile applications is possible.

Placement: To protect the system from damage and create sufficient space, the rubber seal is recessed into the door or frame through a milled channel.



Advantages

- Easy to activate: It automatically activates when a flood is detected. No need to be home or do anything yourself.
- Limited visible changes: because the product is hidden in the door, there is barely any visible change to the house.
- Versatility: this solution works for all types of doors. Frontdoors, sliding doors, garage doors. As long as the seal can be attached in the door or frame.

Limitations

- Invasive installation: installing the product, making a hole in your door, etc. is quite invasive and requires special skills and tools to do.
- Fault-sensitive: when even a small hole is made in the seal, the whole product does not work anymore. This might pose a problem, especially in this high-trafic area.
- Space for the pump: the pump and electronics need to be stored close to or on the door. Space is needed for this.
- Might get pricy: This more complex system with electronics and specialised installation might make this a costly solution.

Variations

Several variations were explored, including integration into the door frame, alternative seal geometries, and replacing the inflatable system with water-activated expanding materials.

4.3.3. The folding trim

How it works

The folding trim is attached to the sides and bottom of the door. When the door closes, the flexible L-shaped trim folds between the door and frame, creating a watertight seal. Rising water pressure pushes the trim further into place, increasing the sealing effect.

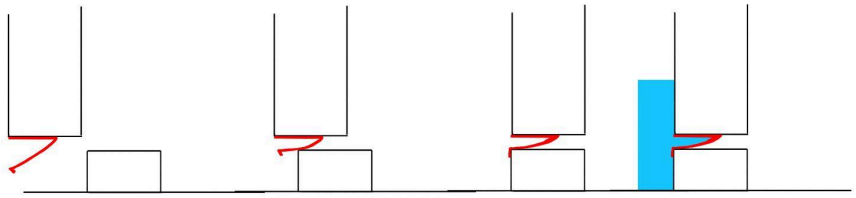


Figure: schematic side profile of the bottom of the door and step. The folding trim closes off the gap between the door and trim when the door is closed and water rises.

Details

Form: The trim deforms from an L-shape into a V-shape when compressed between the door and frame, creating outward pressure that seals the gap. A small edge at the end of the trim helps prevent water ingress at the sides.

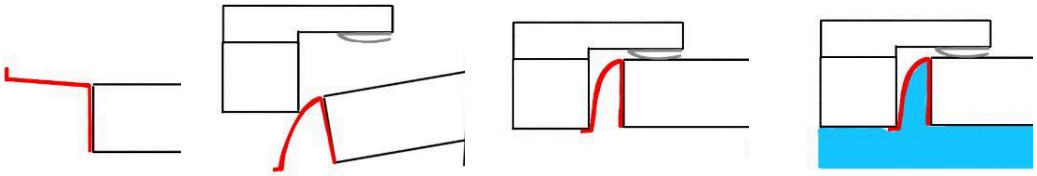


Figure: The L-shaped trim folds in between the door and frame to create a watertight seal

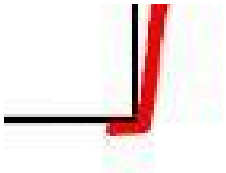


Figure: The small corner at the end of the seal creates an extra protection against the water coming in at the sides.

Material: The trim is designed as a flexible and durable rubber profile, such as EPDM or butyl rubber, suitable for frequent bending and outdoor exposure. The profile is likely produced through extrusion.

Placement: The trim is mounted along the sides and bottom of the door, with the fold facing the frame. Attachment can be achieved through adhesive or screws, provided no gaps remain between the trim and door.

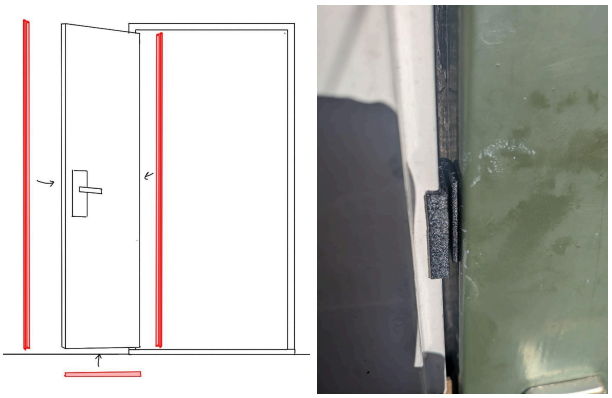


Figure: The folding trim is an add-on to doors on both sides and underside of the door.

Advantages

- Low cost solution: extruding rubber in a simple shape on a big scale is quite cheap.
- Easy to install: This add-on can easily be mounted to the door, with a few simple steps and limited tools required.
- Works always: Automatically activated when the door is closed, no need to set up anything.
- Limited change of appearance of the house: This small add-on is not highly visible and no permanent changes to the house have to be made. It could even be produced in different colours
- Adds insulation: The trim adds an extra layer of insulation to the door

Limits

- Troubles along the corners, hinges and locks: The folding mechanism will interfere with the locks and hinges. At the corners the pieces must completely align to create a watertight seal. More research is needed to solve these problems
- Robustness: The product is folded and unfolded multiple times on a daily basis, on average. Therefore the product must be robust and withstand this use over a longer period of time.
- This product does not work for the front door or sliding doors. Adjustments need to be made.
- Needs enough space: To fit the trim, there needs to be enough space between the door and frame.
- Holes and bumps: Because the trim is one piece, holes and bumps in the door or frame could create gaps and break the water seal and let water in.

Variations

Several variations were explored to improve performance, including integrated springs for increased sealing pressure, foam additions for improved side sealing, and secondary trims placed behind the door.

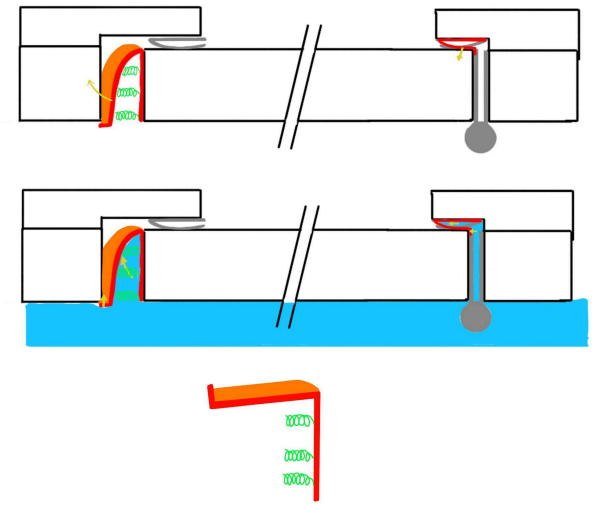


Figure: a version of the folding trim where springs, foam and a smaller version seal the door.

4.3.4. The Expanding Trim

How it works

This concept uses a Water Activated Expanding Material (WAEM) integrated into a protective anti-burglary trim mounted around the door. When water reaches the material, it expands and seals the gaps between the door and frame, creating a watertight barrier.

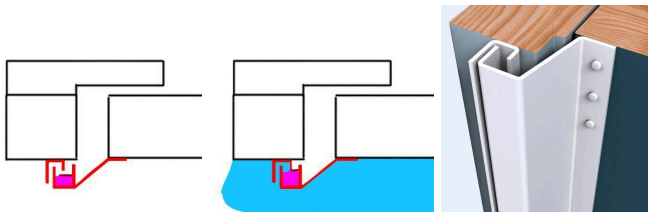


Figure: The WAEM expands when in contact with water and expanded to seal the space between the strips.

Details

Form: The anti-burglary trim protects the WAEM from regular rain exposure while allowing activation during flooding. As the material expands, it fills and seals the open gaps within the trim system.

Material: The trim is made from durable materials such as aluminium or steel. The WAEM consists of Super Absorbent Polymers (SAPs), such as sodium polyacrylate.

Placement: The system is mounted on the outside of the door along the sides and bottom, creating an interlocking seal. This external placement avoids interference with locks and limited spacing between the door and frame.

Advantages

- Works always: As soon as the door is closed, the door is protected for floods.
- Usable for different types of doors: small adaptions need to be made, but this system can be used for many different types of doors.
- Add-on to the current door: Only the anti-burglary strip needs to be attached to the door, no big changes are needed.
- Small change to the house: Adding the anti-burglary trim changes the appearance of the house minimally.
- Extra protected for break-ins: The anti-burglary strip makes the door also protected for break-ins.
- Business model: The WAEM is probably a one-time-use product. After every flood a new strip needs to be ordered and placed. This creates a good business model for Alprokon.

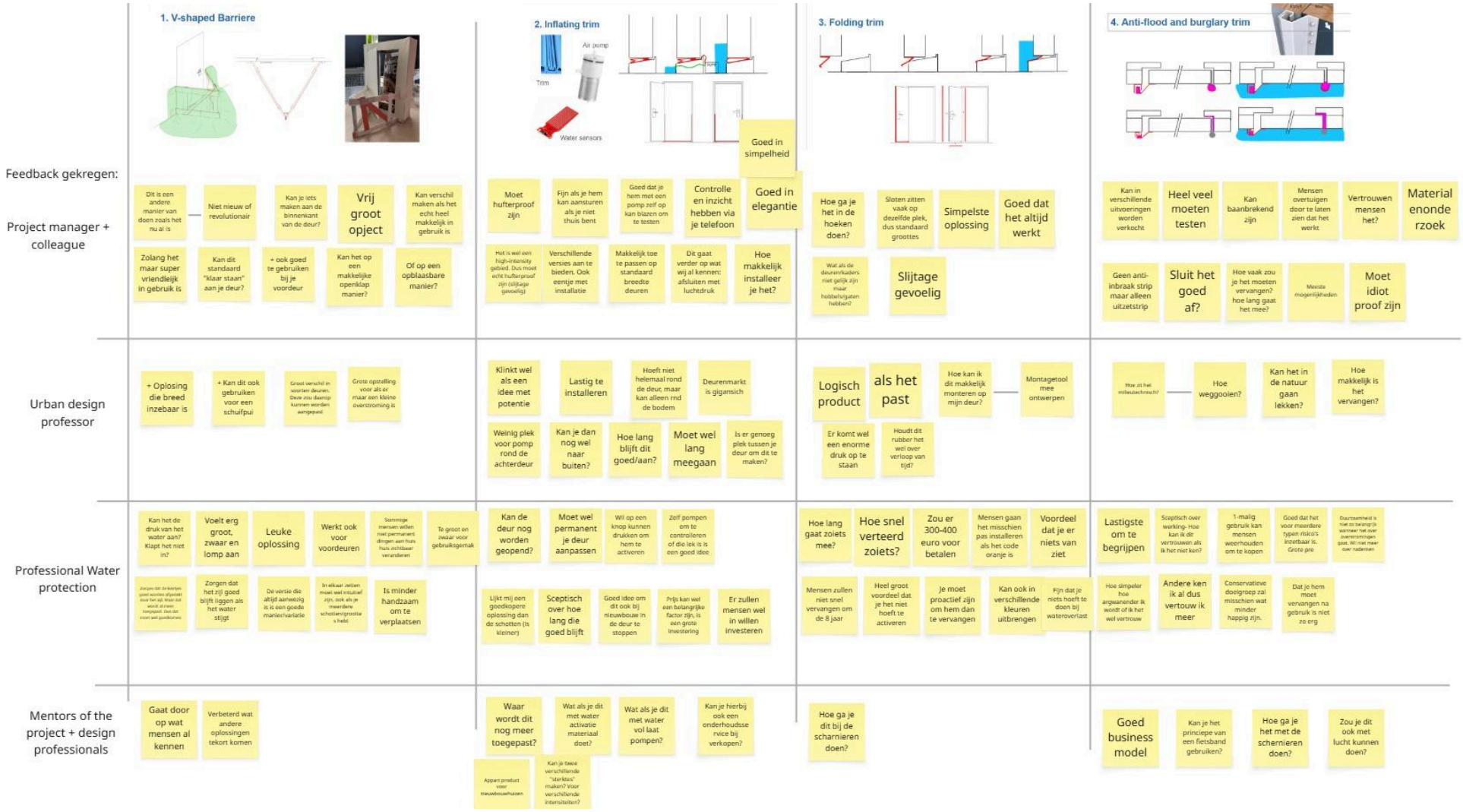
Limitations

- Corners and hinges: Because the strip is placed on the outside of the door, corners and hinges pose a problem where more design is needed.
- Toxicity of the WAEM: it is unclear how environmentally friendly the WAEM is.
- Need refills over time: The WAEM is a one time use product. Consumers will need to reorder and install the new strip each time.
- Humidity of air: The SAP's in the WAEM take up water from the air, making the product unsuitable to keep outside of plastic in a humid environment for long.

Variations

Several variations were explored, including alternative trim geometries, additional sealing rods, inflatable replacements for the WAEM, and fully rubber-based sealing systems.

4.4. Feedback on the four concepts


1. V-shaped Barriere
2. Inflating trim
Air pump
Trim
Water sensors
3. Folding trim
4. Anti-flood and burglary trim
Feedback gekregen:
Project manager + colleague
Urban design professor
Professional Water protection
Mentors of the project + design professionals
Dit is een andere manier van doen zoals het nu al is
Niet nieuw of revolutionair
Kan je iets maken aan de binnenkant van de deur?
Vrij groot opject
Kan verschil maken als het echt heel makkelijk in gebruik is
Zolang het maar super vriendlijk in gebruik is
Kan dit standaard "klaar staan" aan je deur?
+ ook goed te gebruiken bij je voordeur
Kan het op een makkelijke openklap manier?
Of op een opblaasbare manier?
Goed in simpelheid
Moet hufterproof zijn
Fijn als je hem kan aansturen als je niet thuis bent
Goed dat je hem met een pomp zelf op kan blazen om te testen
Controlle en inzicht hebben via je telefoon
Goed in elegantie
Het is wel een high-intensity gebied. Dus moet echt hufterproof zijn (slijtage gevoelig)
Verschillende versies aan te bieden. Ook eentje met installatie
Makkelijk toe te passen op standaard breedte deuren
Dit gaat verder op wat wij al kennen: afsluiten met luchtdruk
Hoe makkelijk installeer je het?
Hoe ga je het in de hoeken doen?
Sloten zitten vaak op dezelfde plek, dus standaard groottes
Simpelste oplossing
Goed dat het altijd werkt
Wat als de deuren/kaders niet gelijk zijn maar hobbels/gaten hebben?
Slijtage gevoelig
Kan in verschillende uitvoeringen worden verkocht
Heel veel moeten testen
Kan baanbrekend zijn
Mensen overtuigen door te laten zien dat het werkt
Vertrouwen mensen het?
Material enonderzoek
Geen anti-inbraak strip maar alleen uitzetstrip
Sluit het goed af?
Hoe vaak zou je het moeten vervangen? hoe lang gaat het mee?
Meeste mogenlijkheden
Moet idiot proof zijn
+ Oplosing die breed inzebaar is
+ Kan dit ook gebruiken voor een schuifpui
Groot verschil in soorten deuren. Deze zou daarop kunnen worden aangepast
Grote opstelling voor als er maar een kleine overstroming is
Klinkt wel als een idee met potentie
Lastig te installeren
Hoeft niet helemaal rond de deur, maar kan alleen rnd de bodem
Deurenmarkt is gigansich
Weinig plek voor pomp rond de achterdeur
Kan je dan nog wel naar buiten?
Hoe lang blijft dit goed/aan?
Moet wel lang meegaan
Is er genoeg plek tussen je deur om dit te maken?
Logisch product
als het past
Hoe kan ik dit makkelijk monteren op mijn deur?
Montagetool mee ontwerpen
Er komt wel een enorme druk op te staan
Houdt dit rubber het wel over verloop van tijd?
Hoe zit het milieutechnisch?
Hoe weggooien?
Kan het in de natuur gaan lekken?
Hoe makkelijk is het vervangen?
Kan het de druk van het water aan? Klapt het niet in?
Voelt erg groot, zwaar en lomp aan
Leuke oplossing
Werkt ook voor voordeuren
Sommige mensen willen niet permanent dingen aan hun huis zichtbaar veranderen
Te groot en zwaar voor gebruiksgemak
Zorgen dat de kieren goed worden afgedicht zodat het zijt. Maar dat wordt al meer toegepast. Slot dat moet wel goed kunnen
Zorgen dat het zijl goed blijft liggen als het water stijgt
De versie die altijd aanwezig is is een goede manier/variatie
In elkaar zetten moet wel intuitief zijn; ook als je meerdere schotten/grootte s hebt
Is minder handzaam om te verplaatsen
Kan de deur nog worden geopend?
Moet wel permanent je deur aanpassen
Wil op een knop kunnen drukken om hem te activeren
Zelf pompen om te controlleren of die lek is is een goed idee
Lijkt mij een goedkopere oplossing dan de schotten (is kleiner)
Sceptisch over hoe lang die goed blijft
Goed idee om dit ook bij nieuwbouw in de deur te stoppen
Prijs kan wel een belangrijke factor zijn, is een grote investering
Er zullen mensen wel in willen investeren
Hoe lang gaat zoiets mee?
Hoe snel verteerd zoiets?
Zou er 300-400 euro voor betalen
Mensen gaan het misschien pas installeren als het code oranje is
Voordeel dat je er niets van ziet
Mensen zullen niet snel vervangen om de 8 jaar
Heel groot voordeel dat je het niet hoeft te activeren
Je moet proactief zijn om hem dan te vervangen
Kan ook in verschillende kleuren uitbrengen
Fijn dat je niets hoeft te doen bij wateroverlast
Lastigste om te begrijpen
Sceptisch over werking- Hoe kan ik dit vertrouwen als ik het niet ken?
1-malig gebruik kan mensen weerhouden om te kopen
Goed dat het voor meerdere typen risico's inzetbaar is. Grote pro
Duurzaamheid is niet zo belangrijk wanneer het over overstromingen gaat. Wil niet meer over nadenken
Hoe simpeler hoe argwanender ik wordt of ik het wel vertrouw
Andere ken ik al dus vertouw ik meer
Conservatieve doelgroep zal misschien wat minder happig zijn.
Dat je hem moet vervangen na gebruik is niet zo erg
Gaat door op wat mensen al kennen
Verbeterd wat andere oplossingen tekort komen
Waar wordt dit nog meer toegepast?
Wat als je dit met water activatie materiaal doet?
Wat als je dit met water vol laat pompen?
Kan je hierbij ook een onderhoudsservice bij verkopen?
Appart product voor nieuwbouwhuizen
Kan je twee verschillende "sterktes" maken? Voor verschillende intensiteiten?
Hoe ga je dit bij de scharnieren doen?
Goed business model
Kan je het principe van een fietsband gebruiken?
Hoe ga je het met de schernieren doen?
Zou je dit ook met lucht kunnen doen?

Summary:
Concept 1: Foldable barrier

+ Familiar to people, easier to trust
+ Easy to set up
+ Fits multiple types of doors
+ Improves on where some other products fail

- It is quite a big thing to have hanging at your house
- Big setup when small floods are happening
- Feels and looks big and heavy
- Some people do not want to change the appearance of their house

Concept 2: inflating trim

+ Good it is always ready and turns on automatically
+ Would give a nice feeling of security to check in the app
+ Limited visible changes at the house

- Installing seems very difficult
- Quite a big thing to place among your door. Including the pump etc.
- Feels scary to leave the activation to electronics. What if they fail?
- Is quite sensitive for faults
- Sceptic how long it will work

Concept 3: folding trim

+ Elegant and simple solution
+ Great it is cheap
+ Seems easy to install
+ Very logical product

- Wear and tare sensitive
- How about the corners?
- You need to be pro-active to replace it after it breaks
- Will it fit all doors?

Concept 4: expanding trim

+ Anti burglary is a nice addition
+ Completely new to what is already known and used
+ Can create a great business model
+ Small addition with big advantages
+ Seems easy to install.

- Because it is this new, it will be harder to trust and convince people it works
- Is it environmentally friendly?
- How to reuse is or replace it?
- Including the anti-burglary trim makes it quite big. Can only the expanding trim be used?

4.5. Possible solutions

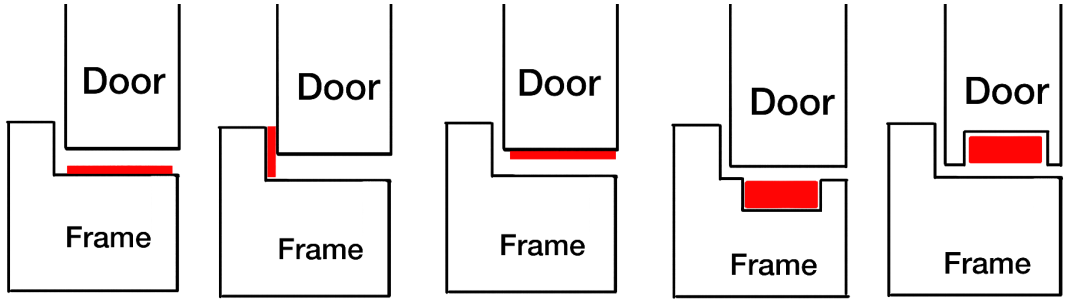
4.5.1. Placement of strips

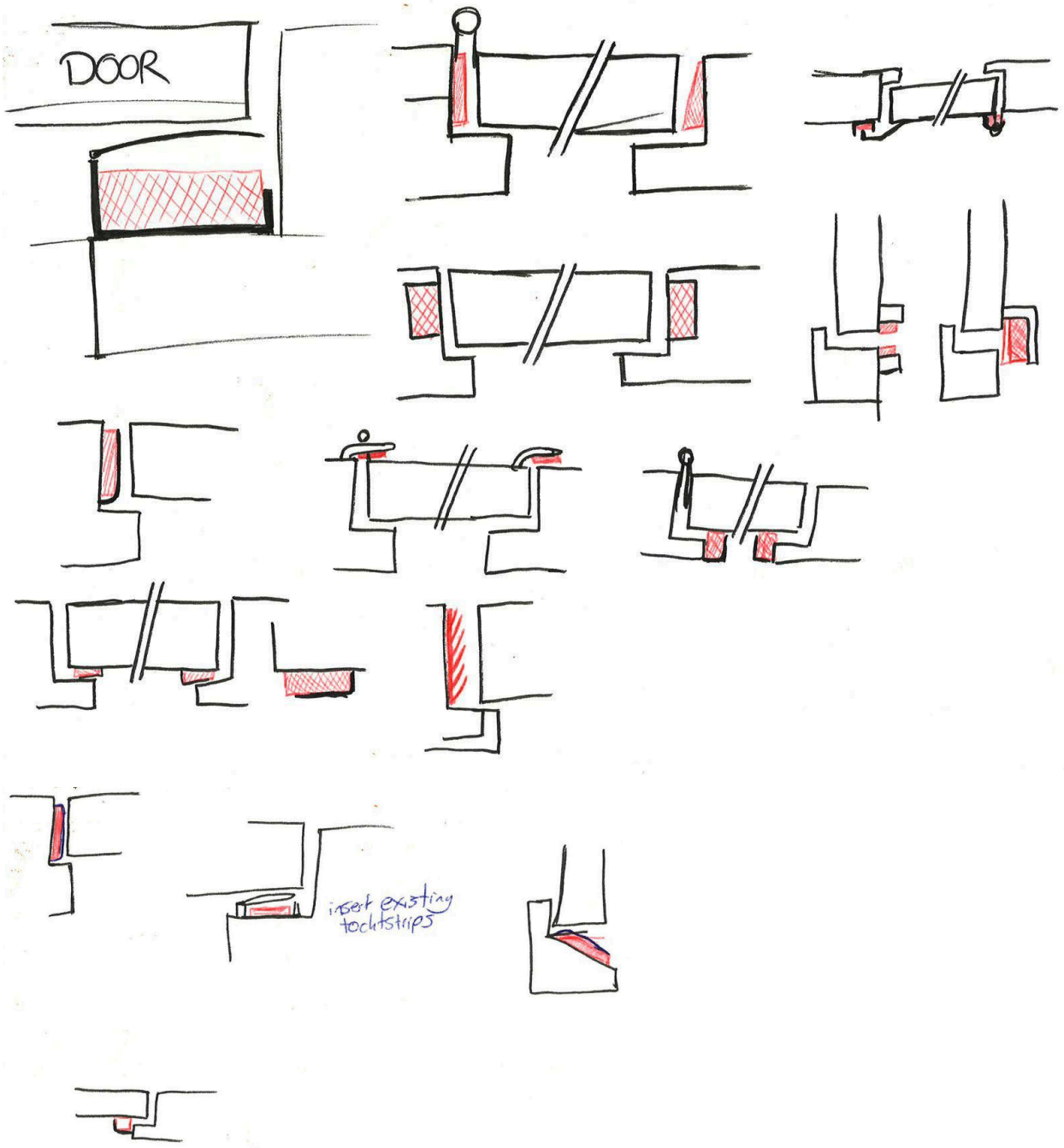
If sufficient space is available between the door and frame, the product can be directly attached there. This is the simplest solution for retrofitting existing doors. The strip can either be attached to the frame or to the door itself.

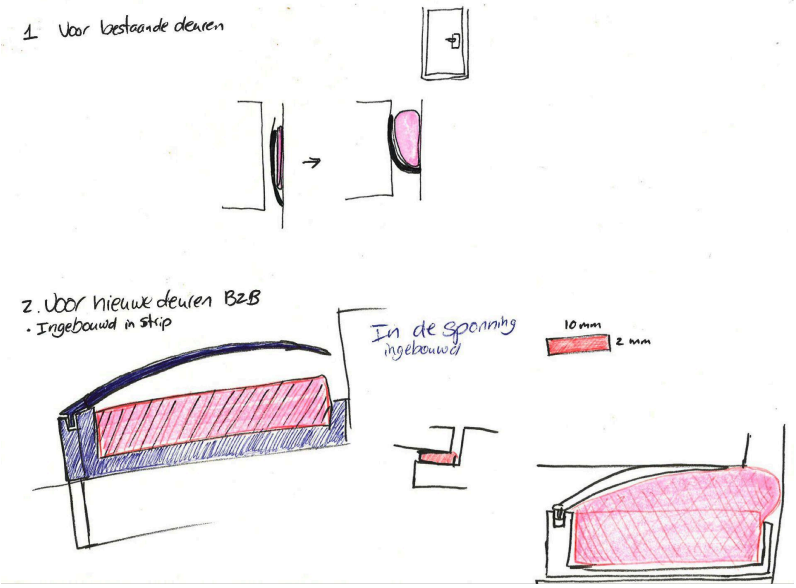
1. Placement on the frame allows floodwater to reach the material quickly, but also increases exposure to rain and daily wear, especially near the threshold. Onto the frame, two possible locations for sticking were identified: along the lock side of the door, where more space is available but hinges and locks may interfere, or at the contact surface where the door closes against the frame. This second location is more protected, although space limitations and pressure buildup on the door require further testing.
2. Attaching the strip to the door reduces wear and exposure, but places the material higher above the ground. As a result, floodwater may reach the material later, allowing more water to enter before the seal activates.

If insufficient space is available between the door and frame, a groove can be milled into either the frame or the door to integrate the material. Although this creates a cleaner integration, installation becomes significantly more complex and may require professional assistance.

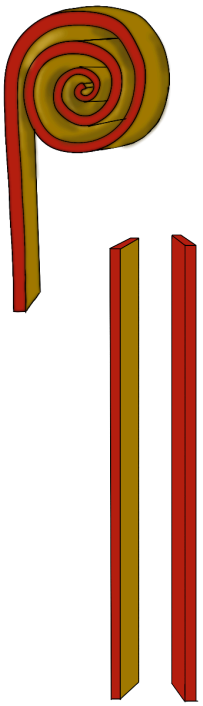
1. Milling into wooden frames is generally possible. However, this is not possible with plastic or metal frames. Or wooden frames that do not provide enough material thickness.
2. Milling into the door has similar limitations. Particularly around hinges and locking mechanisms, milling requires a different solution. As well as the delayed exposure to the floodwater due to its higher placing.




DOOR
insert existing tactilestrips



4.5.2. Type of strips



Flexible strip

Application:

- Unroll and stick it in between the frame and the door, cut to size
- Leave it there until the flood happens
- Dispose of after flood

Pro's:

- Nothing to do when floods happen
- One roll, cut to size
- Easy to store
- Robust

Cons: none

Rigid strip

Application:

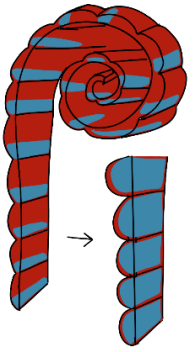
- Stick it in between the frame and the door, cut to size
- Leave it there until the flood happens
- Dispose of after flood

Pro's:

- Nothing to do when floods happen; always protected
- Cut to size; customizable
- Robust

Cons:

- Bit harder to store and transport
- Bit harder to install



Compartiment strip with powdered Water Activated Expanding Material

Application:

- Unroll and stick it in between the frame and the door, cut to size
- Leave it there until the flood happens
- Dispose of after flood

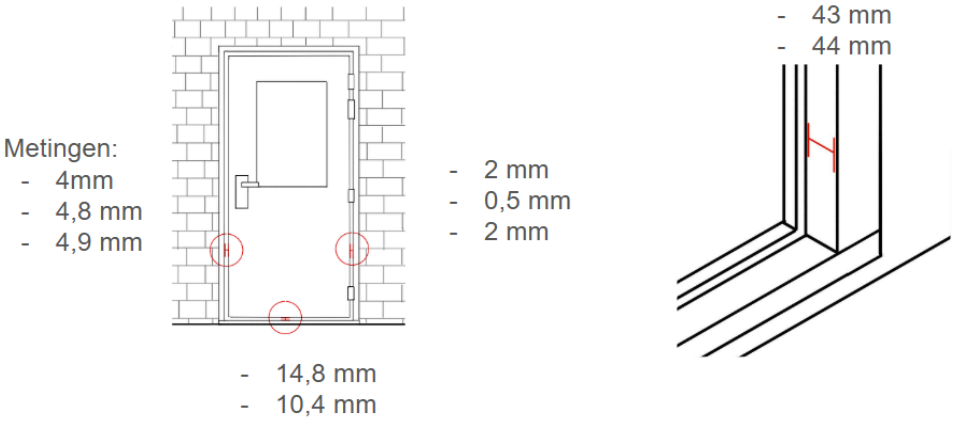
Pro's:

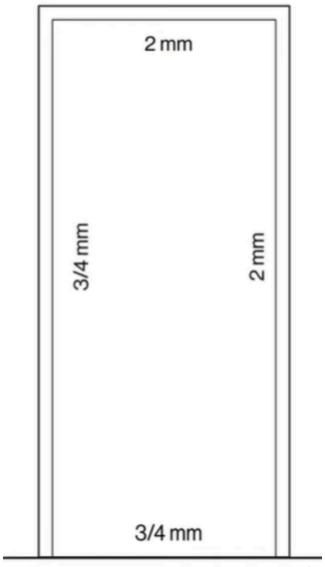
- Nothing to do when floods happen
- One roll, cut to size
- Easy to store
- Robust

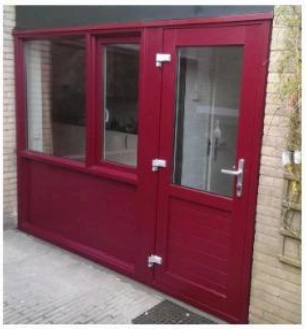
Cons:

- Will it seal all gaps?
- Will it withstand the pressure?
- Harder to cut out parts for locks

4.5.3. Research backdoors

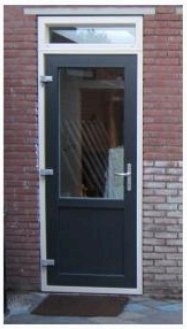
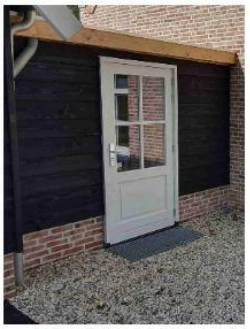
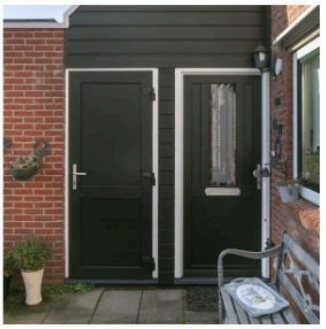




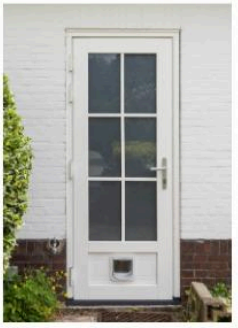
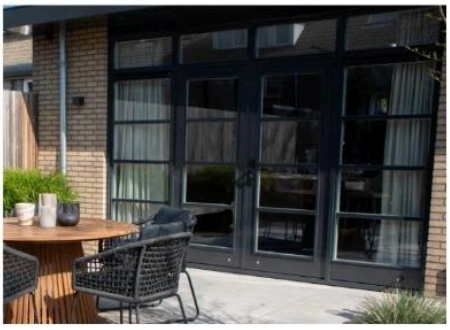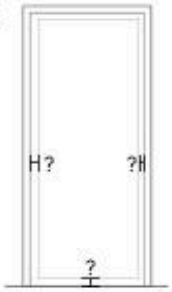












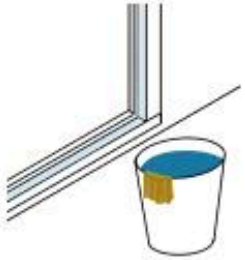


Installing WAEM in 20 minutes

1. Measure the gap between your door and frame. Choose the right thickness. Be aware, the gaps around your door can have different sizes.

Size gap	Size WAEM
2-4 mm	1 mm
4-7 mm	2 mm
7-12 mm	3 mm

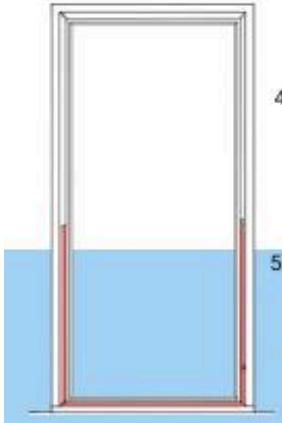




2. Clean the frame where you will paste WAEM with water and soap.

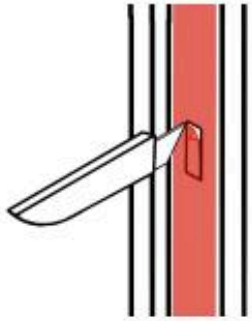


3. Remove the tape on the first part of the WAEM and place at the bottom of the door. Make sure to place it in the middle.



4. Piece by piece take of a part of the tape and paste it on the door. Make it at least 40 cm high, but higher is possible.

5. Repeat this for both sides and the bottom of the door. Make sure you use the correct thickness for each side and that the corners are properly covered.



6. With a small knife, cut out the holes where locks are interfering with the strip. Make sure to leave some pats on both sides of the lock. Otherwise a leak will start here.

7. Done! When the door is closed, the door is protected against floods.

During a flood

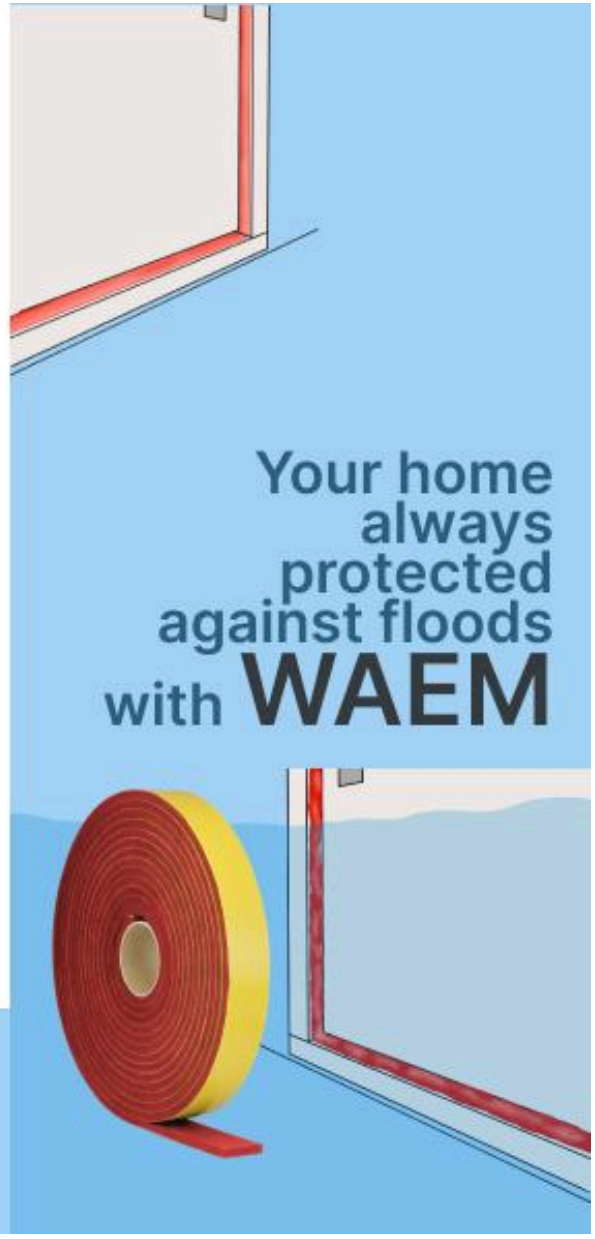
When WAEM is installed correctly, nothing needs to be done when a flood is approaching. When the water reaches the strip, the WAEM will be activated, expand and close off the gaps. No water will get trough anymore.

Disposing

WAEM is a one time use product. After being activated it needs to be replaced. Simply remove the WAEM strip from your door. A bit of rubbing alcohol could help with this. Dispose the strip in in the general waste.

Replacing

Replacing an activated or expired WAEM strip is simple. Just remove the old one, clean the door on residues, leave it to dry and install a new strip the same way you installed the first one.

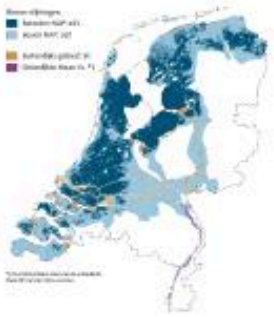


Your home always protected against floods with WAEM

Growing amount of floods

In recent years, the Netherlands and other parts of Europe, have experienced multiple floods. From major floods of cities when rivers flood, to local flooding in streets when drainage systems overflow. Due to heavy rainfall, floods are expected to happen more and more often.

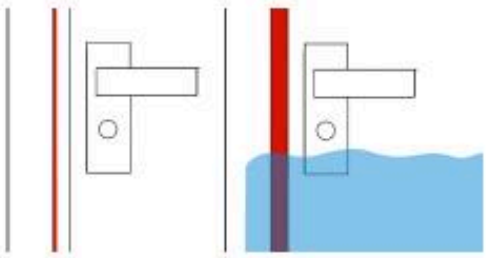
Even a little bit of water entering your home will create serious damage. It will ruin floors, walls, and furniture. Leading to dangerous situations and high costs. Preventing water from entering your home will safe you a lot of money and stress.



Always protected. No stress.

WAEM stops water where it enters your home: the door. The strip activates on contact with water and expands to seal the gaps between the door and frame, keeping the water out.

By installing WAEM, you are always prepared for floods. Even when you are not home. Keeping your feet dry and your mind clear.

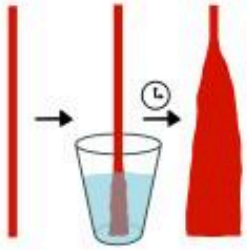


Smart Water-proofing. Works instantly!

WAEM is made from sodium polyacrylate: a super-absorbent material that absorbs water and expands up to 10 times its original size. This automatically seals all gaps along your door and forms a watertight seal.

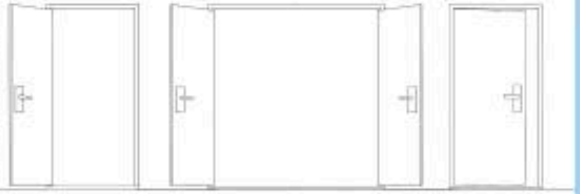
Try it yourself!

Place a small piece of WAEM in water and watch it activate and expand within seconds.



Suitable for every opening

Use WAEM on front and back doors, double doors, garage doors and windows. Suitable for all materials and sizes. Cut it to size and install where desired. The flat strip fits almost anywhere and expands to fill gaps perfectly. Corners, hinges and locks pose no problem for WAEM. Choose the right thickness and make sure the door can still open, WAEM does the rest.



Keep your home dry. Keep your mind at ease. Install WAEM now!

1. Always protected!

WAEM is always present on your door and protects your house at all times. WAEM will be activated automatically by the rising water. Just close the door and you are ready!

2. Secure all your doors

Due to its slim design and great expanding capabilities, WAEM can fit all types of doors and windows!

3. Save thousands of euros

Keeping water out of your house will save thousands of euros because it will protect you from needing a new floor, new furniture and redoing the walls, as well as protecting your emotional objects.

4. Easy installing and replacing

Installing and replacing WAEM is a piece of cake and only takes 20 minutes. Just clean, stick, cut and press. No tools or skills needed.

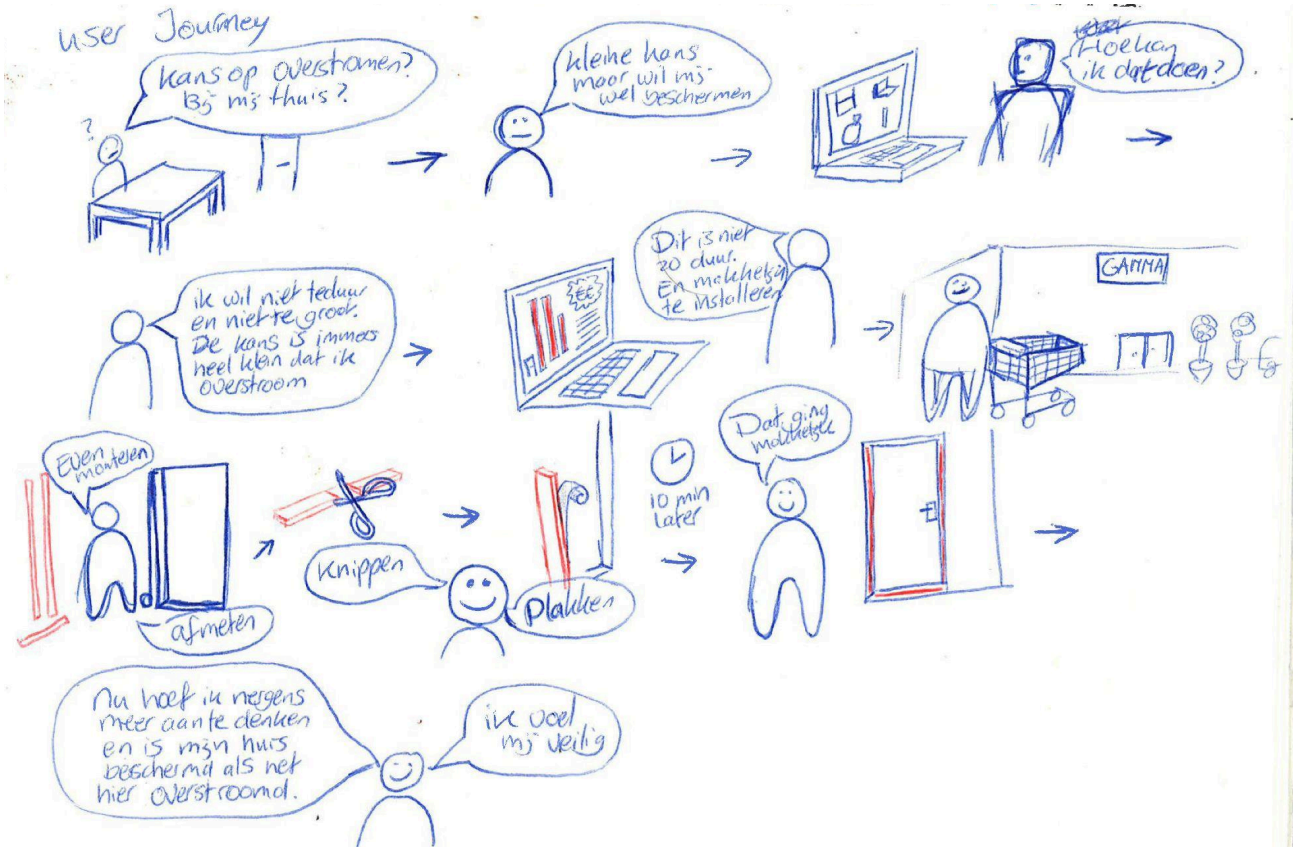
5. Minimal visible changes

The different colour options make WAEM an almost invisible addition to the safety of your home.

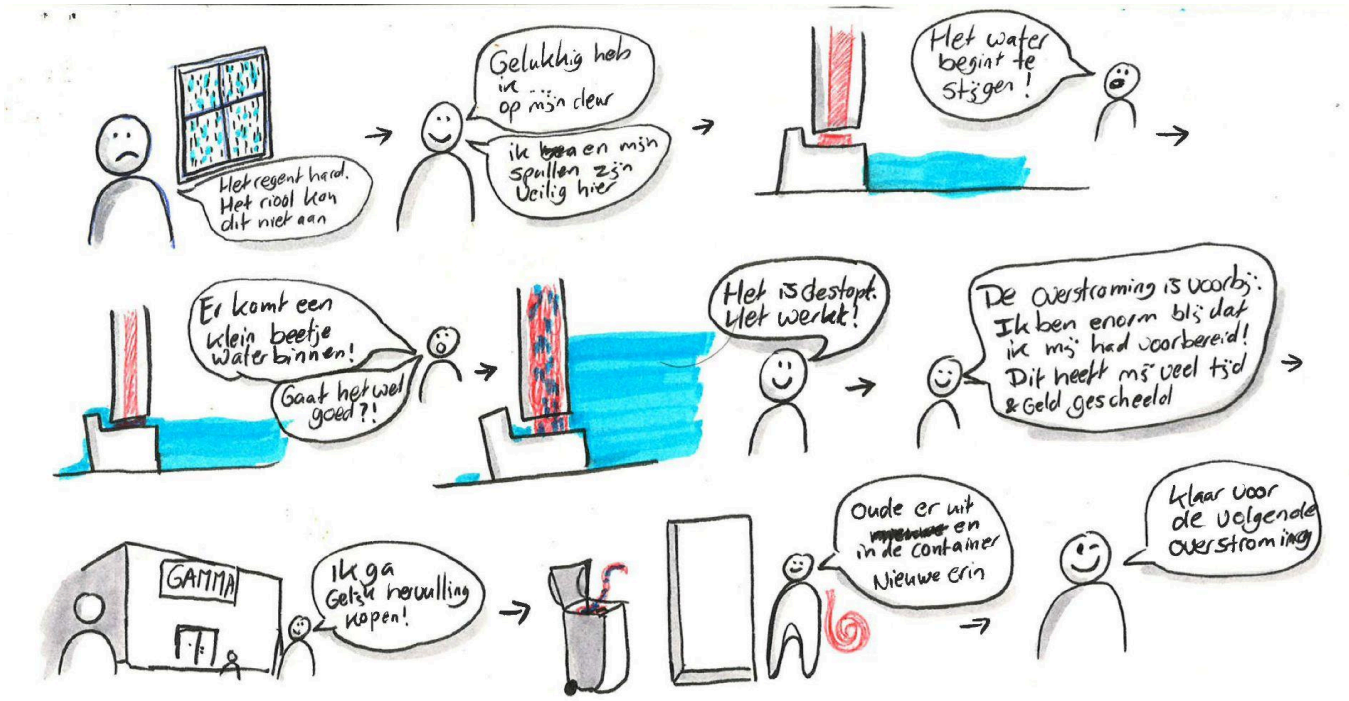
WAEM
ElkeRuimteVeilig.nl
Powered by: ALPROKON.

4.7. User stories for possible design solutions

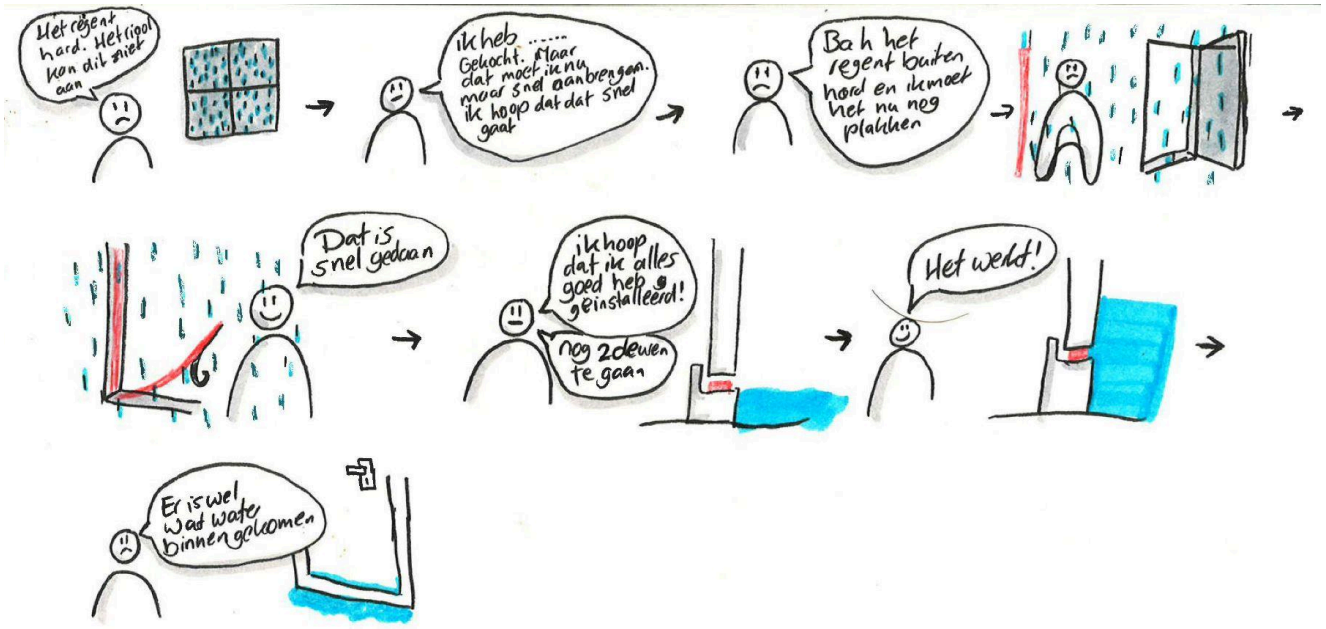
User Journey 1;
First steps of identifying the need for a flood-solution, researching a flood solution and buying a solution (early version of Floud Add-on)



User journey 2:
What the user experiences and thinks during a heavy storm that leads to a flood. And its replacement afterwards (early version of de Floud Add-on)



User Journey 3:
Having a flood solution strip (early version of the Floud Add-on) laying around (or last minute buying one) and installing it during the rise of a flood.

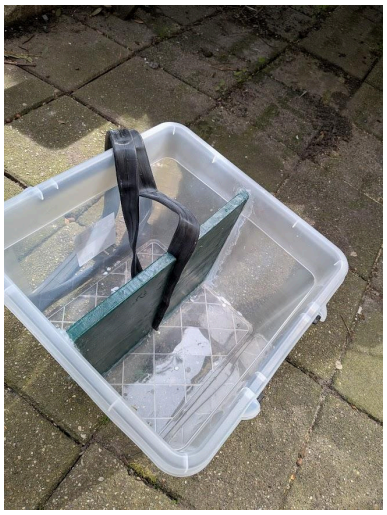


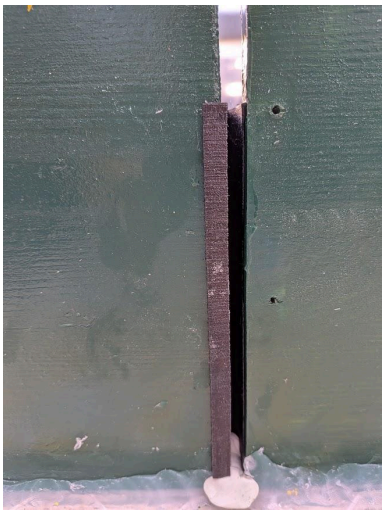
Appendix 5: Chapter 5

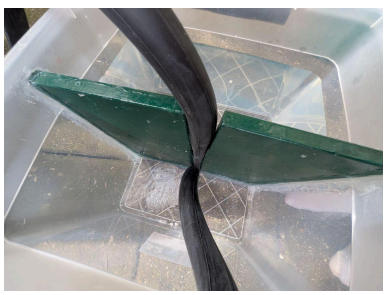
5.1. Concept-water tests

Test set-up
A simple test-setup was made; two wooden planks were placed inside a plastic container with a 1 cm gap in between, representing the gap between the door and doorframe. All attachments between the wood and box were sealed. The different concepts were one by one placed between the two wooden plates. One side of the box was slowly filled with water. The amount of water that the concepts let trough was observed. This way an indication of the effectiveness of the concepts could be made.

- Build the test environment:
    - Plastic box with "doorframe" added
    - The sides of the box will be sealed
    - for each idea create a "door" with the concept can be added
- Add the door with the concept added to it. Position it in a realistic way. Seal the side of the door that touches the box.
- Fill the "outside" part of the box slowly with water (with a hose, o.i.d.)
- See and measure how much water will enter the "inside" part of the box.
- Analyse and answer the research questions:
    - How much water enters the home?
    - If so, where does the water enter the home (weak points)
    - Does it work as expected?
    - What could be improved?







Test plans

Test 1: Does the expanding material stop water?

- Make a thin/flat strip of water-activated material. (powder harvested out of diapers placed in a thin bag made of mesh-fabric)
- Place this between a door and doorpost (1 cm in between)
- Start test
- Version: Add a plate on the bag and see how it moves

Research questions:

- How will the material respond to the rising water?
- How big will it expand?
- How high will it expand?
- Will it stop the waterflow?
- How much water will get in the house?
- How much material is needed to seal the door?
- How strong is the material? Can it withstand the water pressure?
- Will the water "dissolve" the product?

Test 2: Will the folding material stop the water?

- Make a long strip of folding material (10-15 cm)
- Place this between a door and doorpost in "active"-position.
- Make sure the bottom and sides of the "door" are completely sealed with sealant.
- Start the test

Research questions:

- Will it stop the waterflow?
- How much water will get in the house?
- Will the flap stay in the right place when the water rises?
- Does the little corner help to keep the flap in place?
- Is the outward pressure enough to keep it in place?

Test 3: Will inflating trims seal the door?

- place an inner bike tire between the frame and door. Leave around 1 cm space.
- Secure the door and sides and seal them.
- inflate the tire so the gap is closed
- Start the test

Research questions:

- Will it stop the waterflow?
- How much water will get in the house?
- If so, how will the water get into the house?
- How will the material respond to the rising water?
- How big will it expand?
- Can it handle the water pressure?

Test outcomes

Test folding trim:

- Fits nicely
- Folds good in the gap
- Bit big for the wood
- Hard to make completely fit at the bottom
- Creates pressure by the water
- Let some water trough on the sides. Almost completely stops when pressed on.
- The material is too bumpy, creating tiny gaps that let water trough. Other, smooth material will improve

Test expanding trim:

- All material falls to bottom in bag
- Fits nicely in the gap
- Hard to make it completely fit at the bottom
- Needs to be activated, leaves some water trough at the beginning
- When water rises too quickly, water gets over the edge that is not activated yet
- Material “pulls itself up” and is activated +/- 1 cm above waterline. Longer time it will be more
- Slowly still leaves water trough.
- Parts of the SAP get trough the mesh and get away from the seal.

Test inflating trim:

- Bike tire is too big for the appliance
- Awkward fold at the bottom, leaves small gaps for water
- When inflated, box gets pushed outwards, does not influence test too much
- Small pressure is needed to seal all edges
- Keeps water out perfectly, except for the small hole at the bottom fold

5.2. SAP mixing test

Test setup

SAP was combined with different mixing materials in multiple ways: either fully mixed or applied onto a thin layer of binder. In addition, several materials were tested as small “bags” to contain the SAP. The samples were dried and subsequently weighed before testing. Each sample was submerged in water for one minute and ten minutes, after which the weight increase was measured to determine water absorption.

The test setup was exploratory and not fully standardized. Variations in SAP quantities, immersion times, and sample dimensions limited the ability to draw precise quantitative conclusions.

Testplan

Can the water expanding material be stored in an upward strip?

- Create different test trials by mixing the water activated expanding material with different mixers:
    - Glue
    - hars
    - Steenwol
    - Acryl paint
    - Outdoor paint
    - spray paint
    - Spray glue
    - plastic with little holes
    - mesh fabric, big holes
    - Mesh fabric, small holes
    - Cotton
    - Rubber with holes
- See how the material reacts in the mixture
- Leave to dry
- Put water on it
- See how the material reacts with the water

Research questions:

- Can the water activated expanding material be mixed with other materials?
- Can it still absorb water
- How much will it expand?

Samples



Measurements

		Weight before	Weight after 1 min	gr water absorbed in 1 min	Weight after 10min	gr water absorbed in 10 min	gr water absorbed total
1	Plastic zakje	5	24	**19**	60	**36**	**55**
2	Rubber zakje	16	17	**1**	60	**43**	**44**
3	Mesh groot	3	13	**10**	31	**18**	**28**
4	Mesh klein	6	27	**21**	59	**32**	**53**
5	craft glue mixed	3	4	**1**	12	**8**	**9**
6	Craft glue springl	4	5	**1**	7	**2**	**3**
7	Spray glue	2	4	**2**	8	**4**	**6**
8	Wood glue	6	7	**1**	15	**8**	**9**
9	Wood filler			**0**		**0**	**0**
10	Spray paint	2	4	**2**	4	**0**	**2**
11	Outdoor paint	6	8	**2**	11	**3**	**5**
12	Acryl paint	3	5	**2**	9	**4**	**6**

Conclusions

Although no ideal solid mixture was found, the tests provided valuable insight into the behavior of SAP. Samples in which the SAP remained loose inside a permeable “bag” showed the highest water absorption, provided water could easily reach the material. Similar results were seen in samples where SAP was applied on top of a binder layer rather than fully mixed into it. However, this material came loose and was not able to be measured afterwards. Fully mixed samples generally showed a significant reduction in absorption capacity. In most cases, extending immersion from one to ten minutes only slightly increased water uptake, indicating that most absorption occurs rapidly after contact with water.

5.3. Other tests

5.3.1. Humidity test

Other things to test:

Test: Will the water absorbing material absorb water in a humid environment?

- Gather some water activated expanding material in a water-permeable bag.
- Measure the start-weight and take pictures and measurements.
- Place a layer of water in a plastic box.
- Hang or place the bag of material in the top of the box where it does not touch the water
- Close the box tightly
- Place it in a warm environment (in a windowstill, on op of a heater, in the sun, etc.)
- leave it for a few days to weeks
- Measure once in a while the weight and size to see if it captured any water and the humidity of the box.

Research questions:

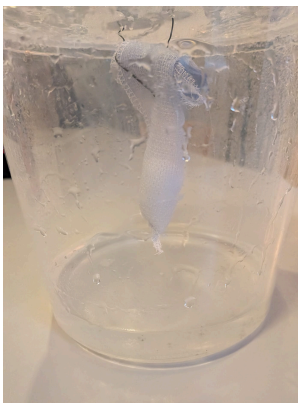
- Does the water activated expanding material absorb water from a humid environment?
- If so, how much and how fast?

Conclusion
The material does absorb water from the air. The weight of the fabric bag + material started on 7 grams and was at the end of the test, after around 4 weeks, 18 grams.
It was clear the material has responded with the water, since it had grown in size, became squishy and half-transparent. Although the humidity in this test was extreme, up to 95% humidity, this material will in the normal environment probably also respond to humidity in the air, which might cause problems.

Before:





After:  

5.3.2. Stopping the water test

Testplan:

How effectively does the water activated expanding material stop water?

- Put some Water activated expanding material in a cloth
- Place this as a dam on the ground
- Pour water on one side of the dam
- Observe how well the water is stopped.

Research questions:

- Does the material stop the water?
- Are there any points where water gets trough?
- How strong is the dam, how much water can it hold?

Conclusion:

- Does stop the water, but not all of it.
- Small streams of water could get underneath the barrier
- Works less well on an uneven ground
- Patting down the material did help.
- Unsure if this is a reliable test: big amount of WAEM, not right cloth, big amount of water in a short amount of time.
- Questions were raised how well it can stand higher pressures, especially with less material.

5.4. Tests with the 3 strips

Test plans
Materials:

1. Bentonite bar
2. Polybar+ from Bekina BeSealed
3. Polybar+ superswell from Bekina BeSealed

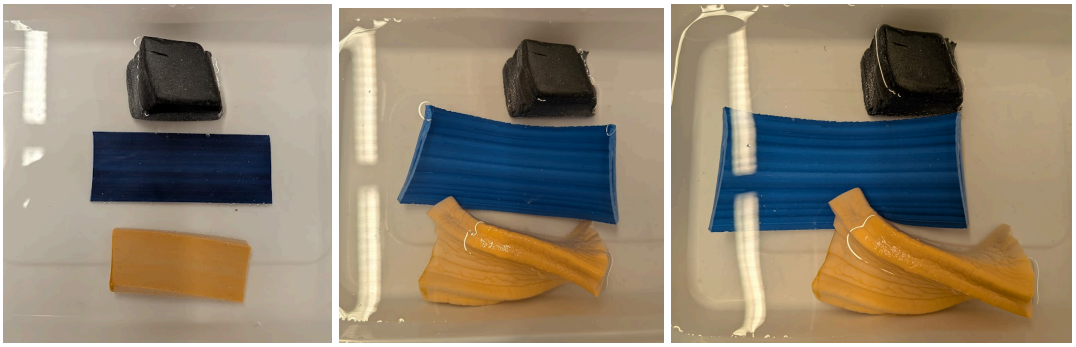
Test: How fast will it expand?

- place a strip of each material in a dry container
- Place a measuring tape behind it
- Start a timer
- Fill the container with water
- Mark how long it takes for the material to reach the 100%, 200%, 300%, 400%, 500%, 600% and 700% growth.

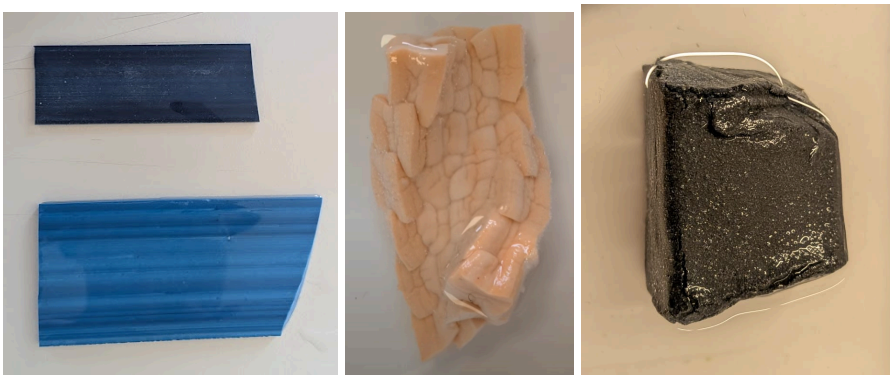
Research questions:

- How fast do the materials start to take up water
- How fast do they reach 500% growth?
- How long does it take for the materials to be fully saturated
- How strong is the product when saturated?

Test setup



Outcomes



It is hard to see when the material had grown 200%, 300%, etc. because the growth was uneven around the product and it was hard to see the difference. Therefore timestamps were used and a visual estimation. This is oke to do since the results of this test are a very rough indication of the speed of swelling and big differences between the materials are expected.

Conclusion
All materials are way too slow in swelling for the envisioned product application. After around 4 hours, the bentonite clay had not shown any difference, the polybar+ (blue) did swell a bit, but not enough and the Polybar+ superswell had swelled from a thickness of 5 mm to 13 mm. This is a swell of around 300%. However, when a flood is happening, this takes way too long.

5.5. Focus tests with Polybar+ Superswel

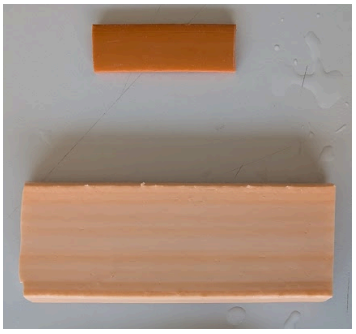
5.5.1. Long-term test

Test: How much can the material expand?

1. Place a small piece of material in a dry container
2. Measure the size of the piece
3. Fill the container with water
4. Leave it in for 72 hours
5. Take it out and measure how much the material has grown

Research questions:

1. How much can the material grow in 72 hours?
2. Is the growth equal over the whole piece?



Outcome:

The material swell from 60 x 20 x 5 mm to 130 x 55 x ## mm. Which is a lot. This demonstrates the possibility to so much it can seal the gaps between the door and frame.

5.5.2. Different surfaces test

Test: Will different surfaces of the material influence the speed of swelling?

1. Create three pieces of material of the same size
    a. A normal piece
    b. A piece with lines cut up to halfway in the material
    c. A piece with cuts diagonally into the material, creating “flaps of material”
2. Place the pieces in a container
3. Slowly fill the container with water
4. Leave it for +/- 3 hours and note the differences between the pieces

Research questions:

1. Does the surface of the material influence the speed of swelling?
2. Does more surface area mean faster swell?
3. Will the materials still be strong after the swell?




Outcome:
The normal piece and piece with lines cut do not show much difference. The piece with diagonal cuts, creating flaps, shows a faster growth in these flaps. Indicating that more surface area does make it swell faster. This could be used in the final product to increase the speed of swelling by adjusting the form of the product.

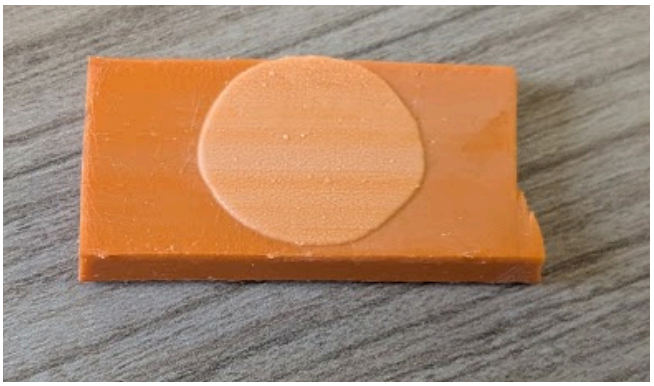
5.5.3. Rain test

Test: does the material respond to rain?

- Place a piece of material on a flat service
- Use a hose, showerhead or waterspray to spray water on the material. Make sure these waterdrops are similar to rain, not thin mist or a big flow of water.
- Note if the material responds to the rain and how

Research questions:

- Will the material react to rain?
- How long does it take before the material starts swelling during the rain?




Outcome:

The material responds to rain quickly. After 30 seconds the form of the drip of water can be seen in the material. On this piece the material has started to respond with the water and therefore has raised a bit. This is not tremendous amounts, but it does respond. It is unsure how it will respond to a heavy downpour.

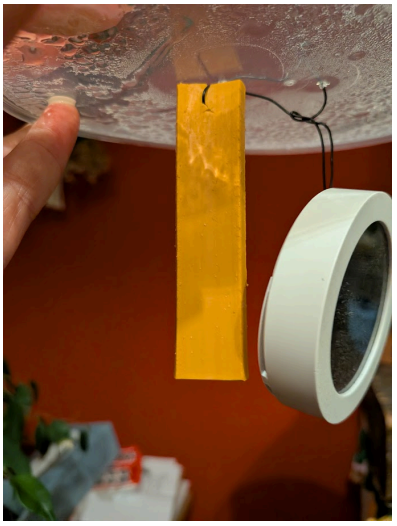
5.5.4. Humidity test

Test: does the material respond to humidity?

- Place a piece of material in a closed container. Measure and weigh the piece
- Fill the container with a bit of water, make sure the water is not touching the material
- (place a humidity measuring device in the container)
- Place the closed container in a warm spot
- Leave the container for a few weeks
- Measure the piece of material multiple times

Research questions:

- Will the material react to humidity?
- How fast does the material take in the water from the air?

Outcome:
The humidity in the box was constantly around 95% and temperatures got up to 35 C. The material was placed in this box for 4 weeks and assessed regularly. After these weeks, the material did not show any impact of the humidity and did not swell. This indicates it could be resistant to humidity. More testing in more realistic and extreme circumstances is needed.

5.5.5. Pressure test

Test: Does the material create pressure if placed in a closed space?

- Place a piece of material between two small pieces of bendable wood (icelolly sticks)
- Secure both ends of the wood with a string. It needs to be tight but not press the material
- Place this setup in water
- Leave it for a few hours
- See how the material responds in its constrained space
- See if the material bends the pieces of wood

Research questions:

- How will the material expand in its constrained space?
- Will the material create enough pressure to bend the wood?
- Will it snap the wood?
- Will the material break under this pressure?





Outcome:
The material creates quite some pressure when it swells. It has bent the ice lolly sticks quite a bit. However, most growth of the material happened in the other direction, making it stick out of the sticks more. This test shows that the material is able to create pressure when placed between the door and frame to position itself strongly and not let water through.

5.5.6. Door sealing test

Test: How does the material seal off water from coming in the house in a more door like setup.

- Place a strip of available WAEM in a container in between two wooden plates with some space in between, mimicking the shape of the hole of the door (same test setup as 5.1. Stick this WAEM with some tape or glue.
- Fill the container with water to activate the material.
- Because this material takes significantly longer than the envisioned WAEM, give it time to swell.
- Remove the water from one side of the box to see how well it seals the gap and holds the water out.

Research questions:

- Will the material seal the door in such a small space?
- Does it grow the same speed all over the strip?
- How much pressure is generated in this strip?

Conclusion:

- The swelling speed of the material was very long. To make sure it created a good seal, it was placed in the water for around 10 hours
- The setup of the test was quite low quality, the seals at the sides of the wood started to break after the water was poured in. By creating tension on both sides of the box, these seals could be pressed closed.
- The WAEM itself creates a great seal, with minimal water getting through
- Since the material grows in all directions, so it does in length. This created some folded parts at the top of the wood. This is something to keep in mind.
- More research can be done to figure of the growing in all directions might create problems if there is nowhere to go and gaps might appear in the seal due to bending and fitting.





Appendix 6: Chapter 6

6.1. Retail price calculations

6.1.1. Cost price calculation

Number sold per year	10.000
Cost per roll Polybar	€ 100,00
# of m per rol Polybar	10
Price per meter Polybar	€ 10,00
# of m polybar per unit draft strip	6,2
# of m polybar per unit add on	3

Price rubber spool	€ 88,67
Length on spool (m)	100
Price rubber per meter:	€ 0,89
Price aluminium strip	€ 1,72
Length aluminium strip (m)	2,45
Price aluminium per meter:	€ 0,70
Price tape	€ 14,57
Length tape (m)	50
Price tape per meter	€ 0,29
Other costs yearly: Labour, transport, storage, distribution, R&D	€ 100.000,00

Add-on		Price per unit
Material cost:	Corst price Polybar	€ 30,00
	Cost rubber	€ 2,66
	Cost glue	€ 0,87
	Total material cost:	**€ 32,66**
Additional cost	Labour, transport, storage, distribution, R&D	€ 10,00
Product cost:		**€ 42,66**

Draft strip		Price per unit
Material cost:	Corst price Polybar	€ 62,00
	Cost aluminium	€ 4,35
	Cost rubber	€ 5,50
	Total material cost:	**€ 71,85**
Additional cost	Labour, transport, storage, distribution, R&D	€ 10,00
Product cost:		**€ 81,85**

6.1.2. Price of competitors

Why

Pricing is partly determined by competitor positioning. A price that is too high may discourage purchase, while a price that is too low can reduce margins or raise concerns about product quality. Therefore, analysing similar solutions is essential.

How
As no direct alternatives exist for sealing outward-opening doors, comparable products for inward-opening doors were analysed to establish a reference. Prices were collected from reliable suppliers (excluding low-cost platforms), averaged per product including taxes, and translated into an estimated cost for sealing a standard door (92 cm wide and up to 50 cm high flood) (Verdouw, n.d.). Where necessary, multiple units were combined to meet this height, although not used this way.

Conclusion
The analysis shows a wide price range, from approximately €16 for sandbags to €6,000 for advanced self-floating barriers, with most solutions priced between €100 and €300. Commonly recommended flood barriers (Wacht niet op Water, n.d.) typically range between €500 and €1,000.

Based on this comparison and the unique advantages of Floud Add-on, such as ease of use, compact storage, and suitability for outward-opening doors, a price range between €200 and €400 is considered appropriate. This positions the product competitively between low-cost, labor-intensive and heavy solutions and more expensive barrier systems, while reflecting its added value.

6.1.3. Payment willingness test

To see what people are willing to pay for Floud Add-on, a short questionnaire/test was made. 3 types of water barriers are shown one by one. A picture with a small description. For each barrier, then, they are asked how much they would pay for this. Then what they think it costs. Then the actual price is shown to create some awareness about actual prices. The third barrier shown is Floud Add-on. The first two barriers shown are used to create a sense of how a person sees the prices. And to create an awareness in the person about the actual prices of barriers.

The barriers shown are:

Barriere 1: Dam Easy® Waterschot





Dit waterschot kan je in je voordeur zetten wanneer een overstroming nadert. Je zet hem neer, schuift de hele delen uit en zet hem volledig vast door de zijkanten op te pompen. Deze is herbruikbaar.

Kosten: €750

Barriere 2: Noaq Waterschot 50 cm

NOAQ





Deze schotten kan je aan elkaar linken om een barriere voor je deur te maken wanneer een overstroming nadert. Je hebt er 2 a 3 nodig per deur. Ze zijn herbruikbaar.

Kosten: €163 per stuk

Barriere 3: Floud Add-on





Deze strip breng je aan tussen de deur en het kozijn. Deze blijft hier zitten. Wanneer er een overstroming gebeurt, zet de strip uit waardoor er geen water het huis in komt. Deze strip moet worden vervangen nadat de overstroming voorbij is.

Kosten: Onbekend

Conclusion:
people have participated in this test. The outcomes can be found below:

	Barrier 1: Dam Easy		Barrier 2: Waterschot		Barrier 3: Floud Add-on	
Participant	Willing to pay in €	Expected price in €	Willing to pay per door in €	Expected price per door in €	Willing to pay in €	Expected price in €
1	60	80-100	60-90	50	12,99	30
2	150-300	175	150-300	75-100	75-100	75
3	70	70	80-120	80-120	100	80

Reasons named to price Floud Add-on are:

- Is really small, would not pay a lot for it
- I am envisioning it to be bought at gamma. Would not spend a lot of money on it if I can buy it there just off the shelf
- Looks like a special piece of tape. Would not pay more than €100 for a piece of tape. I compare it to boat tape, which is more expensive.
- The fact it is not reusable really drags down the willingness to spend a lot of money on it for me.
- I do need proof it works before i am willing to buy it
- You get just a little material for a big amount of money, feels wrong
- If I think about the consequences and those cost, so if i take the time to think about it, i would be willing to pay more.
- I do not mind if it is single use, since i hope i will never have to use it. It does lower the amount of money I am willing to pay for it.

Other findings:

- All participants were shocked on the actual prices of the first 2 barriers
- Multiple started analysing on the cost price and where the cost came from
- All participants somewhere during the test mentioned that these products, and therefore prices, were per door. And that they would need multiple units to protect their house. Some mentioned they would pay this much to secure all of these doors, not for one single door.
- If the order of barriers 1 and 2 were reversed, the given answers for barrier 3 could be different. Since these two are shown to create some sort of awareness of actual prices for participants. However, this awareness does influence the outcomes of the research you are doing.
- The awareness of the dangers and consequences of floods, influenced the willingness to pay. Participants who took the time to think about the problem or discussed it with me overall were willing to pay more.
- The size, location and type of home might influence the willingness to pay of consumers. People with bigger and more expensive houses and interior might have higher costs when floods happen and are therefore willing to pay more.

6.2. Business model

The Business Model Canvas

Key Partnerships

Suppliers:
- production companies of materials
- Packaging supplier
- Brochure supplier

Distribution partners
- Distribution centre
- Transport from factory to distribution
- Transport from distribution centre to consumer

Resellers:
- Construction stores
- Resell websites
- Specialised building stores

Promotion:
- Insurances
- Media
- Information centers & associations

Sales:
- Website creator

R&D:
- Laboratoria
- Research labs

Key Activities

- Promoting the product
- Informing of dangers of floods
- Producing and sending the product
- Making collaboration deals
- Create new products
- Improve product design
- Customer service and support
- Installation services

Key Resources

Inventory
Production facilities of the material
Intelectual property of material
Contracts with resellers
Contracts with distribution
Contracts with suppliers
Contracts for special projects
Customer lists

Value Propositions

Flood solution that is:
- Easy to use
- Always present
- Cheap
- Versatile
- Working effectively
- Easy to store
- Works when you are not home
- Limited visible changes to the house

Giving people a piece of mind knowing they are protected for floods

Saving money later on

Protecting valuable belongings

Delivered at home

Customer Relationships

Information via website: Elkeruimteveilig.nl
Brochures
Delivered manuals
Email newsletters and updates

Support via phone
Support via chatbot

Special projects:
- Tailored assistance
- Installation service
- Maintenance service

Channels

Website:
Elkeruimteveilig.nl
Advertisement:
- TV
- Radio
- Billbords
- Vlogs
- In store
- Socials
- Information centres

Distribution:
- Distribution centres
- Package delivery service (Post NL)

Resellers:
- Gamma
- Praxis
- Hornbach
- Bauhaus

Client support:
- Mail
- Phone
- Website

Customer Segments

Mass market

People with homes on the ground floor:
- Home owners
- Home renters

People living:
- in flooding area's
- close to rivers and lakes
- in the city and village centers

People who:
- are preparing themselves for floods
- want to feel safe
- want to feel prepared
- want to save money
- want other people to be safe
- are obligated by their insurance

Companies:
- Door & frame companies
- Home rental companies/landlords
- Building companies & architects
- Company-building owners
- Realestate companies
- Government

Cost Structure

(raw) materials
Production cost

Transport costs
Packaging costs
Distribution costs
Storage costs
Electricity costs

Website costs
Transaction costs
Advertisement costs
Paperwork costs

Staff costs (wages)

Cost of resellers
Cost of information centres

Revenue Streams

Margin per item sold

Margins with special projects

Capital from Alprokon

Payed via:
- Website option (up-front)
- In store
- Via offers (for projects)

Appendix 7: Chapter 7

7.1. List of Pros and Cons of both Floud concepts

Pro (+) or Con (-)	Pros and cons	Floud Add-on	Floud Draft strip
+	Fits outward opening doors (back doors)	x	x
+	Fits inward opening doors (front doors)	x	x
+	Fits many other types of doors	x	
+	Visual reminder the door is protected	x	
+	Quick installing	x	
+	No skills needed for installing	x	x
+	No special tools needed for installing	x	x
+	Life span of 10+ years	x	x
+	Minimally visible		x
+	Always protects the door, even when noone is home	x	x
+	No need to set anything up when a flood is arriving	x	x
+	Fast activation time		x
+	Usable around hinges and locks	x	x
+	Fits all back doors	x	
+	Refills are easy to store	x	x
+	No visible changes to the looks of the house		x
+	Cosistent seal		x
+	B2B opportunity		x
+	Close to current product range		x
+	Extra functionality added		x
+	Hight of the strip can be decided by the user	x	
+	Easy distribution	x	
+	Could be installed just before a flood	x	
+	Can be partially replaced	x	
+	Can be taken when moved houses	x	
+	Lower cost price	x	
+	Protected against sulight	x	x
+	Protected against wear and tear		x
+	Longer lifespan		x
+	Familiar form factor		x

-	Single use product	x	x
-	Risk to respond to rain	x	
-	Posibility to wear and tear over time	x	
-	Risk of accidental activation	x	
-	Unsure about the working abilities due to unfinished WAEM development	x	x
-	Requires further testing to confirm performance claims	x	x
-	Might get in the way with additions to the door, like locks, hinges, etc.	x	
-	Might not fit doors with very small gaps	x	x
-	More visible; aesthetically unappealing	x	
-	Adhesive may weaken over time due to humidity, UV exposure, etc.	x	
-	Less suitable for professional or high-end installation projects	x	
-	Not compatible with all door types		x
-	More complex installation		x
-	Placing the WAEM can be fiddly		x
-	Less suitable for temporairy living situations		x
	Limited target group: people who live on first floor	x	x
	Hard to convince people to invest	x	x

7.2. Future test plans

Phase 1

Speed test: The expansion speed determines whether the material is feasible for flood protection and will influence the product's form and application.

Research questions:

- Will the material swell 300% in 15 minutes?
- Will the material swell 500% in 30 minutes?
- How long will it take for the material to swell and seal the gap between the door and frame?
- Will the material still swell after it has sealed the gap?
- With an average flood, how much water will get through the door before the door is completely sealed?
- Does the material swell fast enough for this application?

Setup/how to test:

- Place the (measured) material in a container with water
- Put a measuring device behind it
- Slowly fill the container with water
- Measure the time and speed in which it swells
- Draw conclusions
- Adjust the composition of the material, the shape or location of the product to create the best seal for flood protection.

Shape test: Current design assumptions made during the development of the concepts need to be validated through testing. The outcomes will support the design of the optimal form for a functional product.

Research questions

- Does the shape of the material seal the space between the door and frame well enough?
- Is there another shape that seals this gap better?
- How does the shape of the material influence the speed of swelling?
- Does the rubber flap influence the speed of swelling? And the activation moment?
- Does the shape support the location in the door the product is placed?
- How thick must the contact area between the material and the door be to create a good seal?

Setup/how to test

- Create multiple possible shapes and options for the material, with and without the rubber flap
- Test these side by side on speed, ability to seal different sizes of gaps and where it is placed into the door
- Adjust the shape and location of the product to create the best seal for flood prevention

Pressure test: The pressure generated by the swollen WAEM determines how well it stays in place between the door and frame and how it behaves during floods, water currents and waves. Testing across different door sizes will reveal whether further ideation is needed.

Research questions:

- How much pressure does the material build when it is placed between the door and frame
- Is this pressure strong enough to withstand the waves of the flood?
- Does this pressure differ between different sizes of gaps between the door and frame, with the same starting thickness of the material?
- Does the pressure seal the small nooks and crannies of the frame and door?
- Does the pressure change over time?
- Can the door still be opened when the product is activated?
- Can the material be placed linear to the long flat side of the door without pressing the door out of its hinges?

Setup/how to test

- Place some pieces of material between two rigid strips of metal. create different sizes of space between the material to mimic the different sizes of gaps between doors.
- Place a force gauge between the two strips of metal.
- Place these samples in a container with water and slowly fill it
- When the material starts swelling and reaches both strips of metal, measure the force in between them
- Measure the force for 1 hour
- Analyse the pressure created by the material and apply this to the product.

Water pressure test: Floud is designed to withstand approximately 1 metre of water. As floods may exceed this and consumers could decide to seal the complete door, the material's resistance to higher water pressures must be tested and improved upon where necessary.

Research questions:

- How does the water pressure affect the effectiveness of the seal?
- Can the seal withstand the water pressure of 1 m of water? And 2 m?
- Do changes in water pressure (during waves for instance) affect the effectiveness of the seal?

Setup/how to test

- Place a piece of material between two pieces of waterproof wood and make it a closed container on top.
- Let the material expand to seal the gap between the wood completely
- Slowly fill the container with water
- See how much water can fit in the container above the sealed gap, before it starts to let water trough. First drips until it lets too much water through.
- Measure the amount of water in the container before it starts to leak and calculate this into pressure

In-door testing: Once the material properties are established, the product should be integrated into real back doors to identify practical challenges and refine the design.

Research questions:

- Does the product fit in the door as intended?
- How does the material respond to floods when applied in the door?
- Are there any spots where the product does not seal the door completely?
- Can the door still function normally with the product applied?
- Are adjustments needed to improve the working of the product?
- Are there different sizes of product needed to fit the doors best?

Setup/how to test:

- Use a new back door and frame and place it into a big container so the front and back of the door create two closed containers.
- Apply the product as intended
- Evaluate if there are any points in this application process where problems might arise
- Fill the container at the front of the door slowly with water
- Observe how the material responds to the “flood”
- Evaluate if there are pain points or points that can be improved

Time test: Floods can last hours or even days. The material's ability to maintain a watertight seal over time must be tested, and if insufficient, the material or product design should be adapted accordingly.

Research questions:

- How does the product keep water out of the door over a longer period of time?
- Are there any changes in the working of the product when activated over a longer period of time?
- How long can the material maximally be used in a swollen state before losing its properties?

Setup/how to test:

- Place the material between two pieces of waterproof wood or place it in a door
- Fill the water slowly to mimic a flood and activate the material
- Leave this flood for multiple days up to weeks
- Regularly observe the working of the product and if there are any changes in the effectiveness of the product.
- Measure the maximal time the product can be effective in a flood
- Evaluate if these outcomes fit the requirements of the product and adjust it accordingly or take it into account when advising consumers.

Phase 2:

Product use

User test: Dedicated user tests will reveal pain points during installation and use of the product, which can then be addressed in the final design.

Research questions:

- How do users experience the installation of Floud?
- Are there any pain points during the installation of Floud?
- Can adjustments be made to improve this installation process?
- Are there any problems with the product or using the door when Floud is installed?
- How do different people respond to the installation and use of Floud when there are no floods?

Setup/how to test:

- Gather a group of at least 10 participants. But if the test is done (multiple times) later in the project, there is a strong preference for more participants.
- Let them all install Floud into their own back door. Observe this installation
- Reflect with the participant on the installation process
- Note down any pain points and things that are going well
- Let the participants use the product for a longer period of time in their homes
- Ask multiple times along this period how they experience the product, what goes well and experienced pain points.
- Improve the product to eliminate the experienced pain points and enhance the properties that are experienced as good.

Misuse test: Consumers may not always use the product as intended, for example, painting over it, pressure washing nearby surfaces or moving house and taking it with them. Testing these scenarios will set the boundaries of acceptable use or redesigns will adapt the product.

Research questions:

- What misuse can harm the effective working of the product?
- What misuse has to be avoided by users?
- Can adjustments be made to prevent (the impact of) misuse of the product?

Setup/how to test:

- Take multiple pieces of material and “misuse” it in different ways:
    - Paint it over
    - sticking and resticking it multiple times
    - use a pressure washer nearby
    - use a hose to completely wet a closed door
    - walk over it multiple times by heavy objects
    - etc,
- Observe how this effects the material
- Activate the material by mimicking a flood
- Observe if and how the working of the product is changed
- Adjust the product, if possible, to keep the product working if it is misused
- Adjust the product, if possible, to prevent the misuse
- Advice the user on not doing these activities to prevent misuse.

User perception test: Beyond functional performance, understanding how users feel about the product, whether they trust it and feel safe, is essential. Insights from this test can inform improvements to the product's appearance, feel, and usability.

Research questions:

- Do people trust Floud to automatically seal their door during floods?
- Do people feel more safe when they have Floud installed?
- How do people perceive Floud during installation and when in the door?
- Are there ways to adjust the product so people will feel more protected?

How to test:

- Have a big number of participants install Floud in their homes
- Question them beforehand about their reasons to invest in Floud and how they feel about it
- Make sure some of the participants are living in high risk flood-areas or have experienced a flood. But also have participants that do not.
- Question them once in a while about their feelings of Floud, how protected they feel and how much they trust it.
- Evaluate the participants opinions and adjust the product or the marketing strategy to improve how people perceive and trust the product.

Product in real-world conditions

Long-term test: The product must be tested after an extended period installed in a door to confirm it remains fully functional when needed.

Research questions:

- Does Floud still work after being placed in the door for a longer period of time?
- Does normal use of the door influence the appearance and effectiveness of the product?
- What type of conditions influence the appearance and effectiveness of the product the most?
- How do heat temperature changes, UV impact, cold temperatures and storms influence the working of the product?

Setup/how to test:

- Have a number of participants install Floud in their door
- Make sure these participants live in different circumstances
- Let Floud sit in their door for a longer period of time
- Regularly test the appearance and the working of the products
    - Or create a simulation where all these impacts happen in a shorter amount of time
- Evaluate how these conditions have impacted Floud and how it could be adjusted so it still works after a long period of time.

Extreme conditions test: The product may be exposed to extreme heat, heavy rain, cold or storms. Testing these extremes will reveal the product's limits and highlight where design adjustments are needed to do so.

Research questions:

- How do extreme conditions influence the working of Floud
- Could Floud also be used in different climates than the Netherlands?
- Will extreme circumstances influence the readiness of Floud?

Setup/how to test:

- Create a simulation with Floud installed in a door
- Make the simulation go trough various extreme circumstances: extreme heat, cold, heavy rain, winds and a combination
- Test if the product still works during these situations and after these situations
- Evaluate the results of how well the product still and adjust it to make it work in as many situations as possible. Or inform the consumers in which situations it might not work.

Storage test: The product's shelf life in storage must be established to inform purchasing advice, replacement recommendations and stock management for Alprokon.

Research questions:

- How long can Floud be stored in storage and still work as expected?
- How does dark spaces, humidity and being stored influence the products appearance and working?

Set-up

- Leave multiple product units in storage for a longer period of time. This could even be different locations and circumstances of storage.
- Make sure these storage circumstances mimic a realistic storage as when stored in home; not optimal humidity and temperature regulation
- Regularly test the products on their appearance and working.
- Adjust the product or its packaging so it will have a shelf life as long as possible
- Inform the consumer on the maximal shelf life

Flood type test: Different causes of floods influence and vary greatly in speed, severity and water composition. Testing against different flood types will establish which scenarios Floud can protect against and where design adjustments may be needed.

Research questions:

- For what types of floods will Floud be a fitting solution?
- Do the contents of the water, that differ based on the type of flood, influence the working of the product?
- Are there specific regions where Floud will not work appropriately?

Setup/how to test:

- Create a simulation where Floud is build into a door
- Recreate various types of floods:
    - Normal (tap) water flood
    - Floods with dirt from the streets
    - River water
    - Sewage water
    - Sea water
    - Various combinations of above
- Observe and test how Floud responds to these types of floods and how it differs between them
- Adjust the product, where possible, to serve as many types of floods it can
- Inform the user for what type of floods Floud will not work appropriately

Real flood test: Controlled tests cannot fully replicate the unpredictable nature of real floods. Testing in real flood conditions may reveal additional limitations that can then be addressed.

Research question:

- How will Floud respond to a real flood?
- Will Floud respond as expected during a real flood?
- Are there any unforeseen situations or problems that arise during a real flood?

Setup/how to test

- Instal various units of Floud in doors in various situations with high flood risks
    - Or create a ‘fake door’ setup and place this in a high flood risk or location that can be flooded (next to a river, in front of dykes, etc.)
- Let it flood and observe what happens
- Note down anything that happens that was not foreseen, unexpected or might pose problems.
- Evaluate and improve Floud so it works for real floods

Phase 3:

Patents: As outlined in Chapter #, several patents exist for similar products. These must be carefully reviewed to avoid overlap and the possibility of filing a patent for Floud should be explored.

Research questions:

- What patents already exist?
- Does Floud interfere with these patents? Need something to be changed to avoid this?
- Is there a possibility to file for a patent for Floud?

Setup/how to test:

- Online research can be done towards existing patents.
- This can be compared to the design of Floud
- Adjustments on Floud can be made to avoid overlapping designs
- Or the owners of overlapping patents can be reached to discuss possible settlements.
- Or a patent specialist can be recruited to support in this process

Alternative locations: The working principle of Floud has potential beyond the back door. Research and testing are needed to determine what adaptations are required to make it suitable for front doors, double doors, sliding doors and windows.

Research questions:

- Can Floud be applied to front doors, double doors, sliding doors and windows?
- What needs to be adjusted to fit these different locations?
- Is Floud a one time fits all solution, or dedicated versions for each type of door?

Setup/how to test?

- Along the way, especially during phase 2, tests with different types of doors should be done
- This can be done by building it into these different types of doors and testing the effectiveness
- Research will need to be done to different types of, for instance, sliding doors. How they differ among each other and where and how Floud can be applied in a way it will fit most types of doors.

Consumer testing: To support an effective marketing strategy, additional tests can be conducted to understand what consumers value, how the product is best explained and what drives purchase decisions.

Research questions:

- How can you sell Floud best?
- What activates people to buy Floud?
- How can the working of Floud best be explained via marketing?
- What sellable features do users value most?
- How can the working of Floud be best explained in a simple way?
- What drives purchase decisions of consumers buying flood prevention products?

Setup/how to test?

- Put out various questionnaires/interviews to a large and varying group of consumers. ask about:
    - If they have ever bought flood prevention products
    - What were their motivations and steps taken to buy this product?
    - What were the key selling points of the product they have bought?
    - How did they find the product/buy it?
    - Use different ways of explaining Floud to different consumers and test how well they understand and trust it
    - What do people value most in Floud?
    - Why would people buy or not buy Floud?
- Combine the findings of all these different questionnaires and interviews
- Create a marketing strategy to bring Floud to market
- Optionally adjust Floud to be easier to sell