

# ENHANCING THE SHOPPING EXPERIENCE IN FLOORING SPECIALTY STORES WITH PHYGITAL DESIGN

Faculty of Electrical Engineering, Mathematics and Computer Science

**Prof. Dr. Nicu Sebe**

Supervisor University of Trento

**Dr. Khiet P. Truong**

Supervisor University of Twente

**Tjebbe P. Treub**

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# Abstract

Phygital (combination of physical and digital) implementation has become an increasingly popular trend in recent years but outside the fashion and luxury retail a not well-researched topic. To broaden the research field, this study explores phygital implementation in specialty stores. The acceptance of phygital implementation was tested in flooring speciality stores with a phygital installation, called the "Flooring kiosk". Three different modes were created based on opportunities found in the user experience journey of customers to enhance the shopping experience in the consideration phase. The phygital implementation was positively received by customers with a score of 1.407 on the Acceptance scale and was graded with high usability (79.32) on the System usability scale. The results suggest that phygital design can benefit other sectors in the specialty store industry especially if one or more senses are critical and cannot be replicated digitally.

# Preface

I would like to express my gratitude to my supervisor Prof. Dr. Nicu Sebe for his supervision as well as my critical observer Dr. K.P. Truong for her valuable feedback. I want to thank all my colleagues and other interns at The Valley for their insights and fun times during my internship. In special I want to thank Séverine Verhaar and Renske Jongbloed for their great supervision and feedback as my supervisors from The Valley. Lastly, I want to thank all the participants who took part in this study for their participation and insights.

This thesis concludes my master's track at the EIT Digital master school in Human Computer Interaction and Design. This finishes my journey at the University of Twente for the Master of Interaction Design and the University of Trento for the Master of Human-computer Interaction. This thesis was written to help Digital agency The Valley in Amsterdam create insights into the phygital field for one of their clients.

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# Acronyms

**AR** augmented reality

**CX** customer experience

**DSRM** design science research methodology

**EMM** experiential marketing mix

**ERT** extended reality technologies

**PH-CX** phygital customer experience

**SUS** system usability scale

**UX** user experience

**VR** virtual reality

# Chapter 1

## Introduction

### 1.1 Background

Phygital consumption has become an increasingly popular trend in recent years [1][2]. Phygital was defined by Rigby [3] as the contraction of physical and digital experiences. Retail is one of the industries that have started implementing phygital marketing to bridge the gap between online and in-store shopping experiences. This trend in retail will only become more popular as predicted by a report created by Selligent Global. From all the Western countries researched, except the UK, 70% or more of the inhabitants are in the "new normal" after corona expected to go back to physical stores where a strong omnichannel is present [4].

Phygital design is at the moment mainly used by practitioners [5] while there has been limited research into the theoretical development of this phenomenon [6]. The importance of having a good user experience (UX) in phygital design is unanimously stressed within the literature. However, there is no clear overview of the phygital landscape itself and how the phygital installations create value for their users. Therefore, this study contributed academically with an overview of existing solutions in the field of phygital retail design and categorising those solutions according to phygital design frameworks. This creates a better overview of the phygital landscape and what solutions have been applied and created. This can help researchers categorise future studies but also designers to show what various kinds of phygital installations have been created already.

Although there is limited research, retail is the biggest player in implementing phygital experiences as most papers in the phygital literature world are based on marketing and consumer behaviour [7]. The papers contributing to this field are primarily based on fashion and luxury retailing. Batat [2] suggests that phygital should be applied to different settings

to test whether phygital experiences can exist in these new sectors or fields. One of the fields within the retail sector that is unexplored is the sector of specialty stores. A study looking into the expectations of a future user journey of buying new flooring and windows shows great promise for the implementation of phygital installation in those related specialist stores [8]. The expectations of 800 participants showed that 76% in the future still value a visit to a physical store. The main reason for this is to see and feel the product in person and to be able to get advice from a specialist in the exploration phase. Although these participants value the physical store, they do expect a more digitalized experience within the stores in the future. For these reasons, this study investigated the implementation of phygital design in flooring specialty stores. The literature could benefit the exploration of specialty stores as they are more common and not related to fashion and luxurious brands.

This paper describes the double diamond design process of creating a phygital prototype called the "Flooring kiosk". The phygital installation was used to test the acceptance and usability within flooring specialty stores. The results from the store employees and customers indicated a positive acceptance and good usability. were tested on the phygital implementation under customers of flooring specialty stores. This result suggests that specialty stores with items that are physically important can have added value in the implementation of phygital design.

## 1.2 Research questions

The central research question and sub-questions for this research were defined as the following:

***RQ: How can the shopping experience be enhanced with a phygital installation in flooring specialty stores?***

*SQ 1: What does the phygital retail landscape look like and how can it be categorised?*

*SQ 2: How to design phygital installations according to (phygital) design frameworks?*

*SQ 3: What are the needs and frustrations of customers looking to purchase new flooring?*

*SQ 4: How does a phygital installation impact the shopping experience in flooring specialty stores?*

## 1.3 Structure

This study is structured into eight chapters that show the creation of the phygital installation and the study around it.

**Chapter 1 - Introduction** introduces the relevance of the topic and the background



context of the chosen direction.

**Chapter 2 - Background** explains the studied publications on the topic of phygital. The importance of user experience is described together with related frameworks that can guide the design process of phygital experiences.

**Chapter 3 - Related work** categorises the phygital landscape based on phygital design frameworks.

**Chapter 4 - Methodology** explains the design research and related methodologies used in this study.

**Chapter 5 - User research** describes the results of the performed user research and transfers these insights into a customer experience journey and personas.

**Chapter 6 - Flooring kiosk** visualises how the final phygital prototype works and was developed.

**Chapter 7 - Results** showcases how the Flooring kiosk was perceived and tested the acceptance and usability of the phygital installation.

**Chapter 8 - Conclusion and Discussion** describes the found results, showcases the limitations and presents future recommendations.

## Chapter 2

# Background

This chapter describes the background information on relevant topics for this study. The topic of phygital in general will be explored. Secondly, the importance of user experience within phygital design is discussed. Lastly, various design frameworks are presented that help guide the design process of phygital experiences.

### 2.1 Phygital

The term phygital was introduced in the marketing field in 2013 by the Australian marketing agency, Momentum. The term was mainly used in retail to digitalize stores by incorporating social media and websites [9]. Fast forwarding a couple of years, phygital is used by companies to offer immersive and realistic service experiences to customers [10]. The phygital context is now defined as "A setting or service encounter characterised by a set of one or more processes in which overlapping of physical and digital places or spaces occurs. They make bonds, bridges, and webs that enable interaction and sharing among many human and non-human actors" [11].

There is significant excitement about the rise of phygital marketing in the future of retail commerce [1] [12]. While the field is still in its infancy, early research has discovered that phygital experiences can be designed to provide a novel and seamless experience that users enjoy, influencing customer perceptions of product value while generating trust and minimizing confusion [13]. With the rise of emerging digital technologies it is now possible to adopt a phygital strategy that has the benefit of implementing a more delicate and richer customer experience by combining the convenience of online distribution channels with the strengths of offline distribution channels [14] [15] [16].

## Channel approach vs holistic ecosystem

Within the marketing literature, phygital is often linked with the channel approach (e.g. omnichannel, multichannel and crosschannel). Almost all literature links phygital marketing to omnichanneling [3][17], where Klaus even suggests that literature sees it as the most complete form of omnichannel management [6]. Omnichannel retailing is defined as a retail strategy that integrates all sales channels to facilitate customers to have a seamless experience by eliminating the traditional boundaries between them [18]. On top of that Verhoef *et al.* [17] predicted the latest trend where multichannel retailing is moving towards the omnichannel method [17]. Although multichannel retailing focuses on multiple sales channels that have little or no interaction with one another, the omnichannel retail model focuses on the integration and unification of all touch points to allow customers to move seamlessly without interruption [19]. This trend shows the potential that omnichanneling has to offer to companies. Lastly, based on literature reviews Mele *et al.* [11] defined the phygital shopping experience as an omnichannel customer perception.

Recently, Batat [20] wrote an article sharing the belief that the channel approach view limits its application as there is a clear difference between channel marketing logic and the phygital approach. Phygital should be seen as a holistic ecosystem that incorporates multiple channels and various components of the customer experience (CX) [21][2]. Klaus [6] shares the belief that the channel approach is limited as he wants research to accept the complex all-encompassing nature of CX and recognize that CX is dynamic and must be investigated independently of current limited channels.

To conclude, there are two views at the moment on the phygital approach. One side believes phygital should be seen within the channel approach and may even be seen as the most complete form of the omnichannel approach. More recently an opposed view has come to light stating that the phygital approach should be seen outside the channeling approach and instead as a holistic ecosystem. According to Klaus [6], regardless of the channel or view, the focus should be on what is most important to the customer and the overall CX.

## 2.2 Phygital user experience

The literature agrees upon the importance of the UX within the phygital approach. The importance is stated in research associating phygital within the channel approach [22], as a holistic ecosystem [23] and regardless of what view [6]. Mele *et al.* stress the importance of understanding the customers' microworlds and shaping value propositions to enhance the experience [24]. Batat [1] states that companies must now learn what makes these UXs useful to consumers. As phygital shopping continues to evolve, retailers must understand how customers engage with this hybrid shopping experience. The acceptance and rejection of augmented reality or virtual reality demonstrate that some consumers embrace these technologies because they provide new, exciting, and useful phygital experiences, while

others reject or dismiss them as useless tech gadgets. Similar opinions were found on the topic of phygital experiences in general by Batat [1], as some customers considered phygital experiences to be novel, exciting, and valuable, while others dismiss them as meaningless technological gimmicks. As a result, scholars have a limited understanding of what makes such experiences valuable to consumers because the enabling technologies are new [3].

To create this understanding, UX research has become an essential tool for understanding customer behaviour [25] and preferences in phygital environments. By gathering insights from customers, retailers can develop strategies to optimize the phygital shopping experience and create more engaging, personalized and seamless experiences for their customers. Currently, the main issue that phygital design is dealing with is how to provide a seamless physical experience so that customers will not miss out on brick-and-mortar store experiences [26]. The human touch is the missing element in digital experience offerings [27]. Therefore Wirtz *et al.* [28] believe that if implemented well this human touch is the source of seamless CX in phygital settings.

## 2.3 Design frameworks

Although the literature on phygital design is really clear about finding the real added value for the target group with user research there are some frameworks to guide the design process.

Batat [2] created the phygital customer experience (PH-CX) framework to provide a big-picture view of the phygital setting. The PH-CX framework is depicted in Figure 2.1 and consists of two processes: digitalization (shifting from physical to digital) and physicalization (shifting from digital to physical). In addition to these two processes, there are three components (driving forces, connectors and pillars) influencing the design of phygital experiences. The goal of the driving forces is to identify the types of consumer value expressed in the physical setting. The connectors are implemented in the framework to indicate that they are critical to the designing of the phygital setting. Lastly, six pillars are included to enhance the phygital setting and create a holistic experience by creating value for the user. The first pillar, practicality, is fully aimed at creating functional benefits for the consumer. The second pillar, sociability, shows the importance of socialization within a phygital experience. Immersivity is the third pillar and occurs with interaction with a company's experiential atmosphere. Technicality is aimed at the ease of use of technology. Sensoriality aims at including the different senses (sight, smell, sound, taste and touch) in phygital experiences. Affectivity is the last pillar and focuses on creating certain emotions during phygital experiences.

A second framework for the phygital setting is created by Batat and Hammedi [29] with a focus on extended reality technologies (ERT). The goal of the framework is to explore the various types of technology used to create phygital customer and service experiences. This

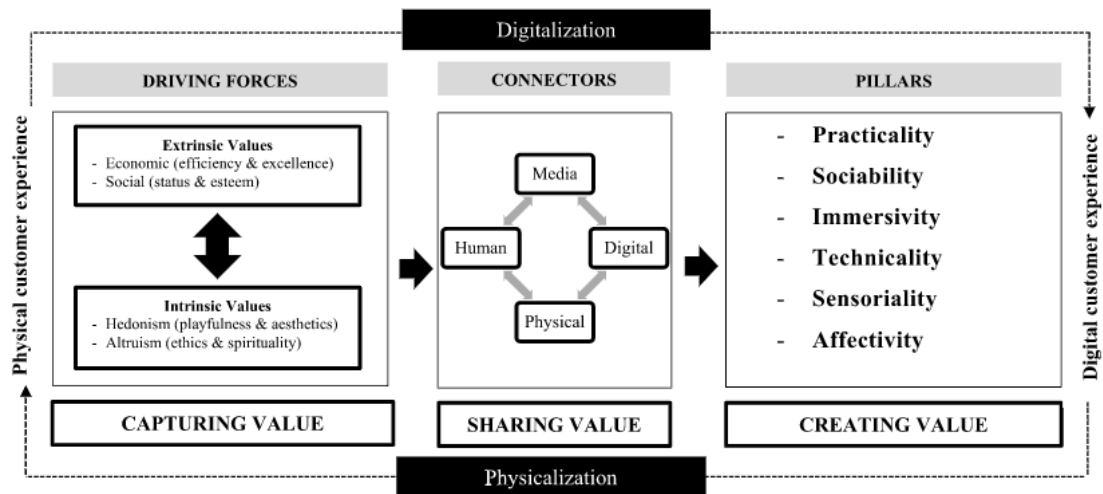


Figure 2.1: Phygital customer experience framework

framework categorises four different extensions within phygital experience design. Extended socialisation aims at creating a social continuum between the digital and physical settings and with that enhances human-machine interactions. Extended self, allows the consumer to experience self-extension by gaining access to data on themselves and others available in the digital space. The extended sensation has the aim to implement devices that can enhance senses in a phygital experience. Lastly, the extended setting creates new environments or enhances the current environment of the user. The ERT framework is depicted in Figure 2.2 in Appendix A.

The experiential marketing mix (EMM) framework, which is depicted in Figure 2.3 in Appendix A, is aimed at helping firms in the phygital age design business experiences [23]. The framework came into existence by questioning the traditional marketing mix logic. This led to a shift away from traditional marketing towards an experiential marketing mix. The overall aim of the framework is at designing around seven pillars, the 7Es (experience, exchange, extension, emphasis, empathy capital, emotional touch points and emic/etic process). These pillars aim at having an experience-centric approach instead of the traditional product-centric approach. The relevant areas of marketing development are answered in a holistic perspective by answering the who, what, how and where questions.

Lastly, Jacob *et al.* [30] created the design science research methodology (DSRM), depicted in Figure A.1 in Appendix A. Comparing this methodology model to the double diamond [31] (depicted in Figure A.2 in Appendix A) it has great similarities. Both frameworks follow the four phases of the double diamond framework, the difference is that the DSRM framework has a final communication step. This step communicates the findings of the study with the scientific and artefact user community, aiming more towards a research

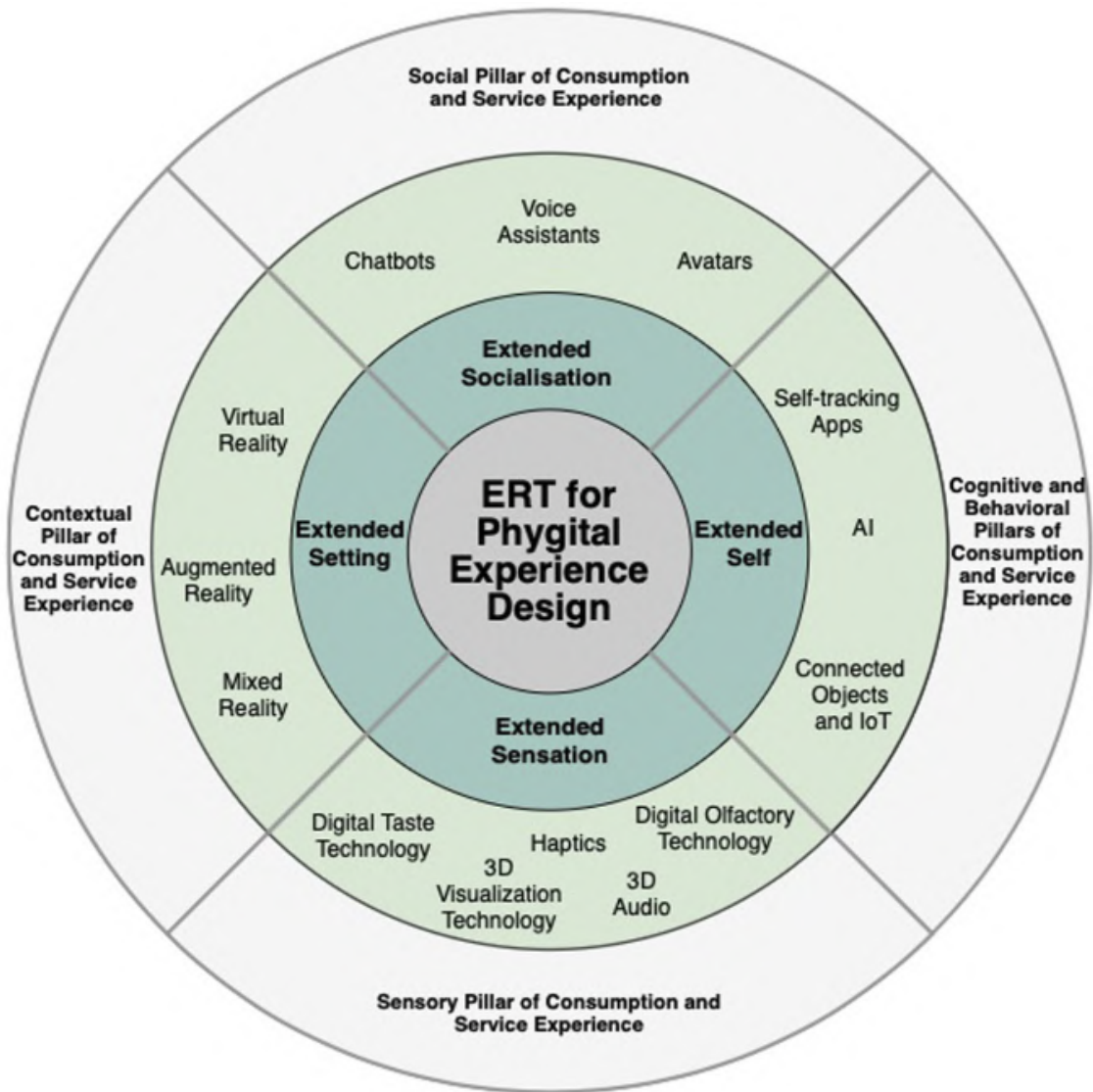


Figure 2.2: Extended reality technology framework

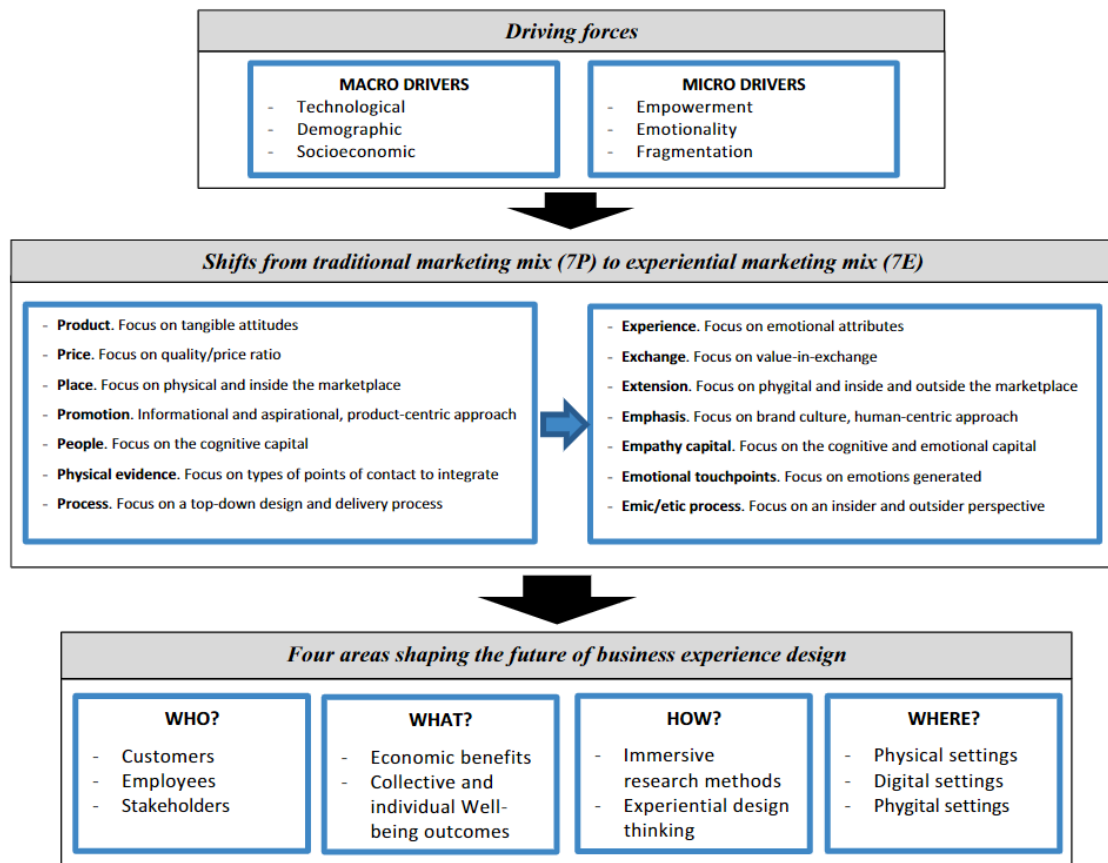


Figure 2.3: Experiential marketing mix framework

perspective. The double diamond framework is often used in design thinking and puts more emphasis on iteration and puts people central.

In addition to the design frameworks Riegger *et al.* [12] found the drivers and barriers for technology-enabled personalization in retail stores. As this field is part of phygital design the barriers and drivers should also apply here following inductive reasoning [32]. Although some of the descriptions are too specific for digital design in general, all categories seem to apply. In total 5 drivers (utilitarian, hedonic, control, interaction and integration) and 4 barriers (exploitation, interaction misfit, privacy, and lack of confidence) were categorised.

## 2.4 Conclusion

The previously mentioned related literature shows that it is hard to design phygital experiences and these are highly dependent on the project and should be designed with user experience central. To help the design process and create an understanding of the phygital landscape an overview of phygital solutions will be created and categorised based on the phygital design frameworks. This will provide an overview of the phygital landscape and group certain solutions.

Almost all research about phygital retail is aimed at the fashion industry or luxurious brands neglecting other sectors in the market. Therefore this study will apply phygital design at specialised stores in the retail sector to see if it can enhance the CX in this sector.



## Chapter 3

# Related work

To create an overview of the phygital landscape the related work was categorised. This categorisation can help with the design of phygital experiences as it showcases the relations between the phygital installations that already exist. The categorisations are based on details of the phygital design frameworks which were presented in Chapter [2.3](#). The extended layers (extended socialisation, extended self, extended sensation and extended setting) of the ERT framework were used as broad categorisation items for the related work. These extended layers divide the phygital landscape by grouping the extended reality technologies on how they affect the cognitive and behavioural, social, sensory and contextual dimensions of the experience.

From the EMM framework, the 7Es were hard to categorise as they are aimed to be used as components. For this reason, the holistic questions (who, what, how and where) shaping the future of business experience design were used as categorisation items. The who and where questions were skipped as the whole phygital landscape will focus on the phygital setting and the customers. To create a better overview, the focus of this framework was shifted from marketing to the phygital experience. With this shift of focus, the what question answers what kind of phygital installation it is. The how question focuses on how the phygital installation can work and thus what technologies are used.

The pillars that create value (practicality, sociability, immersivity, technicality, sensoriality and affectivity) from PH-CX framework were used as the last categorisation item. This last categorisation shows what values are offered to the consumers.

An overview of the total phygital landscape created in a table can be found in table [3.1](#). The main categorisation of the table is the ERT framework. Each phygital installation in the list is explained on what it does, the technology it uses, the value it creates based on

the pillars of the PH-CX framework and the literature source(s).

### 3.1 Extended socialisation

#### Advice

The phygital installations belonging to the extended socialisation layer are aimed at enhancing socialization while offering emotional and efficient phygital experiences [29]. This enhancement is mostly achieved by creating advice for the customer and having the possibility to share this on social media. An example of this is a product experience wall that was created by Zigel [33] with the goal of customizing outfits to an avatar based on the user. The system is able to recognize clothing by RFID tags on the clothes. The system acts as a shopping assistant to help the user in completing outfits. The outfits will be visualised on a real-life-sized avatar. Ultimately, there is the possibility for the user to share the outfit on social media by scanning a QR code.

Similar to the product experience wall two systems were created by Wong *et al.* [34]. These installations had the goal to promote and match clothing. This is done by having RFID tags on products, a smart mirror and a smart dressing room. They aim to add immersivity and practicality to the consumer by suggesting recommendations based on the selected clothes.

Another installation that uses social media is the social mirror created by Zigel [33]. This system has the goal of sharing the user's looks on social media to ask for feedback instead of using the logic of an algorithm. Instead of projecting it on an avatar, the projection is displayed on a smart mirror with a camera integrated. Next to the smart mirror, a touchscreen is placed to control the interaction. The social mirror aims at the sociability pillar to create value.

Service robots are introduced in stores to help customers. They can have various functions but often replace human services such as giving status, ordering and seeking social affiliation. These humanoid robots can come in several forms but most often consist of a camera, microphone and some actuators for movement. The added value of these robots is often aimed at sociability. The effect of service robots in stores was demonstrated by [35].

### 3.2 Extended self

The category of extended self includes phygital installations that enable customers to experience self-extension by accessing digital data about themselves and others [29]. Two of the best-known phygital inventions are the QR codes and kiosks. Kiosks are well-known examples of phygital installations [36]. Dependent on the goals they consist of a touchscreen, a computer and often a printer and credit card reader. The kiosk often has the task of providing the user with extra information, printing a ticket or ordering. Having

information easily available gives the value of practicability.

QR codes are other well-known examples of phygital implementation. These are being applied in retail as they can provide extra information, payment, promotions and linking to experiences. These codes can be scanned by the consumer using their smartphone and they will be linked to the related content [37] [38]. Similar to QR codes are mobile phone applications. Brands develop these applications mostly to gather user data, but the use of the applications can vary widely. Examples of use cases are the scanning of products, personalised recommendations, map overviews and experiences. Most of the applications aim at affectivity or practicality as values [39] [36].

### **Tracking**

Measuring and tracking customers in retail is also applied in various systems. With the use of RFID smart shelves can be created. With the use of an antenna system, items can be tracked and based on what customers buy recommendations within the shop can be generated. This helps the store to know how many items are left in stock and it helps the customer with better recommendations. This personalisation adds to the affection value [40]. Similar to this are smart shopping carts that can be used in combination with smart shelves to complement each other. The smart shopping carts are tracked with RFID tags and can visualise customer patterns. Based on these, the system can create a better understanding and with that create better recommendations to the customer. These recommendations play a role in the creation of value in affection [41] [40].

Instead of tracking the customers also the body of the user can be tracked and measured. An installation that applied this was created by Zagel [33]. Three pillars with depth cameras were placed around the user. These sensors create a 3D model of the user and based on this model create body measurements. These measures make it possible to fit on clothes and see how they would look on the user's body. This installation was created to change the process of fitting clothes by making it easier with the use of technology.

### **Ordering and payment**

The self-scan principle is applied a lot to grocery stores and gives the user the possibility to have a quicker checkout procedure. During the process of scanning items, the system gathers information to provide better personalisation to the customer. This process has the aim of practicality by reducing the checkout time and affectivity by giving better recommendations [42] [36].

Amazon developed the self-scan concept even further by creating Amazon Go which is a checkout-free store. This concept lets consumers enter the store with an application. Through smart tracking, similar to smart shelves, the items are automatically recognised and paid for when leaving the shop, removing the hassle of paying at checkout. This removal

saves consumers time and therefore this concept is aimed at practicality and technicality [43].

Another great example of phygital ordering and payment is developed by the brand Sephora. This brand introduced the digital shopping basket. This concept was introduced to let customers order items that are physically not in stock. With the use of an NFC tag customers can add products to their virtual shopping basket and pay for all their physical and digital items at the same time. This creates the value of practicality for the customers as they don't have to return to the store when something is not in stock [44].

### 3.3 Extended sensation

There are a few phygital installations aimed at exploiting the human senses. Screens are one of the first phygital installations that were used in retail. Digital signage is an example of this, as it makes use of screens to display advertisements, news, entertainment and community information [45]. The presence is experienced as neutral overall, but depending on the content it can extend the sensation of the customers. Therefore, this installation is an extended sensation that can play on affectivity and immersivity.

Zagel upgraded one of the most neglected parts of clothing stores by creating an interactive fitting room. By projecting animations on the wall in combination with sound effects, a unique experience per product type was displayed when the user entered a fitting room. The goal was mostly to emotionally connect the consumer with the product [33]. These kinds of installations creating experiences for customers are becoming more popular and can be seen as one of the latest trends in the phygital landscape. Big brands are applying this style more and more even to the extent of whole experience stores (E.g. Adidas flagship stores, Nike house of innovation). Often 3D visualisation techniques are being used in combination with sound effects and some way of interaction. But also events are organised in dedication to for example product reveals, experiences to try or record attempts [46]. This all is to create an experience for the user to create value through sensoriality and affection.

### 3.4 Extended setting

The last category focuses on enhancing the setting of customers. Zagel [33] created an interactive storefront for Adidas. The user could point at one of the various items and activate product-specific content and environment related to the item. This experience was created by projectors to simulate the visuals and a depth camera that could detect the motion of the user. The installation has immersivity and affectivity as a goal to create a better connection between the user and the product. Virtual reality (VR) is also used with similar goals as the interactive storefront. This technology is mostly used to extend the setting of the user to have an optimal fit with the product or to create an experience. This can give the user an immersive experience with the product in the ideal setting. The goal

of giving value to the user is often provided through immersiveness and affectivity [47] [48]

Next to VR, augmented reality (AR) is being adopted in stores. An AR shop application was created by Claudia *et al.* in a sports fashion shop. The AR layer showed the customer's point of interest with extra information connected to the website of the shop. Next to informing the users about items, the application also highlighted events for a broader experience. The AR shop relates to the value pillar of immersivity and practicality. A more easily accessible technology of AR is mobile AR. An example of this technology that extends the setting is the application Ikea Place [49]. This app lets the user customize their own room by replacing or adding items from the Ikea store with augmented reality. This adds the value of immersivity, as the user can directly envision the new scenario, and practicality as the user doesn't have to physically move all items in real life to have a thought of how it would look like.

### 3.5 Phygital landscape

An overview of the phygital landscape categorised on design frameworks is presented in Table 3.1

| <b>Installation</b>           | <b>Explanation</b>  | <b>Technology</b>   | <b>Value</b>               | <b>Sources</b> |
|-------------------------------|---|---|----------------------------|----------------|
| <b>Extended socialisation</b> |   |   |                            |                |
| Product experience wall       | Outfit selector assistant   | RFID, Camera, store data, third party data                  | Affectivity, Sensoriality  | [33]           |
| Social mirror                 | Interactive mirror to share on social media                                       | Camera, touchscreen   | Sociability                | [33]           |
| Smart mirror                  | Smart mirror with outfit recommendations  | Camera, RFID  | Immersivity                | [34]           |
| Service robots                | Interactive robot that (emotionally) interacts with customers in a human-like way | Camera, microphone, actuators, digitally linked information | Sociability                | [35]           |
| <b>Extended self</b>          |   |   |                            |                |
| QR Code                       | Squared pixel grid that links to digital information                              | Camera  | Practicality               | [38], [37]     |
| Body scanner and cloth fitter | Body measure setup with clothing visualizer                                       | Depth camera, screen  | Practicality, Technicality | [33]           |
| Self-scan                     | Scanner to fasten the checkout process and personalisation                        | bar-code scanner  | Practicality, Affectivity  | [42], [36]     |
| Cashierless checkout          | Automated payment system by walking out the store                                 | cameras, pressure sensors, infrared sensors                 | Practicality, Technicality | [43]           |
| Kiosk                         | Information and ordering screen   | Touchscreen, computer, printer, card reader                 | Practicality               | [36]           |
| Smart shelves                 | Item tracking and personalised recommendations                                    | RFID  | Affectivity                | [40]           |
| Smart shopping carts          | Tracking of customers in shops  | RFID  | Affectivity                | [41], [40]     |

Continued on the next page

**Table 3.1 – continued from previous page**

| <b>Installation</b>       | <b>Explanation</b>   | <b>Technology</b>               | <b>Value</b>              | <b>Sources</b> |
|---------------------------|--|---------------------------------|---------------------------|----------------|
| Mobile application        | Various applications that use the consumer phone               | Camera, sensors, beacons        | Affectivity, Practicality | [36], [39]     |
| Online shopping basket    | Buying physical and online products in a store                 | NFC                             | Practicality              | [44]           |
| <b>Extended sensation</b> |  |                                 |                           |                |
| Interactive fitting room  | Animated fitting room with sounds based on clothing categories | RFID, beamer, speaker           | Sensoriality, Affectivity | [33], [34]     |
| Digital signage           | Screen displays in public showing videos                       | Screen, speaker                 | Immersivity, Affectivity  | [45]           |
| Experiences               | Experiences for customers                                      | varies                          | Sensoriality, Affectivity | [46]           |
| <b>Extended setting</b>   |  |                                 |                           |                |
| Interactive storefront    | Gesture controlled project mapping                             | Projectors, depth camera        | Immersivity, Affectivity  | [33]           |
| AR store                  | Show AR interaction points in shop                             | AR                              | Practicality, Immersivity | [50]           |
| Mobile augmented reality  | Trough a phone use AR  | Camera, GPS, computer vision AR | Immersivity, Practicality | [49], [50]     |
| Virtual reality           | Fully immersive virtual environments to create experiences     | VR headset                      | Immersivity               | [47], [48]     |

Table 3.1: The phygital landscape categorised by phygital design frameworks.

# Chapter 4

## Methodology

The methodology chapter outlines the design process and describes the various methods that guided this research. The overall design process was performed by following a combination of the double diamond framework and the DSRM framework, which consists of five stages with various methods.

### 4.1 Research and design process

This study followed a combination of the double diamond framework and the DSRM framework, both presented in Chapter 2.3. The combination of these frameworks was chosen as they already show great similarities. The double diamond framework puts more emphasis on iterating and understanding how people use a service, which is very important according to the found literature in Chapter 2.2. The DSRM has the goal of managing the phygital customer journey which aligns with the goal of this research. A visualisation of the combined frameworks is depicted in Figure 4.1.

The first step in the framework is the discover phase. This phase has the goal of developing an understanding of the issue and target group. Literature can support this phase with studies that support theories on the problems. In addition to literature, user studies can be performed to create a better understanding of the user. Commonly used user studies in this phase are observations, interviews and surveys.

The define phase is the second step in the framework which aims at formulating a design challenge. This is done by converging the information of the discover phase. This converging is achieved by finding opportunities or bottlenecks but especially by setting the context. Common methods to guide this process are personas, customer journey mapping and defining requirements.



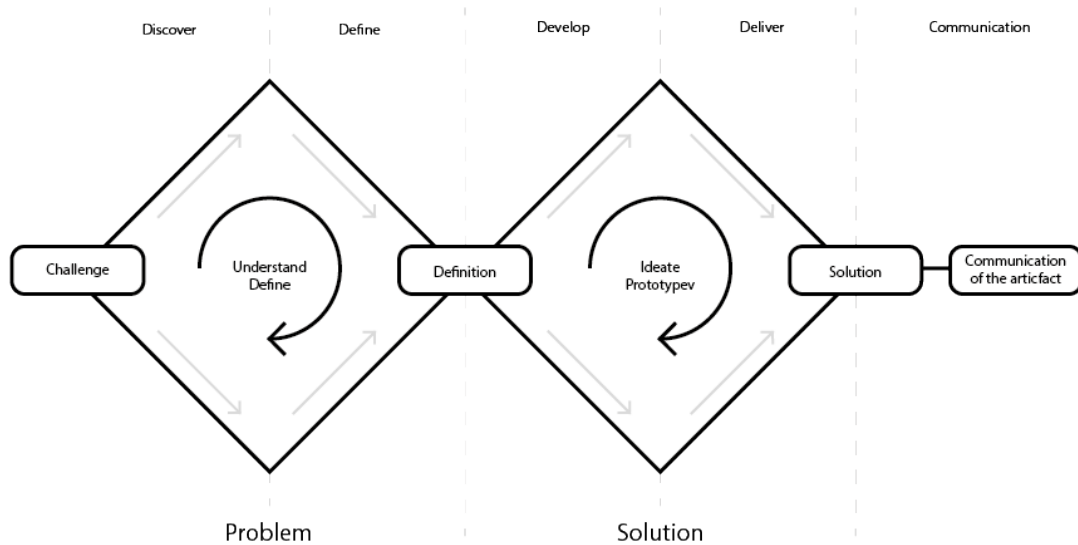


Figure 4.1: Combination of the double diamond and the DSRM framework.

After defining the design challenge the third phase starts. The develop stage aims at brainstorming and quickly testing possible solutions. Often performed methods in this stage include brainstorming, co-design, user flow creation, and the creation of an MVP. It is advised to design with various visions of other people to avoid tunnel vision.

The deliver phase is the fourth step in the design process and aims at creating and testing prototypes. To avoid flaws in the final product include user testing during the development. These user tests can identify flaws which can be iterated on to enhance the final product.

The last step of this framework is to communicate the findings with the scientific and user community to demonstrate the value of the artefact. This should be done by publishing an academic paper and contacting relevant user groups in the field of the research.

## 4.2 Discover

The discover phase started with literature and desk research. As the found literature stressed that the created solution to this study should be based on user research several methods were performed. This qualitative research was performed through bodystorming, observations, interviews and a workshop.

### 4.2.1 Bodystorming

To create a better understanding of the user, the bodystorming method was used [51]. This method has the goal for the researcher to empathise with the user by taking on the role of the user in the contextual setting. The researcher is able to witness the user's needs, and behaviour with respect to their context. To provide the best experience possible, the researcher either participates in the situation or attempts to reproduce it as closely as possible.

### 4.2.2 Observations

The observation method aims at gathering data in the natural setting of the target group. The observations are made as unobtrusively as possible and without direct interactions with the participants in order to avoid influencing them. To guide the observations in the stores the nine dimensions framework was used [52]. This framework aims to give structure to observations. This is done by writing down the observations based on the following items:

1. What the physical space is of the field of research.
2. Who the actors are.
3. All the activities performed by the actors.
4. The objects that are relevant and present or used by the actors.
5. The specific individual actions carried out by the actors.
6. Particular occasions that surface from the research.
7. The sequence of events.
8. What the actors' goals are or what they are trying to accomplish.
9. How the actors feel in given contexts.

### 4.2.3 Interviews

Interviews have the aim of empathizing with the target groups to discover insights into their habits, preferences and thoughts [52]. Interviews can be unstructured, semi-structured or structured. These variations define the amount of structure in an interview and whether topics can be further explored or not. Most interviews start off with demographic and introduction questions to gather background information on the participants. After the introduction, the main topic is explored with questions about their behaviour and experiences. The interviews are closed with some final thoughts on the topic and feedback on the study.

### 4.2.4 Workshop

Workshops exist in many variations and the methods depend on the desired outcome. Workshops often exist out of a group of people who meet to participate in activities related to the research. In the discovery phase, workshops often aim at retrieving information from

the participants. In the later stages of a design process, workshops often aim at creating or testing solutions to problems.

## **4.3 Define**

All the data gathered in the discover phase was analysed and the define phase tried to make sense of all the insights. This was done by creating personas and a customer experience map. This visual gave an overview of the current customer experience journey.

### **4.3.1 Personas**

To summarise findings to target groups, personas can be created [52]. Such a persona reflects a set of potential users who share common aims, attitudes, and behaviour. Persona design aids in the creation of dependable and realistic representations of the main audience groups. The various personas showcase their experiences, goals, emotions and opportunities related to the topic.

### **4.3.2 Customer experience mapping**

A better (visual) understanding can be created by a customer experience map [52]. This map combines the most important insights from previously gathered insights in one overview with all the needs, channels, frustrations and opportunities. On top, a generalised chronological order of the customer steps is depicted showing the various steps in the overall process. The opportunities show where in the customer journey improvements can be created to enhance the experience of customers.

## **4.4 Develop**

In the develop stage two methods were performed. A co-creation session was conducted to spark design decisions for the creation of a prototype. Based on the user research and the co-creation session, a direction was chosen that enhances the shopping experience by facilitating solutions to the pain points and exploiting found opportunities. The prototypes were improved by testing with others during the development by using the through other eyes method.

### **4.4.1 Co-creation**

Co-creation is used to let other people participate in the design process. The goal of inviting people in on the design process is to have a broader view and create more value because of this. The various visions can inspire other people in the room and spark new ideas. To get all participants on the same level the co-creation often starts with a briefing. After the briefing, a brainstorming session starts. The ideas of the brainstorming are shared in the group and can potentially be dot-voted on for the best ideas. Another brainstorming

session within the co-creation is the Crazy 8 method [53]. Herein participants needed to draw eight ideas in eight minutes. The final can again be presented and discussed within the group.

#### 4.4.2 Through other eyes

The through other eyes method is used to have various visions on prototype designs. This is done to avoid becoming too fixated on certain ideas and develop tunnel vision. Multiple design problems and questions are formulated and discussed with participants. During the testing of the prototype, the participants are asked to think out loud. With the multiple visions, a more solid foundation is created for the design.

### 4.5 Deliver

The fourth phase was the deliver phase which developed a prototype. This prototype was designed in an iterative process based on the final direction chosen in the develop phase. After each test round, this was developed into a higher fidelity level prototype. These prototypes were user-tested to find flaws as quickly as possible.

#### 4.5.1 Clickable Prototype

A clickable prototype can exist in various forms, such as physical or graphical prototypes. These prototypes have the aim of testing the user behaviour on the system [52]. Clickable prototypes have a high level of fidelity and can represent the final idea of interaction. Common hardware and software for clickable prototypes are created with Arduino, Figma and Protocie. The users are asked to perform certain tasks and let them think out loud. Based on the thoughts and shortcomings of these tests the designs and flows can be iterated on.

#### 4.5.2 Impact testing

The last step of this research was to test the effects of the prototype on the customer experience. The participants were asked to fulfil three tasks with the phygital installation. After answering questions about the different tasks and impressions, the acceptance was tested by measuring the usefulness and satisfaction with the acceptance scale. The usability of the system was tested with the system usability scale (SUS). The full test plan can be found in Appendix F.

#### Acceptance scale

To test the acceptance of a system the acceptance scale can be used [54]. This scale measures the usefulness and satisfaction of a system. This is done by nine statements from which the uneven statements test the usefulness and the even numbers test the satisfaction. Each

scale is answered by the participant on a Likert scale of five points ranging between opposite statements related to the two main topics (E.g. Useful vs. Useless). The full questionnaire can be found in Appendix [F.2](#). The positive term is graded with two points to the negative term with minus two points. From all the points of the questions related to usefulness and satisfaction, the average is calculated. This score indicates the scale of acceptance. To control the data Cronbach's alpha was calculated on the data [55](#).

### **System usability scale**

The SUS test can be used to test the usability of the system [56](#). The questionnaire uses a Likert scale with five options ranging from strongly disagree to strongly agree. The questionnaire consists of ten statements all related to the topic of usability. The questionnaire is depicted in Appendix [F.2](#). The scores of the tests can give an indication of the usability of the system by placing them on the system usability scale.

## **4.6 Communicate**

After having validated an idea, the last step of the framework is to share insights with the scientific and user community. The scientific community can be addressed by the publication of an article. The value of the artefact can be shared with the user community by getting in contact with key players of these groups.

# Chapter 5

## User research

The user research phase was performed with various methods to create a better understanding of the end user. This data led to the creation of three different personas, a customer journey map and a design challenge.

### 5.1 Methods

The performed user research consisted of four methods: body storming, observations, interviews with store employees and customers and a workshop with branch managers. The results of all the methods were gathered in personas and a customer experience map that shows the general steps of the process of a customer with its needs, channels, frustrations and opportunities.

#### 5.1.1 Body storming

The first used method was the body storming technique, to create an understanding in person of what the process looks like of orientating for a floor. This method was performed as the first step in the user research by the researcher to not get influenced by other insights. The first step was to perform research on the internet and find out about the several kinds of stores and flooring types. The first discovery was that there are a lot of websites giving information but it is hard to find a clear overview directly. Mostly multiple websites need to be visited for a complete overview of all the information. The second step was orientating in stores, for which a construction store and a high-end flooring store were visited. Within the stores discussions with store employees and interacting with the items in the store were the main activities. The main insight here is that the stores have an overwhelming amount of floors and it is really hard to know the differences between some flooring and find one that matches your situation. After the store visits, three kinds of room visualisers were used

to apply flooring visualisations in the researcher’s living room. Based on the visualisations, four samples were selected and delivered home with a sample service. The last steps in the process were measuring and calculating the surface of the room and ordering online till the payment phase. The body storming technique created a first understanding of the overall customer experience journey of someone buying a new floor.

### 5.1.2 Observations

After the body storming, observations were performed in seven different stores. These stores existed out of two construction stores, one low-end and four high-end flooring specialty stores. The researcher was present in these stores to observe customers’ behaviour. The observations were noted down in a notepad and later compared between the various stores on common themes. The summarised observations following the nine-dimension framework can be found in Appendix [B.2](#). The observation’s main outcome created an understanding of the behaviour of customers and employees in stores. The two most important insights were that customers are wandering around a lot in the store and practically always want the advice and knowledge of a store employee.

### 5.1.3 Interviews

The customers of this user study were arranged by using the personal network of the researcher. Four customers were interviewed who bought a floor recently (within three months of the interview). For three of the interviewees, it was their first time buying a floor, the other one had some previous experience of the process of buying a floor. In addition to the customers, flooring store employees were interviewed as they were considered experts in the field of these types of customers. The store employees were gathered and interviewed by visiting flooring specialty stores. In total eight interviews with store employees were conducted in flooring specialty stores. The employees all worked for at least three years in the flooring industry and most had worked their full career within this industry. The interviewed employees covered a full range of roles within the store serving customers, ranging from salespersons to branch managers. The full interview method is depicted in Appendix [B](#). The semi-structured interviews resulted in a deeper understanding of the customer journey, needs, channels, frustrations and opportunities when orientating and buying a floor. Although there are a lot of different entry points and customer journeys, customers use digital platforms mostly for research, education and style whereas store visits are used to see and feel products in real life. All answers to the interview questions are shown in Appendix [B.1.4](#).

### 5.1.4 Workshop

A workshop with around 80 Dutch Carpetright (flooring specialty store chain) branch managers was performed. The participants of the workshop were divided into four different groups, each divided into four subgroups. Each subgroup was related to one of the four

flooring entry points. These entry points existed out of the make-over (redecorating the house), moving or renovating, kids out of the house (giving a room a new purpose) or baby on the way (creation of a baby-proof environment). The first task for each group was to individually write down the main frustrations and frequently asked questions on post-its for their entry point. After a five-minute timer, all data was gathered and discussed within the subgroups. Based on these frustrations and questions the second task was to create possible solutions to these topics. These solutions were again gathered and discussed. The last step of the workshop was to prioritize the biggest areas for improvement or solutions. This whole sequence was repeated three times with the other remaining groups resulting in four results for each customer entry point. After the workshop, the insights were categorised by grouping similarities between the answers from the different participants. The results of the workshop are depicted in digitized and grouped versions in Appendix [B.3.2](#). In addition to some new insights, the workshop mainly validated the earlier found insights. For this reason, the point of data saturation was reached and the user research phase was concluded after the workshop.

## 5.2 Customer experience map

All main insights from the previously mentioned methods were combined in the customer journey map depicted in Figure [5.1](#). This map shows for three phases the general steps taken by customers. For each phase, the customer needs, the various channels used, the customer frustrations and the opportunities are displayed. The following opportunities appeared most frequently and were expected to create the most impact when implemented.

### Opportunities awareness phase

The awareness phase is the first step in the customer journey. In this phase, customers make the decision to need a new floor and start their general research process. The interiors of most flooring specialty stores are not up to the standards of current retail standards. This means mostly that the interior is outdated and the stores have a real product-focused mindset. This representation is often not visible on the websites of these flooring companies and because of that, it creates a mixed image of the brand. This mismatch makes it more difficult for store employees to sell high-end products in a low-end environment. An opportunity is to lower or ultimately eliminate this gap between the online and offline aspects of a flooring brand.

People don't regularly buy flooring and therefore are often not educated in this field. This creates a customer that does not know what to expect from the process before they start. The regular complaints heard were the fact that customers need to visit stores way more often than thought before. This is mostly because of gathering samples in stores and imagining the floor at home with the sample. These store visits add to the time that the whole process takes which is often higher expected. On top of that the delivery time of



flooring is often way higher than expected, where most uninformed people expect to take home the floor immediately. Lastly, people often do not have a complete overview of all the materials needed to lay a floor themselves. An opportunity to solve this is to educate people before they start their search journey for the right floor and indicate delivery times earlier in the process.

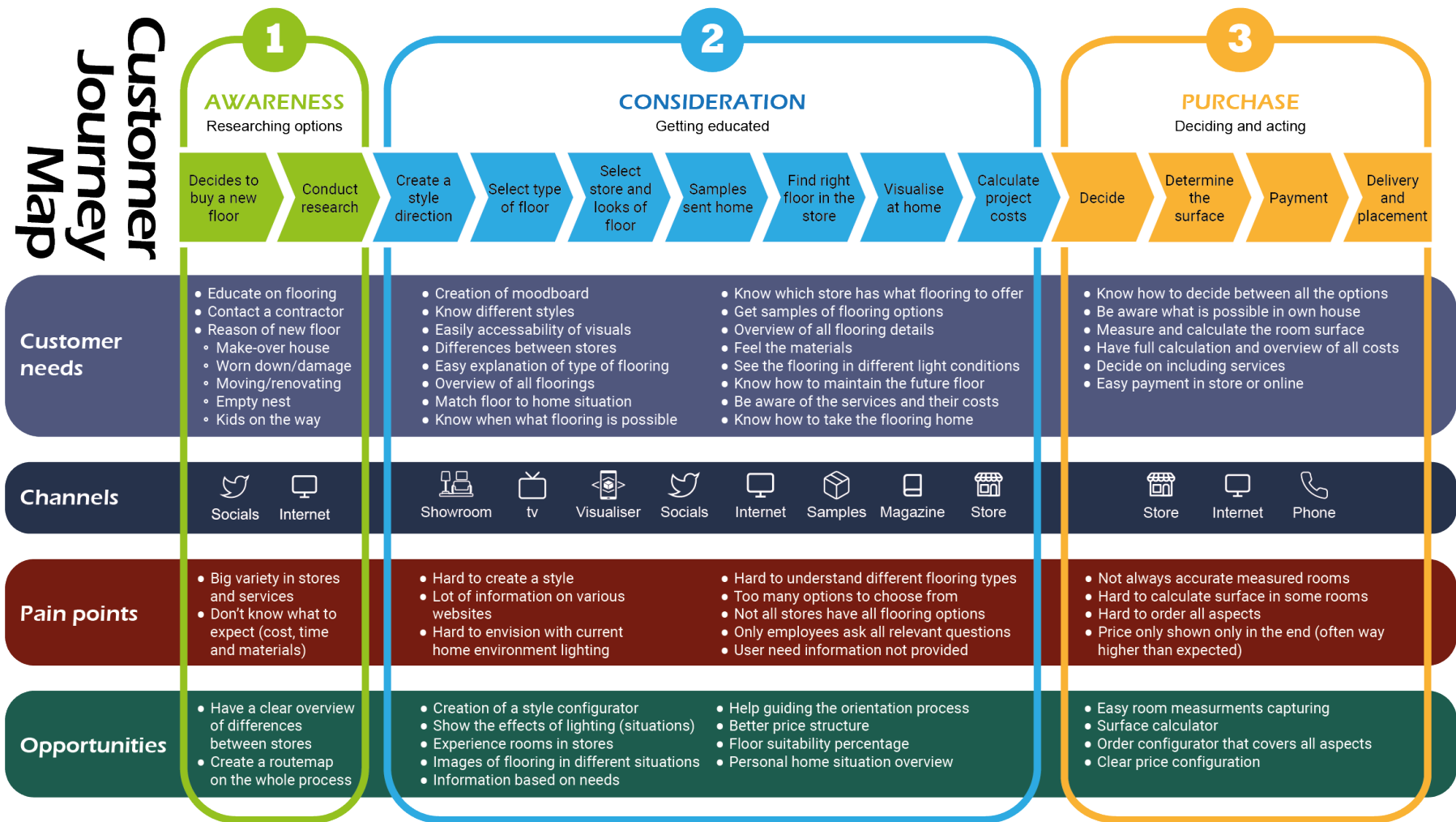


Figure 5.1: Customer journey map.

## **Opportunities consideration phase**

A regular complaint from store employees is that people often visit stores without a clue of knowledge on what kind of style (of flooring) they want. Another example is that customers bring in pictures or samples of their current furniture with no clue on how to style this with a floor. The store employees admitted that they are also no real experts on these kinds of design questions. For this reason, an opportunity arises to create a style configurator for customers in which they can select a style to match with a floor.

One of the most common tasks of a store employee is guiding customers in their decision process. Customers are often overwhelmed with all the choices and don't know how to select which floors are applicable to their own situation. This is mostly done by questioning the customer on their preferences and home situation. Based on certain questions a lot of flooring can be eliminated in the choice process. Common topics that quickly eliminate choices are price, base floor, heating and the way of using the floor. Some store employees complained that not all their colleagues always ask all the important questions, as there is no standard process, which later on results in extra problems. An opportunity is to help customers in the orientation process by showing which flooring is applicable for them considering all aspects. Standardising such a process could similarly result in fewer problems and less occupation time for store employees. A linked opportunity to this is to show a matching score of flooring to each customer. This way customers can quickly see which flooring best matches their preferences or demands.

The biggest aspects of buying a floor are the looks and price. All the flooring prices are displayed in prices per square meter. This price is often useless as you can only buy flooring in packages which are not sold per squared meter. Therefore the price is often hard to calculate for customers. There is an opportunity to create a better way of displaying this and comparing prices with each other.

The biggest innovation in the flooring retail industry is the room visualiser being offered online. These room visualisers show customers how the flooring would look in their own room(s). The biggest problem with these visualisers and online images is that they do not match the real-life looks of the products. There is an opportunity to match the real-life look and touch to the online room visualiser. An additional opportunity is to include various lighting situations as now all flooring is shown in artificial light. Another often asked comment was that customers would like to see the flooring in different lighting of the day (E.g. In the evening with mood lighting).

There is a lot of information available about each floor. Each customer wants different information and the current information on the papers is often not clear. These people are mostly interested in the usage specifications of the floor instead of all the technical aspects. There is an opportunity to provide the usage specifications instead of the technical specifications. Another opportunity could be to create these usage specifications into expe-

periences where people can experience the differences between the products by testing them out directly.

### **Opportunities purchase phase**

One of the biggest complaints is that the total price is only known at the end of the process at the checkout. This is often way higher than customers expect because they mostly calculate the cost of the main floor as this is the most expensive and forget about the extra costs for the base floor, skirting boards and services. For this reason, customers often switch to other flooring in the end but this costs them a lot of time as they have to repeat the orientation phase. An opportunity in this is to have a transparent price structure during the selection process. This way people are not discovering the total price in the end and have to restart the whole process.

A common paid service of flooring specialty stores is to measure your room and calculate its surface of it. People often buy these services as they are afraid of making a mistake in measuring or calculating. An opportunity is to make an easy way for customers to measure their room and help with calculating the surface and circumference. This is especially useful for rooms with uncommon shapes.

## **5.3 Personas**

From all the gathered data there were three types of persons representing the customers. For these customer groups, three personas were created. These personas have the goal of representing distinct user groups. Each persona shows information about how they experience their process of buying a new floor and their related vision, goals and frustrations. The three personas are depicted in figure [5.2](#) and the detailed full-page versions can be found in Appendix [C](#).

Flore is the first persona representing distinct user groups that start their journey with thorough research. Her research starts with finding all the information she needs to know about the differences in flooring. Knowing what she wants, she will create new styles with corresponding mood boards to envision how her new apartment will look like.

Thomas is not aware of what he wants and needs but does prioritise quick availability and price. Ideally, he wants to take the products home immediately and does not want to pay too much. He is not interested in extra services as he will fix it himself as fast as possible.

Gea is the last persona and has experience with buying flooring but is done with the whole process herself and thus wants an all-in service. She doesn't exactly know what kind of look of the floor she wants but it should fit in perfectly with her current furniture. Therefore she wants to test her favourite options with samples at home, and also to look at how they

behave with different lighting conditions.



Figure 5.2: Three personas for the flooring journey.

## 5.4 Design challenge

The design challenge provided the guidelines for the design stage. Analysing the opportunities from the customer experience map, presented in Chapter 5.2, some opportunities seemed to be solely effectively solvable outside the store with the help of the Internet. The remaining opportunities that seemed to be solvable within the store by implementing a phygital installation were the following:

1. Providing simple style orientation methods.
2. Explaining to customers what flooring is technically applicable.
3. Helping customers in the choice process.
4. Providing the feeling of flooring and seeing them in different (day)lights.
5. Providing clear information per floor based on user needs.
6. Explaining the price structure in a clear and transparent way.

The design phase started off with the design challenge of creating a phygital installation in flooring specialty stores while trying to exploit the above-mentioned opportunities.

## Chapter 6

# Flooring kiosk

Based on the development phase a phygital prototype was created, named the "Flooring kiosk". The Flooring kiosk combines samples of flooring with a graphical user interface to help customers in a store find the right flooring for their situation. The final design of the prototype is described in detail by explaining the setup, the design system and the functions of the prototype. A visual of the prototype is depicted in Figure [6.1](#).



Figure 6.1: The phygital prototype, called the "Flooring kiosk".

## 6.1 Development

The goal of the develop phase was ideation, rapid prototyping and testing. The ideation was performed through a brainstorming workshop. The envisioned direction was pursued in an iterative manner by testing with clickable prototypes.

### 6.1.1 Co-creation workshop

Co-creation was used mainly in the develop stage to come up with ideas and get inspired by working with others and their visions. The co-creation session was performed in three different rounds. The session started by briefing all the people present about the insights of the user research phase. After the briefing, the brainstorming session was started, which was afterwards prioritised based on dot voting. The method for the last round was a Crazy 8 [53]. Herein participants needed to draw eight ideas in eight minutes. The final ideas were presented and discussed within the group.

The workshop was performed with five UX (intern) designers from the agency The Valley. The workshop consisted out of three stages. In the briefing stage, the most important insights from the user research were shared together with a visual overview of the phygital landscape. After the briefing, the individual brainstorming stage started. The brainstorming stage created many ideas ranging towards various directions. All brainstorming ideas were shared and discussed between the participants and dot-voted on. The overall best-voted ideas from the brainstorming session were the starting point of the Crazy 8 method. The results of this method are depicted in Appendix D.1. The best ideas of the Crazy 8 method were discussed in the group. The best ideas were combined into two main concepts that could be pursued with a prototype. The first concept was to combine a room visualiser with physical flooring to replicate a better understanding of the behaviour, especially with different lighting conditions. The idea behind this was to directly feel and see flooring options while being able to easily visualise them within home environments. The second concept was focused on guided selling. Based on (technical) questions and styles the system would guide the customer to the right products. These recommendations would have a matching score and clear price structure during the process of selecting the products.

### 6.1.2 Envisioned direction

Both concepts of the workshop were combined in a kiosk that can be placed in a flooring specialty store. Behind the kiosk is a wall with samples of flooring types. The customer can use a guided selling flow to find the right flooring for the user's situation. The selected flooring will light up to indicate which are applicable and the user can directly feel and see the sample floor to compare them to each other. The second function is to show the customers what their flooring will look like in their home situation. This room visualizer function combines flooring samples and a digital screen to show how the flooring reacts to different lighting. The customers can place a sample on the platform under the screen

and see the floor change on the screen as well. The screen gives the user the possibility of changing the lighting situation from for example daylight to a dimmed situation. These light effects will also be simulated on the flooring sample. A third mode will be added to give the user and store employees quick access to information about each floor. A sketch of the envisioned prototype is depicted in Figure 6.2.

Looking at the PH-CX frameworks this envisioned direction can capture value on an economic level by making the process more efficient. This would create value through practicality, immersivity and sensoriality. This phygital installation would be categorised under extended setting for the visualisations of rooms and under extended self for the connected objects in the ERT framework. By shifting from traditional marketing to experiential marketing there are four areas shaping the business according to the EMM framework. The phygital installation will be mostly used for customers but could also provide benefits for employees. The process should improve the selection process which results in fewer store visits and quicker decision-making. This process should be guided by experiential design thinking and should result in a phygital setting.

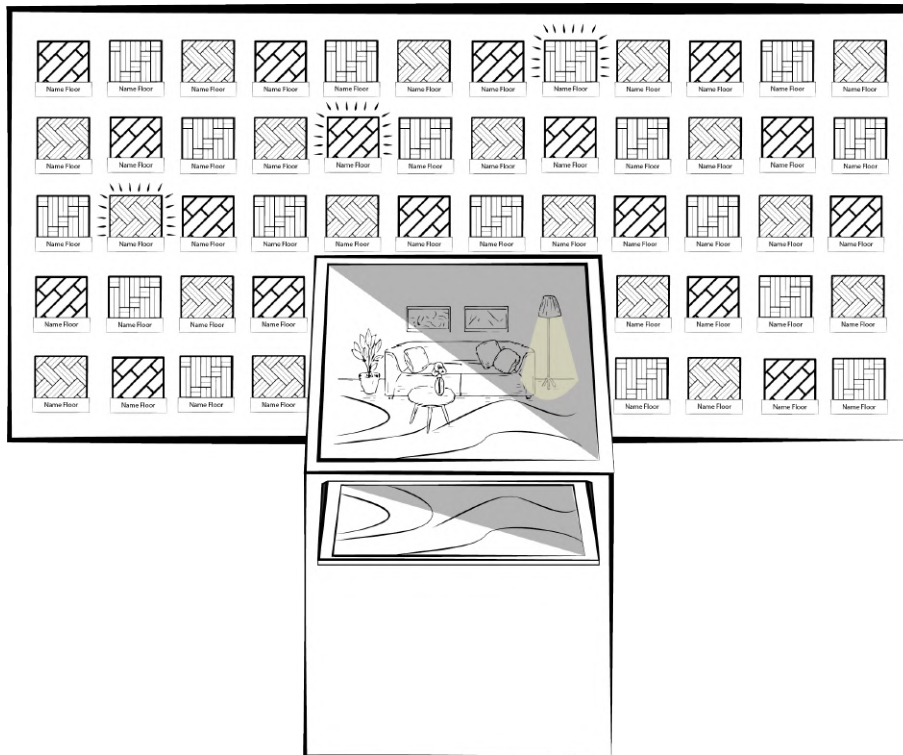


Figure 6.2: Sketch of the envisioned idea.



### 6.1.3 Clickable prototype

A clickable prototype was created in Figma to test the flow of the system. This system was designed as if it were for the flooring brand Carpetright to give it a design direction. This clickable prototype was created with the through-other-eyes method with various employees of the agency The Valley including developers, UX and visual designers. This method was applied various times a week during the development process. The first sessions were performed on a bigger scale. This resulted in an adapted order for the questions to improve the flow. A second change was the progress bar which changed into a menu to create a better overview of the whole process. Some design tweaks were already mentioned such as the activation of a button could be clearer. The later performed sessions with this method resulted in smaller design changes such as visual design tweaks and a change of words for clearer communication.

In total 38 screens were designed to create the clickable prototype that offered the three functions as described in the envisioned direction. These screens were exported from Figma to Protopie. This software was chosen to create the interactions of the prototype as it supports a connection between Arduino and a graphical user interface running on a tablet. After bringing the software and hardware together the setup was user-tested with three more colleagues on additional potential flaws. This process resulted mostly in graphical design adaptations to create a better user experience on the tablet as a lot of buttons were too small to press easily. A new feature was added to the prototype as one of the participants proposed adding a custom lighting function to the room visualizer. In addition to matching different light situations, users can also customize the light source to different colours. This was proposed for the reason that this person has programmable LED lighting at home and this couldn't be visualised. Lastly, audio feedback was proposed when a flooring sample was made active within the system. This was implemented but after testing also discarded as the sound couldn't be properly matched because of latency and unknown quitting of the app started occurring.

## 6.2 Prototype setup

The final prototype setup of the flooring kiosk was designed in SolidWorks. For each part of this assembly, a technical drawing was created that could be transferred to a DXF file that was lasercutted. Except for the acrylic name signs, all the parts were lasercutted out of four-millimetre plywood. Each name sign was engraved with the name of a flooring sample on a four-millimetre acrylic sheet. Under each name sign a WS2812b Neopixel with six LEDs was placed, when powered this resulted in an illuminated name sign. These were all powered by a five volts external power source and all connected to an Arduino Nano with a 330-ohm resistor. In addition to the name signs, there was also a similar Neopixel strip with 18 LEDs placed in the central tub. Lastly, an MFRC522 RFID reader was wired to the Arduino, which was able to recognize the NFC Tags placed on the eight flooring samples

gathered by the Carpetright sample service. An additional power supply of five volts was added to power the whole installation. The full wiring scheme of the Arduino can be found in Image [6.3](#). The code for the Arduino can be found in Appendix [E.1](#).

The Arduino was connected with a wired connection to a laptop that is hidden behind the test setup. The laptop was running Protocie Connect. This program made it possible to create a connection between the Arduino and a wireless tablet. The tablet was running Protocie Player which lets a user interact with a graphical interface. The graphical interface was created by a total of 38 screens which were designed in Figma and given interaction in Protocie.

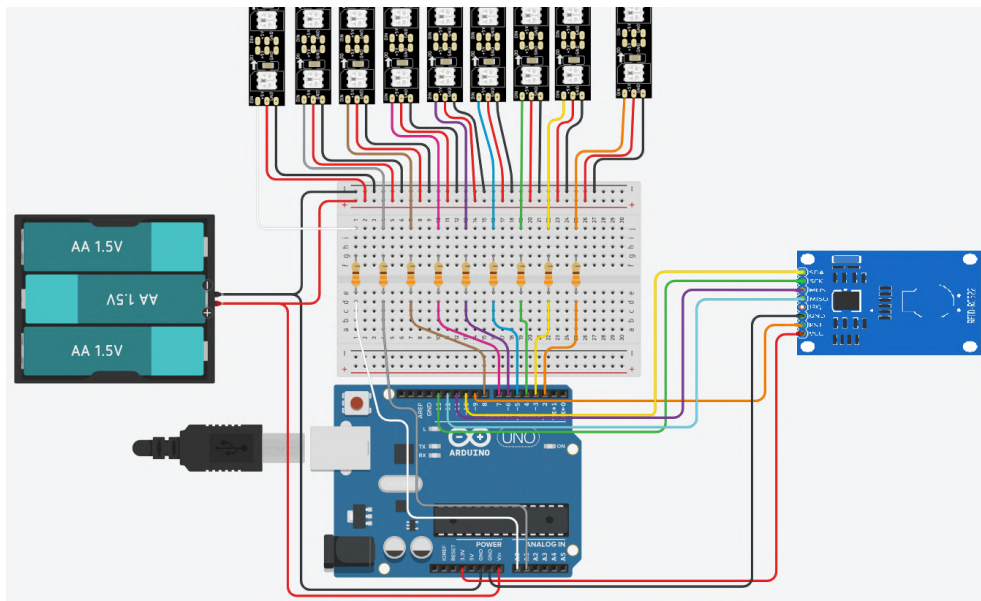


Figure 6.3: Electrical circuit Arduino

### 6.3 Design system

The brand Carpetright was selected to form an inspiration for the design system, a set of standards intended to manage the design. This was done so that no new brand needed to be created and existing design patterns could be used. The brand is known for its vibrant aqua and dark grey colours. An additional element they are known for is the design element of planks in their advertisements. This prototype does not use this design element to give it a cleaner and more premium look. The rest of the brand design was used as inspiration for the graphical interface design.

The font that was used in the whole prototype was *Source Sans Pro*, where the font size ranged from 24 to 64 points. From the font, light, regular and semi-bold weights were used.

Light and regular are used for the various texts and titles, whereas the semi-bold weight was used for more emphasis. An overview of the design system is depicted in Figure [6.4](#)

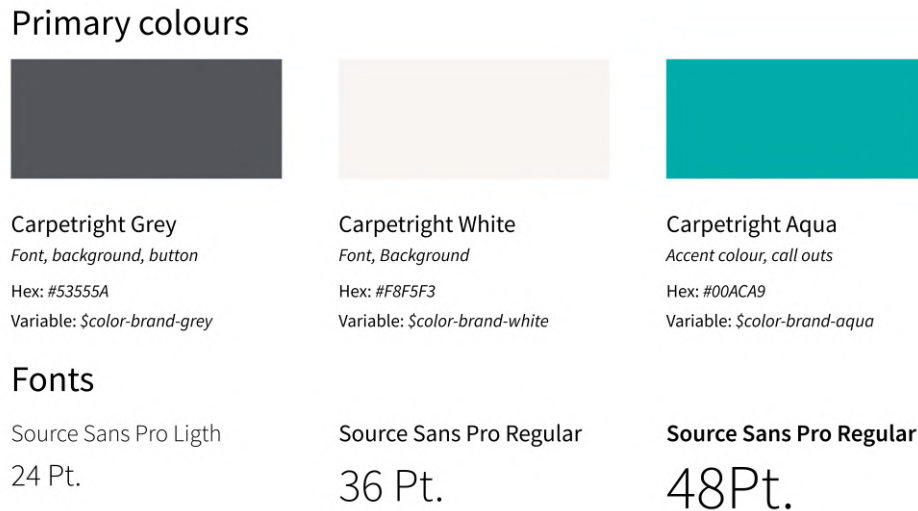


Figure 6.4: The design system of the graphical interface.

## 6.4 Prototype modes

The prototype has three main modes that aim to assist the customers of flooring specialty stores. The Flooring decision aid advises people which floor is best applicable to their home situation. The room visualiser gives customers a visualisation of flooring in different rooms and with various light conditions. Lastly, the flooring details mode displays all flooring and gives additional specifics about each item. The mode selection screen is depicted in Figure [6.5](#)

### 6.4.1 Flooring decision aid

This mode aims to guide customers to the best flooring options for their situation by asking questions. The first section of questions is aimed at understanding the goal of the customer. Customers were asked to share the reason (Make-over/worn down or moving houses) for their project and demands (budget or sustainability) which resulted in different flows. The second section focuses on the technical specifications of the house. These questions are related to how many rooms need new flooring, and the type of housing to discover the need for sound isolation. After this section, the customer can specify per room the style and technical specifications of this room. The style questions create a mood board with colours and images. Each specific colour and image can be replaced if they are not in line with the user's preferences. The technical questions include questions like the type of base floor

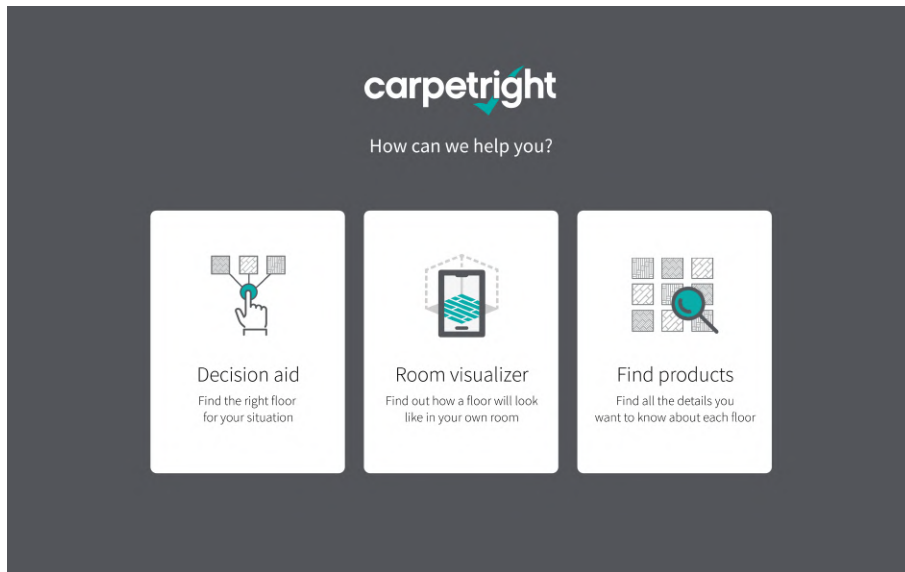


Figure 6.5: Home menu with mode selection

(wood or concrete), the kind of heating (underfloor heating or a radiator), the intended way of use (kids, chairs, animals etc.) and surface size. Based on the style and the house and room specifications the user gets recommended flooring options. The recommended name tags will light up highlighting the options on the wall. This way the customer can directly see and feel the samples. Each floor has a matching score stating with which requirements it matches. The recommendations can be further adjusted based on the demands of the customer. The customer can get extra flooring information for each of the selected flooring options. By selecting a floor and optionally a subfloor and skirting boards the price will be adjusted in each step and per room to give a clear and transparent overview of the price structure during the process. This way the *Flooring decision aid* mode aimed at implementing opportunities 1, 2, 3, 5 and 6 from Chapter 5.4

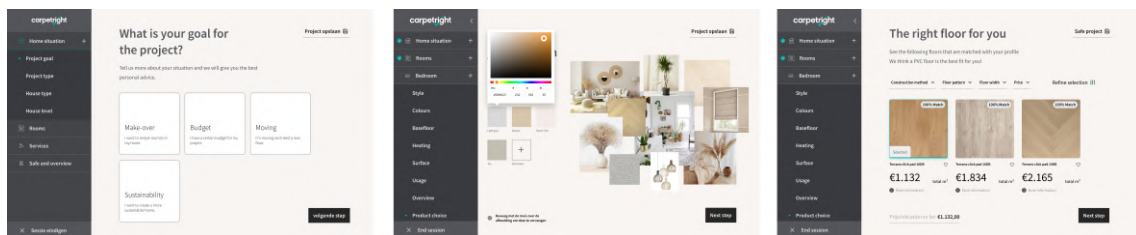


Figure 6.6: Three screenshots of the *Flooring decision aid* mode

## 6.4.2 Room visualiser

The *Room visualiser* mode has the aim of helping users visualise flooring within mock-up rooms or in their own rooms by uploading an image. Within these rooms, the floor can be replaced by selecting a sample of the wall and placing it in the tray of the prototype. When detected by the installation the floor in the digital room will adapt to the one of the sample. This way the customer can see how each floor would look in the selected room. To give a better representation of the real world there are three different light modes: day, evening and night. Each mode will change the lighting in the digital room and will replicate the lighting situation to the active flooring sample in the tray, an example of this is depicted in Figure 6.1. This way the customer can in addition to seeing and feeling the samples, also see how the floor behaves in a real light situation. A last function is custom lighting by selecting a custom colour and projecting this on the floor in the case of having programmable lights at home. When customers develop one or more favourites they can open the product information on these favourites to become more informed about the differences. This mode had the goal of implementing opportunities 3, 4 and 5 from Chapter 5.4.

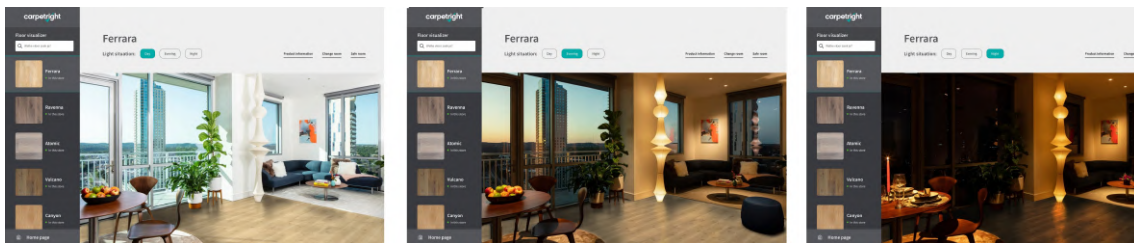


Figure 6.7: Visualisation of the Ferrara floor in day, evening and night light.

## 6.4.3 Flooring details

The last mode is a digital overview of all the flooring present in the store. The prices of the overview can be adapted to show the price that resembles the total price for a room instead of the square meter price. By selecting a floor by clicking or placing it in the tray, the user can gather information about the floor. In addition to the standard information that is already provided in a normal store a few new features have been added. Firstly, each floor has information based on how it performs on usage. This information is visualised with a score between one to five to indicate the greatness or easiness of the specification. In total there are five specifications, these include: Maintenance, heat retention, sound absorption, sustainability and usage. Secondly, the price is again adaptable to the price of the total surface. Thirdly the delivery time is added. Fourthly, all the floors have, in addition to the texture image, pictures of the floor laying at people their homes to give them an indication of what the floor will look like. Lastly, each item has a function that indicates where the item can be found within the store so customers do not have to wander around to find the flooring they want. This way the *Flooring details* mode aimed at implementing opportunities 5 and 6 from Chapter 5.4.

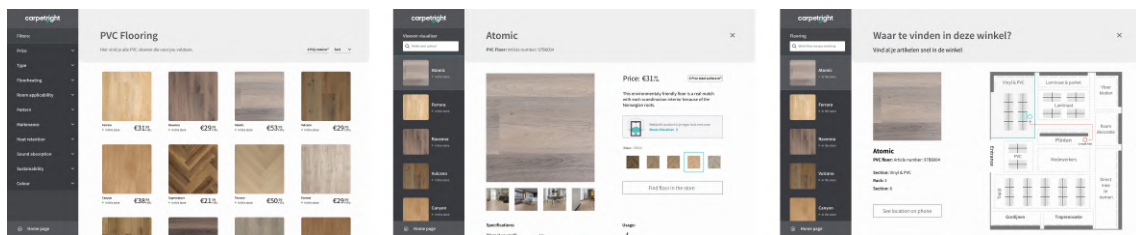


Figure 6.8: Three screenshots of the flooring details mode.

# Chapter 7

## Results

This chapter describes the gathered results through user tests. It explains the participant composition, the findings and user evaluations based on acceptance and usability.

### 7.1 Participants

In total eleven participants took part in the user testing of the phygital installation. Five of these participants were employees working in the flooring industry and the remaining six people were currently looking to buy a floor (2) or did so in the last two years (4). The average age was around 47 years with a standard deviation of almost 16 years.

The customers with previous experience in buying a floor were colleagues within the digital agency The Valley. These participants tested the prototype within the company environment. The second test location was within a Carpetright store in Amsterdam. In this flooring specialty store, one customer and five store employees tested the prototype. Store employees were used in the user testing, as it was assumed that they were experts on their customers. Table 7.1 shows a full demographic overview of all the participants. For privacy protection, all participants are chronologically coded from P1 to P11.

|           | Gender |        | Age  |           | Experience |           |
|-----------|--------|--------|------|-----------|------------|-----------|
|           | Male   | Female | Mean | Std. Dev. | Mean       | Std. Dev. |
| Employees | 4      | 1      | 56.8 | 6.49      | 22.4       | 24.0      |
| Customers | 5      | 1      | 40.0 | 15.81     | /          | /         |
| Total     | 9      | 2      | 47.6 | 15.02     | 22.4       | 24.0      |

Table 7.1: Demographic values of the participants.

## 7.2 Findings

The interviews with the participants gave great insights into the three modes and overall impressions. The full results can be found in Appendix [F.4](#). Besides the interviews, the participants also graded the installation on the SUS and Acceptance scale.

### 7.2.1 Insights

#### First impression

Practically all participants answered that they would like to try out the Flooring kiosk when they saw one being present in a store and had a positive first impression about it. Two participants were more hesitant about using it and stated that it depended on how it was advertised/branded. They also mentioned that the availability of the employees and whether or not they would approach the customer directly when entering the store would influence their actions. All participants guessed certain functionalities of the Flooring kiosk when asked what the installation was expected to do.

#### Decision aid

The decision aid function was received really well and the participants really saw value in the possibility of quickly filtering away flooring options with the questions. All the design opportunities were achieved.

Within the decision aid, all people were enthusiastic about the feature of selecting a style and creating a mood board. Participant 3 suggested that the mood board feature could be expanded by connecting it with *Pinterest* for adding your own preferred images to the mood board.

The Flooring kiosk was positively validated for helping customers in their choice process. Two participants stated that it will make the selection process way more manageable by giving you a concrete selection for you to do a final exploration on instead of the whole collection of a store. Participant 4 described the implementation nicely about also educating the customer: "You are helped to think about things you don't know about. Normally, I only think about the colour and profile of a floor. Now you are pushed into other choices you also have to make." Participant 7 who is also a store employee saw a reel-added benefit for the employees as they can gather an overview of the customer quickly which could result in a head start for a conversation.

Lastly, the price being updated in each step and for each room was really positively responded to by the participants. The store employees also saw the added benefit of this already being implemented in the flow as this can quickly filter away a lot of options. The total price instead of the square meter price was received completely positively as well. Participant 1 still wanted to see the square meter price as this is the standard in the industry



with the goal of making it easier to compare prices to other stores.

### **Room visualizer**

Being able to visualize the flooring within rooms was seen as a big help for customers. Recently there have been applications developed that performed a similar function. However, as stated in the user experience interviews and reiterated by participants 2,4 and 5 in the user tests, the screen will never match the real-life appearance. Therefore the addition of the samples next to the screen was experienced as a pleasant addition.

The function of adding different lighting situations was seen as a great addition. The lighting on the sample in the tray could however be improved a bit further for a final product. The lighting from the room where the installation is displayed now has a lot of influence on the samples. By removing the room light, the effects of the lighting of the installation should have more impact. In addition to changing the room light, it was suggested by Participant 3 to also be able to change the colour of the walls and furniture to have more customization options. Participant 11 praised the lighting feature but suggested going even further with applying the different seasons as these also influence the lighting.

### **Product information**

The last mode was the least innovative but also this was perceived as a great function of the Flooring kiosk. The functionalities of quickly having all the information in one spot was much appreciated. The function of finding products within the store was also praised often as a lot of people were often wandering through the store. Participant 1 mentioned a compare function for the different flooring could be a nice addition to the product information mode for even better comparison. The total pricing feature was again positively received and had even more impact in this mode according to some participants as you can quickly visually see the differences of all flooring in the store.

### **Overall impression**

Except for one store employee, all the participants saw the added value of the Flooring kiosk in stores. They saw the real added benefit in helping people with the choice process by filtering away a majority of flooring options that are not relevant to their situation. It could help people when

### **Employees**

The employees were especially curious about how a final installation would work and look when it would be placed in their store. Some other questions that were mentioned were about whether it would be child-proof and if multiple screens would be needed when implemented. This gave the impression that these participants already accepted the idea of the concept and were thinking into further details of already implementing it.

|              | Score (-2 to 2) | Cronbach's alpha (0 to 1) |
|--------------|-----------------|---------------------------|
| Usefulness   | 1.291           | 0.86                      |
| Satisfaction | 1.522           | 0.82                      |
| Acceptance   | 1.407           | 0.91                      |

Table 7.2: Results of the Acceptance scale.

Two store employees did think that the "Flooring kiosk" would work for (some) customers but were not too keen on the implementation for employees. This critical view can clearly be seen in the scores on the SUS and Acceptance scale. Participant 3 stated that the *Decision aid* mode could replace his job. Participant 10 did not see any added value in the *Decision aid* and *Room visualizer* modes as it would give customers too much information to think about. This would extend the exploration time of the customers because they would want to explore too many items. At the same time, this store employee as an experienced seller would quickly guide the customers towards the right product. This same participant did note that other colleagues could probably benefit from this installation.

### 7.2.2 Acceptance scale

To test the acceptance of the prototype the usefulness and satisfaction were tested with the acceptance scale of [54]. Both usefulness and satisfaction were graded on a range of -2 to 2. From all the participants the acceptance received an average score of 1.407. This was averaged on the scores of usefulness (1.291) and satisfaction (1.523). To control the data on the level of agreement Cronbach's alpha was used. All scores from the questions that were framed negatively were multiplied by -1 to get all scores in a similar scoring range. From each row and column the variance was calculated. With these numbers Cronbach's alpha was calculated, this scale ranges from zero to one. The closer the score is to one, the more consistent the answers of the participants were. Previous literature [55] indicates that the data is reliable if Cronbach's alpha value is 0.7 or higher. The scores for usefulness and satisfaction, ranging between 0.8 and 0.9, can be interpreted as good whereas the overall acceptance score above 0.9 can be seen as excellent. An overview of all the results of the acceptance scale can be seen in Table 7.2.

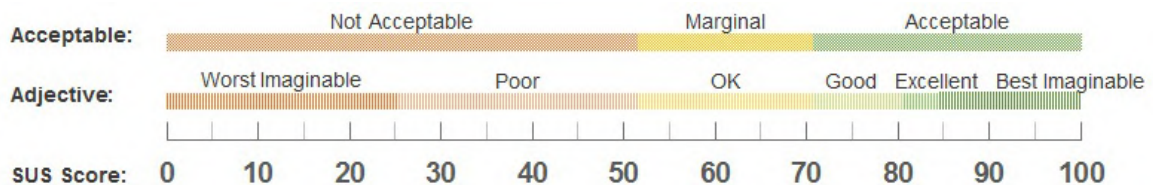


Figure 7.1: Interpretation system usability scale

### 7.2.3 System usability scale

To test if the designed prototype is also found to be usable the SUS test was conducted [56]. This scale is ranging from zero to a hundred. The higher the score, the better the usability of the system was perceived. The interpretation of the SUS can be seen in Image 7.1. The prototype had an average SUS score of 79.32, which can be translated to a good and really close to an excellent indication (>80) of usability. This score has an accuracy of 90% [57]. When the accuracy would be at 100%, the score would lay in the range of 73 to 81. All these results would still be acceptable and result in good or excellent usability.

## Chapter 8

# Conclusion and Discussion

To conclude this study, we will provide answers to the research questions. By addressing the sub-questions, we can arrive at a solution to the main research question. Following this, we will reflect on the project and finally, provide recommendations for future work.

### 8.1 Conclusion

The main objective of this study was to investigate how phygital design could enhance the shopping experience in flooring specialty stores. This was positively achieved by the creation of a phygital prototype called the "Flooring kiosk" based on thorough user research. User research is seen in the literature as crucial for the positive creation of phygital design. The performed user research resulted in a full customer journey of buying a floor with the phases of awareness, consideration and purchase. Each phase highlighted the customer needs, channels, frustrations and opportunities. Phygital design could exploit six opportunities to solve problems mainly in the consideration phase of customers in flooring specialty stores. The flooring kiosk was received positively with high acceptance with great usability from the participants of the user tests.

In the process of designing the "Flooring kiosk" an overview of the phygital landscape was developed. This overview is based on various design frameworks and categorises the phygital designs that have been implemented. This overview can help researchers and designers find and categorise phygital installations. The "Flooring kiosk" could be placed both under the extended setting because of the *Room visualizer* mode and under extended self because of the *Decision aid* and the *Product information* modes. The technologies being used are RFID, a touchscreen and LEDs. The installation creates value through *Practicallity* by guiding the customers in the selection process and giving useful information, *Immersivity* with the *Room visualizer* mode and sensoriality by directly providing samples that can be

touched and seen.

Chapter [2.2](#) highlights the significance of UX research in phygital design. All the praise received for the "Flooring kiosk" features was due to addressing the issues identified in the user research stage. Physical appearance and texture are crucial aspects of the flooring industry. Based on these ideas, it is hypothesized that phygital design can benefit other sectors in the specialty store industry if one or more senses are critical and cannot be replicated digitally.

## 8.2 Limitations

It is important to recognize that the results of the testing of the prototype need to be seen with caution to the small sample size. In total, the prototype was tested on eleven participants. The group (5 participants) that tested within the agency The Valley had a (minimal) collegiate relationship with the researcher, which could have influenced the opinion of the participants. Another limitation is that there is an overlap between the user interviews and the user testing. One store employee and two participants took part in both tests. Only one female participant was present in the user testing in comparison to six male participants. Also, there mostly were two age groups present, one group around 25 years old and one group around 53 years old. This difference is not resembling a true representation of the customers in flooring specialty stores. For these reasons, more testing with a more diverse testing group is advised.

The created prototype was not fully developed as this prototype functioned to test the idea of the product. Even though the prototype did have good usability the interaction with a final product could be experienced differently and therefore the results could differ from the gathered results in this study.

## 8.3 Recommendations

This research focused on flooring within the specialty store industry. The acceptance of phygital design was positive therefore creating the hypothesis that phygital design could also enhance other specialty stores. All features that were praised resulted from extensive user research so this should not be an exception for other industries. Especially stores where visual impressions, feeling or other senses play an important role are expected to have a higher chance of succeeding. This is expected for the reason that people want to experience these products in real life before purchasing, especially for products with a higher price tag.

The use of VR and AR technology could play an important role in the future, especially in the room visualizer function. From the researcher's point of view, these technologies should be further developed before they can create added value. When the acceptance and usability of customers of these technologies are improved, future research could study the

effects they could have on the (flooring) specialty store industry.

Some store employees were hesitant that this would replace their jobs. The prototype is based on the needs of the customers and barely on those of the employees. Future studies could concentrate on improving the "Flooring kiosk" based on the needs of employees to better assist them in their work.

Concluding, it should be emphasized that the prototype is not ready for direct implementation in flooring specialty stores. The main changes that should be made to form a finished product are the following:

- Extend the system and wall with samples to all flooring (types).
- Check and refine the flow architecture within the *Decision aid* mode with experts so all details are included.
- Link the product details of each floor to the decision aid flow.
- The creation of the room visualizer with lighting conditions based on uploaded images.
- Create a market-ready product, steering away from visible wires and the use of wood.

In addition to the main changes, there are still a few suggestions that could potentially improve the installation:

- Add a feature to compare flooring directly to each other.
- Within the *Room visualizer* be able to change the colour of walls and furniture in the mock-up rooms to adapt more to customers' own styles.
- Create a function so customers can ask for help from employees.
- Be able to label floors as favourites to have an easier overview of all the different modes.

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# Appendices

# Appendix A

## Design frameworks

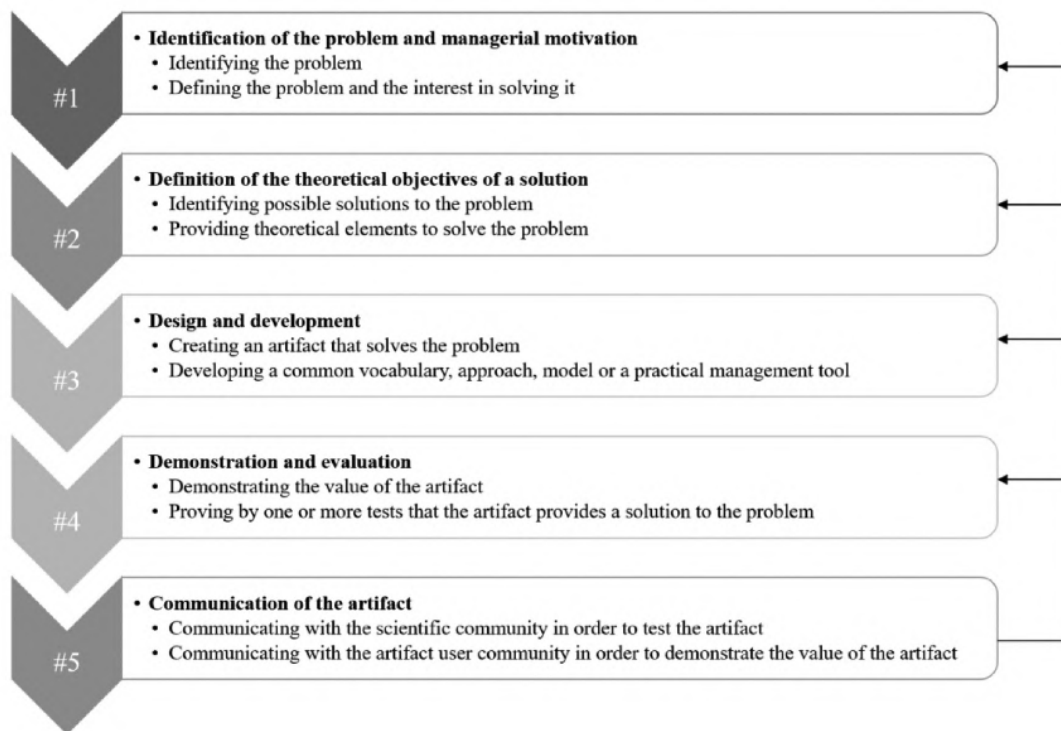


Figure A.1: Design science research methodology framework

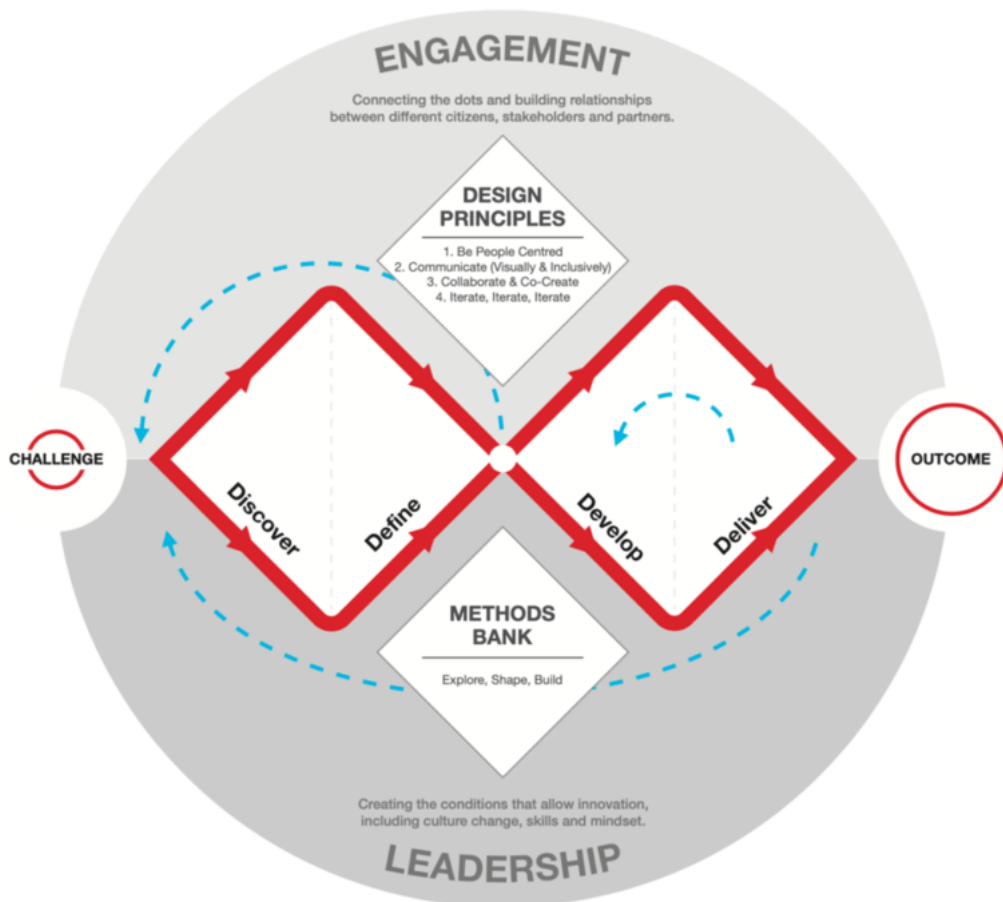


Figure A.2: Double diamond framework

# Appendix B

## User research

### B.1 Interviews

#### B.1.1 Interview flow

The interviews were following a structured flow to have consistent interviews between the participants. The interview flow was structured as the following:

1. **Welcoming and introduction**

The participants of the interview were introduced to the topic of this research and its aims. They were explained why they were being interviewed and if they were okay with this. To formalize this a consent form is signed by the interviewees.

2. **Warm-up**

To get to know who the interviewees were, demographic questions were asked. A main question of this was the question of what stadium they were in in the flooring buying process or their role in the store.

3. **Customer journey**

To gather insights into the whole process of buying a floor questions were asked about the different stages of buying a floor. This started with the awareness phase, going to the consideration phase, leading to the decision phase and lastly the purchase phase. Within these phases, it was questioned what customers expect from a physical store and what information need to make a decision.

4. **Closing**

To close the interview, some more holistic questions were asked on how the process in general could be improved. Lastly, the interviewee was asked for any last thoughts, questions or feedback on the study.

## **B.1.2 Interview questions**

### **Customers flooring specialty store**

#### **Demographic**

1. Is this the first time you're looking for a new floor?
2. Where in the process of buying a floor are you / how long ago did you buy your floor?
3. How often did you visit a flooring specialty store?
4. Why do you visit this store?

#### **Customer journey**

1. Could you take me through your personal process of selecting and buying a floor from start to finish?
2. **Awareness**
  - (a) Why are/were you getting a new floor?
  - (b) If so, how do you do pre-research for buying a floor (social media, Google, websites, visualiser app)?
  - (c) For what do you use the internet in the process of selecting and buying a new floor?
3. **Consideration**
  - (a) Why do you go to a physical store?
  - (b) What would be your ideal store interior/surroundings?
  - (c) What do you expect from store employees assistance?
4. **Decision**
  - (a) What is all the relevant information that you want to know about when buying a new floor?
  - (b) How do you test if it matches or fits within your house?
  - (c) When do you know what floor you want to buy (what criteria)?
5. **Purchase**
  - (a) How do you select what you want to pay (just pay, order online (another store), try to haggle)?
  - (b) How do you get your new floor home (Yourself directly, delivery, pick up at a later moment)?
  - (c) Who is going to lay the floor and why?

#### **Closing**

1. How often did you visit a flooring store already?
2. What are you're next steps in the process?
3. How do you envision technology being applied in the future in this whole process?
4. If you could change anything magically in the process of selecting a floor, what would it be?
5. Any last thoughts, questions, or feedback?



## **Employees flooring specialty store**

### **Demographic**

1. What is your role in the store?
2. For how long have you been working in the flooring industry?

### **Customer journey**

#### **1. Awareness**

- (a) With what thoughts do people come to the store (orientation, just questions, know exactly what they want)?
- (b) For what do customers use the internet in the process of selecting and buying a new floor?

#### **2. Consideration**

- (a) Why do the customers come to a physical store?
- (b) Why do customers go specifically to this store?
- (c) What are ideal store surroundings for customers?
- (d) What are the customers looking for in a physical store? Are they missing anything or are there things that are never being used?
- (e) What service do the customers expect from store employees?
- (f) What are the most frequently asked questions?

#### **3. Decision**

- (a) What is all the relevant information that the customers want to know when buying a new floor?
- (b) What are the main pain points or doubts in the process of buying a floor from customers?
- (c) How do customers test if their new floor would match their (new) house?

#### **4. Purchase**

- (a) How do the customers select what they want to pay (just pay, order online (another store), try to haggle)?
- (b) How do the customers get their new floor home (Yourself directly, delivery, pick up at a later moment)?
- (c) What are the reasons for people to lay the floor themselves or through the store and why?

### **Closing**

1. If you could change anything magically in the process to improve the customer experience, what would it be?
2. How do you envision technology being applied in the future in this whole process?
3. Any last thoughts, questions, or feedback?

### B.1.3 Consent form

## CONSENT FORM

Enhancing the shopping experience with phygital design in specialty stores

I, \_\_\_\_\_, declare to voluntarily participate in this interview about flooring specialty stores by Tjebbe Treub of the University of Twente and the University of Trento.

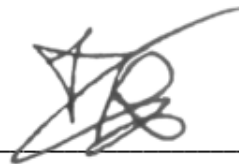
- I confirm that my participation is voluntarily.
- I understand that I've the right to decline to answer any question or I can stop the interview at any time.
- I agree that this interview will be audio recorded and a transcript will be produced.
- I understand that only the researcher will have access to the recordings.
- I understand that my name or any other identifying information will not be linked to the audio recording or transcript.
- I understand that the interviewer can include data, insights in an anonymised form in his study and that this can contribute to the development of a phygital installation for flooring specialty stores. |

Date: \_\_\_\_\_

Place: \_\_\_\_\_

Signature Interviewee:

\_\_\_\_\_



Signature Interviewer:

\_\_\_\_\_

## B.1.4 Results

### Employees

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| Demographic   | What's your role in the store?                     | Branchmanager CarpetRight   | Sales employee Gamma  | Shared branchmanager Vloerhetzelf                               | Assistant to manager CarpetRight  | Sales CarpetRight                              | Doing everything                    |                        |             |           |                |
|---------------|--|---|---|---|-----------------------------------|--|-------------------------------------|------------------------|-------------|-----------|----------------|
|               | How long do you work in the flooring industry?     | 8 years   | Long time in construction in general                            | 33 years  | 5 years                           | 23 years                                       | 15 years                            | 6.5 years              | 3.5 years   |           |                |
| Awareness     | With which mindset do customers come to the store? | Have a concrete idea but want to know what is possible within their house | The know what kind of floor they want but no clue on which one? | Have a concrete idea and colour just need to find the right one | Just looking out of boredom       | Have no clue what they want                    | Have an idea but often not possible |                        |             |           |                |
|               | What do customers use the internet for?            | Inspiration   | orientation   | Looking into the advantages of the different kind of floors     | Pre research but not thoroughly   | Vloerstalen                                    |                                     |                        |             |           |                |
|               | Which channels?                                    | Website CarpetRight   | VT wonen  | Internet  | Social media                      | Pinterest                                      | Television                          | CarpetRight visualiser |             |           |                |
| Consideration | Why do customers go to physical stores?            | Seeing the materials in real-life   | Feeling the material  | Having good/natural lighting                                    | expertise of the employees        | Getting a sample                               | Comparing prices                    | Comparing materials    |             |           |                |
|               | Why this store specifically?                       | All-in service  | Total unburdening   | Gamma is known for attracting the real handymen                 | Price                             | Location                                       | Open on sunday                      | Fits the time          | Famous name | Expertise | Mouth to mouth |
|               | What is the ideal store environment?               | We have practically everything  | Mwao just looking around  | Samples displayed big   | Not all stores have all materials | Should be the same floormap everywhere         | From hard flooring to soft flooring |                        |             |           |                |
|               | What is expected from the service of employees     | Advice on Pricing   | Technical advice on materials (thickness, cushioning, options)  | Advice on colour (with other samples)                           | Honest                            | Being pushed in the right direction            |                                     |                        |             |           |                |
|               | What are the most FAQs?                            | Costs   | Noise levels  | Possible with floor heating?                                    | Technical questions               | What's the difference between PVC and Laminaat |                                     |                        |             |           |                |

**Decision**

|   |  |  |  |                                       |   |  |  |   |   |
|---|--|--|--|---------------------------------------|---|--|--|---|---|
| What information do customers want when buying a floor? | <b>Quality</b><br>□□□□   | <b>The look</b><br>□                                   | Possible with floor heating?<br>□            | <b>Costs</b><br>□□□□□                 | How long will the floor last<br>□         | Low maintainability<br>□                 | <b>Trendy</b><br>□                                     |   |   |
| What are the most important frustrations of customers?  | They come with a drawing of their room measurements, but not always right<br>□ | Wanting to look further<br>□                           | Looking for cheaper options (internet)<br>□□ | Not able to bring home directly<br>□□ | More than just the price on a ticket<br>□ | What they want not possible<br>□□        | Too many options<br>□                                  | Understanding the differences in price<br>□ | The price on a role is misunderstood<br>□ |
| How do customers envision their new floor at home?      | Floor is the starting point of their decoration<br>□                           | Flooring is the last point on the list<br>□            | Bringing in samples of e.g. kitchen<br>□     | Visualiser tool<br>□□□                | Bringing samples home<br>□□□□□            | Look on internet for in situ images<br>□ | Match with furniture colours (simulated in store)<br>□ |   |   |
| Which services do customers use?                        | CarpetRight Visualizer<br>□□   | Voorinspectie (What's possible and measurements)<br>□□ | Laying the floor<br>□□□□                     | Advice from home<br>□                 | Samples send home<br>□                    |  |  |   |   |

**Purchase**

|  |   |   |   |                                      |  |                           |
|--|---|---|---|--------------------------------------|--|---------------------------|
| How do customers think of what they want to pay? | Some customers don't state what they want to pay<br>□ | Customers always try to haggle (joke)<br>□□ | Looking at the price tags<br>□                  | <b>Go in blanco</b><br>□             | Created an estimation when doing a renovation<br>□ | Have a maximum price<br>□ |
| How do they get their floor home?                | Most let it deliver with installation<br>□□           | <b>Delivery</b><br>□□                       | Separate laying service with self-employed<br>□ | Try to take it home if possible<br>□ |  |                           |
| Who is laying the floor?                         | Installing because of the all-in service<br>□□        | <b>Self cheaper</b><br>□□                   |   |                                      |  |                           |

**Closing**

|   |                                      |   |                                      |                                     |                                  |   |                                |   |                              |                         |   |   |
|---|--------------------------------------|---|--------------------------------------|-------------------------------------|----------------------------------|---|--------------------------------|---|------------------------------|-------------------------|---|---|
| If you could change anything in the process of the customers magically, what would it be? | <b>The delivery time</b><br>□□□□     | Better communication to the customer<br>□ | Not coming in pairs (joke)<br>□      | Faster sample service<br>□          | Quicker visualising at home<br>□ | Better training of the employees<br>□   | More thorough questioning<br>□ | Knowing the home delivery status (narrow hallway flat)<br>□ | The orientation process<br>□ | To make a decision<br>□ | Not being able to visualise with current furniture<br>□ | Should be the same floormap and visuals everywhere<br>□ |
| How do you envision technology being implemented in the future?                           | Automation of the communication<br>□ | Room visualiser in the store<br>□□□       | More questions through computer<br>□ | <b>Service Robot</b><br>□           | Better store systems<br>□□       | Merging the several store systems<br>□□ | 3D printing the floors<br>□    |   |                              |                         |   |   |
| Last thoughts or feedback?  | Final check needs to happen<br>□     |   |                                      | Needs to go way more efficient<br>□ |                                  |   |                                |   |                              |                         |   |   |

|   |                            |                                       |  |  |
|---|----------------------------|---------------------------------------|--|--|
| Is het oppervlak letterlijk of al met iets meer inberekend<br>□ | Wat is de ondergrond?<br>□ | Moet er nog een ondervloer onder<br>□ | Communication from higher to the stores not clear<br>□ | Marketing material comes in days after it has started<br>□ |
|---|----------------------------|---------------------------------------|--|--|

## Customers

### Demographic

|  |               |                                     |             |              |
|--|---------------|-------------------------------------|-------------|--------------|
| Hoe vaak heeft u een vloer gekocht             | 1st time      | 2nd time                            | 3th time    |              |
| Waar in het proces zit u?                      | Done          | Waiting for the laying of the floor |             |              |
| Hoe lang geleden dat u een vloer heeft gekocht | Few years ago | 2 months ago                        | a month ago | 2 month sago |
| Hoe vaak heeft u vloerenwinkel bezocht?        | 1 time        | 3 times                             |             |              |

### Awareness

|  |                                    |                                   |                                      |                       |                       |
|--|------------------------------------|-----------------------------------|--------------------------------------|-----------------------|-----------------------|
| Waarom gaat/ging u een nieuwe vloer kopen? | Renovation                         | New house                         |                                      |                       |                       |
| Heeft u vooronderzoek gedaan?              | Getting recommendations for stores | Knew what kind of floor we wanted | Mood board                           | Voordelen soort vloer | Nope                  |
| Via welke kanalen                          | Google                             | Pinterest                         | Instagram                            |                       |                       |
| Wat voor informatie zocht u op?            | Reviews winkels                    | Inspiration                       | Combination with walls and furniture | Reviews with picture  | Voordelen soort vloer |

### Consideration

|   |                       |   |                            |  |                              |                             |              |
|---|-----------------------|---|----------------------------|--|------------------------------|-----------------------------|--------------|
| Waarom gaat u naar een fysieke winkel?            | Inspiration           | Knowledge                                   | Making pictures            | Looking at floors in real-life setting | Looking for a specific floor | Getting samples             | Buy directly |
| Welke winkel en waarom?                           | Specialist store      | Ikea  | Kwantum                    | Gamma                                  | Vloerenboer                  |                             |              |
| Wat is de ideale vloeren winkel inrichting?       | Minimalistic overview | Nice to combine with furniture in the store | Good lighting              | Groot assortment                       | Duidelijk gestructureerd     |                             |              |
| Wat verwacht de u van de service van medewerkers? | Delivery time         | Guiding in the decision process             | Have (technical) knowledge | Get styling suggestions                | Explanation of the process   | explanation about the deals |              |

|   |   |  |
|---|---|--|
| <p><b>Decision</b></p> <p>Wat is de informatie die u wilt weten</p> <p>Wat is de belangrijkste van deze</p> <p>Hoe bedenkt u of een vloer goed past in uw huis</p>  | <p>Wat is de informatie die u wilt weten</p> <p>Wat is de belangrijkste van deze</p> <p>Hoe bedenkt u of een vloer goed past in uw huis</p>   | <p>Prijs</p> <p>Delivery time</p> <p>Environmental (Too chemical)</p> <p>Looks</p> <p>Could be combined with floor heating</p> <p>Quality</p> <p>Feeling of the floor</p> <p>The floor and the stairs have the same flooring</p> <p>Immediate take away</p> <p>Looks</p> <p>Hoe het aanvoelt op blote voeten</p> <p>Immediate take away</p> <p>Prijs</p> <p>The floor is the start of the design</p> <p>If it fits with the created moodboard</p> <p>Samples thuis neerleggen</p> <p>Imagination</p>   |
| <p><b>Purchase</b></p> <p>Hoe bedenkt u wat u wilt betalen voor een vloer?</p> <p>Hoe krijgt u uw nieuwe vloer thuis?</p> <p>Zelf vloer gelegd en waarom?</p>   | <p>Hoe bedenkt u wat u wilt betalen voor een vloer?</p> <p>Hoe krijgt u uw nieuwe vloer thuis?</p> <p>Zelf vloer gelegd en waarom?</p>  | <p>In the shop</p> <p>Online comparison</p> <p>After pay in case things go wrong</p> <p>Prefer online and skip talk with an employee</p> <p>Based on a budget</p> <p>Delivery</p> <p>Take away</p> <p>All-in service</p> <p>Service</p> <p>Self</p>  |
| <p><b>Closing</b></p> <p>Wat is/zijn uw volgende stappen om een keuze te maken?</p> <p>Pijnpunten / Openstaande vragen</p> <p>Dingen niet goed gegaan in het gehele proces?</p> <p>Hoe ziet u technologie in de toekomst toegevoegd kan worden aan dit proces?</p> <p>Laatste gedachten, opmerkingen of feedback?</p> | <p>Wat is/zijn uw volgende stappen om een keuze te maken?</p> <p>Pijnpunten / Openstaande vragen</p> <p>Dingen niet goed gegaan in het gehele proces?</p> <p>Hoe ziet u technologie in de toekomst toegevoegd kan worden aan dit proces?</p> <p>Laatste gedachten, opmerkingen of feedback?</p> | <p>Subfloor necessary?</p> <p>Floor heating?</p> <p>Costs for installation</p> <p>Too many options to choose from</p> <p>Not everybody knows about cutting loss</p> <p>Missing information on websites about texture and grooves</p> <p>Plinten zelf gelegd was een k werkje</p> <p>Faster decision in the store</p> <p>Got a box with chipped sides</p> <p>Net niet helemaal lekker gelegd</p> <p>Ondervloer voldeed niet aan demping certificaat</p> <p>Skeptical about VR because of not realistic visuals</p> <p>Helping with making a choice</p> <p>Floor recommendations based on the decoration of the room</p> <p>Floor layout square meter calculator</p> <p>More personalised</p> <p>Visualiser tool (rekening met licht)</p> <p>Opmeten oppervlak door opsturen vloerplan</p> |

## B.2 Observations

These are the summarized digitalized notes of the observations.

### 1. What's the physical space of the field of research.

- Low-end flooring specialty shops
- High-end flooring specialty shops
- Construction stores

### 2. Who the actors are.

- **Employees:** Branch manager, sales employee, warehouse employee
- **Customers:** Couples, single persons, person with dog, calling customers

### 3. All the activities performed by the actors.

- **Branch manager:** Phone calls, working on a computer, greeting customers
- **Sales employee:** Phone calls, working on a computer, assisting customers
- **Warehouse employee:** Getting orders ready

### 4. The objects that are relevant and present or used by the actors.

- **Employees:** Computer, phone, bell of the door, samples
- **Customers:** Samples, floors, kiosk computer, noise comparison exhibit

### 5. The specific individual actions carried out by the actors.

- **Customer with dog:** Leave the dog in a corner inside the store.

### 6. Particular occasions that surface from the research.

- The amount of time customers spent in the store wandering around.
- Customers practically always want assistance from a store employee.

## 7. The sequence of events.

- **Customer (couple):** Greeting, orientation, (discussing,) ask for advice, get samples, leave.
- **Customer:** Greeting, ask a question, get samples, leave.
- **Customer:** Greeting, ask a question, leave.
- **Customer:** Greeting, orientation, leave.
- **Customer construction store:** Greeting, orientation, grab flooring packages, pay, leave.
- **Employee:** Greeting customers, ask if they need help, give technical advice, ask for home situation, check possibilities, sell say goodbye.

## 8. What the actors' goals are or what they are trying to accomplish.

- **Employees:** Welcoming customers, giving technical advice, asking about the technical home situation, order sequence.
- **Customers:** Wanting (technical/visual) advice, gather a sample, look and feel the floors, buy flooring packages.

## 9. How the actors feel in given contexts.

- Frustrated - wanted item not directly available
- Happy - getting advice / buy a floor / collect samples
- Relieved - collect samples to watch at home
- Overwhelmed - too many items to look at



## **B.3 Workshop**

### **B.3.1 Method**

### **B.3.2 results**

This section displays the result of the workshops. The first two pages display the raw results of the workshop with the store employees and their thoughts on the problems and possible solutions for in the store and with the brand. These were mostly general topics and some were placed under customer specific topics. The third page shows all the possible solutions grouped in overarching themes. The yellow cards are problems and the green ones are solutions.

|   | Oriënteren |  |   |  |  |
|---|------------|--|---|--|--|
| Vragen & Pijnpunten   | Algemeen   | Baby op komst  | Kids uit huis   | Verhuizen/verbouwen  | Make-over  |
|   | Oplossing  | <p><b>Algemeen</b></p> <ul style="list-style-type: none"> <li>Eigenschap: hoeveel tijd met succes (lezen of je hebt)</li> <li>Mit verkende periode de winkel in</li> <li>Old (PI), gedroogd, al in (PI)</li> <li>Technische vragen</li> <li>Vier verwarring</li> <li>Makelijk schoon te maken</li> <li>rubelen om steviger te zijn</li> <li>Ontoet niet: Laatst staat voor grote dan simpel</li> <li>Doorzichtigheid (verwarring)</li> <li>De juiste keuze voor type vier</li> <li>Voordeel in wetenschap met overeen met werkbaarheid</li> <li>Bouwstof → Hoe past het met kasten baklamer etc.</li> <li>Te weinig tijd om goed te bedenken</li> <li>Communicatie naar de klant</li> <li>Levenswijze</li> <li>Liever een eenvoudige afsluiter op gebied van kleur</li> <li>Afgevoel van hoe het moet in de spinnen</li> <li>Website en winkel samen met voorver (dofte uitbreiding, methode)</li> <li>Overstapende producten in winkel (kopen met)</li> <li>Klanten weten meer van design dan de verkoper zelf</li> <li>Wat komt er allemaal bij kijken?</li> <li>Kleur is belangrijk → Wat past daarbij?</li> <li>Probleem basen vrede en fysiek</li> <li>Ordnaten van kennis op gebied van design en kleur</li> <li>Computer systemen (beeldscherm)</li> <li>Website informatie met advies (grijze knoppen met)</li> <li>Algemeen</li> <li>Regelmatige producten tussen vragen en type haken</li> <li>Waarom is de een duurder dan de ander?</li> <li>Wie te vertrouwen verkoper of adviseur?</li> <li>Geduldheid → Weerklaren in PVC zijn ingetand</li> <li>Buiknaam: maatvervangt soms engagement</li> <li>Hebben jullie logservice</li> <li>Hoog en laag, in hoe verpakkingen</li> <li>Het moet ook</li> <li>Mensen weten niet van nieuwe bouw techniek</li> <li>Geen inspiratie + moodboard online</li> <li>Efficiency in ICT moet beter (ECS)</li> <li>Beton of hout</li> <li>Product vinden te moeilijk - Online en in de winkel</li> </ul> | <p><b>Baby op komst</b></p> <ul style="list-style-type: none"> <li>Alleen de kosten van meer</li> <li>Kraanbenedig</li> <li>Geduldig werkt met korte tijd</li> <li>Waterdicht</li> <li>Comfort voor kind</li> <li>Voorkeur van kind (spinnen of meubel)</li> <li>Niet schadelijk voor mens en dier (Gevoel voor mijn kind?)</li> <li>Makelijk schoon te maken (Vangemoutige NI)</li> </ul>        | <p><b>Kids uit huis</b></p> <ul style="list-style-type: none"> <li>Laatste reserve voor de prijs</li> <li>Gevoel van kind</li> <li>Tipsboek</li> </ul> | <p><b>Verhuizen/verbouwen</b></p> <ul style="list-style-type: none"> <li>Raamdeco vaak ergens anders gekocht naast de vloer</li> <li>Vast mont op mont reserve bij Carportgig benut</li> <li>Raamdeco hangt of van de salie</li> </ul> |
| <p><b>Oplossing</b></p> <ul style="list-style-type: none"> <li>Bewachending klant verhoeden</li> <li>AI (AI) configurator</li> <li>Aanpak van situatie op website</li> <li>Verst zichtbaar direct een afpakken maken</li> <li>Bat ing naar bij problemen → Doorvertalen naar online</li> <li>Klanten weten niet in welke contexten het een geheel</li> <li>Stip en product groepen aan elkaar koppelen</li> <li>Advies module voor type huis en ontwerp</li> <li>Doornigen (duidelijke methode verpakking)</li> <li>Arbeids informatie online (Real-time data)</li> <li>Beperkingen weghalen</li> <li>Referentie aanpak van klant (duidelijk en op stalen)</li> <li>Meer kennis aan de klant geven zodat ze zelf bepalen wat moet</li> <li>Afgevoel maken verbeteren</li> <li>Winkel moet een totaal plaatje zijn</li> <li>Interactie bij product</li> <li>Prijz = tijdrende kosten weergeven</li> <li>Online assistent (ingenieur)</li> <li>Per product bijzitter met advies</li> <li>RV info over kennisvraag → geen ontwerp</li> <li>Meer kennis aan de klant geven zodat ze zelf bepalen wat moet</li> <li>Meer inspiratie van design en kleur</li> <li>Aanpak van klant staat ing groot effect</li> <li>Gevoel van klant begint vanuit prijs huizen</li> <li>Doorzichtigheid (verwarring) op de website</li> <li>Deel de achtergrond van de winkel</li> <li>AI in standaard vanuit klant of verwoven advies</li> <li>Makelijken met design van website</li> <li>Vergelijken met de klant type kleuren</li> <li>Neuwigheid van klant ook op de website</li> <li>Steden van klant decoratie</li> <li>Voor afpak of klantverhoeden (duidelijk, waarom, NIJ, onderwerp, (duidelijk))</li> <li>Moodboards</li> <li>Informatie krijgen van klant zonder te vragen voor de afpakking</li> <li>Tool op overzicht van klant (duidelijk, waarom, NIJ, onderwerp, (duidelijk))</li> <li>USP Carportgig: klantverhoeden (duidelijk, waarom, NIJ, onderwerp, (duidelijk))</li> <li>Onderzoek naar klant type producten</li> <li>Facebook per klant</li> <li>Marketing te veel op prijs gericht</li> <li>Stuur en beleving</li> <li>Voorspelling door klantverhoeden</li> <li>Personaliseer de website door klantverhoeden</li> <li>Optimaliseer de website door klantverhoeden</li> <li>Optimaliseer de website door klantverhoeden</li> <li>Checklist van klantverhoeden</li> <li>Vindbaar in de winkel</li> </ul> |            | <p><b>Baby op komst</b></p> <ul style="list-style-type: none"> <li>Onderzoektips</li> <li>Hoofdstuk op de website voor baby op komst</li> </ul>  | <p><b>Kids uit huis</b></p> <ul style="list-style-type: none"> <li>Onderzoektips</li> <li>Tool op de website voor baby op komst</li> <li>Duidelijke tactie op de website (duidelijk, waarom, NIJ, onderwerp, (duidelijk))</li> <li>Artikelen over klantverhoeden, (duidelijk, waarom, NIJ, onderwerp, (duidelijk))</li> <li>Product name + informatie van de klant aan klanten leveren</li> </ul> | <p><b>Verhuizen/verbouwen</b></p> <ul style="list-style-type: none"> <li>Meubels huizen voor klantverhoeden</li> </ul>                                 | <p><b>Make-over</b></p>  |

## Selecteren

## Bestellen en leggen

### Algemeen

|  |   |   |  |   |                                       |  |
|--|---|---|--|---|---------------------------------------|--|
| Hoeveel hebben we nu echt nodig?               | Meest service is niet bekend (eerst was het gratis)                               | Geen voortspectie op de bon                     | Toeslag legservice en inpakwerk is nog niet orbekend           | Geen vooronderzoek                            | Wat voor een ander voor               | Verwachting van het product                              |
| Wat komt er allemaal bij kijken?               | Online alleen de stalen aanvragen is een probleem                                 | Herkeken voor binnen budget                     | Tot plekke googelen naar goedkopere alternatieven              | Niet wetende wat past of mogelijk is          | De prijs / budget                     | Tijdsdruk  |
| Niet van alles een staal beschikbaar           | Visueel er geeft niet de ware kleur weer  | Wat past er binnen mijn budget                  | Man = technisch vrouw = sfeer                                  | Kentle raamsdeco is beperkt binnen Carvafijde | Kunnen we het zelf hebben?            | Prijs per m2 vs strookende meter bij 16 vs prijs per pak |
| Stalen in de winkel om op te halen zonder naam | Geen voorkennis van het proces (waar laat ik mijn spullen, wie helpt ons hierop?) | Roomvisualizer zet kindgraat dwars in de ruimte | Beleving van sfeer huis voldoet niet aan de gezonde versiering | Lever / legrijd                               | Raambekleding bestellen duurt te lang |  |

### Baby op komst

|                       |                            |
|-----------------------|----------------------------|
| Kinderspeelgoed proof | Kind veilig (naamkoortjes) |
| Verdastende gordijnen | Geluidsdemping             |

### Kids uit huis

|                                |
|--------------------------------|
| Doel van de beschikbare ruimte |
|--------------------------------|

### Verhuizen/verbouwen

|                              |  |  |
|------------------------------|--|--|
| Betzing op elfanden duarter  | Afhaken binnen 5 dagen leveren = niet mogelijk | Niet gooien de in de win winkel → komen uit bij bouwmaatschappij (cheaper) |
| Wanneer verhuizen / planning | Neurobouw voucher 20% orbekend                 |  |

### Make-over

|                                    |              |
|------------------------------------|--------------|
| Interim verhuizen (dats huis leeg) | Grter budget |
| Kamer per kamer                    | Mobels eruit |

### Algemeen

|   |   |
|---|---|
| Geen voortspectie op de bon             | Realiteit stoffeerters                          |
| Egaliseren boven is lastig              | Meereren staan niet klaar op moment van leveren |
| Stoffeerters zorgen voor veel problemen | Een maken is lastig                             |

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### Algemeen

|                           |   |                                 |   |   |                           |
|---------------------------|---|---------------------------------|---|---|---------------------------|
| Thuisadviseur bij keuzes  | Uitnodiging naar winkel                                 | Stalen opsturen                 | Raamvisualizer verbeteren               | Vragen welke ruimte er verbouwd gaat worden | Proefstukken in de winkel |
| Uitnodigen naar de winkel | Trechters van keuzes naar 2/3 tot mogelijkheden         | Vragen / afvakt                 | Winkelafpraak want geen/wenig personeel | Risico totaalrij kan klanten afschrikken    | Extrem en simpel filteren |
| Verkoper aan huis         | Stalen ophalen in de winkel = Beter een groot vlak zien | Meestafpraak naar thuisadviseur | Niet voor ouders maar voor de kinderen  | Welke sfeer? Wat tijd er momenteel?         |                           |

### Baby op komst

### Kids uit huis

### Verhuizen/verbouwen

|   |   |   |
|---|---|---|
| Voor opzetten → direct naar ook meervelen | Afraden direct bestellen van kleur verschil | Advies mit deur in voorname goedkoop is niet ???? |
|---|---|---|

### Make-over

### Algemeen

|  |                               |   |
|--|-------------------------------|---|
| Profielen, afwerking en dorpels laten doorleggen | In delen kunnen later betalen | Bij andere verhuur → order/over = door niet goed den carrollen??? |
|--|-------------------------------|---|

## Product keuze

|  |   |   |                             |
|--|---|---|-----------------------------|
| De juiste keuze voor type vloer              | Product vinden te moeilijk - Online en in de winkel | Product naam + informatie van de klant aan kunnen leveren | Checklist lijsten opstellen |
| Stijl en product groepen aan elkaar koppelen | Vergelijksmodule tussen type vloeren                | Ondervloer goed linken aan producten                      |                             |

## Consistentie

|  |  |  |  |
|--|--|--|--|
| Gerelateerde producten in webwinkel kloppen niet | Website en winkel komen niet overeen (zelfde uitstraling, eenheid) | Website informatie niet actueel (prijzen kloppen niet) | Website en winkel komen niet overeen (zelfde uitstraling, eenheid) |
| Visualiser geeft niet de ware kleur weer         | Vloerentype in webwinkel komt niet overeen met werkelijkheid       | Afraden direct bestellen lym kleur verschil            | Juiste informatie online (Real-time data)                          |

## Service aanbod

|  |   |  |   |
|--|---|--|---|
| Hebben jullie legservice                 | Mensen weten niet van nieuwe bouw korting                       | Online niet bekend: Leenstaal veel groter dan sample | Nieuwbouw voucher 20% onbekend                                  |
| Geen inspiratie + moodboard online       | Als iets breekt en dan?   | Meetservice is niet bekend (eerst was het gratis)    | Online alleen de stalen aanvragen is een probleem               |
| Niet van alles een staal beschikbaar     | AI (stijl) configurator   | Moodboards   | USP: CarpetRight speciaalzaak (maatwerk, ontzorgen, ook leggen) |
| Visualiser in de winkel                  | Voorinspectie door stoffeerder                                  | Opmeten als ze een bestelling hebben geplaatst       | Beter aansluiting tussen tools (visualizer en de stalen)        |
| Stalen van raam decoratie                | Duidelijke sectie op de website voor huis inspectie (voornamen) | Aansluiting tussen kleur staal erg groot effect      | Kleurinstalen met artikelen combineren tot een geheel           |
| Verkoper aan huis                        | Thuisadviseur bij keuzestress                                   | Meetafspraak naar thuisadviseur                      | Winkelafpraak want geen/weinig personeel                        |
| Vloer opmeten → direct raam ook meenemen | Tool op sfeerbasis (wat is het doel van de kamer)               | Raamvisualiser verbeteren                            | Proefstukken in de winkel                                       |

## Timing &amp; deadlines

|               |  |               |                                       |                  |
|---------------|--|---------------|---------------------------------------|------------------|
| Het moet snel | Goedkoop want maar korte tijd                  | Leveringstijd | Wanneer verhuizen / planning          | Lever- / legtijd |
| Timing        | Afhalen binnen 5 dagen leveren = niet mogelijk | Tijdsdruk     | Raambekleding bestellen duurt te lang |                  |

## Situatie niet bekend bij mensen zelf

|   |                                 |   |  |   |  |
|---|---------------------------------|---|--|---|--|
| Met verkeerde gedachte de winkel in                           | nabellen om situatie na te gaan | Reden van de make-over?                           | Gezinsamenstelling                                 | Geen vooronderzoek  | Huidieren?   |
| Wat is de huidige situatie                                    | Beton of hout                   | Vloer verwarming                                  | Kleur ton sur ton of te weinig kleur               | Allergiën   | Egaliseren boven is lastig   |
| Technische vragen   | Alleen de kinderkamer of meer   | Raamdeco hangt af van de ruimte                   | Huur vs koop                                       | De prijs / budget   | Getuiddemping  |
| Doel van de beschikbare ruimte                                | Wat voor een ondervloer         | Welke sfeer? Wat ligt er momenteel?               | Nieuwe huizen: soort vloerverwarming + vloer combi | Meer kennis aan de klant geven zodat ze zelf bepalen wat moet | Per product bijsluiter met advies  |
| Extreem en simpel filteren                                    | Bewustwording klant verbeteren  | Goede adviezen op de website                      | Advies module voor type huis en ondervloer         | Online assistent (vragenlijst)                                | Vragen welke ruimte er verbouwt gaat worden  |
| Meer kennis aan de klant geven zodat ze zelf bepalen wat moet | Aangeven situatie op website    | Tool op sfeerbasis (wat is het doel van de kamer) | Trechteren van keuzers naar 2/3 tal mogelijkheden  | Vragen / afvinklijst  | Voor afspraak al klantbehoefte navragen (budget, wensen, stijl, ondervloer, thuissituatie) |

## Voorwaardes voor het uitkiezen van een product

|  |  |  |  |                       |   |
|--|--|--|--|-----------------------|---|
| Hoog en zacht tapijt, in hoe verre platlopen | Makkelijk schoon te maken                    | Tijdloos   | Verduisterende gordijnen                   | Waterdicht            | Comfort voor kind                             |
| Gezondheid → Weekmakers in PVC zijn ongezond | Duurzaamheid (weekmakers)                    | Niet schadelijk voor mens en dier (Gezond voor mijn kind?) | Kind veilig (raamkooortjes)                | Kinderspeelgoed proef | Verwachting van het product                   |
| Krasbestendig                                | Makkelijk schoon te maken (Vlekgevoeligheid) | Artikelen over kleurwens, sfeer, milieuvriendelijk         | Hoofdstuk op de website over baby op komst | Onderhoudstips        | Duurzaamheid duidelijk zichtbaar in de winkel |

## Wat komt er allemaal bij kijken

|                                      |   |  |                                      |
|--------------------------------------|---|--|--------------------------------------|
| Kleur is leidend → Wat past daarbij? | Hoeveel hebben we nu echt nodig?              | Geen voorkennis van het proces (waar laat ik mijn spullen, wie helpt ons hierbij?) | Kunnen we het zelf leggen?           |
| Wat komt er allemaal bij kijken?     | Mensen staan niet klaar op moment van leveren | Bouwdepot → Hoe past het met keuken badkamer etc.                                  | Niet wetende wat past of mogelijk is |

## Meubels

|   |                              |               |                                   |
|---|------------------------------|---------------|-----------------------------------|
| Waar ga ik mijn meubels heen verplaatsen? | Bestaande of nieuwe meubels? | Meubels eruit | Intern verhuizen (hele huis leeg) |
|---|------------------------------|---------------|-----------------------------------|

## Ontbrekende kennis

|   |  |   |                                     |
|---|--|---|-------------------------------------|
| Liever een vrouwelijke adviseur op gebied van kleur | Ontbreken van kennis op gebied van design en kleur | Kennis raamdeco is beperkt binnen CarpetRight | Meer inspiratie qua design en kleur |
|---|--|---|-------------------------------------|

## Contact / Aftersales

|   |   |                           |   |
|---|---|---------------------------|---|
| Vanuit visualizer direct een afspraak maken | Na aanvragen stalen ook optie geven voor advies en extra tips | Uitnodigen naar de winkel | Bel mij maar bij problemen → Doorvertalen naar online |
|---|---|---------------------------|---|

## Totaalplaatje kosten

|  |  |                                      |  |
|--|--|--------------------------------------|--|
| Bijkomende kosten zijn niet duidelijk (alleen m2 prijs bekend) | Waarom is de een duurder dan de ander?             | Geid (Prijs, goedkoop, all-in prijs) | Wat past er binnen mijn budget                           |
| Toeslag legservice en snijverlies bij visgraat onbekend        | Ter plekke googelen naar goedkopere alternatief    | Herkiezen vloer binnen budget        | Prijs per m2 vs strotkende meter op rol vs prijs per pak |
| Risico totaalprijs kan klanten afschrikken                     | All-in standaard vanuit daaruit services uitzetten | Prijs + bijkomende kosten weergeven  | Winkel moet een totaal plaatje zijn                      |
| Gesprek beginnen vanuit prijs indicatie                        | In delen kunnen laten betalen                      |                                      |  |

## Appendix C

# Personas

”I want my first house to be perfect, exactly like I envisioned in all my moodboards.



# Flore Esha

Visual designer

## About

Flore recently purchased her first apartment. She has been looking forward to this moment for years as she can finally create her own home exactly the way she like it. Over the years she envisioned to live in a lot of different home styles. Likes to perform extensive online research to know what she can expect. Flore has a huge passion for design and can't wait to see everything come together.

## Goals

1. Create a new style for her house.
2. Online research on the type of floors.
3. Find a store with a big product range.
4. Find the perfect envisioned floor.
5. Easy way of measuring room surface.
6. Order online.
7. Delivered at home.
8. Lay the floor herself with friends.

## Vision

After creating various moodboards she will decide on a final floor that matches with her new style. The floor will be the basis of her new house and needs to be exactly as she envisions it. This is in order to match all the found furniture in the moodboard. She will lay the floor herself with some handy friends to save some money that she can spend on extra decorations.

## Frustrations

- Wants to try out to many different styles.
- Finds it difficult to decide on a final choice.
- Wants to exactly recreate her vision in real-life.
- Hard to calculate her floor as she has a weird shape in her new apartment.

Figure C.1: Persona Flore

”I just want a floor quickly so I can finally move out from my parents house.



# Thomas Berk

Accountant manager

## About

Thomas recently broke up and lives back with his parents. He finally found an apartment to move into. He wants to leave the house of his parents as quick as possible. He has never bought a floor before and also doesn't really care about it that much. He already has furniture that he owns but he does not have a vision on how to combine this all to a cozy home.

## Goals

1. Find the right store with a lot of knowledge.
2. Get help from a store employee in the whole process.
3. Needs to be compatible with floor heating
4. Take the floor home directly.
5. Lay himself directly so he can move in as fast as possible.

## Vision

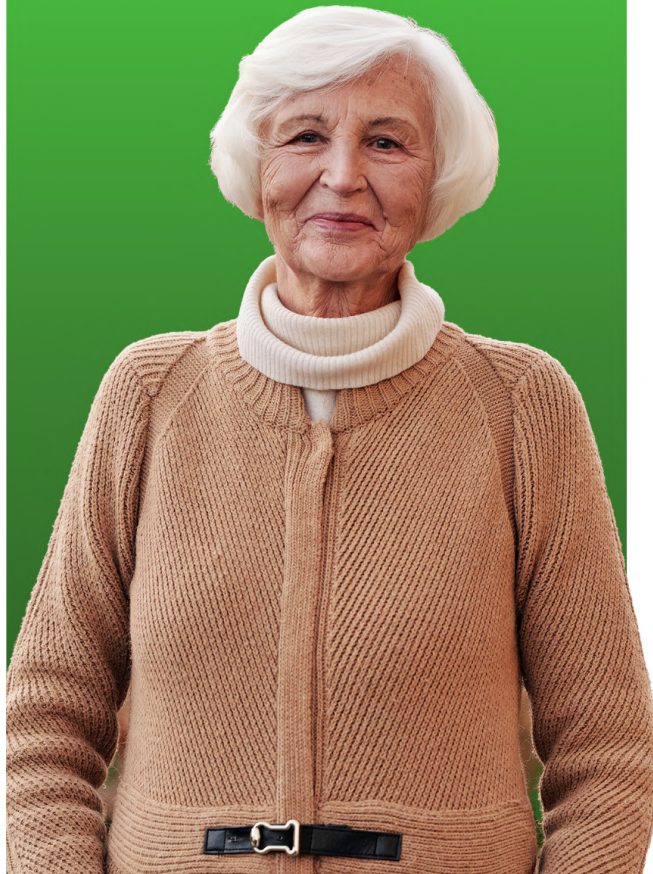
He wants to go to a store and envisions an employee that will guide him through the whole journey of selecting the right floor. Based on the advice he expects to go home directly with a new floor so that he can ensemble it directly to start moving in to his new house asap.

## Frustrations

- Wants help in all processes of selecting a floor.
- Has no idea what he likes or wants.
- Is not aware of the whole process of laying a floor and everything connected.
- Directly wants to take it home.

Figure C.2: Persona Thomas

“I want to redecorate my house but without any hassle.”



# Gea de Heeg

Retired grandmother

## About

Gea is building an annex with her man to the house and wants to directly replace her current floor as this one is worn down over the years. She wants to replace their wooden floor with a laminate flooring to keep the same look but be more resistant for when her grandchildren are coming over. They want to finish this whole building project as quickly as possible and therefore want it to be done by professionals.

## Goals

1. Goes to a full service flooring store to be fully unburdened.
2. Knows what type of floor she wants but not the specific look.
3. Wants to test it at home with samples for different lighting.
4. Wants it to be delivered and installed by professionals quickly.

## Vision

This grandmother knows exactly what she wants and learned from her experiences with her own kids and wants a robust new floor that is protected against spoiled liquids and the use of toys. The new floor should match with her current living room and have a wooden look. The measurement, delivery and placement should all be taken care of by the flooring company.

## Frustrations

- Does not understand the differences in all the prices while it mostly looks the same
- The full pricing for all services not clear from the start.
- Even though she knows what she wants, there are still a lot of options.

Figure C.3: Persona Gea

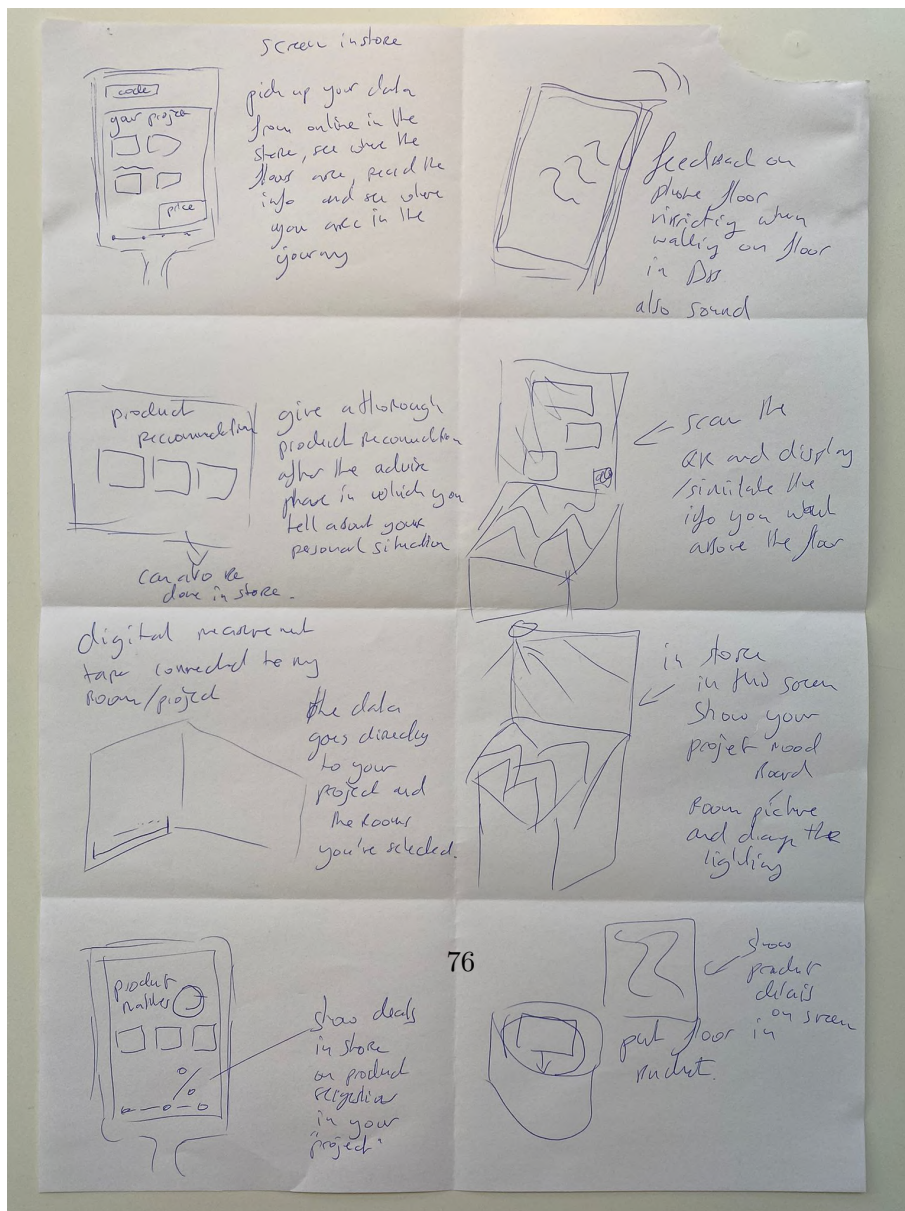




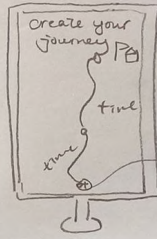
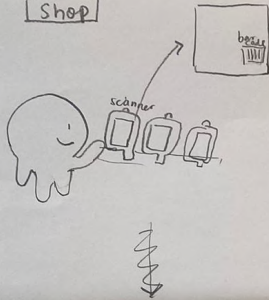
# Appendix D

## Development

### D.1 Workshop



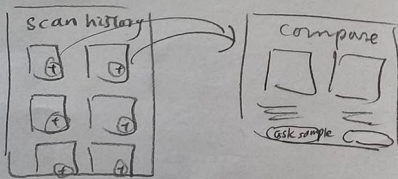
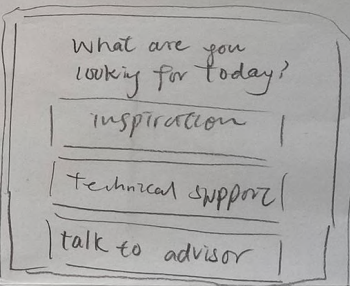
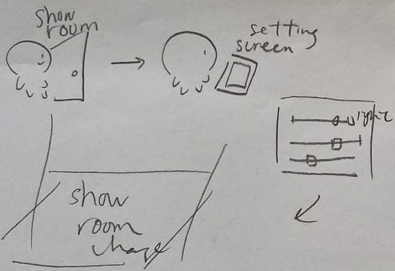
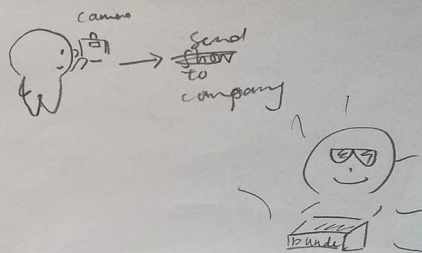
Shop



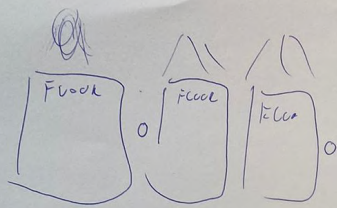
Are you looking for  
 inspiration  
 \_\_\_\_\_  
 \_\_\_\_\_



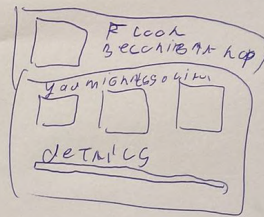
dancefloor idea



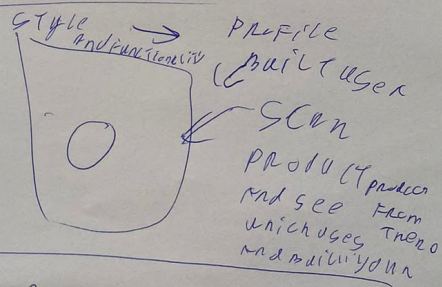
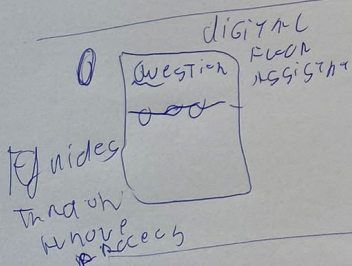
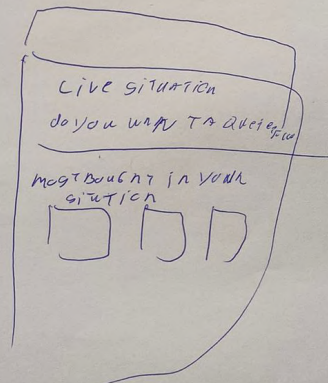
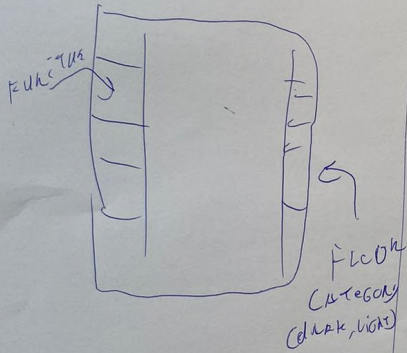
scan house + floor sample → mazer



on  
position  
on

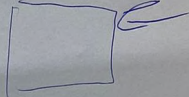


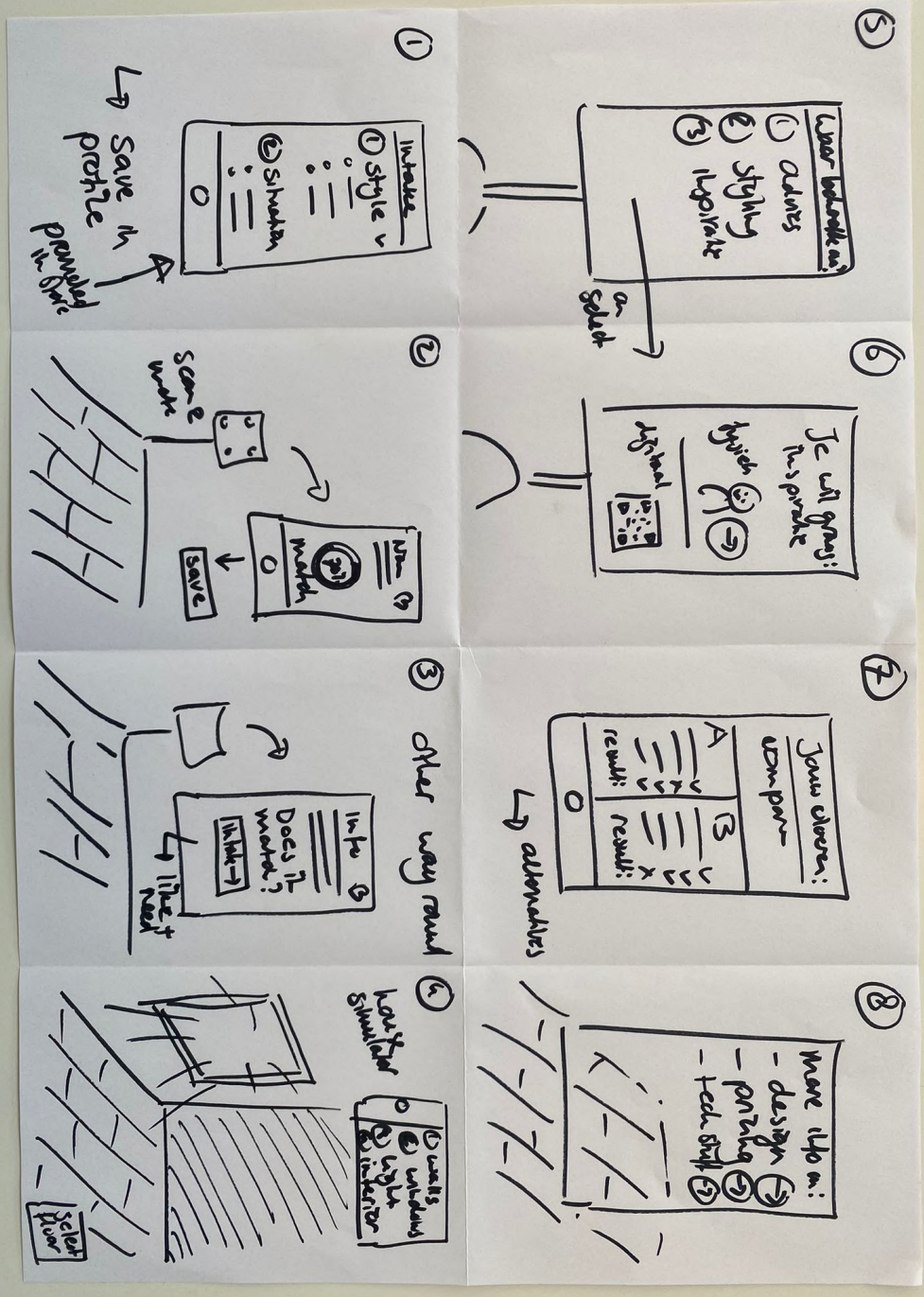
SCAN

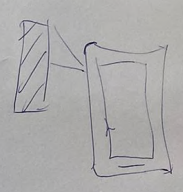
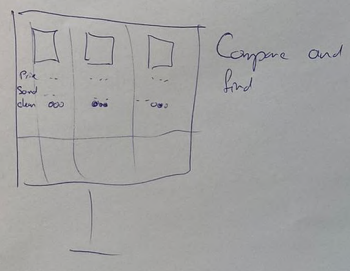
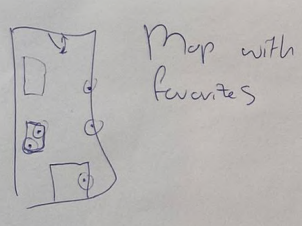
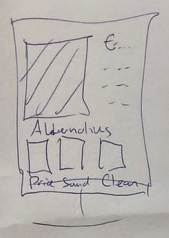
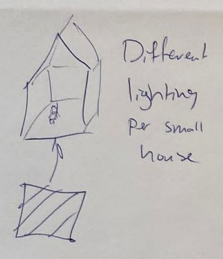
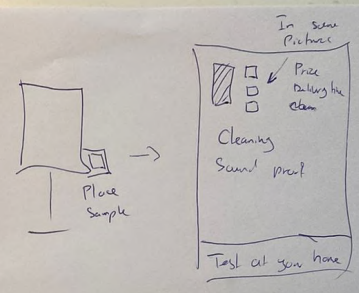
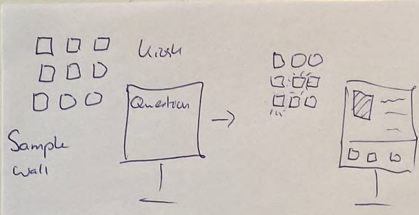


if can digital and furniture

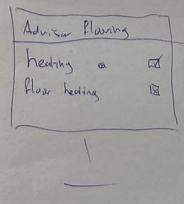
measure tool







Scan product with camera or use get info and add favorites



# Appendix E

## Prototype

### E.1 Arduino Code

```
/*
-----
Code created by Tjebbe Treub for his thesis:
Implementation of phygital installation in flooring specialty stores.
July 2023
-----
*/

/*Include of libraries*/
#include <Adafruit_NeoPixel.h> //Library for Neopixels
#include <SPI.h> //Library for SPI communication
#include <MFRC522.h> //Library for RFID sensor
#include <string.h>

/*Define pin and numbers */
#define NUM_LEDS 6
#define LED_PIN_Supernature 3 /*04 37 D5 11 11 01 89*/
#define LED_PIN_Canyon 5 /*04 85 57 11 11 01 89*/
#define LED_PIN_Ferrara 2 /*04 8B 56 0D 11 01 89*/
#define LED_PIN_Ravenna 4 /*04 31 2E 12 11 01 89*/
#define LED_PIN_Atomic 6 /*04 84 55 11 11 01 89*/
#define LED_PIN_Everest 7 /*04 23 56 05 11 01 89*/
#define LED_PIN_Terrano 8 /*04 79 4E 0B 11 01 89*/
#define LED_PIN_Vulcano A0 /*04 B4 2A 0B 11 01 89*/
#define LED_PIN_Bakje A1
#define SS_PIN 10
#define RST_PIN 9

/*Define colors*/
#define carpetRight 69,172,169
#define off 0,0,0
#define sun 252,238,167
#define yellowLamp 253,184,19
#define orangeLamp 175, 87, 51
```

```

int r;
int g;
int b;

String oldMessage;
String OldData;

/*Create MFRC522 instance*/
MFRC522 mfrc522(SS_PIN, RST_PIN);

/*Create led strip instances*/
Adafruit_NeoPixel Supernature(NUM_LEDS, LED_PIN_Supernature, NEO_GRB + NEO_KHZ800);
Adafruit_NeoPixel Canyon(NUM_LEDS, LED_PIN_Canyon, NEO_GRB + NEO_KHZ800);
Adafruit_NeoPixel Ferrara(NUM_LEDS, LED_PIN_Ferrara, NEO_GRB + NEO_KHZ800);
Adafruit_NeoPixel Ravenna(NUM_LEDS, LED_PIN_Ravenna, NEO_GRB + NEO_KHZ800);
Adafruit_NeoPixel Atomic(NUM_LEDS, LED_PIN_Atomic, NEO_GRB + NEO_KHZ800);
Adafruit_NeoPixel Everest(NUM_LEDS, LED_PIN_Everest, NEO_GRB + NEO_KHZ800);
Adafruit_NeoPixel Terrano(NUM_LEDS, LED_PIN_Terrano, NEO_GRB + NEO_KHZ800);
Adafruit_NeoPixel Vulcano(NUM_LEDS, LED_PIN_Vulcano, NEO_GRB + NEO_KHZ800);
Adafruit_NeoPixel Bakje(18, LED_PIN_Bakje, NEO_GRB + NEO_KHZ800);

// Declare struct
struct MessageValue {
    String message;
    String value;
};

// Declare function that parse message format
struct MessageValue getMessage(String inputtedStr) {
    struct MessageValue result;

    char charArr[50];
    inputtedStr.toCharArray(charArr, 50);
    char* ptr = strtok(charArr, "|");
    result.message = String(ptr);
    ptr = strtok(NULL, "|");

    if (ptr == NULL) {
        result.value = String("");
        return result;
    }

    result.value = String(ptr);

    return result;
}

// Declare MessageValue struct's instance
struct MessageValue receivedData;

void setup() {
    /*Setup of the RFID sensor*/
    Serial.begin(9600); // Initialize serial communications with the PC
    while (!Serial); // Do nothing if no serial port is opened (added for Arduinos based on ATMEGA32U4)
    SPI.begin(); // Init SPI bus
    mfrc522.PCD_Init(); // Init MFRC522
    delay(4); // Optional delay. Some board do need more time after init to be ready, see Readme
    mfrc522.PCD_DumpVersionToSerial(); // Show details of PCD - MFRC522 Card Reader details
}

```



```

ledStartUp();
delay(1000);
turnLedOff();
}

```

```

void loop() {
  //Check if there is a Serial input from the protopie programme
  while (Serial.available() > 0) {
    String receivedString = Serial.readStringUntil('\0');
    receivedData = getMessage(receivedString);

    //Check if it is a new message or still the current one
    if (receivedString == oldMessage) {
      return;
    }
    //If new message check what the message is
    else {
      turnLedOff();
      if (receivedData.message.equals("TurnLedOff")) {
        turnLedOff();
      }
      else if (receivedData.message.equals("ActivateCard")) {
        if (receivedData.value.equals("Supernature")) {
          ledOnSupernature();
        }
        else if (receivedData.value.equals("Canyon")) {
          ledOnCanyon();
        }
        else if (receivedData.value.equals("Atomic")) {
          ledOnAtomic();
        }
        else if (receivedData.value.equals("Everest")) {
          ledOnEverest();
        }
        else if (receivedData.value.equals("Ravenna")) {
          ledOnRavenna();
        }
        else if (receivedData.value.equals("Vulcano")) {
          ledOnVulcano();
        }
        else if (receivedData.value.equals("Ferrara")) {
          ledOnFerrara();
        }
        else if (receivedData.value.equals("Terrano")) {
          ledOnTerrano();
        }
      }
      else if (receivedData.message.equals("EersteSelectie")) {
        ledOnCanyon();
        delay(400);
        ledOnAtomic();
        delay(400);
        ledOnSupernature();
      }
      else if (receivedData.message.equals("TweedeSelectie")) {
        ledOnEverest();
        delay(400);
        ledOnRavenna();
      }
    }
  }
}

```

```

        delay(400);
        ledOnVulcano();
    }
    else if (receivedData.message.equals("Day")) {
        ledDay();
    }
    else if (receivedData.message.equals("Evening")) {
        ledEvening();
    }
    else if (receivedData.message.equals("Night")) {
        ledNight();
    }
    else if (receivedData.message.equals("Bakje")) {
        ledOnBakje();
    }
    else if (receivedData.message.equals("Custom")) {
        String hexstring = receivedData.value;

        long number = (long) strtol( &hexstring[1], NULL, 16);
        r = number >> 16;
        g = number >> 8 & 0xFF;
        b = number & 0xFF;
        ledCustom();
    }
    oldMessage = receivedString;
}
}

Serial.println();
// Reset the loop if no new card present on the sensor/reader. This saves the entire process when idle.
if ( ! mfr522.PICC_IsNewCardPresent() ) {
    return;
}

// Select one of the cards
if ( ! mfr522.PICC_ReadCardSerial() ) {
    return;
}

bool cardRemoved = false;
int counter = 0;
bool current, previous;
previous = !mfr522.PICC_IsNewCardPresent();

/*Reading of the RFID tag*/
String content = "";
byte letter;
for (byte i = 0; i < mfr522.uid.size; i++)
{
    Serial.print(mfr522.uid.uidByte[i] < 0x10 ? " 0" : " ");
    Serial.print(mfr522.uid.uidByte[i], HEX);
    content.concat(String(mfr522.uid.uidByte[i] < 0x10 ? " 0" : " "));
    content.concat(String(mfr522.uid.uidByte[i], HEX));
}
Serial.println();

content.toUpperCase();
if (content.substring(1) == "04 37 D5 11 11 01 89") {

```

```

    Serial.println("Supernature");
    ledOnSupernature();
} else if (content.substring(1) == "04 85 57 11 11 01 89") {
    Serial.println("Canyon");
    ledOnCanyon();
} else if (content.substring(1) == "04 8B 56 0D 11 01 89") {
    Serial.println("Ferrara");
    ledOnFerrara();
} else if (content.substring(1) == "04 31 2E 12 11 01 89") {
    Serial.println("Ravenna");
    ledOnRavenna();
} else if (content.substring(1) == "04 84 55 11 11 01 89") {
    Serial.println("Atomic");
    ledOnAtomic();
} else if (content.substring(1) == "04 23 56 05 11 01 89") {
    Serial.println("Everest");
    ledOnEverest();
} else if (content.substring(1) == "04 79 4E 0B 11 01 89") {
    Serial.println("Terrano");
    ledOnTerrano();
} else if (content.substring(1) == "04 B4 2A 0B 11 01 89") {
    Serial.println("Vulcano");
    ledOnVulcano();
}

while (!cardRemoved) {
    current = !mfr522.PICC_IsNewCardPresent();

    if (current && previous) counter++;

    previous = current;
    cardRemoved = (counter > 2);

    while (Serial.available() > 0) {
        String receivedString = Serial.readStringUntil('\0');
        receivedData = getMessage(receivedString);

        //Check if it is a new message or still the current one
        if (receivedString == oldMessage) {
            return;
        }
        //If new message check what the message is
        else {
            turnLedOff();
            if (receivedData.message.equals("Day")) {
                ledDay();
            }
            else if (receivedData.message.equals("Evening")) {
                ledEvening();
            }
            else if (receivedData.message.equals("Night")) {
                ledNight();
            }
            else if (receivedData.message.equals("Custom")) {
                String hexstring = receivedData.value;

                long number = (long) strtol( &hexstring[1], NULL, 16);
                r = number >> 16;
            }
        }
    }
}

```

```

        g = number >> 8 & 0xFF;
        b = number & 0xFF;
        ledCustom();
    }
    oldMessage = receivedString;

}
}
delay(50);
}
Serial.println("Floor is removed");
turnLedOff();
}

void ledOnSupernature() {
    for (int i = 0; i < NUM_LEDS; i++) {
        Supernature.setBrightness(255);
        Supernature.setPixelColor(i, carpetRight);
        Supernature.show();
    }
}

void ledOnCanyon() {
    for (int i = 0; i < NUM_LEDS; i++) {
        Canyon.setBrightness(255);
        Canyon.setPixelColor(i, carpetRight);
        Canyon.show();
    }
}

void ledOnFerrara() {
    for (int i = NUM_LEDS; i >= 0; i--) {
        Ferrara.setBrightness(255);
        Ferrara.setPixelColor(i, carpetRight);
        Ferrara.show();
    }
}

void ledOnRavenna() {
    for (int i = NUM_LEDS; i >= 0; i--) {
        Ravenna.setBrightness(255);
        Ravenna.setPixelColor(i, carpetRight);
        Ravenna.show();
    }
}

void ledOnAtomic() {
    for (int i = 0; i < NUM_LEDS; i++) {
        Atomic.setBrightness(255);
        Atomic.setPixelColor(i, carpetRight);
        Atomic.show();
    }
}

void ledOnEverest() {
    for (int i = NUM_LEDS; i >= 0; i--) {
        Everest.setBrightness(255);
        Everest.setPixelColor(i, carpetRight);
        Everest.show();
    }
}

```

```

}

void ledOnTerrano() {
    for (int i = NUM_LEDS; i >= 0; i--) {
        Terrano.setBrightness(255);
        Terrano.setPixelColor(i, carpetRight);
        Terrano.show();
    }
}

void ledOnVulcano() {
    for (int i = 0; i < NUM_LEDS; i++) {
        Vulcano.setBrightness(255);
        Vulcano.setPixelColor(i, carpetRight);
        Vulcano.show();
    }
}

void ledOnBakje() {
    for (int i = 0; i < 18; i++) {
        Bakje.setBrightness(100);
        Bakje.setPixelColor(i, carpetRight);
        Bakje.show();
    }
    delay (500);
    for (int i = 0; i < 18; i++) {
        Bakje.setBrightness(0);
        Bakje.setPixelColor(i, carpetRight);
        Bakje.show();
    }
    delay (500);
    for (int i = 0; i < 18; i++) {
        Bakje.setBrightness(100);
        Bakje.setPixelColor(i, carpetRight);
        Bakje.show();
    }
}

void turnLedOff() {
    for (int i = 0; i < NUM_LEDS; i++) {
        Supernature.setPixelColor(i, off);
        Supernature.show();
    }
    for (int i = 0; i < NUM_LEDS; i++) {
        Canyon.setPixelColor(i, off);
        Canyon.show();
    }
    for (int i = NUM_LEDS; i >= 0; i--) {
        Ferrara.setPixelColor(i, off);
        Ferrara.show();
    }
    for (int i = NUM_LEDS; i >= 0; i--) {
        Ravenna.setPixelColor(i, off);
        Ravenna.show();
    }
    for (int i = 0; i < NUM_LEDS; i++) {
        Atomic.setPixelColor(i, off);
        Atomic.show();
    }
    for (int i = NUM_LEDS; i >= 0; i--) {

```

```

    Everest.setPixelColor(i, off);
    Everest.show();
}
for (int i = NUM_LEDS; i >= 0; i--) {
    Terrano.setPixelColor(i, off);
    Terrano.show();
}
for (int i = 0; i < NUM_LEDS; i++) {
    Vulcano.setPixelColor(i, off);
    Vulcano.show();
}
for (int i = 0; i < 18; i++) {
    Bakje.setPixelColor(i, off);
    Bakje.show();
}
}

void ledDay() {
    for (int i = 0; i < 6; i++) {
        int brightness = 130;
        Bakje.setPixelColor(i, (brightness * 244 / 255) , (brightness * 233 / 255), (brightness * 155 / 255));
    }
    for (int i = 6; i < 12; i++) {
        int brightness = 70;
        Bakje.setPixelColor(i, (brightness * 244 / 255) , (brightness * 233 / 255), (brightness * 155 / 255));
    }
    for (int i = 12; i < 18; i++) {
        int brightness = 20;
        Bakje.setPixelColor(i, (brightness * 244 / 255) , (brightness * 233 / 255), (brightness * 155 / 255));
    }
    Bakje.show();
}

void ledEvening() {
    for (int i = 0; i < 6; i++) {
        int brightness = 50;
        Bakje.setPixelColor(i, (brightness * 244 / 255) , (brightness * 233 / 255), (brightness * 155 / 255));
    }
    for (int i = 6; i < 9; i++) {
        int brightness = 155;
        Bakje.setPixelColor(i, (brightness * 253 / 255) , (brightness * 184 / 255), (brightness * 19 / 255));
    }
    for (int i = 10; i < 11; i++) {
        int brightness = 100;
        Bakje.setPixelColor(i, (brightness * 253 / 255) , (brightness * 184 / 255), (brightness * 19 / 255));
    }
    Bakje.show();
}

void ledNight() {
    ///define orangeLamp 175, 87, 51
    for (int i = 0; i < 3; i++) {
        int brightness = 100;
        Bakje.setPixelColor(i, (brightness * 255 / 255) , (brightness * 165 / 255), (brightness * 0 / 255));
    }
    for (int i = 7; i < 10; i++) {
        int brightness = 100;
        Bakje.setPixelColor(i, (brightness * 255 / 255) , (brightness * 165 / 255), (brightness * 0 / 255));
    }
    for (int i = 11; i < 12; i++) {

```

```

    int brightness = 100;
    Bakje.setPixelColor(i, (brightness * 255 / 255) , (brightness * 165 / 255), (brightness * 0 / 255));
}
Bakje.show();
}

void ledCustom() {
    for (int i = 0; i < 18; i++) {
        Bakje.setBrightness(120);
        Bakje.setPixelColor(i, r, g, b);
    }
    Bakje.show();
}

void ledStartUp() {
    unsigned long startUpColor = 0x45ACA9;
    for (int i = NUM_LEDS; i >= 0; i--) {
        Ferrara.begin();
        Ferrara.setPixelColor(i, startUpColor);
        delay(50);
        Ferrara.show();
    }
    for (int i = NUM_LEDS; i >= 0; i--) {
        Ravenna.begin();
        Ravenna.setPixelColor(i, startUpColor);
        delay(50);
        Ravenna.show();
    }
    for (int i = 0; i < NUM_LEDS; i++) {
        Atomic.begin();
        Atomic.setPixelColor(i, startUpColor);
        delay(50);
        Atomic.show();
    }
    for (int i = 0; i < NUM_LEDS; i++) {
        Vulcano.begin();
        Vulcano.setPixelColor(i, startUpColor);
        delay(50);
        Vulcano.show();
    }
    for (int i = NUM_LEDS; i >= 0; i--) {
        Everest.begin();
        Everest.setPixelColor(i, startUpColor);
        delay(50);
        Everest.show();
    }
    for (int i = NUM_LEDS; i >= 0; i--) {
        Terrano.begin();
        Terrano.setPixelColor(i, startUpColor);
        delay(50);
        Terrano.show();
    }
    for (int i = 0; i < NUM_LEDS; i++) {
        Supernature.begin();
        Supernature.setPixelColor(i, startUpColor);
        delay(50);
        Supernature.show();
    }
    for (int i = 0; i < NUM_LEDS; i++) {
        Canyon.begin();

```

```
Canyon.setPixelColor(i, startUpColor);
delay(50);
Canyon.show();
}
for (int i = 0; i < 18; i++) {
  Bakje.begin();
  Bakje.setPixelColor(i, startUpColor);
  delay(50);
  Bakje.show();
}
}
```



# Appendix F

## Acceptance validation testing

To test how the phygital installation is perceived, the participants are asked to fulfil three tasks and answer questions about the prototype. The prototype is tested on its usefulness with the acceptance scale and on its usability with the SUS. In addition to those two standardised scales participants are asked about the how well the design opportunities are implemented.

### F.1 Procedure

#### 1. Welcoming

The participants were welcomed and thanked for their participation. They were firstly informed about the research topic and objectives of the testing. After a small explanation of what was expected from the participant during the user testing a consent form was signed if they agreed with the terms and conditions. The participants were assured that they can quit at any point during the user testing when feeling uncomfortable.

#### 2. Warm-up

To get background information from the participants, demographic questions were asked. To get the participants warmed up the phygital installation was revealed and some general questions were asked about it.

#### 3. Testing

The participants were introduced to the scenario where they enter a flooring specialty store and see this kiosk. They are asked to perform three tasks with the phygital installation. The researcher will perform observations during the performances on the performance of the participants. The participants were assured that they can't

perform any wrong actions. They are informed that this is a prototype and not a fully functioning end product.

#### 4. Closing

To finish the testing some questions were asked to create a more holistic view on the installation. After a last thoughts and feedback round, the participants were thanked for their participation with a small incentive in the form of a cookie.

## F.2 Tasks and questions

### Demographic and introduction questions

1. What is your age?
2. How would you identify yourself?
3. In what stage are you of buying a floor? /  
When was the last time that you bought a floor?
4. What is your first impression of the flooring kiosk?
5. What do you think it would do?

### Task 1 - Flooring decision aid

Imagine walking into the store and all employees are busy helping other customers. You walk through the store and see this kiosk hanging on a wall.

1. Would you imagine yourself trying it out when walking into a flooring store?

You decide to use it, with the goal of finding a new floor for in your bedroom since you want to restyle this room. **Let the user perform the decision aid mode!**

1. To what extend does the flooring decision aid help you with style orientation?
2. In what way does this function help you in the choice process?
3. To what extend does this function help create a clearer price structure?

### Task 2 - Room visualizer

After having selected a preferred flooring from the decision aid you are curious how this floor will look like in your apartment. Unfortunately you don't have a picture of your own

room so you use a mock-up room instead. **Let the user perform the room visualizer mode!** *Help* Try what floor matches your room the best and play with the different lighting options to see how the floor behaves.

1. In what way does this help you envision a floor in your room?
2. To what extent does this help you envision different lighting conditions?

### **Task 3 - Find product information**

Now that you know what floor is best matching your room you want to know more product information. Select a floor and check the usage specifications. **Let the user perform the decision aid mode!** *Help* Try to adjust the prices of the flooring by adding your total square meters of your room.

1. To what extent does this help you match floors by giving better product information?
2. In what way does this help you compare the flooring prices?

### **Closing interview questions customers**

1. What was your overall impression of the flooring kiosk?
2. To what extent do you see an added benefit of implementing this in flooring stores?
3. How would you improve the prototype?
4. Do you have any feedback or remarks about the prototype or study?

### **Closing interview questions store employees**

1. What was your overall impression of the flooring kiosk?
2. To what extent do you see an added benefit of implementing this in flooring stores?
3. Do you expect that customers would use this?
4. Do you expect this could help employees in their job?
5. How would you improve the prototype?
6. Do you have any feedback or remarks about the prototype or study?

### Acceptance scale

Please tick a box on every line to state what you think of the system:

- |                      |  |                |
|----------------------|--|----------------|
| 1. Useful            | <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | Useless        |
| 2. Pleasant          | <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | Unpleasant     |
| 3. Bad               | <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | Good           |
| 4. Nice              | <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | Annoying       |
| 5. Effective         | <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | Superfluous    |
| 6. Irritating        | <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | Likeable       |
| 7. Assisting         | <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | Worthless      |
| 8. Undesirable       | <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | Desirable      |
| 9. Raising alertness | <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | Sleep-inducing |

### System usability scale

Please tick a box on every line to state what you think of the system:

|   | Strongly disagree | Disagree | Neutral | Agree | Strongly agree |
|---|-------------------|----------|---------|-------|----------------|
| 1. I think that I would like to use this system frequently.                                   |                   |          |         |       |                |
| 2. I found the system unnecessarily complex.  |                   |          |         |       |                |
| 3. I thought the system was easy to use.  |                   |          |         |       |                |
| 4. I think that I would need the support of a technical person to be able to use this system. |                   |          |         |       |                |
| 5. I found the various functions in this system were well integrated.                         |                   |          |         |       |                |
| 6. I thought there was too much inconsistency in this system.                                 |                   |          |         |       |                |
| 7. I would imagine that most people would learn to use this system very quickly.              |                   |          |         |       |                |
| 8. I found the system very cumbersome to use.   |                   |          |         |       |                |
| 9. I felt very confident using the system.  |                   |          |         |       |                |
| 10. I needed to learn a lot of things before I could get going with this system.              |                   |          |         |       |                |

### F.3 Consent form

## CONSENT FORM

Enhancing the shopping experience with phygital design in specialty stores

I, \_\_\_\_\_, declare to voluntarily participate in this interview about flooring specialty stores by Tjebbe Treub of the University of Twente and the University of Trento.

- I confirm that my participation is voluntary.
- I understand that I need to perform three tasks on the Flooring kiosk and answer some questions about this process.
- I understand that I've got the right to decline to answer any question or I can stop the study at any time.
- I agree that this interview will be audio recorded and a transcript can be produced.
- I understand that only the researcher will have access to the recordings and these will be completely deleted when transcribed or at the end of the research.
- I understand that my name or any other identifying information will not be linked to the audio recording or transcript.
- I understand that the interviewer can include data and insights in an anonymised form in his study and that this can contribute to the development of a phygital installation for flooring specialty stores.
- I declare that I understand the research and its goals and all my potential questions are answered completely.

Date: \_\_\_\_\_

Place: \_\_\_\_\_

Signature Interviewee: \_\_\_\_\_



Signature Interviewer: \_\_\_\_\_

## F.4 Results

### Acceptance scale (Range: -2 to 2)

| Participant number | Q1   | Q2 | Q3 | Q4   | Q5 | Q6   | Q7    | Q8 | Q9   | Usefulness | Satisfaction |
|--------------------|------|----|----|------|----|------|-------|----|------|------------|--------------|
| 1                  | 2    | 2  | -1 | 1    | 2  | -2   | 2     | -1 | 2    | 1.8        | 1.5          |
| 2                  | 1    | 2  | -1 | 2    | 1  | -2   | 2     | -1 | 1    | 1.2        | 1.75         |
| 3                  | 0    | 2  | -1 | 1    | 1  | -1   | 2     | -1 | 2    | 1.2        | 1.25         |
| 4                  | 2    | 2  | -2 | 2    | 2  | -2   | 2     | -2 | 1    | 1.8        | 2            |
| 5                  | 1    | 1  | -1 | 2    | 1  | -1   | 1     | -2 | 0    | 0.8        | 1.5          |
| 6                  | 1    | 1  | -1 | 1    | 1  | -1   | 1     | -1 | 1    | 1          | 1            |
| 7                  | 2    | 2  | -2 | 2    | 2  | -2   | 2     | -2 | 2    | 2          | 2            |
| Average:           | 5.88 | 6  | 5  | 5.88 | 6  | 6.63 | 6.125 | 8  | 5.88 | 6.13       | 5.988        |

### System usability scale (Range: 1 to 5)

| Participant number | Q1   | Q2 | Q3 | Q4   | Q5 | Q6   | Q7    | Q8 | Q9   | Q10  | SUS score |
|--------------------|------|----|----|------|----|------|-------|----|------|------|-----------|
| 1                  | 4    | 1  | 4  | 1    | 4  | 1    | 4     | 1  | 4    | 1    | 87.5      |
| 2                  | 4    | 2  | 4  | 1    | 5  | 2    | 5     | 2  | 4    | 2    | 82.5      |
| 3                  | 5    | 1  | 4  | 3    | 3  | 1    | 4     | 2  | 4    | 3    | 75.0      |
| 4                  | 5    | 2  | 4  | 2    | 4  | 1    | 4     | 2  | 4    | 2    | 80.0      |
| 5                  | 4    | 2  | 4  | 2    | 4  | 2    | 4     | 2  | 4    | 2    | 75.0      |
| 6                  | 1    | 2  | 5  | 2    | 3  | 2    | 3     | 2  | 3    | 2    | 62.5      |
| 7                  | 5    | 1  | 5  | 1    | 5  | 2    | 5     | 1  | 5    | 1    | 97.5      |
| Average:           | 5.88 | 6  | 5  | 5.88 | 6  | 6.63 | 6.125 | 8  | 5.88 | 6.13 | 5.988     |

### Interview results

| Questions   | Answers   | Improvements |
|---|---|--------------|
| Demographic<br>What is your age?                      | <div data-bbox="891 544 987 643">53</div> <div data-bbox="1003 544 1099 643">25</div> <div data-bbox="1122 544 1218 643">26</div> <div data-bbox="1240 544 1337 643">55</div> <div data-bbox="1359 544 1456 643">22</div> <div data-bbox="1478 544 1574 643">68</div> <div data-bbox="891 663 987 762">50</div> <div data-bbox="1003 663 1099 762">59</div> <div data-bbox="1122 663 1218 762">60</div> |              |
| How long are you active in the flooring industry      | <div data-bbox="891 807 987 906">55 years</div> <div data-bbox="1003 807 1099 906">8 years</div> <div data-bbox="1122 807 1218 906">6 months</div> <div data-bbox="1240 807 1337 906">48 years</div>  |              |
| How do you identify yourself?                         | <div data-bbox="891 951 987 1050">Man</div> <div data-bbox="1003 951 1099 1050">Woman</div> <div data-bbox="1122 951 1218 1050">With a passport</div> <div data-bbox="1240 951 1337 1050">He/him</div> <div data-bbox="1359 951 1456 1050">World citizen</div>  |              |
| How long ago was it that you looked for new flooring? | <div data-bbox="891 1078 987 1177">Currently in the process</div> <div data-bbox="1003 1078 1099 1177">Half a year ago</div> <div data-bbox="1122 1078 1218 1177">5 Months ago</div> <div data-bbox="1240 1078 1337 1177">1.5 years ago</div> <div data-bbox="1359 1078 1456 1177">Almost two years</div>   |              |



|                            |   |   |   |  |  |  |  |
|----------------------------|---|---|---|--|--|--|--|
| <p><b>Introduction</b></p> | <p>What is your first impression of the flooring kiosk?</p>                         | <p>Nice, looks like a paint wall in the Gamma<br/><small>1</small></p>  | <p>I expect this to be in a store to help me<br/><small>1</small></p>                                     | <p>Curious looking<br/><small>1</small></p>  | <p>Impressive<br/><small>1 2</small></p>   | <p>Not finished (prototype)<br/><small>1</small></p> | <p>Inventive<br/><small>11</small></p> |
|                            | <p>What do you think the kiosk will do?</p>   | <p>My expectation is that it will help me select one of the floors displayed here<br/><small>1</small></p>  | <p>It says it will help me, so think it will help me decide on flooring.<br/><small>2</small></p>         | <p>I expect to find flooring that is present within the store and it will help me<br/><small>1 2</small></p> | <p>That you can choose and test different floor types<br/><small>1</small></p>                     |  |  |
|                            | <p>Would you imagine yourself trying it out when walking into a flooring store?</p> | <p>It would depend on how it is advertised, but I would believe it could help to let me ask more specific questions to a store employee. But I would always like to have personal contact.<br/><small>1</small></p> | <p>I would like to try it out especially when I'm still in the orientation phase<br/><small>1</small></p> | <p>I would try it out for sure unless a store employee would directly approach me<br/><small>1</small></p>   | <p>I don't know, but there probably will be customers that want to use it<br/><small>1</small></p> |  |  |
|                            |   | <p>Yeah I think customers would like to use it<br/><small>7</small></p>   |   |  |  |  |  |

|  |  |  |  |   |   |
|--|--|--|--|---|---|
| <p><b>Task 1</b></p> <p>To what extent does the flooring decision aid help you with style orientation?</p> | <p>It's okay, it can help me kill time in the store</p> <p>I believe it can help me, it can show me how the floor matches with other elements in a room</p> <p>Yeah if people didn't look into this beforehand, then this is a really good tool</p>                            | <p>It works for sure, maybe it could be improved by better naming the styles.</p> <p>Looks very nice</p> <p>Could work the other way around</p>  | <p>For the moodboard an extra feature could be added for finding images on pinterest for example</p> <p>Will help absolutely, you can get a nice impression</p> <p>That's okay</p>   | <p>It reduces my choice-related stress and sharpens my frame of reference. This way I can finetune it.</p> <p>Yeah quite sure it would work, but the number of styles need to be expanded on</p> <p>Yes added value</p>   | <p>an extra feature could be added for finding images on pinterest for example</p> <p>Expand the number of styles</p> |
| <p>In what way does this function help you in the choice process?</p>                                      | <p>It can help for sure</p> <p>Works, especially when there is a big product range, it can show the most usefull ones. Make it more managable</p> <p>I think that it is usefull for a lot of other sales person, but not for me</p>  | <p>It will help for getting started with a first selection. To have a final selection you will need to go into more details.</p> <p>Very positive, great, it can help people for sure</p> <p>Yes looking good</p>                                      | <p>It can help people for sure, for me as I knew what I wanted I would like to have a quicker filter function.</p> <p>I think it can work, but employees would still be needed to give the finer details</p>   | <p>Gigantic, it takes away my ignorance, normally I would just look for a colour and profile</p> <p>Yes works, I'm impressed</p>  | <p>The progress bar is more natural to be in the top of the screen</p> <p>Print the results of the choice aid.</p>    |
| <p>To what extent does this function help create a clearer price structure?</p>                            | <p>Good it helps me give an indication of what I will spend. Would also be nice to still have a price per square meter next to the total price.</p> <p>Very nice for someone who can't calculate very well and thus don't have to do it themselves.</p> <p>That looks good</p> | <p>It's really usefull. Maybe add a bit more details for example with the 10% extra flooring is that also calculated in price later on</p> <p>It can really help with the use of the flow to first ask the budget of people</p> <p>Yeah that works</p> | <p>Helps for sure with the overview of all the products</p> <p>Should really pay attention that kiosk doesn't indicate a incorrect price to prevent misinformation from employees</p> <p>The total price instead of price per square meter is good to have immediately</p> | <p>Instead of just getting a square meter price you now get a total price which is clear from the start and can't surprise you. So if the price is what you get that's very nice</p> <p>For customers with a budget for sure, nice!</p> <p>Not really usefull</p> | <p>Would also be nice to have a price per square meter next to the total price.</p>                                   |

| Task 2   |   |  |
|--|---|--|
| <p>In what way does this help you envision a floor in your room?</p>             | <div data-bbox="857 470 1030 566"> <p>Very good, would be a great addition</p> </div> <div data-bbox="1048 470 1220 566"> <p>It's okay but personally not the biggest fan. Depends on the way it's executed.</p> </div> <div data-bbox="1238 470 1411 566"> <p>It's missing details on the small samples such as the floor veins.</p> </div> <div data-bbox="1429 470 1601 566"> <p>I keep disliking the fact that it looks photoshopped.</p> </div> <div data-bbox="857 579 1030 675"> <p>Works well, curious how it will look with own rooms</p> </div> <div data-bbox="1048 579 1220 675"> <p>Gigantic function, the online visualisation will always look a bit different but it will still give you a lot of extra help</p> </div> <div data-bbox="1238 579 1411 675"> <p>I think it can work, but of course it works it best to see it at home</p> </div> <div data-bbox="1429 579 1601 675"> <p>Neat, looking good</p> </div> <div data-bbox="857 687 1030 778"> <p>That's very nice. I'm enthusiastic. Yeah that will help a lot of customers for sure</p> </div> <div data-bbox="1048 687 1220 778"> <p>Great, if it's the same looks of the floor</p> </div> <div data-bbox="1238 687 1411 778"> <p>An added value for sure, especially when the customers brings their own room pictures</p> </div> <div data-bbox="1429 687 1601 778"> <p>Don't really see the added value</p> </div> | <div data-bbox="1653 470 1825 566"> <p>Bit bigger screen and a logo on top</p> </div> <div data-bbox="1653 579 1825 675"> <p>Be able to change colours of the walls in the room visualizer</p> </div>  |
| <p>To what extent does this help you envision different lighting conditions?</p> | <div data-bbox="857 815 1030 911"> <p>Also helps a lot. Putting it to a degree, very high level</p> </div> <div data-bbox="1048 815 1220 911"> <p>Don't really see the use of the custom lights.</p> </div> <div data-bbox="1238 815 1411 911"> <p>Works for sure, but would still take a sample home to see it in real-life</p> </div> <div data-bbox="1429 815 1601 911"> <p>Very nice extra addition to the experience.</p> </div> <div data-bbox="857 930 1030 1026"> <p>Works well, especially for the RGB lights so you won't be surprised at home.</p> </div> <div data-bbox="1048 930 1220 1026"> <p>People find it enjoyable to play with this all</p> </div> <div data-bbox="1238 930 1411 1026"> <p>Yeah seeing it with different kinds of lighting will give you more of a feeling on how it will look like</p> </div> <div data-bbox="1429 930 1601 1026"> <p>The different lighting modes are a nice addition</p> </div> <div data-bbox="857 1038 1030 1123"> <p>Yeah very important function</p> </div> <div data-bbox="1048 1038 1220 1123"> <p>No also not really here</p> </div> <div data-bbox="1238 1038 1411 1123"> <p>Amazing, genius invention</p> </div>  | <div data-bbox="1653 815 1825 911"> <p>Super promising the lighting but maybe on a bit bigger scale</p> </div> <div data-bbox="1653 930 1825 1026"> <p>Would be nice to cover it more so there is less influence from the room light</p> </div> <div data-bbox="1653 1038 1825 1123"> <p>Add the seasons to this function as well</p> </div> <div data-bbox="1832 1038 2004 1123"> <p>What direction is the window facing</p> </div> |

| Task 3  |   |
|---|---|
| <p>To what extent does this help you match floors by giving better product information?</p> | <p>Yeah it's nice, I really found it powerfool that it shows where I could find the products in the store.</p> <p>Works good but could add the filter of thickness.</p> <p>Works for sure, but would still take a sample home to see it in real-life</p> <p>Very nice function of finding the product in the store but hard in realisation</p> <p>Yeah of course, clear but not too much information so yeah works</p> <p>I believe that worked quite well, so you can compare the information easily.</p> <p>For people that don't know anything it can really help for informing and visualising</p> <p>Always, beautiful way of quick filtering for people that have a certain wishes.</p> <p>Yeah nice, also the pictures from people their homes to compare home situations</p> <p>A bit less added value than the others but still good</p> <p>Yeah I do like this, this has added value</p> <p>Yes, I think you created it very well</p> |
| <p>In what way does this help you compare the flooring prices?</p>                          | <p>Find it difficult to say, it's good to see a total price and know what you'll have to spend. But would like to be able to compare them. But an added value for sure.</p> <p>Super nice to see the total price</p> <p>Very nice to have the price function for a quick filtering</p> <p>You can quickly see which are more expensive and the specifics so easy to compare</p> <p>Yeah people always want to know what it's gonna cost, so would be usefull.</p> <p>Yes, ideal</p> <p>For sure, that's something that customers want to know</p> <p>Yes a bit of added value, but you get influenced on the price already over the looks while it's normally the other way around</p> <p>Yes as well</p> <p>Yes added value</p>  |
|   | <p>Have a compare option</p> <p>Have a pop up in the details page to state that you can have a room visualize</p> <p>Have a light on the products to showcase where they are</p> <p>Better wording for applying surface pricing</p>   |

| <p><b>Closing</b></p> <p>What was your overall impression of the flooring kiosk?</p> <td data-bbox="994 247 1218 371"> <p>If it would work fully, good!</p> </td> <td data-bbox="1245 247 1469 371"> <p>Really nice!</p> </td> <td data-bbox="1496 247 1720 371"> <p>Nice</p> </td> <td data-bbox="1747 247 1971 371"> <p>Would love to see it in a store, awesome!</p> </td> | <p>If it would work fully, good!</p>   | <p>Really nice!</p>  | <p>Nice</p>   | <p>Would love to see it in a store, awesome!</p>  |
|---|--|--|---|---|
| <p>To what extent do you see an added benefit of implementing this in flooring stores?</p>  | <p>Even though it's still a prototype it gives a real nice impression of how it can work.</p>  | <p>Neat, nice, beautiful</p>   | <p>Really positive!</p>   | <p>Yeah cool! It's going towards something of this century. I think that it would work well</p> |
| <p>How would you improve the prototype?</p>   | <p>Yeah I'm very impressed</p>   | <p>Looks user friendly</p>   | <p>More than okay</p>   |   |
|   | <p>I can really see it have an added benefit for the ease of waiting times. Also for the store employees this can be a good starter of a conversation with the customer.</p> | <p>Could really help people with starting their journey.</p>   | <p>Makes it more interactive and let's people think more</p>                  | <p>It removes an extra step in the process, so that's good</p>                                  |
|   | <p>It works well for people who are overwhelmed getting into the store and this will help with a personalised route, will become easier because of this</p>                  | <p>I don't know, it will never be a bad thing and will always help a bit</p>                               | <p>Very high, especially for the customer</p>                                 | <p>I see an added benefit but they would still need employees for sure</p>                      |
|   | <p>I think when sales people are not quick with helping this will extend the process as they will want to try out more</p>   | <p>Start or continue the choid aid flow on phone if people are waiting for you</p>                         | <p>Add an button to get support from a store employee</p>                     | <p>How many can you fit in a store?</p>   |
|   | <p>Sometimes the text was a bit small or the context not high which results in a not optimal readability</p>   | <p>Make sure it states clearly that it's an indication of price and not create an issue with employees</p> | <p>Add an pin and printer so you can collect your floor from the magazine</p> | <p>Spraypaint the prototype</p>   |
|   | <p>Extra information with certain flooring on the way of laying, if it needs to dry for example</p>  |  |   |   |