DROP

A NON-INTRUSIVE SENSOR-BASED PRODUCT THAT OPTIMISES WORK EXPERIENCE

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DO NOT DROP YOUR WORK STANDARDS AND START REALISING AN OPTIMAL WORK ENVIRONMENT TOGETHER

Founder of DROP

PREFACE

Before you lies my graduation project "A non-intrusive sensor-based product that optimises work experience." It has been written as the cherry on the cake, in which the cake represents my master Design for Interaction at the TU Delft. By handing in this final project a memorable phase of my life comes to an end. The last two years have been characterised by challenging yet exciting projects. Although a significant part of my master was spent at home behind the screen due to the inevitable Corona pandemic, I had the honour to meet some lovely fellow students. With these fellow students I was able to set some amazing results, in which I often accidently lost track of time due to my enthusiasm for its potential.

Besides the people I have met through the master Design for Interaction, the master has resulted in a better understanding of myself as a designer. A designer that loves to meet actual users and future stakeholders in order to improve current designs or contribute to the conceptualisation phase of a new product. In creating these (re)designs I strive to be unique, since I cannot handle the fact that I would come up with something identical as someone else. This graduation project once more offered me the chance to make a difference and to continue to develop myself as a user-centred designer.

To my research team, thank you Sjoerd en Ianus for inspiring my thoughts and guiding me through rough times in the project. I appreciate that we were able to have a laugh while seriously discussing my progress in our meetings in a serious way. Thank you Sjoerd for your relaxed way of communication and the way you ask the correct questions that spark thoughts and allow me to progress. Unfortunately, we were not able to have one of our meetings in the countryside of France. Thank you Ianus for being a walking encyclopedia of design projects which offered me the opportunity to look at the project from a different perspective.

To my company mentor, thank you Bart for reserving so many hours in your tight schedule. I appreciate that you, including the rest of the design team, have welcomed me with open arms. Our meetings were really productive and not a single minute was lost on unrelated topics. However, we were still able to discuss these unrelated topics through metaphors while watching NEC got beaten by Feyenoord. The games of table football, the 'Tosti'-Thursdays and the many coffees at WARP have definitely contributed in taking my graduation project to the next level.

To my participants, thank you all for getting time off work to help me in generating new and relevant insights for my graduation project. Unfortunately, I was not able to speak with everyone face-to-face due to travelling distances.

To my family, thanks for your enthusiastic reactions to all my graduation stories and the warm words at times when needed the most. I want to thank my sister Milou in particular, since I spent multiple nights at hers to prevent myself from being distracted.

To my girlfriend, thanks Nhan for putting time and effort in transcribing many of the held interviewees. I also liked the cookies, lunches and dinner you made while I was busy studying.

To all the readers, I hope that I can inspire you while reading my report. Enjoy reading!

EXECUTIVE SUMMARY

In the last few years the smart building market has grown exponentially and is estimated to be worth around 100 billion by the year 2025. The amount of active competitors, combined with the required time and effort to launch a new sensor-based product, makes it difficult to enter the market and slows innovation. WeAreReasonablePeople (WARP), a Rotterdam-based digital design agency, is trying to broaden its impact by starting a venture under the name SensorBloxx. This venture is building a universally implementable base to simplify the launch of new sensor-based products. WARP will design the first 'flagship' product build on SensorBloxx to test this universally implementable base and start encouraging other companies.

In order to catch the attention of fellow innovators the product needs to stand out from the competition. A projection of the metaphorical competitive analysis on the Dutch market provides a better understanding of which businesses should be targeted to increase the flagship's viability. Although it initially seemed that the viable audiences were already being targeted, a change of perspective has shown the potential of small-sized businesses in five sectors based in office environments.

Various rounds of qualitative research with stakeholders in the targeted audience indicate the flagship's ability to treat these sectors identically. Desk research brings to light potential motives for business owners to start generating indoor environment data. However, business owners are explicitly devoted to use the data to optimise the work experience of their employees.

A concept is created based on the findings of the explorative qualitative research. This concept is presented to existing and new participants within the target audience. These concept validation sessions provided a better understanding of how the flagship should optimise the employees' work experience. The results of the concept evaluation sparked an iterative digital prototyping process that led to a new concept embodiment. This concept embodiment and its functioning have been once more validated to confirm the flagship's desirability.

A final design arose, a flagship called 'DROP', a non-intrusive sensor-based product that optimises work experience. This flagship involves employees in realising an optimal work environment together. DROP combines a non-intrusive calm display and a supportive mobile interface for employees. DROP can function as a flagship since it genuinely fulfils the needs of a target audience that competitors are barely targeting in the smart building market.

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GLOSSARY

Application programming interface (API)	An interface that enables two or more computer programs to communicate with each other.
Building management system (BMS)	A computer system installed in a building that will communicate with the building's resources.
Corporate social responsibility (CSR)	A business model that guides a company to be socially accountable.
Heating, ventilation and air conditioning (HVAC)	Various technologies to control the temperature, humidity, and purity of the air.
Indoor air quality (IAQ)	The Quality of the air within a building, it relates to the health and comfort of building occupants.
Internet of Things (IoT)	Products that include sensors that connect and exchanges data with other devices.
Industrial design engineering (IDE)	The faculty of the master programme Design for Interaction.
Small to medium sized entreprises (SMEs)	An SME in The Netherlands is primarily a business with two to 249 employees.
SensorBloxx	The name of the venture that will be launched by WARP.
Usability and User eXperience Assessment (UXAD)	An IDE master course in which a digital or physical product is being redesigned in a group.
User Experience (UX)	A focus on having a deep understanding of users' needs, values, abilities and limitations.
Venture	A 'daring' undertaking often part of another company.
WeAreReasonablePeople (WARP)	The company that iniated the graduation project.

CHAPTER 1

INTRODUCTION

This chapter serves as the foundation for the rest of the report. It introduces the client, a Rotterdam-based digital design agency called WeAreReasonablePeople, that wants to enter the ‘smart building’ market. The initial assignment of the graduation project, further elaborated in the project brief, gives a quick perspective on the starting point 20 weeks ago. After which the initial assignment is invalidated and the actual project assignment is described and visualised.

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1.1 | THE CONTEXT

Nowadays, technology has become an integral part of everyday life. On average, people spend 90 per cent of their time within buildings (Arcadis, n.d.). These buildings range from houses , schools, work environments and many others. Since so much of people's time is spent within buildings it is reasonable to see that the rise of technology impacts their perspective towards these buildings. In the last few years this has resulted in an exponential rise of the smart building market. This market has an estimated worth of around 100 billion by the year 2025 (Arcadis, n.d.).

Although the market of smart buildings is reaching enormous heights, there are many perspectives on the definition of a 'smart building'. On the one hand, the definition is defined by the word 'smart', which implies that the building contains 'intelligent' control systems and smart interconnected devices which go beyond the traditional building structure and function (Zhou & Yang, 2018). Other research implies a direct relation between a smart building and systems that realises results such as energy efficiency, user comfort and the monitoring and safety of the building (Venticinque & Amato, 2018). Compared to the perspective of Venticinque & Amato, the final perspective by Arcadis emphasises on fulfilling a particular user group's need for a longer period instead of the urge to tick all the boxes and become a full package as a smart building.

> *"The best intelligent buildings are those that stand the test of time and, rather than succumbing to the latest craze, feature carefully considered technologies that genuinely cater to the needs of occupiers - the residents, employees, visitors or shoppers who come into and use the building every day" - Arcadis*

WeAreReasonablePeople is preparing to enter the smart building market by launching a new proposition based on indoor environment data. This indoor environment data will be measured by a 'carefully considered' variation of six sensors; see figure 1. While WeAreReasonablePeople is busy setting up the hardware side of the proposition, the user's need that the new proposition will cater is not yet defined.

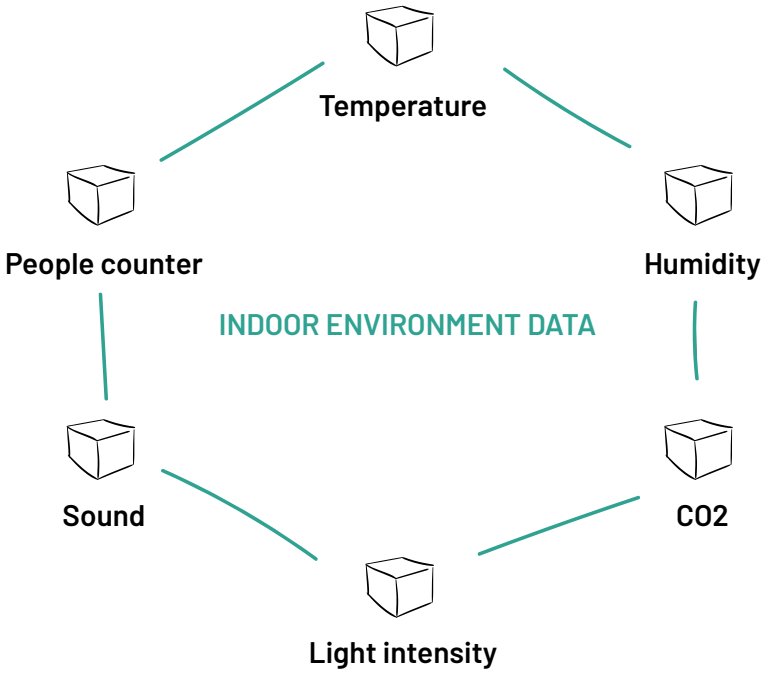


Figure 1 | WARP's selection of six sensors for their new proposition based on indoor environment data.

1.2 | THE COMPANY

WeAreReasonablePeople, shortened as WARP, is a digital design agency based in Rotterdam. The rational and pragmatic view of WARP inspires the company to improve the world around them. WARP's projects can be divided into designs for clients and designs in the name of clients. With the designs for clients, WARP tries to implement digital technology to reshape organisations and communities and enable them to function better (WeAreReasonablePeople, n.d.). The projects in the name of the client are for organisations and communities active in various countries and sectors worldwide. However, these companies primarily build products for business-to-business purposes. Therefore WARP has a higher familiarity with designing for business-to-business than business-to-consumer purposes.

The expertise of WARP's employees can be divided into three overarching categories: UX design, software engineering and data science (see figure 2). The wide range of in-house knowledge indicates that WARP is capable and a perfect fit to design a new sensor-based proposition. This new sensor-based product will be launched by WARP's new venture called SensorBloxx. Its launch aligns with WARP's vision to broaden its impact and diversify its revenue streams.

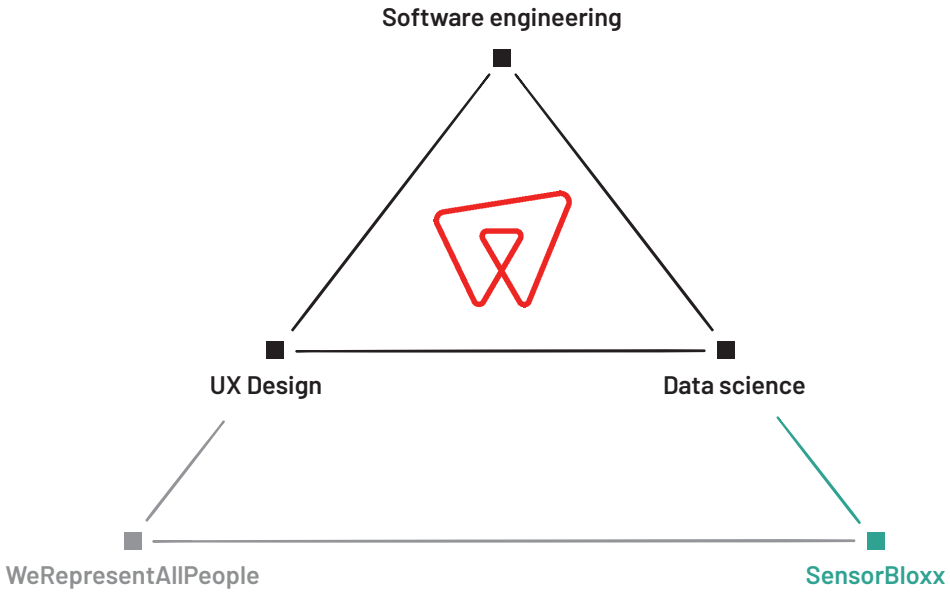


Figure 2 | The in-house knowledge of WeAreReasonablePeople and their ventures.

1.3 | INITIAL PROJECT ASSIGNMENT

The project brief, see appendix A, states that the project arose from the presumption that high-quality data is not accessible to small- to medium-sized enterprises (shortened as SMEs). This inaccessibility of high-quality data originates from the fact that data would be generated by larger product systems exclusively designed for bigger-sized companies. These product systems would limit the SMEs due to privacy regulations, high expenses and low ease of use. The severity of the inaccessibility came to light because SMEs could not access potential indoor climate data to realise a 'safe' work environment during the COVID-19 pandemic. The SensorBloxx proposition should therefore bridge the gap between SMEs and high-quality data by introducing indoor climate data. This indoor climate data would be the starting point for SMEs' digital transformation.

WARP envisioned the Sensorbloxx proposition to consist of three components; a modular set of sensors, an interface and a sharing platform. In this vision, the interface and the sharing platform fulfil the needs of various target audiences, divided into three categories: SME, building and surrounding; see figure 4. The assignment of this graduation project was to design the ideal interface for Sensorbloxx, enabling SMEs to generate and visualise indoor climate data. This interface would be essential for installing the sensors, communicating the data and allowing the data to be shared with the analysis platform. The fundamental design goals were to create a clear distinction between the functionalities of the interface and the sharing platform while becoming relevant for the stakeholders in the scope by fulfilling their needs.

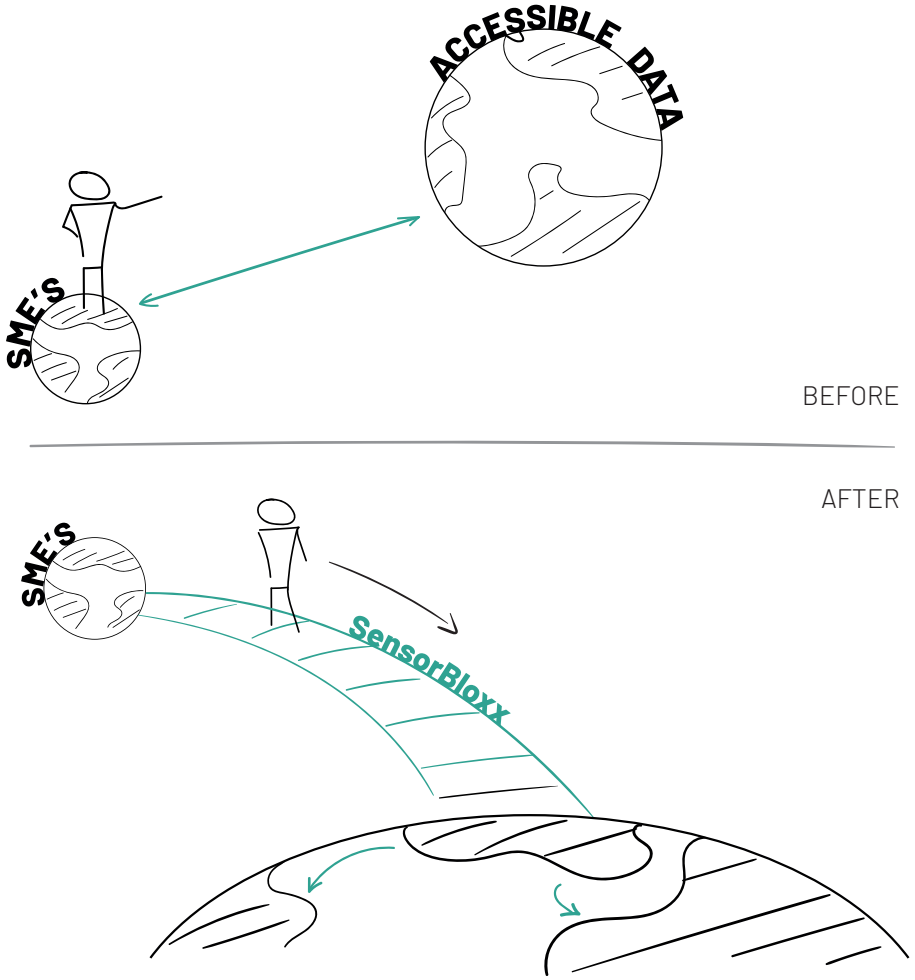


Figure 3 | A representation of the initial context in which high-quality data for is not accessible for SMEs. The world of high-quality data becomes accessible by Sensorbloxx, the starting point for SME's digitital transformation.

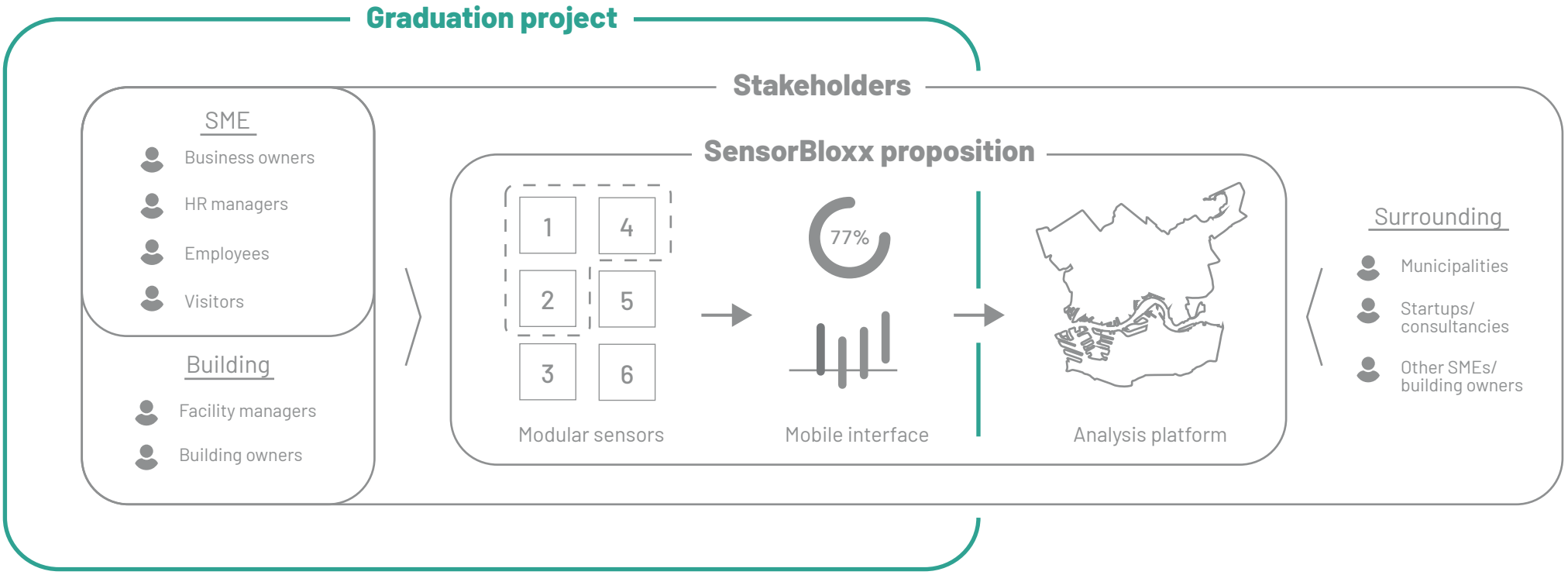


Figure 4 | A representation of the context in which high-quality data for is not accessible for SMEs.

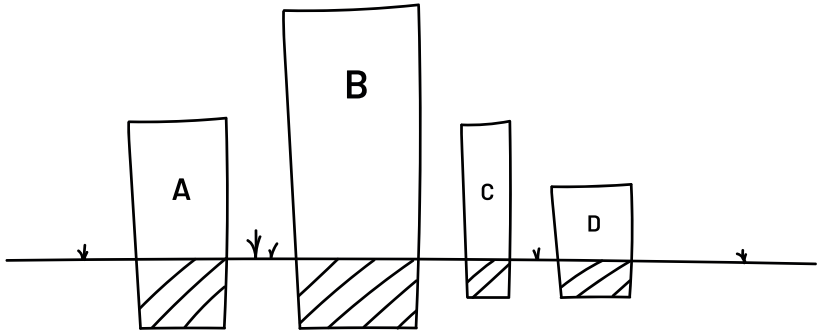
1.4 | PROJECT ASSIGNMENT

In exploring potential values that could be offered by the SensorBloxx proposition, a competitive analysis has been performed to explore which values were already met by other sensor-based propositions. This analysis, see chapter 2.1, shows that indoor environment data is not solely facilitated by bigger product systems but also by smaller ones designed for more specific use cases. Although these small propositions are not exclusively designed for small businesses, the presumption that high-quality data is not accessible for SMEs became invalid. The true origin of the assignment had to be discovered since this inaccessibility would initially be the foundation of the graduation project.

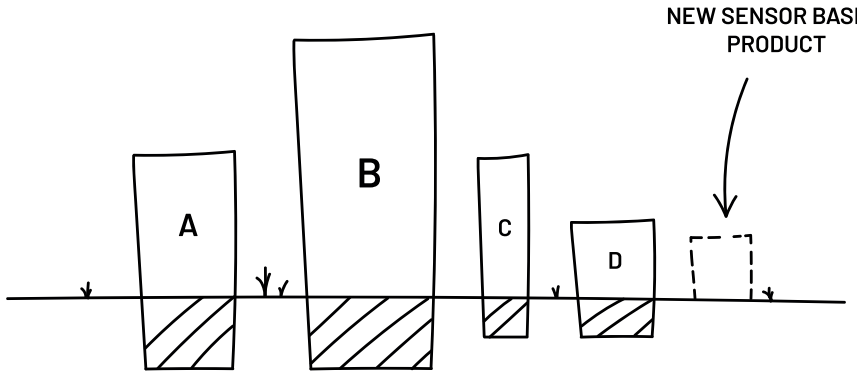
Figure 5 illustrates the motivation for WARP to design a new sensor-based product. Unfortunately, the actual origin of the assignment is less based on a market pull which is led by fulfilling a need or desire of potential stakeholders. The assignment has primarily arisen as a technology push to launch 'a product' which is built on sensors.

The competitive analysis shows that many competitors are active in the smart building market and offer indoor environment data products. These competitors vary in size, target audience, costs and use case. These sensor-based products have in common that they are all created on a base that is specifically designed for their end product. Creating such a base can cost a lot of time and effort since proper sensor suppliers must be found, a matching API must be built, and the hardware must be thoroughly tested. Many of these aspects must be considered before the sensor-based product can even be launched.

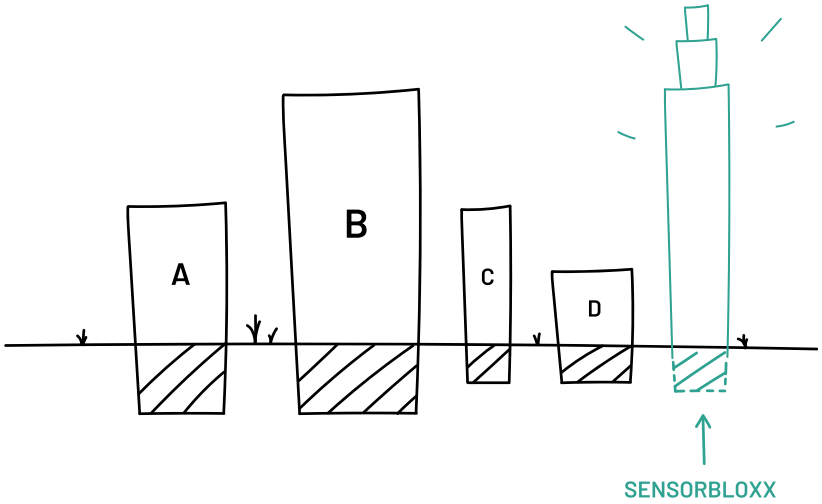
The crowded sensor market and the time and effort to launch a new sensor-based product makes it difficult for other companies to enter the indoor environment data market. WARP wants to decrease these boundaries and stimulate innovation by starting a venture called SensorBloxx. This venture will stop the need to reinvent the wheel by designing a universally implementable sensor base. This universally implementable base consists of a selection of sensors and a matching open API which can be used to simplify the launch of new sensor-based products. WARP will design the first sensor-based product build on Sensorbloxx to enable them to test the Sensorbloxx venture. Additionally, this first sensor-based product will need to function as a flagship to encourage other companies to build a sensor-based product on the universal Sensorbloxx base like WARP did. **Altogether, the true origin of the assignment is to design a 'flagship' for a use case that is feasible, viable and desirable. This product is based on the first set of sensors offered by the Sensorbloxx venture.**



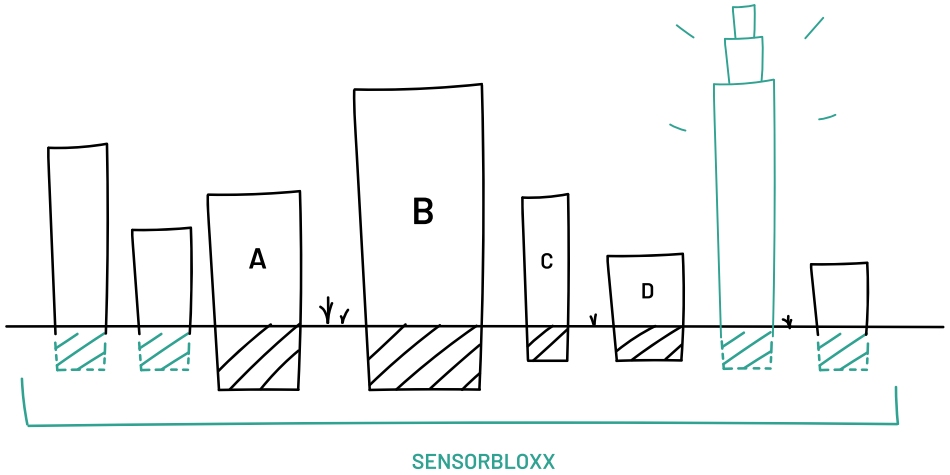
In the current context of the smart building market all the competitors have created their own 'base' on which the product is built.



The combination of a crowded market and the effort to launch a new sensor-based product makes it difficult for companies to enter the market.



WARP will stop the need to reinvent the wheel and designs a universally implementable base called Sensorbloxx.



WARP will design the first sensor-based product build on Sensorbloxx to encourage other companies to start doing the same.

Figure 5 | A comic that visualises the actual context and origin of the graduation project in combination with its goal.

CHAPTER 2

TARGET AUDIENCE

The viability of the ‘flagship’ depends on the degree it catches attention and convinces other companies in the Netherlands to start building a sensor-based product likewise on the Sensorbloxx base. In order to catch the attention of fellow innovators, the product needs to stand out from the competition. In this chapter a metaphorical competitive analysis contributes to a better understanding of the relevancy of the initial project scope. After which, it is used to narrow down the scope by exploring potential target audiences by projecting it on the Dutch market analysis. The viability and feasibility of the sensor-based product are considered by selecting the new potential target audience for the SensorBloxx flagship.

2.1 | METAPHORICAL COMPETITIVE ANALYSIS 20

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2.1 | METAPHORICAL COMPETITIVE ANALYSIS

The exponential growth of the smart building market, as stated in chapter 1.1, has resulted in a market full of varying competitors. Since these competitors have many differences in the following variables: company size, target group, use cases, product library, functionalities and costs, it is difficult to map the competitors. The use of metaphors enables the creation of an overview of the wide range of competitors within the smart building market. The competitors are divided into four categories, named after their related metaphors: home cinema systems, smart TVs, Apple TVs and the Pathés at home. Each of these categories will be further elaborated on in the following paragraphs.

2.1.1 | HOME CINEMA SYSTEMS

> *A home cinema system is a system in which **all the imaginable aspects** are **seamlessly interconnected.** It creates a **complete experience** which combines high-quality audio and video together with the comfort of your own home. These systems can be **fully personalised** to the most detailed level.*

Like home cinema systems, the competitors within this category offer a complete system. These contain sensors, digital interfaces, building management systems (BMSs) and actuated hardware. The systems can be used as a tool to communicate/visualise information as well as actuate their systems. These systems are not universally installable but are fully personalised for their target audiences' use cases. Therefore the use cases can range from public transport stations to hospitals. Due to the extensivity of the products, they come with high prices, therefore only larger organisations can afford them.

An example of a product within the 'home cinema system' category is the one offered by Siemens for the healthcare industry, see figure 6. This healthcare product contains many components; some do not even catch the eye of the end user. Through Siemens' systems each room within the hospital can get in optimal conditions for either work or recovery. One of these subproducts is the patient's ability to personalise the conditions in the room according to their preferences with the Desigo room automation (Siemens, n.d.). Other functionalities such as room lighting adjustment technology, navigation applications and indoor employee positioning systems are a grasp of the possibilities within the system.

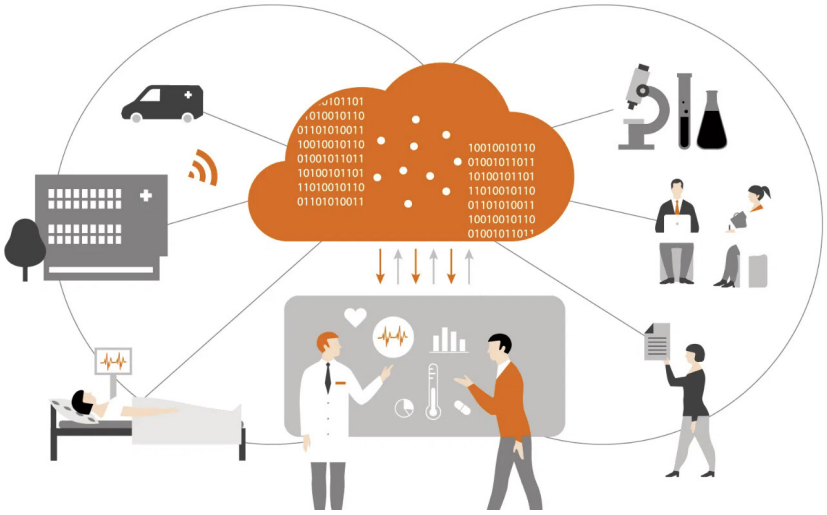


Figure 6 | An overview of Siemens' vision of a smart health care industry (Siemens, 2018).

2.1.2 | SMART TVS

> *A smart TV is a high-end physical product* ***accessible to all target audiences.*** *It can be used for* **many use cases** *due to the countless digital products that can run on its hardware.*

The competitors within this category offer both hardware, mainly in the form of sensors and matching digital interfaces. They are universally installable product combinations that apply to various use cases. Compared with the previous category, this product combination can be solely used to visualise and communicate the generated information by the sensors towards the target audience. This information can be used to increase cost efficiency, space optimisation and environmental monitoring.

Disruptive Technologies is a clear example of a company within the 'Smart TV' category. They offer everyone who would like to get data insights by installing a range of nine different sensors. These sensors are plug-and-play installable and are connected through an included IoT infrastructure. The data generated by the sensors can be seen on a computer dashboard called 'Studio' (Disruptive Technologies, n.d.), see figure 7. This dashboard is personalisable, but mainly used by managers within organisations or facility managers.

Figure 7 | The starterkit of Disruptive Technologies including the computer dashboard 'Studio' (Disruptive Technologies, n.d.).

2.1.3 | APPLE TVS

> *Apple TVs are high-end products that are solely designed for Apple users. Like the previous category, the Apple TV is* ***universally installable*** *in a simple way. It is both a* ***physical and digital product****; however, it is limited to* ***one single use case.***

The companies in this category offer users a physical and digital product combination primarily for one use case. This use case can range from increasing cost efficiency to air quality optimisation. The companies solely focus on visualising and communicating the data. Many companies do collaborate with other companies that supply BMSs.

Kaiterra is an example of a company within the Apple TV category. Kaiterra offers building owners or the management of an organisation the ability to realise a healthy workplace. Data is generated through a product which combines multiple sensors in one, called 'Senseedge mini'. This generated data can be visualised on a physical display and a digital dashboard, see figure 8. Kaiterra collaborates with many BMS suppliers to actuate their systems.

Figure 8 | A product by Kaiterra to generate air quality data that can be visualised on a variety of displays (Smith, 2022).

2.1.4 | PATHE AT HOME

> *Pathé at home is* ***exclusively a digital product****, like any other streaming service. These products often come with* ***low thresholds*** *to quickly increase the number of users.*

The companies in this category offer exclusively smart digital products, without any connection with sensors. These products are designed for specific use cases such as space utilisation and desk management.

An example is Mapiq, a program that decreases the hassles of desk booking, finding rooms and collaborating with remote workers, see figure 9.

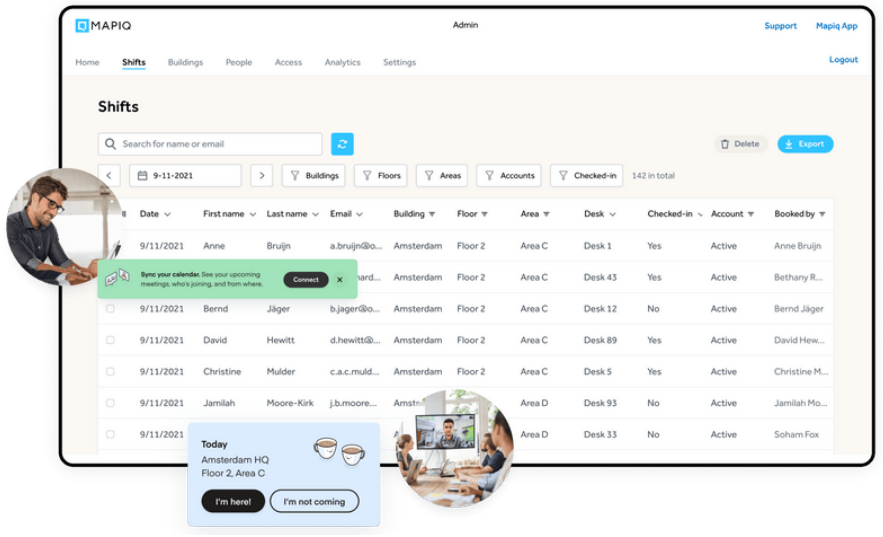


Figure 9 | A digital product by Mapiq to simplify the connected work experience (Mapiq, n.d.).

2.1.5 | SCHEMATIC OVERVIEW OF COMPETITORS

In figure 10, the metaphorical categories are mapped out on two axes: main functionality and the number of use cases. The horizontal functionality axis ranges from products that solely visualise information to products that both visualise and actuate. The vertical use cases axis ranges from products that focus on a specific use case to ones that incorporate all use cases into their product. In this visual the 'Apple TV' and 'Pathé at home' categories both do not distinguish between solely visualising or a combination of visualising and actuating. Therefore these two categories are combined in the visual. Although this overview indicates which companies can become WARP's direct competitors, it does not indicate possible opportunities yet.

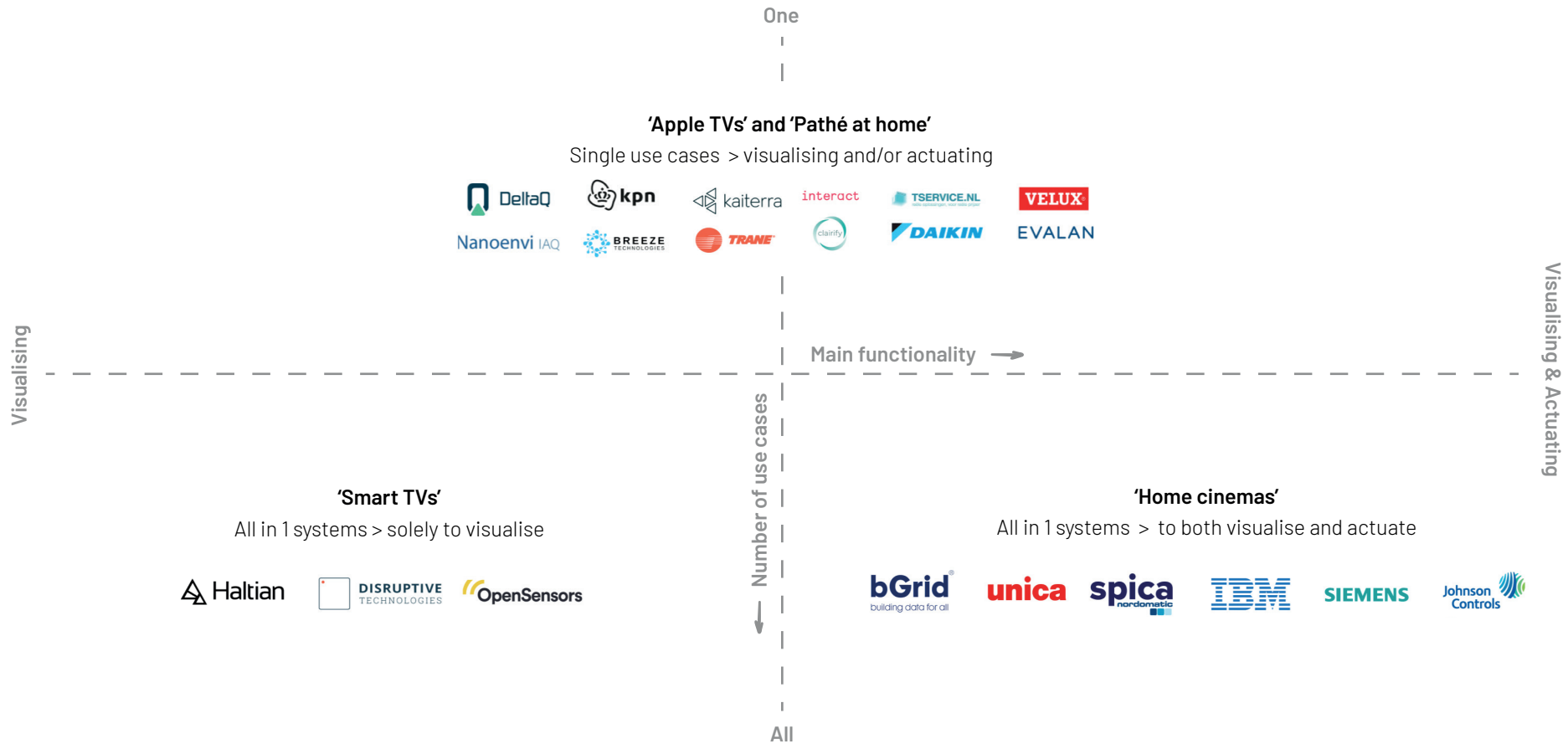


Figure 10 | A schematic overview of the metaphorical categorisation.

2.2 | DUTCH MARKET ANALYSIS

In the schematic overview of competitors, it became clear that there are many potential applications for smart indoor work environment technology. However, no distinct indication of opportunities for WARP's sensor-based flagship was derived to get more clarity on a potential concept direction or target audience. By taking a closer look at the businesses located in the Netherlands, opportunities for WARP's flagship have been found. Ironically, the answers to these questions lay within data itself. This data is visualised as a bubble chart, see figure 11.

Although the hardware components of the Sensorbloxx venture should not play a role in the design process, it does by exploring potential target audiences. All the sectors in the bubble chart could have been labelled as private, semi-private or public sectors. The organisations within the public sector are owned and controlled by the government (Cambridge dictionary, n.d.) and the ones in the private sector do not (Cambridge dictionary, n.d.). Sensor-based products that target organisations within the public sector must match certain strict regulations (N.E.N. norms) set by the government. By the launch of Sensorbloxx these sensors will not directly match their regulations. Therefore the sectors O, P, Q and R will not be considered potential target audiences by considering the flagship's feasibility.

Alphabetical lettering

- A Landbouw, bosbouw en vissery
- B Delfstoffenwinning
- C Industrie
- D Energievoorziening
- E Waterbedrijven en afvalbeheer
- F Bouwnijverheid
- G Handel
- H Vervoer en opslag
- I Horeca
- J Informatie en communicatie
- K Financiële dienstverlening
- L Verhuur en handel van onroerend goed
- M Specialistische zakelijke diensten
- N Verhuur en overige zakelijke diensten
- O Openbaar bestuur en overheidsdiensten
- P Onderwijs
- Q Gezondheids- en welzijnszorg
- R Cultuur, sport en recreatie
- S Overige dienstverlening
- T Huishoudens
- U Extraterritoriale organisaties

Saturation

- ● High percentual growth
- ○ Negative percentual growth
- ▨ Public or semi-public sector

Bubble size

- ⤢ Number of companies x average number of employees per company size

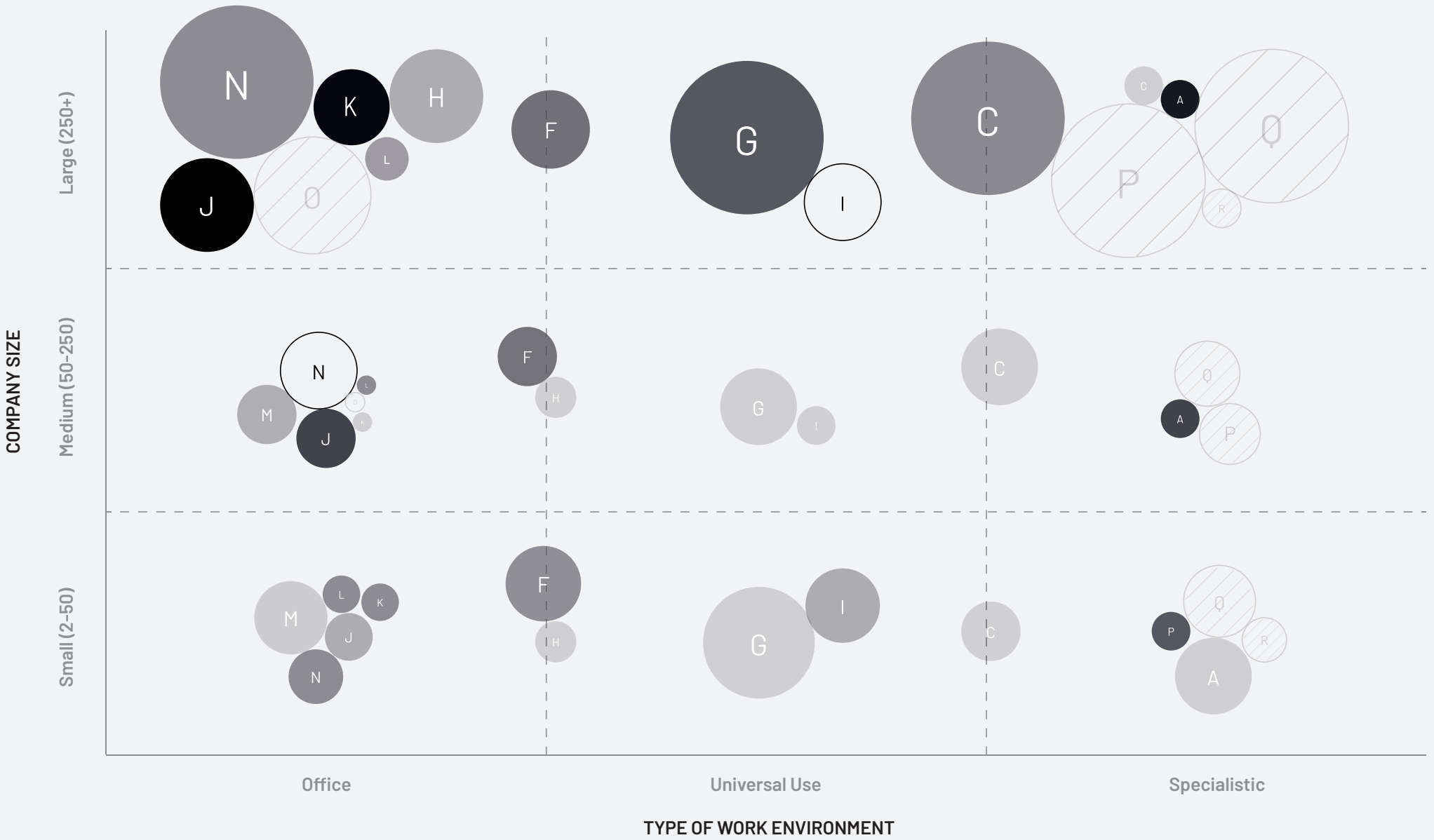
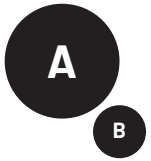


Figure 11 | The bubble chart that represents the Dutch market.

The bubble chart combines multiple datasets in one visualisation through five visual properties: alphabetical lettering, the horizontal and vertical axis, saturation and bubble size. Many other variables could have been included in the visual such as the average work environment surface area, the digitalisation rate or the sick leave rates. However, these were not included due to incomplete datasets on each of the sectors within the Netherlands.



Alphabetical lettering

Each circle within the bubble chart represents a business sector in the Netherlands. According to CBS, the companies within the Netherlands can be divided into 21 sectors (CBS, 2023). The sectors within figure 10 are all labelled with a letter of the alphabet. The sector names behind the letters can be found in the legend. These names are in Dutch since the translation sometimes do not cover the sectors entirely. The sector circles are mapped out on two axes: company size and type of work environment.

Vertical axis

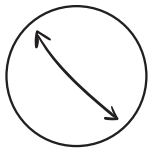
The vertical axis, called company size, is divided into three segments that all present a certain size. Companies in the Netherlands are generally categorised into four sizes, which depend on the number of employees, the annual turnover and the annual balance (RVO Nederland, 2013). However, in this bubble chart, the company size solely depends on the number of employees due to the lack of available datasets that include the annual turnover and balance in combination with the type of sector. Businesses with less than 10 employees are normally labelled as micro, between 10 and 50 as small, between 50 and 250 as medium and above 250 as big. In the bubble chart, the company sizes, micro and small, are combined to simplify and increase the readability of the bubble chart.

Horizontal axis

The horizontal axis, called the type of work environment, is likewise divided into three segments; office, universal and specialistic work environments. The office segment represents all the sectors that primarily work in an office environment. The universal work environment segment represents environments such as warehouses, shop-premises and restaurants. These environments are not explicitly designed for one company or sector but could be universally used by others. This universal use is a clear contradiction with the third segment, specialistic. These work environments are fully designed for single use cases like hospitals or school buildings.

Saturation

The saturation of each circle is caused by the sector's growth within each company size category in the last five years. A higher saturation stands for a higher growth percentage. The circles that are solely outlined stand for negative growth of this sector within this company size. The growth is calculated by the deviation in the number of companies in each sector between 2016 and 2021 (CBS, 2023) since more recent data was yet to be fully available.



Size

The size of the circles depends on two variables; the number of companies within the sector (CBS, 2023) times the average number of employees within its size. The average number of employees for the small and medium-sized company groups is taken from research performed by the overarching SME organisation (Mkb servicedesk, 2021). The other is calculated by dividing the remaining number of employees by the number of companies within its category. Compared to all the other data, these numbers are not sector specific. However, this bubble chart merely functions as an estimated market representation in 2021 and is therefore taken for granted. Obviously some sectors are more significant than others and therefore some would be negligibly small in the bubble chart. These negligible sectors are presented in grey colour in the legend.

2.2.1 | PROJECTION OF COMPETITORS ON THE MARKET ANALYSIS

In the previous paragraph, specific sectors have been excluded by looking at the feasibility. Other sectors can become less attractive by considering the product's viability. It can be assumed that the product's viability will improve by targeting businesses of medium to large company sizes since these companies have a higher number of employees. Although hybrid working normalises, see chapter 3.1, it can be assumed that if the number of employees increases, the required surface area rises to accommodate a place to work for them. More sensors will be necessary to transform this larger surface area into a smart work environment. If the price of WARP's sensor-based flagship is primarily defined by the number of sensors installed, targeting companies above the line means fewer companies will be required to start making a profit. Targeting bigger-sized companies increases the flagship's overall viability since clients bring in a bigger turnover and profit.

Although the viability assumptions can be confirmed by projecting the competitors on the market analysis (see figure 12), the viability decreases since all the competitors already target these bigger audiences. The flagship build on SensorBloxx's universally implementable base must stand out from the competition. The flagship product will not be able to compete with the extensive sensor systems of the 'home cinema' category competitors (visualised in purple) since the SensorBloxx sensor selection is yet too limiting and unable to actuate BMSs. Although the SensorBloxx selection is limited, it could compete with the 'smart TV' competitors by offering more than exclusively visualising the generated data. However, this is exactly what all the competitors in the 'Apple TV and Pathé at home' category are trying to achieve. Altogether, the viable bigger-sized companies, by focusing on the number of installable sensors, are already targeted by the vast majority of the competitors.

Alphabetical lettering

- A Landbouw, bosbouw en vissery
- C Industrie
- F Bouwnijverheid
- G Handel
- H Vervoer en opslag
- I Horeca
- J Informatie en communicatie
- K Financiële dienstverlening
- L Verhuur en handel van onroerend goed
- M Specialistische zakelijke diensten
- N Verhuur en overige zakelijke diensten

Saturation

- ● High percentual growth
- ○ Negative percentual growth
- ▨ Public or semi-public sector

Bubble size

- ⤢ Number of companies x average number of employees per company size

Metaphorical competitor category

- ● 'Home cinema systems'
- ● Smart TVs
- ● Apple TVs and Pathé at home

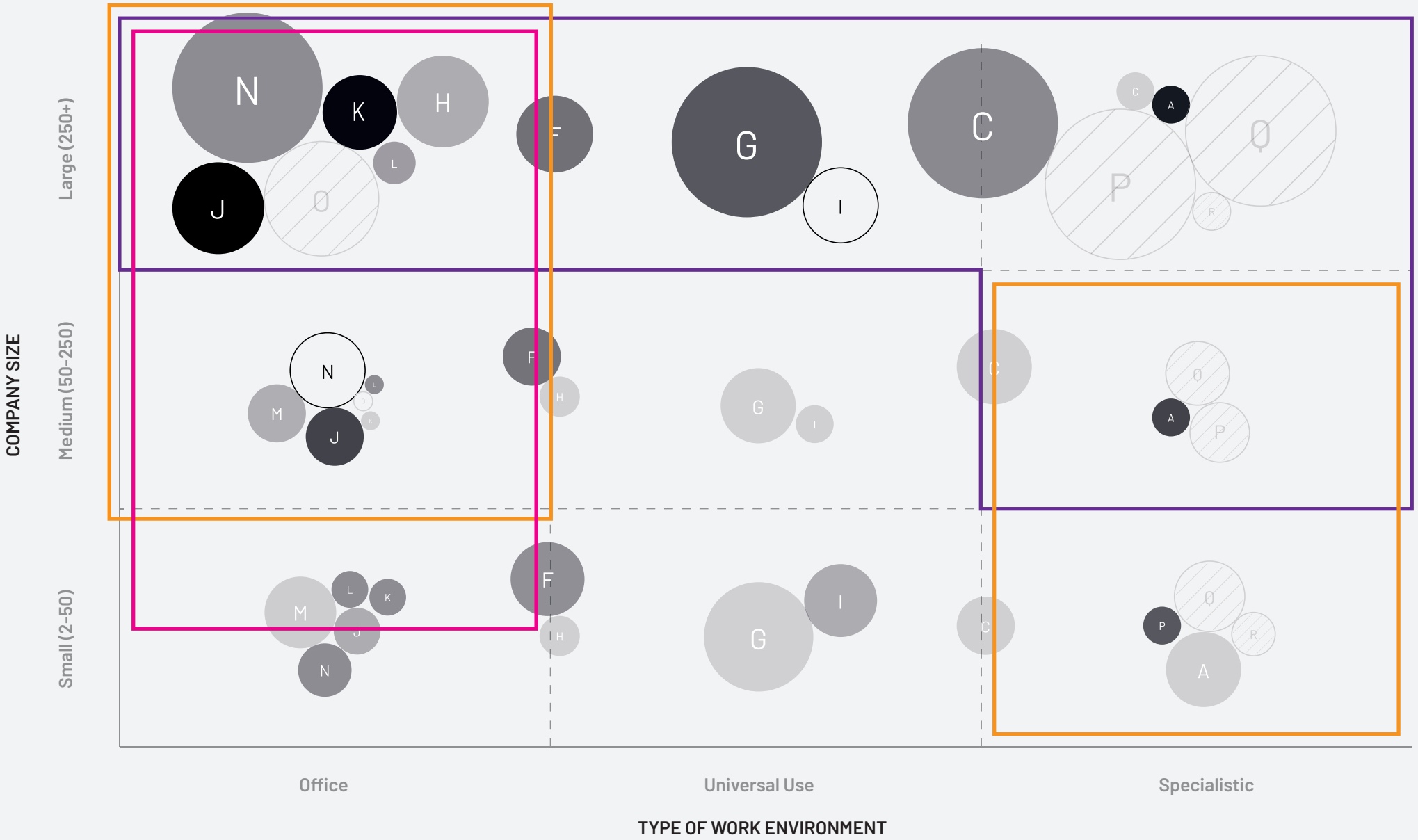


Figure 12 | The metaphorical competitive analysis project on the bubble chart of the Dutch market.

2.2.2 | CHANGING PERSPECTIVE

The nearly untargeted smaller-sized companies do not necessarily have to be less promising. A change in perspective can lead to interesting insights; see figure 13. Instead of focusing on the number of employees within a company, this new bubble chart emphasises the number of businesses. The number of businesses in the small-sized companies segment is significantly higher than in the other two segments. Instead of emphasising selling a higher amount of sensors, the focus should be on fulfilling the needs of business owners themselves. If this sensor-based product can positively impact these smaller business owners, this segment is free to take over.

Three work environment sectors are left in this small-sized company segment. Due to government regulations, most sectors within the specialistic work environment segment are not feasible. This unfeasibility leaves only sector A (agriculture, silviculture and fishery) within this quadrant. Although there are quite a few companies within this sector, I assume the number of similar needs in this sector will be dramatically low. This is also the case with the biggest bubble G, representing the wide variation in businesses active in the trade market. I assume that businesses in the sectors M, J, L, K and N will not vary as much since their work environment is relatively identical. The competitors in figure 12 also treat the office work environment audience equally in the bigger-sized business categories. Additionally, the number of businesses in sectors M, J, L, K and N has grown substantially compared to sector G.

Alphabetical lettering

- A Landbouw, bosbouw en vissery
- B Delfstoffenwinning
- C Industrie
- D Energievoorziening
- E Waterbedrijven en afvalbeheer
- F Bouwnijverheid
- G Handel
- H Vervoer en opslag
- I Horeca
- J Informatie en communicatie
- K Financiële dienstverlening
- L Verhuur en handel van onroerend goed
- M Specialistische zakelijke diensten
- N Verhuur en overige zakelijke diensten
- O Openbaar bestuur en overheidsdiensten
- P Onderwijs
- Q Gezondheids- en welzijnszorg
- R Cultuur, sport en recreatie
- S Overige dienstverlening
- T Huishoudens
- U Extraterritoriale organisaties

Saturation

- ● High percentual growth
- ○ Negative percentual growth
- ▨ Public or semi-public sector

Bubble size

- ⤢ Number of companies

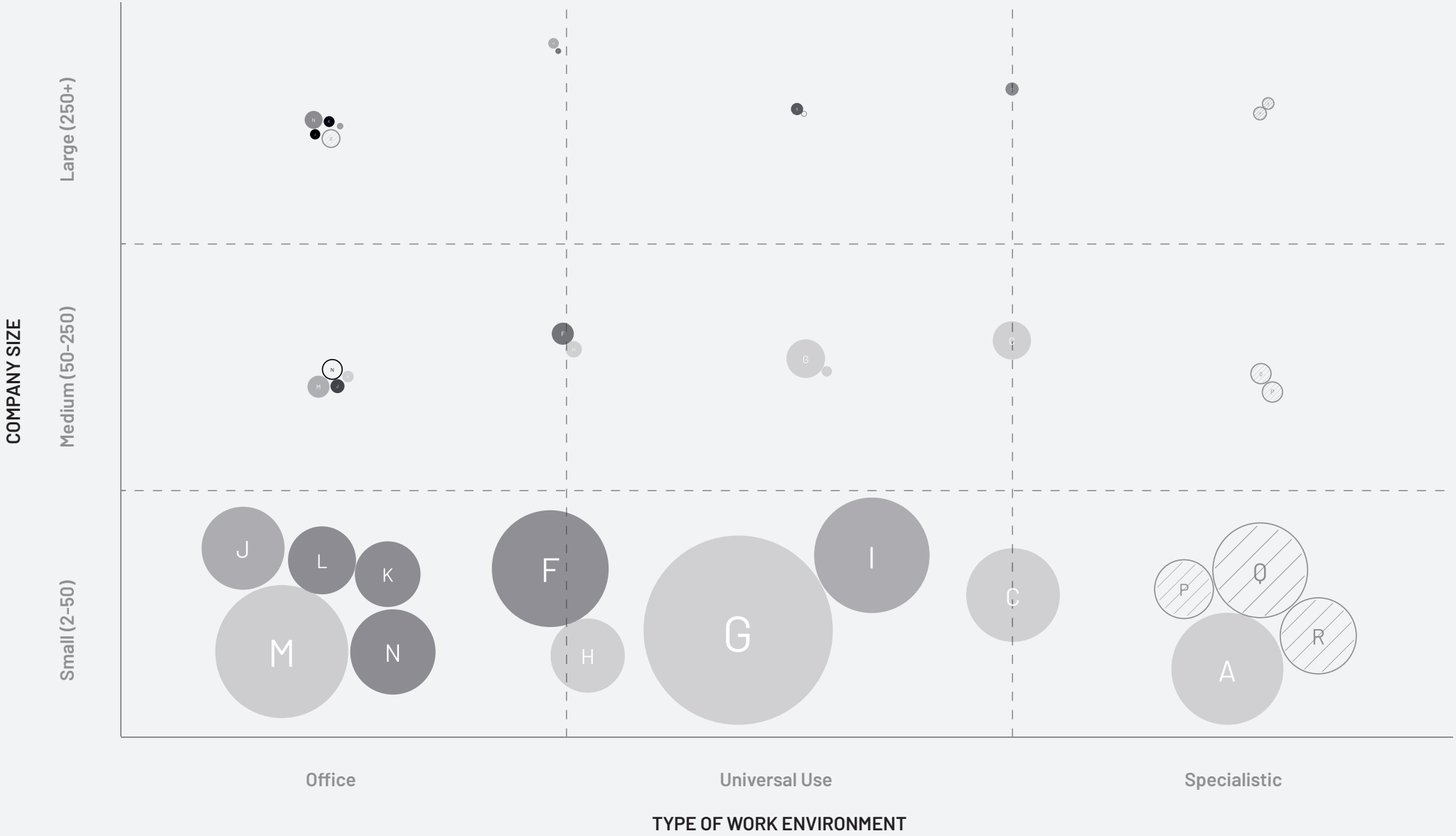


Figure 13 | A change in perspective visualised in the bubble chart that emphasises on the number of businesses.

2.3 | CONCLUSION

In designing a flagship, it is essential to stand out from the crowd and attract the attention of fellow innovators. The flagship should convince fellow innovators of the viability to launch a new sensor-based proposition successfully, after which these companies could likewise start building a sensor-based product on SensorBloxx. In order to stand out from the crowd, WARP should prevent targeting a niche market or having an identical approach to any competitor. At first, it seemed nearly impossible to stand out from the competition and be unique since the smart building market has an extensive range of active competitors. Although the competitors in the smart building market vary in many aspects, a metaphorical competitive analysis created a clearer view of what the competitors have to offer their users.

Unfortunately, competitors in the smart building industry have already targeted more viable audiences. This viability of the target audience was primarily based on the assumption that businesses with more employees would own more surface area to install sensors in. If the primary source of income were the sensors, fewer companies were necessary to start making a profit. However, new possibilities for the sensor-based product arose due to a change of perspective. Instead of selling more sensors as a primary income, the focus should be on impacting business owners with the digital interface supported by the sensors. This change of perspective has shown the potential of targeting business owners of small-sized businesses since these were barely being targeted.

The flagship build on SensorBloxx should target small businesses in sectors M, J, L, K and N. These sectors are located in office environments and indoor environment data can presumably impact them relatively identically compared to other feasible sectors that were left in the bubble chart's small-sized business segment. Suppose WARP succeeds in impacting these small-sized businesses. In that case, a beneficial consequence is that WARP will gradually include the medium-sized company segment in the target audience without any effort, see figure 14.

Alphabetical lettering

- A Landbouw, bosbouw en vissery
- B Delfstoffenwinning
- C Industrie
- D Energievoorziening
- E Waterbedrijven en afvalbeheer
- F Bouwnijverheid
- G Handel
- H Vervoer en opslag
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- **J Informatie en communicatie**
- **K Financiële dienstverlening**
- **L Verhuur en handel van onroerend goed**
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- **N Verhuur en overige zakelijke diensten**
- O Openbaar bestuur en overheidsdiensten
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- U Extraterritoriale organisaties

Saturation

- ● High percentual growth
- ○ Negative percentual growth
- ▨ Public or semi-public sector

Bubble size

- ⤢ Number of companies

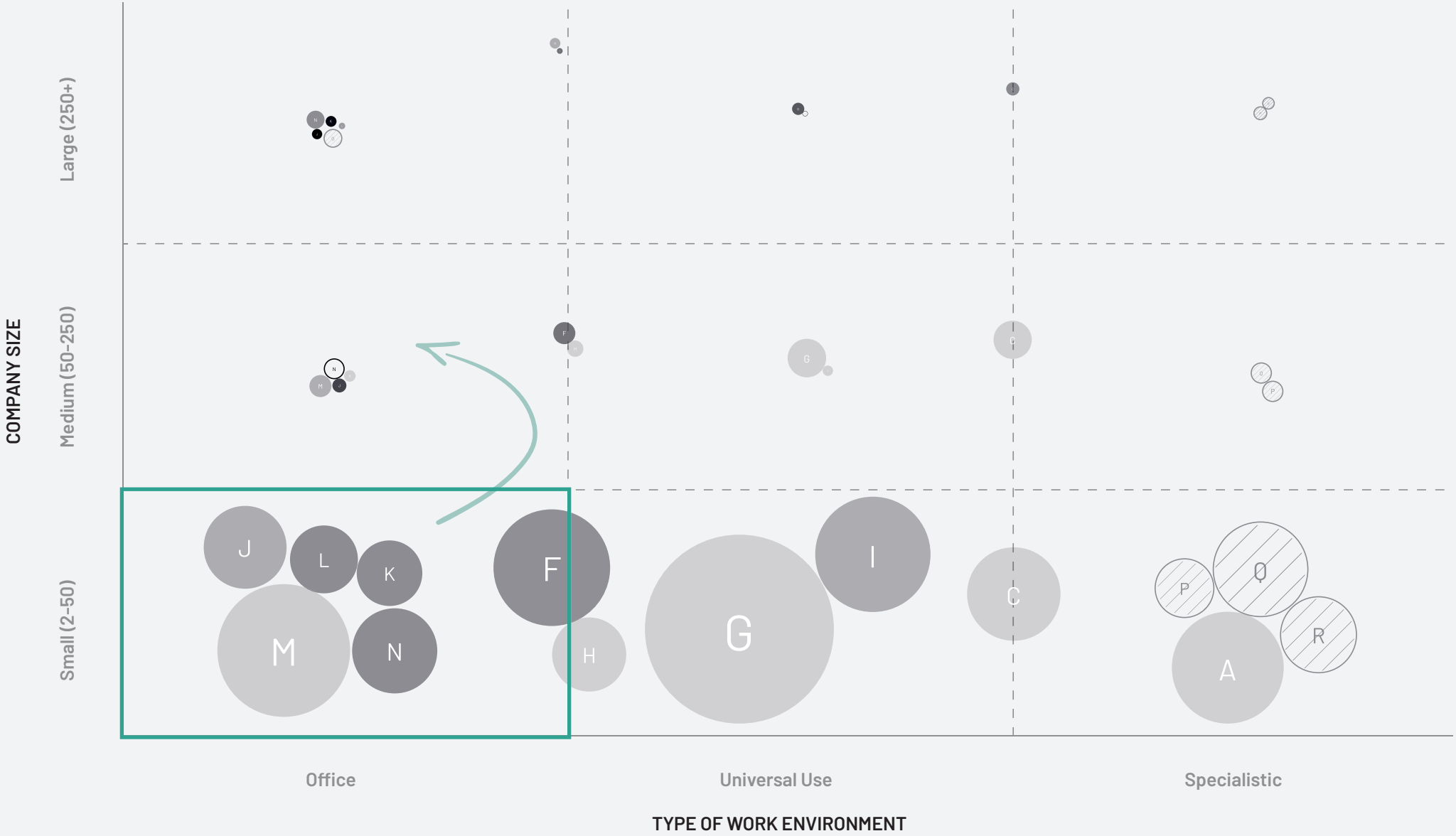


Figure 14 | The change in perspective of the bubble chart that resulted in a defined target audience.

CHAPTER 3

USE CASE

Previously, the viability and feasibility of the ‘flagship’ are considered in defining the target audience: small businesses in sectors M, J, L, K and N. However in order to realise a human-centred ‘flagship’ design, the product should cater the needs of the defined target audience and become desirable. This chapter discusses potential motives for businesses in office environments to start measuring indoor environment data. Taking these opportunities in mind, interviews with flex offices, business owners and employees have resulted in a better understanding of the target audience’s context. This context contributed to the discovery of an indoor environment data use case that fulfils the needs of business owners and their employees.

3.1 | MOTIVES TO GENERATE INDOOR ENVIRONMENT DATA 36

3.2 | EXPLORATIVE INTERVIEWS FLEX OFFICES 39

3.3 | EXPLORATIVE INTERVIEWS BUSINESS OWNERS 45

3.4 | EXPLORATIVE INTERVIEWS EMPLOYEES 51

3.5 | CONCLUSION 57

3.1 | MOTIVES TO GENERATE INDOOR ENVIRONMENT DATA

The projection of the competitors on the market analysis, see chapter 2.2, showed that competitors target bigger-sized businesses in office environments. This confirms that sensor-based products are able to impact stakeholders in these types of environments. However, it is yet unclear if sensor-based products could impact the target audience, small businesses in office environments. This chapter discusses potential motives based on desk research for organisations within the target audience and their building owners to start generating indoor environment data. The organisations' motives are divided into the three Ps of corporate social responsibility: people, planet and profit (see figure 15) These three Ps of corporate social responsibility (shortened as CSR) are a common benchmark for entrepreneurs in the 21st century (RVO, 2018).

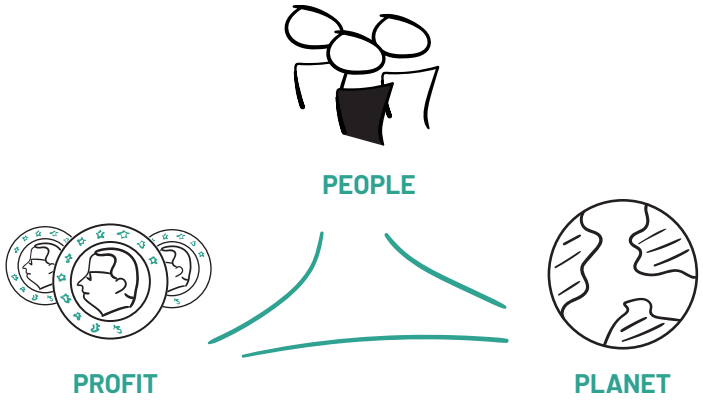


Figure 15, an overview of the three P's of corporate social responsibility (RVO, 2018).

3.1.1 | PLANET

The most recognised value that indoor environment data can deliver is saving energy. The most obvious reason to save energy would be to reduce costs. However, due to the severity of climate change, organisations are challenged to protect the environment by embracing sustainable practices (Deloitte, 2020). Reducing energy consumption through implementing smart technology can be one of these practices which significantly affects a company's environmental impact.

The heating, ventilation and air conditioning systems within buildings (from now on shortened as HVAC) alone consume, on average, a total of 40 per cent of the energy in a building (Arcadis. n.d.). In combination with the energy used on lighting, these costs can be significantly reduced by installing sensors in combination with analytics software. Which could actuate the already present building management system (from now on shortened as BMS).

Reducing the environmental impact of companies by transforming buildings into smarter ones benefits the overall society as well as the image of the company. The business owners that are behind these companies are therefore the stakeholders that benefit the most from this transformation.

3.1.2 | PROFIT

Reducing energy consumption within a building not only positively impacts an organisation's environmental impact, but also contributes to cost efficiency. The company's cost efficiency can further increase by implementing space utilisation and maintenance optimisations through smart technology (Arcadis, n.d.).

Optimising space utilisation and maintenance became increasingly important after the inevitable Covid-19 pandemic. This pandemic resulted in most employees being forced to work from home. This change in the day-to-day work environment accelerated the shift towards hybrid working after Covid-19 ended (Microsoft, 2021). However, hybrid working can negatively influence the productivity of tasks and activities in some sectors (Lund et al., 2022). Therefore, the level of impact of space utilisation and maintenance depends on the sector in which the company is active.

To optimise space utilisation, smart buildings can behave as accordions in which they expand and contract by switching zones on and off in the building (Arcadis, n.d.). Switching zones on and off in the building can be either done based on current occupancy or predictions with the help of the occupancy patterns measured by sensors within the building. Switching off these zones will decrease the urgency of maintenance within these parts of the building, resulting in cost reduction.

Increasing cost efficiency will benefit business owners the most, like reducing the previously stated environmental impact. With the money that otherwise would have been spent, the businesses can extend the profit or reinvest in other aspects of the company.

3.1.3 | PEOPLE

Positively impacting people within the building is the third and final motive to transform a building into a smarter one. According to research by the World Green Building Council, 90 per cent of the organisation's costs, on average, are spent on employees (Soulti & Leonard, 2016). This percentage indicates the importance of realising an optimal work environment for employees. There are multiple ways in which smart technologies can have an impact on employees and as a consequence of this also on its business performance. However, compared with the previous planet and profit motives, these improvements are harder to quantify (Arcadis. n.d.).

Temperature-controlled, well-ventilated and well-lit workplaces increase employees' physical and mental health (Priva, 2021). These healthy work environments can resolve the absenteeism linked to inadequate workspaces. This absenteeism is a significant concern in the Netherlands (Priva, 2021) since sick leaves eventually affect 47 per cent of all employees and annually cost employers in the Netherlands 11.5 billion euros (Miller, 2020).

Research by Kronos indicates that employees trust and expect their employers to realise a physically safe and healthy work environment (Kronos, 2020). This expectation of an organisation's responsibility can quickly become a primary requirement for employees. If a healthy work environment becomes a primary requirement for employees, the indoor environment data can become a tool to retain existing staff and attract talented new ones. This tool becomes an even greater deal by taking into account the expenses that are related to replacing personnel. Employers spend on average as much as 35.000 euros per head on things such as severance pay, recruitment and training costs (The Cost of Brain Drain, 2014). Combined with the current scarcity of new skilled personnel in the Netherlands (NOS, 2022) the effect of realising a healthy work environment should not be underestimated.

Actively realising a healthy work environment can positively influence the image of an organisation. Good intentions of the business owners' can improve the overall performance of their employees (Seppälä & Cameron, 2017).

A healthy work environment might also help to attract employees back from working at home after the pandemic. In the Netherlands, 70 per cent of employers try to constrain hybrid working and try to get employees to physically come back to work (Toe Laer, 2022). From the employer's point of view hybrid working results in a loss of social cohesion among the personnel and reduces control over work activities.

Altogether a healthy environment benefits both the business owners and their personnel. The personnel benefits from the definite improvement in their physical and mental well-being. This improvement can indirectly reduce absenteeism, fulfil a future requirement, retain existing staff, attract talented new ones, increase overall performance and attract personnel back to the workplace. These indirect consequences of a healthy work environment mainly benefit business owners.

3.1.4 | MOTIVES BUILDING OWNERS

Apart from the motives of people within organisations, the implementation of smart technologies can be initiated by people within the building management category. People within this second part of the scope range from building owners to facility managers. Compared with the previous paragraph, the buildings owners' motives are not divided into the three Ps of CSR.

A building that initiates cost reduction, decreases environmental impact and is healthier for its visitors will increase its attractiveness to potential tenants (Priva, 2021). This attractiveness becomes even more important since these buildings need to be occupied by more organisations than before. Considered that since the normalisation of hybrid working organisations are looking for less surface area than before (Mearian, 2021). By taking into account the over-supply of commercial property, property owners that can demonstrate smart improvement within their building will have a higher chance to prosper in the future (Priva, 2021).

Building owners that already have implemented smart technologies into their buildings show great results. Considering that the ones that possess information about business benefits of their smart building investments confirm an increase in attractiveness. By possesing this information 73 per cent of these building owners report faster leasing rates, and 62 per cent cite higher asset value (Dodge data & analytics, 2016).

3.2 | EXPLORATIVE INTERVIEWS WITH FLEX OFFICES

Apart from the standardisation of hybrid working, see chapter 3.1, the pandemic has caused a rise in the number of flex and co-working spaces. In the last few years, the number of these flex offices has been growing yearly worldwide by, on average, 20 per cent (de Groot, 2022). These offices offer an environment accommodating people from all sectors and company sizes to come and work (Hogarty, 2021). Especially SMEs choose to rent desks and rooms within these flex offices instead of buying or renting their own dedicated offices. This change can be confirmed by the fact that 65 per cent of the people working within flex offices are within the targeted audience, see figure 16. Small to medium-sized companies represent 38 per cent of the people, and another 27 per cent are represented by startups (Konya, 2019). Only 3 per cent of the total visitors work at larger companies.

The data above shows that flex offices are attractive to smaller companies and startups, including the targeted audience for the sensor-based product. These offices allow companies to lease for a shorter period of time. This shorter lease period increases the flexibility of small businesses and startups. They no longer restrict themselves by planning, predicting growth and bearing in mind setbacks for long-term lease plans (Menaged, 2022). Next to the flexibility, the reputation of the companies within a flex office can be positively influenced. Flex offices are located in desirable locations and have similar work environment qualities as global companies (Menaged, 2022). Therefore, renting a flex office spot can help secure the right clientele, funding or reputation for small companies and start-ups. Small businesses and startups also get to know many companies in similar situations in these flex offices.

The flex offices are attractive for smaller businesses, therefore I assume that they care about realising an optimal work environment adjusted to the needs of their users. In this chapter, the flex offices' community managers and directors are considered experts on the defined target group. Interviews are conducted to get a view of their perspectives on small businesses. These perspectives can be used to better understand the targeted audience and their needs.

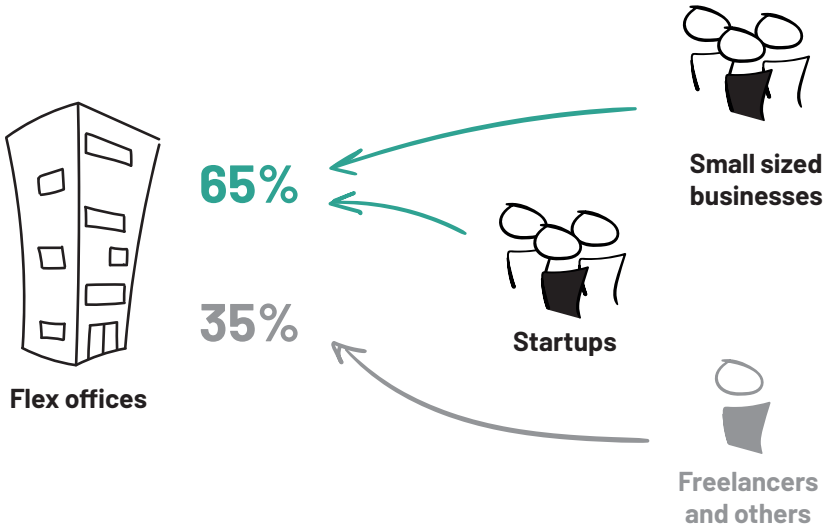


Figure 16 | Flex offices can be labelled as experts of the target audience.

3.2.1 | METHOD

There is a wide range of flex offices located in the Netherlands, which are primarily located in its cities. Before any potential participants were contacted, the nearest flex offices in the area were mapped out. As a given area, three cities were selected; the Hague, Delft and Rotterdam, since this simplified the ability to have a face-to-face meeting. I assume that flex offices in these cities can generally represent flex offices in the Netherlands since most flex offices are part of overarching organisations with multiple locations across the country. These overarching organisations are taken into account while contacting potential participants. This consideration resulted in targeting just one of their locations to interview. Eventually, four interviews were scheduled.

The interviews were held with the following co-working spaces: Microlab Rotterdam, 'Het Industrie Gebouw' (HIG), Spaces the Hague and Co-Office. The interviewees ranged from facility and community managers to business owners and directors. Two of the four interviews were conducted face-to-face in their flex offices; see figure 17. Due to the interviewees busy schedules, the other two were held through a video-call meeting or a phone call.

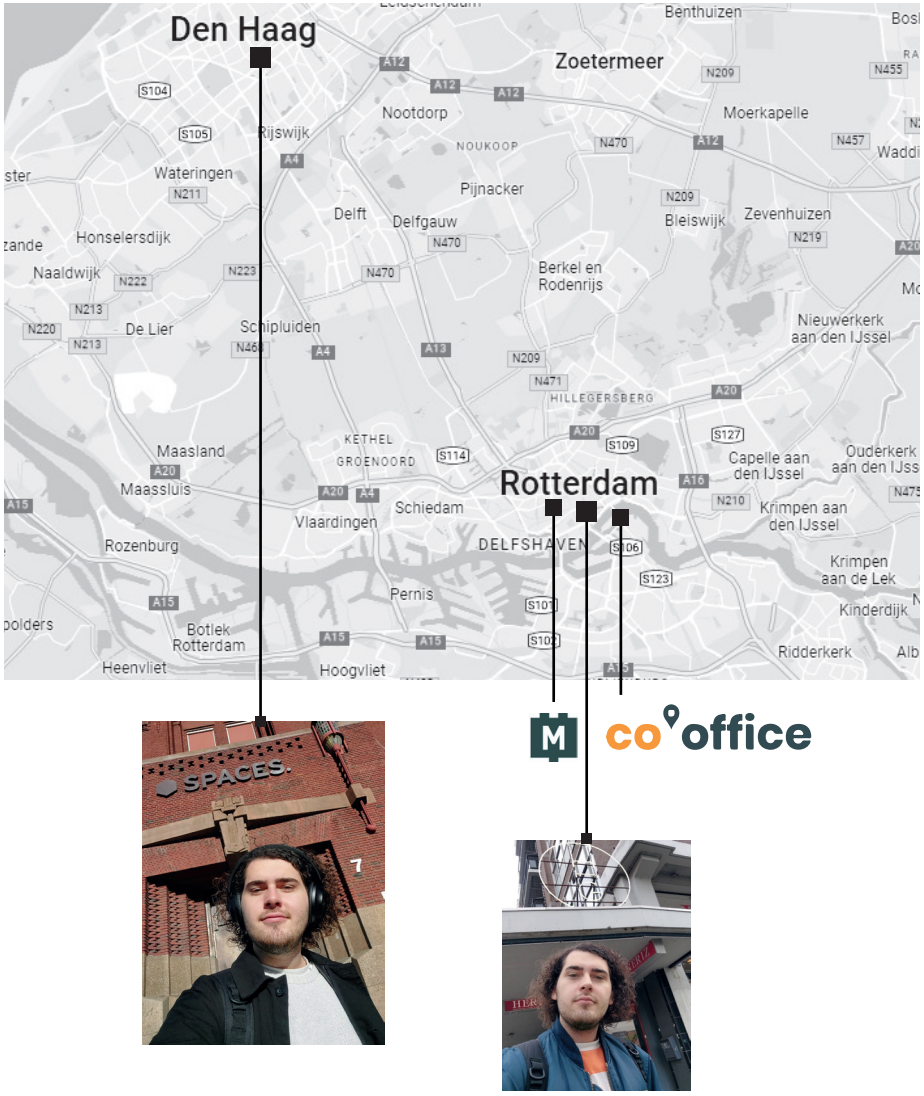
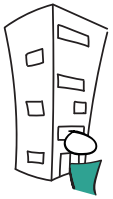


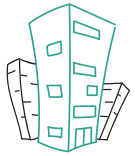
Figure 17 | A map of the participating flex offices including the physical visits.

The interviews were held with the help of an interview guide, see appendix B. This guide covered various topics such as personal, flex offices, businesses, businesses' journey, businesses' exit and data statements. Each segment had its own goal and purpose in the interview. A foldable visual speaking prompt, also known in Dutch as 'praatplaat', was created to guide the interviewee as a storyline through these five segments; see appendix C. This prompt was unfolded by the interviewer and placed in front of the interviewee during the physical interviews. The following segments were discussed in the interview, which took about 30 minutes.



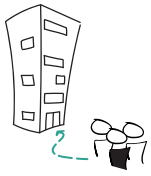
Personal

After a short introduction of myself, this segment is meant to get a similar quick impression of the role of the interviewee. A positive start to the interview is given by asking the interviewees about the fun aspects of their jobs. This segment primarily functions as an icebreaker.



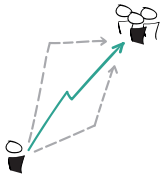
Flex offices

The goal of this segment is to get a better understanding of the value proposition of the flex offices. What do they have to offer to their visitors? What value does that add? How do they differentiate themselves from their competitors? Although much of this information is already available on their websites, it is important to hear it from the interviewees. The interviewees do not have all day, so they keep it to the essential aspects. Their answers provide an realistic perspective compared to the overload of nicely written information on their websites. The value proposition is the first step in getting to know the target groups' needs, because it is likely to be based on their needs.



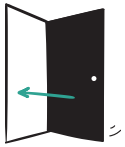
Businesses

This third segment is about the user of the flex offices. What kind of businesses comes and work at these flex offices? What makes them choose for a flex office instead of a regular one? What are the agreements made with the businesses? Although interviewing business owners renting a spot in these flex offices could result in more in-depth answers, these interviewees can quickly provide a more general 'high over' perspective on the target audience. Otherwise, a wide selection of businesses in or out of flex offices should be interviewed to get a similar answer. Altogether, this extra information will possibly help to form a better understanding of the target audience.



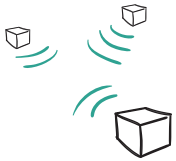
Businesses' journeys

This segment is about the journey of the user. When do they begin to rent a desk or room? Do companies within different sectors act the same way? Can they be compared with each other? Do the needs of these companies change in their growth process? This segment is created to better understand the typical growth process of these small businesses combined with the target audience's changing needs and benefits. These needs can be essential in formulating an initial direction for the sensor-based product. This segment might also confirm the assumption that the sectors within the target audience behave similarly.



Businesses' exit

This segment is about the reason for leaving the flex offices. Where do the businesses move to afterwards? Is there a clear gap after leaving the flex work environment? One of the assumptions is that the businesses that leave the flex communities will struggle at the beginning due to new responsibilities previously in the hands of the flex communities. The answers given in this segment can partially confirm this assumption.



Data statements

This final segment is about in-depth data statements. These statements were chosen instead of questions to jump-start a discussion on its topic. This is the first segment that introduces indoor environment data to prevent pushing the interviewees' previous answers in a certain direction. It introduces indoor environment data in the form of accessibility to indoor air quality. The other motives to install smart technology and start measuring indoor environment data do not apply to the business in flex offices. One of the final statements starts the discussion about the normality of an optimal indoor environment.

3.2.2 | RESULTS

The four interviews with flex offices were recorded to fully compehend their answers. These recordings made it possible to turn the given answers into 'quote' post-its on a Miro board. The important post-its in the raw data were clustered to generate new insights; see appendix D. These clusters resulted in three overarching categories: flex offices, small businesses and indoor environment data, further elaborated in the following paragraphs.

Flex offices

The flex communities primarily offer a fully facilitated office environment to their visitors. You name it; they offer it: coffee, tea, events, meeting rooms, douches, online platforms, bike parking, wifi, cleaning services, Friday afternoon drinks, lunches, et cetera. One of the interviewees even compared their services with hotel services since they take over all peripheral matters for the companies that hire a desk or room. This results that employees within these small businesses benefit from things that normally would solely be linked with corporate work environments.

> *Basically the way you rent a hotel room is similar to renting an office with us." - Flex office 3*

The flex offices emphasise that their offered facilities have no hidden costs. Businesses are offered one fixed monthly price, which includes the work environment and all its facilities. Nonetheless, the monthly costs vary between the businesses in these flex communities due to differences in requested surface area, their varying number of employees and the degree of services included. Although all the facilities are included in the price, things such as heating still can be a point of discussion, especially during these high energy prices. The flex offices try to maintain the businesses' awareness of the high costs of energy and its environmental impact.

> *You get all the facilities within a fixed amount that you pay, of course, it depends on the tenant, but there are no hidden costs." - Flex office 2*

The flex offices primarily are a place where multiple organisations come together to work. However, these flex offices often are more than just a work environment. It functions as a community which brings the companies working within together. The flex offices bring the companies closer and stimulate social cohesion by organising various events. This social cohesion can have great consequences, such as solving problems for each other or even bringing in new projects.

> *Our goal is to provide the most accessible platform possible for cross-pollination at a later moment in time." - Flex office 1*

The flex communities bring a lot to the table compared to 'conventional' offices, like the previously mentioned facilities and cross-pollination, all within a fixed price. Compared to the big differences with conventional offices, flex communities have no major differences. The flex offices mentioned minor details in which they distinguish themselves from the rest. These include being personal in communication, having vandal-proof appliances, maintaining consistent work environments or replying quickly to complaints.

> *It sounds kind of silly but it doesn't necessarily matter if you rent a place here or anywhere else." - Flex office 1*

Small businesses

Most businesses that rent a spot in the flex communities started renting at the beginning of their growth. They start with a couple of separate desks and eventually move towards a dedicated office within the flex offices. Although it is impossible to offer all these companies exactly the same place, all the companies within the different sectors are treated identically. From the flex community perspective, the businesses that rent a spot do not have varying needs. All small businesses just want to become more autonomous in their growth process.

> *We offer only one product and every company uses it differently, because all these companies do not have varying needs." - Flex office 3*

In line with the previously stated urge for autonomy, there are more reasons why a business eventually wants to leave the work environments offered by the flex communities. It can happen that the business just grows out of the space offered by the flex offices while there is no bigger space available at that time in the building. Although the flex offices try to facilitate switching rooms with other companies, moving out of the flex office is sometimes inevitable. Next to physical room availability, cost efficiency can play a role in moving to rent a place on their own. The switching point when renting a place on their own becomes more cost-effective does vary per sector and business type. Lastly, some businesses go bankrupt and have to leave the building because they simply cannot pay the rent anymore. Overall, in the eyes of the flex communities, leaving them will bring some extra responsibilities. A lack of personnel for office and facility management functions mainly causes these responsibilities.

> *The cost-effective tipping point varies for each organisation." - Flex office 1*

Indoor air quality data (IAQ)

All the flex communities agree that the office should always contain optimal indoor air quality. The businesses should not have to worry about the optimality of the IAQ; otherwise, the building lacks a core product feature. However, one of these flex offices is located in a monumental building and therefore limited in options to realise an optimal IAQ mechanically. This results in the fact that they are practically unable to realise a constant optimal IAQ. Compared with the other interviewed flex offices, which fully own operational climate systems. Although sensors do not control all these climate systems (yet), they are fairly new and can be actuated by smart technologies.

Some flex offices allow the companies to get insight into parts of the measured IAQ data. One flex community offers insights into CO2 levels while the others solely offer insights into temperature, but it is never the full spectrum of data that influences indoor air quality, which is communicated. One of the interviewees has never heard of the business owners' necessity for accessible IAQ data, because the small businesses should be able to trust the correctness of the IAQ.

> *The optimality of the indoor air quality must be arranged, or else you have a lacking core product." - Flex office 1*

At the moment, none of these flex offices uses data to optimise the experience of the companies within. The experience is optimised solely through face-to-face conversations about the delivered services with the business owners. The flex offices do see the potential of a completer set of data, especially on how their offered work environment is used. Altogether, in order to be able to perform an optimisation analysis, more indoor environment data should be generated.

3.3 | EXPLORATIVE INTERVIEWS WITH BUSINESS OWNERS

The interviews with the management of flex offices offered a general perspective on small businesses in office environments. The responsibilities of running a small business became more apparent, especially the ones that are taken out of the hands of the businesses by renting a spot at a flex office. However, the targeted audience consists of all small businesses, including those not previously located in flex offices. Therefore it was necessary to conduct explorative interviews with the full spectrum of targeted business owners to extract their needs and anticipate on potential opportunities for the sensor-based product.

3.3.1 | METHOD

Through the help of WARP, the venture manager of SensorBloxx and business owners in my circle of friends I managed to set up six interviewees with business owners. These interviewees present a wide and varying sample size due to differences within the type of industry, company size and office building. The businesses range from a total of two employees to approximately thirty. These businesses are all active in varying industries, such as sustainable consultancy, web development, mobile acquisition, organisational consultancy, media design and the energy sector. The contacts that helped gather these participants said that the business owners have already experienced many types of office work environments.

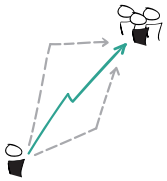
These interviews were conducted both face-to-face and digitally. The business owners working in Rotterdam and Delft offices were interviewed face-to-face. The business owners in other parts of the Netherlands, like Amsterdam and Utrecht, were interviewed through a Google Meet video call. The face-to-face interviews were held with a visual speaking prompt which guided the interviewee as a storyline through the interview; see appendix F. This time the prompt did not guide the segments in a fixed order. It depended on the conversation itself, which segment would be next. During the interviews, I was able to put comments on this prompt.

Figure 18 | The digital setup of an interview with a business owner.

All the interviews, face-to-face as well as digital, were conducted with the help of an interview guide. Like the previous interview round, the guide was divided into five segments, see appendix E. This guide covered various topics such as personal, businesses' journey, business owners responsibilities, work environment and indoor environment data statements. Each segment had its own goal or purpose in the interview. The following segments were discussed in the interview, which took about 30 minutes.

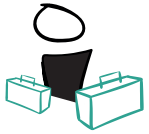
Personal

This segment is identical to the interview guide formulated for the flex office interviewees. It functions as a first introduction and icebreaker for the interview. In this segment the role of the interviewee is discussed and what they like most about it. The interview starts on a positive note by asking what the business owners like the most about their work. I assume that business owners usually do not like the day-to-day aspects of running a business. By getting to know what they like or dislike, opportunities for indoor environment data can arise.



Businesses' journey

In this segment, the focus primarily lies on the business itself. Especially from where the business came from and how the business was able to reach the point on which they currently are. These questions result in a better understanding of small businesses' general growth process. This growth process has a clear impact on the location and work environment at each moment in time. I expect that the companies often start at flex communities and grow towards more conventional work environments. By understanding the company's growth, I try to spot possibilities in which a sensor-based product can impact them similarly.

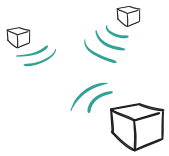


Businesses owners responsibilities

Their role as business owners is generally discussed in the previous personal segment. Nevertheless, this segment will look closely at the responsibilities that arise or disappear while changing the work environment. I expect that the responsibilities during growth will increase and opportunities for a sensor-based product will occur to assist in some of these responsibilities.

Work environment

This segment is about business owners' perspectives on an optimal work environment. I expect that small businesses have experienced a wide range of work environments and have formed their own opinion on it. Although the topic of indoor environment data is not yet introduced, this segment can confirm if the optimality of a work environment is connected with things measurable by Sensorbloxx sensors. This segment also discusses the business' way of staying attractive for employees. I assume that a proper IAQ will not be top of mind, especially not the communication of this data. The final part introduces the indoor environment data by focussing on what data is available or would interest the business owners.



Indoor environment data statements

This final segment is all about data in the indoor work environment. These are statements similar to the interviews with flex communities that try to spark a discussion on more specific topics.

The first statement sparks the discussion on if IAQ should be accessible for employees, since a healthy work environment became more prominent after the Covid-19 pandemic. My assumption is that the indoor environment data shouldn't be necessary to communicate or make it accessible because employees should be able to trust their employers. This statement is followed by a statement on their right to generate user data in their own work environment.

The third statement introduces the potential motives from previous chapters to start measuring indoor environment data. It mentions gaining insights into sick leaves, cost reduction, space utilisation and employee experience. I assume that not all motives will interest business owners at any moment in the growth process of their businesses. This third statement will reveal which use cases the questioned stakeholders find the most interesting.

The final statement concerns the business owner's interest in raw indoor environment data or the related recommendations based on this data. I assume that business owners would less quickly base their decisions on the recommendations and trends generated by a sensor-based product. I expect they would like to receive this information, combined with the raw data, to verify these recommendations. On the other hand, this raw data could take too much time to digest, so the sensor-based product recommendations could be more important.

3.3.2 | RESULTS

The six interviews with the targeted business owners were recorded to fully compehend their answers. These recordings made it possible to turn the given answers into 'quote' post-its on a Miro board. The important post-its in the raw data were clustered to generate new insights; see appendix G. These clusters resulted in three overarching categories: small businesses, indoor environment data and employees, further elaborated in the following paragraphs.

Small businesses

As assumed, small businesses 'devour' work environments, especially at the beginning of their growth. One business owner even said they are currently in their seventh location in three years. For these smaller businesses it is difficult to plan ahead and move towards a location for a longer period of time. Since smaller businesses grow organically instead of gradually, combined with the normalisation of hybrid working, it can be difficult to define the correct size of the work environment. This difficulty often causes businesses to work in suboptimal conditions due to too many employees in a small surface area.

> *"*chuckles* We've had, I think, 6 or 7 offices already." - Business owner 2*

Some business owners do not have a business degree but a different background, therefore there is still much left to learn. The business owners realise that sharing data with fellow small businesses could have prevented certain problems for each other. For example, data on work environments previously rented by other small-sized businesses could come in handy before signing a new contract. Some work environments are negatively experienced due to incorrect expectations. Fair agreements can be set up between business owners and building owners through accessible data. In addition, having data available on similar-sized businesses can help set up benchmarks for their own business since some business owners do not know what a typical amount of energy consumption for their company size is.

> *I would like to see how much electricity I will use in my future work environment...I think that could be very interesting because I have to arrange my own electricity contract." - Business owner 5*

The small sized businesses want to exude their professionalism. They do not want to be labelled as the startup or the business that works in the flex office. In their eyes, renting a place for themselves provides a professional attitude to their surroundings. In everything businesses do they strive for professionalism to get taken seriously by their clients.

> *Surely you are taken more seriously than over there. There it's still the flex concept ...." - Business owner 1*

Indoor environment data

The term 'data' did not ring many bells while discussing an optimal work environment. It is unclear what possible datasets could be measured in the indoor work environment. In the eyes of some business owners, indoor environment data is quickly linked with stately corporate buildings, which does not match the image the small businesses want to project. The business owners are entirely unaware of the accessibility of valuable indoor environment data for companies within their business size.

> *Insight into data? What do you mean?" - Business owner 4*

Previous experiences with suboptimal work environments created awareness of the long-term consequences of a poor IAQ. Some business owners experienced low energy levels among their employees due to bad lighting conditions and the lack of ventilation capabilities. Other business owners experience musty environments, which they link with potentially high CO2 levels. By discussing these consequences,

the business owners realised that measuring certain indoor environment datasets could confirm and contribute to solving these suboptimal situations. Considering that up till now, the cause of these consequences has stayed uncertain.

> *Yes, what I just said...people have a hunch but don't know what it is. If you know it's 23 degrees and warm air is coming out... GREAT! Then you know if the system is working well." - Business owner 6*

Some business owners have never thought about starting to measure indoor environment data because they blindly trust the expertise of the building owners and their facility managers. However, some have learned it the hard way in previous work environments, which led to distrusting their current and future building owners. One of the business owners does not even trust the sensors within the thermostat anymore since it is not installed by themselves.

> ** laughter* It's actually kind of sad to say that you cannot take good indoor air quality for granted because its correctness is something you kind of assume in offices." - Business owner 3*

If indoor environment data will become accessible for these small businesses, the benefits and reasoning behind some datasets are yet unclear. These business owners need to become more familiar with all the possibilities and motives to install these sensors in their work environment. Therefore relevant recommendations and trends based on raw data would be more useful than the raw data itself. The raw data would not be interesting for business owners due to their lack of knowledge of these datasets. They cannot extract relevant information and conclude from this raw data because they do not know what levels of data are related to optimal and suboptimal work environments.

> *If you read through the raw data, you think it could be interesting, but then you see that the humidity is 92 per cent, which doesn't tell me much at all as a filmmaker." - Business owner 4*

The knowledge that the work environment is in an optimal or suboptimal state should be sufficient for the employees, according to the business owners. Compared with business owners' scepticism for the optimality of the indoor work environment, their employees should be able to trust them. The businesses' personnel should always have the right to work in the most feasible optimal work environments. The raw data will only function as a distraction for the employees instead of adding extra value to confirm the optimality of the work environments. This results in the fact that the raw data should be kept private from the employees.

> *Well.... should I give them insight into all the details like humidity and such.... No, it is not necessary and takes it a step too far." - Business owner 4*

Communicating the optimality of the work environment should be combined with actionable tasks for business owners and employees. The ability to control the indoor environment will result in a higher acceptable range of the optimality of the work environment.

Employees

In one of the statements, the motives to install smart technologies were formulated. Surprisingly, the employees' experience is the most important one. From their point of view, the datasets can be interesting separately but can become way more impactful by combining them with work experience data. While multiple indoor environment data variables are measured to optimise the work experience, they could also be used, for instance, to reduce costs.

> *[Employee Experience] Yes, this is the most important one!" - Business owner 2*

The business owners confirm that attracting good employees in the current market is tough. Therefore they try to do their best to retain their current personnel. The loss of employees, due to sick leaves or because other companies care more about their physical and mental health, is far more important than cost reduction.

> *It is essential that you know what's going on among your people. Because absenteeism is the worst thing that can happen to you as a business owner." - Business owner 6*

Business owners recognise that creating an optimal work experience for their employees will increase efficiency and overall productivity. This productivity could be further increased by realising the feeling of being heard because more involvement results in more commitment.

> *When everyone feels heard things will go better because more involvement means more commitment." - Business owner 6*

Business owners believe that employees face challenges communicating all negative and positive aspects of work. Sometimes, employees are discontent about aspects of their work, but these aspects often do not reach the ears of the business owners. It is unlikely that employees communicate with their employers in complete honesty. Nevertheless, this information is essential for business owners to realise an optimal employee work experience. Although dedicated individual meetings with the employees can partially extract this information, this can be experienced as a burden for the business owners. It is a lot more complicated to get a grasp on employees' work experience compared to work activities like administrative work.

3.4 | EXPLORATIVE INTERVIEWS WITH EMPLOYEES

The interviews with business owners showed that the ability to optimise employees' experience is a clear motivation for business owners to start generating indoor environment data. The employees' perspective on 'the optimal' work environment and experience is essential since it can spark the ideation and help shape what the sensor-based product should entail. In this chapter, interviews with employees are performed. Topic such as indoor environment data or smart technology are not discussed at the beginning of the interviews. The reason behind this decision is to prevent any biases or push the participants' answers in a certain direction.

3.4.1 | METHOD

Compared with the difficulty in finding a decent number of business owners in chapter 3.3, finding employees in small businesses was less complicated. Some participants were contacted through the business owners of the previous interview round. Others are alumni from the IDE faculty who have worked at the target companies for over a year. I assume that employees with more than one year of experience can form their own opinion on the questions about their work experience and environment.

Like the business owners, these employees are active in a wide range of industries; sustainable consultancy, educational prototype design, organisational consultancy, the energy sector, transport and data analytics. The businesses in which the employees are working range from two to thirty employees. Although the variation in industries and company sizes is representative, the participants' ages range from 25 to 35. Gathering a broader age range was not manageable in time, compared to all the previous interviews that were conducted with a wider age range.

Figure 19 | The digital setup of an interview with an employee.

These participants work at various places in the country: Amsterdam, Rotterdam, Delft, Utrecht and Dordrecht. The participants that work in the neighbourhood were interviewed face-to-face, and the others were performed digitally. Compared to the previous interview rounds, these interviews were not guided through a visual speaking prompt. Therefore the setup and, indirectly, the level of interaction was identical for the face-to-face and digital interviews.

An interview guide once again maintained consistency throughout the interviews; see appendix H. This guide covered various topics such as personal, work environment, indoor environment data, employer effort and work experience. Each segment had its own goal or purpose in the interview. The following segments were discussed in the interview, which took about 30 minutes.

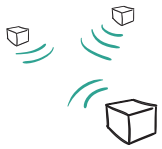
Personal

Like any previous interview round, the interviews begin with a short introduction of myself. Afterwards, the interviewees are asked to introduce themselves and explain their role in the company. The interviewees are asked why they have chosen for their current company. This question is asked to derive potentially common triggers that play an essential role in employees' decision-making process. This segment is concluded by asking them about their current opinion of the company to discover if the previous expectations differ from the actual work experience. This final question indirectly introduces their opinion on their work experience to stimulate answers for later segments.

Work environment

This segment is about the optimal work environment, without any correlation with the current work environment situation. The interviewees are asked to give their perspectives on an optimal work environment. After given their perspectives, the interviewees are asked to make a distinction between nice-to-haves and must-haves. I assume that these must-haves are similar to their previously mentioned triggers for choosing to work for a particular company.

Secondarily, the interviewees are asked how companies could stimulate them to physically work more often at the office. Although I assume that no extra triggers will derive from this question, it might confirm potential possibilities for returning personnel to the work environment. The final question within this segment is to what extent the employees want to control or have an impact on the day-to-day work environment.



Indoor environment data

This segment is about the accessibility of indoor environment data. It is introduced with a statement followed by questions to jump-start the conversation. Firstly, the employees current accessibility is discussed, after which the interviewees are asked what data they want to be able to access. The segment is concluded by asking to what extent the work environment should maintain an optimal indoor air quality on an everyday basis. These questions could confirm the perspective of the business owners that the employees should be able to trust the optimality of the IAQ. It can bring to light if they can or want to trust their employers. This question also introduces the next segment of the employers' effort.

Employers' effort

Like the data segment, this segment is introduced with a statement to extract the level of consciousness on the fact that employers try to realise an optimal work environment. This question is followed up by how this effort is communicated with the employees and how this can be improved.

Work experience

This final segment is like the previous two, introduced with a statement about the awareness of business owners on the state of mind of their employees. This statement provides another perspective on the feeling of business owners that lack to grasp the employees' work experience. This segment will result in a better understanding of how employees communicate with their business owners. Especially to what extent the differences in their roles impact their communication. If there is a barrier between the employees and their employer, how could this be overcome? The final question of the interview is if the employees feel that they would be taken seriously if they communicate how they feel. Does the shared information have an impact on the way these two stakeholders interact with each other?

3.4.2 | RESULTS

The seven interviews with employees were recorded to fully compehend their answers. These recordings made it possible to turn the given answers into 'quote' post-its on a Miro board. The important post-its in the raw data were clustered to generate new insights; see appendix I. These clusters resulted in three overarching categories: small businesses, indoor environment data and communication, further elaborated in the following paragraphs.

Small businesses

A critical trigger for employees to choose a particular company is the industry in which they are active. However, many interviewees mention that they have deliberately chosen a smaller-sized company in the industry they work in. In the eyes of the interviewees, smaller businesses are often related to more freedom, extra responsibilities and the ability to have a say in matters. Small businesses regularly involve employees in making decisions outside their job descriptions. This involvement positively affects the employees since they feel important as an individual by being able to contribute to make an impact. This involvement in small businesses is contrary to the feeling of being a number in big corporations, which some participants also have experienced. In these small companies, the employees solve problems and consider opportunities together as a team. Although these responsibilities are generally positive, it could also increase the pressure on employees, making it an overwhelming experience.

> *I have the feeling that I can truly make a difference and contribute on making impact." - Employee 5*

The employees confirm the drive of small businesses to express professionalism to the outside world. This professionalism is often implemented in the choice of work environment or dress code. However, in the eyes of the employees, the company's image is primarily caused by the type of people working within it.

The majority of the employees state that there is a high social cohesion between the employees of small businesses. Small businesses have relatively few employees, which causes a higher level of trust between the employees. The employees regularly look after one another personally but could also help each other in their work activities. It often happens that problematic situations are already being resolved without bothering business owners. In their eyes, this social cohesion will increase even more if employees are frequently present at the office. The employees state that they are more willing to travel to the office if they know which fellow employees will be working at the office.

> *We solve things among the employees, it is often not necessarily to bother someone in a management position." - Employee 3*

From the employees' perspectives, small businesses' work environments play an important role in realising the ideal work atmosphere. An ideal work atmosphere inspires the employees, offers the ability to focus and has a representative character. However, realising such an ideal workplace is not the primary focus of a business owner. Therefore the employees start initiatives to realise this ideal atmosphere by personalising the work environment by purchasing plants, putting pictures or art on the walls and creating varying spaces. These work environments transform from cold, conventional environments to ideal places where employees can work in the way they want.

> *It was originally a bit of a boring space, but we did some work on it ourselves, like buying plants and putting pictures on the wall. This is not done by the company itself." - Employee 5*

Indoor environment data

In the discussion on the perspectives of an optimal work environment, some employees mention small businesses struggle to maintain an optimal temperature. Besides the temperature, no other indoor environment variables are accessible to the employees. Nevertheless, the temperature is the only variable they genuinely understand and know how to influence.

> *Can you give an example of what other data there might be?" - Employee 5*

The employees are aware of frequent suboptimal effects in the work environment. They just need a clear idea of what data could have caused this suboptimal situation and how to solve it correctly. Although they are unaware of the potential data, most are not interested in getting to know the specific indoor environment data. The employees mention that they do not know what to do with the humidity and CO2 levels if they become accessible. The emphasis should instead lie on the effect of suboptimal indoor environment data and how to resolve it.

> *I actually do not care about that the kind of data.... but more specifically about the effect it has on me." - Employee 4*

In the eyes of the employees, good indoor air quality is essential for an ideal work environment. However, some employees expect that they can take the optimality of it for granted. The employees do not constantly want to check or be notified of the optimality of the indoor environment. Although it should primarily inform the employees when a suboptimal indoor environment occurs, the indoor environment data should always be accessible to verify whenever they are hesitant about a situation. If a suboptimal indoor environment occurs, the employees want to be informed of its short and long-term effects on them. After getting to know the suboptimality, the employees want to know how to solve it and realise an ideal work environment again.

> *It's more that if I want to see the IAQ I want it to be accessible. I do not have to receive a daily notification of it, like 'the office has an ideal work environment." - Employee 4*

The employees are aware of the uniqueness of every company and therefore doubt the effectiveness of the offered solutions. Solutions can not be as effective in all situations. In some offices, heating can be turned on, but will barely increase the temperature in an hour. This results in the fact that they would like personalised solutions for the businesses' context to prevent the product from becoming useless.

> *If you turned on the heating at the old office you were literally heating for outside." - Employee 4*

Communication

The majority of the employees believe they can open up and discuss their experiences without any misconceptions or negative consequences. However, only a few employees discuss their personal experiences regularly. Some rather keep things private and start acting differently to mask it. This behaviour is partially a result of the fact that employees are cautious about opening up because there is a chance that others start perceiving them differently and might judge them. If employees open themselves up to other, by communicating their experiences, it is perceived as losing their pride.

In the rare moment that employees share their thoughts and experiences, the business owners often go into action mode. These business owners instantly try to solve their employees' negative experiences. However, this negative experience could be just an exceptional circumstance and necessary to communicate to feel relieved for the employees.

> *Then [business owner] tries to look for solutions right away. Sometimes the comment was just about one particular afternoon, but I just wanted to get it off my chest." - Employee 4*

Changes in the work environment or actions done by business owners are a sign of being taken seriously. The employees feel that their employers do not always take their experiences seriously. The lack of change after communicating the experiences is the leading cause of this feeling.

> *If you point something out, nothing gets done with it by the business owners ..." - Employee 2*

3.5 | CONCLUSION

The three explorative interview rounds with flex offices managers, business owners and employees have contributed to a better view of the targeted small businesses in office environments. Although many potential motives exist to generate indoor environment data, a new motivation namely optimising employees' work experience, arose from the interviews with the business owners. The interviews with employees brought a more in-depth understanding of how the sensor-based product could optimise their work experience. The following paragraphs elaborate on this small business context, the use case for indoor environment data, work experience elements and design direction takeaways.

Small businesses context

Each business is unique due to variations in business vision, work culture, size and work location. However, **the target audience, small businesses in the sectors M, J, L, K and N, which are located in office environments, have many overarching similarities and can be treated identically.** The interviews with business owners and flex offices showed that the targeted small businesses grow organically and, therefore, frequently change office environments. This organic growth is partially caused by the fact that many business owners are yet unfamiliar with running a business. This growth process emphasises the need for plug and playability of the overall sensor-based product to stand the test of time, as stated in chapter 1.1.

The interviews with the business owners and their employees showed the urge that small businesses want to exude professionalism to the outside world. At the start, this often results in renting a work environment in a flex office to experience the convenience of the facilities often solely connected with bigger corporate buildings. During the growth process, the expression of professionalism transforms into the urge to become more autonomous, to get rid of any labels and increase the need to be taken seriously. From the employee's perspective, professionalism of a business is primarily expressed by the behaviour and attitude of the employees themselves.

Besides the day-to-day work activities, these businesses have to cooperate with extra responsibilities, especially after leaving the fully-facilitated flex offices. These extra responsibilities range from office and facility management to finance and cost efficiency. Although these responsibilities are just a fraction of the total set of responsibilities of the business owners, these are the responsibilities that are not described as business owners' favourite compared with the acquisition of new projects, for example.

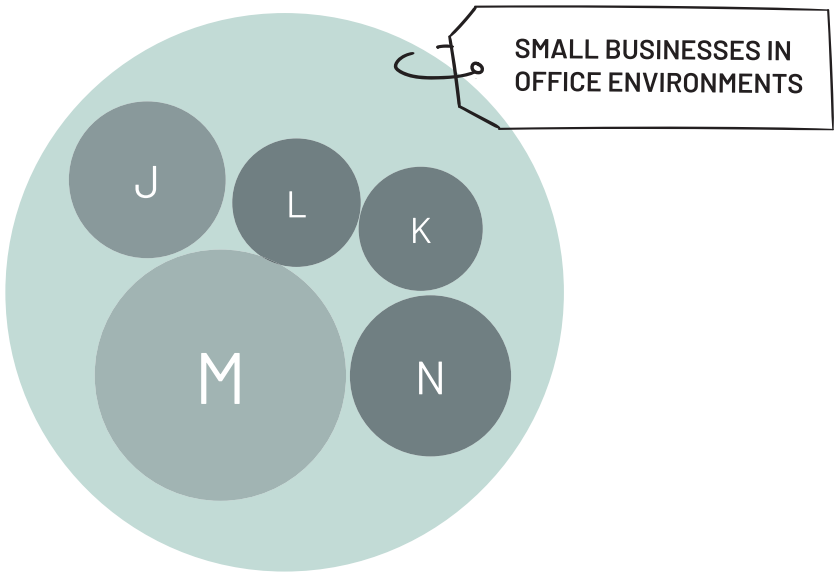


Figure 20 | The target audience, small businesses in the sectors M, J, L, K and N, can be treated identically.

Indoor environment data

The targeted small businesses based in and out flex offices are generally unfamiliar with indoor environment data and its opportunities. The indoor temperature is one of the only measurable variables which is clearly accessible and can be concluded from with the current small businesses' knowledge. This unfamiliarity with indoor environment data is partially caused by the fact that proper indoor air quality, which is a big component of the overall optimality of the indoor environment, has been blindly trusted on. The employees trust the business owners which on their end trust the building owners to realise an overall optimal indoor environment, including proper indoor air quality. The flex offices confirm that optimal indoor air quality is one of the essential features of an office. Although optimal indoor air quality can generally be trusted in fully facilitated flex offices, some business owners located in conventional office environments have experienced short and long term consequences of a suboptimal indoor environment. Through these negative consequence these business owners have learned the hard way, that the optimality of the work environment should not be blindly trusted.

Measuring indoor environment data can help in preventing these suboptimal consequences and start realising a healthy work environment. At the same time this data can assist in the facilitation of cost reduction and the reduction of the businesses' environmental impact. Although all these use cases could be of interest for business owners, **the business owners were only devoted to start generating indoor environment data to optimise the work experience of their employees.** The employees' work experience is complicated to grasp for business owners since they feel that the 'complete' employees' experience does not reach them. Nevertheless, business owners recognise the importance of it, because it positively affects the efficiency and productivity of their employees. Without getting to know the complete experience of the employees, it is difficult to maintain the optimality of the indoor work environment and retain the personnel. Realising an optimal work experience and environment could benefit business owners in attracting new personnel, which can be problematic in the current employment market.

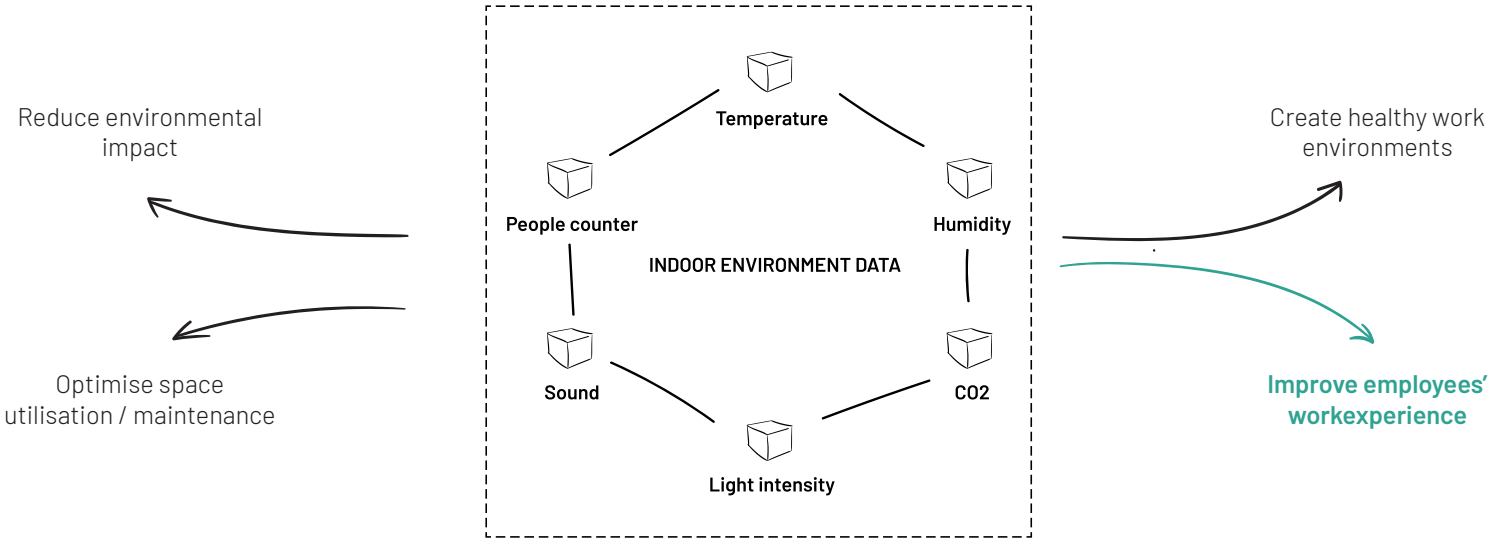


Figure 21 | A rough overview of the potential of indoor environment data.

Optimise employees' work experience

The work experience of employees in small businesses is currently affected by five elements: their contribution to make impact, fellow employees, personalisation of homely work environment, optimal work conditions and the feeling of being heard.

Apart from location, employees primarily consider the type of industry and size of a business while choosing a workplace. Small-sized businesses often offer their employees more freedom, extra responsibilities and the ability to have a say. This results in employees being regularly involved in making decisions outside their job descriptions. These equally distributed responsibilities combined with fewer employees result in stronger social cohesion and a pleasant work experience.

This social cohesion can become even stronger when fellow employees are frequently present at the office. This presence could be increased by informing the employees which colleagues are planning to work at the office. Through an increased employee presence combined with a personalised and homely work environment set-up an appealing work atmosphere can be realised. This work environment setup could stimulate the employees in their creativity and ability to focus. Unfortunately, the realisation of this setup often has to be initiated by the employees themselves.

Initially, the employees trusted their employers in realising an optimal indoor environment. However, they have experienced certain suboptimal situations in which they did not know what could specifically have caused it. Insights into indoor environment data could help clarify the cause of these suboptimal situations to help maintain an optimal indoor environment and indirectly increase the work experience.

The final influence on the employees' work experience is the feeling of being heard. Although many employees state that they can communicate their work experience, many do often not communicate it. Communicating their (personal) experience can feel like they lose their pride or they might be judged and perceived differently by others. In the rare moments the employees do communicate their feelings, business owners often go straight into 'action mode' and try to prevent future bad experiences. Although the actions by the business owners are a sign of being taken seriously, the employees' negative experience could be an exceptional circumstance and solely meant to be communicated as a way of relief.

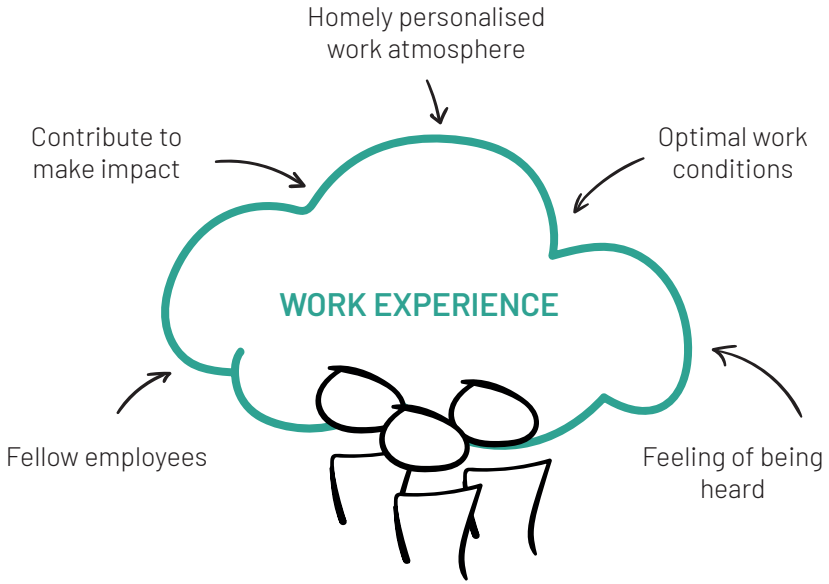


Figure 22 | An overview of the aspects that can affect the employees' work experience.

Sensor-based product takeaways

If raw indoor environment data gets generated by the sensor-based product, it should be processed into recommendations and trends. The raw data will not ring any bells for the business owners, especially at the beginning. These recommendations and trends should be communicated with actionable tasks to solve suboptimal situations and maintain an optimal work environment. The ability to control te businesses' work environments will result in a higher acceptance range of the measured variables. Nevertheless, the raw data should stay accessible for the business owners to gradually learn and gain more background knowledge.

Although raw indoor environment data could confirm the optimality of the work environment to the employees, in the eyes of business owners, it should not be easily accessible to the employees to prevent further distractions. If the sensor-based product does increase the work experience by informing the employees about the optimality of the indoor work environment, the employees do not actively want to check or constantly receive notifications. The employees exclusively want to get notified in suboptimal situations by communicating its effect and how to resolve it. The indoor environment data should still stay accessible to enable employees to take a look when they are hesitant about the correctness of the indoor environment status.

Additionally, this generated indoor environment data could be shared with similar-sized companies. Sharing this data can help business owners that are unfamiliar with running a business by setting common variable benchmarks and mediating in negotiations for new work environments.

Ideally, the sensor-based product could help boost small businesses' professional image and enthuse visitors or future customers. Maintaining an optimal work environment for employees will already positively impact this image of professionalism.

CHAPTER 4

CONCEPT

The indoor environment data can become desirable by optimising the employees' work experience. Although the sensor-based product can impact this experience in various ways, this chapter transforms the use case and its product takeaways into actual designs. An ideation phase based on the product takeaways led to the first concept: No time for Work. This concept is thoroughly evaluated with four participant groups, distinguishing new and existing participants. The results of the concept evaluation sparked an iterative digital prototyping process that led to a new concept embodiment. Once again, this concept embodiment is evaluated, but this time through two interactive prototype setups. These final validation sessions have resulted in a better understanding of what the final design for the sensor-based 'flagship' should entail.

4.1 | CONCEPT 64

4.2 | CONCEPT EVALUATION 68

4.3 | CONCEPT EMBODIMENT 82

4.4 | CONCEPT EMBODIMENT EVALUATION 88

4.5 | CONCEPT NOTIFICATION EVALUATION 100

4.1 | CONCEPT

In chapter 3.4, the employees' perspective showed that it is not always necessary to include and bother the business owners in suboptimal situations. The exclusion of the business owners clarifies the lack of grasp on employees' work experience, which the business owners mentioned. On this note, a suiting concept has been designed to increase the employees' work experience; the ideation of this concept can be found in appendix J.

4.1.1 | CONCEPT EXPLANATION

The sensor-based concept designed for small businesses in office environments is called; 'No time for work'. This concept unites and improves the autonomisation of employees by normalising an optimal work environment. In this concept, the generated data by the SensorBloxx sensors is combined with the communication of the time on a physical object.

If it is up to me, having access to time is as normal as it gets. However, this concept will not provide employees with time, partially to normalise a proper working environment. The concept states that it is no 'time' for work when certain indoor environment variables are not as they optimally should be. The clock stops communicating the time to indicate the suboptimal indoor environment to the office employees. This clock will notify the employees of the optimality of the work environment in a non-intrusive way, so they will not have to actively check it themselves or constantly get notified and distracted.

Next to these environmental factors, human behaviour can also cause the clock to stop visualising time. It tries to encourage employees to have breaks, chat with fellow employees, and not work overtime to further increase social cohesion. These encouragements are added to create a balance between positive and negative indications of the clock not visualising the time.

There are two other components within the concepts' ecosystem besides the sensors and the physical clock. The clock physically communicates to the employees and the business owner(s) that something is up, but both parties do not precisely know what is wrong or how to solve it. Therefore the clock is connected to a mobile interface and a dashboard interface. The mobile interface is designed for employees and business owners instead of the dashboard, which is solely dedicated to business owners.

The mobile interface makes its users aware of the suboptimal situation. It explains what causes the clock to stop visualising the time in combination with communicating the severity of the situations on a short or long-term basis. After telling the cause, the interface provides the users with concrete solutions specified to their situation. These solutions are combined with making the users aware of the currently active systems within their office building, like the status of a possible HVAC system. However, sometimes some situations cannot be solved directly; therefore, employees can report the problem anonymously to their business owners. The feature to anonymously report will assumably lower the threshold for employees to inform about suboptimal situations.

The mobile interface users' reports are sent to the dashboard application, which the business owners manage. Here the business owners get personalised recommendations of long-term solutions for the suboptimal situations measured by the sensors. These solutions get backed up by the implementation results of similar small businesses coping with the same situation. Next to normalising good indoor environment quality, many other applications of the raw sensor data are available in the dashboard application. The trends in the raw data will be highlighted for the business owners to prevent other suboptimal situations, reduce costs and optimise the workspace.

NO TIME FOR WORK

A product-system that normalises an 'optimal' work environment. This concept increases the social cohesion and the level of autonomy of office employees by enabling them to take control over their work environment.

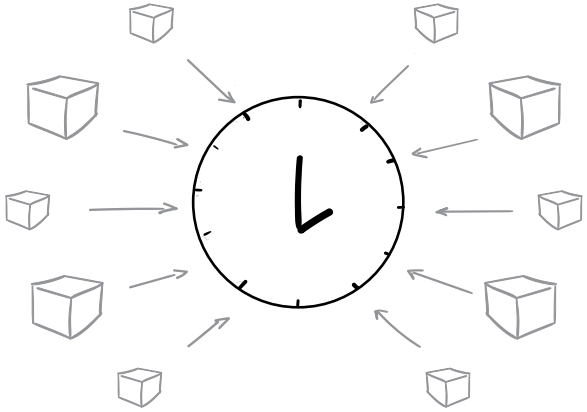


Figure 23 | A visual representation of the goal of the concept 'No time for work'.

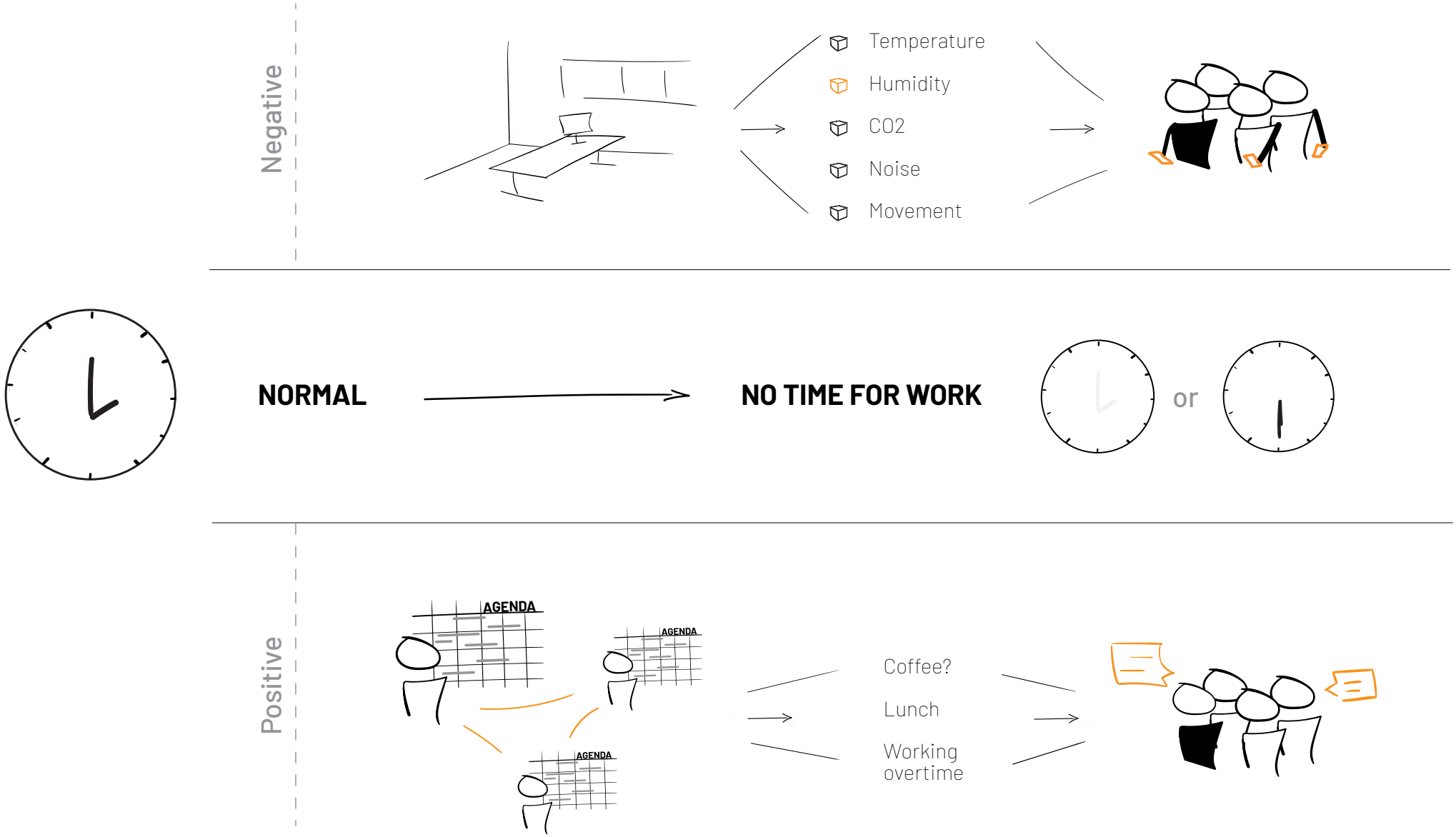


Figure 24 | A visual representation of the concept 'No time for work', which combines 'negative' notifications based on indoor environment data with positive ones to further increase social cohesion.

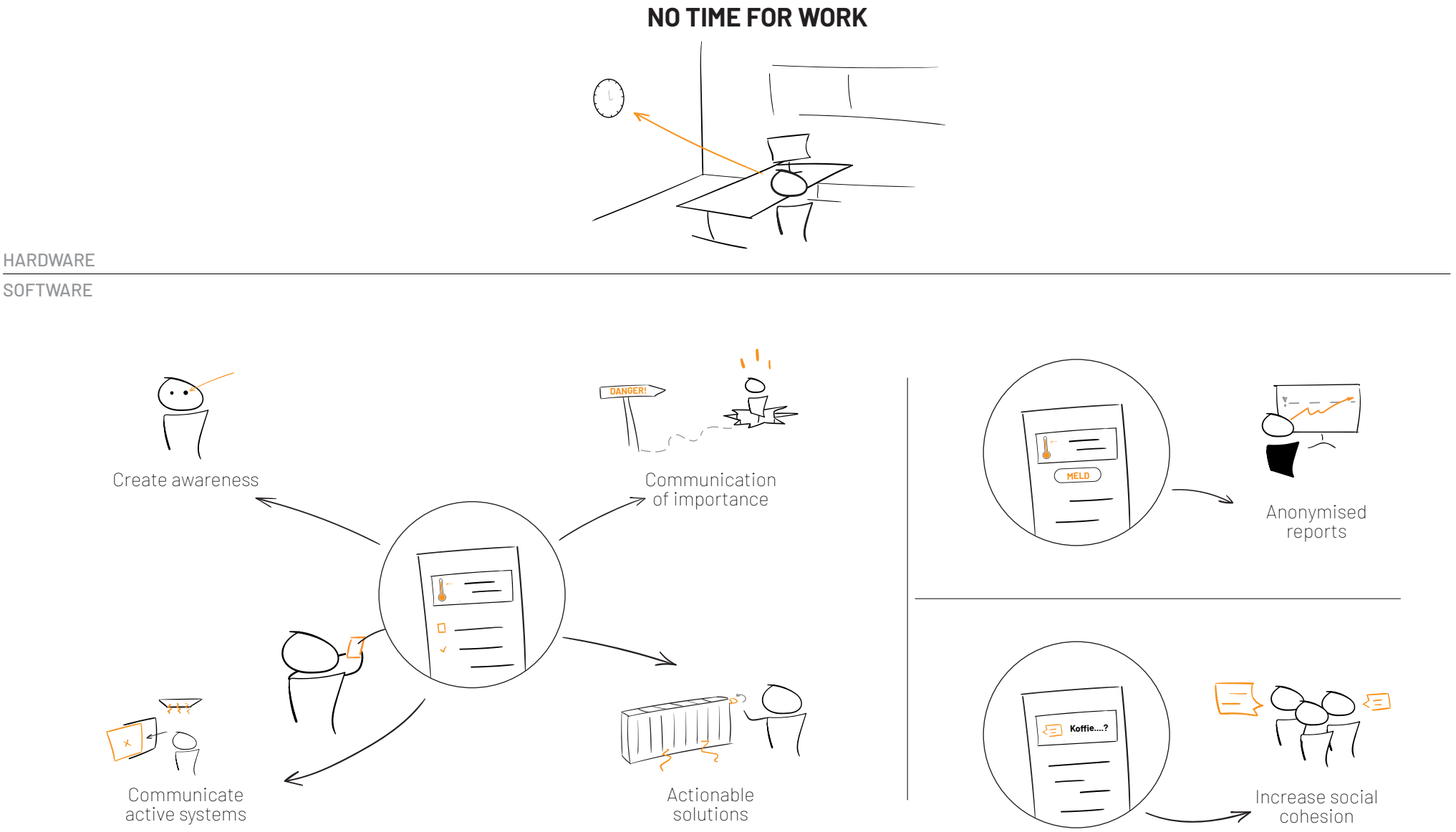


Figure 25 | The full set of components of the concept ' No time for Work', which include a digital mobile interface and computer dashboard.

4.2 | CONCEPT EVALUATION

The concept: No time for Work is presented to a wide sample size consisting of new and previous participants. This evaluation round is essential to validate the correctness of the concept direction and further improve the desirability of the concept. This concept evaluation is performed in a non-interactive way through visualisations on praatplaten.

4.2.1 | PARTICIPANT SELECTION

A representative sample participant group that combined business owners and employees had to be gathered. Although the 'No time for Work' is designed for business owners, the product will primarily be used by employees. Both groups of stakeholders are subdivided into new participants and existing participants from previous interviews. Talking to these previous interviewees (so-called 'existing participants') again validates whether this concept direction matches their given answers. The new participants will offer a fresh perspective and are not biased due to possible previous conversations. These new participants will also bring to light if the concept is universally applicable and implementable. The ratio between new and existing participants is as close to 50:50 as could be arranged in time. This results in four separate participant groups see figure 26. These four groups combined created a total of 18 participants.

The 'newness' of the two participants on the business owner's side is debatable because they both operate in a company I was already in contact with. However, neither of these participants was involved in the earlier stages of the research. Therefore they are both still taken into account as new participants. This only resulted in a decrease in the number of new businesses.

Two of the 18 selected participants stand out from the rest, coloured in green in figure 26. These two 'new' employees are contacted to look behind the borders of the defined target group. One of the participants works in a design consultancy and flex community in one. This results in an office space filled with employees from various companies. The other participant works in a company with more than 50 employees, but they are divided into three different locations. These separate groups of employees might act similarly to the targeted small-sized companies. Although these two interviews cannot function as proof of concept with these related stakeholder groups, they can offer a preliminary view of the possibilities to design for and include other target groups, like flex communities and medium-sized companies.

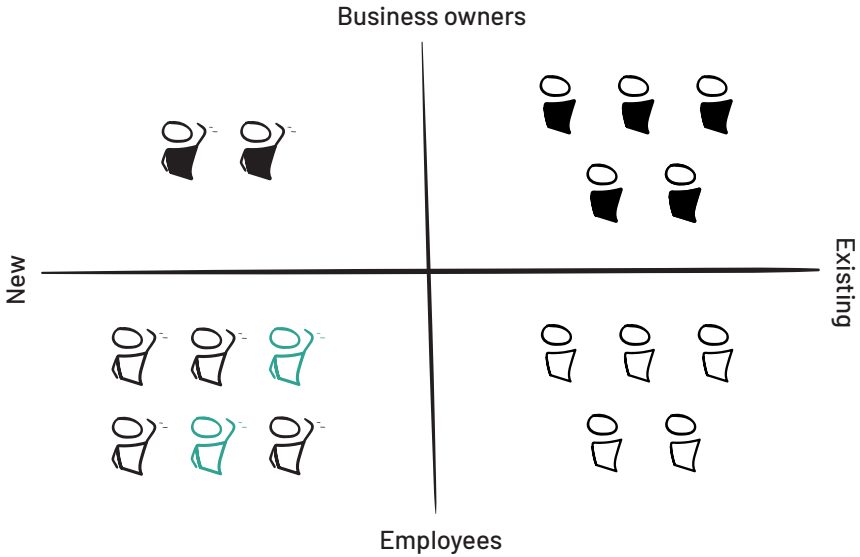


Figure 26 | The four varying participant groups. Top-left quadrant visualises two new business owners. Top-right quadrant visualises five existing business owners. Bottom-left visualises six new employee participants and bottom-right five existing participants.

4.2.2 | METHOD

Each of the participants was asked for 30 minutes of their time. The way that these 30 minutes were organised was identical for each of the four participant groups. However, during the meetings with the existing participants, it was possible to follow up on items said in previous meetings. These follow-ups were key in creating an in-depth validation of the concept. In the interviews with the business owners, the emphasis was more on the overall concept.

During the explorative interviews, I discovered that an in-person meeting decreases any borders between the interviewer and interviewee. It opens up the conversation and simplifies interpreting the participants' emotions while discussing. Therefore ninety per cent of the validation sessions were held in person. Unfortunately, the last ten per cent was held digitally due to the travelling distances and difficulties in planning all the sessions within one week.

During the physical sessions, the interviewee was either facing me or next to me; see figure 27. This setup made it possible to have the 'praatplaten' in front of them and enabled me to guide them through the visuals of the praatplaten. In the two digital sessions, the 'praatplaten' were shared during the video call; see figure 27. Although the participants did not have direct control over the 'praatplaten', they were told to instruct me whenever needed.

The validation sessions could be divided into a concept pitch, a general discussion, and a more in-depth discussion on communication. These three parts were guided digitally and physically with four 'praatplaten'; see figure 23, 24, 25 and 28.

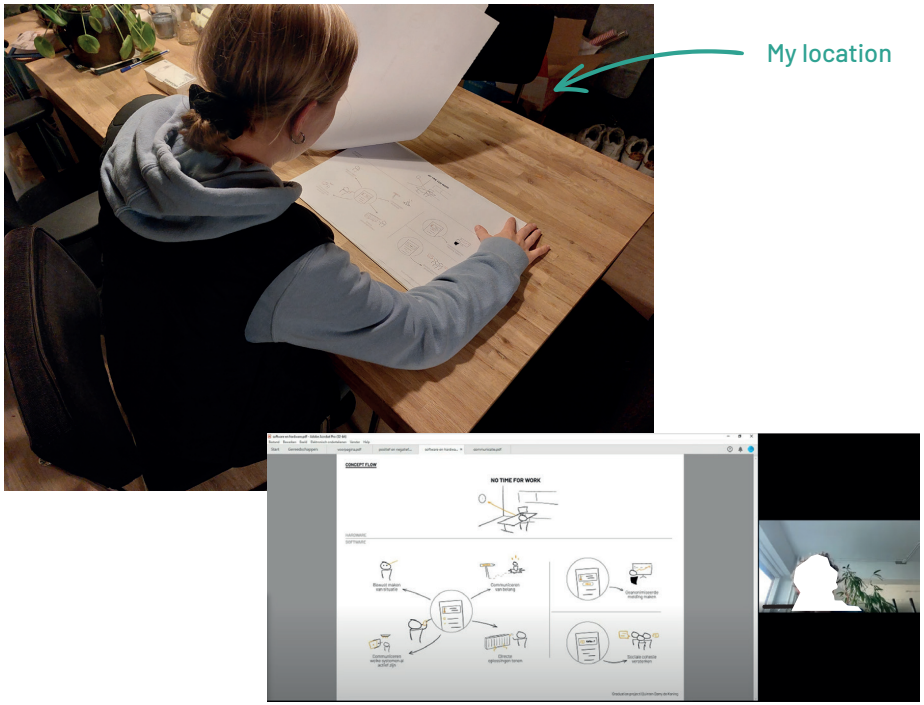


Figure 27 | The setups of both the digital and physical validations sessions.

Concept pitch

The first three 'praatplaten' were designed to support the concept pitch given to the participants. The concept pitch is similar to the previous description of the concept. The participants were allowed to interrupt this concept pitch and to be brutally honest.

General discussion

The presented concept was further discussed in the second part of the validation sessions. The interviewee's opinion on the presented concept direction came to light in these discussions. A list of potential questions was formulated to spark and guide a discussion. This discussion is the only part without a dedicated visual speaking prompt. However, the participants were allowed to use the previously presented praatplaten to clarify their points. The conversation started with their opinion on the designed concept and gradually moved towards the effect of the concept. The formulated questions are translated and can be found in appendix K, because the interviews are held in Dutch.

In-depth discussion on communication

The final in-depth communication discussion brought an end to the validation sessions. This part was added to let the participants think outside the boundaries of the presented concept. However, this part was only performed if there was still enough time left after rounding off the general concept discussion. This in-depth communication discussion presented five scenarios in which the clock could notify the users differently. The scenarios are named: urgency, solved, solvability, mute, and waiting. The fourth visual speaking prompt visually backed up these five scenarios, see figure 28.

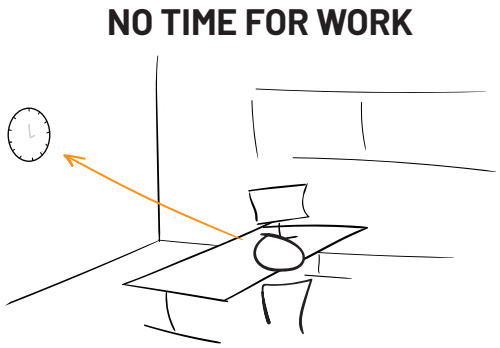
URGENCY | In the current design, the product will only communicate two extremes: optimal or suboptimal indoor environment quality. However, some of the variables that initiate these suboptimal and optimal states will have a more significant impact on the productivity of the employees than others. Should the clock visualise the urgency of the suboptimal situation? If so, would it become a gradual process or match the communication of the extremes?

SOLVED | In the third prompt, the user's flow is defined up until the task to solve the suboptimal situation. What should happen after a task has been completed? Should it immediately switch to the optimal state?

SOLVABILITY| As stated in the third prompt, not all the suboptimal situations are solvable by the employees due to fundamental problems. Should the product notify the employees in the same way in both situations?

MUTE| In the current design, the sensors keep measuring the data, and the physical product will notify the user of suboptimal situations at all times. Should employees have the ability to mute the system at all? I can imagine that in some cases, the employees would want to have the ability to mute the notifications.

WAITING| Similar to the solved scenario, the product will notify the users of a suboptimal situation. Sometimes these suboptimal situations will be solved over time by the currently active systems. If the employees decide to wait for the variable to reach the target level, what should the physical object communicate? Should the clock directly switch to an optimal state after telling the system there will be waited?



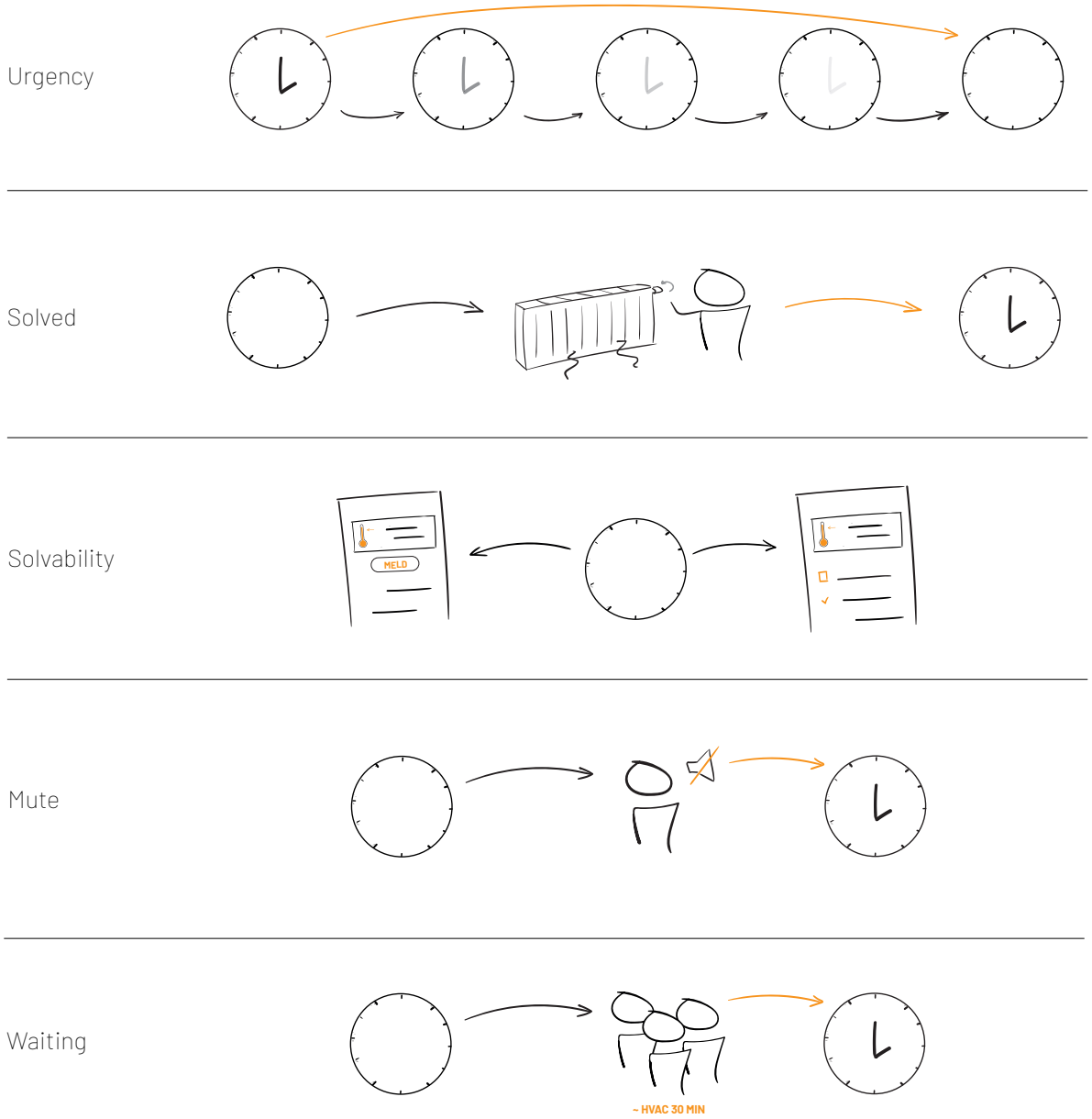


Figure 28 | The fourth visual speaking prompt that visualises the undefined functionalities of the concept that are discussed in the final part of the interviews.

4.2.3 | RESULTS

The 18 interviews with the four participant groups were recorded to relisten to their answers more carefully. These recordings made it possible to turn the given answers into 'quote' post-its on a miro board. The important post-its in the raw data were clustered to generate new insights; see appendix L and M. Although the insights from the business owners and employees are separated, the division between new and existing participants is solely mentioned when there is a remarkable ratio between these participant groups. These clusters resulted in four overarching categories: physical display, notifications, digital interface and others, further elaborated in the following paragraphs.

Physical display

All the participants, business owners and employees mention that the notifications on the clock should be visible from each workplace. From the employees' perspective, this clock does not necessarily have to be pontifically present for everyone while looking up. However, it should be at least possible to see, for example, when wandering around. The consistent level of visibility for each employee is crucial because if this is not the case, the employees that can see the clock will eventually solve all the suboptimal situations which could become a burden. These inequalities among the employees could harm social cohesion and divide them instead of uniting them.

To realise equal visibility, in some work environments, the clock must be of substantial size or placed in multiple locations in one work environment. Communicating time in a substantial size or multiple times in one room can become confrontational for the employees since it will emphasise 'time' in the work environment.

> *I would like it if I could see it when I look up. It doesn't have to be fully in my field of vision"*

In the eyes of business owners, a clock is not the best fit for the embodiment of the 'subtle hint'. Most businesses do not even own a clock, especially not in every room. The employees confirm that they never use physical clocks since they can check the time on their watch, phone, or computer while at work. The time is even visualised in multiple locations on the screen during a video call meeting. A physical clock is often bought as decoration rather than for its functionality. The notification displayed by the clock can be seen as a disadvantage for the few employees that do actually use the physical clock's functionality. This disadvantage again results in inequalities between the employees, considering that a handful of employees will be negatively affected by not seeing the time and being the first to notice the notification displayed on the clock.

> *The clock is rather a work of art than a timepiece. I already see the time in three places on my screen"*

Some business owners and employees are hesitant about the level of subtlety of the notification on the clock. In their eyes, the notifications will not catch the eye of the employees while working in focus.

> *Of course, it is very nice that the trigger is not intrusive, but as long as I am focused on work, I will never see it.*

In some industries, it is common that third parties like customers and partners often visit the office. The notifications displayed on the clock can be confusing for these parties, because it is not a familiar clock functionality. If a suboptimal situation occurs, it has to be explained repeatedly to the new visiting parties. Although it is good to openly communicate about the importance of a good indoor environment, if not done properly, it could harm the company's reputation, according to the employees.

> *"It works better in an office with many permanent employees and few guests. It shouldn't cause confusion for third parties."*

One of the employees likes how the clock gets humanised, which is drained of energy when the indoor environment quality is suboptimal. The fact that the clock has a certain personality encourages this employee to solve the suboptimal situation even more. Other employees and business owners mention that it would be beneficial if the product itself could somehow motivate the users to solve a suboptimal situation, without taking the intrinsic motivation of solving the indoor environment quality into account. The product could become a pity when it notifies the stakeholders and is aesthetically pleasing when it is in an optimal state. If the product can motivate the employees, it might become part of long-term behaviour and not result in something that only gets used in the first few weeks after installing the product.

> *"It is difficult to get everyone on board, so you need to find a fun way to get people excited."*

Notifications

Most employees emphasise that the product should not notify them too much, since in an ideal world, the suboptimality of the indoor environment should not be a thing to worry about as an employee. Too many notifications can act as a distraction and be experienced as spam. This experience, combined with the benefits for business owners of employees staying focused, can harm the product's acceptability. The employees agree that it is acceptable that the number of notifications is higher at the beginning, since no systematic approach or individual learning curve has occurred yet. One of the employees proposes that the product could become location specific to minimise this number of notifications.

> *"It also depends on how often it happens in a day. If it happens 10 times, I would think "leave me alone", but once is fine."*

Two employees mentioned that the notifications on individual behaviour should not be communicated through the clock to minimise the number of notifications further. Communicating suboptimal individual behaviour through the clock could become frustrating for employees who focus on optimising their behaviour. On the other way around, it could also cause employees to feel ashamed of their suboptimal behaviour.

> *"It can also be annoying, imagine someone sitting behind the desk for too long and you are focusing on doing everything right. Then it will be like: what's the matter now... it will become frustrating. "*

The employees' opinions varied on how the clock communicates the optimality of the indoor environment. Currently, the clock distinguishes between an optimal or suboptimal indoor environment. This way of communication is immediately understandable and lowers the need to learn and understand the clock's behaviour. Others believe that the clock should gradually communicate optimality because this is a more realistic approach to communicating the data on which it is based.

> *I'm not sure if that's something I want to see on the clock, because then you'll keep looking at the clock all the time. I'd rather be able to see at a glance that the hands are gone."*

If the clock functions as a tool to call for action, it could go directly towards its optimal state after a task has been performed. However, in the eyes of many employees, returning to its optimal state will not be an honest visualisation of the indoor environment quality since the variables will not instantly turn optimal.

> *If you actually see it go up gradually, your action actually has a purpose and not that it immediately jumps back to normal when you turn the knob. That doesn't match with my reasoning."*

The employees' opinions varied on how the clock communicates the optimality of the indoor environment. Currently, the clock distinguishes between an optimal or suboptimal indoor environment. This way of communication is immediately understandable and lowers the need to learn and understand the clock's behaviour. Others believe that the clock should gradually communicate optimality because this is a more realistic approach to communicating the data on which it is based.

Although the subtle hint should not instantly jump back to the optimal state, the employees like a third state to be added that indicates a task has been performed. Meanwhile, the indoor environment is gradually moving towards the optimal state. In their eyes, this feedback should be communicated on the clock and digital interface. This feedback proves that the person performing a task has done it correctly. The business owners like that this feedback state reassures other employees that the work environment was suboptimal, no action is needed anymore, and in a certain amount of time, the product and the situation will be in optimal condition. Nevertheless, after a certain time, the product should start remeasuring the variables to inform the employees that a follow-up solution might be necessary.

> *I would like immediate feedback. That the system sees that I have interacted, I would prefer to hear; "good that you took action and it's back to normal within this time."*

Two employees want to recognise which variable is suboptimal in the notification of the clock. However, two other employees disagree completely by considering that employees could become lax. If some variables are not recognised as necessary by some, they will probably ignore the notification of a suboptimal work environment.

One final comment by one of the business owners states that the subtlety could decrease over time to catch the employee's attention.

Digital interface

Some employees said they would rather have the digital interface installed on their work computer than on a mobile phone since, in small businesses, employees hardly ever receive a work phone compared with the norm of receiving a work laptop. The employees would rather not install work-related software on their phones to separate their professional and private lives.

Although the use of a mobile phone is not prohibited, looking at it during working hours can be perceived by colleagues as doing nothing. This would need to be clarified since the employee would be trying to optimise the working environment. The employees mention that looking at their phones could also distract them from further work due to other applications such as WhatsApp. One of the employees mentioned the possibility of implementing the product as a plug-in to Slack or Microsoft teams instead of installing another software package.

> *During a workday, I try to minimize my phone usage. Sometimes I turn it off or put it in my bag. My laptop is for work, this (phone) is for free time. I would also like to have the ability to check it on my laptop.*

One of the business owners contradicts these statements from the employees. The business owner states that the digital interface should be designed exclusively for mobile use since the employees constantly take their phones with them, which is not the case with their work laptops.

> *I would go for the phone! You already have all kinds of systems on your computer. You often walk away and you take your phone with you."*

The business owners mention many differences in the targeted small businesses. These differences, for example, the type of office building, market, future vision and work culture will influence the importance of certain features of the concept. Some of these features might not be useful or desirable at all for some businesses. The desired target levels of the indoor environment variables can also vary due to these differences. From the business owner's perspective, the optimal level of the measured variables should be primarily defined by science. However, they should be able to overrule this scientifically defined target level by considering the company's vision; for instance, a sustainable ambition could lower the optimal temperature level.

> *I understand that science knows best, but we want to lower the heating due to sustainability, so it's always a bit cooler here."*

Some employees identify the desire to adjust it to their personal preferences. Within a company, people have different characters and ways of working. Therefore the product should not generalise the characteristics of the employees and allow employees to adjust it to their optimal working conditions. One of the employees mentioned that the product could be able to set a company-specific approach by asking each employee for individual feedback. This feedback could be for instance, about the productivity of the day. This extra generated information, combined with the generated sensor data, could formulate a truly optimal working environment for businesses and their employees. The business owner confirms the relevancy of gathering employee feedback since it will also positively influence the reliability of the recommendations. A similar use case of in-depth data is how the level of focus is measured while driving a car. The car can learn the user's behaviour over time by combining data sets. This learning process can eventually recognise certain behaviour and prevent future problems. The overtime learning process of the product can even become smarter by confirming the predicted scenarios through input from the employees.

> *Then, through all the feedback you give every day, the system can build up to the optimal working atmosphere for you and the rest of the office."*

Fundamental problems can cause some of the suboptimal situations measured by the sensors. In the eyes of business owners, these fundamental problems should not be notified by the clock at all, even though this contradicts the earlier mentioned 'honest' representation of the indoor environment quality towards the employees. Although employees feel betrayed by the product if they get notified of a fundamental problem without any recommendations, in their eyes, there is always something they can do about the situation. What they can do might not be a direct solution, but the product maintains its honesty. An alternative could be to go for a little walk outside while the CO2 level is decreasing in the office. The feeling of betrayal will disappear if these alternatives are communicated like solutions because they will not be disturbed for no reason.

> *Imagine there's a shortage of oxygen... then I can still take a walk... that's an action. If I can't do anything, I would find it frustrating."*

The business owners would like that the interface prevents the unwanted behaviour that notifications will be linked with the feeling that a sensor is working incorrectly. Therefore the employees need to have the ability to see the status of each of the sensors. In combination with the locations of these sensors, it will enforce the transparency of the product towards employees.

The employees expect that all the notified suboptimal work environment situations will be automatically reported to the business owners. So instead of deliberately alerting the business owners through the interface, it should be automated by the product itself. However, they do want to be able to highlight certain trends within the data and notifications to create more awareness among the business owners. The employees should be able to see the history and trends of the sensor data to create the ability to highlight trends. Some employees want to have the option to deanonymise these highlights to be able to discuss them at a later moment with the business owner. There are no barriers to discussing these types of problems in some businesses. It creates the possibility of searching for a suitable solution together because the person who highlights the problem will be the one who is most familiar with it.

> *From my perspective, anonymous reporting should be optional. So that I can be approached to talk about it"*

Compared with the quick recommendations for employees, the fundamental problems are not solved within seconds. In some cases, the problem even has to be solved by the building owners or can't be solved at all. Altogether solving these fundamental problems can take a while. The business owners want to be able to mute the variable or change its target value until the solution is realised. The employees agree that if something breaks down, a specific variable should be able to be muted for a predefined period of time by the person accountable. Otherwise, the product keeps notifying the user, which could become annoying for the employees.

> *Imagine it takes a week, you wouldn't walk around with a disabled clock for a week. So that it then switches back to normal for the rest of the sensors."*

The employees agree that individually muting the notifications is not in line with the goal of the product. An individual employee should not be able to mute the entire product for others while they are in the room. However, business owners do want the ability to mute when a variable is overruled on purpose. For instance, when together, it is agreed that the heater is activated because someone 'feels' cold.

> *Actually not, what is then the point of the clock?"*

Others

Multiple employees mentioned that the product could be bought after the initiation of the employees. One of the employees mentioned that it would be easier to convey the business owner by offering a trial package. After buying the trial package, the business owner can decide to expand the product whenever it convinces them. The business owner is not always the person who will buy and install this product. Some businesses have an office manager who will be accountable for everything in the office environment.

> *An important point though, our company owner is not the person who handles this. Our company owner is [Name] but they would never ever do anything with it. It would go to the office manager."*

The business owners agree that all the components should be offered to them as a package deal. This package should be easily installable or installed by a representative of SensorBloxx. This representative can help the SMEs create an optimal fit with their situation.

Two of the employees mention the presence of in-height adjustable desks. These desks are often only used for the first few weeks after they have been installed. However, the concept could stimulate the use of these desks while advising on the employees' way of working.

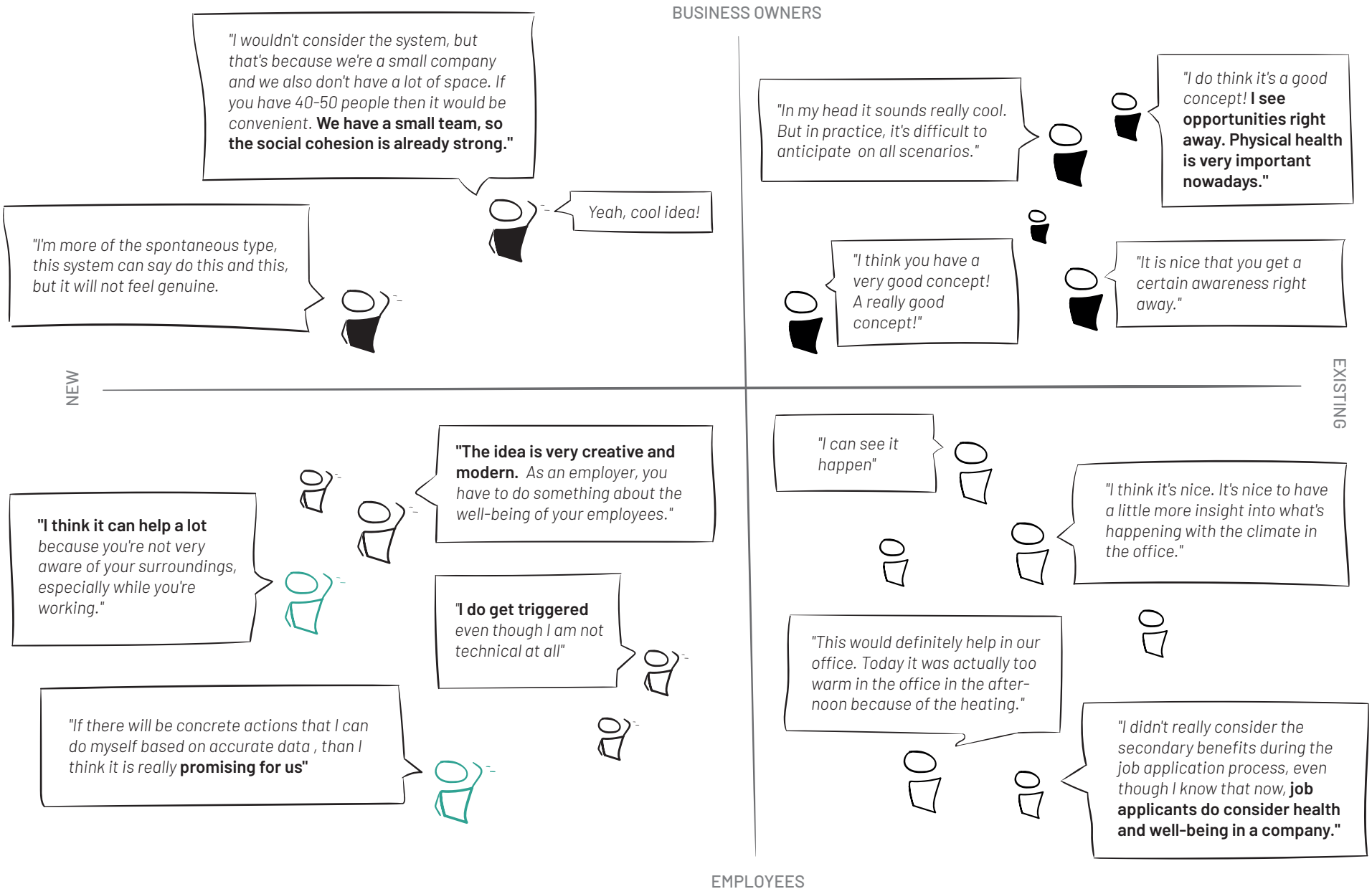


Figure 29 | The quotes of the general comments on the presented concept.

4.2.4 | CONCLUSION

According to the business owners, the presented 'No time for work' concept is already a step in the right direction. Although implementing the insights from the validation sessions can already positively impact the adaptability of the product, more significant changes in the concept are necessary to convince the target audience fully; see figure 29. The product should not forcefully increase social cohesion to optimise the employees' work experience. The product should rather focus on the other two aspects thaWt optimise the employees' work experience; an optimal work environment and the feeling of being heard. Ideally, further optimising social cohesion can still be considered, but more as a secondary objective.

The majority of the employees are interested in the product. Although the businesses' image for employees improves, it would not directly affect their company choice because other factors such as location and salary are more important. Some employees state that they could already have benefited from using the product in the past week. Overall, from the employees' perspective, it will improve their awareness of an optimal work environment, which they were yet unaware of.

There is no clear distinction in the answers between the new and existing participants. This similarity confirms that the product is not only designed for the needs of the participants of previous interviews. The participants outside the target group also show that the product can be useful in their cases. However, further research is needed to validate their result thoroughly.

Next to the overarching changes in the concept, the other necessary ones are defined in the following paragraphs. These changes are once more grouped into the same themes as in the previous results chapter.

Physical display

The business owners and employees agree that the clock is not the correct embodiment of the 'subtle hint'. The 'subtle hint' should strive for equality between the employees. This equality shouldn't be harmed by the direct connection with a functional object in the office space since some individuals will use this functional object more than others and therefore have a disadvantage. The relation with a functional object can also create confusion by visiting third parties. In addition, to be in line with the strived equality the 'subtle hint' should be visible from each desk. Therefore it should become a product which can be installed in multiple locations in the office without it becoming too intrusive.

Ideally, the 'subtle hint' should motivate the employees without relating it to the indoor environment data it represents. Adding this motivation will increase the long-term usability of the overall concept among the employees. In line with the long-term usability, the product should not distract the employees that work in focus. Therefore, the current level of subtlety will not be changed.

Notifications

According to a vast majority of the employees, the number of notifications hugely impacts the desirability and usability of the entire concept. Too many notifications will keep the employees from their work and too few notifications will decrease the relevancy of the product. Therefore a balance in the number of notifications should be created while maintaining its honest character.

The 'subtle hint' should communicate three states: optimal, suboptimal and solved. The product will only make use of extremes instead of taking the realistic gradual visualisation into account. Although a gradual visualisation will match how data changes over time, it will continuously notify the user, which is not in line with the maximum amount of notifications. However, through the implementation of the 'solved' state, the realism and honesty of the product can be maintained. The solved state will be visualised after an employee executes a solution. It will bridge

the gap between the suboptimal and optimal states to create transparency for the employees that a solution has been executed, but the environment is not yet optimal. This extra state will also confirm the success of the task to the employee who executed it.

Partially to decrease the overall notifications, the individual variables will not be communicated through the 'subtle hint'. Therefore the variables will be located on the digital interface of the employee in order to prevent any further feelings of shame possibly caused by other employees.

The ability to recognise the variable in the subtle hint and the call for attention will not be implemented in the product. The recognizability of the variable will create a possible unwanted behaviour. It will thereby add a certain relevancy to the variables, which should already be taken into account by the product. The call for attention to the employees is not stimulating the user to work in focus, which is the main task of the office space and therefore not implemented.

Digital interface

Some employees question if for day-to-day use the digital interface should be a mobile device. Due to the fact that employees within the targeted smaller businesses often will not receive a phone from their work. Some employees aim to keep their business and private lives separate. Downloading a work-related application on the phone could harm this division. At the same time, using a mobile phone during working hours can be perceived as odd by fellow employees and can further distract the user from their work. However, the current concept is built on the fact that the product knows your location, because it will communicate the IEQ of the room you are in. A mobile phone will be more often brought along with you in comparison with a desktop or laptop. Therefore the digital interface will still be primarily designed for mobile phones.

The product will be delivered with predefined target levels of the chosen variables. These predefined settings are based on findings in scientific research. However, the context of the targeted small businesses varies a lot; therefore, some features might not even be desirable or useful. Business owners should be able to adjust the scientific target level to match their company. Next to the major differences between companies, the optimal working environment in the eyes of the employees varies too. In order to match their personal preferences a feature to provide feedback should be added. The product should be able to recognise patterns within this feedback in order to suggest changes in target levels of the variables. The product's reliability will increase through the implementation of this input feature.

Some of the suboptimal situations measured by the sensors can be caused by fundamental problems. The business owners do not want these problems to be communicated with the employees at all, because the employees will not be able to do anything about it. On the other hand, the employees think that if there are no direct solutions available there are always alternatives that can be performed. In combination with the honesty and transparency of the product, the alternatives offer a reason to keep communicating the fundamental problems on the digital interface.

In the current design, the employees should manually alert the business owners of repetitive situations, so-called trends. The employees want all the trends to be automatically recognised and sent towards the business owners because they are the ones responsible for a good working environment. The employees do want to be able to highlight certain trends to create awareness among the business owners. These highlights should be able to be deanonymized. By knowing the name of the employee that highlighted it the business owners can start a conversation with them about the severity of the situation and the possible solutions.

Both the employees and business owners know that a mute feature decreases the relevancy of the overall product. Nevertheless, there are scenarios in which a mute feature would be desirable. If something breaks down, the 'subtle hint' would constantly notify the users, which will keep distracting the users from working. In this case, the business owner wants to be able to mute the variable until the situation is fixed. The variable should not be able to be muted for an indefinite period of time to keep the pressure on the business owner to solve the situation. Sometimes the target level might be exceeded intentionally for a part of the day. In this case, the employees should be able to mute it together for a certain duration of the day. However, this feature should not be too easily accessible for the employees.

Business owners ought that some notifications might be falsely associated with sensors that are not working properly. To prevent this behaviour and match the transparency of the concept the employees should be able to see the status and locations of each of the sensors.

Other

Some business owners want the product to be offered as a package deal that is easily installable. This once more emphasises the required plug-and-playability of the concept. One of the employees mentions the ability to try it out to convince the business owners to buy the product. Although in some cases it will not be the business owners who will be responsible for this product. Therefore from now on, the target users are the ones 'accountable' and the employees.

Nowadays, a lot of businesses own in-height adjustable desks. These desks can be easily implemented in the advice on the individual behaviour of the users.

4.3 | CONCEPT EMBODIMENT

The previous concept evaluation sessions generated many insights that have been implemented in a renewed design. An iterative design process has led to a testable higher fidelity concept embodiment. This chapter explains the new aspects of both the physical and digital components.

4.3.1 | IDEATION

The insights on the digital interface's functionalities are structured in an information architecture, see appendix N. This information architecture is used to categorise functionalities and better understand their hierarchy, which is essential in designing a suitable navigation structure for the application. Although the information architecture is helpful at the beginning, it does not support interactive connections between functionalities. Therefore a task flow diagram has been created, see appendix O. Creating such a task flow diagram is like making a jigsaw puzzle, in which connections between parts are explored.

The information architecture and task flow diagram gave a proper view on the digital design to start making wireframes. Although I usually spend a lot of time making paper wireframes, this time, I primarily designed digitally by using wireframe kits. These wireframe kits resulted in the first digital prototype iterations, see appendix P, Q and R. The two weekly meetings with my company mentor allowed me to perform a quick iterative process. These first wireframes allowed me to remove bad UX practices before creating the testable concept embodiment.

In the concept evaluation, it became clear that the notification should not be implemented in a functional object. A visit to Ikea inspired redesigning the notifying object since it was desired that this notifying object would contribute to a homely atmosphere. Pictures were made and were used to initiate a brainstorm, see appendix S. One of the ideas was selected by considering the user's needs and wishes, including the ability to use aspects of it in the digital interface.

4.3.2 | RENEWED CONCEPT

The presented concept and embodiment in the validation rounds builds upon the new vision: 'realising an optimal work environment together', see figure 30. The optimality of the work environment is built up on the variable target levels set by scientific research. These target levels can be adjusted to match the businesses' visions, for instance, sustainability. The level of optimality can get personalised based on the employees' experience in the indoor work environment by gathering feedback. In this way, the optimality becomes businesses specific and increases the overall relevance of the product.

The work environment is primarily the current location of employees combined with the planned location according to their agenda and their personal preferences. These three main work environment aspects played an important role in shaping the digital interface.

The optimality of the work environment gets visualised on the calm display in three states; optimal, suboptimal and solved. These three states are based on the generated data by the sensors on which the employees can be informed. This information is slightly hidden since it might distract the users. After getting notified of a suboptimal situation the employees get informed of tasks that can be executed to solve the suboptimality.

Realising an optimal work environment should be done together with colleagues as a team. Within this team the product tries to prevent any inequalities between the employees combined with a transparency between the business owners and the employees.

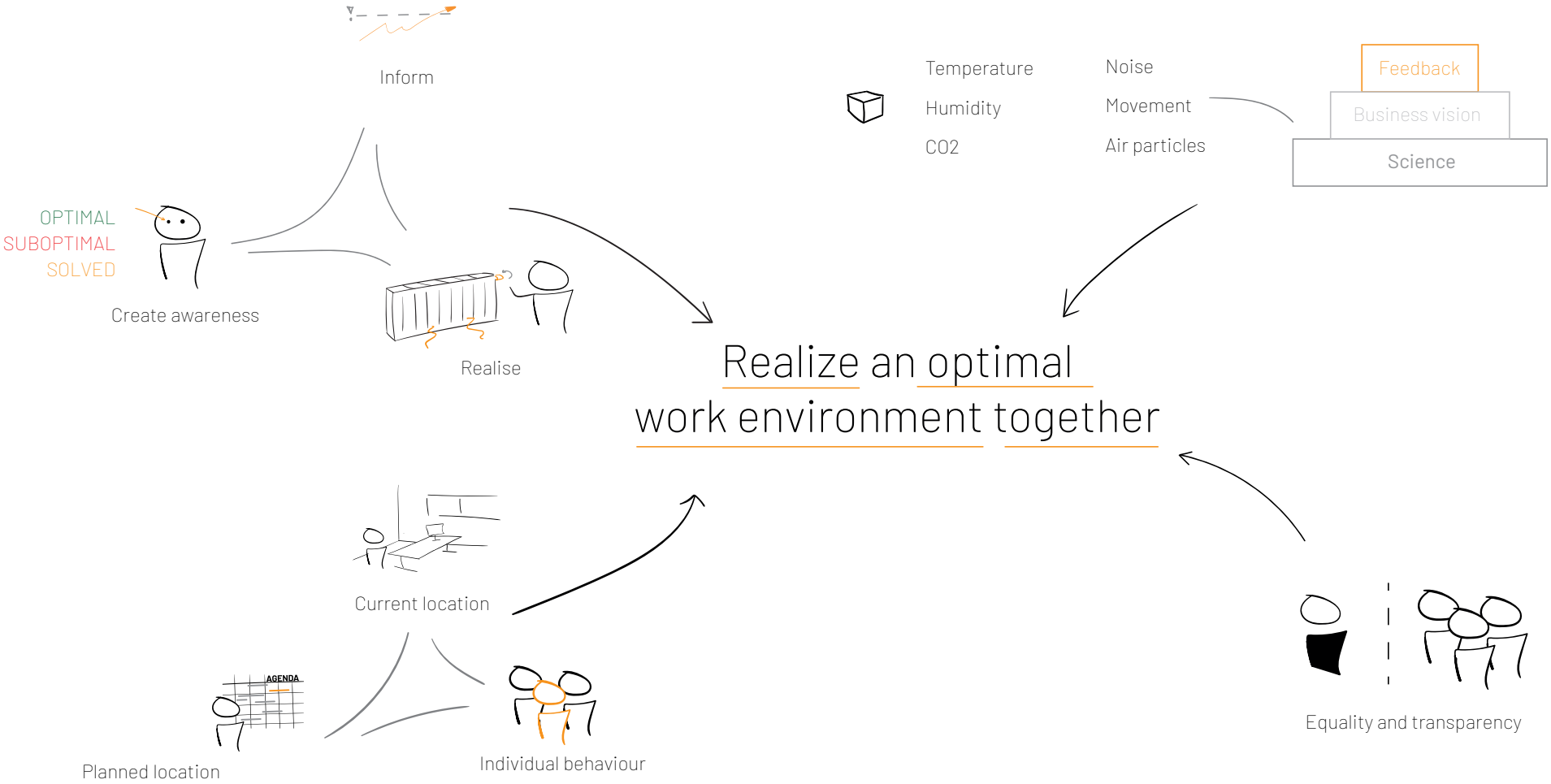


Figure 30 | The visual speaking prompt that is used to recap and update the participants.

4.3.3 | PHYSICAL CONCEPT EMBODIMENT

The calm display changed from a clock to a hanging mechanism; see figure 31. An artwork, logo, or picture can be placed on this mechanism. This mechanism allows businesses to personalise the calm displayed to their preferences and character to increase their affinity with the product. The calm display is not visible in its optimal state since it will hide behind the product placed upon it. In a suboptimal state, this product is visible at eye level while standing to increase the number of employees that can see the product. In a suboptimal situation, the calm display will gradually lower the product to the floor, which the employees will, in a non-intrusive way, notice. After being notified, the user can see the cause in the digital interface, after which the employee can solve it. The hanging mechanism will gradually return the product to its optimal state.

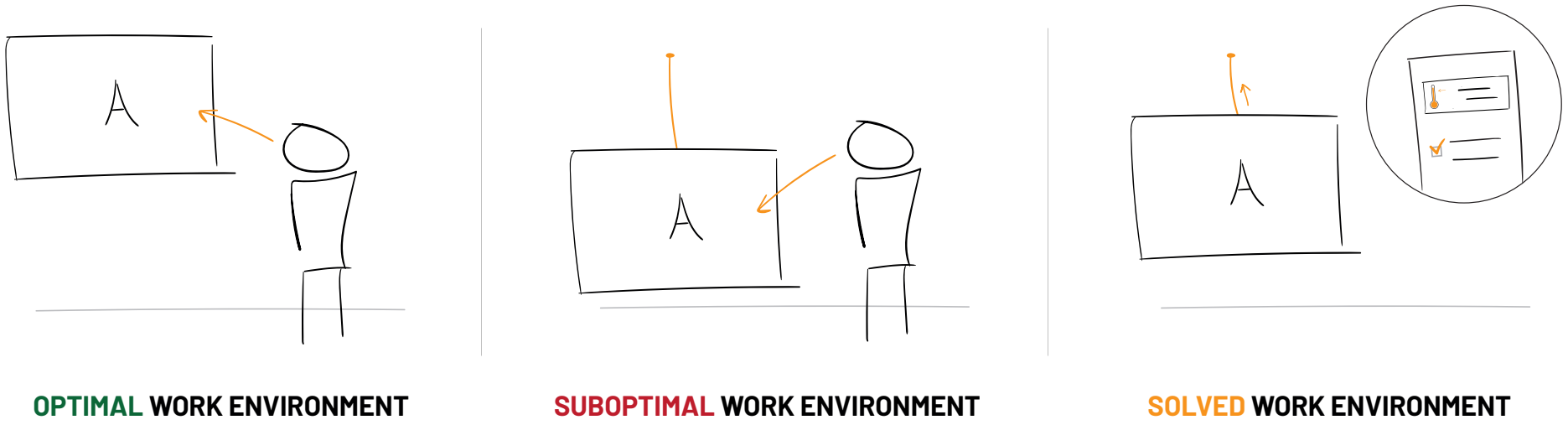


Figure 31 | The three states in which the calm display notifies the employees about the optimality of the work environment.

4.3.4 | DIGITAL CONCEPT EMBODIMENT

The digital concept embodiment consists of two testable prototypes. One represents the daily use of the application in optimal conditions and the other represents the flow of providing feedback. The navigation menu comprises three main components: current room, personal and planned room. In these screens the information displayed on the screen is a bare minimum. The information is minimised to discover the participant's perspective on desirable or necessary information. The application tries to minimise the user's digital flow to prevent employees from being distracted for a longer period of time.

The interface tries to encourage users to give feedback by making the information not accessible right away. This feedback is necessary to realise their context's optimal work environment. In the feedback process the users are asked how they are currently feeling. If the users are feeling good the feedback process comes to an end. Otherwise, the users are asked to select one or more identifiable images that could have caused their negative experience. These identifiable images are consequences of suboptimal work environments, which the measured variables can cause. The interface explicitly does not ask to give direct input on the target variables since the system is smart enough to recognise which variables could have caused the negative experience.

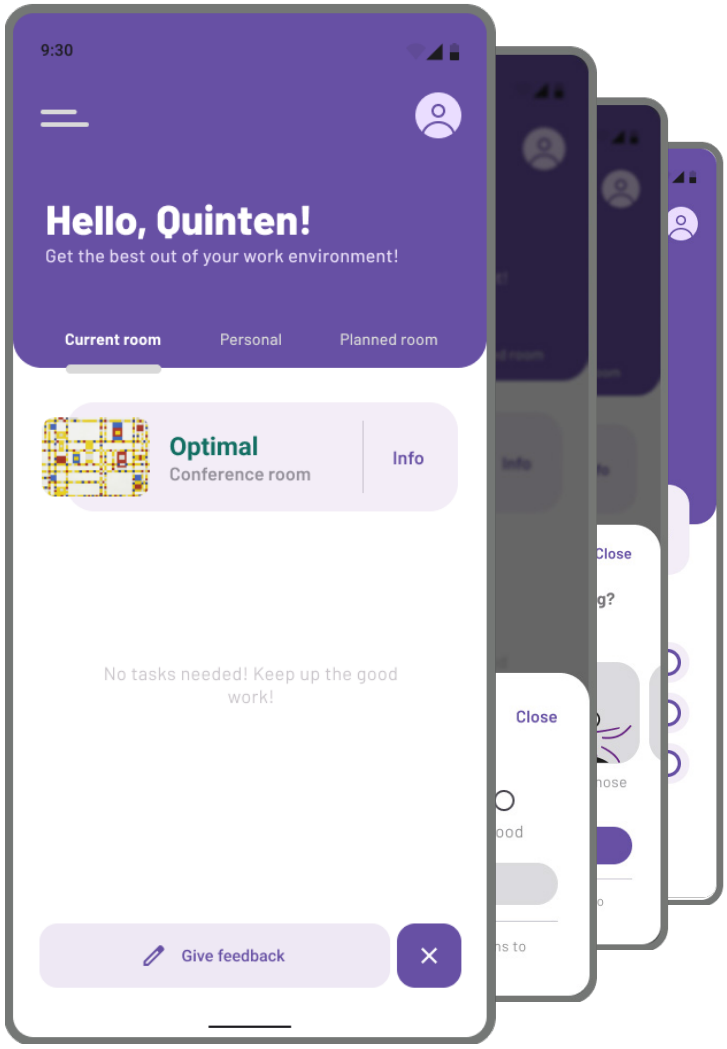


Figure 32 | The mobile interface that supports the calm display. The interactive interface can be tested through this link: https://tinyurl.com/4etxc22y

Day-to-day concept embodiment

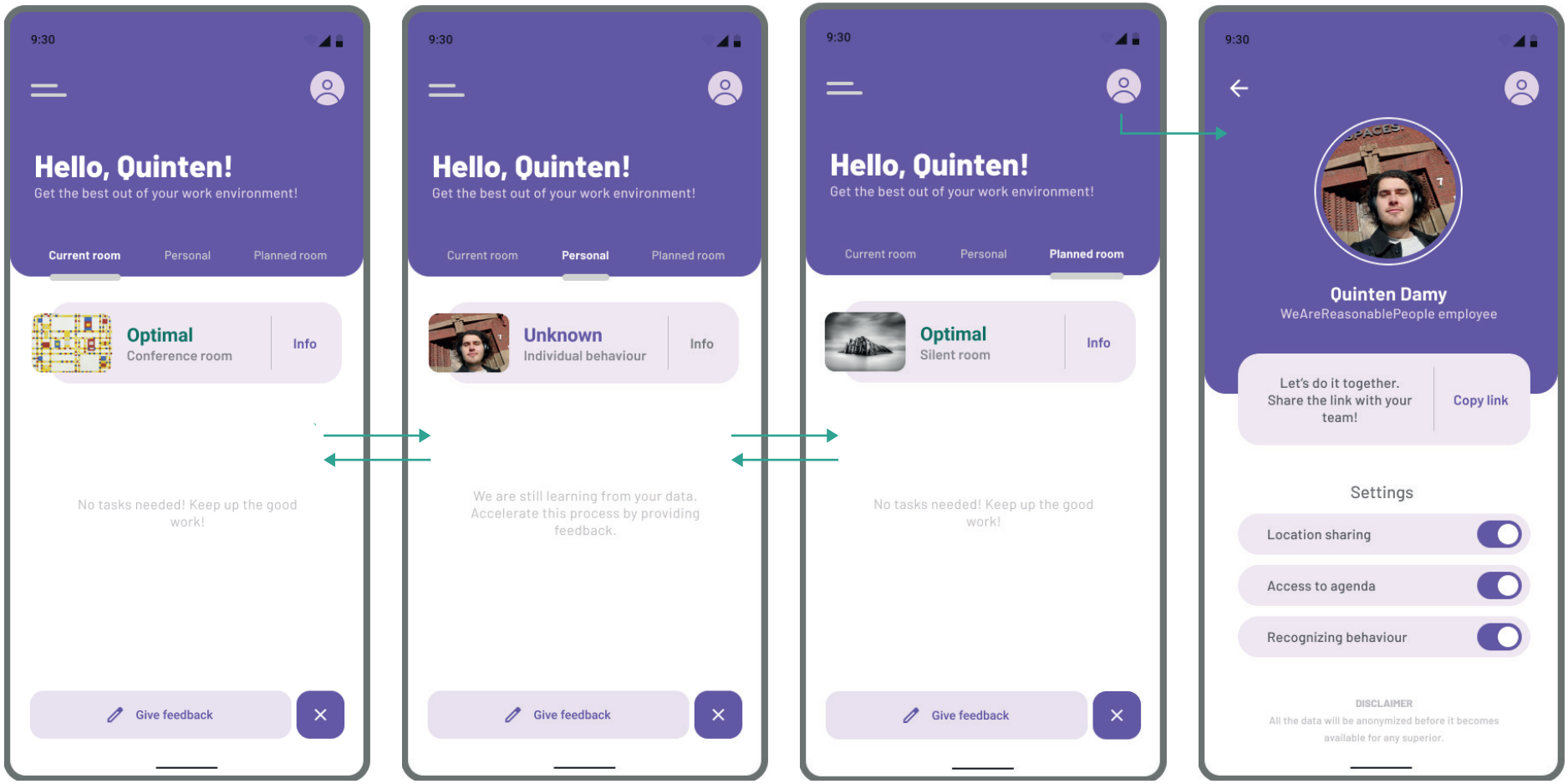


Figure 33 | The screens of the digital day-to-day interface later used for validation.

Concept embodiment that allows providing feedback

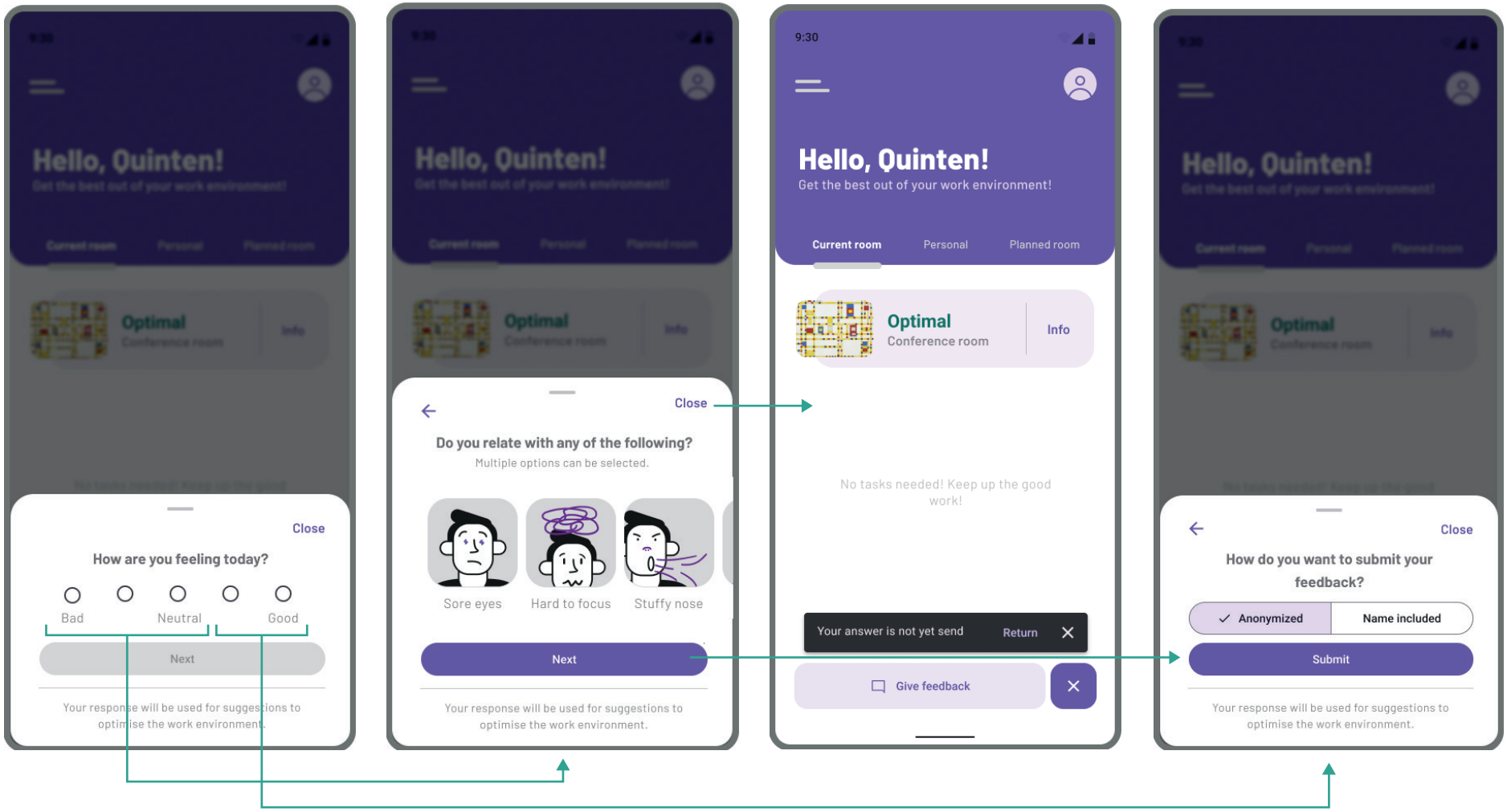


Figure 34 | The screens of the digital feedback process later used for validation.

4.4 | CONCEPT EMBODIMENT EVALUATION

In chapter 4.3, a new concept embodiment was created based on previous evaluation rounds' findings. In this chapter, this concept embodiment gets once more presented to previous participants to provide a final view on the type of functionalities the flagship should entail. This concept embodiment evaluation is partially performed in an interactive way since the digital prototypes are presented to the participants using Figma.

4.4.1 | METHOD

For this final input round with the target audience, the previous participants were once more asked to give feedback. Although gathering new participants could have resulted in fresh perspectives on the designs and overall concept, I intentionally chose to stick with the previous participants. In the previous interview rounds, I discovered that 30 minutes is the maximum time participants can take off their work for these sessions. In these embodiment validation sessions, the participants will see the digital designs and are asked to interact with them, which often takes up quite a lot of time. Therefore the previous participants were once more asked to save time; otherwise spent time explaining the entire concept to new participants. Asking previous participants could also result in more in-depth feedback, because most of the general concept direction feedback has already been given in chapter 4.2.

The selection of previous participants consisted of three business owners and seven employees. The employees will be the primary user of the designed interface. Therefore the prototype of this interface will be tested by a larger amount of employee participants compared to the business owner participants. The business owners are asked to look at the designs from two perspectives. On the one hand, through the perspective of themselves as business owners, by looking at the functionalities they want to provide their employees with the product. On the other hand, through the eyes of the employees, to test if they would be able to understand the designs as well. The total selection of participants provides a varying sample size since it can be compared with the one in chapter 4.2.

The session could be split into three segments; a concept update, generally interacting with the digital interface and explicitly providing feedback. None of these segments were guided with an interview guide, but some follow-up questions were on standby.

Concept update

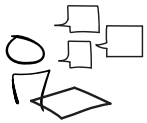
The first segment is supported with, once again, two praatplaten. The first prompt shows an overview of what the overall concept stands for. It provides a recap for the participants and presents the changes made since the previous stakeholder sessions; see figure 30. The second prompt is to show the changes made on the calm display because this is entirely new compared to the clock presented in the concept validation sessions. This prompt introduces the three stages of the optimality of the indoor environment; see figure 31.

General digital interface

The second segment includes the participant interacting with the digital interface. The participants are asked to think out loud and tell what they expect, see and do. The second segment is introduced with a scenario presented to the participants, after which they could wander through the application. The scenario is primarily identifiable by the employees. However, the business owners were asked to imagine themselves in the situation.

"You received a download link through the companies' whatsapp or slack channel. This download link resulted in downloading the digital interface to realise an optimal indoor work environment. You have just finished the walkthrough and gave permission to all the functionalities in the application. This is what you get to see."

To spark a conversation on the digital interface multiple questions were on standby. What do you see? Which information is available for you? Is there more information feasible? How would you be able to get access to this? If you would see the optimal state on the subtle hint, but still decide to open the application, would you be reassured or satisfied with the presented information? What is necessary to realise this reassurance? These questions are to better understand the balance between restraining information from employees to prevent becoming distracted and being assured of the optimality of the work environment. Next to finding this balance, this segment tests the intuitiveness of the navigation structure and the hierarchy between the different components, especially the link with the ability to provide feedback.



Providing feedback

This third segment is exclusively about the feedback functionality of the previous prototype. Before the participants were allowed to interact with the prototype, they were asked about the expected effect of pressing the feedback button. The participants are once again asked to start interacting with the prototype, this time without introducing a scenario. This prototype includes two flows; feeling good or bad. The participants are asked to provide feedback twice, so they get to experience both of these flows. Afterwards, some following up questions were formulated to spark a discussion. What will happen with their provided feedback? How is providing this feedback useful or necessary at all? How often would you provide this feedback? Is there something you would like to add to this feedback functionality? These questions better explain how the feedback functionality could be improved.

4.4.2 | RESULTS

The nine interviews with the employee and business owner participants were recorded to relisten to their answers more carefully. These recordings made it possible to turn the given answers into 'quote' post-its on a miro board. The important post-its in the raw data were clustered to generate new insights; see appendix T. The insights from the business owners and employees are combined. However, it is mentioned in the text when there is a remarkable ratio between these participant groups. These clusters resulted in seven overarching categories: calm display, navigation structure, feedback, personal, planned room, settings page and feedback process, further elaborated in the following paragraphs.

Calm display

All interviewees, both employees and business owners, are enthusiastic about the overall concept direction, especially on the new calm display. The business owners confirm that the design fits their context perfectly. In their eyes, it would be a shame if WARP would not continue with the proposed design.

> *I would consider it a terrible shame if the idea would not be pursued further."*

The most impactful change is the ability to personalise the calm display to your situation. Every interviewee likes that it can match the personality of their businesses by being able to customise it instead of installing a universal implementable product. In their eyes, this customizability makes it playful and positively impacts the atmosphere of the work environment. Some employees immediately imagine and recognise where the calm display can be installed in their work environment. The business owners like that the calm display is subtle and will not be immediately recognised by people from third parties.

> *It's great that you can customize it to your company's vibe. You can make it your own, it will not be a standard product you have no affinity with."*

One of the participants mentioned that it could be used for advertisement purposes. Recruitment companies could bond with small businesses and provide them with branded calm displays, including its sensors. These displays help realise optimal work environments for the employees recruited through these recruitment organisations. In which the small businesses return the favour and keep recruiting with the help of these organisations.

> *You can offer it to the companies you recruit for; you get this from us, but then you have to continue recruiting with our help."*

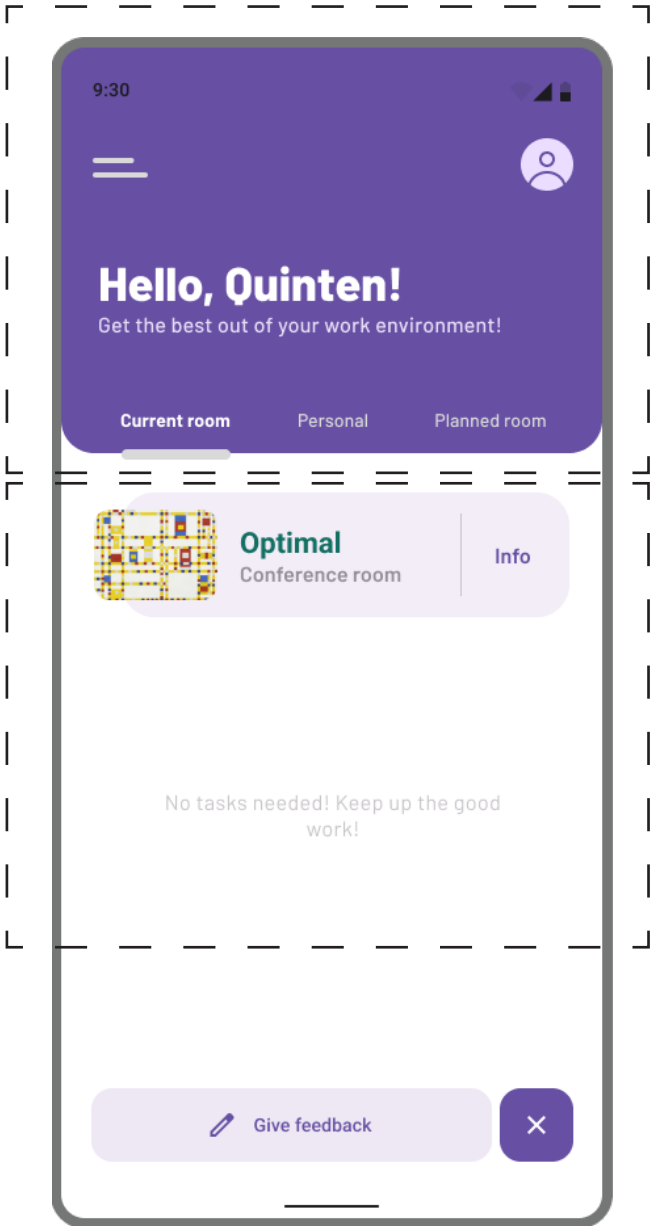


Figure 35 | The home screen of the application that displays the current room.

Navigation structure

From both participant groups' perspectives, the interface's overall navigation structure is clear and well-organized. The participants immediately recognised that they are currently looking at the optimality of the work environment based on their current location.

> *Chill and straightforward. I immediatly saw that it about my current location."*

It is unclear why the hamburger menu is not responding. The participants think it is just excluded from these prototype test sessions or just bugging at the moment.

The purple colour makes one participant think there is a connection with its Microsoft Teams software.

One of the employees appreciates the touch of addressing the users personally by name.

Current room

The participants recognise that the room is in optimal condition. However, the green colours do not stand out since the purple colour of the navigation structure is quite intense.

Overall there is no clear relation with the calm display. Only one participant mentions that the artwork is probably hanging at eye level during its optimal state.

The artwork image on the screen is quite confusing. One participant even thinks it is the map of the room since it is an artwork of Mondriaan. Eventually, the participant recognises that it could be a visualisation of the calm display.

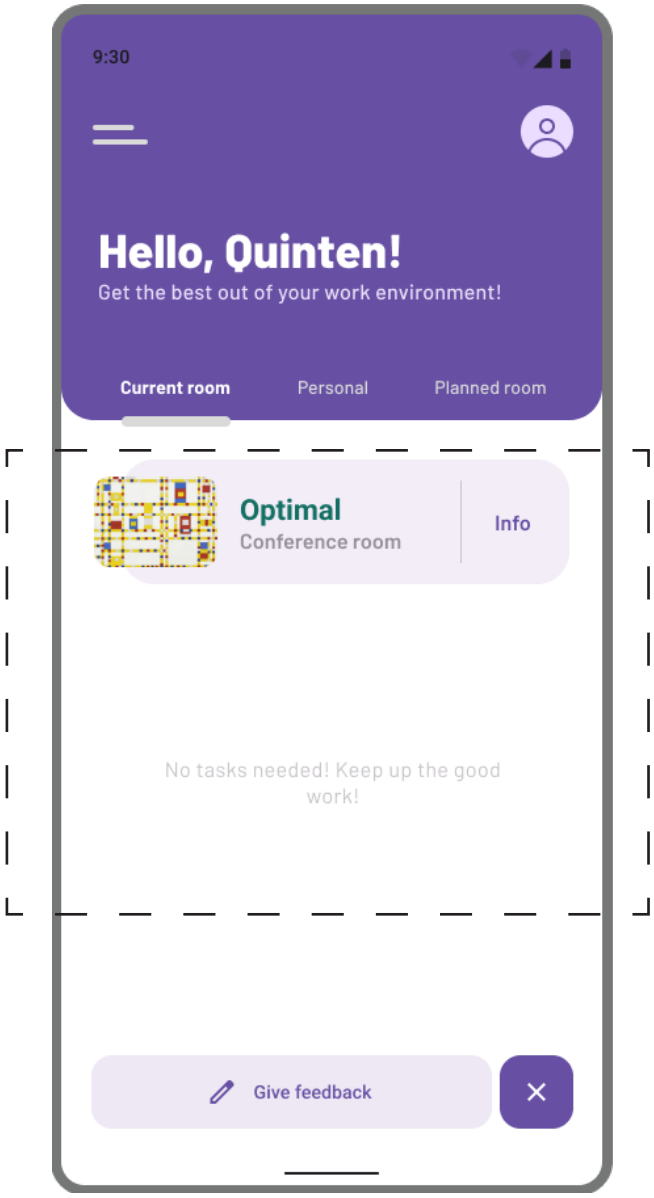


Figure 36 | The home screen of the application that displays the current room.

Some participants mentioned that there was something off with the component that visualises the optimal conditions of their current room, but they did not clearly know what was wrong. They feel that other rooms will be added to this view, which would contradict the fact that this page presents their current location. One of the participants confirms the others' confusion because, apparently, it is visualised as part of a list view.

All the participants kept clicking on the 'info' button. The participants expect that more information will become visible on which variables define the optimality of the current room. If there is a button in the application, it should work and show the result of their action. The employees were mainly curious about what information they would have received by clicking on the button. After a short discussion, they mention that they do not necessarily need to know this extra information in an optimal situation to be reassured. In a suboptimal situation, they want to know what caused the problem. To maintain transparency in the application, the employees want access to this information to better understand what is defined as suboptimal and optimal. On the other hand, business owners want immediate access to the data on which the optimality of the room is based.

> *"I would decide not to show it in optimal conidtions but solely in suboptimal ones, because then you want to know what's going on."*

Some participants mentioned the poor readability of the message; no tasks is needed.

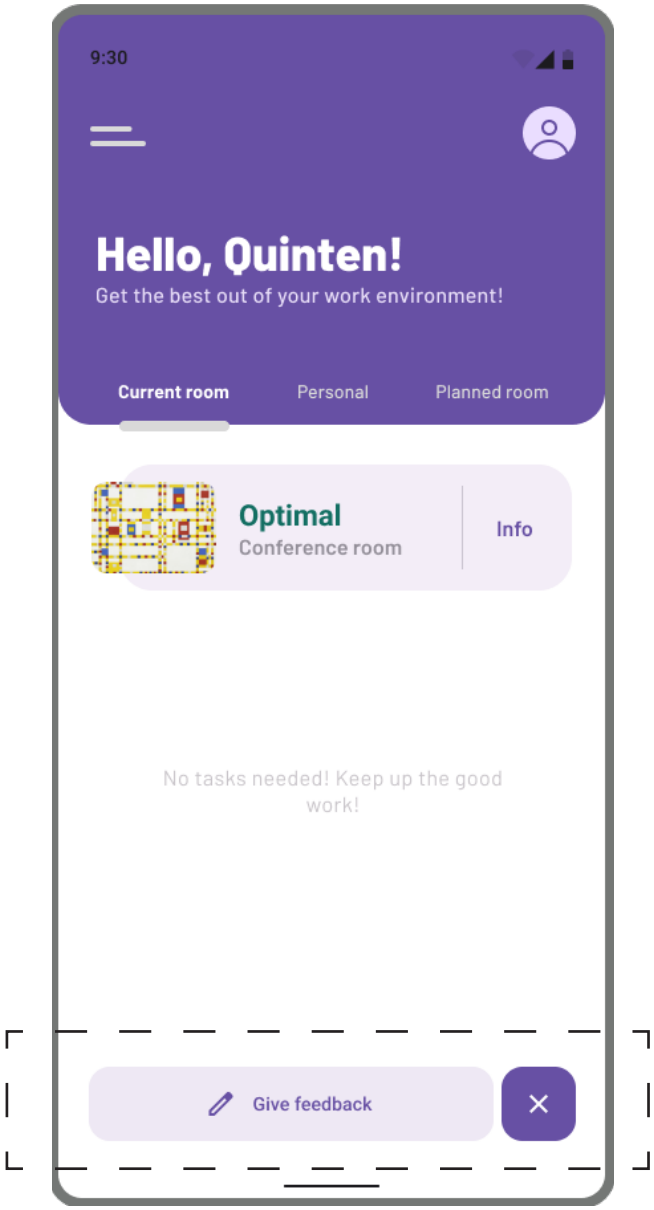


Figure 37 | The home screen which displays a feedback button on the bottom of the screen.

Feedback

The purpose of the feedback button located at the bottom of the screen is for every participant unclear. The wording 'feedback' sparks so many possible use cases in the eyes of the participants. The button could allow the users to provide feedback on the overall application or to mention possible malfunctioning functionalities. However, giving a button with this function such a prominent place in the application would be weird. Some participants even relate it to those annoying pop-ups in certain apps to give them a rating in the app store.

> *"I assume this is feedback about the app itself. I personally find this quite prominent for something you may assume works well."*

Another possible use case in the eyes of the participants would be to provide feedback on the optimality of the room. The wording 'feedback' might not be the best terminology in this scenario. It is not obvious at all that the feedback button is related to the optimality of the screens since only a fraction of the participants recognised the possibility. Since the button is consistent on every screen, swiping left and right, the link between the optimality of the current room and the feedback becomes even more questionable. In their eyes, this insinuates that the feedback could be screen-specific.

> *"I don't know what give feedback does, is it only about this room? Or about the entire app? It seems to me that the feedback is specifically about each tab?"*

After a short explanation of the functionality of the button, the employees mentioned that they would exclusively provide feedback if, according to them, the work environment is suboptimal or they currently experience any complaints. These complaints could also occur at the end of the working day, and therefore, it should also be possible to provide feedback on the whole day instead of a specific moment in time.

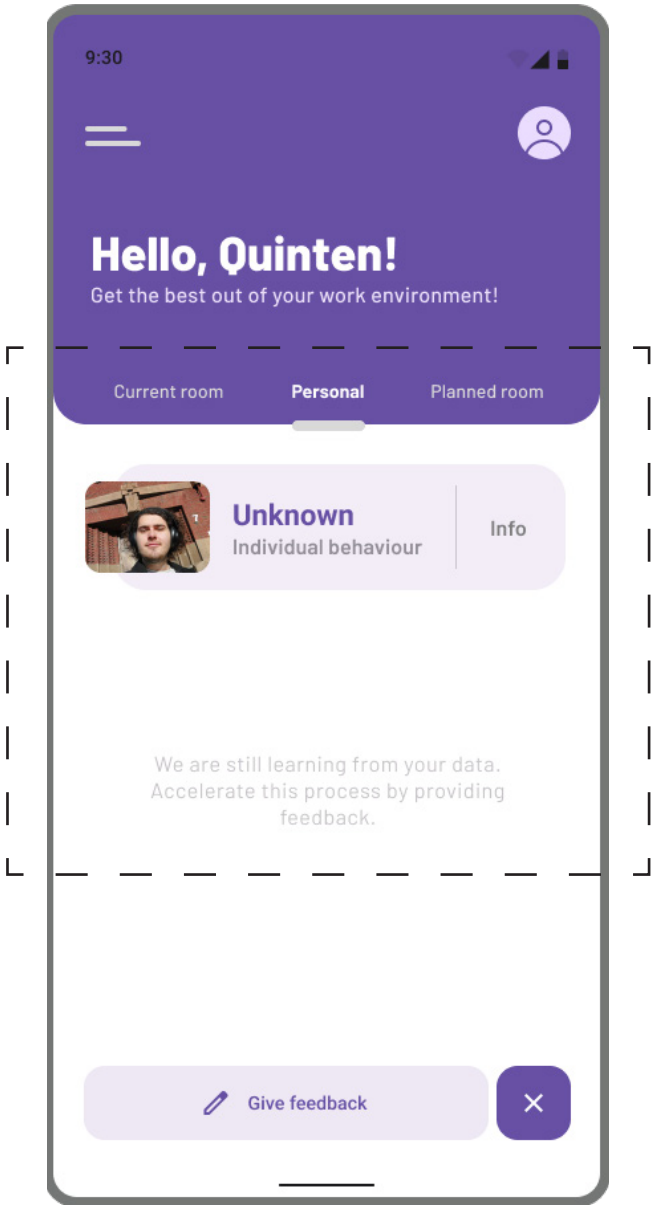


Figure 38 | The second screen of the application that displays the personal recommendations.

> *"I would also give feedback afterwards, then I can personally confirm that that it was the experience of a whole day and not just a snapshot in time."*

The cross button next to the feedback button insinuates that the participants can remove the feedback button on the screen.

Personal

The account button on the top right of the screen feels odd while on the personal page because it is more of a settings functionality than a page for their account.

The participants do not fully understand what will be displayed on this screen since primarily 'unknown' behaviour is communicated on the prototype. The 'unknown behaviour' is experienced as vague since the application already knows the participants' names and has a picture set up. Although the participants get annoyed by the feedback button jumping up, it is unclear what extra information is needed to get rid of this 'unknown behaviour'.

> *"I don't understand why 'unknown' would be here, because it's about me and my name is already known."*

Some employees would think this screen provides information on their regular workplace since the other screens are also work environment related.

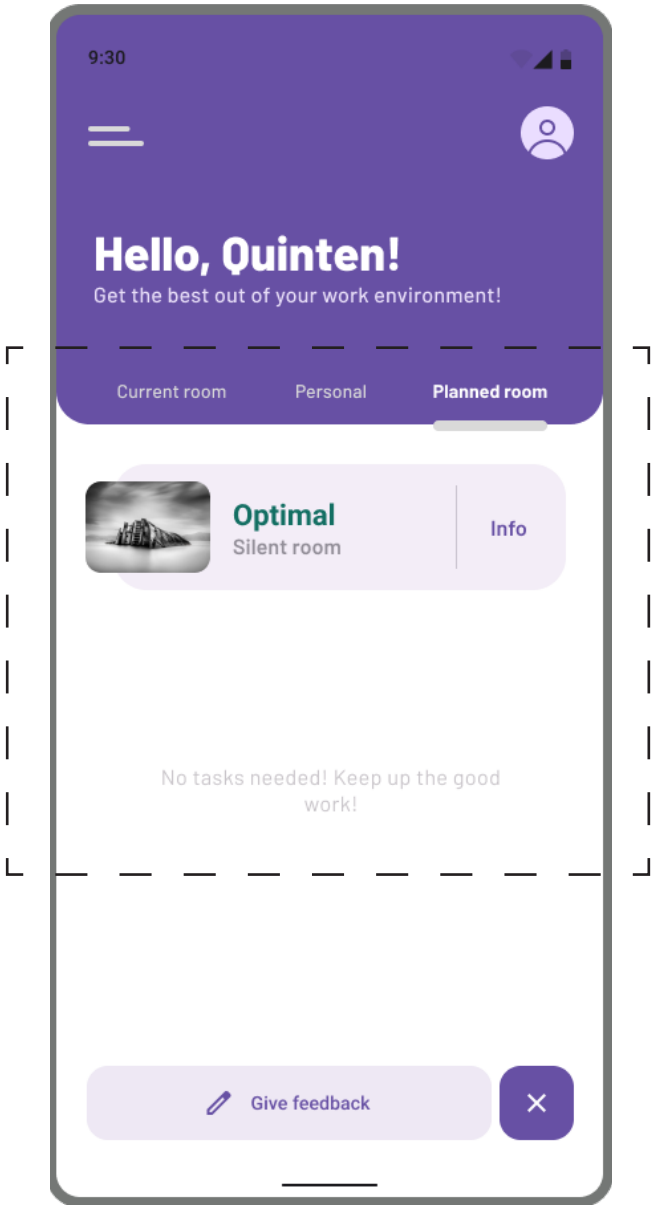


Figure 39 | The third screen of the application that displays the optimality of rooms based on the user's agenda.

Planned room

The employees like that they can see the optimality of the work environments they are planning to visit. However, the connection with the agenda could be more obvious since essential agenda components such as meeting time are missing.

One employee mentioned that it is weird that positive feedback is given while the user is not explicitly in the room. This harms the intelligent image of the overall product.

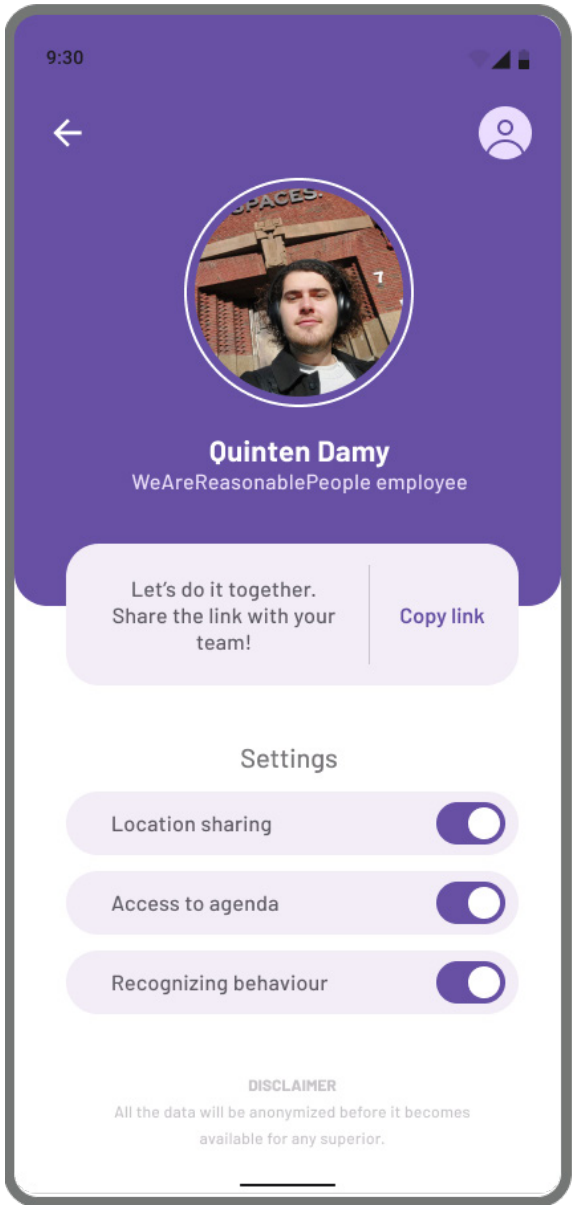


Figure 40 | The settings page in which certain functionalities can be switched on and off.

Setting page

The participants did not expect a sharing link functionality on this screen since the icon of this page insinuates that it is an account page. From their perspective, an account page does not relate to the functionality of the sharing button. After a discussion on the functionality of the sharing button, all the participants liked the goal of the button. However, in the current setup, it feels like a sharing possibility of their account instead of the application.

> *"It feels like it's a kind of a social media feels . I would rather add people to the space than have them follow me."*

All the settings are currently toggled on, but they expect they would have given permission in the application's walkthrough. The employees are also curious about the impact specific settings have on the functionalities of the overall product. These employees would like more information on the result of toggling off these settings.

> *"Here you might also have an info icon to get an explanation as to why turning it on is important for the app's functionality."*

A disclaimer is placed at the bottom of this screen, informing the user that the data will be shared with the employer. Although all the data is being anonymised, the users' location should not be shared with the employers according to the employees. If the management were present at the office, they would be able to recognise the anonymised users through their location sharing.

> *"Even if it is anonymized, you only have to be in the office for one day and you can recognize who the user is."*

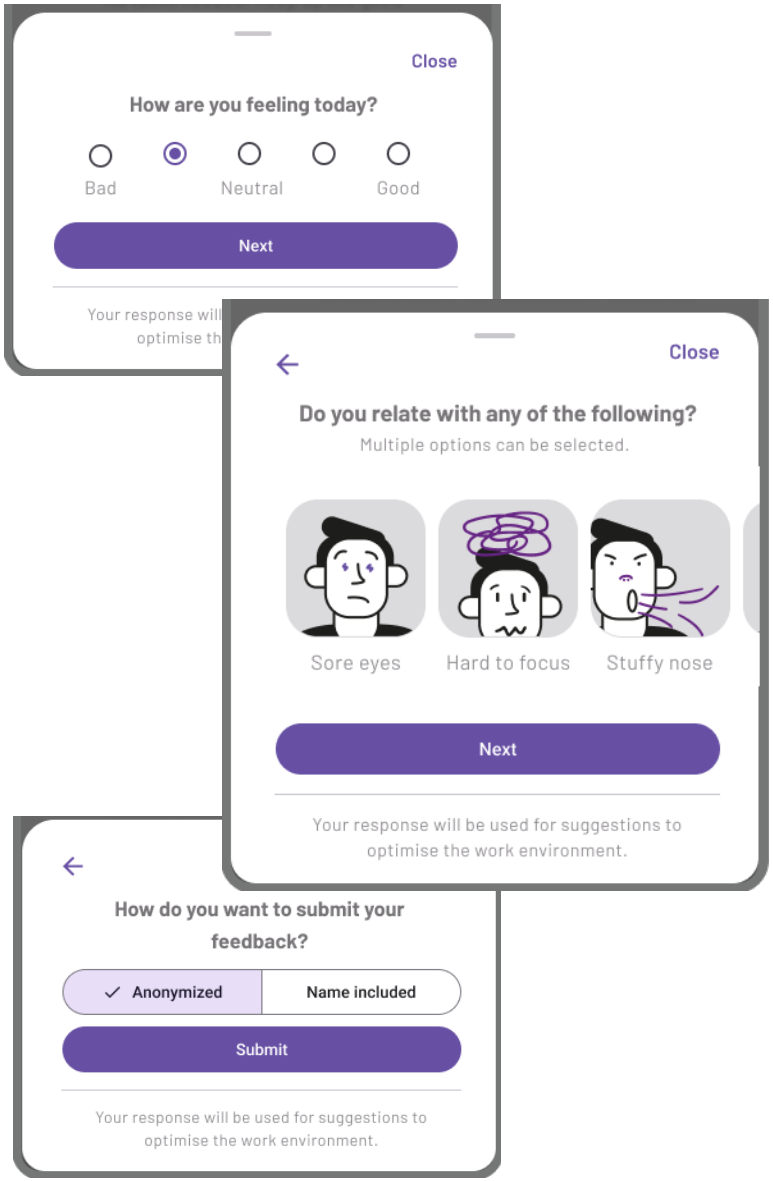


Figure 41 | Fractions of the feedback process in the interface.

Feedback process

The first question in the feedback procedure is more ambiguous than expected since it primarily focuses on their mood instead of on the variables within the work environment.

All the participants positively received the second step in the procedure. Although some situations could be added, like busy or stressed, the cartoonlike images are clear for the users. The employees expect that after selecting specific scenarios, they will receive recommendations on how to solve their situation individually in the short term.

One employee mentioned that it was positively triggered to think further about what has possibly caused their negative feeling. It also positively affects some employees by realising they should not complain since they are confronted with everything they could experience.
The anonymise button is well received because the employees confirm that they would rather be sincere and anonymised than dishonest, and their name is known. The employees confirm that they would more likely include their names when they are positive about the work environment.

One employee is curious about when the participants can provide feedback for a second time. It could occur that one moment a participant is feeling great, but after a few minutes, they start feeling bad. The participant is curious if there would be an overview of its given feedback since they want to tweak it potentially.

4.4.3 | CONCLUSION

The overall concept is well received by the employees and the business owners since it suits their context perfectly. The customizability of the calm display creates a playful character which positively affects their affinity with the overall product. The majority instantly recognised ways to implement the product in their context. The calm display will not confuse visiting third parties since the notification is no longer implemented in a functional object.

In the digital interface, some changes still need to be made. The overall navigation structure is clear and well-organised, but the participants get confused and frustrated when buttons are present on screens while they are not working. This frustration will negatively influence the adaptation of the product among the employees. If the two states remain in the application, the participants visually need to be informed of which state they are in. All the functionalities should be visible and active in one state, and in the simplified one, only the working functionalities should be included.

In the 'current room' screen, the employees do not necessarily need to get more information in optimal conditions to get reassured. However, in suboptimal conditions, which variable caused the problem should be clear and what the variable level should have been according to the target levels. This information will help the employees better understand suboptimal situations and eventually will lead to the ability to recognise certain situations beforehand. Although the state of the work environment is the most important information on the page, it does not immediately attracts attention since the purple colours is quite intense. In this screen, the connection with the calm display is not identifiable, which could be more to the foreground in further optimisations.

The feedback button is currently not clear at all. The button is consistently visible on all the screens, swiping left to right, but it is unclear if the functionality will also be identical on these screens. The participants do not know if the functionality of the feedback button is to provide general feedback on the interface and calm display to WARP or if it functions to create the ability to provide input on the optimality of the work environment. From the employees' perspective, they will solely provide feedback when they are hesitant about the optimality of the work environment or when they experience complaints.

On the other hand, the feedback process itself is well received. The identifiable images create a clear overview for the employees and stimulate further reasoning about suboptimal conditions. The employees successfully confirm that they would rather be sincere in their feedback and anonymised than dishonest, and their name is known. However, the feedback process should add if the given input is exclusively for that moment or over the timespan of the day.

The account icon on the top right of the screen should be a settings page since it confuses the employees with the 'personal' screen. The employees should be able to get extra information about the functionality of certain settings to understand their necessity.

In the rest of the digital interfaces, some details need to be changed to increase the readability or create a clearer hierarchy between components. In the 'personal' and 'planned room' screens, some extra functionalities need to be added to increase the desirability for the employees to start using the interface.

4.5 | CONCEPT NOTIFICATION EVALUATION

In chapter 4.4, the physical object that notifies the user is presented to the participants. Although the physical object including its non-interactive character is well received, the level of intrusivity of the concept is not yet experienced while working. This chapter tests the level of intrusivity with a wizard of oz prototype in an imitated office context.

4.5.1 | METHOD

A wizard of oz test has been conducted to test the level of intrusiveness of the calm display. Ideally, this test would have been performed with the actual target audience. However, it was performed with students in an imitated target context since there was not enough time left to reach the target audience again. In this imitated context, five students were working on their tasks while located near the 'calm display', which was temporarily installed on the wall. Some of these participants faced the prototype's direction others were facing the other way to maintain the similarity with the actual context and be able to test if these two directions are experiencing it identically, see figure 42.

The participants were briefly introduced to the concept. They received a folded form (see appendix U), which they were allowed open when they saw that the calm display notified them of the suboptimal work conditions. The calm display was installed on the wall and could be lowered by a rope attached to a weight. After the participants were introduced to the test, I waited for 20 minutes before I started gradually lowering the frame. The frame was lowered by taking small steps, approximately 5 centimetres every 5 minutes.

Figure 42 | The material that has been used for the wizard of oz test session including its setup.

After noticing the notification of the calm display, the user had to open the form. In this form they were asked to write down the time, to understand how long it took before they saw it. In addition, the participants had to write down their activity when they noticed the notification, their location, the direction they faced, the amount the product dropped and if they would solve the suboptimal conditions by opening a window. The users were asked not to hand in the form themselves since this could trigger other participants to look at the notification.

4.5.2 | RESULTS

In 25 minutes all the participants noticed the notifications of the calm display. Although this seems fast and likely intrusive, four of the five participants saw it when they were not working in focus. The participants started noticing it while leaving their work spot to fill up their water bottle, go for a toilet break or start collaborating with a fellow student. Since it only got noticed in these moments, the direction the participants were facing did not influence their answers.

The participants did not notice any direct movements of the frame. The difference between the optimal and suboptimal states became obvious by revealing the hanging mechanism since it is not visible in suboptimal conditions. If the hanging mechanism reveals itself, including a small gap with the frame, it is already sufficient to indicate that the optimal conditions have been changed.

The participants mentioned that they would resolve the suboptimal situation after grabbing their mobile devices. The mobile interface supports the calm display's notification since it convinces the user of the importance of a task through its colour and unbalanced visualisation.

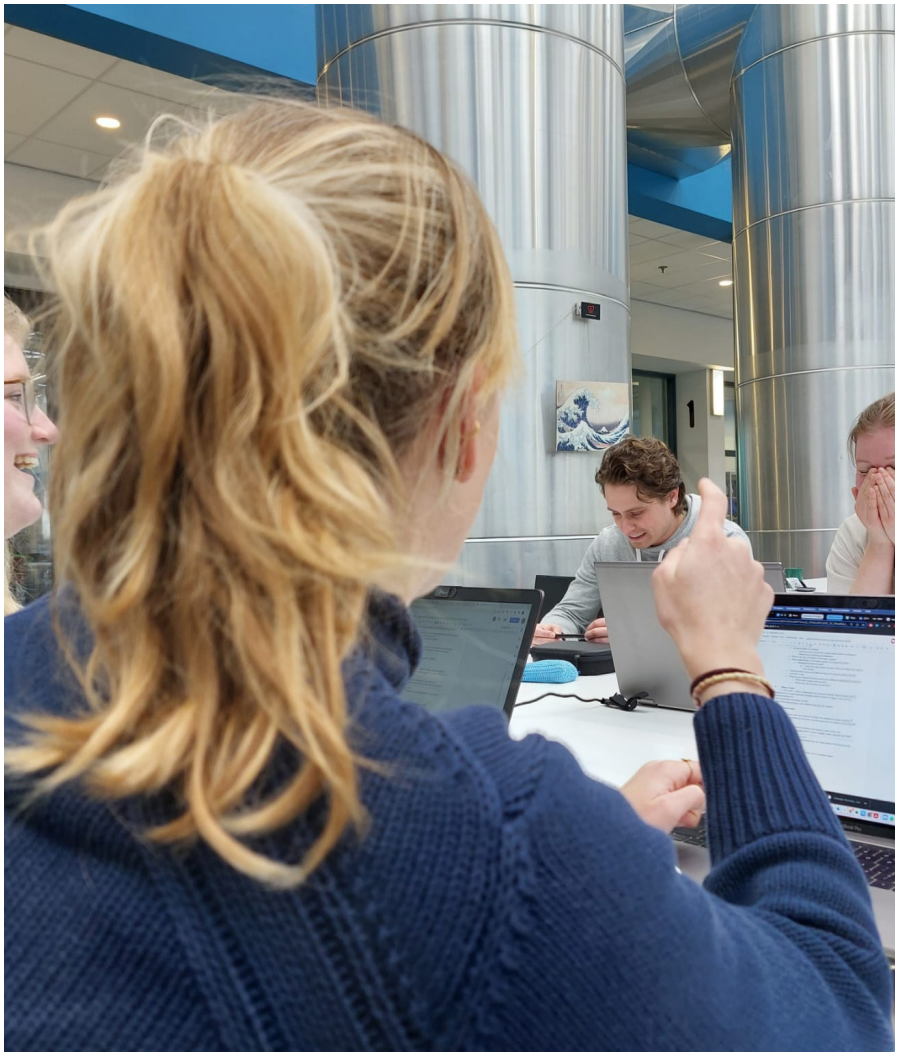


Figure 43 | An employee that recognises the notification of the calm display in the distance.

CHAPTER 5

FINAL DESIGN

The final flagship design, targeting small businesses in office environments, is called: DROP. The product is primarily designed for business owners to facilitate the optimisation of their employees' work experience. This work experience is improved by involving the employees in realising an optimal work environment through a notifying physical calm display and a supportive mobile digital interface. This chapter will combine the findings of all the interviews and evaluations into one final design.

5.1 | CALM DISPLAY 105

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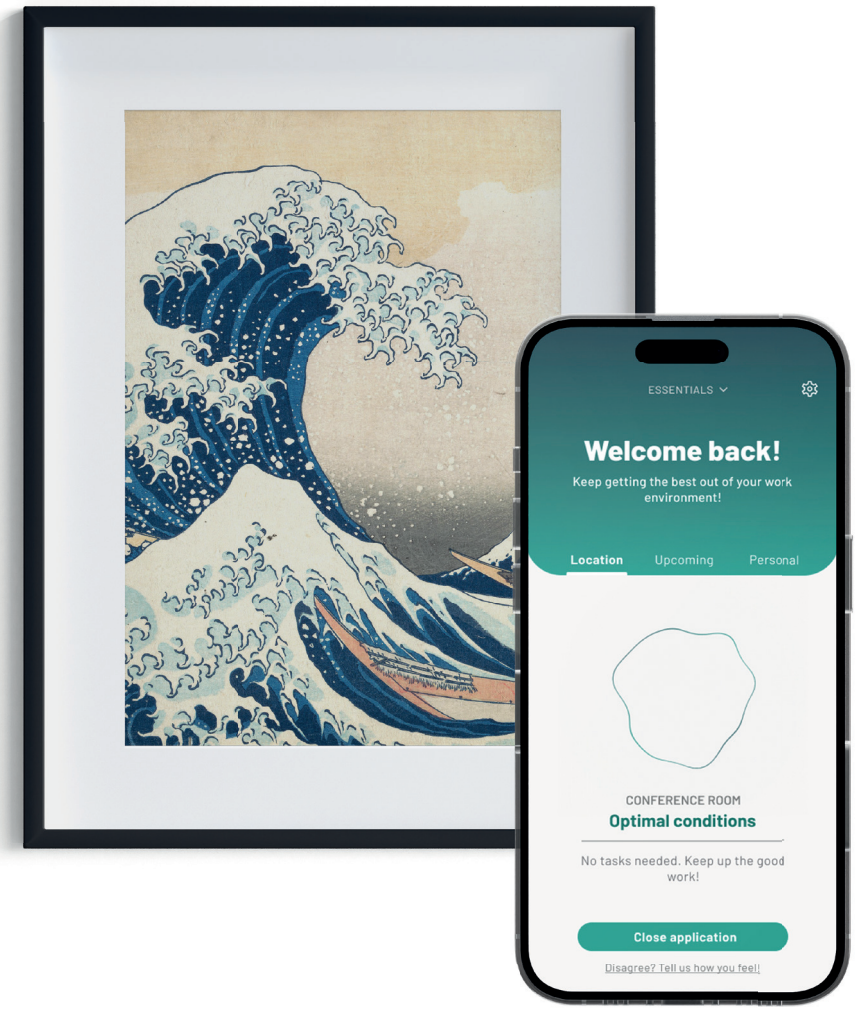
DROP

DO NOT DROP YOUR WORK STANDARDS AND START REALISING AN OPTIMAL WORK ENVIRONMENT TOGETHER



5.1 | CALM DISPLAY

The calm display, a personalisable frame installed on the wall, involves the employees by informing them of the optimality of the work environment in a **non-intrusive** way. In line with the overall goal, to optimise the work experience, it is essential to notify the employees in a non-intrusive way to prevent any distractions from their work activities. The **notification** is designed to merely catch the employee's attention while having a break, getting something to drink, visiting the restroom or preparing for a meeting.

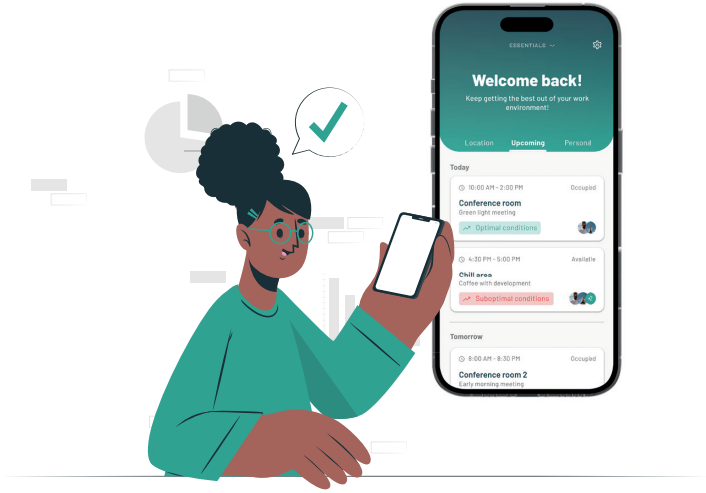
The calm display exclusively notifies the employees of the conditions of the room in which it is installed to decrease the number of notifications and further reduce its intrusiveness. Due to its **room-specificness**, the frame should be installed in each work environment. It should be installed on eye level (while standing) so that it is visible from each desk to maintain the **equality** of the employees in small businesses. The calm display will inevitably be better visible for some employees and less for others, but the result in chapter 4.5 was marginal between these two users.

At first glance, the calm display is a regular frame hanging on a wall, similar to any other painting or picture. However, the actual calm display is hidden behind the frame since it is the **hanging mechanism** on which the frame is placed. The hanging mechanism lets employees and business owners personalise the calm display to match their businesses' character. The product that will be placed upon the calm display hanging mechanism can vary in size and could be an artwork, logo, picture or quote. This calm display's **personalisable character** increases the user's affinity with the product, indirectly motivates the user to resolve a suboptimal situation and contributes to the realisation of a homely atmosphere.

Figure 44 | A representation of the calm display installed in the context of one of the targeted small businesses based in an office environment.

Scenario in optimal conditions

The calm display communicates optimal work conditions while the employee is working in focus.



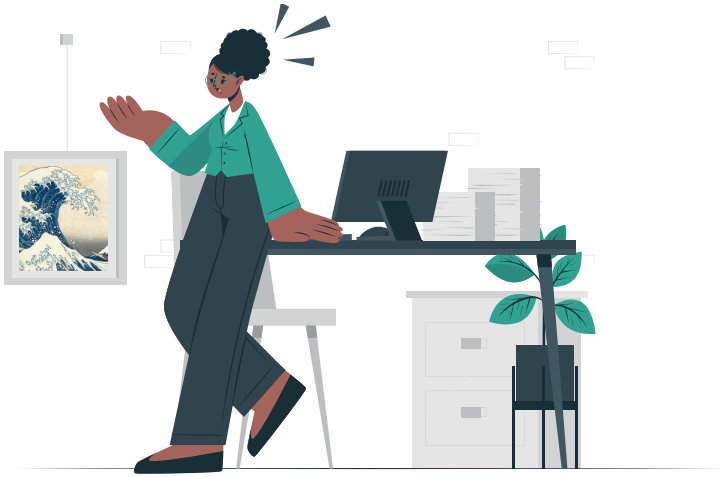
The employee has a meeting planned with a client in half an hour. She checks if the reserved space will be in optimal condition to be able to welcome them in a professional manner.

Figure 45 | The scenario in optimal conditions.

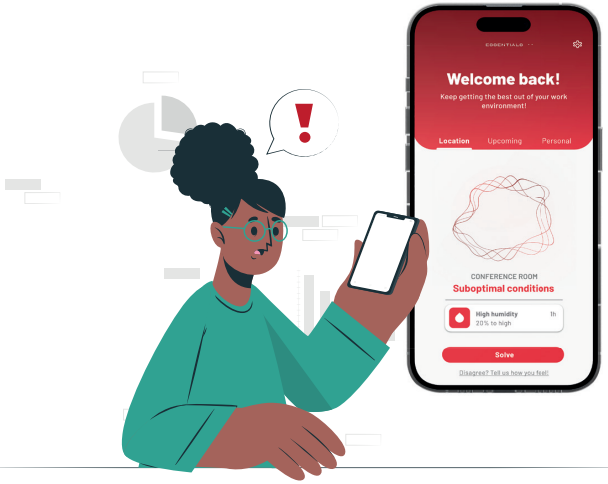
The calm display informs the optimality of the work environment by distinguishing **three states**; optimal conditions, suboptimal conditions and a third state, called solved, where a task has been performed to resolve a suboptimal situation. In optimal conditions, the frame is on eye level and solely contributes to a **homely personalised atmosphere**. In suboptimal conditions based on indoor environment data, the frame will gradually drop to notify the employees. The amount the frame has dropped insinuates the work environment's duration in suboptimal conditions. If employees notice that the frame has dropped, they can resolve the suboptimal situation by performing a task communicated by the mobile interface. After executing a task, the frame will gradually (in approximately 30 min) return to its optimal state. This gradual return is an honest representation of reality since the conditions will not immediately be optimal after executing a task.

Scenario in suboptimal conditions

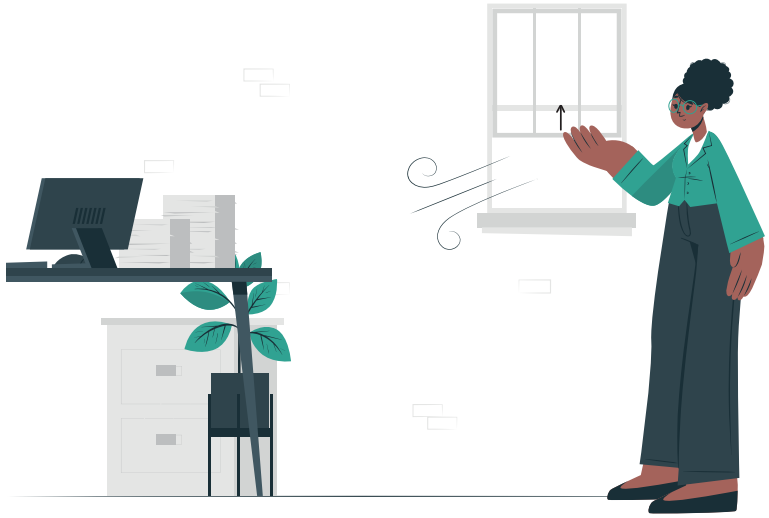
The SensorBloxx sensors sense a high humidity. The calm display informs the employee of the suboptimal working conditions by gradually lowering the frame. This non-intrusive notification allows the employee to continue working in focus.



After 20 minutes the employee chooses to take a toilet break and notices the calm display's notification.



The employee opens up the mobile application to see what could have caused this suboptimal work condition. The employee gets informed of the high humidity and decides to resolve the situation before she starts working again.



The employee was asked to open up a window for about 15 minutes and performs the task accordingly.

Figure 46 | The scenario in suboptimal conditions.

5.1.1 | RECOMMENDATIONS

Balance in drop distance

A proper balance in drop distance must be found to realise the necessary effect to notify the user, communicate the severity of the situation and prevent confusion with third parties, which could indirectly harm the businesses' professional image.

Minimum drop height

The minimum drop height should not be adjustable. A gap between the hanging mechanism and the frame is sufficient to notify the user and indicate the suboptimality of the work environment, according to the notification evaluation in chapter 4.5. Therefore the minimum drop height will depend on the eventual size of the hanging mechanism combined with an approximate gap size of 10 cm.

Maximum drop height

The maximum drop height depends on the distance from the bottom of the frame to the floor, which on its end, depends on the chosen frame size in combination with the middle point of the frame. The middle point of the frame is consistent and should be on eye level, approximately 160 cm (TU Delft, 2020), to maintain equality between employees. However, the frame size is personalisable; therefore, the user should be able to define the frame size in the application so the product can calculate the maximum drop height accordingly.

Plug & playability

The installation procedure of the calm display hanging mechanism should not harm the plug and playability of the SensorBloxx proposition. It is recommended to at least match the ease of the regular installation procedure of frames on a wall to prevent any increased boundaries of purchasing this system and reduce its viability.

Marketing tool

The calm display could contribute to the realisation of a higher level of brand awareness since the overall concept needs to function as a 'flagship' for the SensorBloxx universally implementable base. Visualising the product's name combined with the phrase 'based on SensorBloxx' on the calm display's hanging mechanism could further increase SensorBloxx's brand awareness. Compared with the SensorBloxx sensors, the calm display is a better 'canvas' for marketing purposes since it has a more prominent position in the work environment.

Advertisement purposes

Since the hanging mechanism can act as a 'canvas' for marketing purposes, the sensor-based product can also be used for advertising purposes of recruitment companies. One of the employees, see chapter 4.4, mentioned that recruitment companies could provide the sensor-based product to businesses that recruited personnel through their services. Providing this sensor-based product as a service could increase the attractiveness of the recruitment company itself since they realise the chance to improve the work experience for their recruited employees. It could also serve to create a bond between the recruitment company and their clients, to continue the collaboration and keep recruiting with the same party.

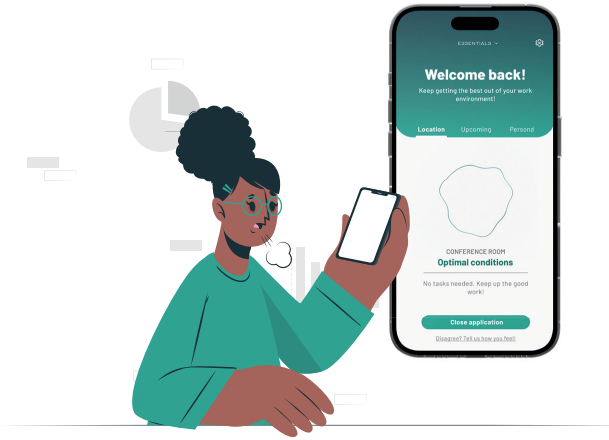
5.2 | 'OPTIMAL' INDOOR ENVIRONMENT DATA

The calm display exclusively communicates the optimality of the work environment in which it is installed. The optimality is primarily determined by scientific research on the generated indoor environment data offered by the sensors of the SensorBloxx venture. The SensorBloxx venture envisions to start with a selection of 6 sensors, measuring the following data: temperature, humidity, CO2, light intensity, sound and movement. This sensor selection should be expanded by adding a seventh sensor, measuring air pollution, since multiple business owners have experienced suboptimal conditions, presumably caused by the presence of undesirable air particles, see chapter 3.3.

The flagship product primarily communicates the generated raw data by the SensorBloxx through trends, recommendations and manually actionable tasks. The raw data itself will, especially at the beginning, not ring any bells for business owners and their employees. In the current context, the only variable that is being measured is temperature, which affects the users' ability to conclude from the raw data of the other indoor environment variables. In chapter 4.4, it is concluded that the users do not necessarily need this raw data to get assured of the optimality of the work environment. However, the users emphasise the necessity for the raw data to stay accessible to be able to take a look if they are hesitant about the correctness of the communicated work conditions. Due to the uniqueness of the business's context including its work environment, the experienced optimality by the employees can vary from the one determined by scientific research. Therefore the employees are able to provide input which can be used to train the product and tweak the target variables overtime.

Scenario of providing experience-based input

Although the calm display informs the user of optimal work conditions, the employee suddenly experiences an intense headache.



The employee grabs her phone to check if the calm display is working accordingly. The employee gets reassured by the application, but provides input since the optimal target levels might not be accurate for her context.

Figure 47 | The scenario in which the employee provides input.

5.2.1 | RECOMMENDATIONS

Adjustable target levels and tasks

Although scientific research can create a general implementable perspective on optimal and suboptimal conditions, the targeted small businesses vary among others in culture, future vision and work environment. These differences impact their perspectives on the optimal target levels and capabilities to perform certain tasks to resolve suboptimal conditions. A business' vision to be sustainable could, for instance, result in lowering the temperature target levels to reduce the energy spent on heating. Since the capability of tasks varies in each office, the business owners or the person accountable should be able to define the performable tasks in each room in the installation procedure.

Admin dashboard

Although the business owners are the primary target group, the product could be managed by an accountable employee like an office manager. These users with an administrator role should be able to access the data on a computer dashboard. This dashboard interface primarily provides a better analytic overview of the advanced functionalities of the flagship product. Through the dashboard's analytic character, the admins can use the indoor environment data simultaneously for other use cases such as cost reduction, reduction of environmental impact and space or maintenance utilisation.

Sharing data

The anonymised generated indoor environment data could be shared with similar-sized businesses on the dashboard interface. This data can help business owners that are unfamiliar with running a business by setting common variable benchmarks and mediating in negotiations on standards for new work environments.

Actuate BMSs

With the current target audience, SensorBloxx does not need to be able to actuate building management systems since they do not have access to these kinds of resources. However, the targeted small-sized companies will eventually outgrow their current work environments and move towards bigger-sized offices. These bigger-sized office environments can be solely controllable by automated systems. In order to retain these businesses and gradually include medium-sized businesses in the target audience, it is recommended to start exploring how SensorBloxx could actuate these BMSs.

One room trial

In some cases, the employees suggest purchasing the flagship product. The flagship could be offered in a one-room trial package to lower the purchasing boundaries. This package can consist of a pre-defined amount of sensors, including one calm display to start measuring the conditions of one room. If the business owners and employees are pleased with the trial's outcomes, they can expand by ordering more calm displays and sensors to install in the other rooms at the office.

5.3 | THE MOBILE INTERFACE

The mobile interface supports the room-specific notifications communicated by the calm display. The main functionality of the mobile interface is to **either reassure or activate the employees** based on the generated indoor environment data of their current location. Due to the substantial role of the user's location, the interface is explicitly designed for mobile interfaces. Although employees of small businesses generally do not receive work phones, their personal phones are more often brought along than their work laptops.

The application's first screen immediately informs the user of the optimality of the current room. In optimal conditions, the application's colour is a positive, calming green which reassures the user of the optimality of their current location. In the middle of the screen, a circle insinuates through subtle controlled movements that data is being measured and the work environment is in balance. The circle visualisation is supported by a 'No tasks are needed. Keep up the good work' message that encourages the user to keep realising an optimal work environment.

In suboptimal conditions, the application's colour turns into an alarming red, which activates the user to perform a task to resolve the suboptimal situation. One or more of the generated data variables causes the suboptimal situation, therefore the circle insinuates that the work environment is unbalanced. The variable that exceeds the target level is communicated in combination with the severity of the situation. The severity of the situation is based on the time it has been suboptimal and the degree it exceeds the target level. The users can solve the situation by performing a task by clicking on the solve button. These tasks are manual performable since the target audience's small businesses generally do not have access to actuatable building management systems. If none of the performable tasks are left to solve a suboptimal the situation, the product informs the employees of alternatives.

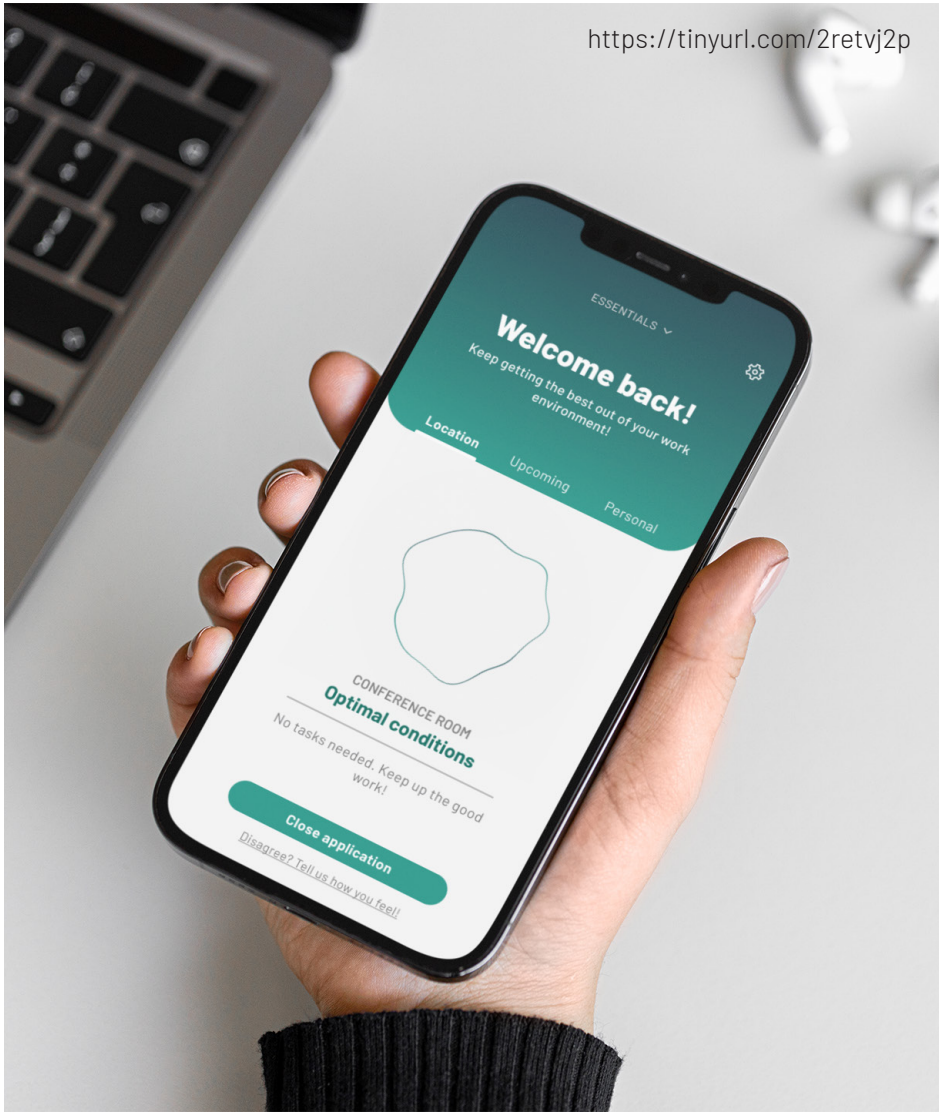


Figure 48 | A representation of the mobile interface in context.

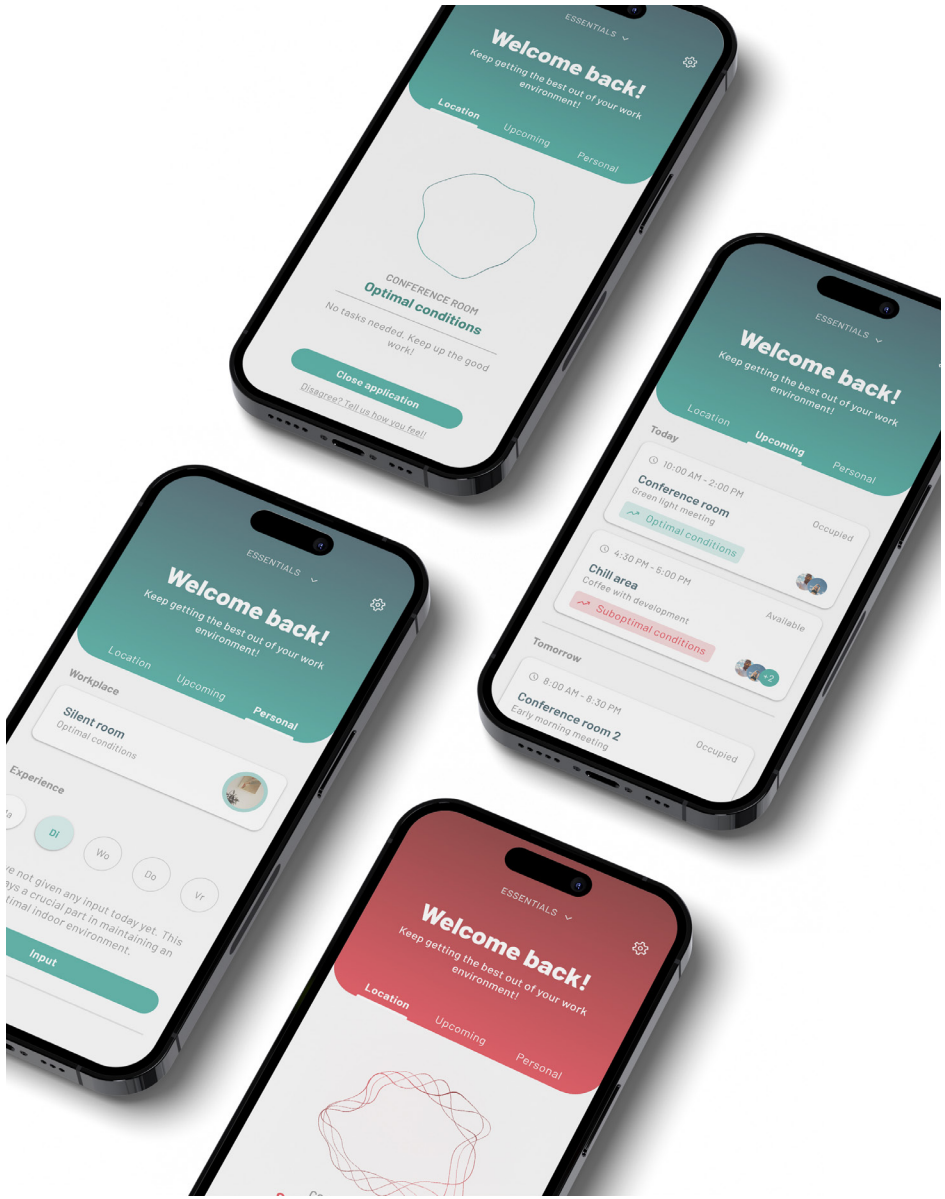


Figure 49 | An overview of the final mobile interface screens.

The application creates an **equal playground between business owners and employees** to fully involve them in contributing to the realisation of an optimal work environment. This equality is expressed by the application's **honest and transparent character**. This character results in the accessibility of raw indoor environment data for employees, including its historical data and trends over time. However, this extensive amount of accessible data could keep the employees from their work activities. In combination with the distracting nature of the applications on the employees' phones and fellow employees' negative perception towards mobile phone usage, the user's flow is intentionally designed to be as short as possible in the application. The **intentionally short user flow** is expressed by two modes in which the application's functionalities are divided: essentials and advanced. In the essentials mode the functionalities directly affecting the user's work experience are located without any sign of raw indoor environment data. The full set of functionalities, including the essential ones, are combined in the advanced mode. These additional functionalities include the raw indoor environment data categorised by each room, the location of the sensors, an activity log, the target levels of the variables, et cetera. The users can switch between these modes through the drop-down menu at the top of the screen. In line with the goal to shorten the user's flow, the solve button is transformed into a 'close application' button in optimal conditions to quickly return to their day-to-day work activities.

The generated indoor environment data combined with analytics software has a high potency. The 'upcoming' screen provides a glimpse of SensorBloxx's potency'. By synchronising the work agenda, the employees can check the optimality of the work environments they plan to use. The displayed planned work environment's optimality predicts the time the employees have planned to use this room. These predictions are based on the current data measurements, the impact of the previously planned meetings and historical data. These predictions can be used to realise optimal conditions prior to an important meeting with a client, for example, to prevent exuding an unprofessional image through the state of the room.

5.3.1 | RECOMMENDATIONS

Solved state

In the current interface design the overall colour of the application depends on the state of the user's current location. In optimal conditions, this results in an interface with a calming green colour and in suboptimal conditions it transforms into an alarming red one. The screen for the state where a task has been performed is yet to be designed. This screen is recommended to be as reassuring as the 'optimal conditions' screen since no further tasks are needed yet. However, the user should be able to quickly recognise the difference between optimal conditions and the solved state. Although there are many ways in which this difference can become apparent, it is recommended not to communicate this state through a yellow/ orange colour. In combination with the other states, it will quickly be compared to a traffic light. At the same time, the colour does not support the visual style of the application since its white text will not be readable.

Positive tone

The viability of the product increases by staying relevant for a longer period of time. The product communicates in a positive tone to satisfy the employees and encourages them to contribute to realising an optimal work environment. Since this tone is well received in the evaluation in chapter 4.4, it is recommended to continue its implementation on the screens that will be added to the product in the future.

Share application

Through the flagship the employees autonomously realise an optimal work environment. Since the flagship strives to create equality between the employees and benefits from the continuous involvement of all employees, it is recommended to include a sharing functionality. This functionality enables employees to quickly include new personnel autonomously without bothering the admins.

Employee presence

Employees can select their common work location in the office on the personal page. Although hybrid working gets normalised, the ability to see which employees will be present in their common work environment can convince employees to likewise work at the office. The expected presence of fellow employees could be implemented in the common work environment feature to bring the employees back to the office and have better control over their work experience.

Mute

Both the employees and business owners know that a mute feature decreases the relevancy of the overall product. Nevertheless, there are scenarios in which a mute feature would be desirable. The calm display would otherwise constantly notify the users if something breaks down. At these moments, the employees cannot recognise other suboptimal variables. In this case, the business owner wants to be able to mute the variable until the situation is fixed. It is recommended that a variable cannot be muted indefinitely to keep the pressure on the business owner to solve the situation.

Experience based input

In chapter 4.4, the way to provide honest experience-based input has been tested. In the design the employees are asked about their feelings instead of their opinions on the target variables and raw data. Employees who do not feel great are presented with identifiable visualisations based on the consequences of suboptimal variables. The identifiable images create a clear overview for the employees and stimulate further reasoning about suboptimal conditions. It is recommended to use this indirect way of communicating which variable is suboptimal since the participants received it well. The employees successfully confirm that they would rather be sincere in their feedback and anonymised than dishonest and their name is known.

CHAPTER 6

CONCLUSION

WeAreReasonablePeople wants to design a flagship based on their venture SensorBloxx. In order to catch the attention of fellow innovators, the flagship needs to stand out from the competition. This final chapter shows how the designed flagship product can reach this goal. After which the discussion highlights various aspects that still need to be taken before it can be launched.

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6.1 | CONCLUSION

Initially, the project aimed to bridge the accessibility gap between SMEs and high-quality data by introducing indoor climate data. This data would serve as a starting point for SMEs' digital transformation. Throughout the project the accessibility gap was invalidated since the smart building market competitors did not exclude SMEs. Nevertheless, gradually the actual underlying motive for the graduation project arose. This project aimed to identify how WARP's first sensor-based product, built on the universally implementable base of SensorBloxx, can act as a flagship towards other innovators. At SensorBloxx's launch it will contain six sensors that can measure 'indoor environment data'. This selection of sensors served as the starting point for the exploration to become a flagship.

It can be concluded that this flagship should be designed to improve the work experience of employees working at small businesses in office environments, based on a metaphorical competitive analysis, a Dutch market analysis and a thorough qualitative user analysis. By targeting small-sized businesses in office environments the flagship product will stand out from the competition and increase its viability since this target audience is barely being targeted. Although every small business is unique, the results indicate that the flagship product can treat the sectors M, J, K, L and N within the target audience identically. The businesses in the target audience generally grow organically, aim to extrude professionalism, want to become more autonomous, have similar day-to-day responsibilities and are unfamiliar with indoor environment data besides temperature.

Although the indoor environment data could benefit the business owners of the target audience in various ways, they were explicitly devoted to use the indoor environment data to increase their employees' work experience since it is difficult for them to grasp. Business owners recognise the importance of good work experience since it affects the efficiency and productivity of their employees and can contribute to the retention and attraction of personnel, especially considering the current difficult employment market.

The flagship, DROP, primarily improves the employees' work experience by involving the employees in realising an optimal work environment. The employees' work experience is directly affected by realising optimal working conditions, which generally cannot be blindly trusted by the target audience. The product explicitly involves the employee in this realisation, since this allows them to contribute to make an impact which is a common motive for employees to work at smaller-sized companies. The personalisable character of the calm display indirectly optimises the employees' work experience further since it leads to a personalised homely work atmosphere. Additionally, the employees can provide input to adjust the 'optimality' of the work environment to match their businesses' contexts. Business owners can use this input to make adjustments or initiate conversations, increasing employees' feeling of being heard. Although increasing social cohesion in small businesses can significantly improve the employees' work experience, the flagship should not directly stimulate it. Nevertheless, the honest and transparent character of the product stimulates equality between employees and business owners and affects the businesses' social cohesion indirectly.

6.2 | DISCUSSION

Target audience

The primary target audience for the flagship went from SMEs in general to small businesses in office environments within the sectors M, J, K, L and N. This change in the product's target audience is caused by the need to stand out as a flagship product. The opportunity of targeting small businesses arose from the projection of the metaphorical competitive analysis on the Dutch market analysis, see chapter 2.2. A change in perspective in this projection showed that smaller-sized businesses were barely being targeted. Although these untargeted were considered as an opportunity in this project, it could potentially have arisen due to the high expenses of targeting these smaller-sized businesses. The design's costs and affordability is not considered since WARP asked me to be 'the dot on the horizon'. I did not restrict or delay the design process in this near-future scenario by taking money in consideration. However, the product's costs and business model still need to be explored to confirm the flagship product's viability.

The concept evaluation in chapter 4.2 provided a sneak peek into extending the target audience by including flex offices and medium-sized businesses spread over multiple locations. This sneak peek resulted in positive reactions from these participant groups. However, to confirm their interest and desire to use the flagship product it should be presented to a more substantial-sized participant group within this extended target audience.

Chapter 4 shows that the concept is well received in multiple rounds of qualitative research with the actual target group. The employees mention that the flagship contributes to an increased professional perception of small businesses. This improved professional image could result in attracting new personnel. However, the non-intrusive character lowers the visibility and recognisability of the product for third parties. Therefore, it could only contribute to attracting new employees if the product's presence is explicitly mentioned. In case the presence of the product is known to the employees, it will likely be taken into account as a secondary condition of employment. Other factors, such as location and salary, play a more prominent role in the employees' selection procedure.

The calm display

The calm display is designed to notify the employees in a non-intrusive manner. Although the level of intrusiveness is evaluated in chapter 4.5 through a wizard of oz test, it is solely evaluated with a group of participants outside the target audience. In order to genuinely confirm the non-intrusive character of the product, a more elaborate user test needs to be conducted with the help of a higher fidelity prototype installed in the actual context.

Since the actual calm display is the hanging mechanism itself, one of the unique selling points is the personalisable character of the calm display. The user can choose and switch between the type of frames, visuals, materials, frame size, et cetera. However, the hanging mechanism must be strong enough to support these varying characteristics and lower/lift the frame. Since WARP asked me to design the 'dot on the horizon' and not to be restricted by peripheral matters, these technical properties are not considered. In order to confirm the feasibility of lowering and lifting a wide variety of frames, a closer look into the types of rotation motors needs to be performed before any high-fidelity prototypes can be created and tested. The research on rotation motors will simultaneously provide a better understanding of the feasibility of hiding the hanging mechanism behind the frame.

Besides contributing to the realisation of a personalised homely atmosphere, it is assumed that the adjustability increases the employees' affinity with the overall product. This increased affinity with the product can motivate employees to realise and maintain an optimal work environment in addition to their intrinsic motivation to maintain optimal work conditions. Although the employees and business owners mentioned that their affinity with the product would increase by making it personalisable (see chapter 4.2), the presumption is not supported yet with actual user test data on this increased affinity. The increase in their affinity with the product and, indirectly, their motivation to realise an optimal work environment can be confirmed by conducting a second test with two participant groups. One of the groups is presented with a random visual and the other one should be able to personalise the visual. In this test, the speed and rate at which tasks are performed can confirm the increased affinity with the product.

The calm display distinguishes three states to inform the users of the optimality of the work environment. It communicates the optimality by no movement at all, by lowering the frame or returning it to its original position. To maintain a non-intrusive character and prevent making the displacement directly visible, the frame is dropped at a low speed. However, this low drop speed can make it difficult to directly distinguish between 'lowering' in suboptimal conditions and 'returning' after a task has been performed. The users have to use the mobile interface to instantly recognise the state of the room or wait a few minutes to see the difference over time. In an ideal scenario, the employees would be able to directly recognise the state of the work environment through the calm display.

Mobile interface

The flagship exclusively notifies the employees of the conditions of the room in which it is installed through the calm display and the mobile interface. The interface is explicitly designed for mobile interfaces due to this substantial role of the user's location. Although mobile devices can accurately measure the location outdoors, it is complicated to realise this accuracy indoors. An inaccuracy of a meter could already result in the users receiving the wrong information, namely the optimality of another room. In designing the flagship the ability to accurately measure the location indoors was presumed, since I was told not to be restricted by peripheral technical matters. However, the assumption must be validated to confirm the flagship product's feasibility. The sensors could play a role in realising the indoor location sharing and with that, the room-specific character of the flagship.

In the mobile application a circle visualisation informs the user through subtle movements that the sensors are actively measuring data. In combination with the changing application's colour, the circle's intensity reassures or activates the user on the optimality of the work environment. Although these circles have added value, they can be reconsidered since they can be perceived as an alternative visualisation of the calm display. Using certain characteristics of the calm display in this visualisation can strengthen the connection between the mobile application and the calm display.

6.3 | REFLECTION

Changes in my approach

As written in chapters 1.3 and 1.4, the actual assignment varied significantly from the assignment I eventually executed. In the initial assignment I wanted to dive deeper into the usability of certain functionalities in the application, such as the sensor installation procedure, the way to visualise data and how to convince users to start sharing data. This usability approach originated from my positive experience in the UXAD course in which designs were created by iteratively testing with actual stakeholders. The ability to contact and talk to many different stakeholders was the primary motive for following this approach since these conversations always come with surprising insights. To follow this approach, a clear foundation for the product direction is advisable, which includes the target group, their context and the product's goal. This foundation was mainly based on presumptions written in the grant application for SensorBloxx. However, in my desk research and competitive analysis I quickly discovered that the initial foundation was hanging by a thread. I found myself in a position where I could choose to continue with the approach that I had in mind or start from the beginning and create a foundation based on user research. Since I strive to design something unique and the actual assignment benefitted from standing out, I decided to create the foundation myself. Unfortunately, this resulted in a final design that cannot yet be directly launched on the smart building market. Nevertheless, I included the underlying reason for following the usability approach, namely approaching and conducting many interviews with actual stakeholders.

Although I decided to follow a different approach for my project, I kept being fixated on my initial personal goal to realise a final design representative enough to show to future employers. This fixation caused me to start designing an interface without any focus on specific components of the application and this led me to leave out certain elements due to time issues. This personal design fixation was impossible to realise in time due to the reason of changing the approach earlier in the process. I should have got rid of the fixation earlier in the project since it resulted in postponing writing the report and caused frustration since it was not manageable in time.

Writing

After having written the entire report I came to the conclusion that putting work on paper could have helped in structuring my thoughts earlier in the process. It could have contributed to a narrowed scope of the digital design process, prevented frustrations caused by the writing workload at the end of the project and a positive perspective towards the project. However, this is easier said than done since the complete view of the flagship's desirability emerged in the final part of the project.

While writing the report I was struggling to find the right structure for the chapters and finding a way to improve the readability of the report. Especially in chapters 3 and 4 the findings and methods of multiple qualitative research rounds resulted in many pages representing the gained knowledge. Although this knowledge was essential in developing the final design, it does not contribute to simplified readability. If it were in the hands of others, parts of this knowledge would have been hidden in the appendix. However, I believe these parts are important to include in the main report to better understand the scarcity of knowledge I started with. Additionally, it is included to convey the urge to extract the stakeholders' needs and find opportunities for the flagship product.

I found out that it is beneficial to make a presentation previous to the structuralisation of the report since it is a shorter version of the knowledge written in the report and easier to comprise. During the project I came to the realisation that I experience more joy from making presentations than writing the entire report, since I find it difficult to find the right words to put my thoughts on paper.

Interview prompts

I started looking for ways to make the interviews with stakeholders less general. I have tried to increase the level of interaction between the researcher and the interviewee by involving them in the storyline of the interview. Instead of making visual speaking prompts to summarise interviews, I tried to do it the other way around and use it during the interviews. The first interviews were held with a foldable prompt see appendix C. Although the interviewees received the prompt well, it has also restricted the interview's from going to places the interviewee might wanted to go to. Due to this finding, the interview prompt has undergone some changes for the next round. This second visual speaking prompt enabled me to make notes and the freedom to introduce topics based on the direction the interview was going. Eventually, a more high-fidelity interview prompt was used to convey the first sensor-based concept, see figure 27. This prompt helped the interviewees envision the concept and produce enough material for discussion. I would recommend using visual speaking prompts for interview guidance to fellow students, since it helped making the interviewees enthusiastic about my project. This enthusiasm enabled me to quickly come up with more participants and gave me the opportunity to plan a consecutive meeting with participants.

Digital prototyping

After the concept evaluation phase in chapter 4.2, I started to make the first screens based on an information architecture and task flow. Although I usually spend many hours making paper wireframes, this time I chose to follow a different path and decided to make the wireframes digitally, since WARP recommended trying this out. However, in the process of making digital wireframes, I found out that there is a thin line between making wireframes and the first lo-fi digital prototypes. Although building digital wireframes with the help of wireframe kits quickly resulted in representable prototypes, I felt restricted in my design process since you constantly have to consider the kit's capabilities. Additionally, I found out that I quickly get lost in digital designs without any proper scope on what has to be created. For my future work I would rather spend more time on paper wireframing instead of instantly starting to make wireframes through a digital wireframe kit.

In between the creation of the lo-fi prototypes and the final design a lot of time has been spent on exploring a suitable look and feel for the interface. However, before my graduation project was initiated, WARP had already performed a creative session with its designers to set a visual vision for the SensorBloxx proposition. This vision contained a dark-themed interface with yellow and blue highlighting colours. Although incorporating this existing vision in the designs of my graduation project would have saved a lot of time, it did not match the reassuring character of the flagship that I imagined. For my future work I would try to extract certain elements of existing visions to prevent having to start from scratch, since this costs a lot of time and effort.

This graduation project was my first digital design project starting from scratch. Although I have experienced designing digital interfaces during the UXAD course and my internship, building an application from scratch is a different cup of tea. I am glad I could design this interface in a safe environment at WARP with experienced digital designers. The weekly meetings with Bart, my company mentor, enabled me to quickly iterate and prevent implementing bad UX practices. Still Bart left plenty of space to learn from the stakeholders in the concept embodiment evaluation phase. In this phase, I learned that all visible functionalities should be enabled without being forced to provide user input. Pushing the user in a direction can drastically decrease the adoption of the interface. At first, I thought the user interface had to steer users in providing input to prevent biases based on the accessibility of the raw data. However, a 'smart' product can take into account the potential biases after the input has been provided while processing it. For my future work I will consider which functionalities can be executed out of sight of the users to optimise their experience.

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APPENDIX

DESIGN FOR our future

TU Delft

IDE Master Graduation

Project team, Procedural checks and personal Project brief

This document contains the agreements made between student and supervisory team about the student's IDE Master Graduation Project. This document can also include the involvement of an external organisation, however, it does not cover any legal employment relationship that the student and the client (might) agree upon. Next to that, this document facilitates the required procedural checks. In this document:

- The student defines the team, what he/she is going to do/deliver and how that will come about.
- SSC E&SA (Shared Service Center, Education & Student Affairs) reports on the student's registration and study progress.
- IDE's Board of Examiners confirms if the student is allowed to start the Graduation Project.

USE ADOBE ACROBAT READER TO OPEN, EDIT AND SAVE THIS DOCUMENT
Download again and reopen in case you tried other software, such as Preview (Mac) or a webbrowser.

STUDENT DATA & MASTER PROGRAMME

Save this form according the format "IDE Master Graduation Project Brief_familyname_firstname_studentnumber_dd-mm-yyyy".
Complete all blue parts of the form and include the approved Project Brief in your Graduation Report as Appendix 1 !

family name: de Koning
initials: QD given name: Quinten Damy
student number: 4594290
street & no.:
zipcode & city:
country:
phone:
email:

Your master programme (only select the options that apply to you):
IDE master(s): ( ) IPD (★) DfI ( ) SPD
2nd non-IDE master:
individual programme: - - (give date of approval)
honours programme: ( ) Honours Programme Master
specialisation / annotation: ( ) Medisign ( ) Tech. in Sustainable Design ( ) Entrepeneurship

SUPERVISORY TEAM **

Fill in the required data for the supervisory team members. Please check the instructions on the right !

** chair: Ianus Keller dept. / section: DCC
** mentor: Sjoerd van Dommelen dept. / section: SDE/KInD
2nd mentor: Bart de Klein
organisation: WeAreReasonablePeople
city: Rotterdam country: Netherlands

comments (optional): Bart de Klein is the head of design within WARP.

Chair should request the IDE Board of Examiners for approval of a non-IDE mentor, including a motivation letter and c.v..

Second mentor only applies in case the assignment is hosted by an external organisation.

Ensure a heterogeneous team. In case you wish to include two team members from the same section, please explain why.

TU Delft

Procedural Checks - IDE Master Graduation

APPROVAL PROJECT BRIEF
To be filled in by the chair of the supervisory team.

chair Janus Keller date - - signature

CHECK STUDY PROGRESS
To be filled in by the SSC E&SA (Shared Service Center, Education & Student Affairs), after approval of the project brief by the Chair.
The study progress will be checked for a 2nd time just before the green light meeting.

Master electives no. of EC accumulated in total: EC

Of which, taking the conditional requirements into account, can be part of the exam programme EC

List of electives obtained before the third semester without approval of the BoE

YES all 1st year master courses passed

NO missing 1st year master courses are:

name date - - signature

FORMAL APPROVAL GRADUATION PROJECT
To be filled in by the Board of Examiners of IDE TU Delft. Please check the supervisory team and study the parts of the brief marked **.
Next, please assess, (dis)approve and sign this Project Brief, by using the criteria below.

- Does the project fit within the (MSc)-programme of the student (taking into account, if described, the activities done next to the obligatory MSc specific courses)?
- Is the level of the project challenging enough for a MSc IDE graduating student?
- Is the project expected to be doable within 100 working days/20 weeks ?
- Does the composition of the supervisory team comply with the regulations and fit the assignment ?

Content: APPROVED NOT APPROVED

Procedure: APPROVED NOT APPROVED

comments

name date - - signature

Initials & Name QD de Koning Student number 4594290

Title of Project Collecting indoor climate data as starting point for digital transformation

Personal Project Brief - IDE Master Graduation

TU Delft

Collecting indoor climate data as starting point for digital transformation — project title

Please state the title of your graduation project (above) and the start date and end date (below). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.

start date 19 - 09 - 2022 — 17 - 02 - 2023 end date

INTRODUCTION **

Please describe, the context of your project, and address the main stakeholders (interests) within this context in a concise yet complete manner. Who are involved, what do they value and how do they currently operate within the given context? What are the main opportunities and limitations you are currently aware of (cultural- and social norms, resources (time, money,...), technology, ...).

Nowadays, data-driven innovation is one of the key pillars for growth. Companies that use their digital resources effectively and truly understand its data, have an advantage over competitors that don't. However, most of this data and especially the high-quality data, is often exclusively in the hands of big companies. As a result, the local small to medium sized enterprises (SMEs) experience difficulties due to the lack of accessible data.

In the current situation it is possible for businesses to generate data with the help of sensors. However, the sensors which are currently on the market are part of bigger systems which are designed for domestic use or large office buildings. These propositions are limiting the SMEs due to privacy regulations, high expenses and ease of use. This introduces the first boundary, a lack of modular sensors which are plug and play installable, including matching software and analytics tools. A second boundary occurs when data is generated through these modular sensors, which is the absence of a safe and honest infrastructure to share the generated data.

Due to the COVID-19 pandemic the severity of the entire situation came to light. It became clear that local SMEs didn't even have access to their own indoor climate data. By offering a set of modular sensors to generate this indoor climate data, WeAreReasonablePeople (hereinafter referred to as WARP) tries to set up the stage towards digitalisation for SMEs. The indoor climate dataset will be a starting point for SMEs to start working on their digital transformation. The data will be generated through a combination of upto 6 different sensors. After which the generated data can be communicated on the mobile interface and be shared with third parties on the sharing platform. Through the sharing platform, WARP will offer SMEs the ability to match and combine other datasets to see higher level trends and correlations. Altogether the proposition of SensorBloxx contains three main components: a modular set of sensors, a mobile interface and a sharing platform. In figure 1, these three components are further introduced.

In the second figure an overview of the SensorBloxx proposition and its currently known stakeholders is visualized. In this visual the stakeholders are divided into three subcategories: SME, building and surrounding. In order to make the analysis platform fruitful, many SMEs should start generating data through a selection of sensors and share it through the mobile interface.

space available for images / figures on next page

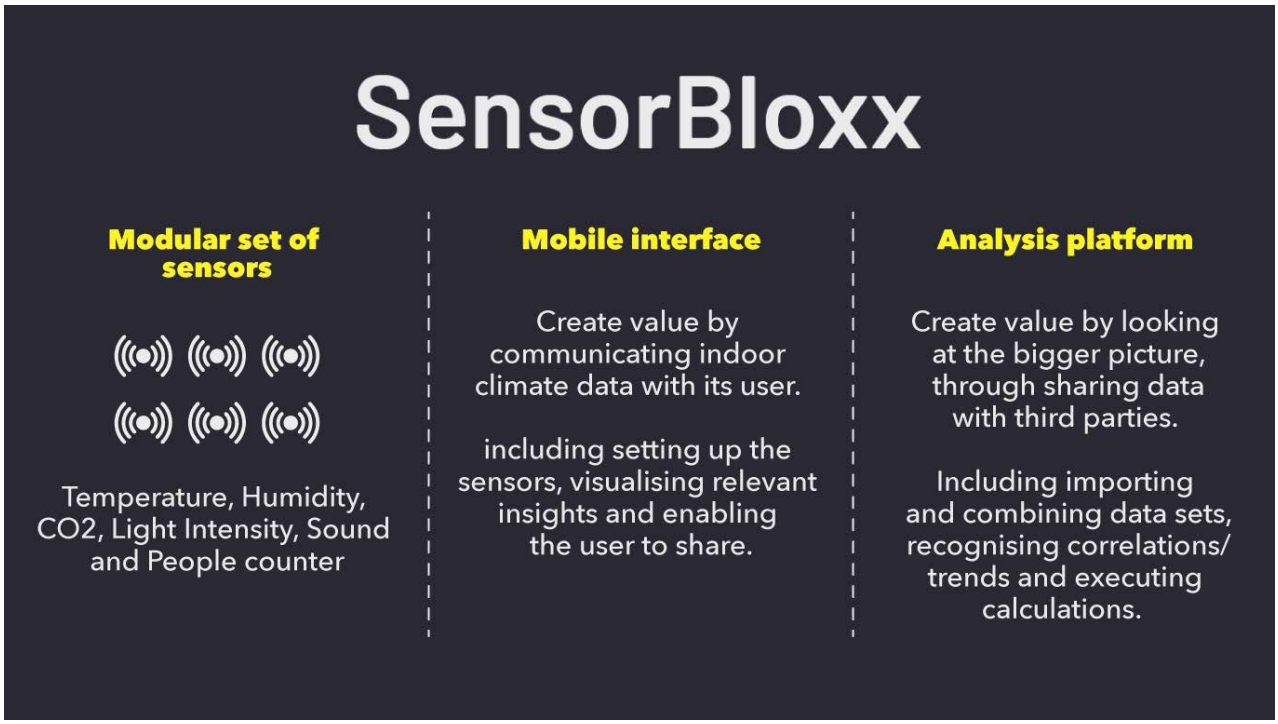


image / figure 1: The three main components of the Sensorbloxx proposition

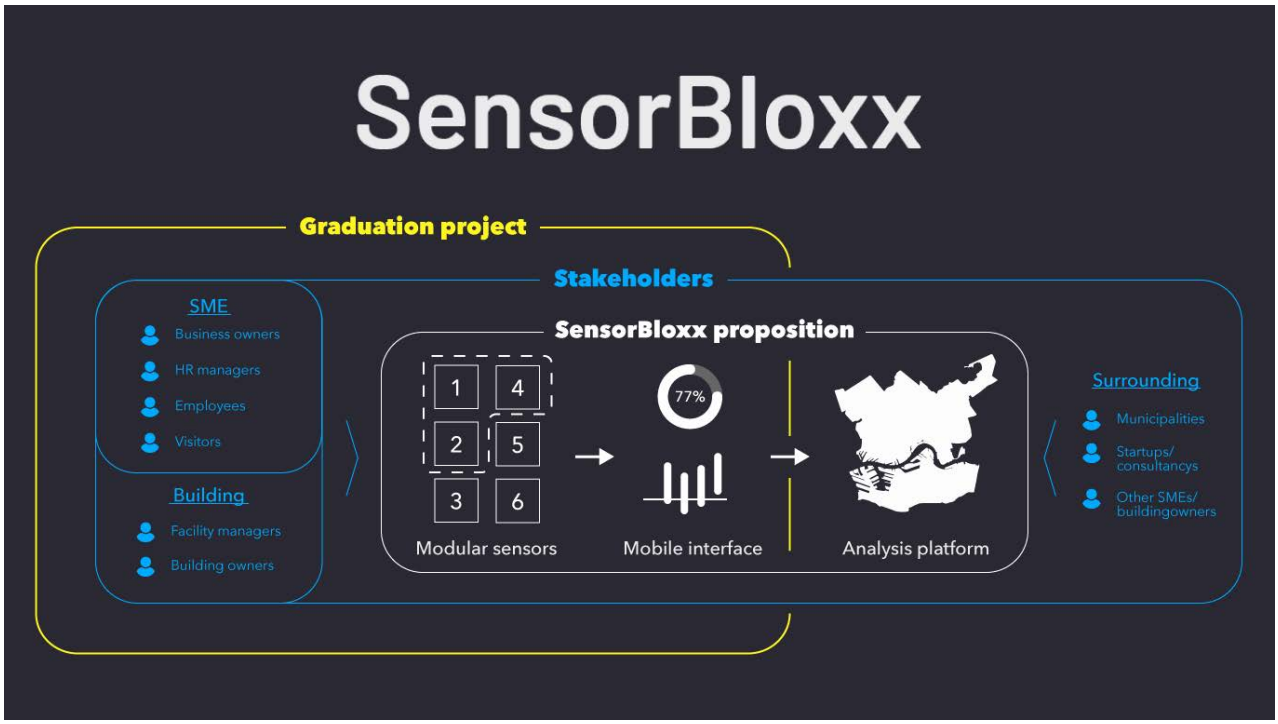


image / figure 2: Scope of the project, designing the mobile interface for its users.

Personal Project Brief - IDE Master Graduation

TU Delft

PROBLEM DEFINITION **

Limit and define the scope and solution space of your project to one that is manageable within one Master Graduation Project of 30 EC (= 20 full time weeks or 100 working days) and clearly indicate what issue(s) should be addressed in this project.

During my graduation project I will be focussing on the mobile interface component of the SensorBloxx proposition. Within the scope (see figure 2) there are multiple stakeholders in the subcategories SME and building who will make use of the interface . One of the main challenges of the project is to define the importance of the interface for each of these stakeholders and thereby use these strengths throughout the project.

Before any data can be collected, the modular sensors have to be selected and installed properly. The stakeholders that benefit the most from the data will be more willing to buy and install SensorBloxx. Therefore these stakeholders must be guided and assisted throughout the installation procedure.

After installing a set of sensors, data will be collected and visualized on the mobile interface. The stakeholders that did not install the sensors themselves will also be introduced to the potentials of SensorBloxx. The second challenge is to define the functionalities and the visuals for the wide range of users within this interface. As well as creating a clear distinction between the mobile interface and the sharing platform.

To enrich the SensorBloxx proposition, the data needs to be shared with their surroundings. This brings me to the third and final challenge to show the value of sharing the data and let them start using the analysis platform.

ASSIGNMENT **

State in 2 or 3 sentences what you are going to research, design, create and / or generate, that will solve (part of) the issue(s) pointed out in "problem definition". Then illustrate this assignment by indicating what kind of solution you expect and / or aim to deliver, for instance: a product, a product-service combination, a strategy illustrated through product or product-service combination ideas, ... In case of a Specialisation and/or Annotation, make sure the assignment reflects this/these.

Design the ideal interface which enables SMEs to generate and visualize indoor climate data with the help of Sensorbloxx. This interface is essential for installing the sensors, communicating the data and allowing the data to be shared to the analysis platform. Altogether this concept will offer a clear value for the stakeholders within the SMEs and their buildings as well as their surroundings.

This mobile interface will be the connecting component of the SensorBloxx proposition, which links the six modular sensors (see figure 1) indirectly with the analysis platform. This mobile interface needs to satisfy the needs of a wide group of stakeholders within the SME and building subcategories. These needs will be fulfilled by three main functionalities of the interface: introducing and installing the sensors, communicating the generated data and making users aware of the value of sharing data.

Before data can be generated the sensors need to be selected and installed properly. The interface will introduce the user to all the possible implementations and enthuse them by presenting the added value of SensorBloxx. After which this interface helps the user to set up the location and the connection to the system.

How the generated data can be of value for each type of stakeholder is yet unknown.The mobile interface can either play an active or a passive informing role for the user. It could trigger actions, show warnings, give feedback or just inform through the visualizations of the data.

Next to offering added value for the SME themselves, the interface is the key tool to start sharing the data with their surroundings. The interface could open up their eyes and make them realize the value of allowing the sharing of their indoor climate data.

Initials & Name QD de Koning Student number 4594290

Title of Project Collecting indoor climate data as starting point for digital transformation

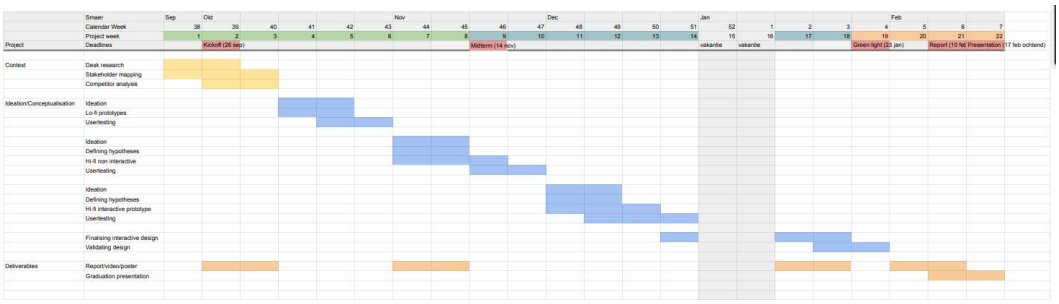
Personal Project Brief - IDE Master Graduation

TU Delft

PLANNING AND APPROACH **

Include a Gantt Chart (replace the example below - more examples can be found in Manual 2) that shows the different phases of your project, deliverables you have in mind, meetings, and how you plan to spend your time. Please note that all activities should fit within the given net time of 30 EC = 20 full time weeks or 100 working days, and your planning should include a kick-off meeting, mid-term meeting, green light meeting and graduation ceremony. Illustrate your Gantt Chart by, for instance, explaining your approach, and please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any, for instance because of holidays or parallel activities.

start date 19 - 9 - 2022 17 - 2 - 2023 end date



My entire graduation project will be performed full-time for a time span of 20 weeks. To start off my project I want to define the context of my project. During this period I will start reading articles about the value of digital transformation for businesses. After looking into the needs of the diverse group of SMEs and existing smart business propositions the context phase is complete.

After gathering enough information multiple design cycles will lead to a final design. All these cycles include ideation, creating hypothesis, making different types of prototypes and eventually testing these to be able to answer the hypothesis. Each cycle will function as an input for the next one. At the beginning of each cycle the tests should be planned in order to have a decent amount of participants.

https://docs.google.com/spreadsheets/d/1B00SfUoOgQ-Uwz3QXkk5oBznyHb8A8mbfaa_R_MRpQY/edit?usp=sharing

Initials & Name QD de Koning Student number 4594290

Title of Project Collecting indoor climate data as starting point for digital transformation

Personal Project Brief - IDE Master Graduation

TU Delft

MOTIVATION AND PERSONAL AMBITIONS

Explain why you set up this project, what competences you want to prove and learn. For example: acquired competences from your MSc programme, the elective semester, extra-curricular activities (etc.) and point out the competences you have yet developed. Optionally, describe which personal learning ambitions you explicitly want to address in this project, on top of the learning objectives of the Graduation Project, such as: in depth knowledge a on specific subject, broadening your competences or experimenting with a specific tool and/or methodology, ... Stick to no more than five ambitions.

In the last few years it became clear that I like to come up with unique concepts and especially test these with current/future stakeholders. I just like the fact that you can not foresee users their reactions beforehand at all.

My preference for creating unique concepts and testing came to light in the interactive environment minor of the bachelor. However during the course UXAD in the DFI master, I found out that these design activities could also be executed for digital products. During this course I liked the way that you start looking really critically at the current situation, after which you start testing a diverse set of new concepts. This process of designing and testing can even be executed up to the last pivots for the final product.

During my internship at 'het Financieel Dagblad (FD)', I tried to find out if I actually like to become an UX designer. I found out that I do, but want to start at a digital design agency instead of at a company who owns the product themselves. Due to the fact that I like to explore and design for new markets, to be able to learn and keep doing 'new' things.

In this final project of my master, I will be working with WARP and indirectly for the municipality of Rotterdam. By collaborating with WARP I will get to see how it is to work for a design agency. The second thing I will learn is designing an interface fully from scratch, in comparison with my internship and UXAD course in which the final concept was a redesign. At last I am really curious of the conversations about sharing data, due to the conflicting ambition and feeling of privacy.

FINAL COMMENTS

In case your project brief needs final comments, please add any information you think is relevant.

Initials & Name QD de Koning Student number 4594290

Title of Project Collecting indoor climate data as starting point for digital transformation

Interview Guide | flexoffices

Goedemorgen! Heel fijn dat je tijd vrij hebt gemaakt voor dit moment.

Kort voorstellen: Ik ben in **Quinten Damy** en ben nu aan het afstuderen aan de master **Design for Interaction.** In mijn afstudeeropdracht doe ik research naar **groeiende/kleine bedrijven en hun gebruik van de werkruimte.**

Tijdens dit interview zal ik verschillende topics aankaarten aan de hand van een praatplaat. Dit interview zal ongeveer **30 min** duren. Zoals je ziet ben ik hier in mijn eentje, om deze reden zou ik je willen vragen of ik het gesprek zou mogen **opnemen.** Met behulp van een opname kan ik achteraf op mijn gemak aantekeningen maken zonder het gesprek te verstoren. Ik zou je willen vragen of jij de **consent form** zou willen tekenen, zodat ik jouw geanonimiseerde inzichten kan gebruiken voor mijn onderzoek.

[START OPNAME]

[ACTIE 1] doel > introduceren

A| Jij — Zou je jezelf kort kunnen voorstellen?
- Wat is je rol binnen de organisatie?
- Wat is het leukste deel van je werk?

B| Jullie — Wie zijn jullie als bedrijf?
- Wat bieden jullie bedrijven aan?
- Wat maakt jullie uniek in vergelijking met de andere bedrijfsverzamelgebouwen? / Hoe distantiëren jullie van de concurrentie?

[ACTIE 2] doel > behoefte in een journey te kunnen mappen en hoe ze deze behoefte oplossen

C| In kantoor? — Door wat voor bedrijven worden jullie benaderd voor een plek in het
- Wat voor afspraken maken jullie met deze bedrijven over de werkruimte?
- In hoeverre bieden jullie wat anders dan reguliere kantoorgebouw aanbieders?
- Hoe waarborgen jullie de kwaliteit van de werkruimte? Houden jullie je aan de afspraken?

[ACTIE 3] Verschillende sectoren/groottes binnen kantoren over 1 kam kunnen scheren

D| Verschillen — Kan je me meenemen in het process van start tot vertrek?
- In hoeverre zijn verschillende sectoren met elkaar te vergelijken? Kan je ze op dezelfde manier behandelen?
- Ontstaan er nieuwe behoeftes vanuit bedrijven tijdens het groeiproces?

[ACTIE 4] doel > valkuilen/nieuwe verantwoordelijkheden ontdekken bij het verlaten van een flexoffice

E| Uit — Wat zijn mogelijke redenen voor een vertrek uit jullie kantoor?
- Bij het vertrek uit het kantoor waar gaan de bedrijven naartoe? Wat hebben die panden, wat jullie niet hebben?
- Wat zijn mogelijke valkuilen voor bedrijven die jullie verlaten?
- Wat zijn de extra verantwoordelijkheden voor een bedrijfseigenaar na vertrek?

[ACTIE 5] doel > belang van data, wie moet in contact komen met welke data?

F| Data & stellingen

1. Bedrijven moeten inzage en of controle hebben op de indoor air quality van het kantoor.

2. Als bedrijf moet je je geen zorgen moeten maken over de indoor air quality, het moet een gegeven zijn dat het goed is.

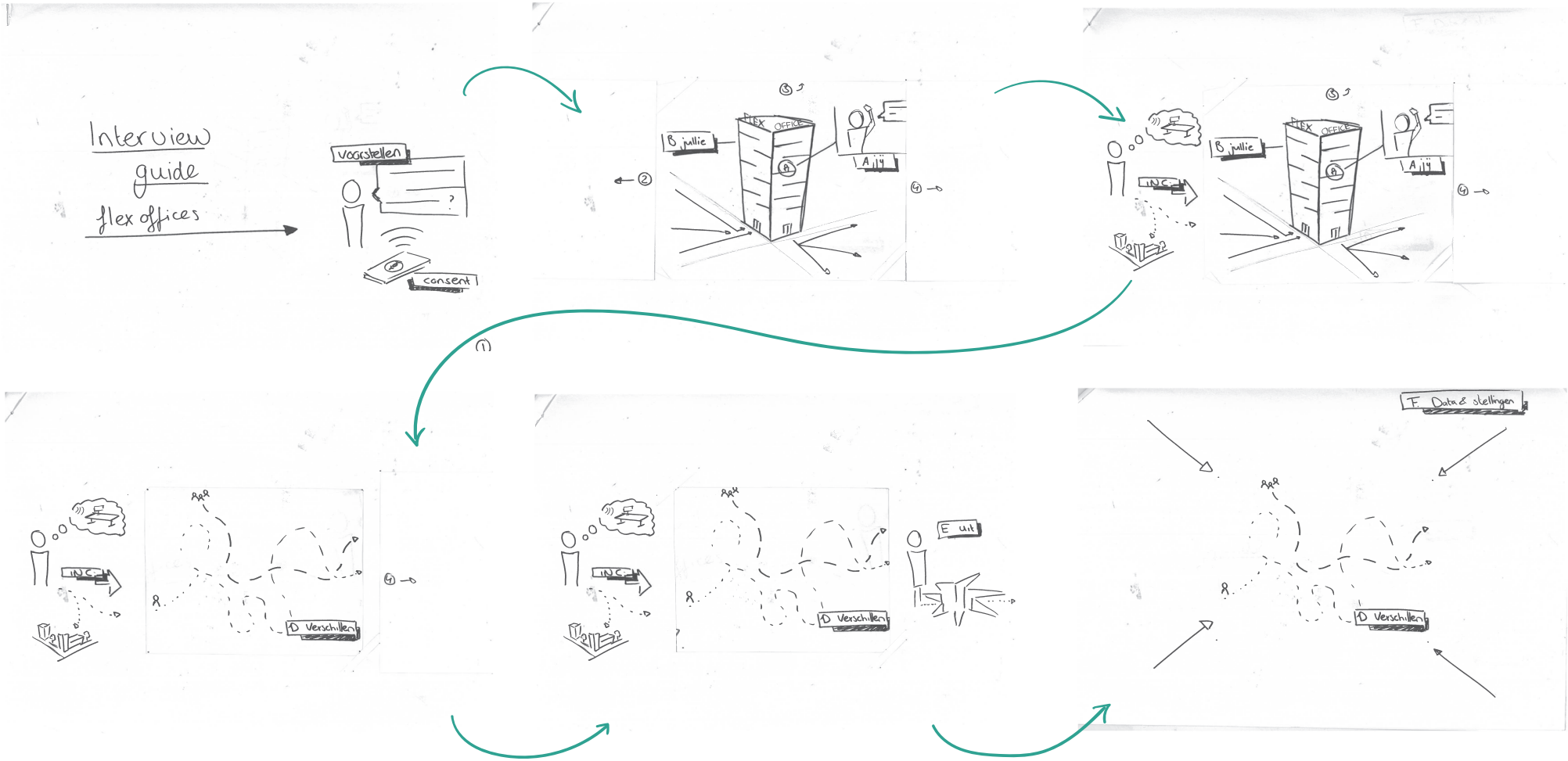
In hoeverre veranderd je mening, als je de context naar buiten jullie pand verplaatst?

3. Gebruikersdata wordt gebruikt om de experience voor onze bedrijven te optimaliseren?

Kan je hier wat meer toelichting op geven? Wat voor data zou vooral nuttig zijn voor de bedrijven na het verlaten van jullie pand?

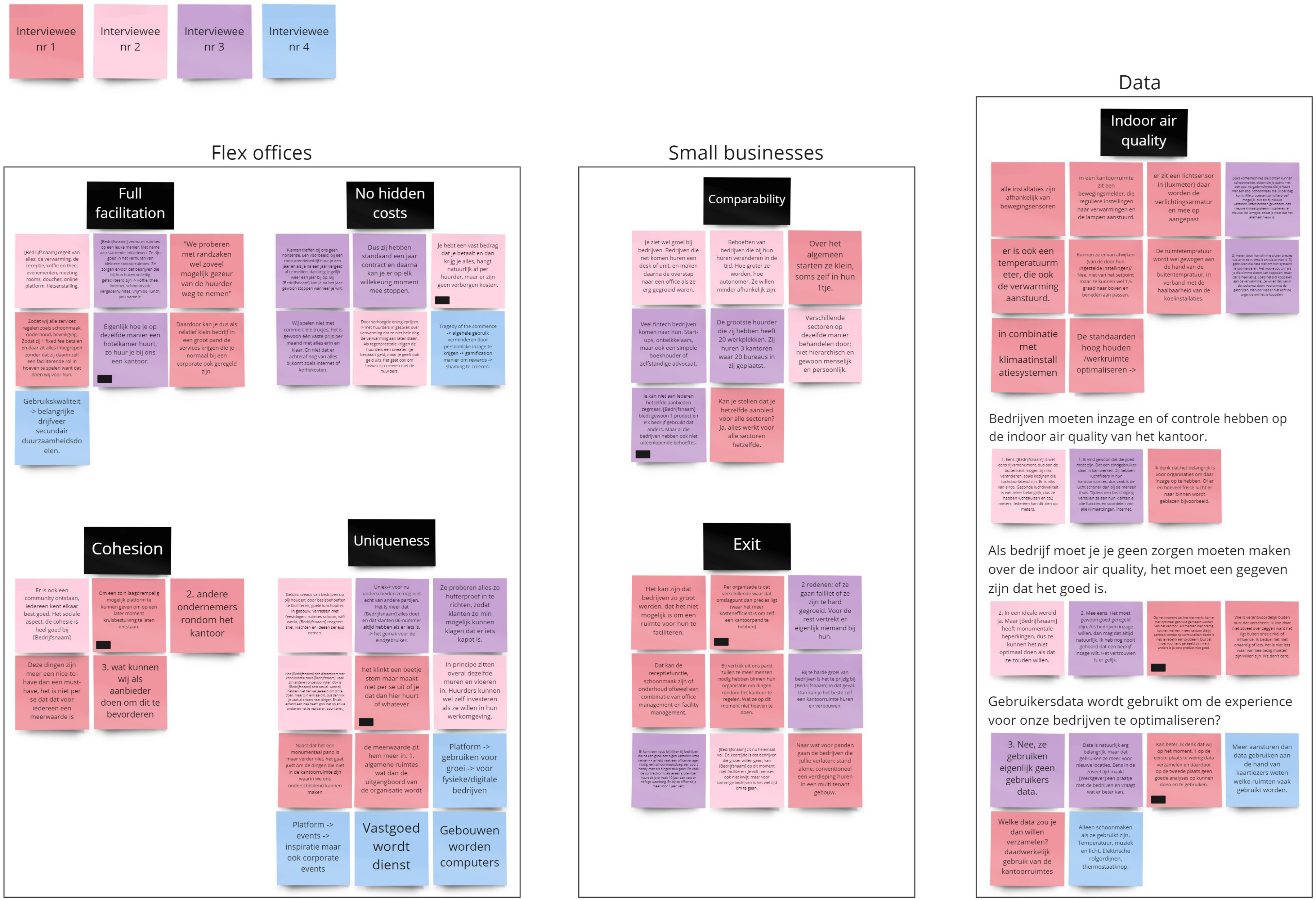
G| Snowball — Weet jij welke bedrijven ik mogelijk zou kunnen spreken die verhuisd zijn naar een ander pand?

C | FOLDABLE VISUAL SPEAKING PROMPT



D | CLUSTERS INTERVIEWS FLEX OFFICES

Full scale here: https://tinyurl.com/544vh3ae



Interview Guide | business owners

Goedemorgen! Heel fijn dat je tijd vrij hebt gemaakt voor dit moment.

Kort voorstellen: Ik ben in **Quinten Damy** en ben nu aan het afstuderen aan de master **Design for Interaction.** In mijn afstudeeropdracht doe ik research naar **groeiende/kleine bedrijven en hun gebruik van de werkruimte.**

Dit interview zal ongeveer **30 min** duren. Zoals je ziet ben ik hier in mijn eentje, om deze reden zou ik je willen vragen of ik het gesprek zou mogen **opnemen.** Met behulp van een opname kan ik achteraf op mijn gemak aantekeningen maken zonder het gesprek te verstoren. Ik zou je willen vragen of jij de **consent form** zou willen tekenen, zodat ik jouw geanonimiseerde inzichten kan gebruiken voor mijn onderzoek.

[START OPNAME]

A| Jij

Zou je jezelf kort kunnen voorstellen?
- Wat is je rol binnen de organisatie?
- Wat is het leukste deel van je werk?

B| Nu & verleden

Wie zijn jullie als bedrijf?
- Vanaf waar zijn jullie gekomen? Kan je me meenemen in het groeiproces van het bedrijf?
- Kan je me meer vertellen over de bedrijfsruimtes waar jullie gedurende deze periode hebben gewerkt?

C| Proces

Wat zijn je verantwoordelijkheden als bedrijfseigenaar?
- In hoeverre verandert deze bij het verplaatsen naar een ander gebouw?
- Wat valt hieronder maar doe je niet graag? Als je taken uit handen zou kunnen nemen, welke zouden dat zijn?

[15 min]

D| Bedrijfsruimte

Wat maakt een goede bedrijfsruimte?
- Hoe maak je de werkruimte aantrekkelijk voor medewerkers (in dit hybride tijdperk)?
- Hoe zorg je dat je medewerkers hiermee tevreden blijven?
- Wat voor data over je bedrijfsruimte is voor jou beschikbaar?
- Waarin zou je inzage willen krijgen?

Stellingen

1. Medewerkers moeten inzage krijgen in het binnenklimaat van de ruimte
   - In hoeverre moet een goed binnenklimaat een gegeven zijn?

2. Als bedrijfseigenaar heb ik het recht om gebruikersdata te genereren binnen de werkruimte

3. Door data te combineren zou ik inzage willen krijgen in: ziekteverzuim, kostenreductie, werkruimte optimalisatie, werknemers experience, _____

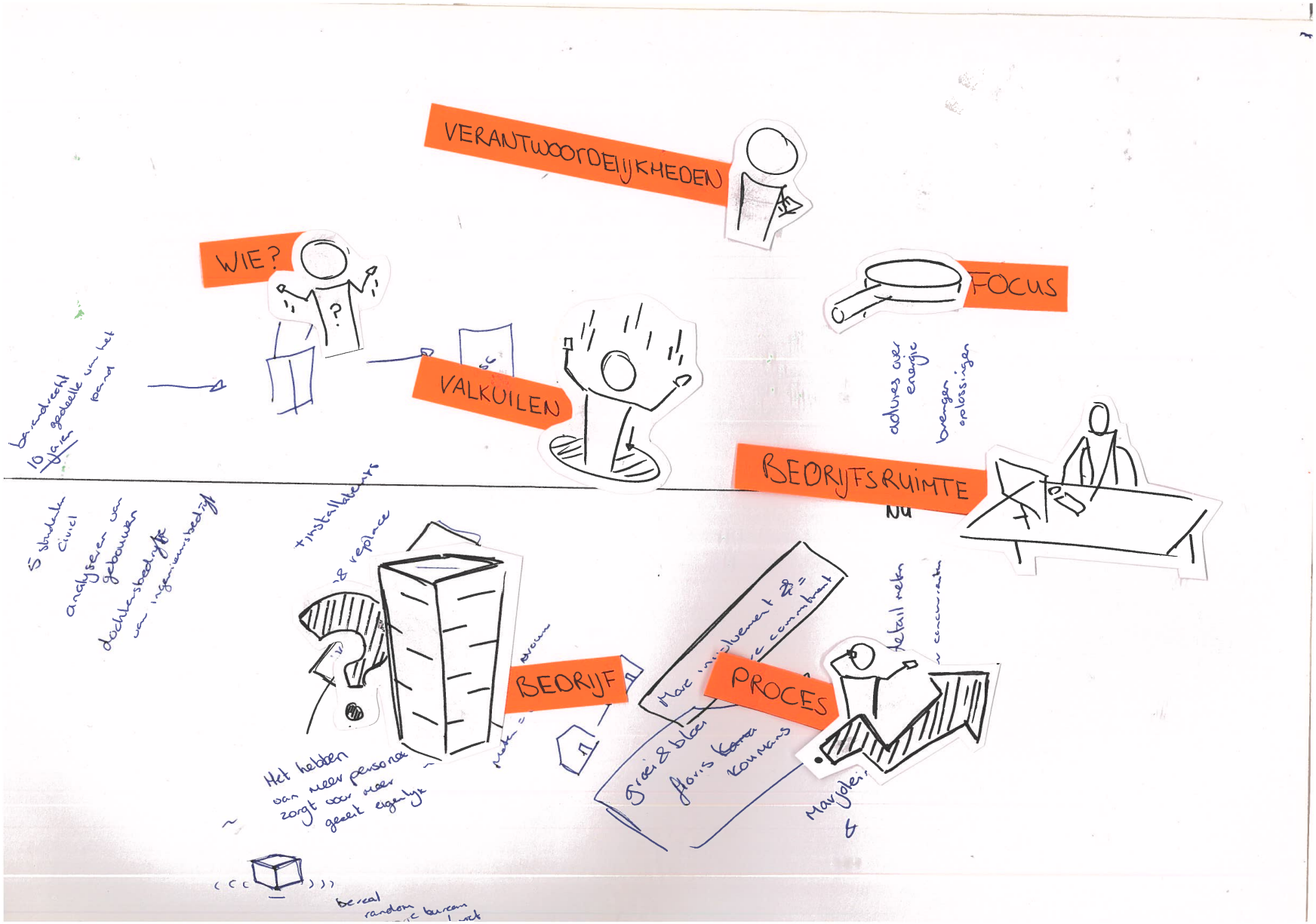
4. Zowel ruwe data als aanbevelingen zou ik willen ontvangen over wat er in mijn bedrijfsruimte gebeurd.
   - Wat weerhoudt je om dit op dit moment te realiseren?

E| Vervolg & andere bedrijven

Over 3 tot 4 weken -> Interface design -> bespreken van concepten

Is er iemand anders die jouw rol hiervan zou kunnen overnemen?

F | ADJUSTABLE VISUAL SPEAKING PROMPT BUSINESS OWNERS



G | CLUSTERS INTERVIEWS BUSINESS OWNERS

Full scale here: https://tinyurl.com/4vx5sfxb

Business owner nr 1

Business owner nr 2

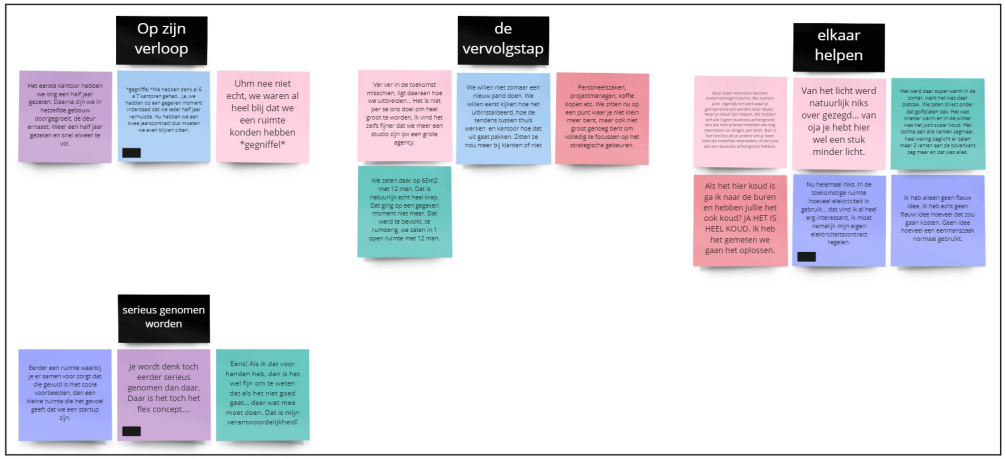
Business owner nr 3

Business owner nr 4

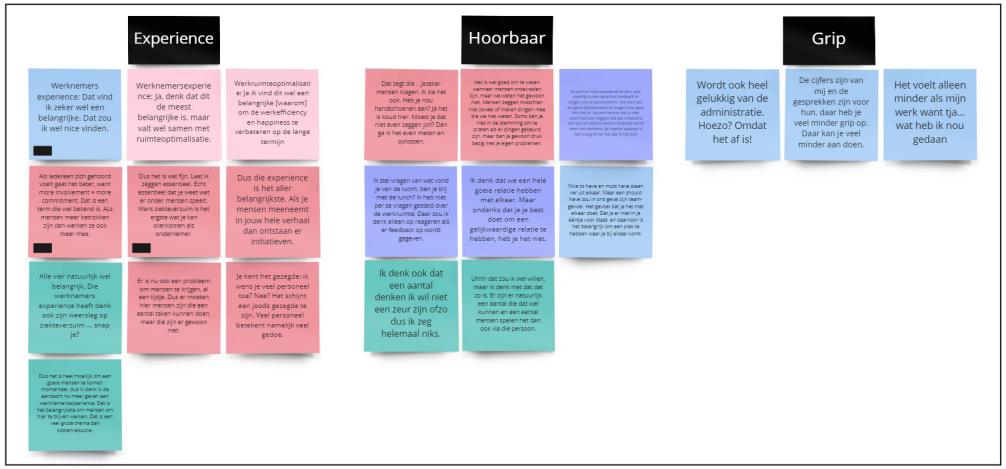
Business owner nr 5

Business owner nr 6

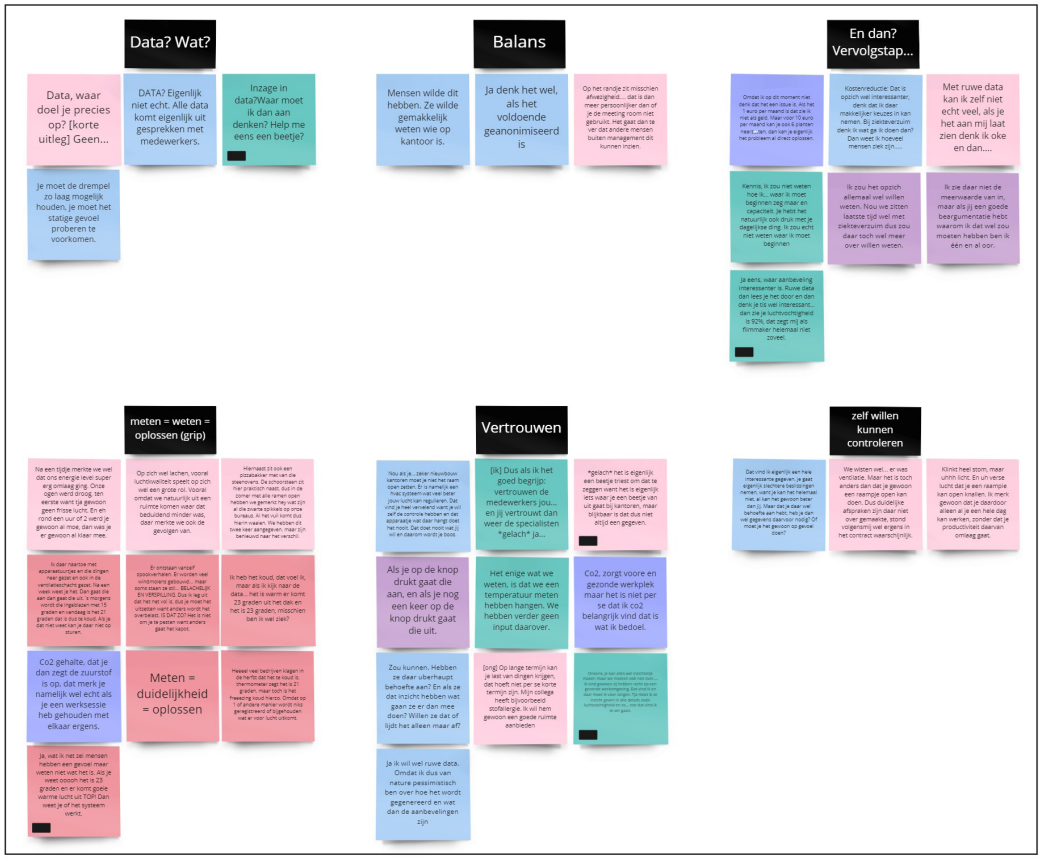
Groei



Medewerker



Data



Interview Guide | Employees

Goedemorgen! Heel fijn dat je tijd vrij hebt gemaakt voor dit moment.

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Dit interview zal ongeveer **30 min** duren. Zoals je ziet ben ik hier in mijn eentje, om deze reden zou ik je willen vragen of ik het gesprek zou mogen **opnemen.** Met behulp van een opname kan ik achteraf op mijn gemak aantekeningen maken zonder het gesprek te verstoren. Ik zou je willen vragen of jij de **consent form** zou willen tekenen, zodat ik jouw geanonimiseerde inzichten kan gebruiken voor mijn onderzoek.

[START OPNAME]

A| Jij

Zou je jezelf kort kunnen voorstellen?
- Wat doe je voor werk?
- Wat maakte dat je hier ging werken?
- Wat is je huidige mening over het bedrijf?

B| Bedrijfsruimte

Wat maakt in jouw ogen een goede werkruimte?
- Wat zijn hierin nice-to-haves en must-haves voor jou?
- Wat zou je aansporen om frequenter naar kantoor te gaan?
- In hoeverre wil je controle/inspraak op je dagelijkse werkomgeving?

1. Ik heb inzage/toegang in data over mijn dagelijkse werkomgeving
   - Welke data is voor jou beschikbaar over je bedrijfsruimte?
   - Waarin zou je inzage willen krijgen?
   - In hoeverre moet het een gegeven zijn dat het binnenklimaat in orde is?

2. Ik ben me bewust dat mijn werkgever een zo'n optimaal mogelijke werkomgeving realiseert.
   - Hoe zou dit met jou gecommuniceerd kunnen worden?

3. Mijn werkgever weet precies wanneer het goed of slecht met me gaat
   - Op welke manier deel jij deze informatie?
   - In hoeverre wordt je beïnvloed doordat hij/zij een leidinggevende rol heeft?
   - Op welke manier kan dit laagdrempelig blijven?
   - Hoe weet jij of deze data wel serieus wordt genomen?

E| Vervolg & andere bedrijven

Over 3 tot 4 weken -> Interface design -> bespreken van concepten

Is er iemand anders die jouw rol hiervan zou kunnen overnemen?

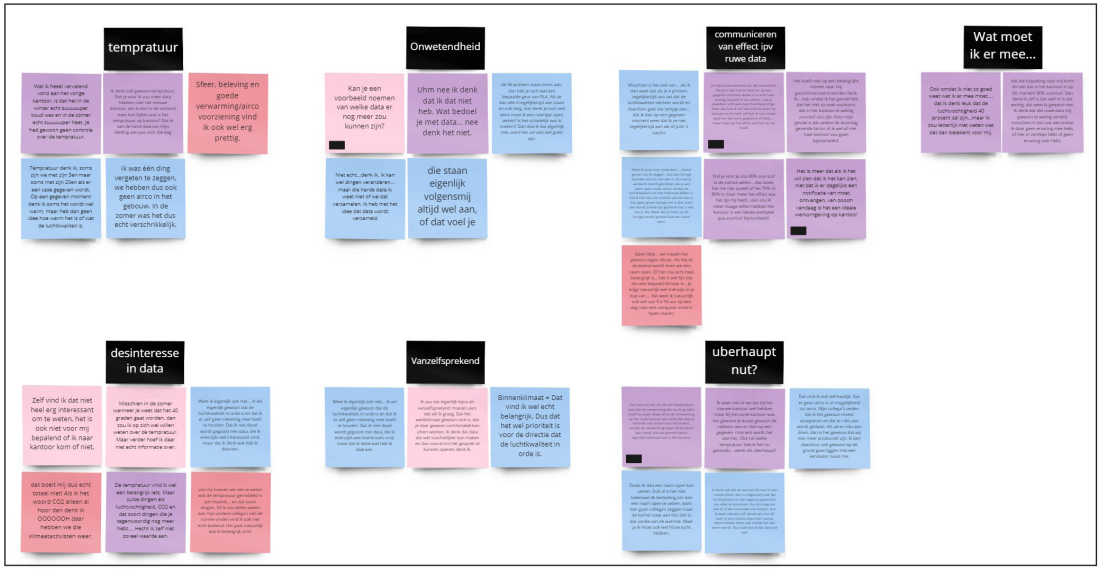
I | CLUSTERS INTERVIEWS EMPLOYEES

Full scale here: https://tinyurl.com/4twyhth8

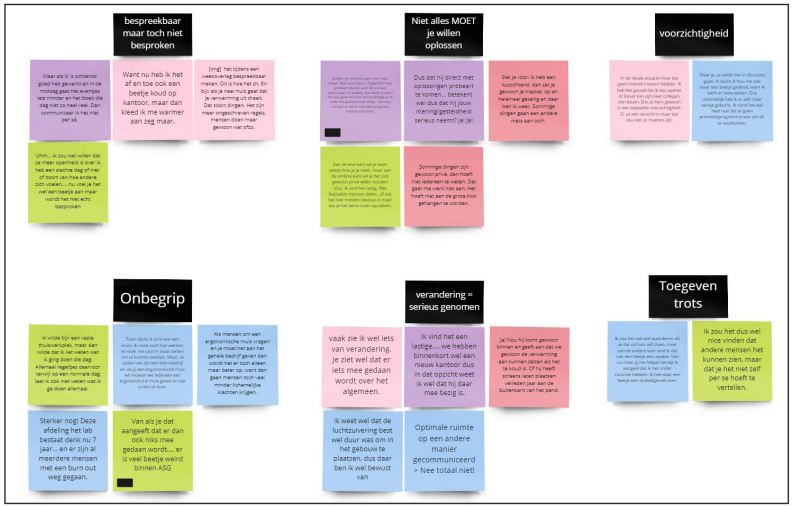
Employee nr 1 | Employee nr 2 | Employee nr 3 | Employee nr 4 | Employee nr 5

Small businesses

Data

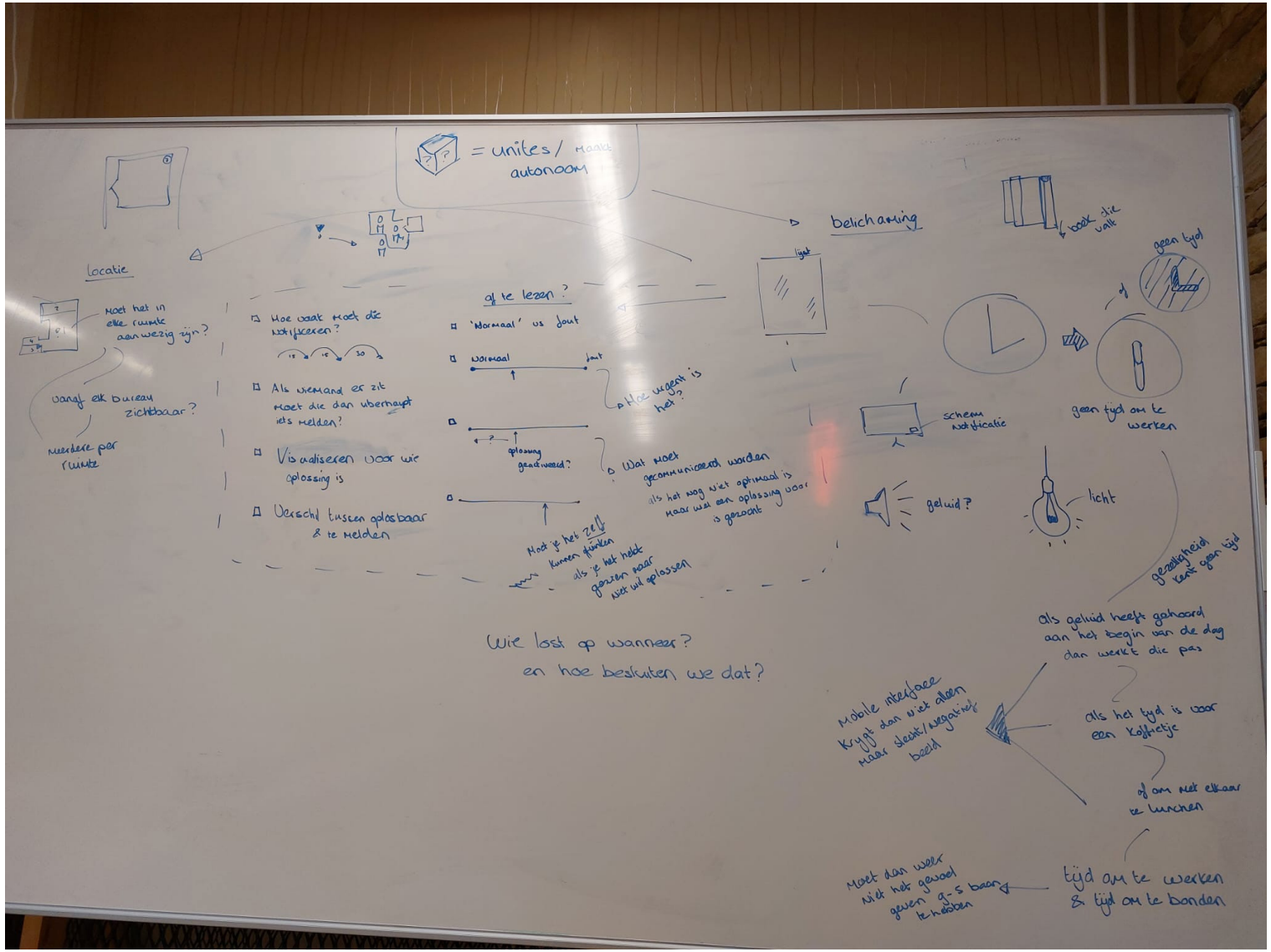


Communication



J | CONCEPT IDEATION

Apart from this whiteboard my entire booklet was full of idea sketches



K | CONCEPT GENERAL DISCUSSION QUESTIONS

What is your opinion on the presented concept?
Wat is je mening over het idee?

What appeals to you the most about it? And why?
Wat spreekt je het meest aan en waarom?

How would this concept match the company you work at?
Hoe zie je dit voor je in jullie geval?

Would you initiate buying a product like this at your company?
Zou je zelf dit opperen bij het bedrijf? Waarom?

How would your choice of a company be influenced by a product like this?
Als je zou solliciteren bij een bedrijf die dit geïnstalleerd heeft, zou je keuze dan hierdoor worden beïnvloed?

In what way would it change your perspective towards the company?
In hoeverre veranderd het je kijk naar het bedrijf?

L | RESULTS CONCEPT EVALUATION BUSINESS OWNERS

Full scale here: https://tinyurl.com/3vy5txxu

Digitale design

Notifications

other

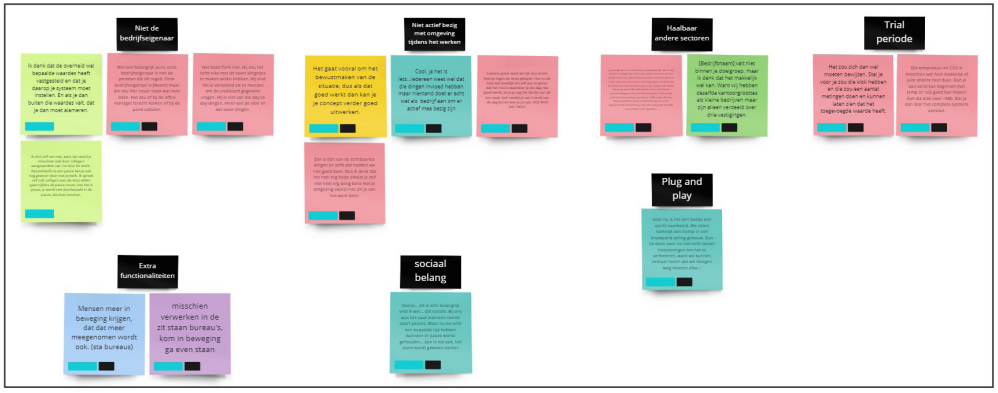
Klok

M | RESULTS CONCEPT EVALUATION EMPLOYEES

Full scale here: https://tinyurl.com/2jabfxu7

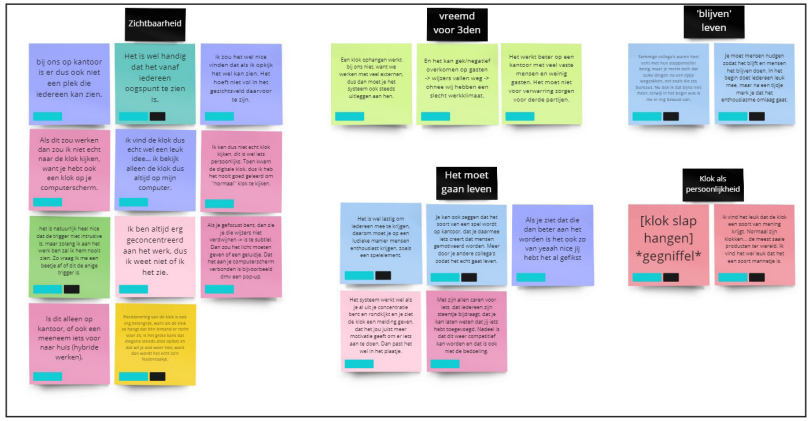
digital interface

Other



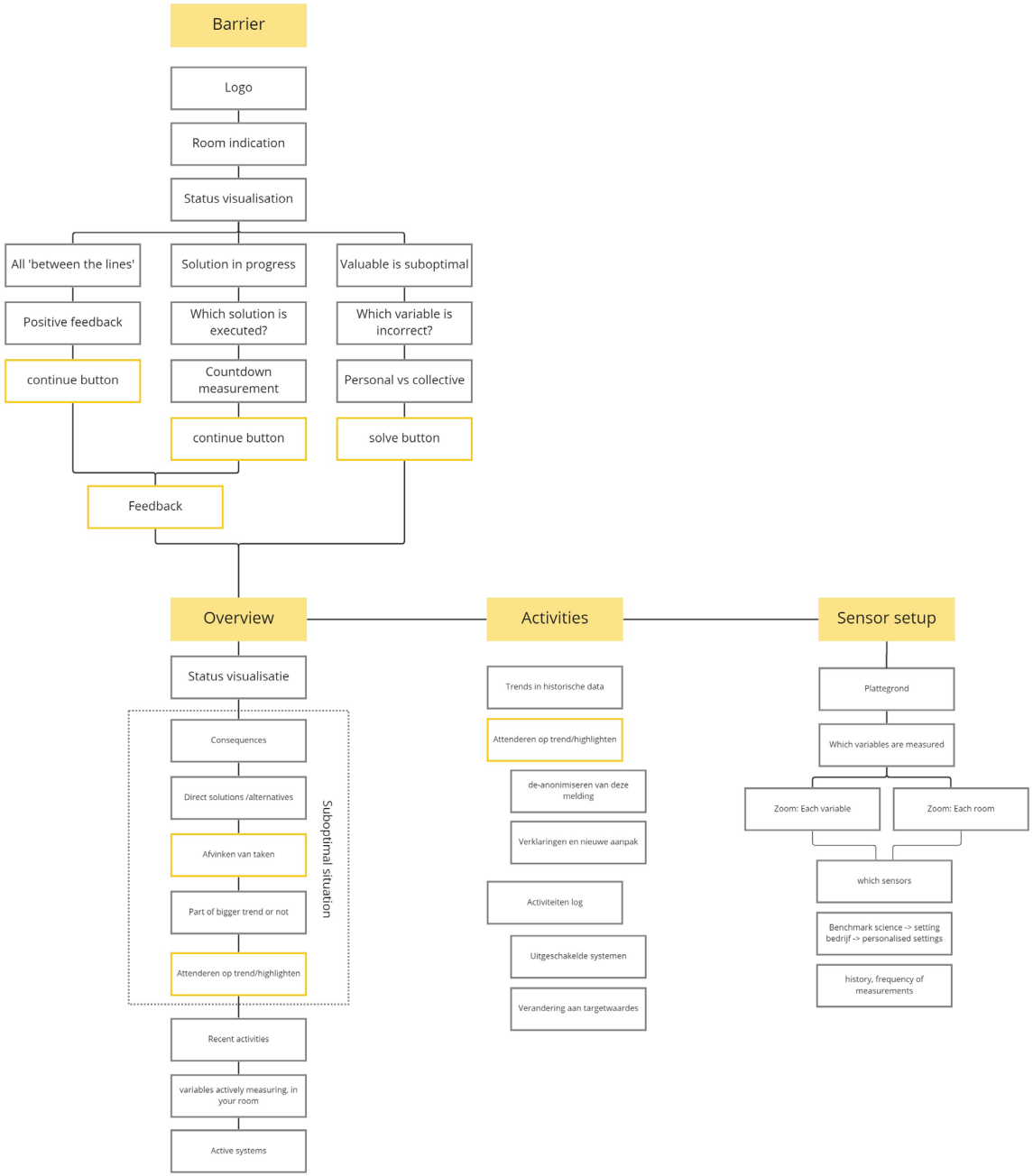
Notifications

de klok



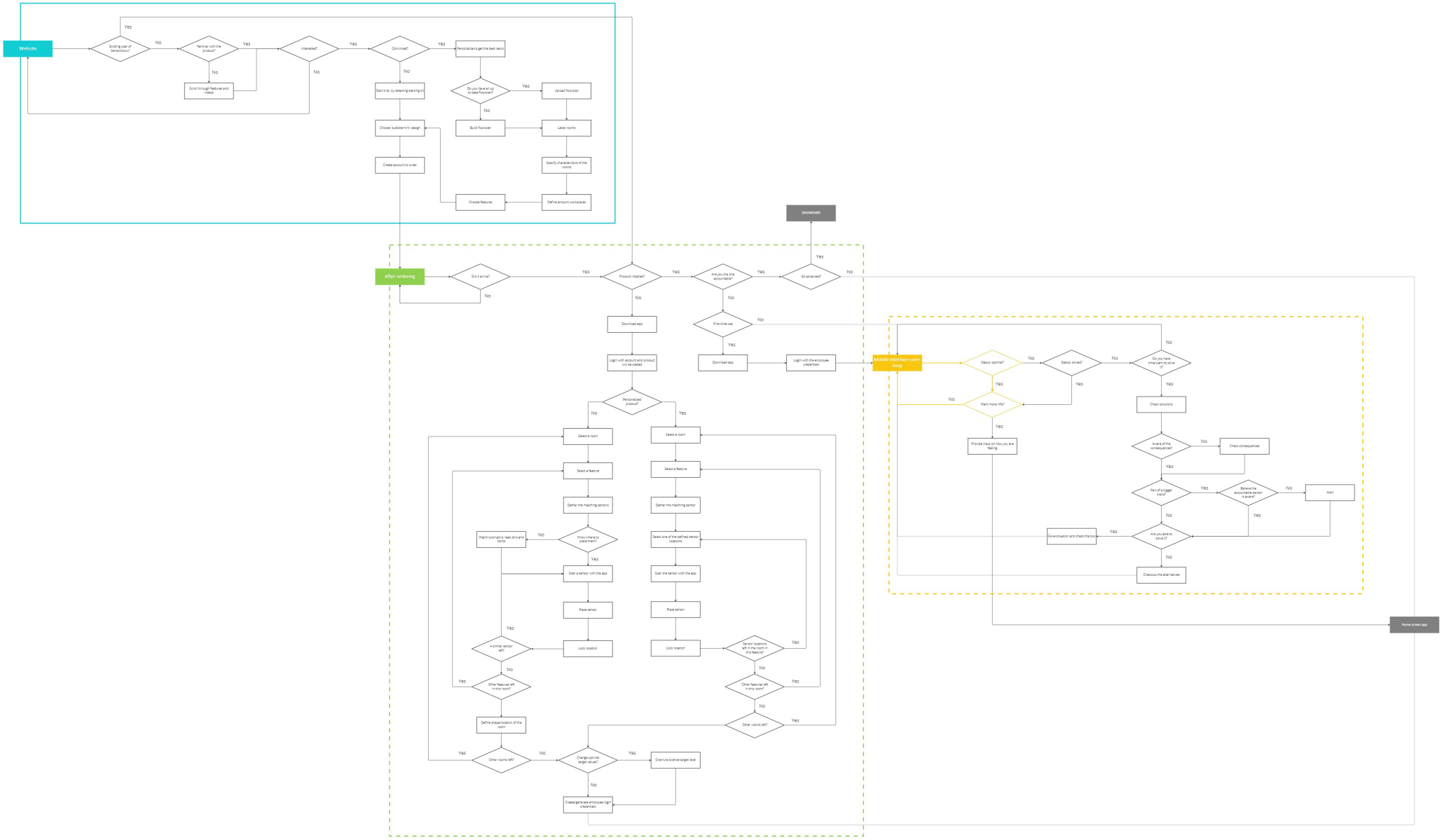
N | INFORMATION ARCHITECTURE

Full scale here: https://tinyurl.com/yeayc84n



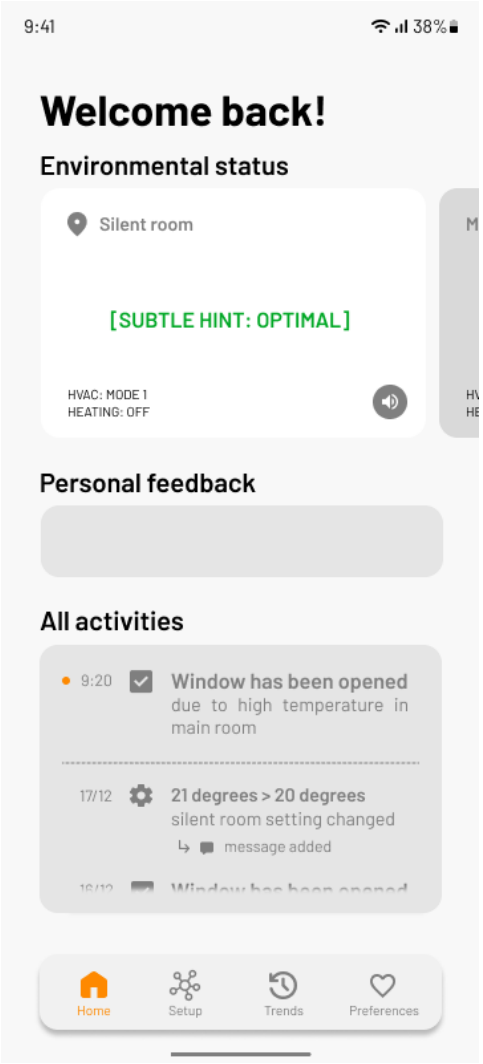
0 | TASKFLOW DIAGRAM

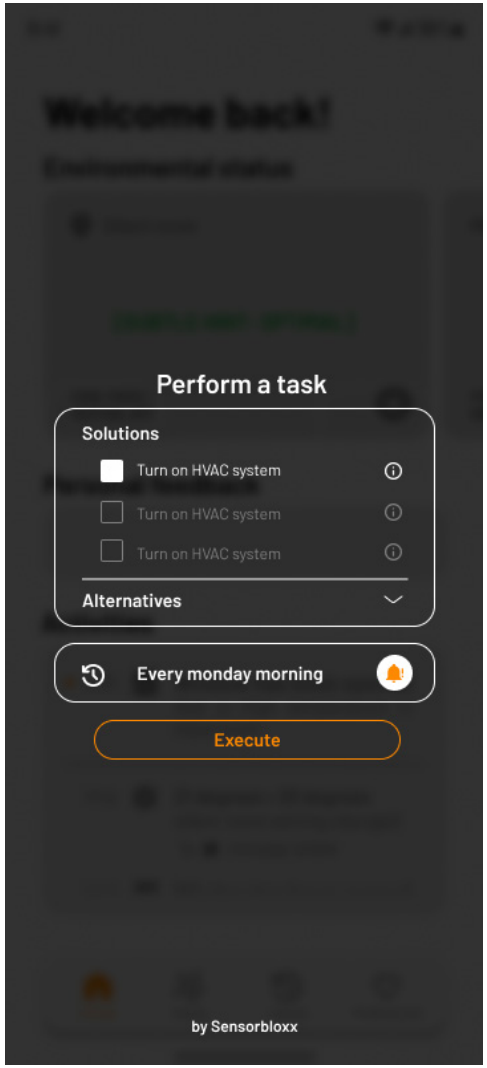
Full scale here: https://tinyurl.com/3k9y4947

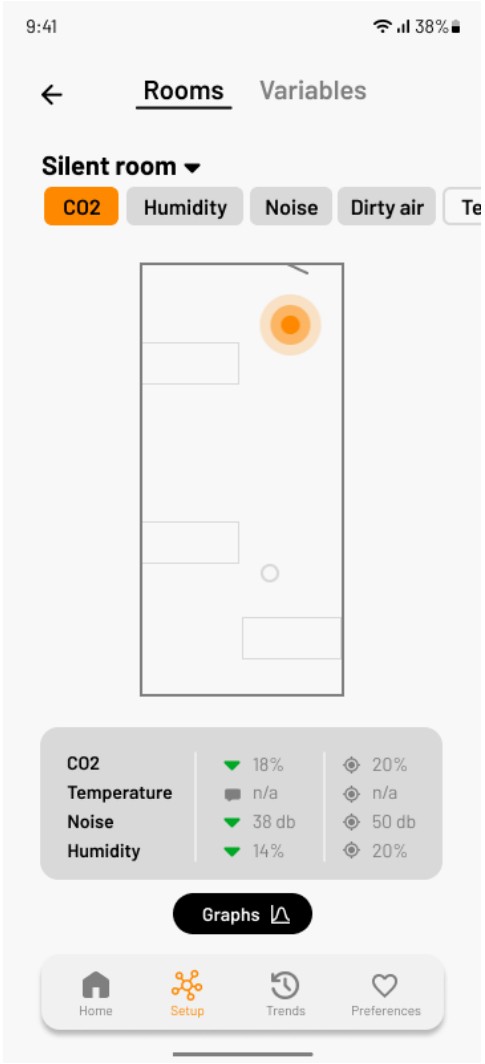


P | FIRST DIGITAL PROTOTYPE ITERATION

A fraction of the screens in the first iteration: https://tinyurl.com/4trt6wwv

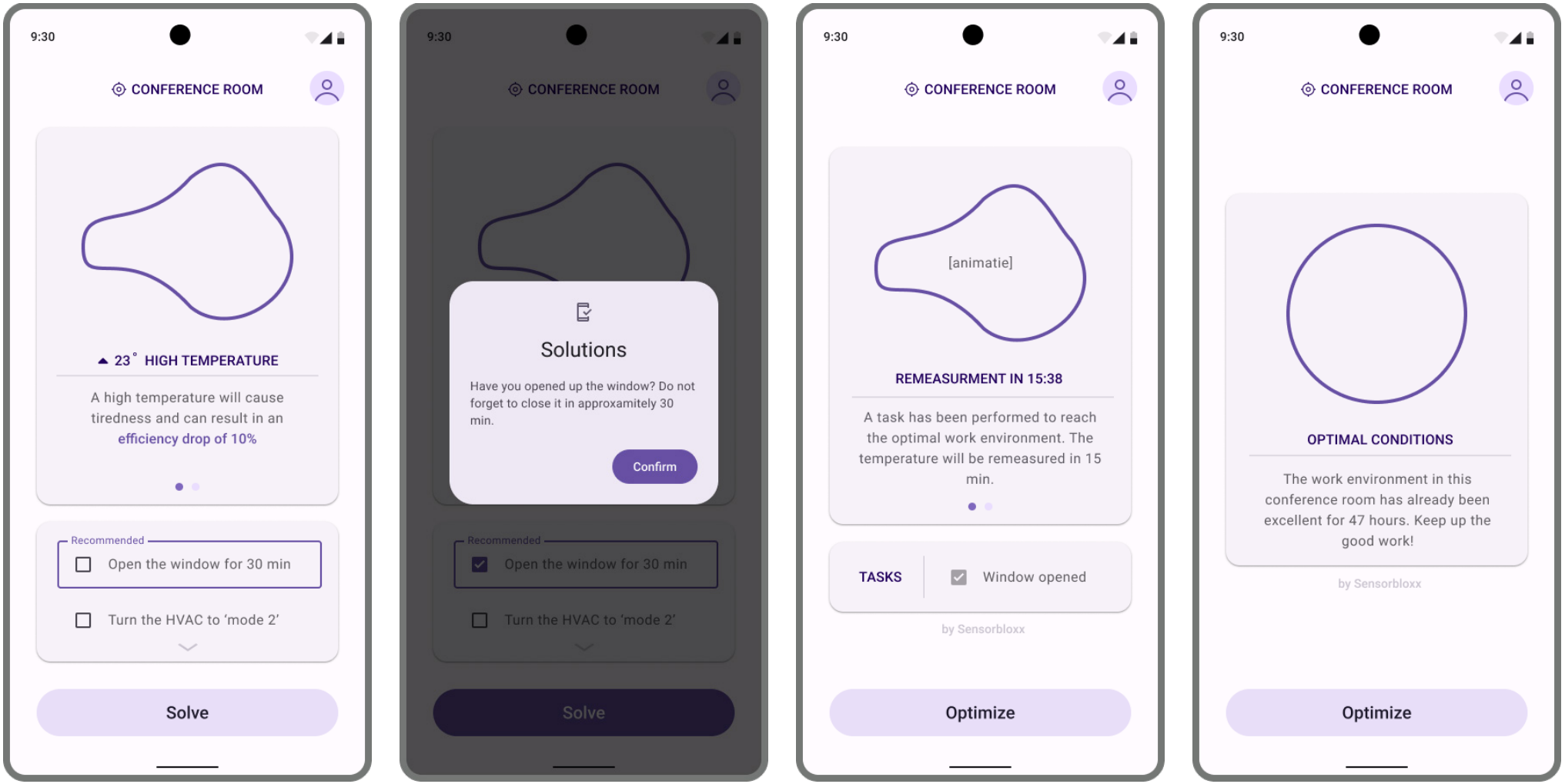






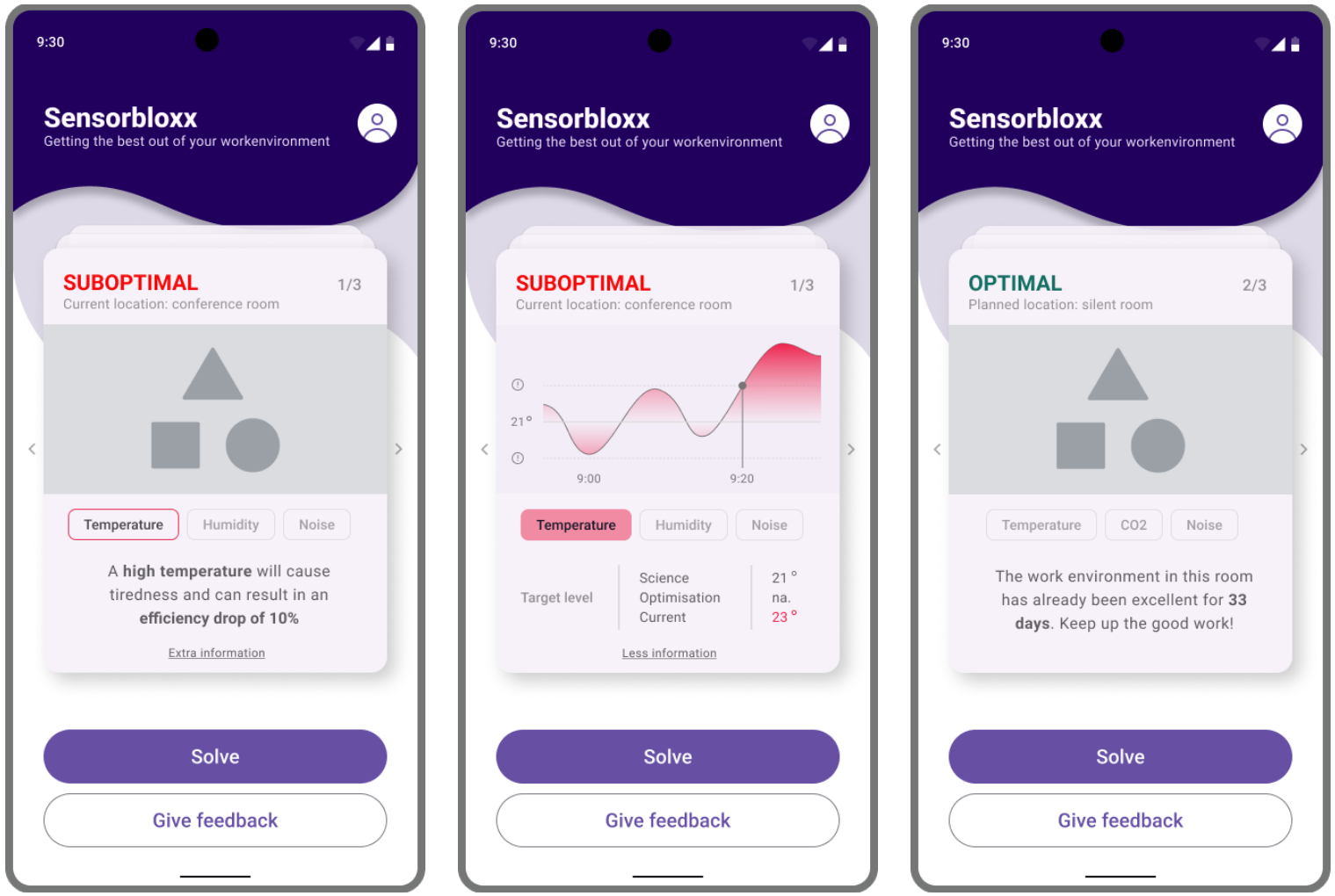
Q | SECOND DIGITAL PROTOTYPE ITERATION

A fraction of the screens in the second iteration: https://tinyurl.com/4ba2dj6f

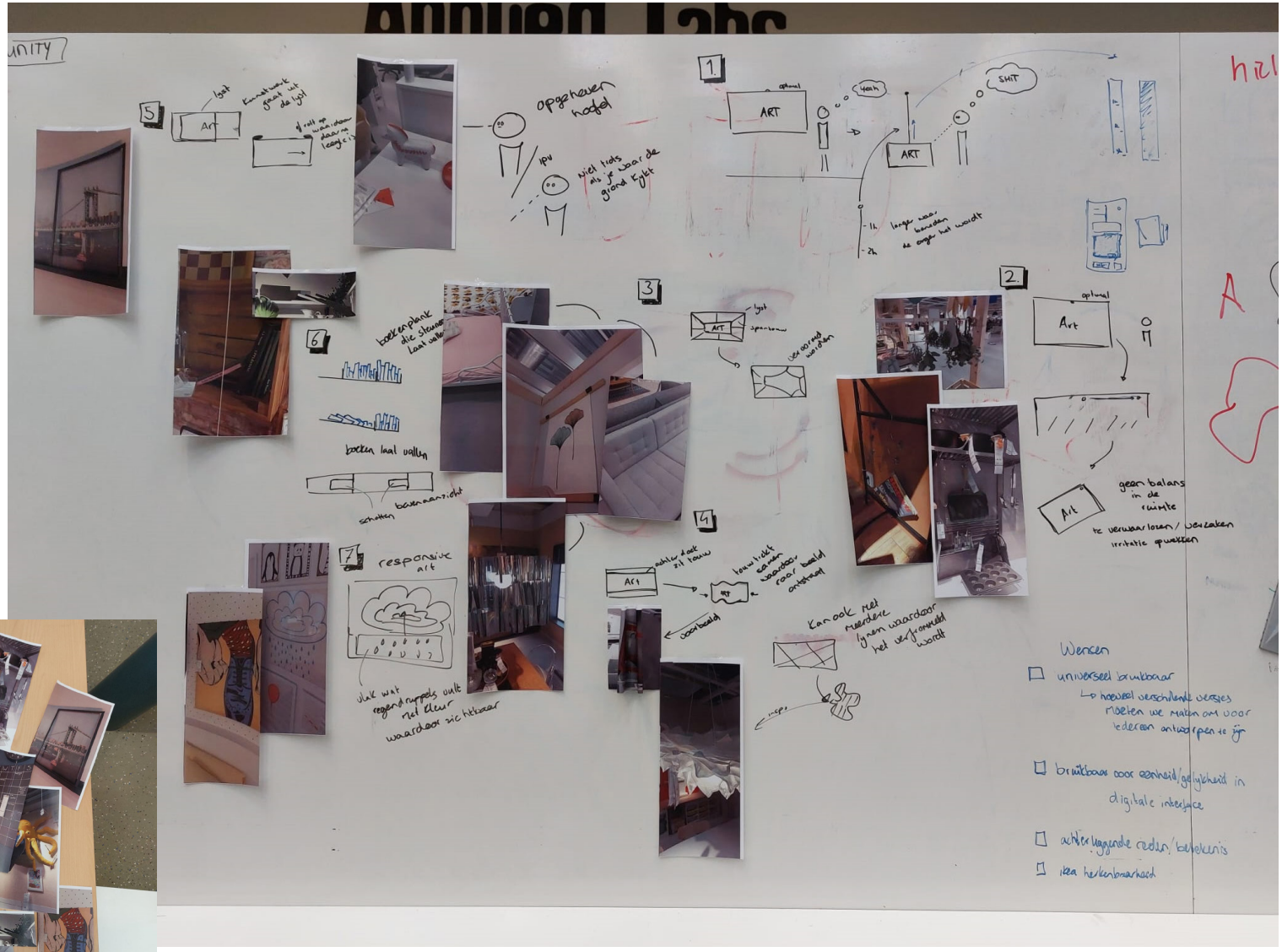


R | THIRD DIGITAL PROTOTYPE ITERATION

A fraction of the screens in the third iteration: https://tinyurl.com/4ba2dj6f

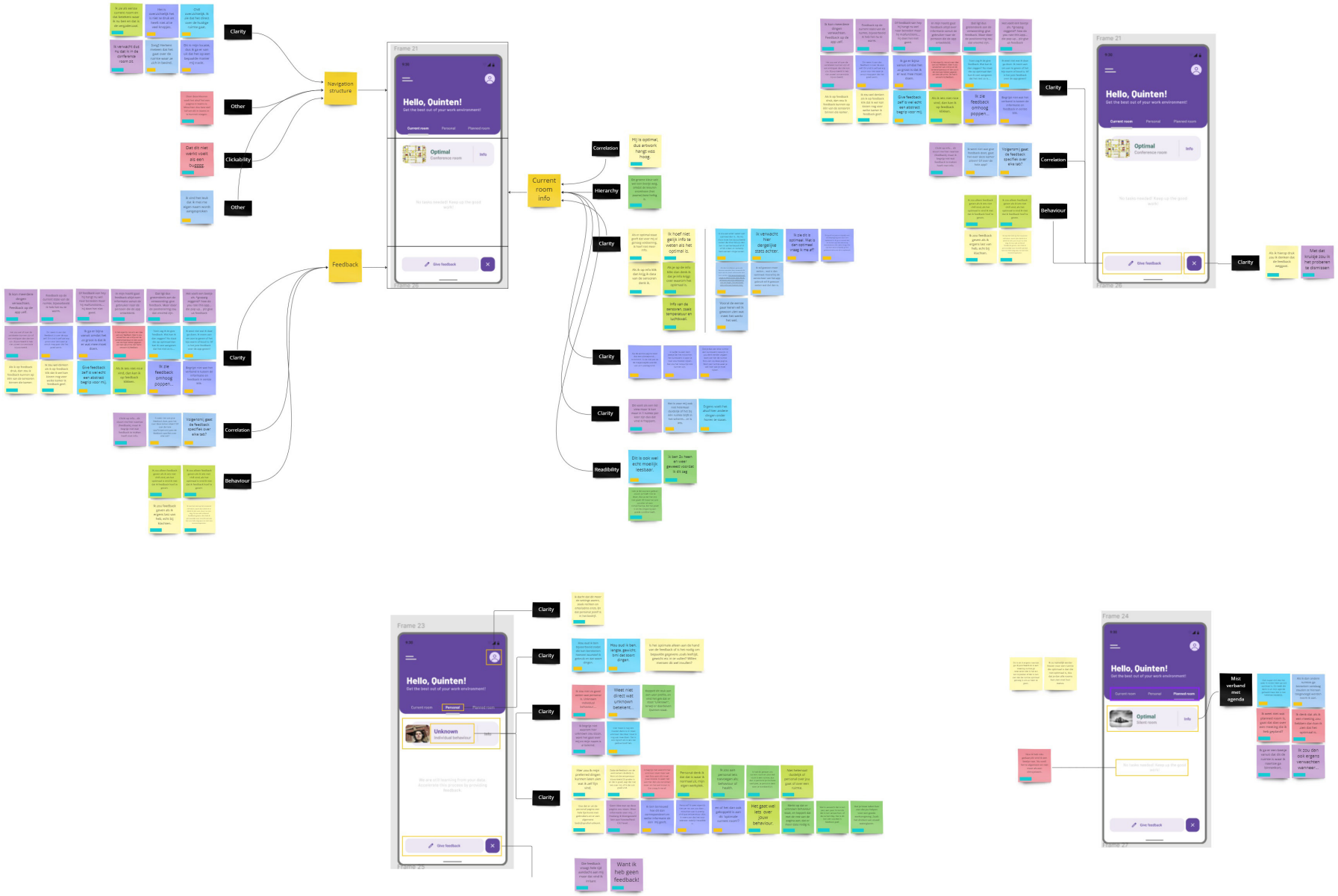


S | CALM DISPLAY BRAINSTORM



T | RESULTS CONCEPT EMBODIMENT EVALUATION

Full scale here: https://tinyurl.com/ym2vmf7b



U | WIZARD OF OZ TEST FORM

Name _____

1. Did you see the notification? What time is it?

_____

2. What were you doing at the moment you saw the notification?

_____

_____

_____

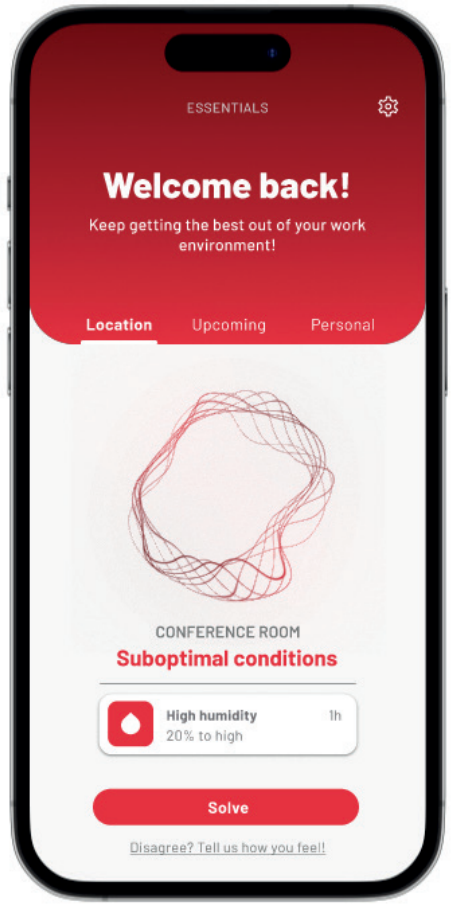
3. How much did the painting drop?

_____

_____

_____

4. Can you make a little drawing where you and the painting are located? Specify the direction you face.



4. If you were able, when would you solve the suboptimal situation by opening up a window?

_____

_____

_____

DO NOT DROP YOUR WORK STANDARDS AND START REALISING AN OPTIMAL WORK ENVIRONMENT TOGETHER

GRADUATION PROJECT | QUINTEN DAMY DE KONING | 4594290

EUROPESE UNIE
Europees Fonds voor Regionale Ontwikkeling.
Mede gefinancierd in het kader van de respons van de Unie op de COVID-19-pandemie.

WE ARE
REASONABLE
PEOPLE