Changing Littering Behaviour of Intoxicated People

AALBORG UNIVERSITET

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Collaborator: Development department of Urban Equipment (DDUE) from the Technical & Environmental Department (TMF) of the Copenhagen Municipality

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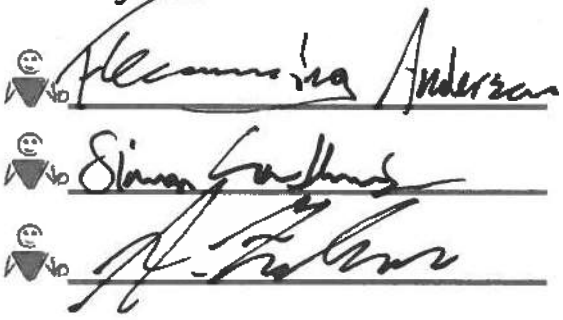


Pages: 119 pages

PREFACE

This report tells the story of all the work we have put into our master thesis of 30 ETCS points "Changing Littering Behaviour of Intoxicated People", as the conclusion of the MSc programme at the Sustainable Design Engineering education. This project has been conducted from February to June 2019 at the Aalborg University CPH, and in collaboration with The Technical and Environmental Department, Copenhagen municipality. During the entire project, we have received guidance and feedback from our supervisor who is an expert within Design Engineering. The guidance has given us a significant advantage structuring the design processes and the use of various design methods developing a solution.

ACKNOWLEDGEMENTS

The completion of this master thesis has received essential support from varies people, whom we would like to express your gratitude.

First and foremost our deepest gratitude to our supervisor, Signe Pedersen for continuous advice, guidance and support.

A special thanks to project managers Kira Gizella Olah Thume and Søren Ærendal Mikkelsen and employees Jonas Ras Pazdzior & Magnus Ring Hunov from the Development department of Urban Equipment (DDUE) from the Technical & Environmental Department (TMF) of the Copenhagen Municipality for accepting us as collaborators for their project.

A thanks to blacksmith Johnny Jensen for sharing knowledge and developing our solution

Also, we would like to thank the following operators for the Operation Department who participated in the project; Zaid, Allal & Ib

Lastly, thanks to our fellow students for contributing with valid informations, and the local life in Gothersgade for participating in this project.

ABSTRACT

One-third of the Copenhageners perceive their city as clean (Jensen, 2016).
This number is not enough. The vision is that in 2025, Copenhagen Municipality would like to see that twice as many people consider the capital as a clean city. Continuously increasing amount of litter left in the bins, with a high pocentage left as littering on the ground has grown to more than 5000 tons within recent years (Appendix - Report A; Windström, 2014). Especially, the party areas of Copenhagen have an extraordinarily high amount of litter floating around the street. With Gothersgade taking the place as the number one problematic street, which is why particular Gothersgade is the focus of this master thesis.

Gothersgade have already been subject for several test and some of the solutions have been implemented. The implemented solutions have had an positive effect on the area, but there is still a litter problem which requires more work.

Our contribution to support the current change of littering behaviour of intoxicated people in Gothersgade has resulted in the design of a new litter bin named, 'The Arcade'.
In collaboration with the Development department of Urban Equipment (DDUE) from the Technical & Environmental Department (TMF) of the Copenhagen Municipality. We have used user-centered design methods for developing a litter bin for the intoxicated people in Gothersgade.

The development of The Arcade is conducted based on a comprehensive amount of empirical gathered material, from multiple iterations in Gothersgade. This resulted in co-creation and acceptance of concepts in the ideation phase with important actors such as the Operation department and the project managers of DDUE. The final concept has gradually been adapted to the needs of the users, through building and testing several prototypes.

The Arcade is first and foremost a modular bin, which means that the top half can be customised for different types of events such as CPH Pride, Kulturnatten etc. This will also add a sustainability aspect of prolonging the lifespan of the bin, as gamification elements easily can be changed to keep the users motivated.

The Arcade acts as an interactive litter bin by providing the users with a joke/icebreaker as a reward for throwing litter in the bin. The specific designed shape, light and sound has been verified in order to create awareness about the litter bin and providing it with an identity in the vibrant nightlife of Gothersgade. Finally, co-created gamification elements in terms of 'more litter = better icebreaker quality' has been added using Arduino and LED display panel, to encourage the user to throw more litter our besides their own litter.

We have high hopes and faith that The Arcade will support the change of littering behaviour, resulting in a cleaner Gothersgade, and contributing to the goal of the Copenhagen Municipality being CO2 neutral by 2025.

1 DESIGN STRATEGY

2 THE CASE STUDY

3 EMPHASISE

4 DEFINE

5 IDEATION

6 DEVELOP

7 TEST

8 IMEPLEMENT

9 CONCLUSION

READING GUIDE

This is the written result of our master thesis. The report will introduce the reader to the thoughts behind the thesis. During the rest of the report, the master thesis "*Changing the Littering Behaviour of Intoxicated People*" will be referred to as 'the project'.

Project Process

This project has been conducted with the framework of Design Thinking inspired by IDEO's five overlapping phases of the design process(Brown, 2008), where the process is considered divergent and convergent (See figure 1, *next page*). The method provides a general view of the design process; The five overlapping phases starts off with the diverge phase, '*Emphasise*', an explorative investigating of the field, followed by the converge phase '*Define*', were we analytical challenge the understanding of the problem and resulting in a set of specification requirements. The third phase being diverged, '*Ideation*', generating ideas for conceptualisation, followed the respectively diverge and converge phases '*Develop*' and '*Test*'. Last but not least we have applied the model with a six-phase, being '*Implement*', which includes the future strategy in order for the solution to be implemented.

An important notice is, the design process is not a linear, but should be considered as iterative, meaning the five phases are overlapping going back and forth between the phases. Hence, we continuously investigate and analyse throughout the entire project.

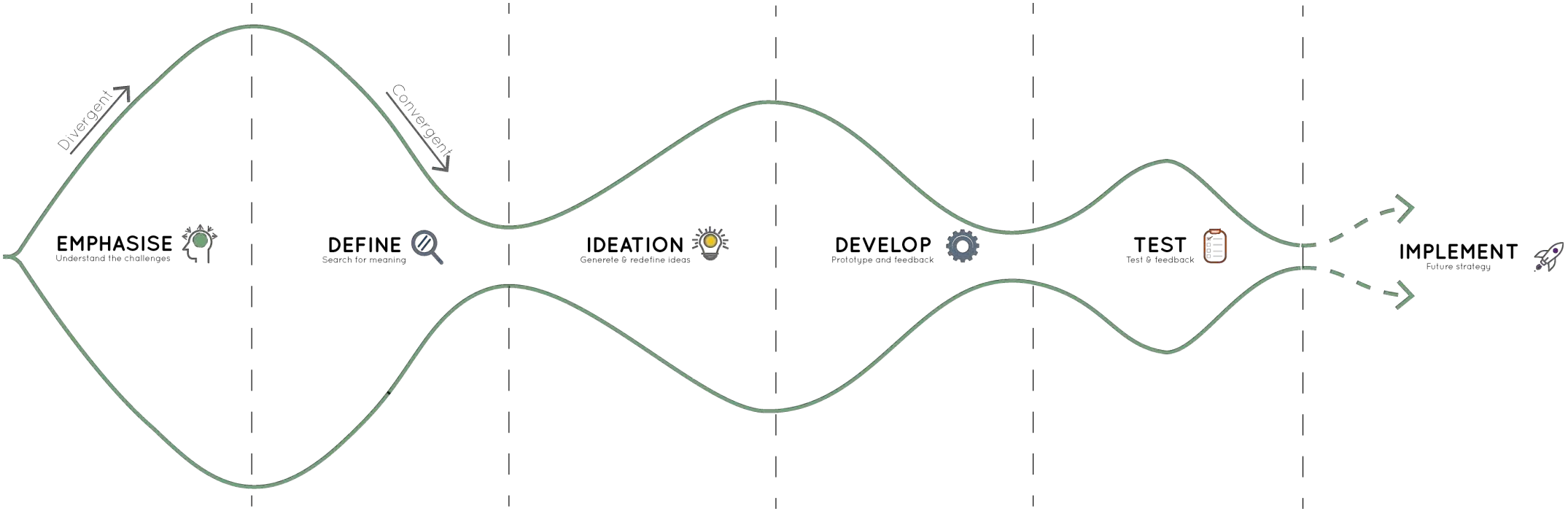


Figure 1. Indicates our design process, illustrating the six overlapping design phases. Source: Made by authors.

Report Structure

The report introduces eight chapters in relation to how the design process has occurred in this process:

Chapter 1 introduces our design strategy, which includes the methodological and theoretical framework to give the reader an understanding of how we have worked as design engineers in this project.

Chapter 2 is a description of a situated network describing the main actors involved in this project. This will give the reader an introduction to the case study of this master thesis.

Chapter 3 describes the phase Emphasise, which provides the reader with a detailed description of our gathered empirical material concerning Gothersgade and an understanding, how it contributes to littering behaviour?

Chapter 4 is the define chapter, which provides the reader with an insight into how the problem of littering has been scoped, concerning the intoxicated people, who contribute to littering in the street. The chapter results in a design specification used to structure the further process strategically.

Chapter 5 describes how we have used different design methods for idea-generating on various solutions involving different actors as co-designers, to find a proper solution that can support the desired change of littering of intoxicated people in Gothersgade.

Chapter 6 introduces the reader the conceptualisation of the final idea, namely The Arcade, and describes the multiple iterations the concept has been through before it becomes a 1:1 solution adapted and designed to fit the needs of the important acotrs in the concext of Gothersgade.

Chapter 7 describes how The Arcade is going to be tested in Gothersgade in the period between the hand of this master thesis on the 7 of June and the oral exam on the 24 of June.

Chapter 8 describes what is needed for the solution to be implemented as a solution that can support the desired behavioural change of intoxicated people in Gothersgade. It includes a set recommendation for the continuation of the development of the Arcade.

Chapter 9 introduces the reader to an overall conclusion of the project, and a reflection, which also involves a discussion of the uncertainties which has occurred in the design process of developing The Arcade.

General information

The separate appendix-report contains additional information and pictures, which is referred to during this report. The appendix is divided in three, it contains appendices, with pictures, notes and results from research, design games and observation, these are referenced to as *Appendix XX*. The Appendix also have a section which include Minutes of Meetings (MoM) from important meetings we have had during the project, these are reference as *MoM-X*. Lastly, the appendix also includes important reports that is not is not accessible online, these are referenced to as *Appendix - Report XX*.

Last but not least, we hope you enjoy reading our master thesis!

LIST OF NOTIONS & ABBREVIATIONS

TMF	Technical & Environmental Department (*in danish; Teknik og miljø forvaltningen*)
DDUE	Department of development of Urban Equipment
Project managers	Employees of DDUE, TMF
Litter	Synonyms; *Trash, Waste, Rubbish, Garbage*
Operators	Employees of the Operation Department. Emptying litter bins, sweeping etc.
DT	Design Thinking
PD	Participatory Design
ED	Engineering Design
MoM	Minutes of meetings

INTRODUCTION

"*One-third of the Copenhageners perceive their city as clean.*" (Jensen, 2016)

According to the municipality, this number is not enough. The vision is that in 2025, Copenhagen Municipality would like to see that twice as many people consider the capital as a clean city(*ibid.*). According to the non-profit organisation Hold Danmark Rent (2016), an excellent urban life attracts tourists, creative people, and companies. It provides economic growth and creates a positive image of both the city, businesses and cultural life which results in an increasingly lively city with a vibrant nightlife. Last but not least, clean city life is an essential part of a socially sustainable city. (Bylivsregnskab, 2017)

Copenhagen is a lively city with a vibrant nightlife, which is not free of charge. Especially littering from the nightlife is a major inconvenience to the citizens of Copenhagen (Project manager of DDUE, MoM-1 ; Report A);

"*It is important that Copenhagen appears clean and neat. It is reprehensible that people do not manage to throw their garbage into the bins. Especially the nightlife, there are big problems, and that is not good enough* " (The Culture and Leisure Mayor, Windström, 2014)

Especially, during the weekends the operators from The Technology -and Environmental Administration (TMF) face a significant challenge when cleaning the streets. The nightlife leaves a large amount of litter to be swept and washed away before the city opens. The operators think that it is, in particular, the nightlife that generates a large proportion of the litter;

"*We use twice the time cleaning Gothersgade in the weekends, after all the intoxicated people and their parties.*" (Operator; Soundfile - The Gothersgame #2)

The Technology -and Environmental Administration (TMF) of the Copenhagen municipality has, among other things responsibility for being in charge of practically cleaning the city and taking care of the parks (TMF, 2019). One of TMFs clear goals is to reduce the amount of litter from littering on the street; In 2018, in the municipality of Copenhagen, 263 million kroner were allocated for the cleaning of the streets of Copenhagen (Mollerup, 2018). However, since 2008, there has been a 47.7 per cent increase in the litter that ends up on the ground. At the same time, there has been a decrease in the amount of litter that is thrown into the litter bins (ibid).
The increased amount of littering in the nightlife is among other things due to the development in the city in recent years(Bylivsregnskab, 2017). As more inhabitants have come, several companies have started serving fast food, coffee to go, and outdoor dining(ibid).

"*We become more Copenhageners, and more permits are also given to organizing outdoor events which of course produce a lot more waste" (Project manager of DDUE, MoM-1).*

In 2025 there will be significantly more Copenhageners. The City of Copenhagen is growing by approx. Ten thousand inhabitants a year, and it can already be felt out in the city (Hold Danmark Rent, 2016).

TMF has in recent years had several campaigns and other initiatives that have improved the littering behaviour of the Copenhageners (Report A). However, despite the efforts, the amount of litter left in the litter bins and in particular also in the streets has grown from almost

4,268 tons in 2010 to more than 5000 tons within recent years (Report A; Windström, 2014).

"*It will be necessary to spend more money over the years to keep Copenhagen clean. […] We have become more residents, and it is clear that this tension, increases the need for money to clean up services. Unless Copenhageners start cleaning up after themselves, but I allow myself to doubt it*" (Morten Kabell - former environmental mayor, Windström, 2014)

Particularly the party area of Gothersgade is a victim of massive amounts of littering, and during the early mornings in the weekends the area resembles a regular 'war zone'; Friday, Saturday, and Sunday morning, the street is buried in litter. Gothersgade is a big mess with pizza boxes, napkins, plastic mugs, and cigarette butts everywhere. At the surrounding walls of houses, you can still see little streams, with strong smells that reveal that several of the intoxicated people have returned parts of their intake of alcohol before going home. However, the issue of littering in the nightlife does *not* only relate to an increasing amount of inhabitants, the major variety of fast food places or even the selection of events do also contribute. Studies and our observations show that the primary target group for littering in the nightlife is 15-27-year-old men heavily influenced by alcohol. (Report A; Chapter three and four of this report). The reptile brain characterises highly intoxicated people's behaviour, whose brain function is limited to think about three things; food, power and sex (Report B). TMF has not worked directly with these elements regarding solutions to reduce littering from intoxicated people. TMF want to investigate the potential for using the cognitive focus of the intoxicated people, to get them to clean up after themselves and others;

"*We have reached the point where we recognise that it is not about changing the behaviour of the intoxicated people, but rather making solutions that support the desired behaviour*" (Project manager, DDUE; Gate21, 2019)

Hence, in this project we use Gothersgade as a case study, in order to examine and develop a solution that can contribute to the desired behavioural change, so litter from intoxicated people are thrown into the bins - not on the ground. The project is a design project in cooperation with the Development Department of Urban Equipment (DDUE), who is a part the Technological and
Environmental Administration, in the development of a solution that includes a finished and mountable solution, that supports the following:

How can we develop a litter bin that ***supports the desired change*** *of* ***littering behaviour*** *of* ***intoxicated people*** *in* ***Gothersgade****?*

In order to provide an answer for the research question, a number of sub-questions and underlying assumptions need to be answered.

1. How do we understand intoxicated people, so we know who to design for?
2. What needs to be present in order to motivate the target group to throw out litter in the bin?
3. What kind of elements works best for raising awareness of the litter bin, among target groups without disturbing residents and local businesses?
4. How do you ensure that the solution forms part of the party for the target groups and is not disturbing or regarded as a municipal element?
5. What kind of reward provides the target group with the greatest motivation to repeat the action (throwing litter into the bin)?

CHAPTER

DESIGN STRATEGY

This chapter introduces the framework used throughout the design process of this project, developing a solution that supports the desired behavioural change regarding intoxicated people and littering in Gothersgade. The framework builds upon three different design approaches; Design Thinking(Brown, 2008) is used within the design team to structure the design process inspired by five overlapping phases. Engineering Design(Cross, 2008) is used to strategically structure identified criteria for concept development. Participatory Design is used in order to design democratically with TMF and their relevant business associates as well as the businesses, and the intoxicated people in Gothersgade.

Actor-Network-Theory is used as a theoretical foundation for considering which actors to involve in the heterogeneous design process and negotiate their matters of concerns (Latour, 2004). ANT and PD are both sensitive towards the role of materiality such as mock-ups and prototypes in knowledge sharing(Brodersen & Pedersen, 2018), thus, the notion of intermediary objects is used to facilitate negotiation of the various actors involved, using materialities representing the involved actors' matters of concern. To stage negotiation, we use the methodological framework of negotiation spaces (Pedersen, 2016) which is used throughout the design process to several contemporary negotiation spaces in order to develop a solution that supports the desired behavioural change of intoxicated people.

DESIGN THINKING

Picture 1 The development of prototypes. Source: Taken by authors

Design Thinking has drawn much attention and is by some design researchers considered as two different streams (Johansson-Skoldberg et al., 2013; Carlgren, Ruth & Elmquist, 2016): The first stream is 'Designerly Thinking' which goes back to the 1960s. It pertains to the design research tradition of studying how designers think and what makes a good designer(Cross, 2018; Johansson-Skoldberg et al., 2013). The second stream relates to 'Design Thinking' which pertains to the managerial concept(Carlgren, Ruth & Elmquist, 2016) In this framework we use the current managerial stream, using the term Design Thinking (DT). Most notably promoted by IDEO in 1991 and originally coined by CEO Tim Brown (Kimbell, 2011; Brown, 2008; Pedersen 2019). DT is presented as a human-centred approach to problem solving, creativity and innovation (Brown, 2008; Carlgren, Ruth & Elmquist, 2016). In this project, DT is used as a framework for an iterative process. Likewise, the approach emphasises a holistic view of the design process, which is used to manage, navigate and focus on problem scoping, gathering problem information, prioritising criterias and generating concepts. It is used within the design team as a common way of think and work, and an understanding of a deductive and inductive logic throughout the process. In other words, we use it to structure the design process in order to develop a solution that supports the desired behaviour of intoxicated people in Gothersgade.

Thus, DT is a structured methodology based on five overlapping phases (see figure 2):
The first phase being ***empathise*** where we are going to emphasise with the user using ethnographic methods such as observations, interviews, and workshops and challenge the identified problems. The next element being ***define*** where we start to define the users and empirical investigated problems through personas, role objects, and define criteria a solution-concept have to fulfil. Afterwards, we move on to the ***ideation*** phase, where concepts start to develop using methods from engineering design to strategically brainstorm and rate concepts. Then the concept will be ***prototyped*** through mock-ups, scale models and get feedback an acceptable solution through several iterations. Finally, the prototypes are to be ***tested*** in a suited environment and the result evaluated. Note that the five phases are overlapping and consist of many iterations. In relation to our project, we have felt the need to add a sixth phase, ***implement*** where we are

going to describe, what further work is required in order to fully enroll the employees of DDUE into a possible implementation of our solution.

DT provides a toolbox of methods that will be useful in gathering knowledge in the explorative and define phase using interviews, observations, and workshops to identify several problems within the field. Also, to define and scope the problem of concern, based on the involved relevant actor's matters of concern and criteria.

DT does not refer directly to classic design disciplines such as Engineering Design (Carlgren, Rauth & Elmquist, 2016). In this project one of the main focuses is to develop a solution that changes littering behaviour in Gothersgade, using methods from traditional engineering design regarding product development.

ENGINEERING DESIGN

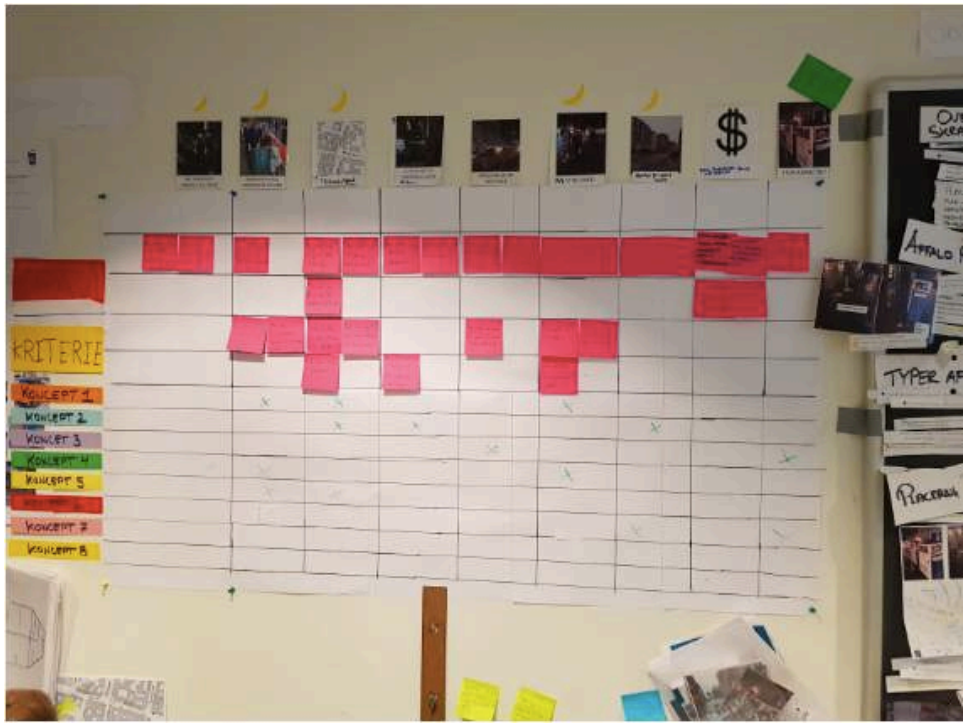


Figure 2. Customised morphology chart (Cross, 2008) used to develop concepts. Source: Taken by authors

With inspiration from *Engineering Design Methods* (Cross, 2008), designed as a manual of procedures, principles, processes, and practice of design, with the focus on product development. Some of the methods are used as an approach to develop strategically and others to help us choose a successful design. Methods such as 'brainstorm', 'morphology', 'rating schemes', are used to identify criteria. The methods are not used as what Cross (2018a) calls a 'straitjacket', stifling creativity. We use the methods as inspiration to improve the quality of the design decisions. Likewise, the methods have been useful in the development

of prototypes, early in the design process testing sub-elements in Gothersgade. Prototyping is used with different purposes depending on what phase of the process we found our self in. For example, rapid prototyping is used in the '*Define*' phase to test sub-elements in the problem context. Rapid prototyping is helpful at proving or is-proving assumptions in the early stages of the design process; "*fail often and fail soon*" *(Carlgren, Rauth, & Elmquist, 2016)*, as well as identify needs and specific criterias that have to be considered in a design specification when designing a holistic solution. The ideation and prototype phase is building as well on the methodology of Cross' (2008) engineering design methods, building mock-ups in various scales as well as the final solution.

While Design Thinking is used to structure and navigate the phases of the design process, and the Engineering Design methods provides the framework for conceptualisation, we turn our attention to Participatory Design in order to design *with* the user inviting them into a democratic process acting as co-designers.

STAGING PARTICIPATORY DESIGN

Picture 2. Designing concepts with the project managers of DDUE. Source: Taken by authors

Staging Participatory Design Is used as a framework to empower the various actors considering the processes to be democratic, meaning we design *with* the relevant actors as co-designers and not *for* someone; e.g. by staging a workshop allowing TMF of the Copenhagen

Municipality to come with suggestions for concept development, applying their ideas by sketching and facilitating.

In comparison to Design Thinking, which focuses more on a user-centric approach, Participatory Design offers a framework where the actors are partners in the design process (Pedersen, 2016). It is therefore relevant for us to supplement both of these approaches in order to engage with TMF and their business associates, as well as partners related to Gothersgade, and not only the intoxicated people.

Participatory Design offers a framework of how to set up a space where the collective insights and matters of concern of each actor can be negotiated (Pedersen, 2016).

ACTOR-NETWORK THEORY

The selection of Actor-Network Theory (ANT) responds to our need for understanding actors and their relations in a dynamic network. The theoretical framework provides a vocabulary that enables the navigation and negotiation of actors' concerns, such as network-formation, translation, and alignment. The notion of translation is used as the framework to provide insight into the socio-material context as well as providing a foundation for considering which actors to involve in the heterogeneous design process(Brodersen & Pedersen, 2018).

ANT builds upon a constructivist ontology that considers the social world along with the material one and together constructs knowledge of reality (Waldorff, 2013; Callon, 1986; Bruun Jensen et al. 2007). Hence, in this project, we emphasise that human and non-human entities or actants interact with one another within the actor-network (Law, 2007). ANT has been chosen as an analytical framework since ANT takes into consideration both actors and objects within the dynamic network-in-the-making.

ANT provides a vocabulary to discuss potential conflicting matters of concern and negotiation spaces; seeking matters of concern (Latour, 2004) for the relevant actors and objects. In relation to our objective, will this be an important aspect for us as the designers to strategically navigate the design process. The notion of matters of concern (Latour, 2004) is used to provide insight into the involved actors' different concerns and their meaning.
in order to translate the various actor's matters of concern to something tangible, we use the notion of intermediary objects in order to negotiate and stage the role of different materialities used in the Interaction/ involvement of various actors throughout the design process (Blanco and Boujut, 2003)

"[...] intermediary objects are intermediate states of the product if we consider the objects as mediators translating and representing the future product." (ibid, p. 210-211)

Hence, intermediary objects have materiality, that facilitates negotiation between actors and, through a refinement, advances from negotiation to negotiation (Brodersen and Pedersen, 2018). Thus, an object undergoes many iterations over time, thus acting as intermediation of different actor's matters of concern. In this project, we use different materialities to translate the matter of concern throughout the process, in order to understand and identify to develop a solution that considers these matters of concern. Intermediary objects is thus staged in various spaces such as workshops using design games, prototypes, concept drawings, mock-ups in order to facilitate negotiations throughout the five overlapping phases of the design process.

Negotiation Spaces

Inspired by Pedersens (2016) methodological framework, we use staging and facilitating spaces to the negotiation of matters of concern during the design process. We will use the terminology negotiation spaces in order to navigate democratically in the various actor's matters of concerns.

Multiple configured negotiation spaces are staged throughout the design process. Thus several spaces are configured and allow knowledge to circulate in facilitating negotiation of the involved actor's matters of concerns. As explained by Signe Pedersen (2016):

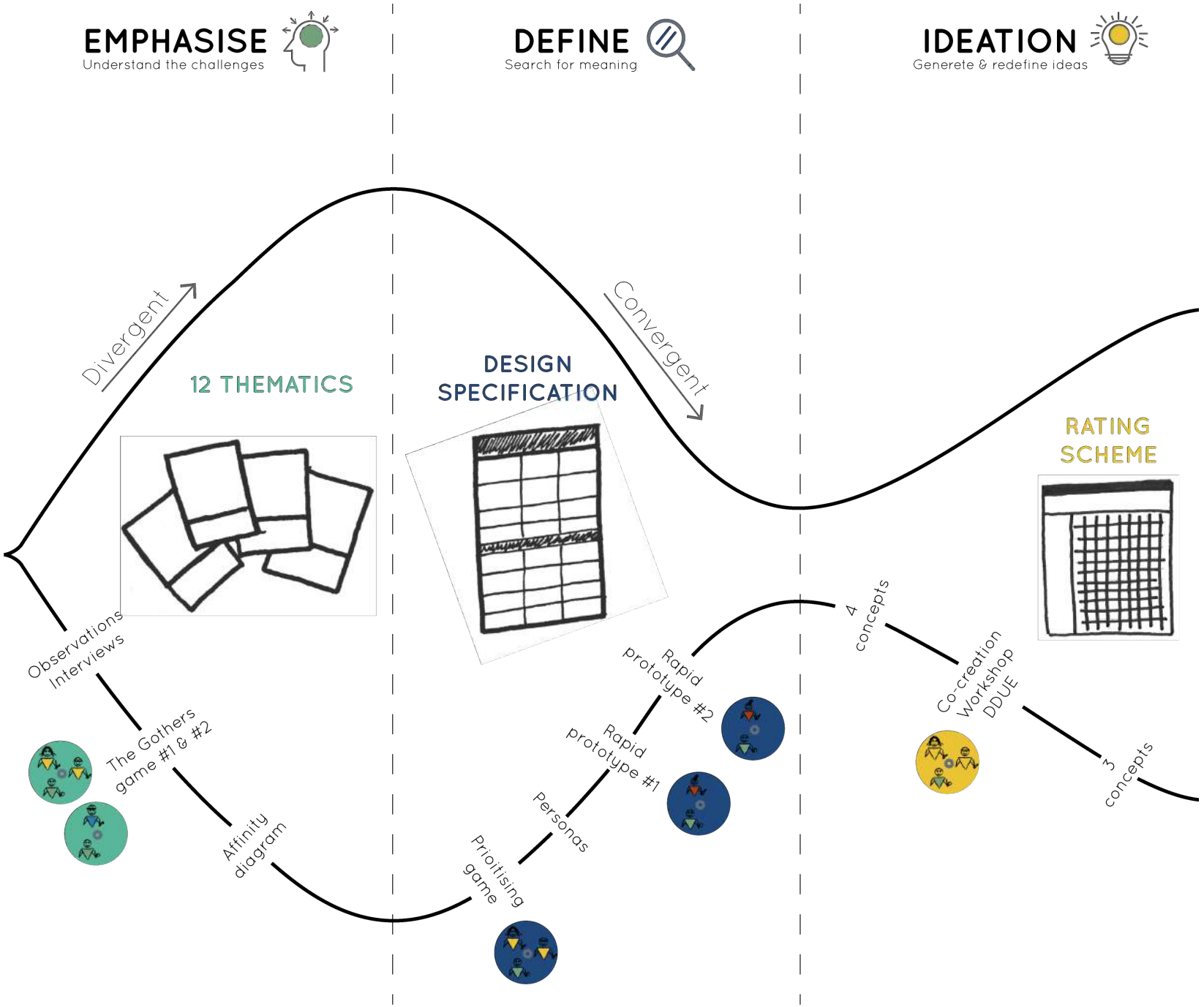
"*Spaces helps in directing attention to how these diverse actors might need to be involved and addressed in different ways to support their involvement" - (Pedersen, 2016, p. 112)"*

According to Pedersen (2016), Negotiation spaces are temporary spaces meaning, that it is a space were a negotiation takes place and once settled, the actors move on. It aims at understanding the process of configuring the political and conversational elements of the negotiable space for the actors (Clausen and Gunn, 2013).

In relation to our project, we will continuously create multiple temporary negotiation spaces through workshops with TMF and prototype testing with intoxicated people in Gothersgade plus other relevant actors. Once settled, a new workshop will be facilitated. This will offer us an approach to the planning and creation of those spaces, where the systemic perspective is being negotiated within the design team (Clausen & Gunn, 2013), considering the three elements of a negotiation space; Staging, Facilitating and Synthesis.

Staging is used to plan the desired negotiation within the space, planning roles of the participants, location, the role of materialities etc. *Facilitation* is planned on behalf of the desired negotiation which in our case often is facilitated using intermediary objects as mediators representing the participants' matters of concern. Facilitation is needed in order to encourage dialogue and negotiation with clear rules and a starting point. This will allow actors in our project to express their matters of concern and further negotiate towards a common agreement.
Synthesis is used to discuss the outcome of the facilitated negotiations in the space thereby navigate the entire design process by translating the encountered knowledge. This will lead to a new negotiation space in regard to another workshop with new tangible elements.

The framework of our design strategy will be further elaborated regarding the five design phases our design process consists of starting from chapter three.


EMPHASISE
Understand the challenges
DEFINE
Search for meaning
IDEATION
Generete & redefine ideas
Divergent
Convergent
12 THEMATICS
DESIGN SPECIFICATION
RATING SCHEME
Observations Interviews
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4 concepts
Co-creation Workshop DDUE
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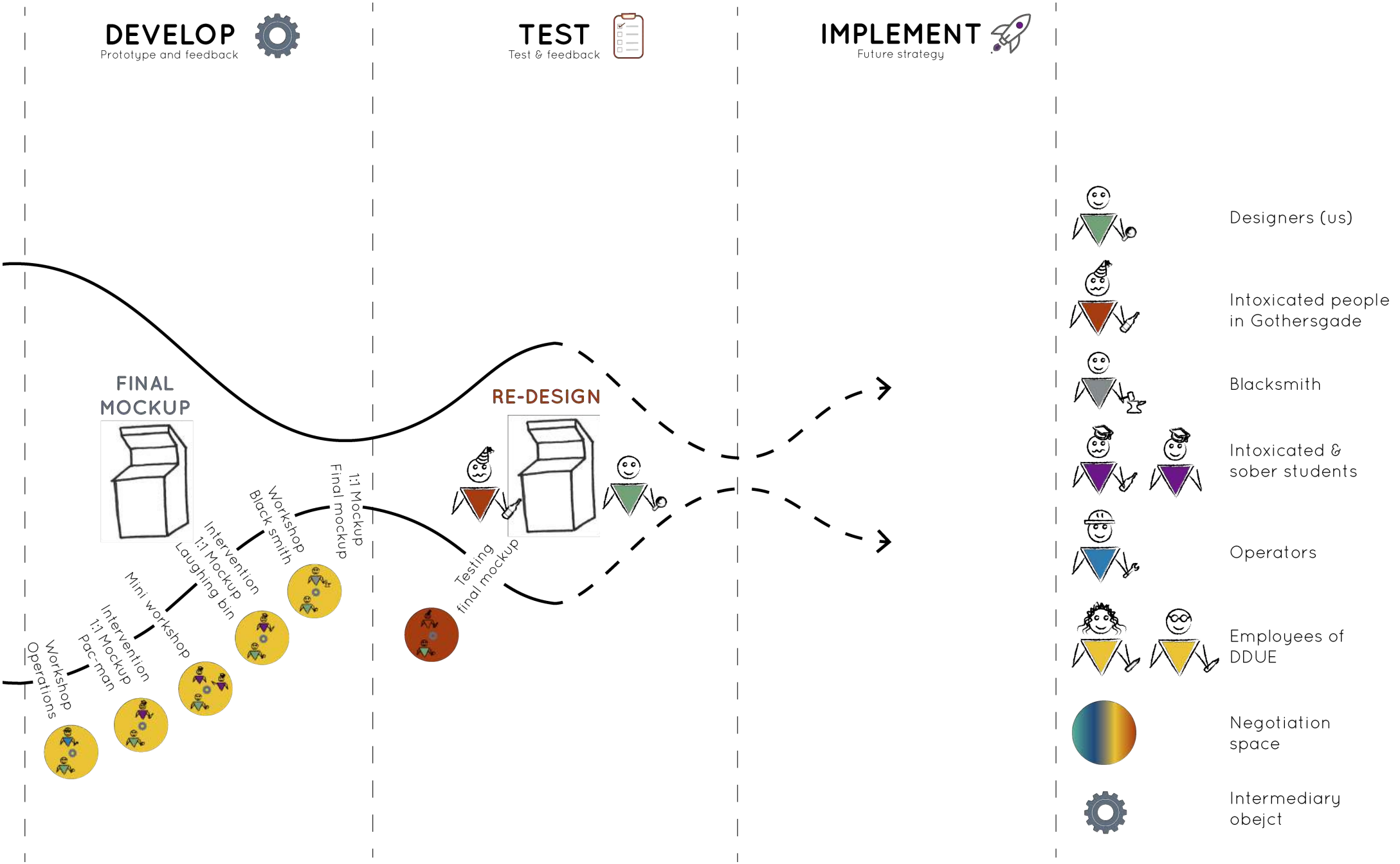


Figure 3. Our iterative project model. The phases are overlapping each other - a nonlinear process. Source: Made by authors

CHAPTER 2

THE CASE STUDY

This chapter, we introduce the street and how we have gotten the project of changing littering behaviour in Gothersgade. We will use a situated version of the Actor-Network, which will later be expanded through chapter 3, where we emphasise and explore the network and open up the problem. For now, we use ANT to draw the contours of the problem.

The municipality is responsible for keeping the street clean and their citizens happy. In that regard, they have a department that is developing new solutions to meet the challenges in relation to cleaning. This department is referred to as **DDUE** (Development Department of Urban Equipment), and they introduced us to the littering problem in **Gothersgade**, which involved **intoxicated people** partying in Gothersgade and an excess flow of **Litter**, as a result, undesired littering behaviour.

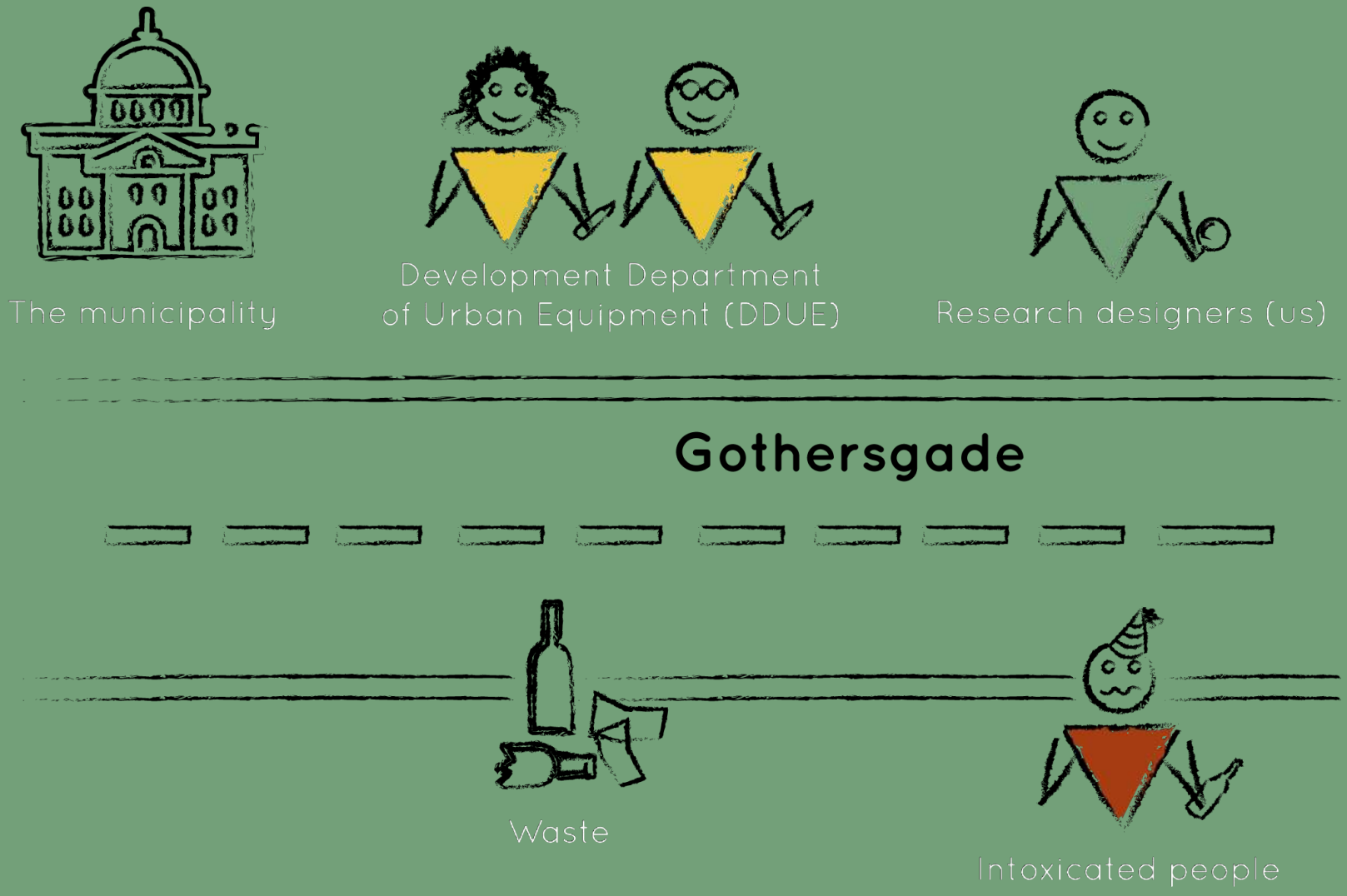


Figure 4. The current known actors and object in the street. Source: Made by authors

GOTHERSGADE
INTRODUCING THE CHAOS

Gothersgade is one of the main party streets in Copenhagen and is a street of interest because the level of litter in the street is significantly higher than "regular" streets in inner Copenhagen.
Figure 5, shows the cleaning time the operation use on cleaning Gothersgade compared to the other streets in the area. The red colour indicates that they spend 2-5 times the amount of time on cleaning that street compared to the green areas during the weekends. However, during the weekdays (Monday-Thursday) the operation spends the same time on cleaning Gothersgade as any other street.

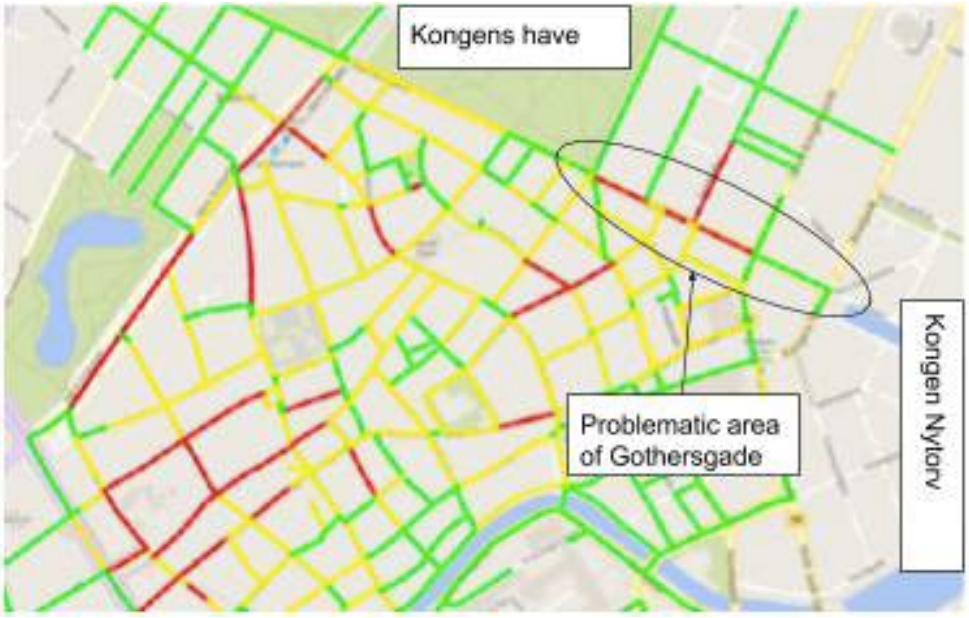


Figure 5. An overview of Gothersgade and the problematic area. Source: Made by authors

Geographically, Gothersgade is placed in Central Copenhagen and stretches from the lakes in the inner city to "Kongens Nytorv". Operation of the part of Gothersgade that passes "Kongens have" is unproblematic and similar to the operation in most parts of the city, because most visitors think rational and thus act according to social norms. Hence, they throw the litter into the litter bins. After the King's Garden (see figure 5) the situation starts to turn.

Gothersgade, also in the problematic end, is a street like any other city in the inner part of Copenhagen, during the daytime and the week-days. The citizens of Copenhagen drink their Café latte at the cafés, and the tourists walk through, to see Nyhavn or catch the metro. When the weekend arrives and it turns dark, the situation starts to change, as more people arrive to visit the fancy restaurants in the street and when the evening turns to night, it starts to get really crowded. People start to leave the restaurants or go out for drinks, and the younger generation from High Schools are starting to arrive in the street to visit the clubs and bars. Somewhere and somehow, in this flow of people arriving and leaving the street the litter starts to build up. In chapter 3 we visit the street to discover, how and why the litter builds up in the street.

Picture 3. Gothersgade on a night during the weekend. Source: (Thume ,2017) and authors

THE DEPARTMENT OF DEVELOPMENT OF URBAN EQUIPMENT (DDUE)

This section is uncovering who the municipality is and who in the municipality we have worked with.

The purpose of the municipality of Copenhagen, like all other municipalities, is to serve the citizens. We have been working with a sub-department in the department of technological and environmental management (in Danish; Teknik -og Miljøforvaltningen), from hereof TMF. TMF is a department with 2000 employees, whose job is to make sure the city is clean, green and a place where people can live a life of high quality (KK, 2019a). This includes keeping the streets of the city clean, among other things.

Organisational, TMF is divided into sub-departments, figure 6 is just showing the two departments we have been working with, but there are more departments in the TMF.
The Center for Operation consists of a number of sub-departments that is divided into physical location around the city. These departments are in charge of practically cleaning the city and taking care of the parks (TMF., 2019). The employees working in these departments are operators, who know how to drive a sweeping machine, a garbage truck and empties the litter bins, among a lot of other tasks.

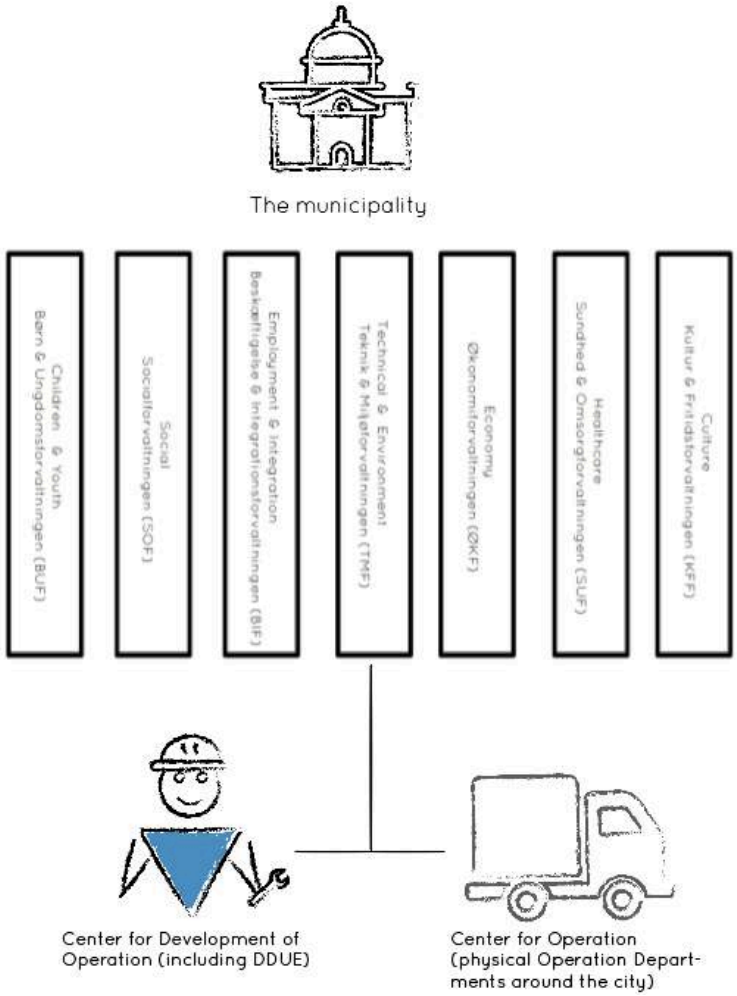


Figure 6 - Organisation diagram of the Center For Operation and Center For Development of Operation. Source: made by authors

To find the department we have been working with, we have to look at the more administrative level in TMF, where there is a development department which works above the street level and across all the sub-departments in the TMF. It is in this department, plans are made for how to meet the politician's targets on a practical level. It is also the departments on the development level that have the responsibility of carrying out the plans and achieve the goals (TMF, 2019). The department we have been working with is responsible for the development of urban equipment, that will create a better work environment, a more efficient operation of the city and a cleaner city. The department does not have a specific name in the organisational terms of TMF, but we will refer to it as the Development Department of Urban Equipment, from hereof (DDUE).

In the DDUE we find two experienced project managers who manage the development budget of the department. One project manager has a classical Mechanical Engineering degree from DTU, and the other is educated as a Design Engineer also from DTU. The department is given a budget each year to develop new equipment that can fulfil the political targets of being more efficient, create a cleaner city and improve the work environment, further introduced in the next section.

Figure 7. Icons representing project managers of DDUE. Source: Made by author

Gothersgade is a street of interest for the DDUE, because it is one of the worst areas in Copenhagen in terms of bad littering behaviour. Bad littering behaviour is defined as litter thrown on the street and good littering behaviour is litter which ends up in the litter bin. Designing of litter bins does, therefore, play a role in the design of solving the littering behaviour problem in Gothersgade, which is why the department has chosen this project.

POLITICAL GOALS

The Municipality is making policies and strategies for how the city should develop. It is TMF that have the responsibility to develop the city, so it fulfils those political targets e.g. a CO2 neutral city or 50% of all commuting done by bike or 75% of the citizens experience Copenhagen as a green city.
Most relevant for DDUE and this project is the target set on the cleanliness of the city. The politicians have made a target, that 2 out of 3 citizens in Copenhagen, must experience the city as a "clean city" by 2025 (KK, 2019b). In 2018 only 29% of the citizens in Copenhagen saw the city as a clean city, so there is work to be done and Gothersgade, is number one in terms of littering.

Besides working on making a cleaner city, DDUE also develops equipment that creates a better work environment for TMFs operators. The operators do many repetitive lifts during the day and it is important that the equipment they use does not wear out the operator's body (Andersen, 2019).

Lastly, it is important that everything they implement makes economic sense. Like most other public institutions TMF is trying to do more with less, this means that new investments should contribute to a more efficient operation (ibid).

Why is litter so important?
Besides designing for political targets of saving money, litter might in the streets have a bigger influence on our lives than one might think. According to "Hold Danmark Rent" (an organisation that is mapping littering in Denmark) a survey made in England in 2006 showed that litter in the street is the 2nd most annoying problem (Hold Danmark Rent, 2011), the only thing that is more annoying is urination in the street (ibid). A Survey from Denmark made in 2011 also revealed that ⅔ of the Danes experiences their neighbourhood as being dirty. They especially pointed out that littering affected their mood negatively or made them angry or sad (ibid). The litter in the street also affects tourists' experience of Denmark and the likelihood of them returning (ibid). Furthermore, people also answer that litter in the street is making them feel unsafe and it affects the community feel negative (Hold Danmark Rent. 2016).

Besides the negative effects on people's mood, it is also expensive to clean up after littering. It is estimated that 500 million DKK is used every year by the municipalities in Denmark on cleaning litter that has been thrown in the streets (Hold Danmark Rent, 2011).

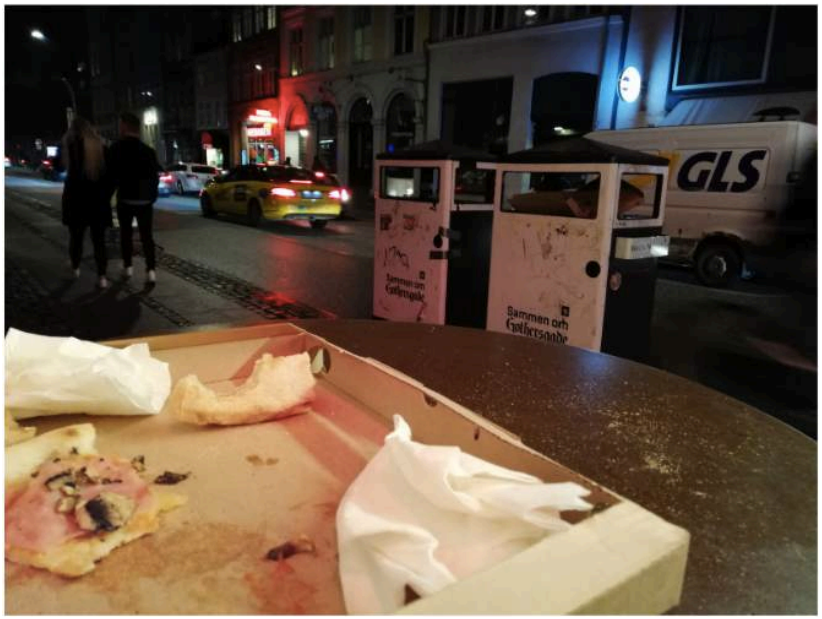
INTOXICATED PEOPLE

An important actor in the problematics of excessive litter on the ground in Gothersgade is the intoxicated people. Young partygoers, that visit the street from 10 pm to 6 am in the morning are there for having a good time and party. Litter does not seem to be of much concern and especially not if the barrier for using the litter bin is too high. E.g. if the litter bin is full, they just leave the litter or put the litter nicely next to the bin, see picture 5. In chapter 3 and 4 we will go into the depth of the intoxicated people's behaviour.

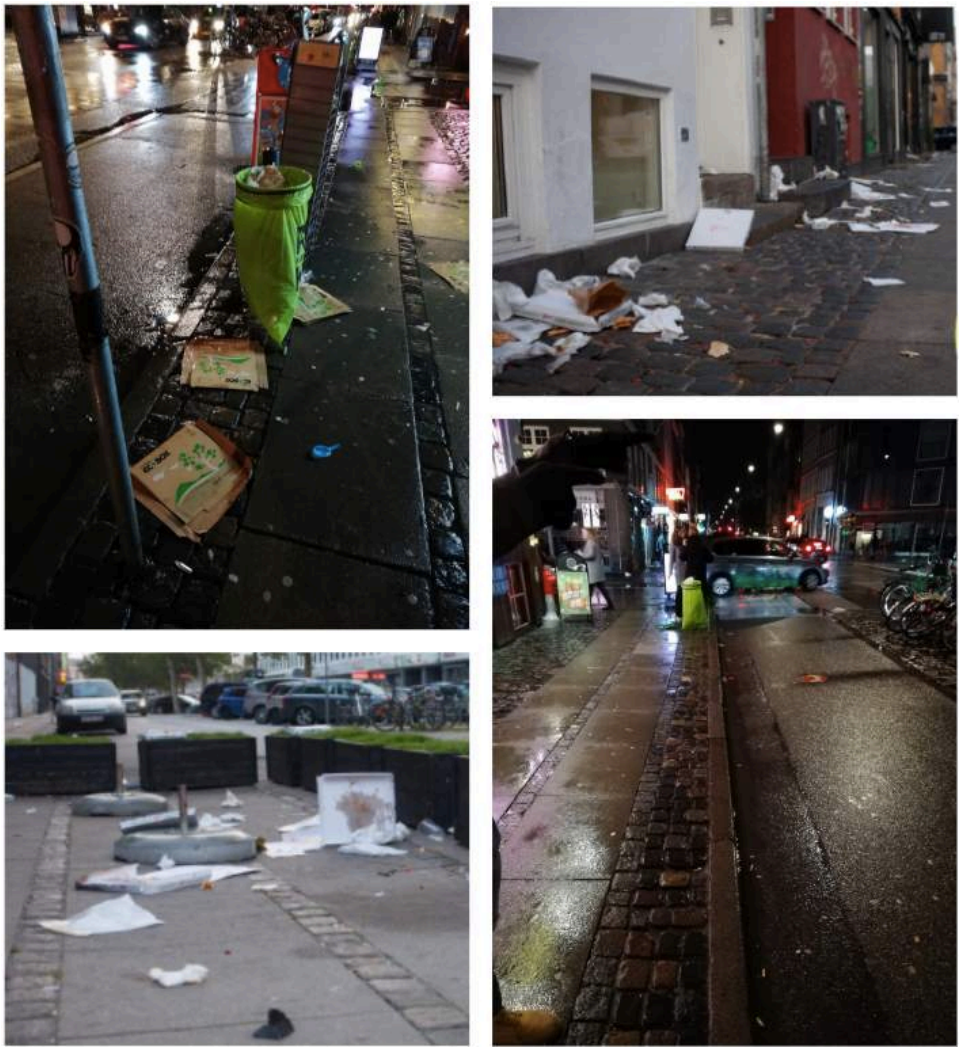
Figure 8. Icons representing intoxicated people. Source: Made by author

LITTER

Litter in Gothersgade is an important non-human actor because it is what constitutes the problem and conflicting with the political goals, such as having a clean street. Furthermore, it is expensive to remove. As already introduced, litter in Gothersgade requires extraordinary attention, because of the high flow of people and the intoxicated people's careless littering behaviour, see appendix 3 .
The types of litter found in the street are many, as earlier projects of the street show but it is mainly pizza boxes, fast food wrapping and cigarettes that catches the eye.



Picture 4 - Pizza box left on the table in front of Pizza House Source: Taken by authors, 2019



Picture 5 Different types of litter in the street. Source: Taken by Authors, 2019 ; Thume, 2017

CHAPTER

3

EMPHASISE

This chapter introduces of process of emphasising with actors in our network.
The first step of Design Thinking (DT) is emphasising. As DT is very user-focused, we have used this phase in an ANT perspective and used it to not only understand the user but to explore the whole network and get an in-depth understanding of the problem.

Figure 9 illustrates how we have opened up the network with ethnographic methods, such as observations, fly on the wall, follow the actor and interviews (Guest et al., 2017). Besides, the ethnographic methods have we also played Design Games (Brandt et al., 2008) with the project managers from DDUE and the operation to get an in-depth understanding of the street and the problems within the street.
To process all of the information from several sources, the method of affinity diagram was used. This worked very well as a method of categorising the problems, relating the challenges in the street and defining main findings. It is essential to notice that the affinity diagram has been used iteratively, meaning we have updated after each time we have done an iteration observation, interview or design game. We have also used the affinity diagram during the process to categorise data, so we were able to present it for other actors as structured data. E.g. before the design game we played with the operation and the project managers, we presented them to worksheets with main findings from the street, that they could then comment on. The main findings have been updated through several iterations, which turned into thematics and further used to involve relevant actors to negotiate and discuss the problems identified and later turned into design requirements, which we could design for.

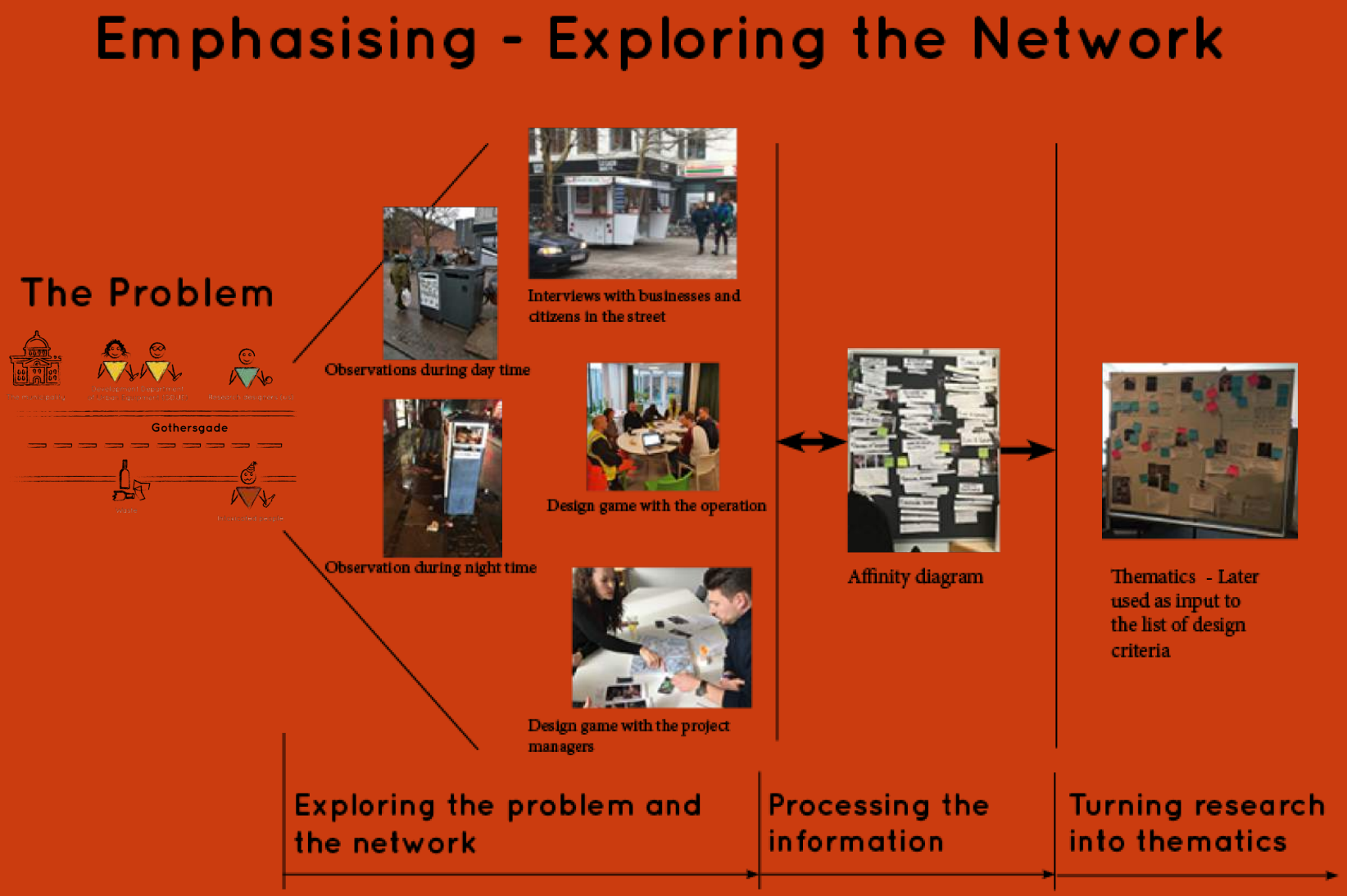


Figure 9. Summary of chapter 3, Emphasising. Source: Made by authors

GETTING A SENSE OF THE FIELD

This chapter is about emphasising with the actors in relation to litter in Gothersgade, but to do so, we needed to gain a little bit more knowledge about the field of study.

Initial observations

To do so, we visited the street numerous times both night and day. This gave us an understanding of not just the actors in the street, but also the non-human actors, such as; types of litter, the litter bins and the general flow of people. All of this will be important to take into consideration for a later conceptualisation.

Flow of people

It is important to include the flow of people to know, when our future solution should be active, also in relation to the surroundings. It is important to investigate which stores, restaurants, shops and bar/clubs are open during peak hours to know, where the intoxicated people move and where litter is generated.
To investigate this, we went to Gothersgade serval times both day and night (Appendix 1; Appendix 2).

The flow of people and the accumulation of litter is illustrated in figure 10. After 6 pm there is a shift in the streetscape, especially Friday and Saturday. More people start to arrive at the street as they are on the way to restaurants in the area. After it gets really crowded in the street as people are starting to go home from restaurants or go out for beers and drinks. Around midnight the young partygoers start to arrive at the street. During the whole seance, a lot of people visit the fast food shops in the street. From midnight and until 2 am in the morning, people are both arriving and leaving the street, and the flow in the street is very high. After 2 am the flow of people is slowly decreasing until 6 am in the morning where the last people are leaving the bars and the cleaning crew sets in (Appendix 2).

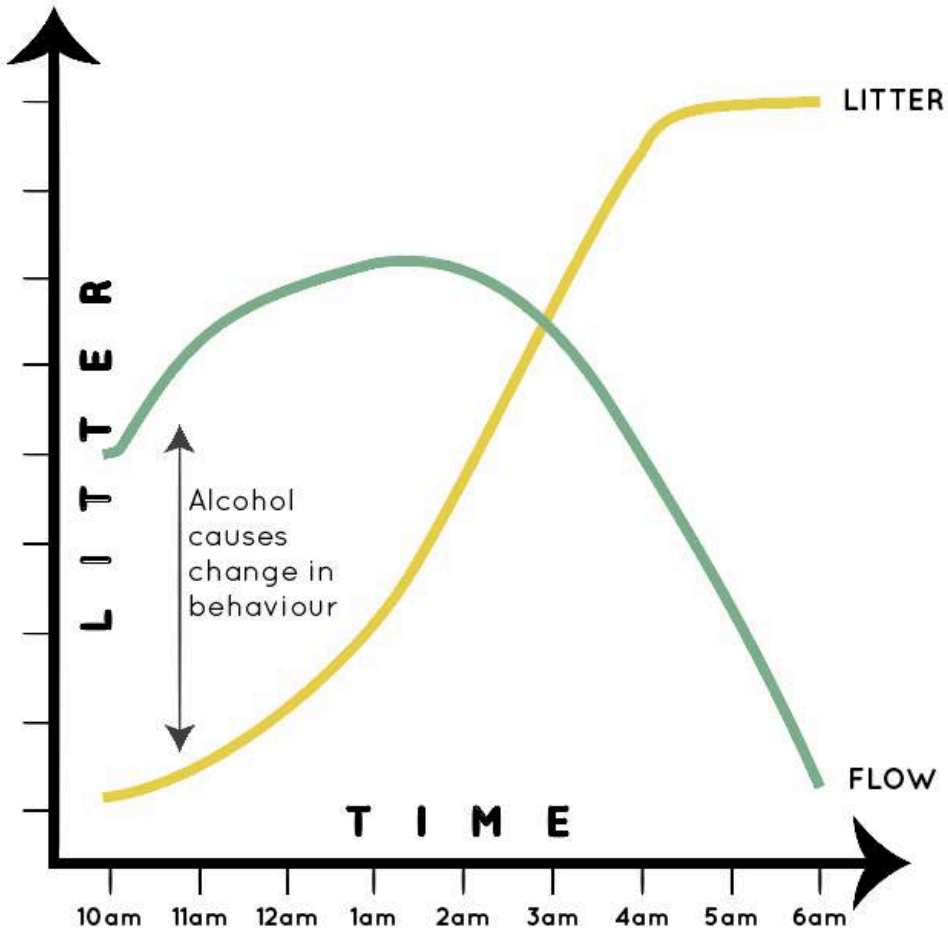


Figure 10 - The flow of people in relation to litter. Made by authors, 2019

Type of litter in the street

During our observations, we observed the different type of litter in the street. It is relevant to know the different types of litter since these can influence set demands for future conceptualisation. The types of litter are therefore investigated further, both from previously conducted projects and our current observation, respectively.

DDUE got help from a behavioural consultancy called "KL 7". They have made a quantitative measurement of the litter in Gothersgade. The result of this could be categorised into three types; *Pizza boxes, cigarette butts* and *other litter*.

These findings correspond well with our observations (Appendix 3) here is not a lot of pizza boxes present on the ground in numbers, but they are easy to spot and take up a lot of space. We have also noticed that there is a lot of cigarette butts on the ground, but because it is dark in the night and the cigarette butts are small and orange, they blend into the streetscape and are difficult to spot, when looking down the street. However, there is a lot of other types of litter, such as napkins, food litter, cans, bottles, food wrapping, sandwich bags and alike. A newer trend, that the KL7 report did not account for, has also emerged into Gothersgade in quite a high quantity - nitrous oxide cartridges (N2O). We, therefore, categorise litter into the following:

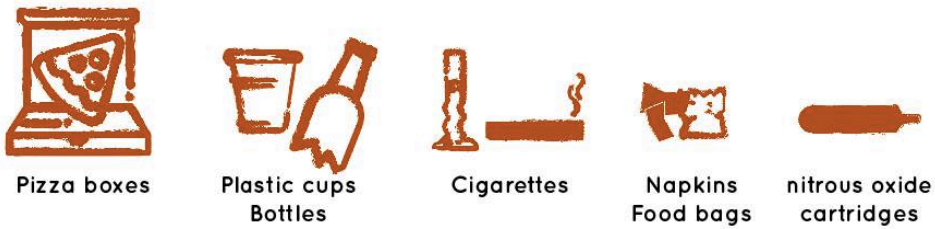


Figure 11 - The identified categories of litter. Source: Made by authors

From our night observations, we learned that the capacity of the bins is a problem. Early in the night, they get full, and the litter starts to flow around the bins. It is therefore interesting to consider if we should also design for capacity issues in order to support the behavioural littering change.

Different litter bins in the street

To get an understanding of why litter ends up on the ground and not in the litter bin, the placement and the design of the litter bins were investigated further.

The municipality uses a mix of three types of litter bins in Gothersgade which are designed and strategically located for different purposes.

Figure 12 - Map of litter bins placed in Gothersgade. Source: Made by authors

Pizzakurven

⊕ Optimised for volume
⊕ Nudging for specific type of litter

⊖ Only fits at specific places
⊖ Absorbs dirt from cars. The white foil gets dirty
⊖ Blends into the streetscape, especially at night

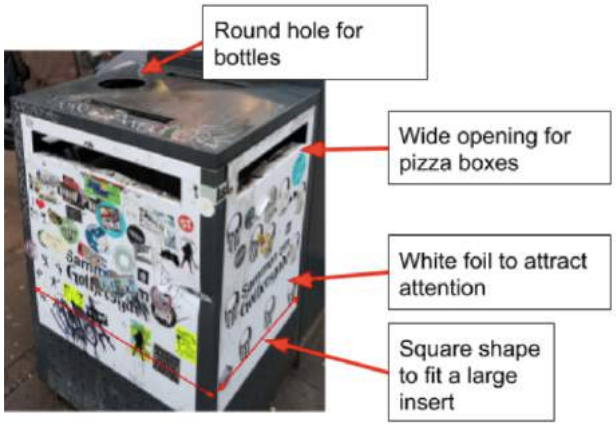


Figure 13. Pizzakurv (litter bin).
Source: Made by authors

Pariserstativet

⊕ Changed every day
⊕ Visible during the night

⊖ Limited capacity for pizza boxes

Figure 14. Pariserstativet (litter bin).
Source: Made by authors

Tårnkurven

⊕ Designed to fit narrow pavements
⊕ Designed for all type of litter

⊖ Pizza boxes easily stack up occupying space
⊖ Absorbs dirt from cars. The white foil gets dirty

Figure 15. Tårnkurven (litter bin).
Source: Made by authors

EMPHASISING WITH CURRENT IDENTIFIED ACTORS

To understand the actors initial matters of concern from our current network, we went to the street and performed semi-structured interviews (Guest et al., 2017) combined with pictures from previous observations, so they could relate to specific situations. Below we have short statements from the interviews, for more information, see Appendix 4.

Actors in the street

Employee from 7-Eleven

She had not really thought much about litter, in general, I Gothersgade. It was all just "routine" for her (7-Eleven employee). However, she was irritated by all the people using the empty space outside their store. According to the employee, there was a constant smell of pee, puke, alcohol etc.

"*We have our own garbage can outside our store, which we are permitted to empty multiple times during the night*" (7-Eleven employee, Appendix 4)

Homeless / 'pant' collectors

A group of homeless people formulated, that they operate being the night a more or less organised. They each have their own area for collecting cans/bottles. Main irritation is people peeing all over the place and locked litter bins, so they can search them through.
After talking to them for a few minutes, one of the homeless wanted money from us. In general, they seemed to have a hence of aggressive tendency.

Hotdog stand employee

The employee of the hotdog stand had worked in Gothersgade for many years which means, that he had experienced the municipality testing all sort of different solutions. He seemed to have a tense relationship with them.

"*Ohh, another solution to be tested. Let me tell you something, I don't think there's anything to be done. The operators cleaning in the morning are doing a great job*" (Employee from hotdog stand, Appendix 4)

To try and strengthen the relationship with the municipality, and implicit us as well, we asked him what he think could be done. It was clear that we had not been enrolled in one of the previous projects at this stage before. He quickly started ideating ideas with his favourite being using pizza boxes as frisbees somehow.

The employee of Andy's Bar

From previous observations during the night we know, that Andy's bar is one with the high popularity of customers. The employee told us, that they do not actively contribute to cleaning the street.

"*No, we don't actually. They (the operations) come every morning a ndsweep the street clean anyway*" - (Employee from Andy's Bar, Appendix 4)

However, we would suggest that the litter bins (Tårnkurve) outside the bar became more attractive.

A previous resident of Gothersgade
The elderly man main matters of concern were the number of cars, mainly taxis that constantly drove fast through the street. It made it hard to safely cross the road.

Owner of PizzaTime
The owner of Pizza Time was very friendly when we explained our purpose for interviewing him. He told us, that during the summer night, we remove his tables from the inside, which results in people standing in groups outside eating food. To attract people, we play loud party music. His main matters of concern were the constantly shifting competition that opens up in Gothersgade. He further explained that the two litter bins (Tårnkurve) placed outside his restaurant were also full.

First time tourist in Copenhagen (Gothersgade)
The younger lady arrived yesterday from Slovakia and had only spent a few in Gothersgade during the previous night. She told us, that she was used to travelling to new places, and that she always tried to adapt to the environment she was in.

"[...] I didn't specifically look for trash yesterday during the night, but I don't think that it was a big issue. [...] I mean, right now there's a lot of trash cans on this street alone. - (Turist, Appendix 4)

It is worth taking into consideration, that when we talked to her, she was in a sober state of mind. Her behaviour might change then under the influence of alcohol.
The different findings and matters of concern will be summarised later on in this section under *'Navigating in complexity'* on page 13.

Actors maintaining the street - DDUE & the Operators

The Gothersgame #1 & #2 - Identifying problems

Two design games were staged with DDUE and the Operation Department, respectively. The purpose of the design games was to identify new problems and to identify the involved actors' matters of concerns and to get a deeper understanding of the challenges identified by the preliminary observations and interviews.

Staging the negotiation space

The design games were staged at their respective headquarters in TMF, to meet them at their 'homecourt' and get a sense of their daily work environment. It was an opportunity to stage and facilitate the identified problems as well as discover new ones through negotiation.

The game was centred around an intermediary object in the form of a Mock-up of Gothersgade cut out in styrofoam. This allowed the game for a more hands-on experience since needles and pins could be placed in the styrofoam.

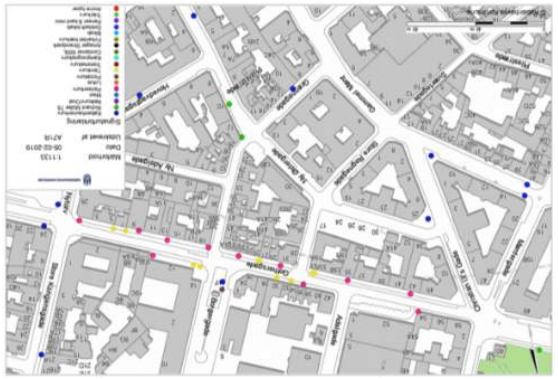
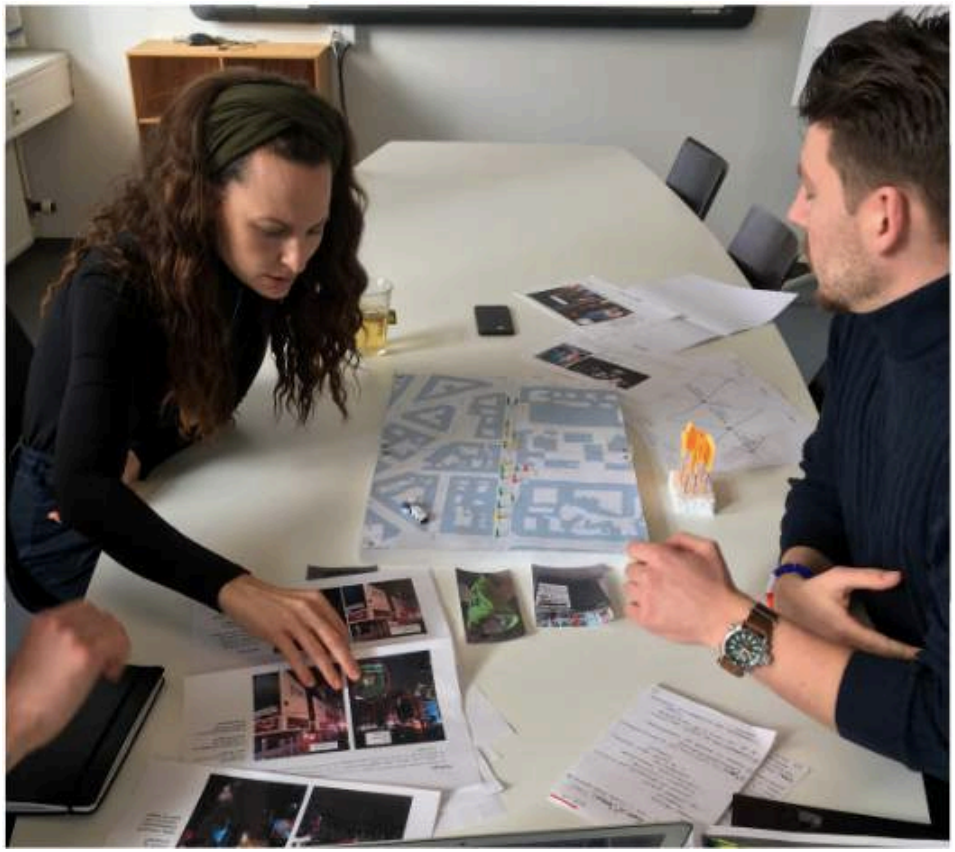


Figure 16. The map used the for design games. Source: Made by authors



Picture 6. The involvement of project managers of DDUE in TMF, using objects in staging of the space and to facilitate the negotiation. Source: Taken by authors

Facilitating the negotiation

To facilitate the dialogue the participants were presented with pictures of different situations in Gothersgade combined with headlines of the problems that had been identified. It gave the involved actors an opportunity to relate to the situations and topic of the problems related to littering and Gothersgade.

The headlines and pictures of identified challenges can be seen in Appendix 5.

Picture 7. Sheets with challenges. Source: Made by authors

Synthesising: Findings from the design game with DDUE

The litter bins in Gothersgade are ***strategically located*** where people are bypassing, sitting and eating their food from the food places. Besides, ***the design/shape*** of the litter bins is a challenge, as they have to stand from a distance from the building facades and the cycle path. Likewise, it is not allowed to dig any further than 0.5 meters, into the ground, due to cables and supply pipes. The requirements of the shape of the litter bins relate to the ***lack of capacity*** in the bins, discussed in earlier interventions.

"[...] if we can get people to take litter from the ground and throw it, into the litter bins that have the capacity, then we are happy" (project manager, DDUE, Sound file - Gothersgame #1).

Since capacity is an obvious challenge for TMF causing littering, the pictures used in the design game helped explore the problem. According to DDUE it is clear that there is a need for extra cleaning staff during the nights at the weekends.

"We are in negotiation with the politicians, about extra resources to deal with the problem of capacity. So we are already taking care of the problem. But who knows how long it will take to break through. It might not be the first priority of their concerns, the politicians."(Project manager DDUE,, Sound File - Gothersgame #1)

It is difficult to convince the politicians that the litter bins in Gothersgade must be emptied at night, as it might require more resources. In order to enrol the politicians, DDUE have to figure out the precise cost of the problem, concerning littering and capacity.

The sheet of behaviour, also worked very nice as an object for discussing what behaviour is and what behaviour we want to change. DDUE sees the wanted behavioural change as a short term change in behaviour. The t bin should be appealing to people who are nearby the litter bin and would have otherwise thrown the litter on the ground. They do not see the project, as a project where the goal is to change people's long term littering behaviour. E.g. next time an intoxicated person visit the street, he will walk further to throw the litter into a bin, because he had learned something from the last time when he visited the street.

Likewise, the general situation in TMF is unstable due to some unfortunate cases within the organisation. Several CEOs and leaders have been fired and the mayor has taken a pause from politics indefinitely (Kristensen & Kirkegaard, 2019ab; Beck, 2019).

Recently, TMF was fined for charging wrong prices for keeping the pavements clean. The result of the case was that they had to outsource the job. 20 employees from the operation department were therefore transferred to NCC, who won the contract. Afterwards, some of these transferred employees got fired and the whole situation is creating a lot of uncertainties in the operation department and in DDUE. The cleaning situation of the street has now changed, and that have changed the practices of the operators who see a lot of challenges in the new situation.

The situation might also influence our design, as we are working with the municipality, but our litter bin is placed on the pavement, which NCC have the responsibility of cleaning. This raises questions of who will get the benefit of more thrash in the bin and less on the ground?

One of the topics discussed in the design game was behavioural change and what that means? It turns out, that when DDUE is talking about a littering change of intoxicated people, they define it as a change that happens instantly. E.g. if there is an intoxicated person on the street, about to through his litter, the litter bin, should influence that decision immediately, so he is throwing the litter into the bin instead of the street.

Synthesising - findings from the design game with The Operation Department

Picture 8 - Design game with the Operation Department

The design game and pictures illustrating the identified problems were modified regarding the operators cleaning routines and practicalities of cleaning Gothersgade.
Regarding the problem with lack of capacity, none of the involved is interested in emptying the bins at night due to harassment from intoxicated;

"*The work environment is important, and we need to feel safe when we are working*" (Operator, MoM-2)

Likewise, ***the work environment*** one of the main focuses for the operators cleaning the street. E.g. the inserts, when they are filled with litter are pretty heavy;

"*[...] If you are going to make a new insert it must not be heavier than the current*" (Operator, MoM-2)

Time spend, cleaning the street is also an important aspect to consider. The current ashtrays are causing a lot of problems for the operators, which means they have to bring extra equipment to empty the trays.

Overall, exploring and challenging the problem of littering made us aware that littering not only is caused by bad behaviour from intoxicated people but also a lack of capacity in the bins. Nevertheless, there are strict requirements to the current bins in Gothersgade; Both the strategical placement but also the shape of the bins. The work environment is a priority, translated to workload, and time used cleaning the street. Emptying the street at night is a concern, but the prospect of the practice occurring is uncertain.

In the footsteps of the Operation Department - Clean-up team

To gain greater insight and a further understanding of their practices, we were welcomed to join a morning cleaning route of Gothersgade after a night of partying. Notes from the observation can be seen in the worksheet created in appendix 6.

The operation department has two areas of responsibility in Gothersgade, the cycle paths, and the carriageway. In order to explore the practicalities in emptying bins as well as cleaning up the street in general. We followed the morning team, who cleans the street.

Picture 9 - Understanding the Operators matters of concern through joining the morning route. Source: Taken by authors

It takes about an hour and a half cleaning the street in peak periods (Thursday - Sunday morning), and longtime during the summer. The complete cleaning procedure can be seen in figure 17. According to the operators the flow of party-people increases in periods with good weather, typically in the summertime.

"*The weather relates to the number of people, and with increasing people the number of litter increases, definitely*" (Operator, MoM-2)

The problem of lack of capacity is a well-known problem among the operation department. Instead, it is more feasible for the operators to place more bins in the street. But, with an implementation of more bins, another problem follows. The current bins in the street are placed strategically so the bins are available for the cleaning operators, not blocking the traffic from cars and trucks.

"*It is not possible to place more bins in Gothersgade. It will simply block the traffic in the morning, when the operators are cleaning the streets*" (Project manager DDUE, MoM-1)

According to the operation department, it is not feasible to empty the bins at night during the peak periods; "there is only one driver who has a driver's license for trucks, and the operators has been harassed by intoxicated young people in the street before"(Coordinator of operation, MoM-2);

"*Along with verbal threats and violence, harassment accounts for about one-third of the 34 work-related accidents recorded last year among inner-city cleaning workers.*" (Windström, 2014)

The lack of rationality by intoxicated people and their behaviour is the reason why the bins in Gothersgade are not emptied at night.
The bins (Tårnkurv and Pizzakurv) are sometimes causing problems for the operators;

"When the homeless people search the litter bins for bottles, they leave the door open. When an intoxicated person come by they sometimes kick the door so it breaks. This makes it difficult to open the door sometimes."(Operator, MoM-2)

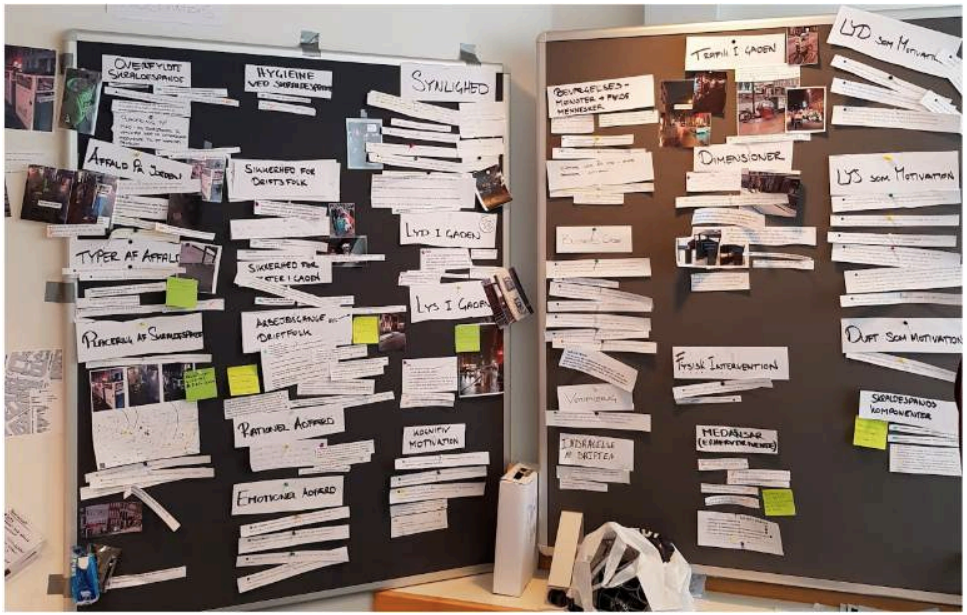
According to the operational Department, Intoxicated people and their behaviour are not only causing littering during the party peak periods. Some of them are also causing damage to the bins placed in the street.

Nevertheless, what occurred following the Cleaning Team is their handling of the bins and other materiality cleaning the street. Their handling is routine based and extremely quick cleaning the street. It is important to involve the cleaning-team in the development of a solution if it affects the current handling of the bins.

Figure 17. Process of the clean-up. Source: Made by authors

Navigating the complexity

"*There is no better way to see the broad scope of the problem quickly.*" (Beyer & Holtzblatt, 1997, p. 163)



Picture 10. A sample of our affinity diagram used to gathered collected material. Source: Taken by authors

With inspiration from Beyer and Holtzblatt (1997), the method Affinity Diagram is used to gain an overview of the field and which challenges it consists of as well as how the problems are related. The method is used with a bottom-up approach, which means it is notes, quotes, phrases, and pictures we have found relevant in the literature, desk research, interviews, observations, and from design games to form and qualify thematics, presented after this section.

The method has guided us in identifying problems related to each other. Eg. In Gothersgade, there is a *capacity problem,* identified during *peak periods. Littering ends* up on the ground, as there is not always capacity in the bins located at *specific places* such as Pizza Time and Pizza Huset. The challenge of capacity relates to the *strategic location* of litter bins in the street chosen for *aesthetic considerations* and *legal constraints* (minimum distance from facade - not digging deeper than 0.5m). This complex relations of different challenges constitute for the design of litter bins that must fit into the *streetscape* both in *daytime and night hours.*

The constructed thematics relate to identified problems, opportunities or previous initiatives carried out in Gothersgade, which have been presented above, through the exploration of the challenges and the introduction to the problem in chapter 2.

SUB-CONCLUSION - UNDERSTANDING THE FIELD

Using ethnographic methods such as interviews, observation, follow the actor, and staging spaces to explore the socio-technical arrangements, and the problems related to littering and Gothersgade, have been useful in exploring and understanding the field and the involved actors' matters of concern. The empirical data are the steppingstone to define the scope of our concern in the development of a proper solution that has the potential of changing littering behaviour.

Instead of solving the problem of lack of capacity due to lack of political interests, DDUE acknowledges, that Gothersgade is not only a mess, because of lack of capacity, but also due to the bad littering behaviour of the intoxicated people. They are working on increasing the capacity, by investigating the possibilities for nightly emptyings, maybe performed by a private company and with the use of security guards. Therefore, the interest of DDUE is focused on changing the littering behaviour of intoxicated people. When DDUE is talking about littering behaviour they are thinking about a solution that is working immediately and changes the short term littering behaviour of the user. Both DDUE and the Operation Department are considered as important actors that have to be involved in designing a solution concept.

The design game played with DDUE, revealed that when we are discussing behavioural change, they are referring to a short term behavioural change that changes the littering behaviour immediately.

From this we state our research question;
How can we develop a litter bin that ***supports the desired change*** *of* ***littering behaviour*** *of* ***intoxicated people*** *in* ***Gothersgade****?*

Turning exploration of the field into 12 thematics

The "result" of the emphasising phase, is presented below with the thematics, including a picture representing the thematic, where it comes from, and the main challenges we have identified. The thematics will be used in later chapters to prioritise and translate the identified challenges with DDUE and then used as the foundation for some of our design requirements, that we introduce in chapter 4, *Define*.

High Visibility

Where did the Thematic come from:

Observations showed that it was difficult to see the trash bins during the night.

The Design Game played with the project managers revealed that they had worked with the visibility and as a result they had put white foil on the trash bins. However, observations revealed that the white foild got dirty and full of graffiti.

Challenge: It is difficult for the intoxicated people to locate the trash bins.

Intoxicated people's behavior

Where did the Thematic come from:

Observations showed that intoxicated peoples behavior had a bad influence on their littering behavior. The littering problem is not only caused as a lack of capacity, because intoxicated people were observed to litter next to almost empty bins.

Challenge: A change of intoxicated people's behavior is needed

Large capacity

Where did the Thematic come from:

Observations showed that trash bins in Gothersgade overflow early in the night.
Design games with project managers showed that they are aware of the problem, but do not have many possibilities for putting more trash bins in the street. Another solution they are working on is nightly emptyings, but that is not wanted by the operation.

Challenge: Increasing the capacity

Availability

Where did the Thematic come from:

Observations showed availability of trash bins is very important, at there must be a trash bin present at the moment, when the user is about to throw his/hers trash, otherwise the "obstacle" is too big, and the user is throwing the trash on the ground.

Design Game with project managers, revealed that they had been working with strategical placement of the trash bins for a long time, placing them in front of bars and pizza places.

Challenge: Always having a trash bin available when the user wants to get rid of the trash.

Responsibility from Local businesses

Where did the Thematic come from:

Going through the types of thrash on the street and in the bins it bacame clear that most of it came from local bars, 7/11 and pizza places. This raises the question if the local business have some sort of responsibility for the problem.

Inteview with Pizza Time also revealed that they were interested in the cleanliness of the street. The Design Games opened up for involving local businesses as they are seen as having part of the responsibility of the problem in Gothersgade and TMF have worked with them before

Challenge: Involving the local businesses in a solution

Types of trash

Where did the Thematic come from:

Obesevations and litterature review showed that there are many different types of trash, but does in focus are; cigarette butts, N02 cartridges and pizza boxes. The different types of trash consitues different types of problems.

Challenge: Which type of trash should the solution focus on?

Aesthetic design

Where did the Thematic come from:

Design game with the project managers and interviews with locals revealed that the trash bin must be somewhat asesthetic designed, so it does not interupt the the city scape too much during the day. The trash bin has to look good in the 'eyes of the citisens.

Challenge: Designing a trash bin that draws attention at night, but is aesthetically pleasing during the day.

Work environment for the operators

Where did the Thematic come from:

Observing the traffic in Gothersgade and following them on duty revealed that the operators are working in a very stressful environment. The Design Game with the operators also revealed undesirable coincidents with intoxicated people. The Design played with the project managers also revealed that safty for the operators is of most importance.

Challenge: How do we design a solution that does not expose the operators to more danger.

Regards to local life

Where did the Thematic come from:

Playing the Design Game with DDUE revealed that paying attention to the local life is very important. The residents and the local businesses of the street depend on the municipality's work and it is important that they are satisfyed with it.

Challenge: How do we design a solution that does pay regards to local life in the street, both during night and day.

Satisfaction from local businesses

Where did the Thematic come from:

Playing the design game with DDUE revealed that local businesses play an important role in the problematics of the street and it is important to have them 'on board' when making the solutions for the street, because in the end, it is also them we design for.

Challenge: How do we design a solution that satisfy local businesses needs and can we involve them?

High safety in relation to traffic

Where did the Thematic come from:

Observation showed that the traffic in the street is intense and expose a danger both to the intoxicated people and the operators.

Challenge: How do we design a solution that does not increase the risk of being in Gothersgade for all actors in the street (operators, intoxicated people, bypassing people, cars and bikes)

Resonable use of the citisens money

Where did the Thematic come from:

Design Game with DDUE showed that the project managers do only invest in a new solution if it makes economically sense. They need to know the cost of a new solution and the economical effects if they are to make a proposal for investment in a new solution.

Challenge: How do we design a solution that makes better use of the money spend on cleaning Gothersgade?

Table 1. The emphasising phase resulted in 12 thematics. Source: Made by authors

CHAPTER 4

DEFINE

This chapter is where we start to converge the process by widening, challenging and reframing the problem based on the findings from previous chapters. The chapter describes the restrictiveness of our area of focus through the involvement of a Prioritising Game, played with the project managers of DDUE. The understanding and categorisation of the intoxicated people are visualised through various personas, with the importance of how to change their behaviour through elements such as; reward, awareness & identity. An array of rapid prototypes will be tested within each element, and subsequently combined. This will provide us with essential knowledge of what the final solution should entail.

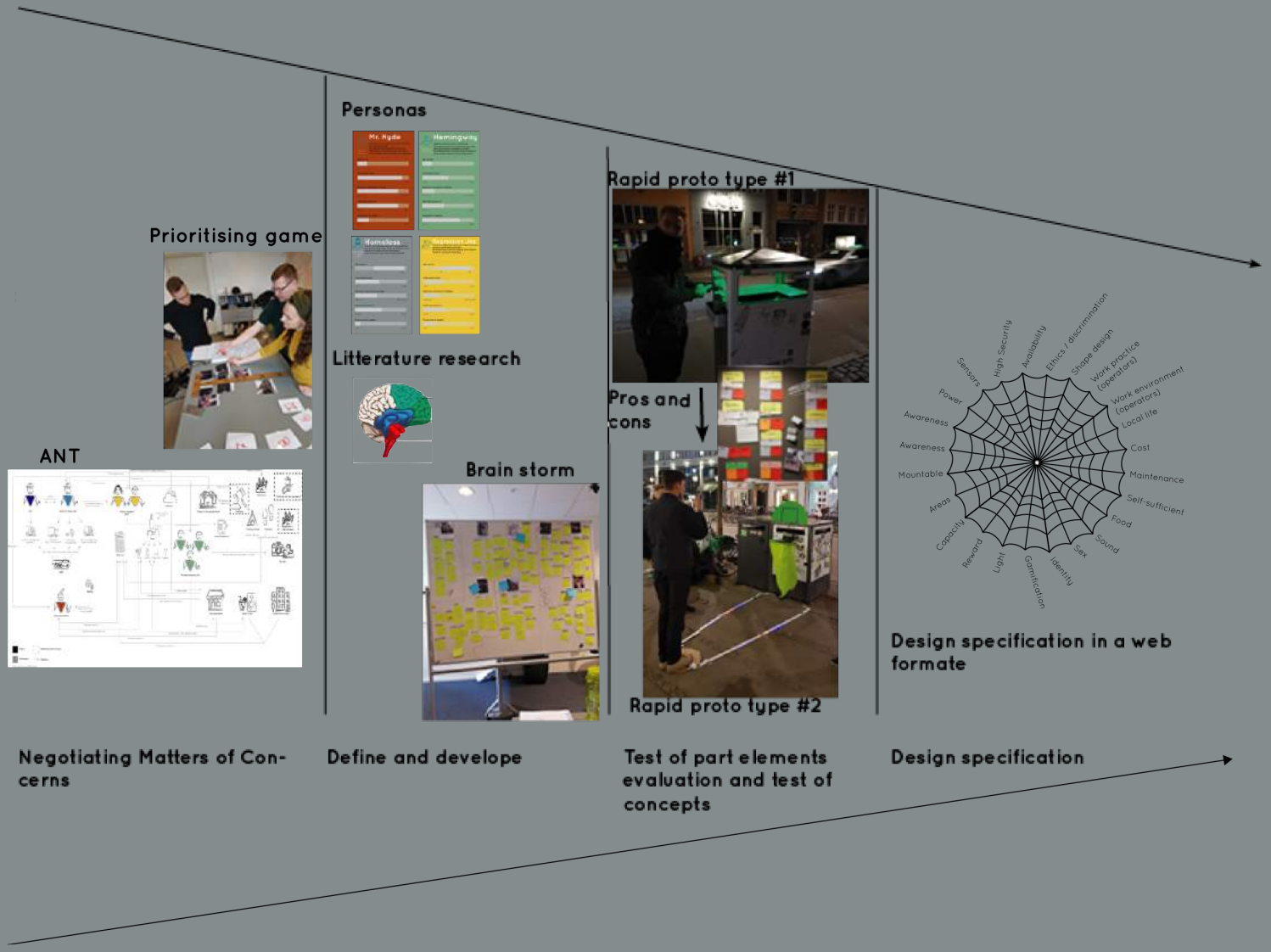


Figure 18. Summary of chapter 4, define. Source: Made by authors

SPECIFYING THE SCOPE

During the process of interacting with the relevant actors from the previous chapter, *emphasise,* we found that our current network consists of a larger array of both human-actors and non-human-actors, which all have an effect on our navigation of the project.
We discovered that The Operation Department could not be categorised as one unit, and due to tension in their own community and with NCC had to be further elaborated. Our network has therefore been further specified in figure 19.

This is only a pre-project for developing a solution for Gothersgade. However, if this project is successful there is a further after-match, which includes involving even more actors such as politicians, consultancies, manufactures etc. to get the project implemented. Due to lack of limited time this project runs, investigation of the *political empowerment, laws and regulations, external consultancies and broader management division* will, therefore, be black boxed, which mean it is out of the scope for this project.
We acknowledge that some of these actors and objects can have potential influence in relation to affecting the network.

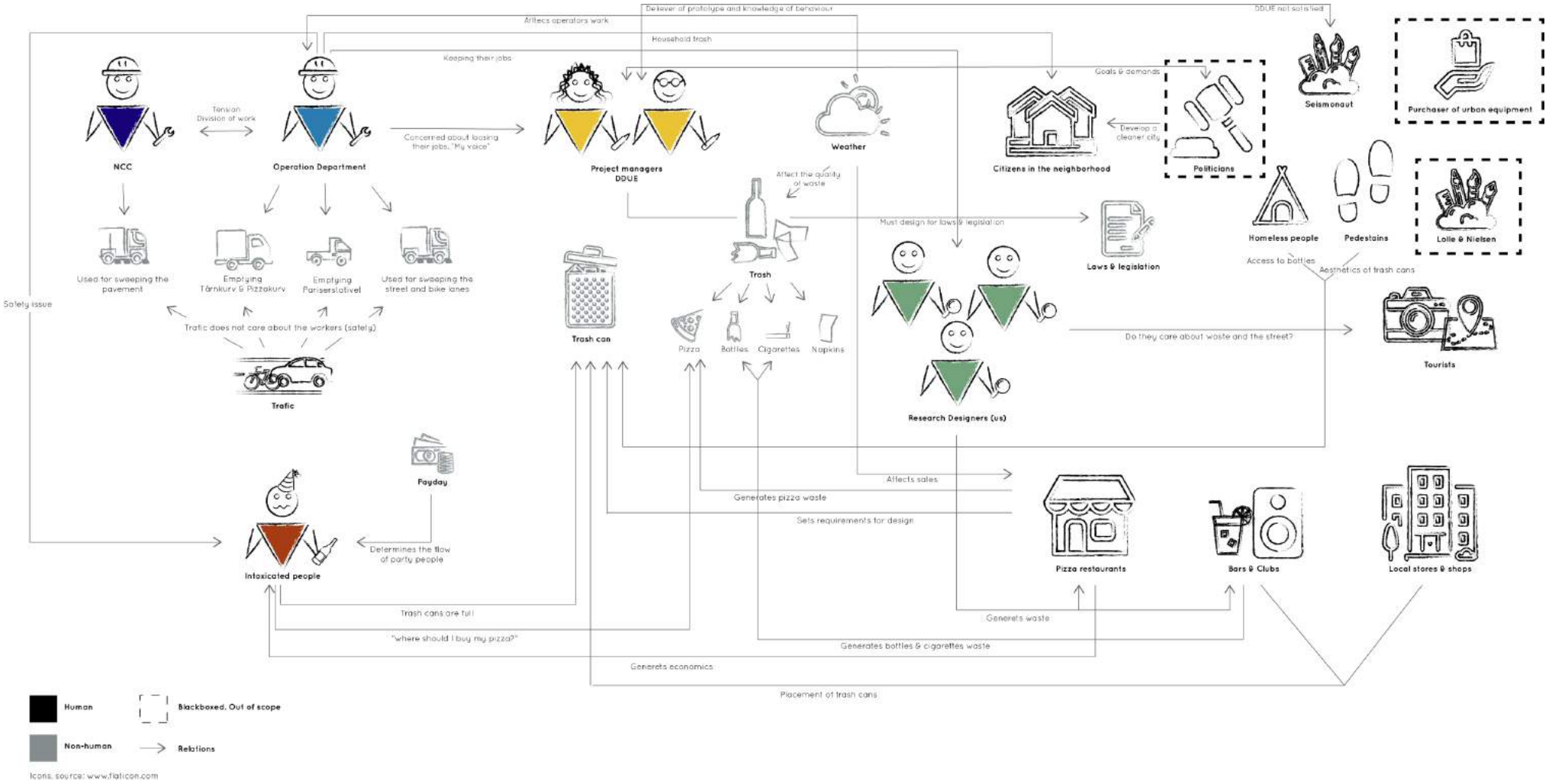


Figure 19. Specification of our network. Source: Made by authors

THE PRIORITISING GAME

The end-result from the previous chapter, *emphasise* was the categorisation of twelve thematics. To further concretise the project and specify an area of expertise for further progress, we staged a new negotiation space, that allowed for the matters of concerns, in terms of the twelve thematics, to be discussed and prioritised. Furthermore, we wanted the space to allow for advocating/provoking the project managers from DDUE to make them think of other possible design solutions and areas of Gothersgade. Since it is the project manager's task to develop the street in the smartest possible way.

Staging the negotiation space

The staging was centred around a prioritising 'gameboard' ranking from 1-5. In addition, the different thematics along with a picture were brought to create the feeling of being present in Gothersgade.

Facilitating the negotiation

One person acted as the facilitator in the negotiation space. Another person took pictures, recorded sound and took notes. The last person had prepared challenging / slightly provocative question, so we could facilitate the negotiation according to the pre-set rules of the game.

The game consisted of two rounds:

1. For a starting point in the game, one of the thematics were turned over, respectively. The participants then ranked them from 1-5 and explained the reasoning. It was possible to place several topics outside the same number.
2. To gain a greater degree of specification and allowing for provocation, the participants were asked to limited the thematics to only one per prioritising number - meaning five topics in total. This gave us the opportunity to get more knowledge of how the thematics were related from their perspective.

Picture 11. The project managers of DDUE prioritises the twelve thematics. Source: Made by authors

Synthesising

"It is important for us that you look at a litter bin that can change intoxicated peoples incorrect behaviour." - (Project Manager of DDUE, 26:00, sound file - Prioritising game)

The main finding from the workshop was, that the emphasis should be on a behavioural change, where capacity is not an issue. However, if this aspect could be scripted into the design, it would be much appreciated, since it was an issue that they are also currently working with. Creating a space that obligated them to prioritise between the thematics lead to an essential discussion with the outcome that ***pretty streetscape*** and the ***aesthetics*** of the solution itself was prioritised the lowest. Also, it was formulated that a future solution should be designed with its **focus on the night time**, because this is mainly were the littering behaviour occurred. The focus on day time was, at this current time, not of great importance.

The thematics themselves also acted as intermediary objects and mediated a negotiation between the employees of the DDUE. It was discussed what the actual core matter of concern within each thematic was, which resulted in a change of understanding plus the definition of some of the thematics.

CATEGORISATION OF PERSONALITIES IN RELATION TO INTOXICATED PEOPLE

After the prioritising design game with the project managers of DDUE, it was clear, that the main priority was to **change intoxicated people's behaviour.** However, before starting developing prototypes for these people, we still needed to explore who 'people' actually is. Internal documentation, from an external consultancy named KL7 (Appendix - report A), developed for the municipality categorises intoxicated people as men at the age of 15-27. However, our observations show, that men within this age period still act very differently, and it is, therefore, relevant to further explore this segment. To do so, we first need to understand, what exact methods and studies have been done to understand these individuals in the transition from a sober to an intoxicated state, and how their behaviour change.

Therefore, the following section will investigate the typical behaviour types in both stages and further comparing them to one another. This will provide us with an understanding of what to target, in order to support the desired behavioural change.

The Five-Factor model

One of the most common developed and applied models to identify personalities is the five-factor model (FFM) (McCrae & Allik, 2002). FFM is best described as a model of an individual's personality that divides it into five traits. These are understood as patterns of thought, feeling, and behaviour that are relatively enduring across an individual's life span.

The Five-factor model in relation to intoxication

The model is constructed through the investigation of people being in a sober state of mind. To investigate the behavioural change of people when intoxicated, Rachel Pearl Winograd et al. (2015) conducted a comprehensive study on 374 intoxicated people based on the Five Factor Model. The test was based on a comparison of the selected individuals in a sober and intoxicated state of mind, with the result being, to some degree simulations between these two stages were similar. When under the influence of alcohol, people can be divided into four categories (figure 20);

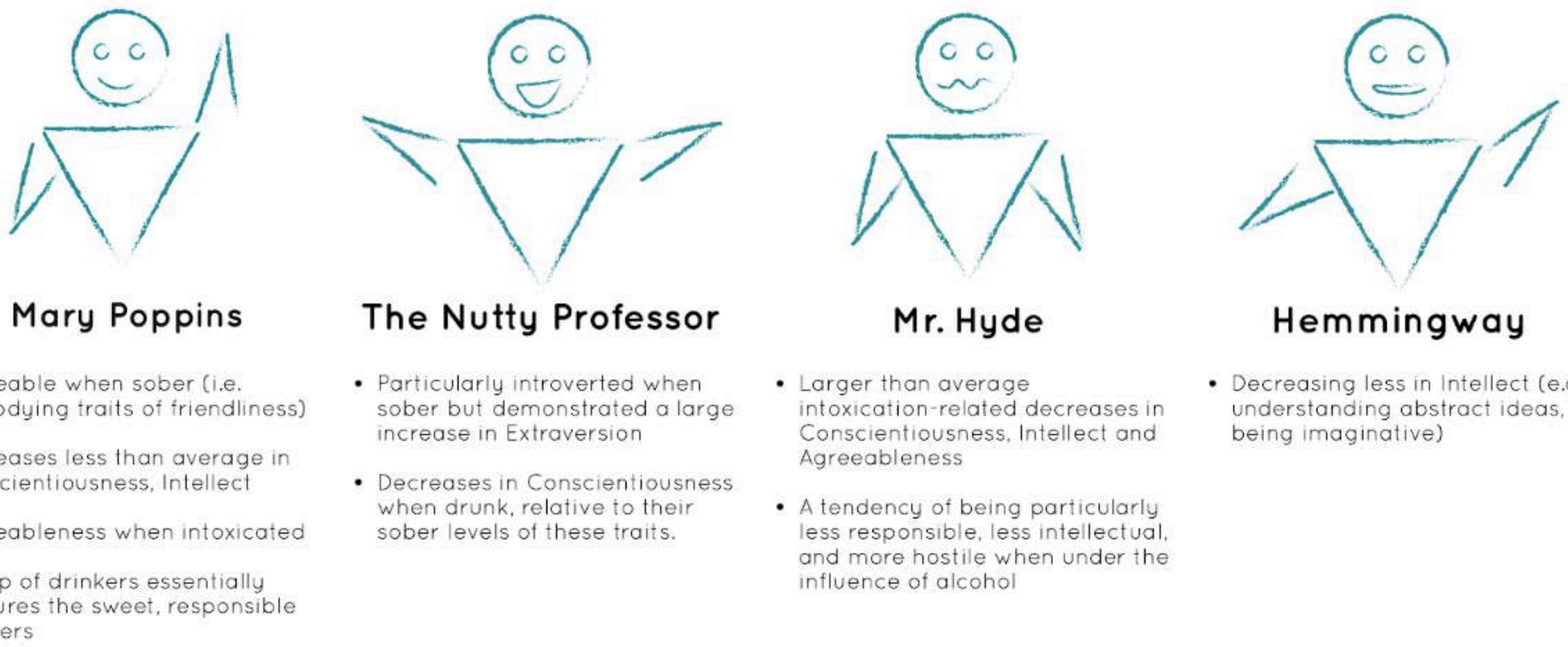


Figure 20. The categorisation of the four types of intoxicated people. Source: made by authors

Experimental research from the University of Missouri supports the findings from 'Searching for Mr Hyde' concluding, that the majority of intoxicated individuals, fits under the category 'Hemingway'. Meaning, their behaviour do not change much going from a sober to an intoxicated state (Winograd et al., 2017).

Summary

The two experimental investigations interestingly conclude, that the majority of the observed people, can be placed under the category 'Hemingway'. Meaning, that with this type of person, only smaller changes in behaviour occur when under the influence of alcohol. The experiments did not take the point of view in the relation of littering into consideration, and it is relevant to consider if the people in Gothersgade are then thinking rational when littering, or if the amount of litter can be traced back to other types of personalities and categorisation. To gain a broader understanding of our actors in relation to our field of study, we will be examining the intoxicated people in Gothersgade through a variety of socio-technical methods, which will be further elaborated in the next section, *Testing the Five-Factor model in Gothersgade*.

Testing the Five-Factor model in Gothersgade

To test the hypothesis by Winograd et al. (2017) that the majority of actors can be placed under the category 'Hemingway', we went out two nights in Gothersgade, to gain an initial, fundamental understanding of the various actors.

Methods

To conduct a well rounded investigation, a variety of socio-technical methods will be applicable, such as; Thick description combined with Fly-on-the-wall (Geertz, 1973; Hanington & Martin, 2012), where the aim is to obtain as much information as possible from the field of study, while acting as a natural part of the environment.

Follow the actor were used to gain further information about the studied actor groups, including how they moved, behaved, interacted etc.

It did not take us long to pinpoint the different sort of personalities, that Winograd et al. had composed. To see how they acted in relation to littering, we followed while observing each of these types of persons. Below are a few specific situations that very well describes the characteristics of these personalities.

Identifying Mr Hyde

The trigger for aggression and sex for Mr Hyde are demonstrated by two specific situations.

1) Groups of guys are standing outside Andy's bar talking and having a smoke. They are clearly intoxicated and shouting after girls. As illustrated picture 12, a member of the group crosses the street, stops in the middle of the road and start to dry hump it. A clear sign of both an aggressive attitude and sexual behaviour.

Picture 12, Screenshot from film clip. Mr. Hyde dry-humping the street. Filmed by the authors.

2) Picture 13 illustrates a group of guys are just about to have a competition of who can kick in the lid of the littering bin the hardest. Again, a clear sign of no rational thinking and aggression/power domination.

Picture 13. Littering bin minutes before a group of guys starts to kick it. Taking by authors.

Recognising the importance of the homeless

An actor group that the literature did not take into consideration but still is of great importance, to our future conceptualisation and ideation, is the recognising of the homeless people.

As picture 12 expresses, the leftover food in front of PizzaTime is just about to be inspected by a few of the homeless people. Apparently, because there was no actual food left, they pushed the pizza boxes and its content on the ground. Either to signal the other homeless people that there was nothing here, or it was in spite of irritation and anger. We also recognise that the group of people have a tendency of being

intoxicated, and further have an aggressive appearance towards people when asking for money, a smoke etc. Furthermore, if the inserts are somehow hard to get to in order to search through them, an aggressive and irritable tendency initiates.
Therefore, they should be taking into consideration for a future conceptualisation and ideation, because they are a contribution to littering, and can pose a potential security risk to our final solution.

Picture 14. Leftover pizza. The picture was taken just before getting inspected by a few of the homeless. Taken by authors.

Perceiving the elderly crowd

A smaller proportion of "elderly" people in the age period from 30-45 can be found in Gothersgade as well. This group of people seems to be there for the sake of bachelorette parties (mainly at Badabing Strip club), 30's birthday etc. They are intoxicated but act relatively rational although they are still causing some littering in the street.

Picture 15. A group of men of their way to Badabing in the age of 30-35. Taking by authors.

Summary

Although, during our literature research, we found that previous conducted experimental studies place the majority of intoxicated people under the category 'Hemingway' (Winograd et al. 2016). Meaning, that the majority does not change much in terms of their behaviour. However, during our observations and interventions in Gothersgade it has become clear, that although the majority of people in the street, as well can be placed under the Hemingway category, these types of individuals do not contribute much to littering in this area. Our research shows, that the targeting group, which changes in behaviour and causes an increased amount of litter, is what is referred to as Mr. Hyde (Winograd et al., 2015).

These are from a literature perspective being described as personalities that have a tendency of being particularly less responsible, less intellectual, and more hostile when under the influence of alcohol. This is also in line with our empirical research, where, as picture 12 and 13 illustrates, it seems like this type of personality is not thinking rational but are moreover moving towards an emotional state.

Furthermore, based on all of our observations and interactions with people in the street, we have encountered other actor groups that the literature did not account for such as the homeless people and the people in the age period from 30-45. As the observations demonstrate, some of these groups and their matters of concern will be relevant to take into consideration when we start to conceptualise, because they hold the power to de-script our end-solution.

CREATING RELATABLE PERSONAS

In order to understand these actors, their matters of concern and design for such, the method of creating personas is appropriate. Persona is a clustering of people from similar social worlds constructed into one fictive person (Grudin & Pruitt, 2003). The method will be appropriate when we start to conceptualise, so we know the aspects of the person(s) we are designing for. The method can give us an understanding for which personas to enroll into the conceptualisation of a solution.

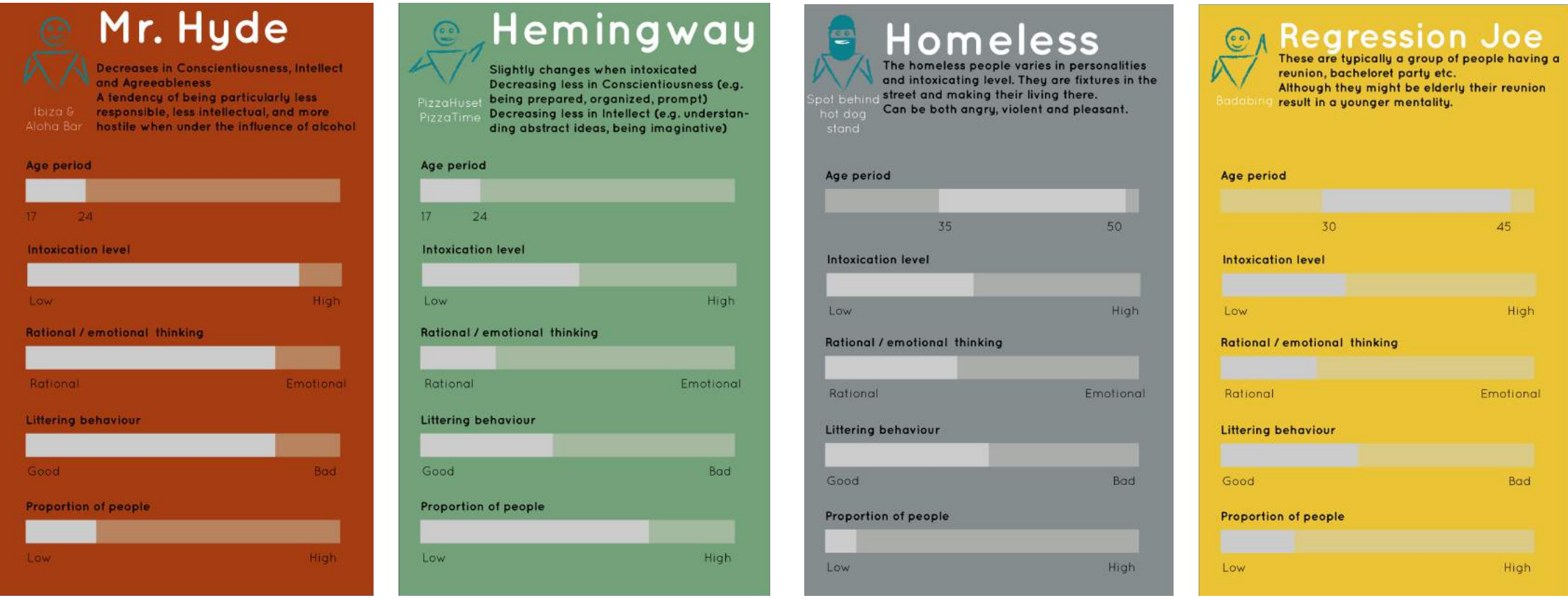


Figure 21. Our gathered materials has formed the following personas. These will be useful in a future conceptualisation. Taking by authors.

Our target groups here are '*Mr. Hyde*' as primarily and '*Homeless*' as secondly. From our empirical collected data we know, that the homeless people make their living out of collecting bins and eating leftover food from restaurants, contributing to a littering behaviour, and have tendencies to be aggressive towards the bins if they cannot search them through. We argue, that since both '*Hemingway*' and '*Regression Joe*' are relatively rational thinking, they will also be able to understand our end-solution if Mr. Hyde is able to.

TAKEOVER OF THE REPTILIAN BRIAN. FROM RATIONAL TO EMOTIONAL THINKING

As illustrated in our *'Mr. Hyde'* persona, when under the influence of alcohol and/or narcotic, the person is most likely to behave according to an emotional state-of-mind. Therefore, an understanding of exactly what happens, when the person undergoes a transformation from a rational to an emotional state of mind, will, later on, be helpful in our concept development phase.

For this understanding we will have to take a closer look at our brain, specifically, the part called The Triune brain (Komninos, 2019). As figure 22 demonstrates this part of the brain consists of three sub-parts (MacLean, 1990):

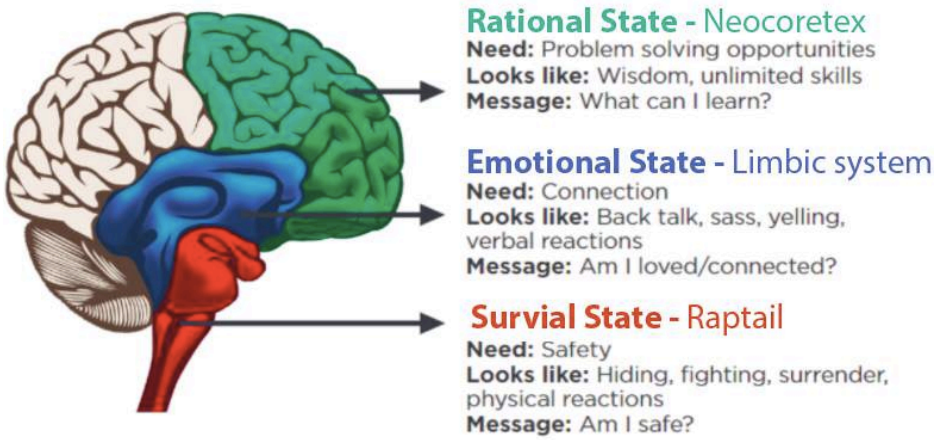


Figure 22: The function of the Triune brain. Source: Conscious Discipline's Parent Education Curriculum © 2017 Loving Guidance. www.ConsciousDiscipline. com

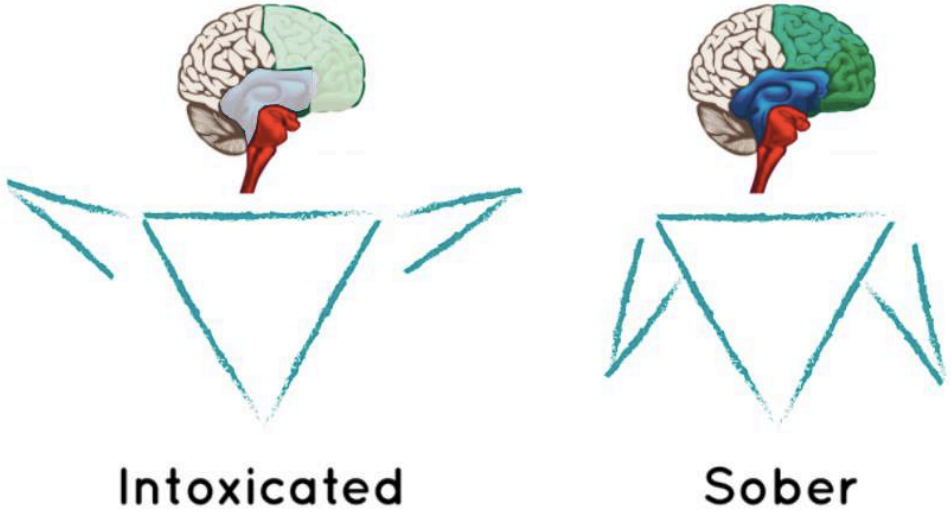


Figure 23: The increasing of the mid-brain. Source: Made by authors

According to the well established Danish online magazine, Udforsk Sindet our survival state and dependence by power are closely related. Personalities controlled by the reptile brain is guided by emotions that are primitive, aggressive and lacking in empathy. The only thing that exists is the pleasure of dominance and concern for themselves. In their minds, self-control does not exist and no concern for anyone else. (Udforsk Sindet, 2017).

These statements are supported by the author Andreas Komninos writing for the Interaction Design Foundation (2018) and Ditte Okman journalist for the Danish newspaper BT (2012) with reference to the Danish neuroscientist Peter Lund Madsen.

They state that the mid-brain with reference to our primitive- or reptilian part of the brain controls our behaviour. When we do an activity that makes us feel good, we release dopamine in the reward system of our brain. Our reptilian brain recognises that we just yielded positive results, and it affects our behaviour (Okman, 2012; Blaukopf & DiGirolamo, 2007). According to Kominos (2018) and Madsen

(Okman, 2012) some of these triggers, that makes us feel good are; **sex, food** and **power/aggression**.
These statements are very much similar with our initial observations of our actors in Gothersgade, and is also in line with what Winograd et al. categorise as the personality type; Mr Hyde (Winograd et al. 2015).

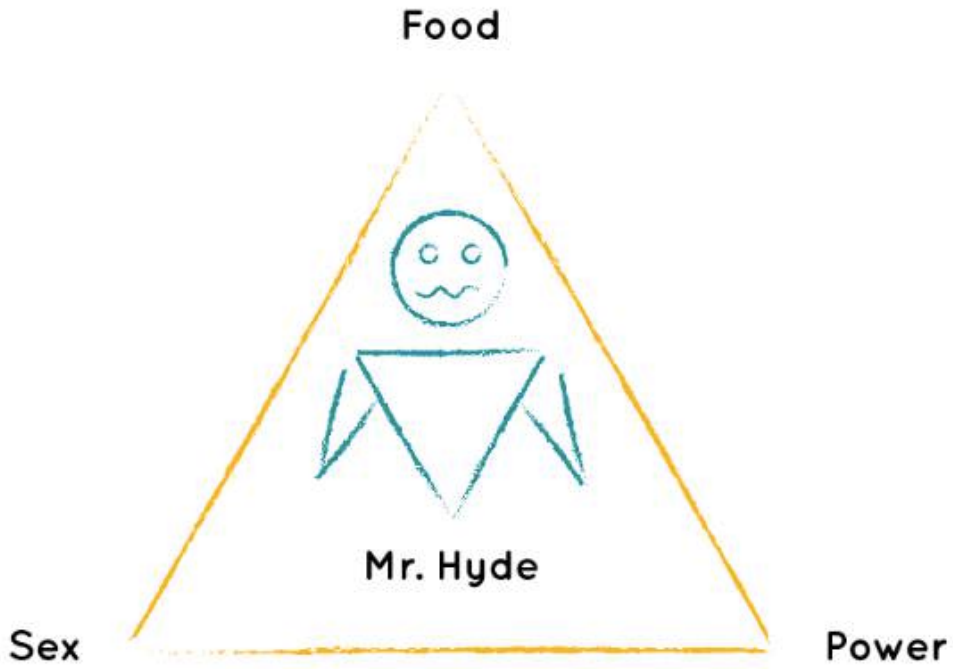


Figure 24: Triggers for the reptilian brain of the personality type; Mr. Hyde. Source: Made by authors

Summary
We have established that our main personality type who causes littering is the character referred to as Mr. Hyde. When the person is under the influence of alcohol he uses the mid- or reptilian part of their brain that controls their behavioural effect and also causes the person to shift from rational thinking towards a more emotional. Triggers for adjustment of behaviour for this person is typically food, sex and power. However, the understanding of the notion behaviour, and what needs to be present within the triggers, *sex, food* and *power,* is still to be further investigated.

Changes of behaviourism - a fundamental understanding

As previously stated in our strategy, in order to support the change of behaviour, we first have to understand the notion of behaviourism, then further investigate what has been done within this area of expertise and if it is at all possible to change behaviour.
According to The Municipality of Copenhagen's former Technology and Environmental Mayor, Morten Kabell a successful change of the citizen's behaviour are very doubtful;
"[...] unless Copenhageners begin to clean up after themselves, but I allow myself to doubt" - Morten Kambal, (Winström, 2014)

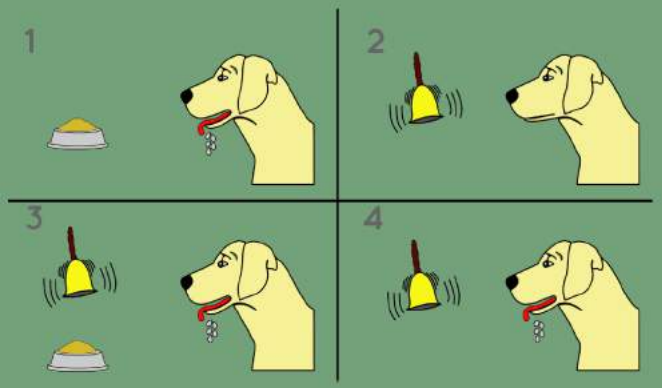
Instead, they have attempted to delegate fines for people when littering, but from 2008 - 2014 only 32 fines have been given (Winström, 2014). It is therefore interesting to investigate, what it would take for a successful change of behaviour to occur.
Behaviourism is built on this assumption, and it aims at promoting scientific studies of behaviour. It does not emphasise on cultures or social groups but on the behaviour, of the individual person and animals (Baum, 2017).
The fundamental understanding of behaviourism is often credited to Parlov, Watson and Skinner (Pavlov & Thompson, 1902; Baum, 2017; Skinner, 1938), who performed individual experiments in order to investigate the notion of behaviour (appendix 7).

DOGS SALVATION
EXPERIMENT 1

EXAMPLE
Dog drools at the sight or smell of food. Palov would let a bell ring several times before the food was served to the dogs. He here observed that the dogs began to drool just by the sound of the bell (Pavlov & Thompson, 1902 ; Baum, 2017).

FINDINGS
- **Dogs had learned to connect the sound of the bell with food**

- **Find out what the users want and give to them as a reward**



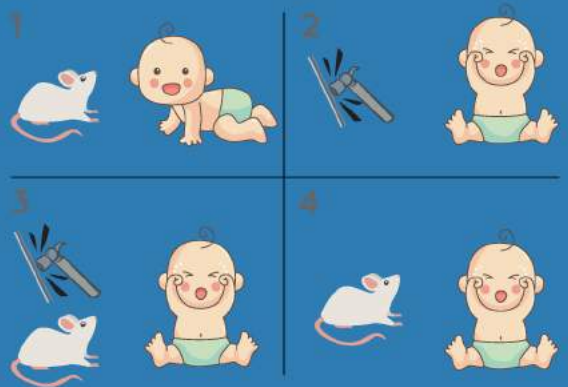
Pavlov's illustration of the experiment with dogs salvation. Credit: Parveen, 2017

LITTLE ALBERT & THE WHITE RAT
EXPERIMENT 2

EXAMPLE
Watson wanted to force a fear for the white rat in Albert. He did this by making an unpleasant metallic sound every time he showed Albert the white rat repeatedly. Albert developed a fear of the rat. Albert also began to develop a fear for objects that resembled the white rat (Watson & Rayner, 1920).

FINDINGS
- **Change of behaviour can occur with the use of the right trigger**

- **Stimuli (S) creates a specific reaction (R)**



Watson's illustration of the experiment with Little Albert and the white rat. Credit: www.freepik.com & authors

THE SKINNER BOX
EXPERIMENT 3

EXAMPLE
Increasing a rats behaviour. The experiment contained a cage with a feed pedal, that the rat could press to achieve a reward in the form of food. With this, Skinner found that the rat learned a behaviour based on the fact that the behaviour innated a reward. (Skinner, 1938 ; Shrestha, 2017).

FINDINGS
- **Reward to increase a behaviour. Punishment to decrease**

- **It learned a behaviour based on the fact that the behaviour innated a reward**

Skinner's illustration of the experiment with the rat and the operant condition. Credit: Seong (Cherry, 2019) Verywell.

Summary
Based on Pavlov, Watson and Skinner, in order to adjust the desired behaviour, a **reward** has to be presented (ie. dog food, rat snacks) plus a trigger that creates **awareness** (ie. bell, loud uncomfortable noise, leaver, lights).
It is relevant to consider, that these experiments were all done under a controlled environment with specifically selected actors and objects. It is therefore relevant to test if this hypothesis, in order to adjust the desired behaviour, will also apply to our field of study, in the festivity area of Gothersgade with intoxicated people. These test will be further elaborated in section; *Rapid Prototype #1 - Testing sub-elements*

CHANGE OF BEHAVIOUR THROUGH REWARD & AWARENESS

In order to change the desired behaviour of the Mr Hyde persona, triggers are *food, sex & power* where a reward and awareness has to be present.

Awareness

In Skinner's case with the rat, the cheese created awareness by appealing to the sense of taste in the rat.
However, as we know taste is just one out of five senses in humans (Bradford, 2017).
For a more elaborate description on each sense in relation to awareness, reference is made to appendix 8.

TASTE

EXAMPLE

Bitter taste is a signal for danger. So people who have heightened sensitivity based on their genes for bitter taste may also have higher sensitivity to other signals of danger in other areas of life, like the social area (Romero, 2016).

FINDINGS

- Appealing to taste through shape and illusion to create awareness
- Well linked with the reward system and amygdala part of the brain

TOUCH

EXAMPLE

People holding a heavy clipboard were more likely to judge someone as serious (Ackerman et al., 2010)

FINDINGS

- Testing if people would touch a rough and dirty surface
- A well established connection needs to be present

SMELL

EXAMPLE

The smell of citrus can cause us to keep our kitchen cleaner, by subconsciously putting the idea of hygiene in our minds (Holland, Hendriks, Aarts, 2005)

FINDINGS

- Testing of citrus fragrance to keep area clean
- The brain recalls smell the best

HEAR

EXAMPLE

The ringing of a bell at different times may mean that the class is about to start (Halpern et al., 1986).

FINDINGS

- Testing high-frequency sound in order to create awareness
- Already existing variety of noises in Gothersgade

SIGHT

EXAMPLE

Light

Conclusive studies has been done on lights in relation to sleep, where the effect is tremendous (Christensen, 2014).

Colour

Adding a white colour to litter bins stands out during the night time

FINDINGS

- Testing if artificial light in can have an effect in creating awareness
- Testing neon green vs. white colour for awarenss

Reward

To understand what can be done within the area of reward, we first have to take a closer look at a specific part of our brain - the reward system. It refers to a group of structures that activates by rewarding stimuli (Bresan & Chippa, 2005), the brain responds by increasing release of the neurotransmitter dopamine, and thus the 'feeling' of satisfaction.
We have found that the reward system can be activated by reinforces such as; *food, power & sex*. Even though these are key reinforces, further studies also emphasise the use of *money, drugs, humour and beauty* (Berns, 2004).
Berns do not present the element of power/aggression as a reinforcer for the reward system, which according to previous findings can act as a trigger. It is therefore interesting to investigate, what can and have been done to appeal to this element.
To further understand what can be done in terms of rewards, in relation to our field of study, we will first summaries our collected empirical knowledge from the workshops with the project managers of DDUE. Afterwards, we will be analysing existing solutions and experiments.

Limitations

No physical objects

From our previous workshops with the DDUE we know, that they do not want to give the user's physical objects, as a thank you or reward for throwing their litter out.

"*[...] we have tried with 'pant' on pizza boxes with money as a 'thank you', but that was not the way to go. [...] it (the solution) should act as '**part of the party**' where they want to use it*" - Project manager of DDUE, MoM-3

They argue, that this will also result in an organisational restructure emphasising on new practices, and with an increase in a potentially new business case.

Not contributing to a conflict

They also formulated that they under no circumstances which to contribute to a potential conflict. A provided example of this was, with the parliamentary election coming up (deadline for this May 28th (Bergman, 2019), an idea could be to let people vote with their litter for the new prime minister. However, this could lead to potential conflict and would occur in DDUE creating provoking aspects (DDUE workshop, MoM-3).

Fragile authority line

The municipality has in the past had a reputation for being authoritarian. So they are careful with telling people what to do, and how they represent themselves. Hence, why they are working with a behavioural approach.
Furthermore, from the interactions we also know, that creating a solution that appeals directly to sex, alcohol or drugs, are prohibited.

Existing solutions and experiments

Money and a place to sit

In 2014 DDUE, the School of Design (KADK) and the consultancy KL7 made a project in Gothersgade with the purpose of reducing littering. KADK was responsible for the design process and KL7 did quantification of the problem through observations.

1) The Party bench - The creation of hangout places with litter bin nearby, where the intoxicated people could consume their food and easily throw out their litter. The reward here was to give people a place to sit and relax while eating. However, this resulted in what was being intercepted as a place for 'street-partying', hanging around, drinking alcohol, which was not the attention of the municipality's' point of view.

Picture 16: The Party Bench with litter bins. Source: (Thume, 2017)

2) 'Pant' on litter - They replicated the 'pant' system well known from bottles and cans. The reward consisted of giving money back for pizza boxes and fast-food bags, which were returned to them.
However, this did not change the intoxicated people's behaviour. It was the homeless people, who created a living from collecting bottles and cans who returned the litter with pant.

Picture 17 - 'Pant' on litter. Source: (Thume, 2017)

3) The sleepy ghost - White highly visible littering bin placed close to the places of consumption and giving voice feedback when something is thrown out. The Sleepy Ghost is the frontrunner to TårnKurven, which is placed at several locations in Gothersgade today. From the Sleepy Ghost, the DDUE learned that a littering bin needs high visibility and large openings for all kinds of litter.

Picture 18 - The Sleepy Ghost. Source: (Thume, 2017)

Even though, that all of the above interventions gave good results, none of them was implemented, because of the downside reasons. Jon Pape, who is Center Service Chief and have the power to allocate money for implementation of a new project also stated in a newspaper article, that there is a need for changing the citizens littering behaviour and projects like these show that it is feasible, but they were too expensive to implement in operation versus the benefits (Winström, 2014).

A previous attempt on an interactive litter bin

Before our project started, DDUE had already initiated a project with a strategic and digital development house called Seismonaut and an innovation house called Artilinco. They came up with a concept that was fitted to the existing pizza bin, picture 19. The solution was based purely on knowledge from the literature on gamification and human behaviour.

The solution is described shortly in steps below:

1. Awareness was created through LEDs that would light up the litter bin

2. When something is thrown out the litter bin would change colour and light intensity. The litter can will also play a sound file, for example, a cheering sound.

The idea behind the game is that the light will shift and a new sound will play, each time a new piece of litter is thrown out (up till four times).

Picture 19 - Seismonauts solution for an interactive litter bin Source: Report D

Unfortunately, Seismonaut did not do any observation of their solution and the only data that exist from the test is, that eight pieces of litter were registered by the sensors during the one weekend it was tested. Therefore, we do not know if the solution works or not, but we have made our own experiences through rapid prototypes, which will be explained in the coming section; *Rapid Prototype #1 - Testing sub-elements*.

Elements of gamification: awarding the users to throw

One of the possibly most well-known rewards comes from the virtual world of gaming (Esanu, 2018). The feeling of getting an extra life, more strength or points, have a well-documented effect of providing stimuli to our brain (ibid). The ideas with providing the users with a bonus, if they perform well have been transferred to the physical world as well in terms of sports, such as football, tennis, basketball etc. Especially basketball have serval times been transferred to the area of litter. However, basketball litter bins are still not implemented anywhere in Copenhagen. It is therefore interesting to test, rather the element of appealing to Mr Hyde's aggression by allowing the person to throw its litter at a target would be a great enough of a reward or if a more complex point system is needed. The creation of such will be further elaborated in the next section, *Rapid prototype #1 - Testing sub-elements*.

Picture 20 - Basketball litter bins
Source: facebook.com/basketballtrashbinsARMY

Humour as a mean of reward

As mentioned by Berns (2004), humour can act as a reinforcer for activating the rewards system in the brain. According to author Graeme Ritchie (2004), there is currently no theory of how humour works. He argues, that jokes seem to have an effect of change in the way we act and behave. Since no actual studies are drawing parallels between jokes and littering in the nightlife, it is relevant to test, if humour in the form of jokes can have a positive effect on the human reward system.

Figure 25. Illustration of the test areas of rapid prototypes in Gothersgade. Source: Google Maps & made by authors.

RAPID PROTOTYPE #1 - TESTING SUB-ELEMENTS

Now, that we have our fundamental understanding of our users and knowledge regarding awareness and reward in place, we could start to develop rapid prototypes (Boer & Donovan, 2012). With inspiration from Engineering Design (Cross, 2008) we are going to test partial elements of a holistic concept. The purpose is to gain knowledge with the area of awareness and reward, therefore, these elements will be tested individually through low-fidelity prototypes (House & Hill, 2007).

Ideation - Preparing the staging of the negotiation space

The process of developing rapid prototypes began with an ideation phase, building upon a combination of Design Thinking methods such as brainstorm and brainwrite (Dam & Siang, 2019), so it fitted our perspective. The aim was to ideate, what is possible with the area of awareness and reward based on our existing knowledge from literature and field studies, respectively. Yet, it was still important to take into consideration the current DDUEs demands and criterias from, among others, the prioritising game.

During this ideation phase, we also took into consideration the issue of capacity, as we found from the previous workshop with the project managers of DDUE, that this was not the main priority but still an important issue. We decided that in order for us to test the effect of our rapid prototypes, it would require that the current litter bins were relatively empty, otherwise, people would not be able to use them. Furthermore, this was an issue that the DDUE was already working with, so if a design for this could be thought into our end-solution, it would be much appreciated.

Enrollment of the employees from DDUE

To gain acceptance and further enroll the project owners from the DDUE into the beginning of the conceptualisation, we forwarded our materials, followed by an iteration over a phone. We were told that our concept which tried to appeal towards the sex trigger for Mr Hyde by having the shape of a 'person' (women) was too provoking and risky. Instead, one of the employees suggested the use of optical illusion as an element of changing their behaviour. Development of such, however, takes time and will therefore not be tested during the first rapid prototyping phase, but later on in the process.

Staging the negotiation space

The prototypes acted as intermediary objects to help us translate matters of concern from Mr Hyde from our personas. The staging of each prototype was specifically selected, based on optimal location and time during the night from previous observations of the street (appendix 1).

Facilitating the negotiation

The location resulted in high availability. This, combined with a high flow of people, allowed for dialogue and interaction with the users.

Figure 26. Rapid prototypes with focus on Awareness. Source: Made by authors

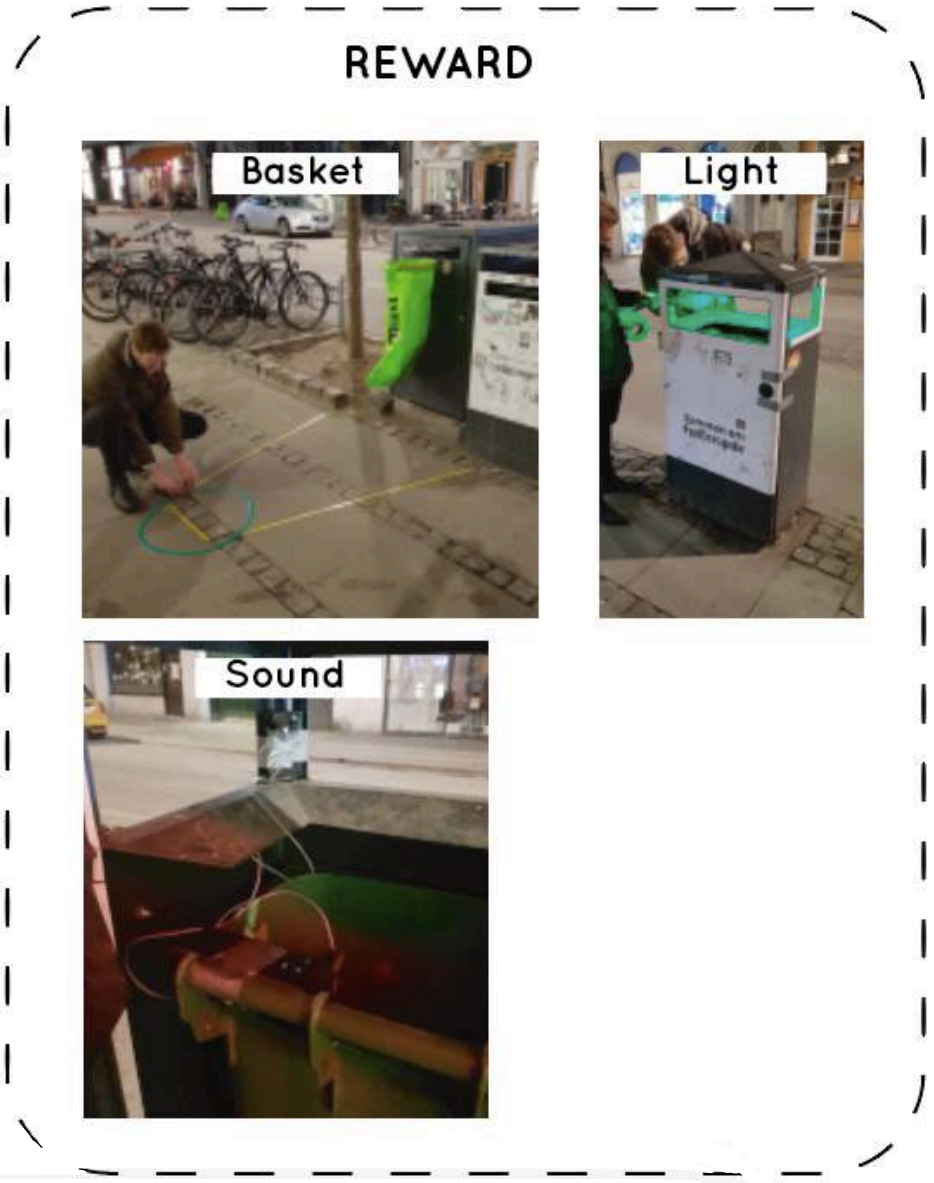


Figure 27. Rapid prototypes with focus on Reward. Source: Made by authors

Figure 28. Rapid prototype with focus on Capacity. Source: Made by authors

Synthesising

The staging

- Negotiation space not flexible enough

Due to the fact that multiple bypassers did not have anything to throw out, interacting with the prototypes was not always an option. Therefore, the negotiation space was not staged with high enough flexibility. Thus, some of the reward elements had to be articulated instead of observed in action.

- Lack of authority

We strategically decided not to wear the high visibility municipality vests, because we wanted to act as a neutral part of the environment, so our presence would not affect the interaction and outcome. Nonetheless, we realised that we were lacking authority during the setup/installation period. People seemed confused even worried about what we were during. Similarities occurred when we wanted to interview/talk to people regarding our prototypes. We were lacking the representation of who we were and our purpose for talking to them. During the movement of people interacting with our prototypes, not wearing vests allowed us to naturally act as a fly-on-the-wall (Geertz, 1973; Martin & Hanington, 2012).

The prototypes

For further elaboration of findings for each concept, reference is made to appendix 9, where a description of the tested concept, the method and the results can be found.

Due to the high intensity of lights in the street, it was not possible to test the luminescent graphics. It simply would not have had any effect. Further, due to the chosen day for testing was a Thursday, there were not that many people in the determined area for the out-of-order'

prototype. It was therefore decided, that the prototype should be tested the next day, Friday.

Conclusive elements

- Reward, awareness… and identity

So far we had to build our prototypes on the ideology, that it should have a **reward** and elements for **awareness**. However, when a sound was added to the litter bins, people seemed confused about where the sound came from.

"*(laughing) Wait, was that your phone?*" - Girl in street
"*(laughing) No, I think it came from that one (the litter bin)*" - Guy in street

Multiple users suggested, that we added a third element - **identity** in shape of a mouth or even a face/head to go with the sound.

- Sub-elements can not stand alone

Each of the prototypes in terms of reward and awareness contributed to their own finding. Yet, in order to create a short term behavioural change, several elements have to be combined.

RAPID PROTOTYPE #2 - COMBINING ELEMENTS

With the findings from each prototype in the first testing interaction analysed, we could now start to combine the different elements into more holistic concepts.

Ideation - Preparing the staging of the negotiation space

To do so, we used the baseline from the method of Morphology Chart (Cross, 2008) to ideate concepts. The morphology chart is a visual way to capture the necessary product functionality and explore alternative means and combinations of achieving that function. Typically, it is used later in the process to ideate for alternative solutions for a specific product (Cross, 2008). Yet, we will moderate this method so it fits our function.
To do so, we will be using the aspect of visualising a possible ideated solution to the thematics of awareness, reward, and identity, while taking our findings from rapid prototype #1 into consideration.

Staging the negotiation space

- Handing out candy

To accommodate that people had some litter to throw out during the testing period, we drew upon the inspiration from 'Keep Britain Tidy' (House, 2005), and handed out candy to people. The idea was, they could use the wrapping foil from the candy as litter, in order to test our prototypes. We stood at strategically picked locations and handed it out.

- Visibility vests

With the learning outcome from the first testing phase, we now wore high visibility vests during the setup/installation and when interviewing/talking to the users. This gave a much better feeling of trust and allowing for conversation. The testing phase lasted over two days Thursday and Friday.

Facilitating the negotiation

The distribution of candy allowed for a more flexible negotiation space was the candy 'broke ground' and allowed for opening a dialogue. An interview guide was also prepared with questions regarding uncertainties, which had occurred when developing the combined prototypes. This also encouraged dialogue and gave us concrete feedback in relation to each prototypes sub-elements during the testing phase.

Picture 21. Optical illusion. Source: Taken by authors

Picture 22. The three combined concepts. Source: Taken by authors

Synthesising

Staging

- Thursday, qualitative - Friday, quantitative

The first day had a lot lower flow of people in the street, which allowed for more qualitative conversations in a calmer atmosphere. Friday was a lot more 'chaotic' which 'puts the concept to the test', and allowing for more quantitative data.

The concepts

For further elaboration of findings for each concept, reference is made to appendix 10, where a description of the tested concept, the method and the results can be found.
Due to a high and strong variety of smell through the street, it was not possible to get the desired effect with the use of a citrus scent.

Conclusive elements

- Identity as a requirement for further development

With findings from rapid prototype #1, we added identity to some of these concepts. This leads to great feedback from the users, and it is, therefore, a requirement together with reward and awareness.

"[...] I mean, it looks childish but I like that it has a face" - Guy in the street

He then goes and "punches" the eyes on the springs.

- Choosing specific areas

From previous observations and testing prototypes, we started to get a generalised picture of the 'hang-out places' in correspondence to the type of litter. In general, there are three types of area:

1. Outside specific bars
2. Outside specific pizza restaurants
3. Outside 7/11

Picture 23 illustrates our chosen areas for the greatest impact for a behavioural change.
For are a more detailed description of these areas, reference is made to appendix 11.

Picture 23. The specification of area. Made by authors

- Shaping the demands and criterias

In the overall perspective, each of the concepts has to lead to a more detailed shaping of criterias and demands for our design specification.

SUB-CONCLUSION - IMPLEMENTING A REWARD, AWARENESS & IDENTITY

The define phase has contributed with a prioritising of thematics and providing us with the specification of focus areas. This lead to a further understanding of our actors in the street, which were categorised through the use of personas, with the result of Mr Hyde being our main target group. In order to change the behaviour of this target group, the understanding of the notion 'behaviourism' was investigated from a literature point of view. The result of this being, that main triggers for Mr Hyde is ***sex, food & power*** where, through a literature point of view, a *reward & awareness* has to be present, in order to appeal to these triggers.
A variety of rapid prototypes were tested to investigate what could be done, to appeal to these triggers. The result of this was, that both ***reward, awareness & identity*** has to be present for a behavioural change to happen. Aspects such as ***light*** in the shades of blue plus the right height, high-frequency ***sound*** and ***elements of gamification*** seem to have the desired effect and feasibility in the context.

From this we state our new sub-research question;

How can we develop ***a solution*** *that appeals to the three triggers* ***(sex, food & power****) through* ***reward, awareness & identity*** *to support the* ***desired change*** *of* ***littering behaviour****?*

Knowledge translated into a Design Specification

At this point in the process, we had gathered a large amount of specific data. Therefore, the method of compiling it into a design specification is appropriate. This will provide us with a structure of what exactly our final solution has to contain.

Based on the knowledge from interactions and staged negotiation spaces from the two previous phases, a Design specification(DS) is made. The DS represents the various actors involved in the design process MoCs, and then becomes an intermediary object, used to processing into the ideation phase, and start conceptualising.
Inspired by Nigel Cross (2008) the design specification is used as a methodological framework for conceptualisation. Thus, it is a way of structure our findings and makes them explicit in the development of concepts. The various actor's MoCs are translated into demands and criterias. In this project, *demands* are considered as something a concept-solution must fulfil, and *criteria* are considered as something that is nice to fulfil if possible. In simplified terms; *need* to have and *nice* to have.

The design specification indicates the requirements to be considered in the further concept development. The purpose is also to keep all concept solutions up to the table to which the concepts are rated in order to see how well the concepts meet all requirements. The demands and criterias are further elaborated in appendix 12.

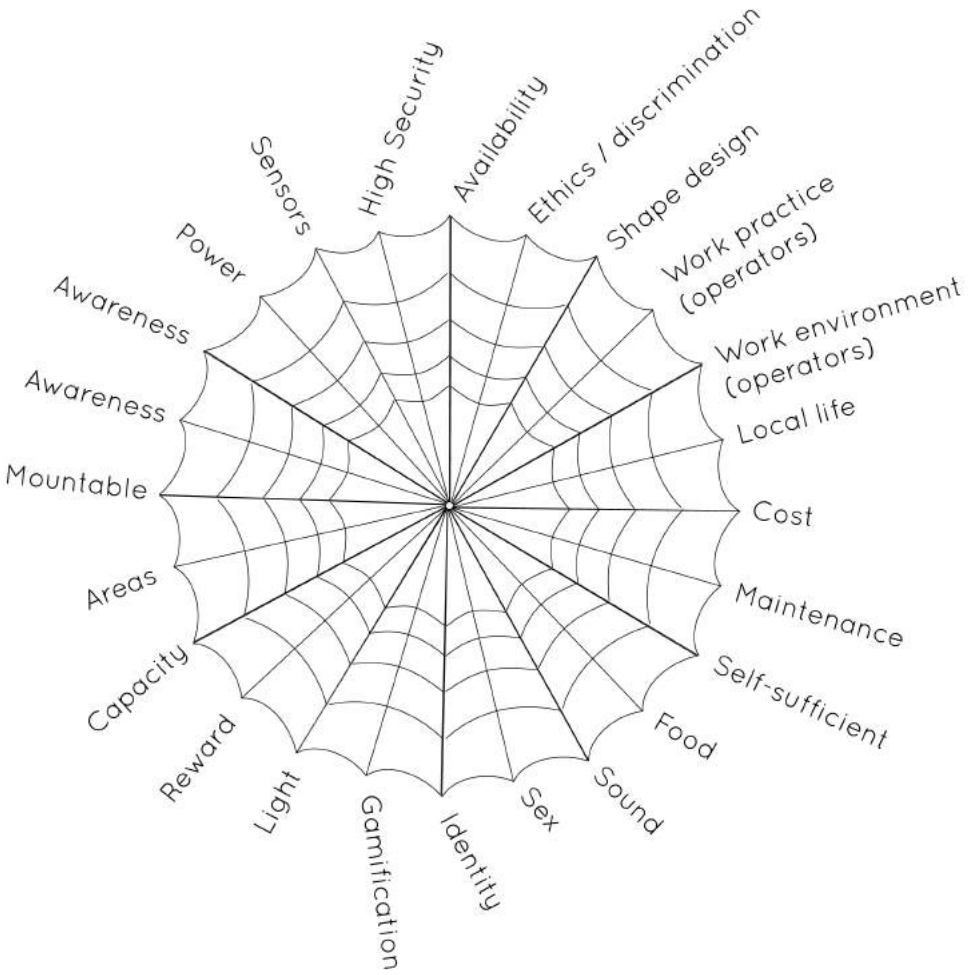


Figure 29. The categorisation of our design specification in a visualised spider web. Made by authors

CHAPTER

IDEATION

This chapter is where the concept for a potential solution starts to develop based on the empirical findings and the analysis of it, from the two previous phases.

This chapter describes the **development of four concepts** based on the framework of the demands and criteria. To negotiate a contemporary space, a **workshop is staged with the DDUE** to negotiate our work represented by the four concepts and to ideate on the concepts through negotiation. The findings from the workshop with DDUE are used in the development of **three new concepts** emphasising the input from DDUE and an update of the demands and criteria gathered at the workshop.

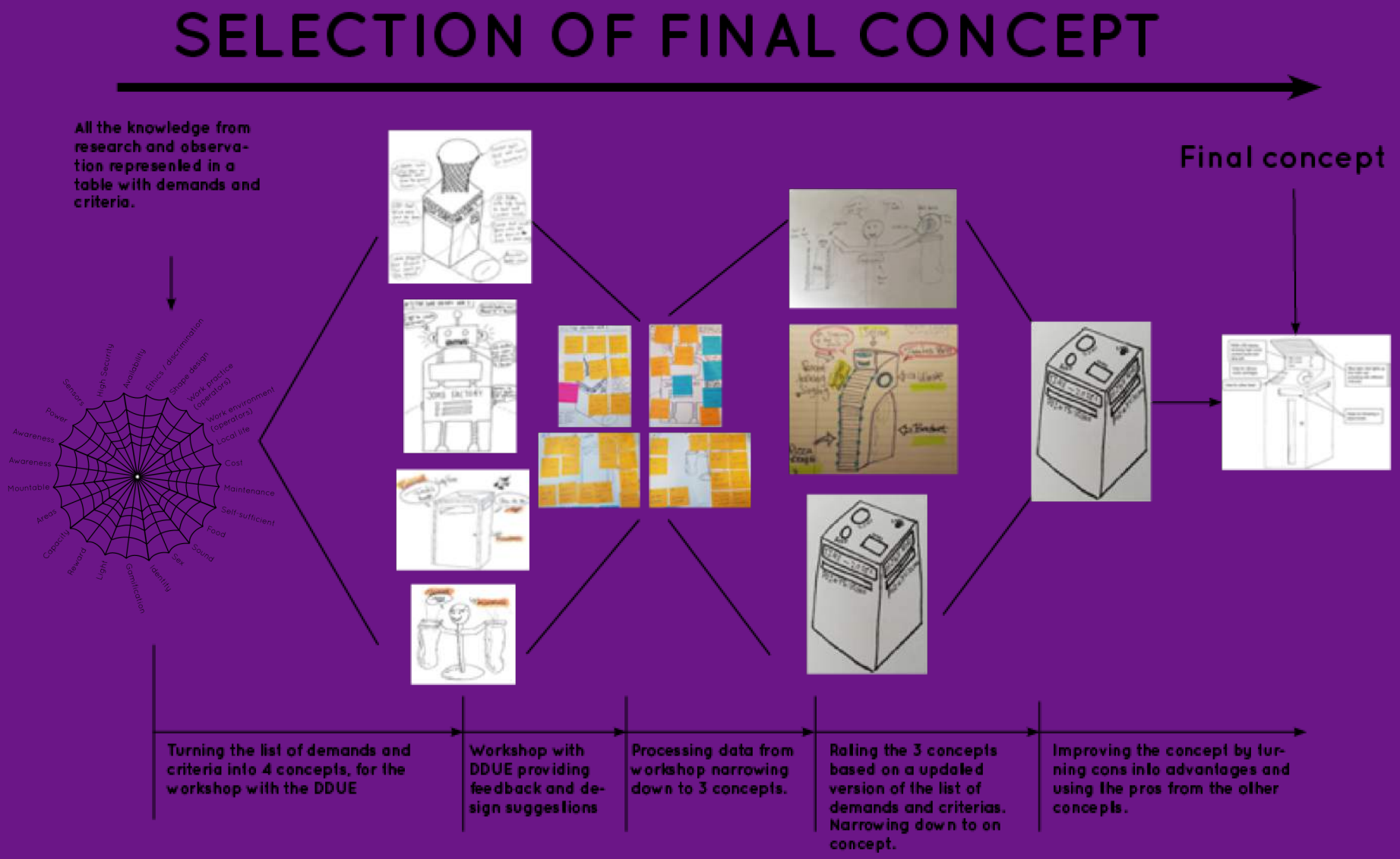


Figure 30. Summary of chapter 5, ideation. Source: Made by authors

CO-CREATION OF CONCEPTS

As part of the ideation phase, a workshop was staged and facilitated with the project managers DDUE. The purpose of the workshop was to evaluate four constructed concepts by presenting the ideas to the DDUE with the opportunity to provide feedback, ideate and reconfiguring the concepts based on their inputs. The underlying purpose was to empower the participants influencing the concept to be designed, as well as get acceptance of the work done, which the facilitation of the concepts represents. The synthesis of the workshop is later used in the development of new concepts at a more detailed level being more specific of what elements concepts have to include.

Four concepts

To set the stage and have something tangible the participants can relate to, four concepts were developed.
The four concepts are strategically based on a few handpicked requirements that are important to get feedback on and acceptance from the DDUE. Requirements such as 'Reward', 'Awareness', and 'identity', using 'Sound', 'Light' and 'Scoreboard' as a gamification element. These are all important findings from the rapid prototyping phase.

To developed the concepts, brainstorm and brainwrite (Dam & Siang, 2019) were used to ideate for solutions within the previously mentioned requirement.
Afterwards, each member of the group selected specific ideas within each category and demand (eg. ideas within reward and sound). At the same time, we had a discussion and elaboration of why that exact idea.

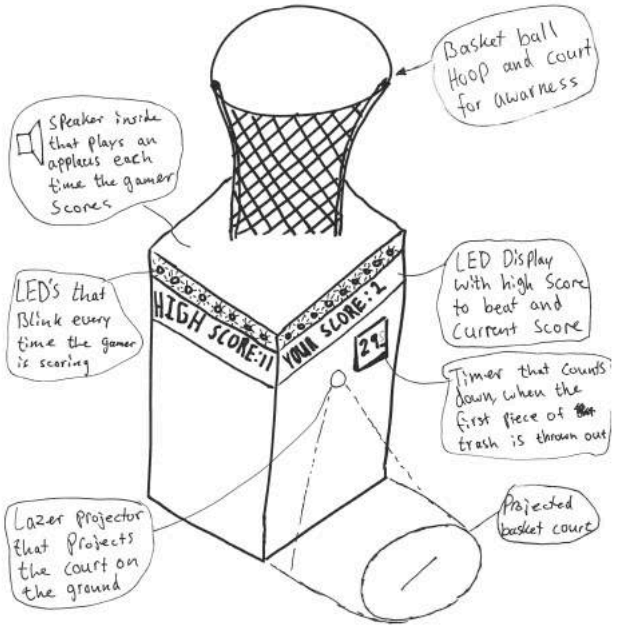
This led to aspects of a customised morphology chart (Cross, 2008), where the selected ideas were composed in relation to the feasibility of the specific element. The composed ideas were drawn into four tangible concepts.

Picture 24. The ideation board, in Danish. Taken by authors.

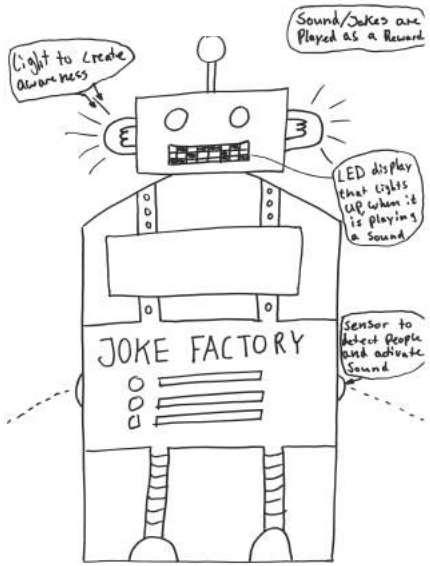
The four concepts are visualised by drawings on a paper of low fidelity. The reason is to invite the participants to draw and sketch on the concept drawings visualising their input, and to force them to be open-minded and still specific suggesting new ideas for re-configuring the concepts.

The Singing Bin

The Basket Bin



The Joke Factory



The Happy Little

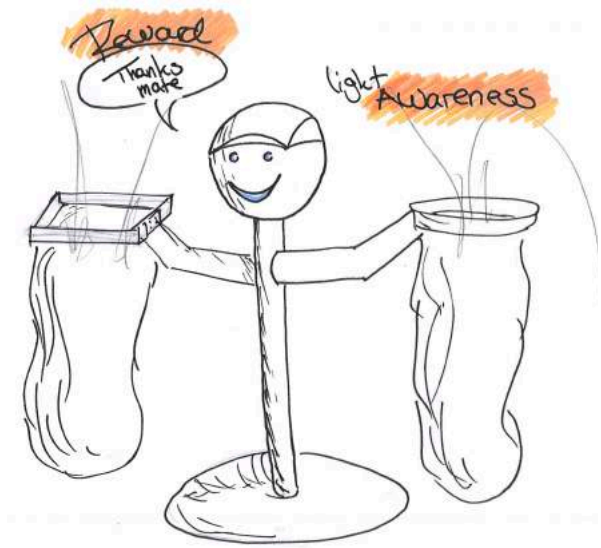


Figure 31. The four different concepts. Source: Made by authors

Each of the four concepts has its own emphasis of focus. The reason for this is to allow for a broad scope of ideation among the participants in the reconfiguring of the concepts.

The Basket Bin
With the findings from rapid prototype #1 and #2, the Arcade 2.0 was developed with a focus on aggression by throwing.
This concept consisted of a partly re-design

The Joke Factory
With the positive feedback from rapid prototype #1 and #2, the reward element of getting a joke was conceptualised into 'The Joke Factory' with a focus on human and identity. This concept consisted of the existing bin with new layout

The Happy Little Helper
To appeal to the trigger of sex and aggression, by having an identity and strong arms, the 'Happy Little Helper' concept was constructed.
This concept consisted of a complete redesign

The Singing Bin
To draw upon the finding of using a high-frequency sound to cause awareness, the 'Singing Bin' was developed. It also took into consideration the aesthetics and acceptance of the local life.
This concept consisted of attachments for an existing bin.

Staging the negotiation space

The workshop was held at DDUE headquarters to save time for the participants, emphasising they have a busy schedule. To set the stage a presentation of the findings from rapid prototype test #1 and #2 was presented to enlighten and recall what prototypes were tested and based on what findings. Likewise, a brief description of the constructed personas was presented using infographics to illustrate the characteristics of the users in Gothersgade. Also, pictures of the identified test areas which were defined by the personas. In this way, the participants have a scope and an idea of who the users are, and to start ideate new suggestion for reconfiguring the four concepts. The four concepts were performed by the facilitator and discussed among the participants, writing and presenting pros and cons to the concept for further ideation and negotiation.

Picture 25. Co-creating concepts with the project managers of DDUE. Source: Taken by authors

Facilitation of the negotiation

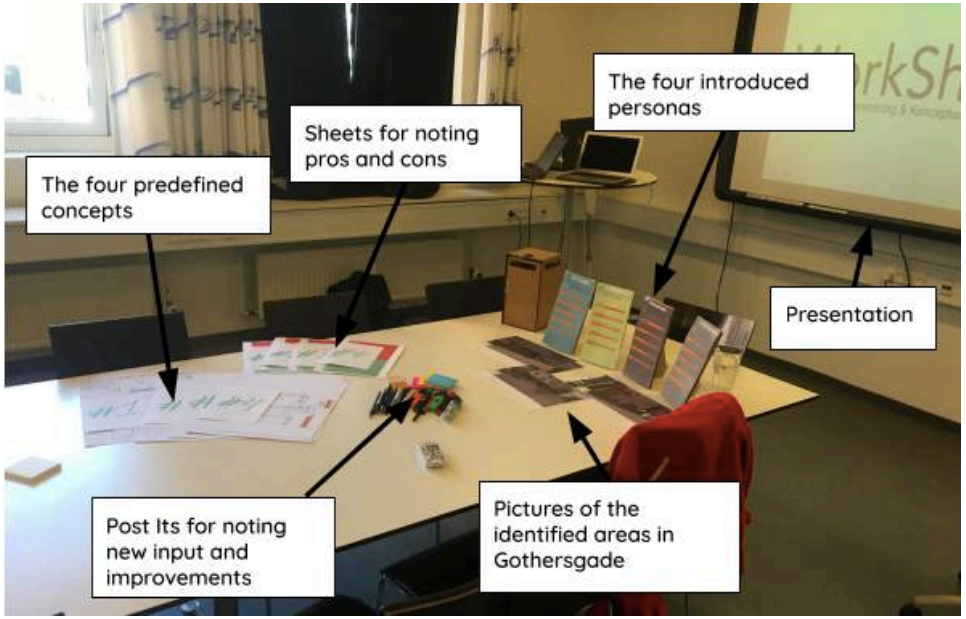


Figure 32. The materials presented at the workshop. Source: Made by authors

The Arcade

Based on previous interventions, presuppositions about the element of having the users to throw their litter would quickly be a 'no-go' by the DDUE. However, this turns out not to be the case. The presentation of the Arcade and the results of the testing phase, made all of the participants intrigued about having an element of throwing the litter. This lead to a variety of ideas such as; dartboard, handball, a hopper that spins suggested by the participants.
The participants, however, have concerns about the expansion of targeting groups. Meaning, that the solution also appeals to other personality groups, who normally use the existing litter bins.

"*We may be able to target people, who would otherwise throw litter into other buckets that are now throwing and not hitting*" - Project manager of DDUE (MoM-4)

The participants had presumptions that the behaviour would not really change, if people just use the solution, and did not hit the target(the bin) and then leave the litter on the ground.

The Joke Factory

Give the users something 'useful' such a joke or pick-up line created a good response from the participants. However, they had doubts about whether the integrity of constantly providing users with only the variety of 4-5 jokes. It would require a larger arsenal of jokes/pick-up lines which have to be updated at given times.
The look of the litter bin in terms of providing it with a personality was however, a bit more difficult for the participants to brainstorm on. The argument was, that since they did not have the full insight and understanding of the users, knowing that the exact personality appearance of a litter bin was rather difficult.

"*It is difficult for us to brainstorm solutions for eg. the appearance when we do not really know the target audience. What triggers them etc.*" - Project manager of DDUE (MoM-4)

The Singing Bin

This concept was more tangible and a re-design of the Pizzakurv litter bin. It was more in line with the initial request from the DDUE at the beginning of the project. However, DDUE argued the concept lacked a personality and the element of becoming "*part of the party*" formulated by one of the participants.

The positive aspect was, that during the daytime it would appear neutral without drawing too much attention.
One of the main topics of discussion in relation to this concept was who the concept would actually;

"*It will probably draw attention to the flow of people. Not so much to the people who are staying*" - Project manager of DDUE (MoM-4)

Since the scope of the project was to target the Mr Hyde persona at the 'hang-out' places, the concept would have to be re-configured. The participants suggested adding elements of gamification in order for it to become part of the party.

Happy Little Helper

All the participants thought the idea of combining extra capacity with a personality litter bin was a good idea. Nevertheless, making it look like an employee from the municipality would make the users discard immediately because it looked like an authority telling them to behave, which can evoke feelings of despite or provoked.
Specifically interesting during the review of this concept was, that one of the participants started to draw on the concept itself. The litter bin holding two plastic bags, reminded him of a goalkeeper in soccer, except you had to score with your litter. A discussion between all participants; Is it necessary to collect the litter into the bins or is it to collect the litter in specific areas in the streetscape? Previously stated by the DDUE, the main focus was the litter had to be thrown out in the bins;
"*Move away from that mindset that we have to collect it in one of the litter bins. [...] the important thing for us is to make a solution that can get the litter in one place. Then we will find a solution from there*"
- Project managers of DDUE (MoM-4)

The output of reconfiguring the four concepts

Generally, the participants collectively agreed that the final solution should include gamification elements, at the specific hang-out areas in Gothersgade - it was an aspect in the context, to best target the Mr Hyde personas. Furthermore, finding the right personality of the bin was important for both day- and night time. It had to be moderately neutral during the day, and target the intoxicated during the night.

Synthesis

Results of the facilitation

It is clear we are the experts making a solution dealing with littering and Gothersgade users. Exploring the field using prototypes have made a far greater Insight about the field and the users. Although the framework for an ideate session has been facilitated by a presentation of findings, infographics of personas and focus areas in the street, it was challenging for the participants to make changes to the four concepts.
From this we conclude, that even though the DDUE holds a great deal of knowledge about this field of study, it is more on an organisational/ administrative level, where we, as designers have a lot of hands-on experience from the nightlife in Gothersgade, and therefore the final conceptualisation should be created by us.

The scope of the project

The presentation of our findings from all the observations and prototype testing have worked as an eye-opener for DDUE. The DDUE's scope of the project is changed to:

- The litter no longer needs to be collected into the bins, but just collected in strategically placed so it is easier for the cleaning team to collect.

- Previously their focus was on a solution for the nightlife. However, now the effect of it during the day seems quite important as well.

- In order to design a solution for the Mr. Hyde personas, gamification elements are acceptable to use in the night hours.

Nonetheless, the development of a solution gathering the litter at specific places in Gothersgade is not considered feasible knowing that wind can spread the litter to the rest of the street. Rain as well makes it more difficult for the operators to collect the litter. Yet knowing it is acceptable by the DDUE to gather litter, makes it easier for the further design process to develop a solution considering gamification elements, such as throwing, sound, light, game elements etc.
Yet, the main focus is to develop a solution that the Mr Hyde personas want to use as well as get people to throw out their litter *in* the bin.

THREE CONCEPTS

The workshop provided us with a lot of useful feedback, like the pros and cons of each of the concepts, and new ideas for improvements and completely new ideas for new concepts. To process all the information and feedback we got at the workshop we decided to use individual brainstorming, where each of us, would turn all of the information we were provided with into a concept that fulfilled as much of the design specification as possible.
The brainstorm led to three concepts. For a more detailed reference is made to appendix 13

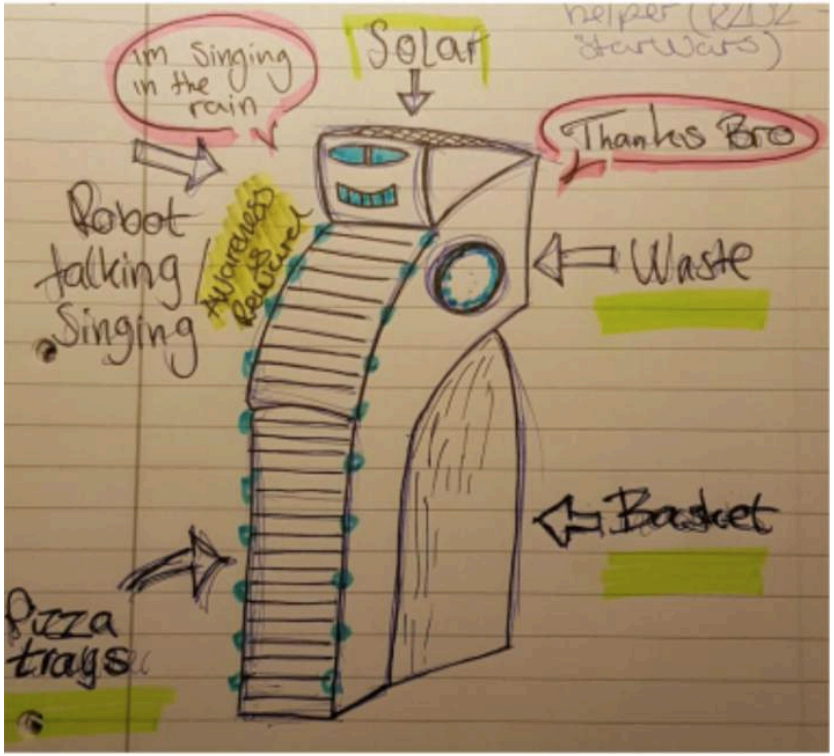


Figure 33. Robo Bin concept Source: Made by authors

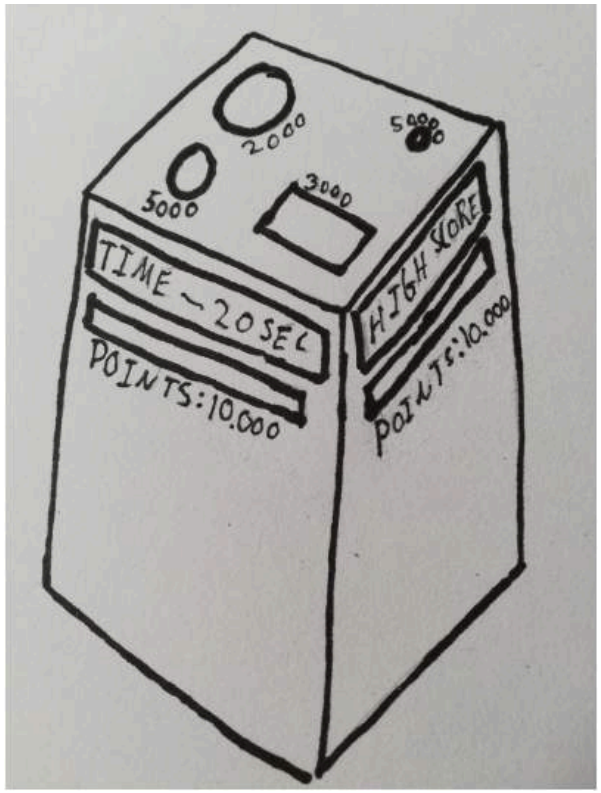


Figure 34. The Arcade concept.
Source: Made by authors

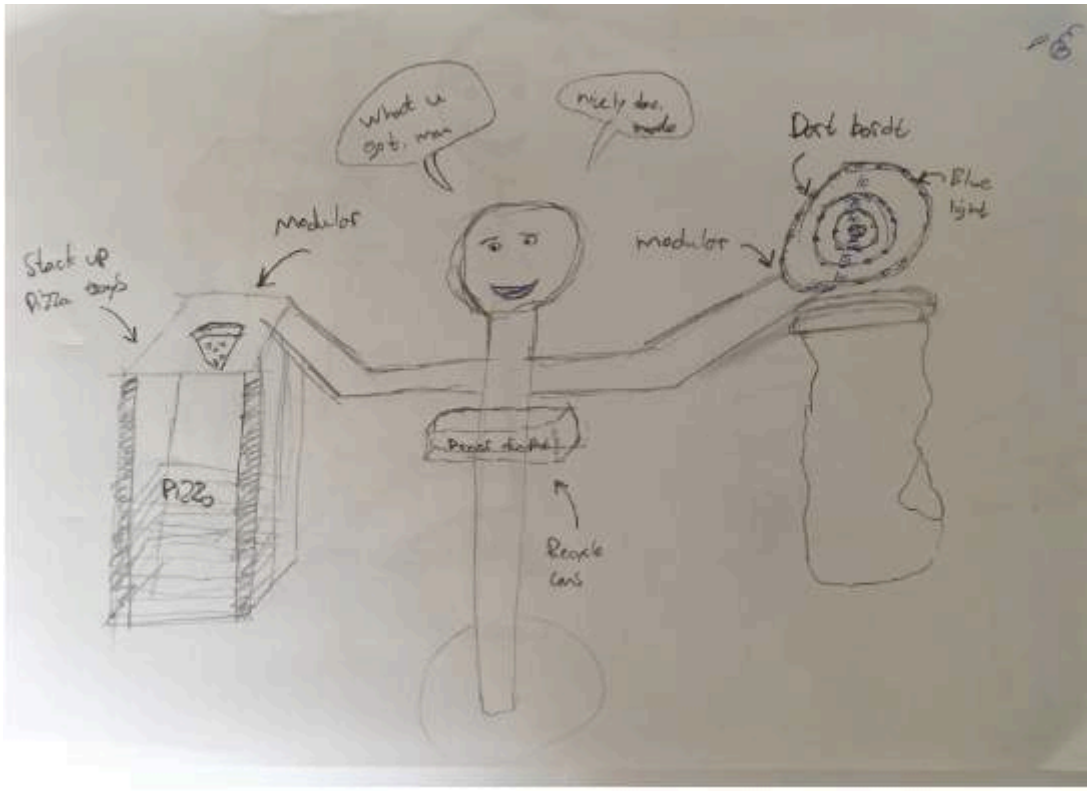


Figure 35. Happy Little Gamer concept.
Source: Made by authors

Applying morphology to select the best idea

We then presented the ideas to each other and used the list of requirements from the design specification representing the matters of concerns from the different actors. To compare the different solution we created a rating scheme inspired by Nigel Cross (Cross, 2008). The rating scheme was an updated version of the design specification, re-evaluated after the workshop because the matters of concerns from the project manager's of DDUE had changed. E.g. they were now more focused on just changing the littering and getting the litter to one place, than the technical elements of the solution. In that regard, the requirements for electronic components and power was neglected until the gamification elements were determined and accepted by staging various iterations with the users who are going to interact with the litter bin. We focused on the aspects which make the solution capable of changing littering behaviour, such as, ***reward, awareness, gamification and identity***. However, we chose to keep a holistic design approach and address the matters of concerns from most actors and choose to keep demands such as cost, theft of equipment and maintenance, which are all important if the solution is to be implemented in the long run.

The rating scheme (Appendix 14), with a complete list of the rating criteria, and the detailed description of the reasoning of selecting the final concept can be seen in Appendix 15.

Here we will provide a short description of the reasoning of choosing, what came to be the "The arcade" concept.
These are illustrated through the use of a radar or spider chart (Kurian, 2013)

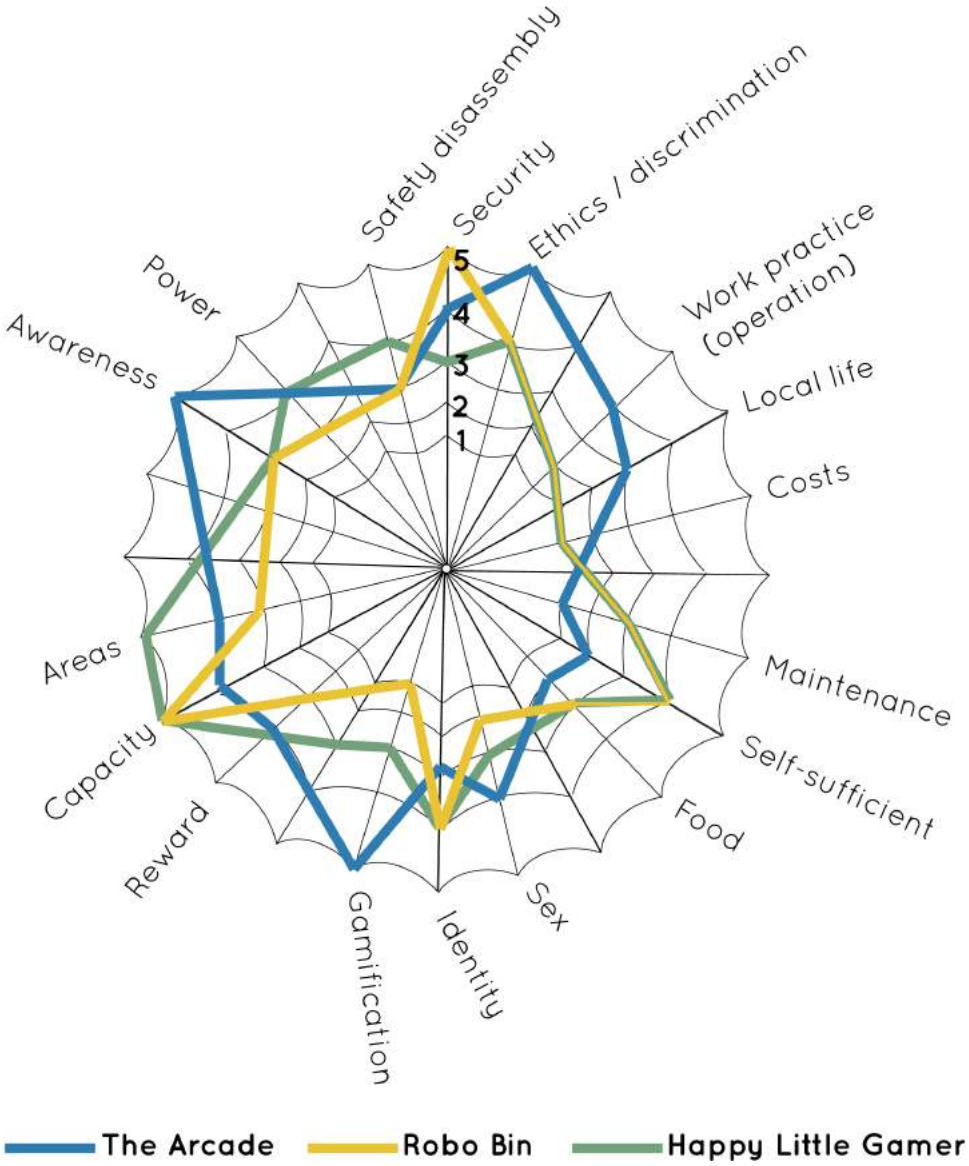


Figure 36. The spider web visualisation to rate the different concept.
Source: Made by authors

The Arcade scored particularly high on gamification, awareness, power, sex, ethics, capacity and work practices. Which were all parameters that were scaled high, because our research, of what it takes to create a change in litter behaviour and the most important matters of concerns, pointed at these parameters.

However, the Arcade did score low on other parameters and the other concepts also had features like the pizza stacking that was ideated by the employees from DDUE during the workshop.

Combining of sub-elements

We made another idea generation session where we transformed negative scores to positive and took good ideas from the other concepts and combined them into a final concept which we believed in. The result of the ideation session can be seen in figure 37. It is only shortly introduced here, as we will go more into depth with the description of the concept in the next chapter.

80's inspiration

The Arcade concept reminded us of the '80s Whac-a-Mole Arcade game. More research regarding today's trends showed various aspects from the '80s are quite popular. One element is the fashion trend made a comeback over a year ago (Adhav, 2018). Another is some of the most popular games of 2019, where three of the iconic Mario games are in a global top 20 (Ranker Games, 2019). Serval relaunches of the popular Game Boy have also seen the light of day within the past few years (Nissem, 2018). With the inspiration from such The Arcade concept was shaped into an actual iconic arcade.

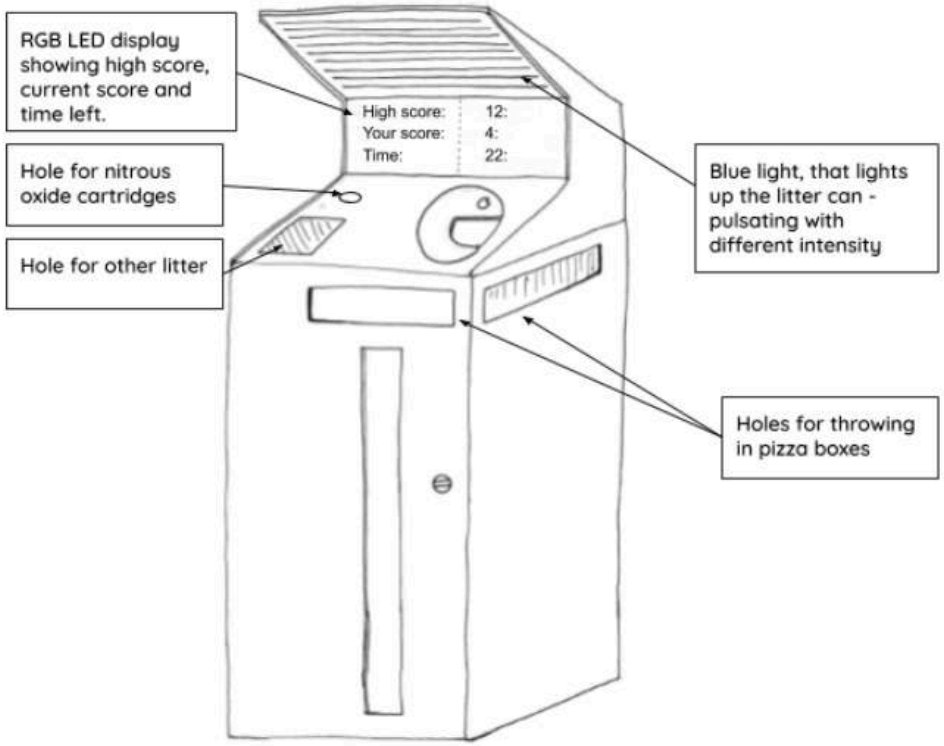


Figure 37 - The final concept selected

Feedback from The project managers of DDUE

After our selection of the final concept (see Appendix 15), we got some positive feedback from the project managers of DDUE. However, they had some uncertainties about the concept(see email in Appendix 16);

1. Too many holes for throw-in might generate confusion. Likewise, the clarity of what type of litter needs to go where in the bin disappears in the Pac-Man graphics.

2. Avoid throw-in from the back of the litter bin, as it encourages to hang out on the bike path, which is not good due to the safety of cyclists and pedestrians.

3. Afraid that the solution has the opposite effect if there is no game that people are disappointed

4. Think of the look of the litter bin during the day and early evening. It has fit into the cityscape during the day

The constructive feedback from the project managers is considered as important to address in order to keep them empowered in the development of the final solution. We did that through prototyping, which will be introduced in the next chapter.

SUB-CONCLUSION - NEW AND IMPROVED SPECIFICATIONS FOR DEMAND & CRITERIA

The ideation phase has been rewarding regarding the development of four concepts narrowed to three, which have further paved the way to the idea of the final concept. The phase shows how we have challenged the collected empirical work and experience by staging a workshop. The workshop was not only an idea generation reconfiguring the four concepts presented, but also to enroll DDUE into the further development phase by them expressing acceptance of the knowledge and concept ideas presented. Knowledge from the workshop resulted in ***gamification*** being introduced as a requirement in the further development of three concepts in order to design a solution Mr Hyde will use in the selected places of residence in Gothersgade. Likewise, the solution has to ***fit into the environment both day and night***, causing it not to awake to much attention in the daytimes. Thus, a solution has to be ***timed*** so it only functions at peak hours at night from Thursday till Sunday morning.

From this we state our new sub-research question:
How can we develop an ***interactive litter bin*** *that includes elements such as* ***electronics and programming****, and still f****its into the environment both day and night****, without* ***disturbing*** *or r****egarded as an authority****?*

CHAPTER

DEVELOP

This chapter is where our final concept will undergo comprehensive iteration, to adapt it to the specific needs of the relevant actors. Serval mockups in different scales will be produced and tested through the staging of multiple negotiation spaces. To further co-design with the operators, a workshop will be staged with a miniature scale mockup acting as an intermediary object. The enrollment and acceptance of the local business life in Gothersgade will take place with the use of the co-created miniature mockup. The multiple iterations will shape and narrow the parent lines of the concept down to the last details, where lastly a blacksmith will be enrolled to evaluate the feasibility elements of our final concept.

DEVELOPING THE FINAL SOLUTION

Miniature Mock-up

Feedback from DDUE, Operation, Blacksmith and local businesses

1:1 Mock up

Feedback from test at Friday bar

1:1 Mock up

Feedback selected students

1:1 Mock up

Feedback from test on school

Development of final prototype

Co-creation with the blacksmith

Illustrative presentation of final concept

The Arcade which will be tested, when produced

Figure 38. Summary of chapter 6, develop. Source: Made by authors

MOCKUP #1 - MINIATURE (SCALE 1:4)

Co-creation of the concept with the Operators & businesses in Gothersgade

Since this concept would have an effect on the current network and the various actors within it - not just the DDUE, we wanted to further understand all their matters of concerns/uncertainties in relation to this concept.
In order to do so, we staged two contemporary negotiation spaces.

Workshop with the Operators

Since this concept would require a re-design of the current insert, and thereby also small changes in the practice of the operators, we decided to further co-create the concept with them through an iterative workshop. The intention was that they should provide feedback and input to the precise handling of the solution in practice. In this way, the practice-oriented knowledge and hopefully unpredictabilities could be translated and thought into the further development of the final prototype. The purpose was also to create ownership and acceptance around the solution, as the operation department is the one that in the future has direct hands-on with the solution in Gothersgade.

Staging the negotiation space

Location

The location for the involvement of the operators was at their own facilities. It was important that the operators involved felt safe and expert within their profession/expertise area to get constructive feedback on the prototype.

Mockup as an intermediary object

To stage this workshop, we wanted to draw upon the element of using an intermediary object as a mean of translating their matters of concern in relation to the concept, into tangible design aspects.
We acknowledge that the operators are not designers, and perhaps do not have the same capability in terms of concept visualisation if the intermediary object were a drawing on a piece of paper. Therefore, we developed a mockup of the concept in scale 1:4, that will not be of the highest fidelity, so they still feel like they can change or rearrange elements if needed.

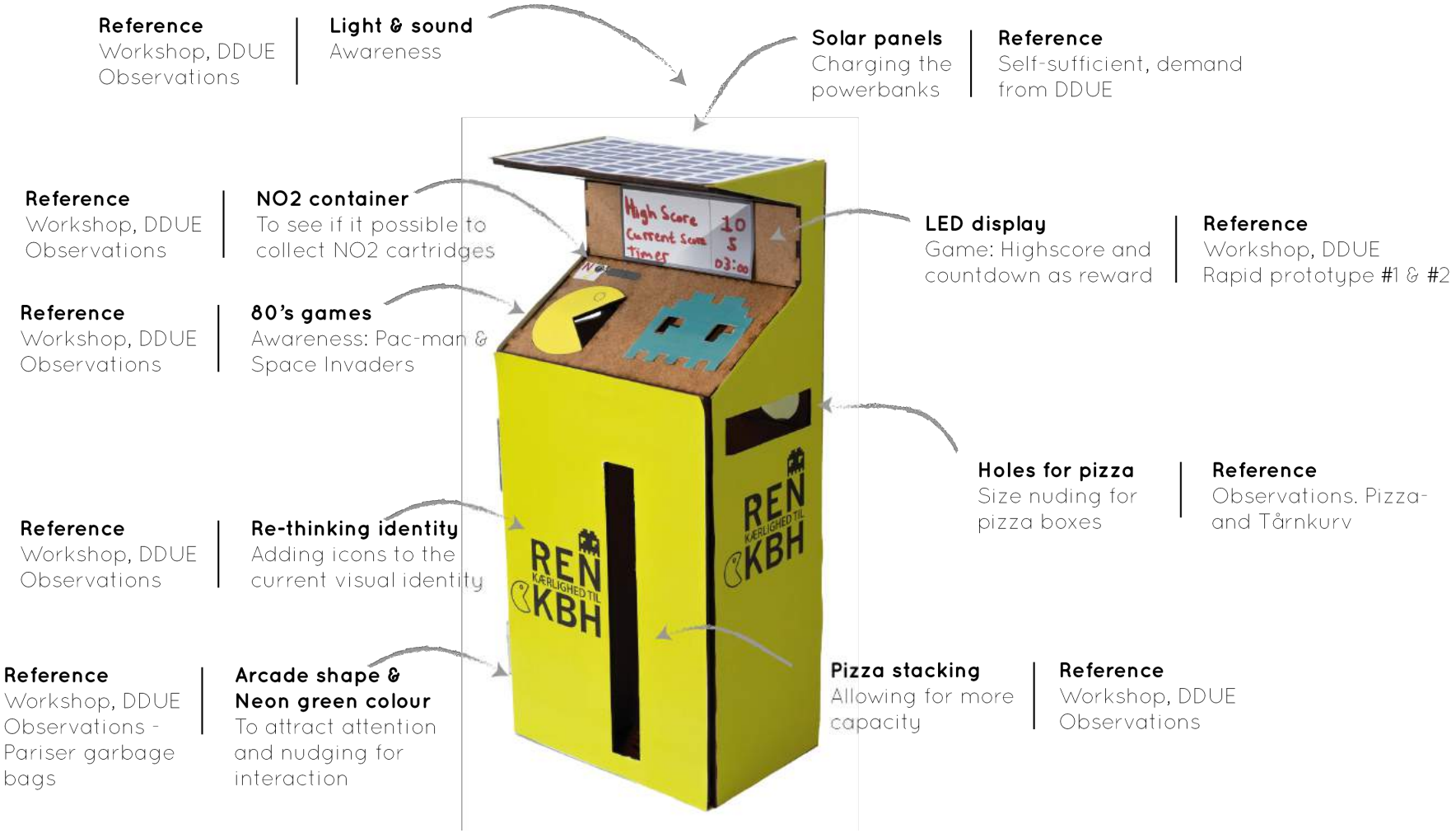


Figure 39. A mockup (scale 1:4) used as an intermediary object for the workshop with the operators. Taken by Dave Jarvis (fellow student)

Facilitating the negotiation

The workshop was facilitated around the practice of the operators and the possible change, that our end-prototype would cause. This was also a sensitive subject for the operators.

"The effort must not be too heavy when we have to get it out and on the car" - (Operator 1 workshop, Sound file - Workshop with operation)

"We can thoroughly wipe the sensors off if it does not take too long" (Operator 2 workshop, Sound file - Workshop with operation)

However, they were very open and keen on our concept and even came with a concrete suggestion for improvements. These will be further elaborated under further down under *'synthesising'*.

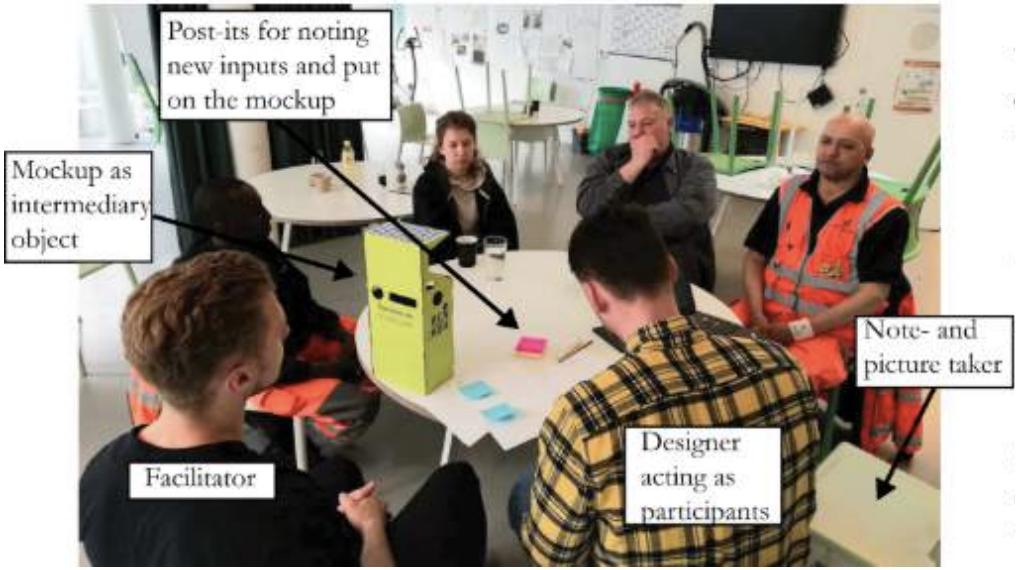


Figure 40. Workshop with the Operation Department with our 1:4 scale mock-up as intermediary object. Source: Made by author

Business in Gothersgade

As previously mentioned, one of the findings from rapid prototype #2 was the specification of hang-out places in Gothersgade, where a large quantity of littering occurs - outside 7-Eleven, in front of Ibiza Bar and Pizza Time.
Since our end-prototype most likely were going to be tested at one of these locations, we wanted to enroll the owners and their matters of concern in relation to our prototype.
The location outside of 7-Eleven is a more open space owned by the municipality. Therefore, the 'owner' of 7-Eleven will not be enrolled during this section.

Bar Manager of Ibiza Bar & the owner of PizzaTime

Bar manager of Ibiza Bar

After the workshop with the operators, we bought our mockup to the bar manager of Ibiza Bar. Due to a busy schedule, we did not have that much time for us. However, he thought the concept seemed interesting and we were more than welcome to test in front of this bar. He additionally added that a lot of these customers often went outside for a smoke, so we should remember to add an ashtray to our final prototype.

Owner of PizzaTime

The owner of Pizza Time gladly invited us in. He has had his restaurant there for 40 years now and had seen all of the different solutions the municipality had tested over the years. However, the thought the shape- and gamification elements of the concept would add some new interesting discoveries. We were more than welcome to test our final prototype in front of his restaurant.

Synthesising

The use of a mockup as an intermediary object was a good method to translate matters of concern from the different social worlds into tangible design elements:
The iterations gave us the approvements from a variety of relevant actors. However, smaller improvements had to be made based on their suggestions:

- An ashtray (preferably the newer kind) has to be attached
- According to the experience of the Operators, the chosen neon green colour will quickly observe dust and air pollution from cars and lose its elements of attraction. It was suggested to add a darker colour instead.
- The angel on top of the litter can should have a steeper angle, so people can not place glass and bottles on top of it.
- The electronics should not be accessible to the guests/users in the street of safety for them, but also the components mounted.
- The electronics must be accessible to the actors who must maintain the litter bin if something breaks.
- Consider the choice of materials according to the effort. It must not be too heavy in terms of the working environment. The solution that encircles the insert must be made of durable materials that can withstand the weather, as well as residues from the flake that, over time, may appear to be more sensitive to the litter bin.
- The litter bin must be secure so that it cannot tip over. The bin must be bolted into the ground.

MOCKUP #2 - PAC-MAN (SCALE 1:1)

Idea with Pac-Man

After the iterations with various relevant actors, and through the use of intermediary objects, we were able to translate their knowledge into tangible design suggestions.

Considering uncertainties

After taking all of these suggestions into consideration in a 1:1 mockup, we still had some uncertainties surrounding our concept'. These uncertainties were noted and a counter responds for how to test them were ideated.

We decided that these uncertainties were of such a character, that going straight into a full-scale production would be with a lack of clarification. Instead, another iteration was needed in order to bring clarification to these uncertainties.

'Final concept - Uncertainties'		
Nr.	**Uncertainty**	**Solution for testing**
#1	Height of prototype	A 1:1 cardboard mock-up suitable for testing at a party at AAU CPH
#2	Dimensions of holes	Summit the identified type of litter for testing at a party at AAU CPH
#3	Pizza stacking	Buying pizza boxes plus leftover food in boxes. Testing at a party at AAU CPH
#4	80's / arcade look	Observing plus interviewing at a party at AAU CPH
#5	Understanding of gamification element	Develop a analogue cardboard screen prototype that illustrates the changes that will occur
#6	Understanding of icons	Try an array of different printed icons

Tabel 2. Uncertanties in relation to our 'final concept'. Soruce: Made by authors

Building a full-scale, partly functional cardboard mockup

To accommodate these uncertainties, we decided to build a partly functional cardboard prototype, whit focus on the elements that were related to the mentioned uncertainties.

Pizza stacking

We wanted to test the hypothesis that seeing a few pizza boxes stacked on top of each other, would nudge people to throw them incorrectly, and they would, therefore, land horizontally in the inner litter bin, resulting in higher capacity. To do so, we bought 10 pizza boxes (same sizes from the one being sold in Gothersgade) from the local pizza place. The inner litter bin was designed, so it could fit both pizza boxes and other types of litter.

The Arcade game

The gamification element would be tested by adding points around the different holes for throwing in litter. Due to limitations such as time and resources a simulation of a screen with a high score, current score and a timer were added.

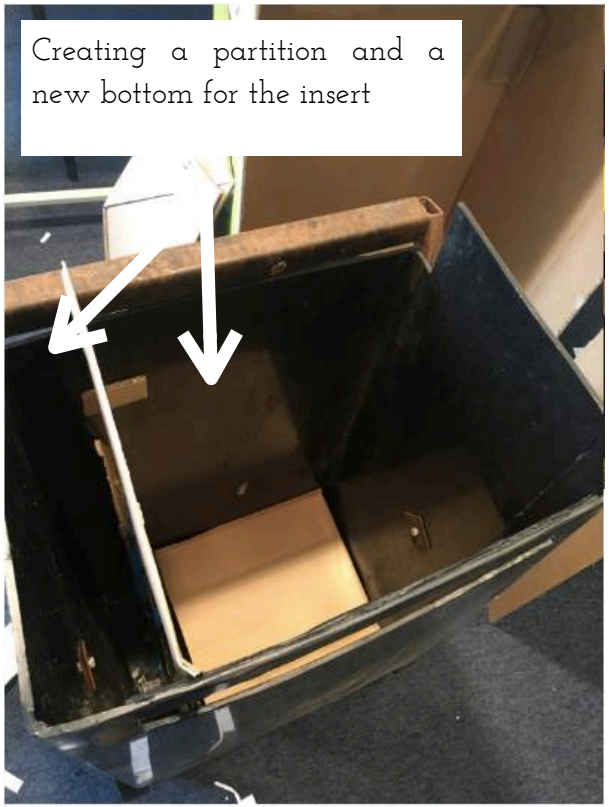


Figure 41. The insert for the Arcade mockup. Source: Made by authors

Figure 42. 1:1 mockup for the 'final' concept, the Arcade. Source. Made by authors

TESTING FOR UNCERTAINTIES AT AALBORG UNIVERSITY CPH

From previous observation we knew, that testing prototypes in Gothersgade during the night time would mean a test of the strength of the materials. Combining this with the criteria from the Municipality, that a full-scale mockup such as ours would have to be solid fasten to the ground. In order to meet safety requirements and not cause harm to others, we decided to test it at a banquet at Aalborg University. We were aware that the surroundings, the atmosphere and the people would be different. However, if certain elements were to difficult for less intoxicated people at the university to understand, then we could conclude that it also would be for those in Gothersgade.

Staging the negotiation space

We placed the prototype near one the entrances, which also acts as a pathway to the toilets. Choosing this specific place allowed for attention, because it stood out in its white surroundings. This was also at the periphery of the party, meaning that it allowed us to have a deeper, more qualitative conversation with the users, and hereby gain greater knowledge in relation to the aim of uncertainties.

Picture 26. The strategic placement of the mockup during party at AAU CPH. Source: Taken by authors

Facilitating the negotiation

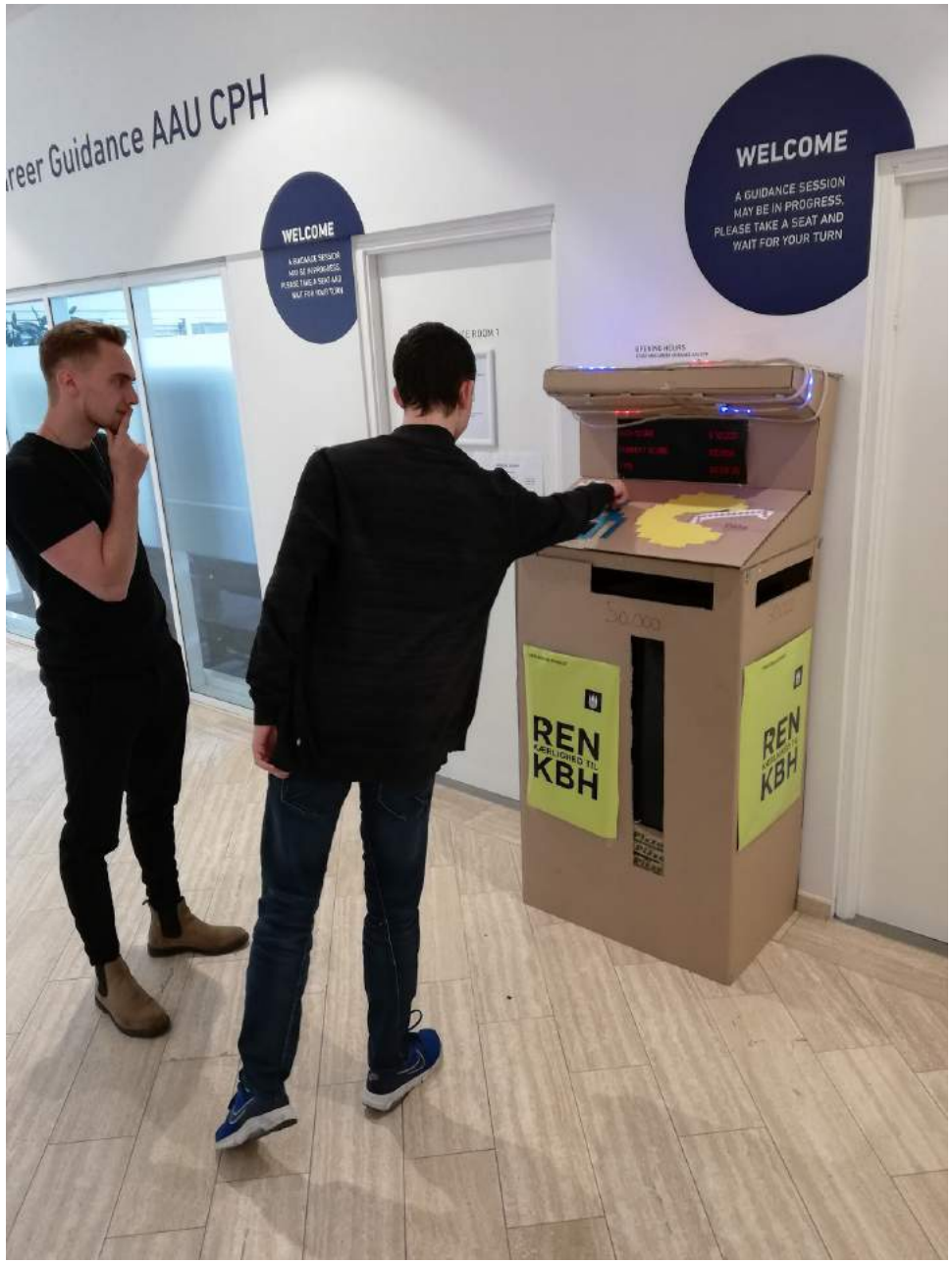
Two of us were in charge of testing this prototype.
When one of us would be interviewing, the others would take notes.
The litter bin itself was placed against a wall as much part of the party as possible. We placed the specific type of litter from previous observations from Gothersgade, such as pizza boxes, plastic cups, napkins and even a few nitrous oxide cartridges on tables and the ground around the litter bin. The purpose was to see, if the game would Intrigued people enough, so they would collect more litter to get a high score as possible. However, because the electronics such as a counter for a high score were not actually attached, we had to tell people the idea behind it, and what was supposed to happen after they had thrown out their pieces of litter.

Identifying our developed personas at the university

During the testing phase, there were clear comparisons to our developed personas. A few people felt that they wanted to kick and punch the litter bin to see if they could get any money out of it. All notes can be seen in Appendix 17.

"Like in real life with, you know, those vending machines you want to shake to see if you can get any stuff to fall out of it." - Student, Appendix 17

This type of behaviour was in clear comparison to our main target group, Mr Hyde. Since the atmosphere at this party was not as hectic as in Gothersgade, people were more willing to talk, describe their emotions and give concrete suggestion for things to add/change.



Picture 27. The Mr Hyde persona wanted to throw instead of putting litter in the bin. Sign of aggression. Source: Taken by authors

Synthesising

The findings from this intervention are illustrated through the use of a radar or spider chart (Kurian, 2013). Below are elaborated important findings within awareness, reward and identity.

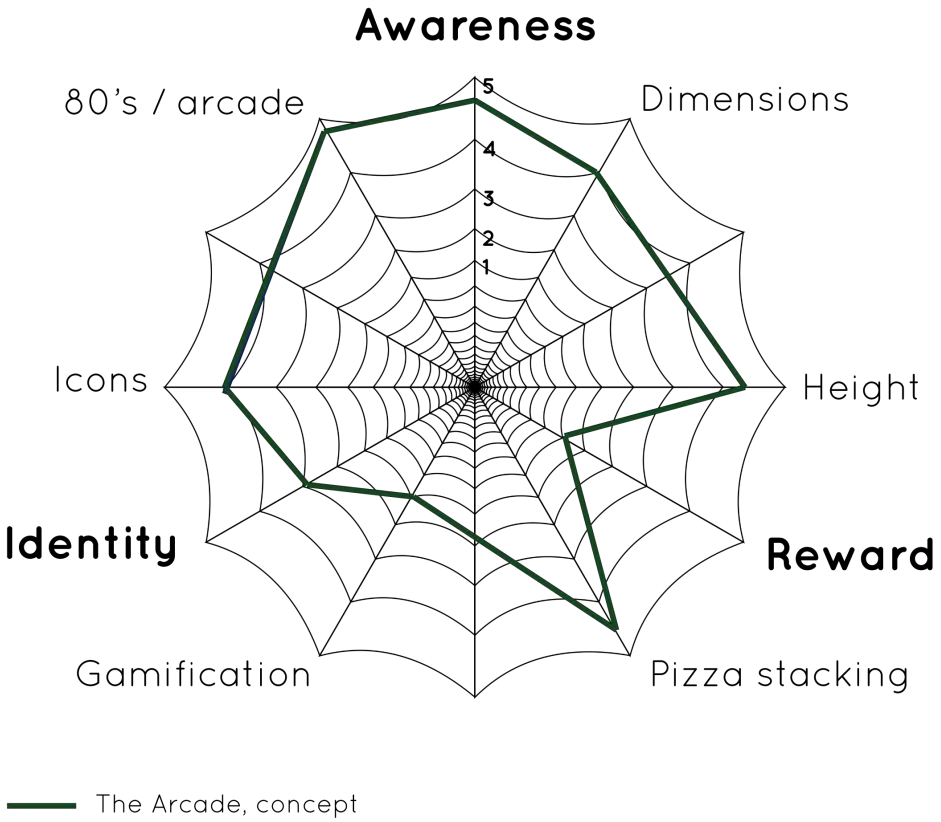


Figure 43. Spider web used to illustrate the main findings from the iteration.

Awareness

- Light in the top caught their attention instantly
- The whole arcade form and illustration were something that people recognise and relate to. Positive feedback for this choice of design
- Not enough awareness that it is actually a game
- Suggestions for a sign on the top of the bin
- Suggestions for a voice that says: "come play a game" or similar
- Good with sound for awareness

Reward

- Having a high score is not enough for a reward
- Some people wanted physical elements (tickets, vouchers, condoms etc.) as a reward
- Serval wanted sex / romance

Identity (gamification)

- too complicated of a game
- takes too much time to understand how the game work
- To much 'stuff' is going on (colours different places, lights and a digital screen)

CO-CREATION WITH STUDENTS

In order to further ideate on some of these findings from the intervention, we invited some of the participants for a mini-workshop. The purpose was to co-create the gamification and reward elements of the concept. We had specifically invited what corresponds to a Mr Hyde and Hemingway personas, due to these two characteristics represents the majority of people in Gothersgade.

Staging the negotiation space

However, since the participants were also students and therefore did not have a long time to spare, we had prepared alternative solutions for the gamification and rewards elements based on the feedback from the previous intervention.

Developing The Date Factory

To accommodate the attention aspect of sex in an appropriate manner, which from previously collected data we know, are a trigger of awareness for Mr Hyde, we created 'The Date Factory'.

Awareness

Based on the positive feedback, we choose to keep the arcade form and lights at the top. A sign was added to the top saying 'The Date Factory'.

Based on positive feedback from previous prototype testing, we added The Singing Lion plus a voice saying "Feed me some litter, get a joke" to this concept.

Identity

To ease the complexity of the 'too much stuff is going on' and have a clear line of understanding, the Pac-man and Space Invaders icons were removed and replaced with a three-step manual.

Figure 44. The new and improved 'gameboard' with a three step manual. Source: Made by authors

Reward

As a reward the concept would now give a joke / pick-up line. Depending on how many pieces of litter is thrown out, a barometer would indicate a date guarantee. The higher amount of litter - the higher guarantee of a date.

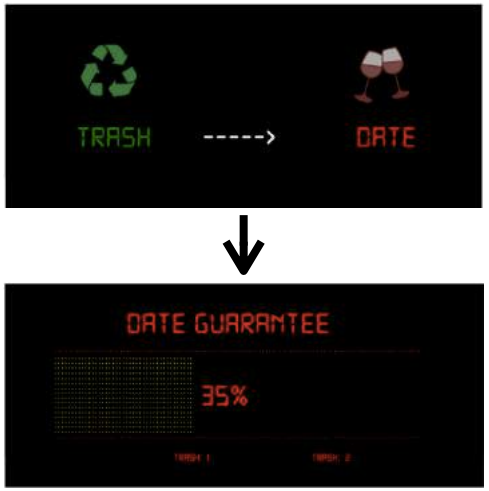
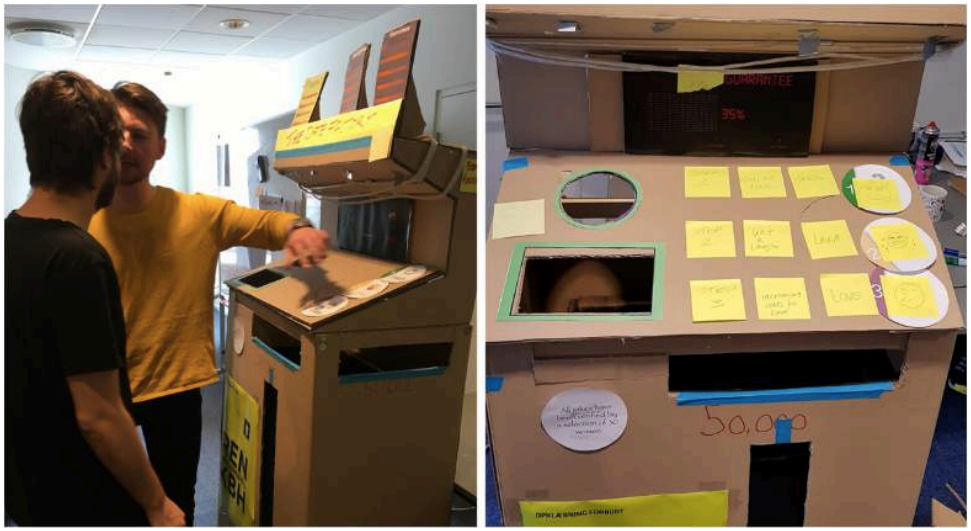


Figure 45. Game with focus on date guarantee. Source: Made by authors

Facilitating the negotiation

Two people a Mr Hyde and Hemingway gave us feedback and further co-designed the concept with us.



Picture 28. A Mr Hyde relatable persona, co-developing The Arcade concept. Source: Taken by authors

Synthesising

For a more visualised gathering of our findings, we have elected the Spider-web approach (Greif, 2014).

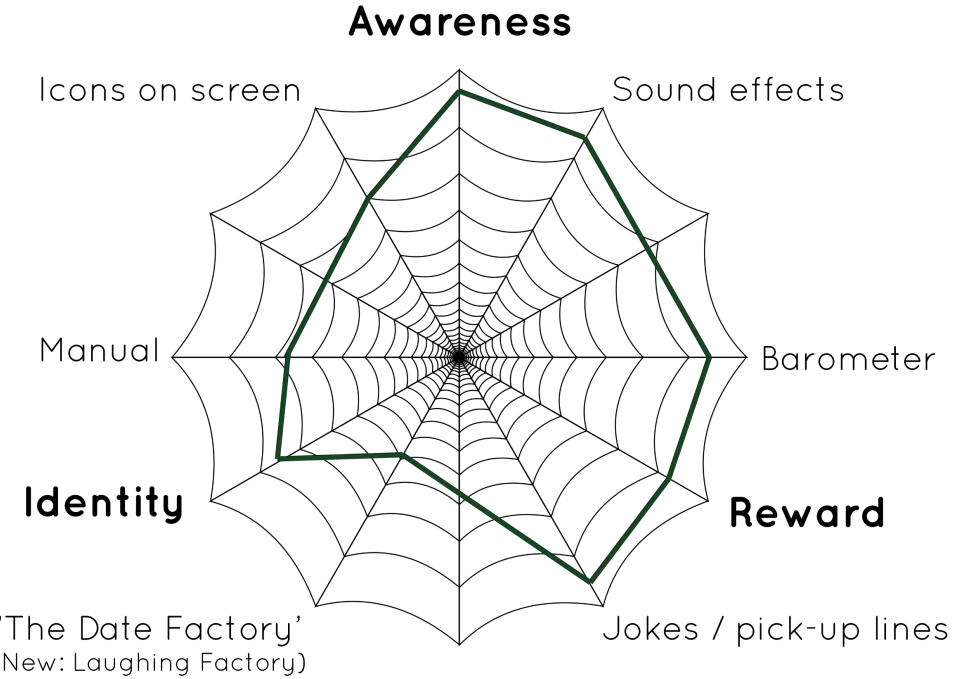


Figure 46. The result of the workshop. 'The Date Factory' replaced with 'The Laughing Factory'. Source: Taken by authors

Solutions for these challenges were in an interactive process designed for, and a new improved concept was born, *The Laughing Factory*.

MOCKUP #3 - THE LAUGHING FACTORY (SCALE 1:1)

Now that our concept had been further developed, a new contemporary negotiation space where the concept could be tested was staged.

Staging the negotiation space

Testing in an open area at Aalborg University CPH

The space was staged with a certain flexibility, so it allowed for multiple bypassers to interact with the mockup.

The location for this intervention was at AAU CPH in an open area, where a lot of people and different personalities are passing by and 'hanging-out'.

This time, the fidelity of the concept was of higher quality. We had attached sensors, sound and the digital screen to the prototype. We wanted to get an overall perspective of all the newly designed elements in a user context.

Facilitating the negotiation

In order to test the individuality of the concept, people were told to just interact with it without further explanation from us. We had placed small pieces of litter around the concept, so people had something to throw out.

Picture 29. Bypassers testing the new and improved concept, 'The Laughing Factory'. Source: Taken by authors

Synthesis

Findings to improve identity

- In general, people did not understand the correlation between step 2 and 3 (from 'get a laugh' to 'increase odds for love')
- The manual needed emphasising on the keyword to quickly identify the objective
- It could be event based / modular. So during CPH Pride, Kulturnatten (The night of culture) etc. the game could be adjusted accordingly together with the aspects of getting an ice-breaker and using it to generate love.

Findings to improve reward

- The jokes/pick-up lines can be a bit difficult to hear from the beginning.

Findings to improve awareness

- All the hole for throwing in the litter should have the same level of attention

Improvements

Identity

Brainstorming with people after their feedback leads to the conclusion, that instead of a laughing bin that provides jokes, it should be mentioned as ice-breakers. In that way, it ties

Reward

In order to make the jokes more clearly to hear from the beginning, a small noise should be added just before the joke itself starts, to make people aware.

Awareness

To create equal attention for all the holes in the bin, neon green colours should be added around all the holes to indicate 'throw your litter here'.

CO-CREATION WITH THE BLACKSMITH

Now that our concept had gone through multiple iterations of the different sub-elements, the next elements were to develop it in high fidelity, that was capable of being tested in Gothersgade. To further understand the feasibility of our concept, a blacksmith was enrolled in the project, where final elements were to be discussed.

Staging the negotiation space

In order to understand the feasibility of our concept, a pre-design meeting with the blacksmith that TMF usually use for development projects was staged. To negotiate the details of the concept, and appeal to his social world, a detailed drawing (see Appendix 18) of the final concept was sent to the blacksmith beforehand.

The negotiation space was staged at the blacksmith's office. To negotiate the matters of concern from both parts. Our 1:4 scale mockup was used to facilitate the dialogue.
The mock-up model worked very well as an intermediary object which transferred knowledge from our design thoughts to the blacksmiths more practical approach. The mock-up made it easy for him to see the purpose of the concept and come with suggestions to how it could be built.

Facilitating the negotiation

At the pre-design meeting, we also asked him what he thought of the design and what we needed to change, so it could become a sturdy prototype that could handle a test in Gothersgade. He used the drawings for creating a base for the prototype, where he only made do parts, for which the dimensions were certain.

Picture 30. Co-creation with the blacksmith with 1:4 scale mockup used to translate knowledge. Source: Taken by authors

Synthesis

The meeting with the blacksmith inherited more in-depth insight into his knowledge of the construction of the litter bin. One of our concerns was the durability of the material to choose, regarding the harsh environment in Gothersgade; intoxicated people, Littering, weather, etc. The blacksmith suggested we chose galvanized steel. A material that is easy to work with and which the blacksmith has a good experience.

With galvanized steel, it is easy to reinforce the frame of the litter bin without destroying the material too much. However, plastic deformation will occur in the bends which cures the material, but since the material extends, the surface is destroyed. In order to make the surface robust to corrosion, the blacksmith proposed to powder coat the litter bin so that it is susceptible to weather and other liquids in Gothersgade.
The meeting culminated in negotiations on a price for finding the litter bin, including materials and working hours. Together we agreed to hold two afternoons where, together with the blacksmith, we assembled the bin. It was an opportunity to incorporate and implement all electronic components in the bin.

Constructing the bin

We then agreed to meet up at his workshop for a "co-creation" day where we brought the electronics we had brought and our newly discovered findings, we had found through additional testing at the school. On the "co-creation" day we discussed how the prototype should be assembled, disassemble, how to service it, how much space we needed for electronics and how it could be produced. By meeting up with the blacksmith and finish the design together, challenges started to occur in producing the bin, for example, some bends were not able to be made, but because we designed with the blacksmith we were able to solve the challenges right away because he used his expertise and we used ours.

Picture 31 - Designing with the blacksmith. Soruce: Taken by authors

FINAL PROTOTYPE - THE ARCADE (SCALE 1:1)

After designing with the blacksmith, who provided us with his expert knowledge, we have our final prototype. We acknowledge that it is not the final solution, but it's a prototype of such quality, that it is ready to be tested over a longer period of time in Gothersgade.
3DFigure 47 summaries the end-result of all our iterations, observations, interviews, desk research, design games and workshops, The figure is followed by a table which unfolds all the design features, where they come from and where reference to supporting research can be found. Later, in this section, a user scenario of how the prototype works is introduced.

Figure 47. 3D model of our final concept. Source: Made by authors

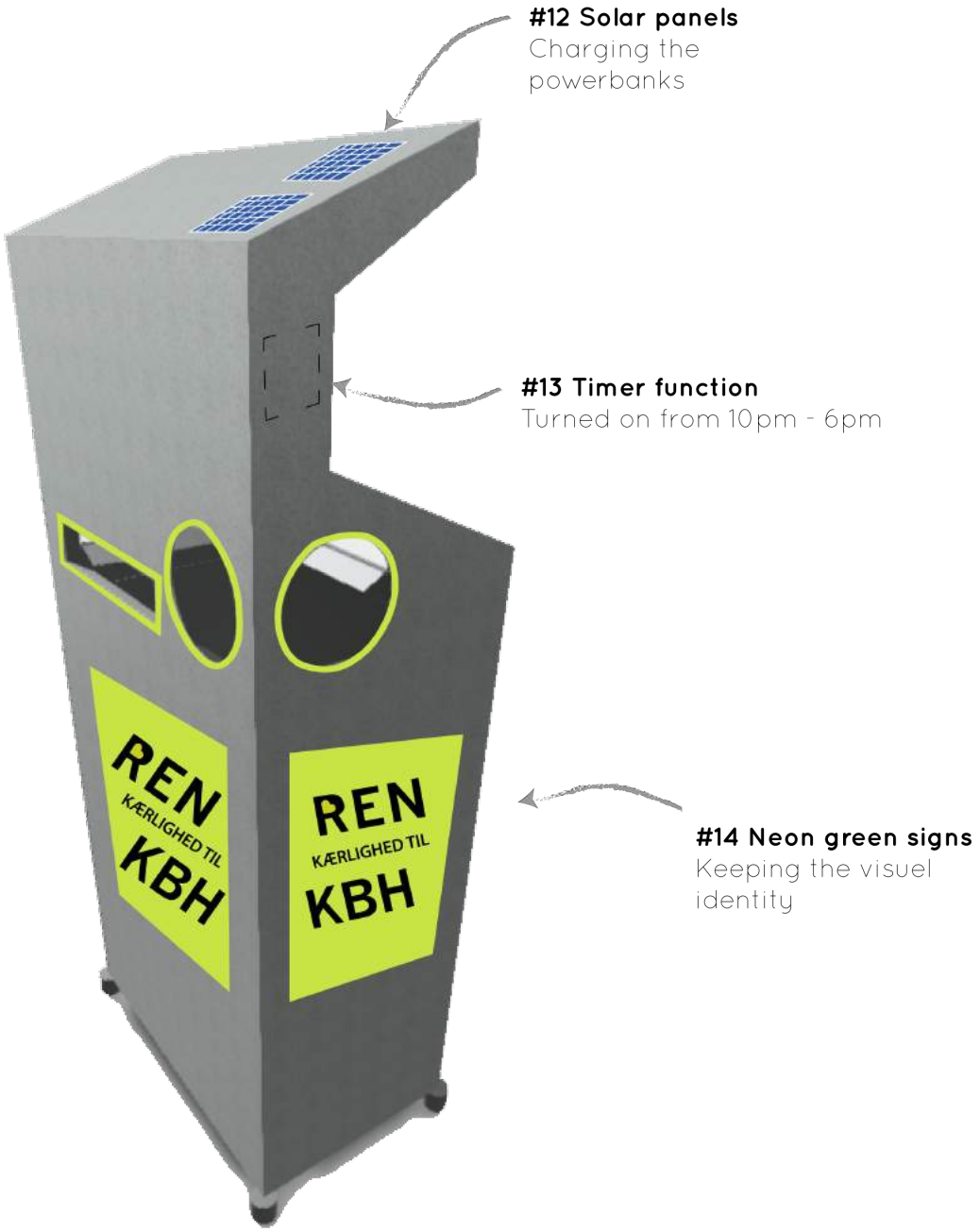


Figure 48. 3D model of our final concept. Source: Made by authors

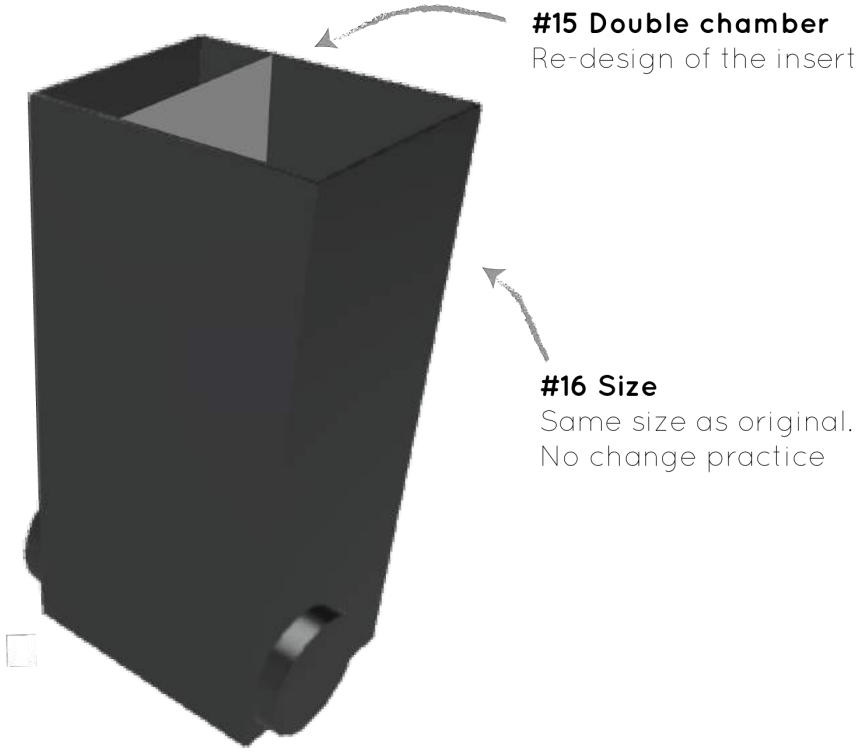


Figure 49. 3D model of our final concept. Source: Made by authors

THE SCRIPT OF THE ARCADE

Table 3 describes all the design features gathered throughout the design process.

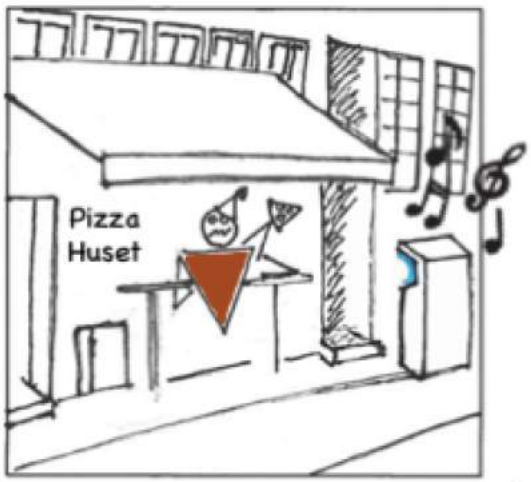
# of the design feature	Title of Design feature	Explanation of design feature	Reference to research	Direct reference (read more about the research that is behind the design Decision)
1	Sign	Provides the user with a simple "guide" that describes what the Arcade does.	The test of the mock-up #2 (PacMan) showed that the students were looking for a sign to inform them what kind of machine it is.	-Testing for uncertainties at Aalborg University CPH page 87
2	LED strips	LED strips programmed to show blue switching lights that are made for catching the users attention.	The test of rapid prototypes showed that blinking LED light is especially good at catching attention, because it breaks the streetscape, and many of the bars are showing a red and green light. Many users pointed out LED lights as a cool feature at the test of the Mock-up #2 - PacMan.	-Rapid prototype #2.4 (see appendix 10) -Rapid prototype #1.8 (see appendix 9) -Testing for uncertainties at Aalborg University CPH page 87
3	LED display	The LED display creates awareness by playing a programme that simulates a talking robot mouth. The mouth is lightening up the same time as the Arcade is "talking".	Rapid prototype test showed that the litter bin, must have some sort of identity, so the user can identify where the sound is coming from.	-Rapid prototype #2.1 (See appendix 10)
4	Manual	A piece of foil printed with a simple "manual" of how the game is played.	From the test of Mock-up #2 (Pac-Man), we discovered that the users are looking for some sort of game of how they play the game.	-Testing for uncertainties at Aalborg University CPH page 87

5	Throw-ins for pizza boxes	A rectangular throw-in that nudges people to throw their pizza boxes in. The purpose of sorting the pizza boxes is to get them to stack nicely, so the capacity of the insert will increase.	Observation from Gothersgade showed that the capacity in the inserts is limited, because pizza boxes stack up unevenly, because of other types of litter mixes in between. A lot of capacity is therefore lost.	-(Appendix 2 - Observation at Gothersgade 08-09/02 (Friday night) -The equipment used in the street page 32
6	Pizza stacking illustration	A piece of foil is attached to the front of the litter bin, showing a stacking of pizza boxes, to give the user a feeling of what is inside the litter bin.	The idea of a pizza stacking came from the co-creation workshop with DDUE, where one of the project managers suggested a stacking function, because they have noticed at earlier observations. That people nicely stack the pizza boxes next to the litter bin when it is full.	-Chp. 5 Co-creation of concepts page 69
7	Shaped as an arcade	The function of the arcade shape is to build awareness and affordance to something that is possible to interact with.	Rapid prototype test showed that the litter bin, needs some kind of identity, so the user is capable of identifying it and knows that it is something you can interact with.	-Rapid prototypes #2 (appendix 10) - Combining elements - Synthesising page 62
8	Approved icebreakers	Functions as a humour element, for those that want to explore the Arcade further.	The idea came from testing uncertainties at Aalborg University's Friday bar and was later approved by other users in the following workshops.	-Testing for uncertainties at Aalborg University CPH page 87
9	Neon green holes	The holes are made as a gamification element, where the user can try to insert different kinds of litter into the holes, to see what happens. The holes are neon green around, which is the same colour as the "REN Kærlighed til KBH" campaign and thus indicates litter.	The idea of a round and a squared hole, comes from the idea of making a gamification element.	-Testing for uncertainties at Aalborg University CPH page 87

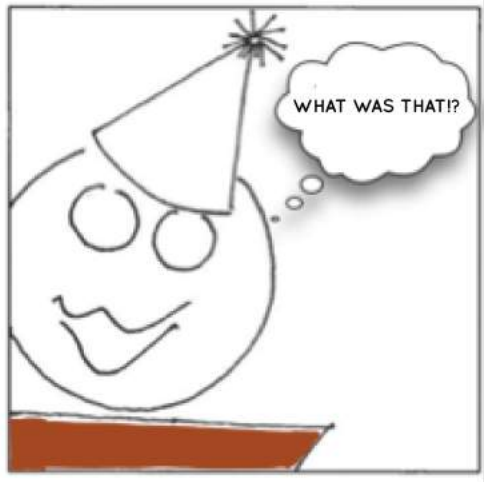
10	Sound	The Arcade is making is making soul-music sounds and providing instructions that play "hey you! give me some litter and I will tell you an Icebreaker" for awareness. As a reward, the Arcade plays an Icebreaker that the user can tell a friend.	Our Rapid prototype testing showed that jokes functioned very well as a reward and sound was also something the intoxicated people reacted to.	-Rapid prototype #2.1 (Appendix 10) -Co-creating with students page 90
11	Modular design	The whole front plate can be removed so the design can be changed. E.g. to a front plate with a design that is addressed towards the bar areas	The design feature will improve the lifespan of the Arcade and will thus improve the business case of the Arcade, but also the sustainability of it, as can be used for a longer time, by adding something new to the design.	-
11	Solar panels	The arcade is supplied with solar panels, to test if there is any chance that the arcade eventually will be self-sufficient.	It is a requirement from DDUE that the final implemented solution is self-sufficient, so the operators do not have to spend the time of switching batteries. Likewise, it is too expensive to connect the solution to the grid.	-MoM-3 - Notes from the Prioritising game
12	Timer function	The arcade is only turned on from 10 PM to 6 AM	The Co-creation workshop with DDUE revealed that the design and the look of the litter bin during the day are also very important. The design should not disturb the streetscape during the day.	-Co-creation of concepts page 62
13	Neon green signs	The neon green signs fit with the rest of "REN Kærlighed til KBH" campaign which people associate with litter bins.	The test of the mock-up #2 (PacMan) confirmed that the users were thinking of litter when they saw the Arcade, because they could recognise the "Ren Kærlighed til KBH" campaign.	-Testing for uncertainties at Aalborg University CPH page 87
14	Double chamber	The insert has been modified so it fits the pizza box solution introduced in #5.	-	-
15	Size	The insert has a larger volume than the inserts used today, but it can still be emptied with a regular garbage truck.	From playing the design game with the operation we learned, that a solution was more likely to be implemented in it worked with the existing practices.	-Synthesising: Findings from the the Gothers game with The Operation Department page 29

Table 3. Design features elaborated. Source: Made by authors

USER SCENARIO

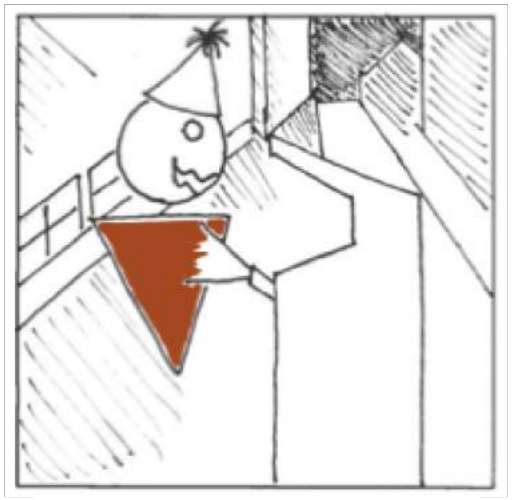


Mr Hyde eats pizza in front of Pizza Huset. Bin sings the Lion Sound to create awareness.



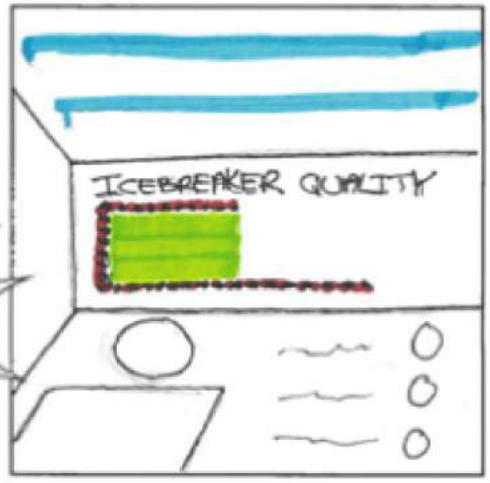
Mr Hyde gets curious about the sound, and then discovers the blue light at the bin.

The Arcade creates further awareness by telling Mr Hyde what to do, to get a reward.



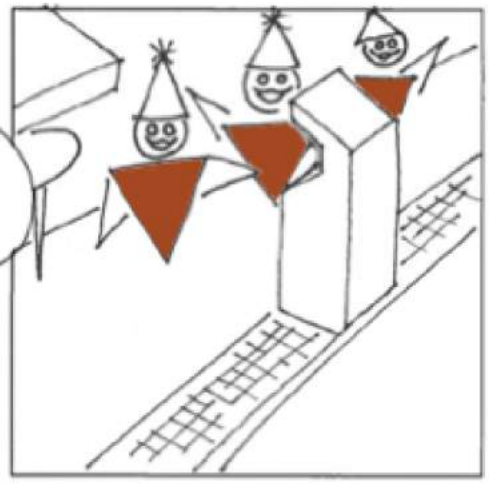
Mr Hyde finishes his pizza and throw the pizza box into the bin.

The Arcade gives an icebreaker as a reward.



The display indicated the quality of the icebreaker, and count down from 20 seconds.

Mr Hyde finds it hilarious, and call his friends.



Fellow Mr Hydes finds some litter to throw out.

Figure 50. User scenario. Source: made by authors

THE ELECTRONICS OF THE CONCEPT

The prototype includes quite a lot of electronics which needs to function, in order for the prototype the work. It has been quite a demanding task to code, program, solder and setup hardware throughout this project. We have also used our iteration approach throughout the project to develop and select the electronics needed to test the different concepts. Figure 51 is a screenshot of the representation of the electrical setup, that will be used in the prototype. The setup can be seen in full scale in Appendix 19. To make sure that the setup will have enough power for a test and to see how many solar panels are needed to charge the electronics, we have made calculations and test which can be seen in Appendix 20. The result of the calculations and test indicates that the electronics will consume approximately 13.000 mAh in an 8 hour test period. With the battery capacity, we have available within our given budget, the prototype can run for approximately two days before the prototype runs out of energy. The prototype is also equipped with solar panels, however, it is only for demonstration purposes and they are not capable of fully charging the batteries but can extend the time of the batteries. To determine the feasibility of a self-sufficient solution, it is calculated that the prototype needs 9 x 1,5 Watt solar panels, to be able to fully charge the batteries on a day with 8 hours of direct sunlight. This needs more testing, but it indicates, that with the selection of the right solar panels and energy-saving electronics a self-sufficient solution might be possible.

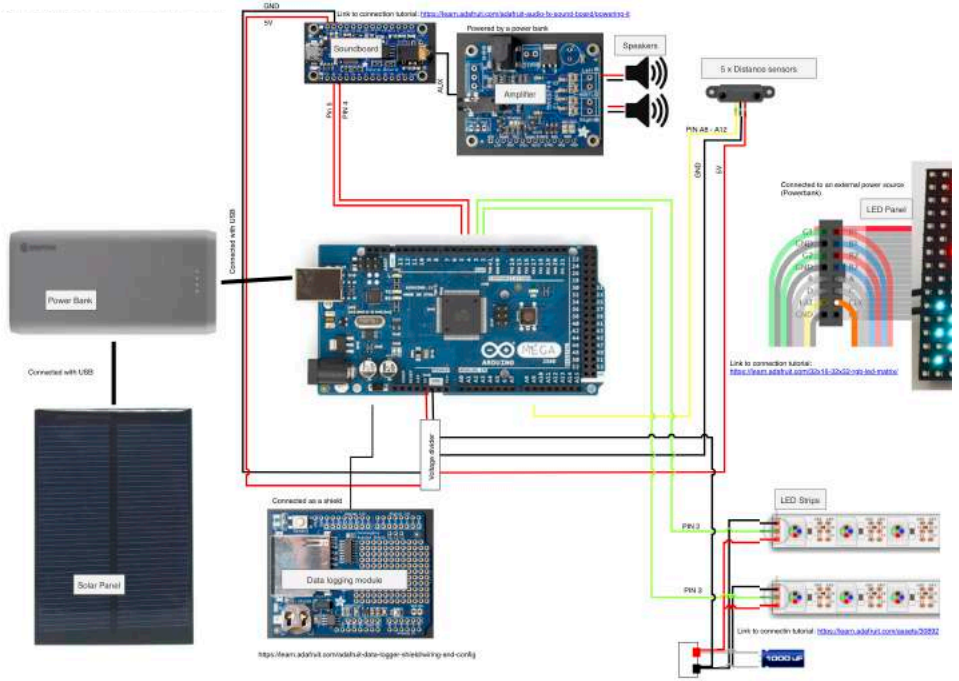


Figure 51. Overview of our electronics. See Appendix 18. Source: Made by authors

SUB-CONCLUSION - MULTIPLE ITERATIONS LEAD TO THE ARCADE

The prototype phase had contributed with a narrowing of the patent lines of the concept, the Arcade. The development of serval mockups gave us the opportunity to stage multiple iterations, where we found that the Pac-man and Space Invaders combined with a high score, where to complex for intoxicated people to understand. The concept was then co-developed in a gradually new negotiation space which leads to the result, that the Arcade as a reward should provide ***ice-breakers*** in relation to jokes. The 80's game icons were replaced with a ***three-step manual*** for how to operate, with inspiration from the ideation process facilitated in one of the negotiation spaces. Lastly, a blacksmith was enrolled through specific drawings and mockups, acting as intermediary objects. The purpose was to understand the feasibility of our concept in future development. This enrollment gave us the ***final adjustments*** to our concept, before going into production.
The inspiration from Design Thinking regarding testing and fail fast, has enabled us to adapt 'The Arcade' to the specific needs of our relevant actors in the environment of Gothersgade.

From this we state our new sub-research question;
Can the identity of ***an Arcade*** *with* ***light*** *and* ***sound*** *as awareness plus* ***icebreakers*** *as reward support the* ***desired change*** *of* ***littering behaviour*** *of* ***Mr Hyde****?*

CHAPTER

7 TEST

In this chapter we will describe how we plan to test our final prototype, 'The Arcade'. In order to accommodate if our solution **actually supports the desired change of littering from intoxicated people**, a test in the context of Gothersgade is crucial. Hence, we will elaborate on **when** and **how** we are going to test 'The Arcade'.

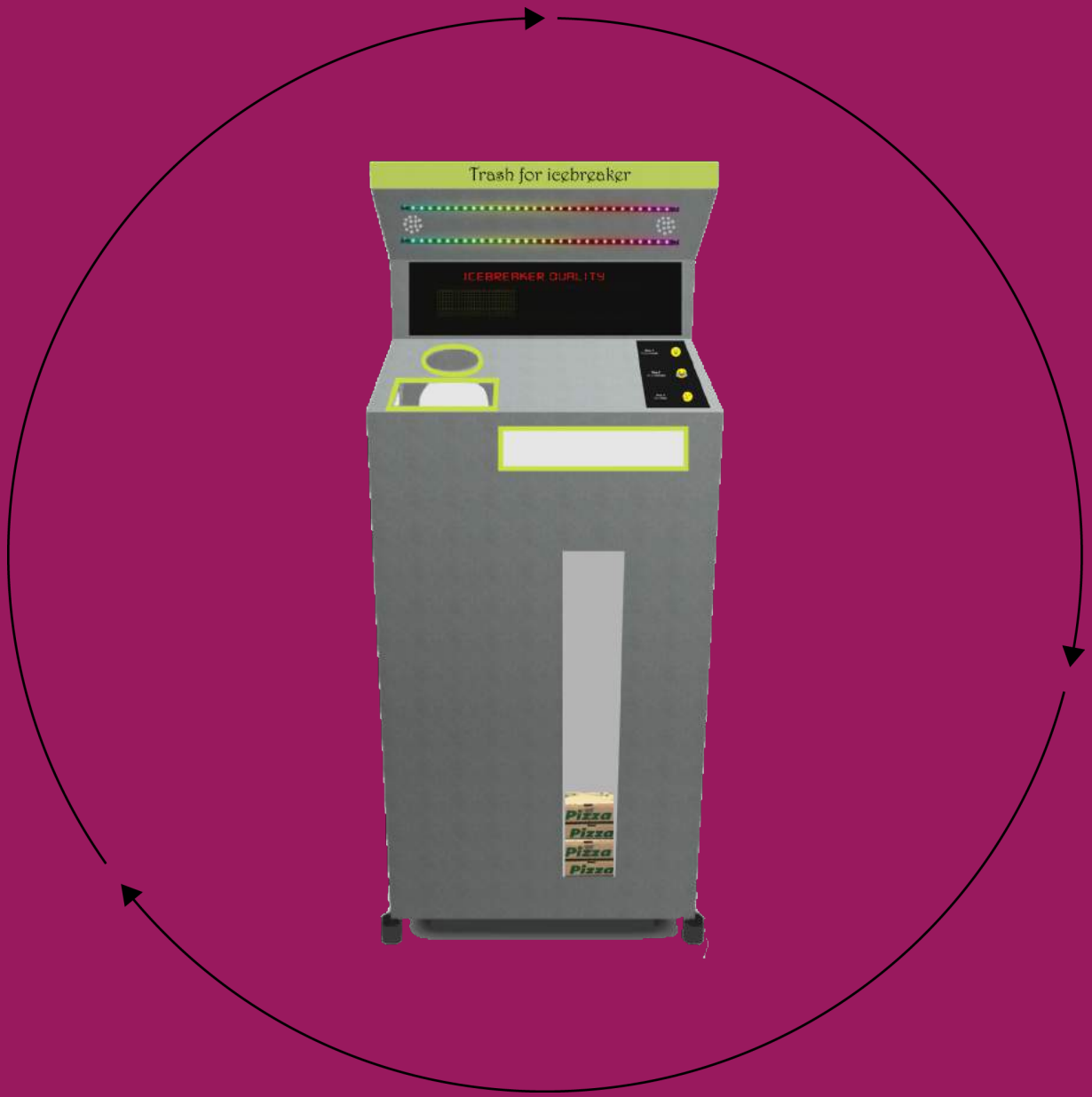


Figure 52. Illustrating multiple iteration of the final concept, The Arcade. Source: Made by authors

TESTING THE ARCADE

Purpose for testing

Even though 'The Arcade' has been developed through multiple iterations with relevant actors, there are still some questions which can really only be answered by placing the solution in Gothersgade over a longer period of time.

The overall question is;
Does our solution support the desired behavioural littering change of the Mr Hyde personas?

Sub-questions, to answer this are;

- Does it meet the requirements of our design specification?
    - If not, which adjustments have to be made?
- Does it actually function in the context of Gothersgade?
- Does the gamification elements work in the context of Gothersgade?
- Is the construction durable enough?
- Feedback from the operators; does it cause a change of practice?
- Feedback from local life; what is their opinion of it in practice?
- Feedback from DDUE; Is the solution acceptable according to a future implementation in the street of Gothersgade?

Through the use of a staging a flexible negotiation space, we will seek to provide an answer to these questions.

Test period

From all of our gathered material we know, that the weekdays allows for qualitative data. Meaning, that since there will be a lower flow of people, it will provide us the opportunity to stage a negotiation space, that allows for a deeper conversation with the users. The Arcade will also be tested during a weekend, which allows for quantitative data. Meaning, that due to a high flow of people, the solution will presumably interact with a lot more people.

The test will currently take place in 10 days of the period from July 13th - 23rd.

How we are going to test it

Based on our previous rapid prototype tests in Gothersgade, we use a variety of socio-technical methods such as; Observations and interviews. By using both methods which allows for conversation and observation, we will gain an understanding of its practice with no infiltration, where we will act as a natural part of the environment, and also more qualitative data. Furthermore, we will take pictures of the area around the prototype during test and around Tårnkurvene at the other popular pizza place (Pizza House) and afterwards compare the pictures to see if it makes a difference, but at the same time we are aware that many other factors can influence the pictures.

Furthermore, with the findings from rapid prototype test #1 & #2, we are wearing high yellow security vests during setup and interviews to demonstrate more authority.

Where we are going to test it

The selected locations for testing are spread over two different places;

- **Pizza Huset -** To test if the stacking of pizza boxes in the context of Gothersgade has the wanted effect and if the technical aspects thereof are working accordingly.
- **Ibiza Bar -** Afterwards, the solution will be moved to the front of Ibiza Bar, since we know, that this is one of the more popular hang-out places.

However, since the litter can have to be bolted to the ground, it requires specific staff from the DDUE to help us properly install and move it. Therefore, there is a possibility that the solution is only going to be tested in one of the selected places.

Figure 53. Test scenario in front of Pizza Huset. Source: Made by authors

Figure 54. Test scenario in front of Ibiza Bar. Source: Made by authors

CHAPTER

8

IMPLEMENT

This chapter describes the future strategy for what is needed for this litter bin to be implemented in the whole city. This project has been performed as a pre-project, where the main focus has been to see if it is possible to change the behaviour of intoxicated people in any way, there are a few requirements that the pre-project has to fulfil, before the DDUE, will take the project to the next step and test it on a larger scale. The implementation strategy, see figure 55, builds on experiences from previous projects and interviews with DDUE. It must also be stated that it is difficult to make a long term plan because the first step of the strategy must be completed before moving into the next step of the strategy. There is a very likely chance that the solution will not even overcome the first step and that DDUE shut the project down again, or it might fail in one of the other steps. E.g. if the solutions do not show any promising effect, there will be no upscale testing.

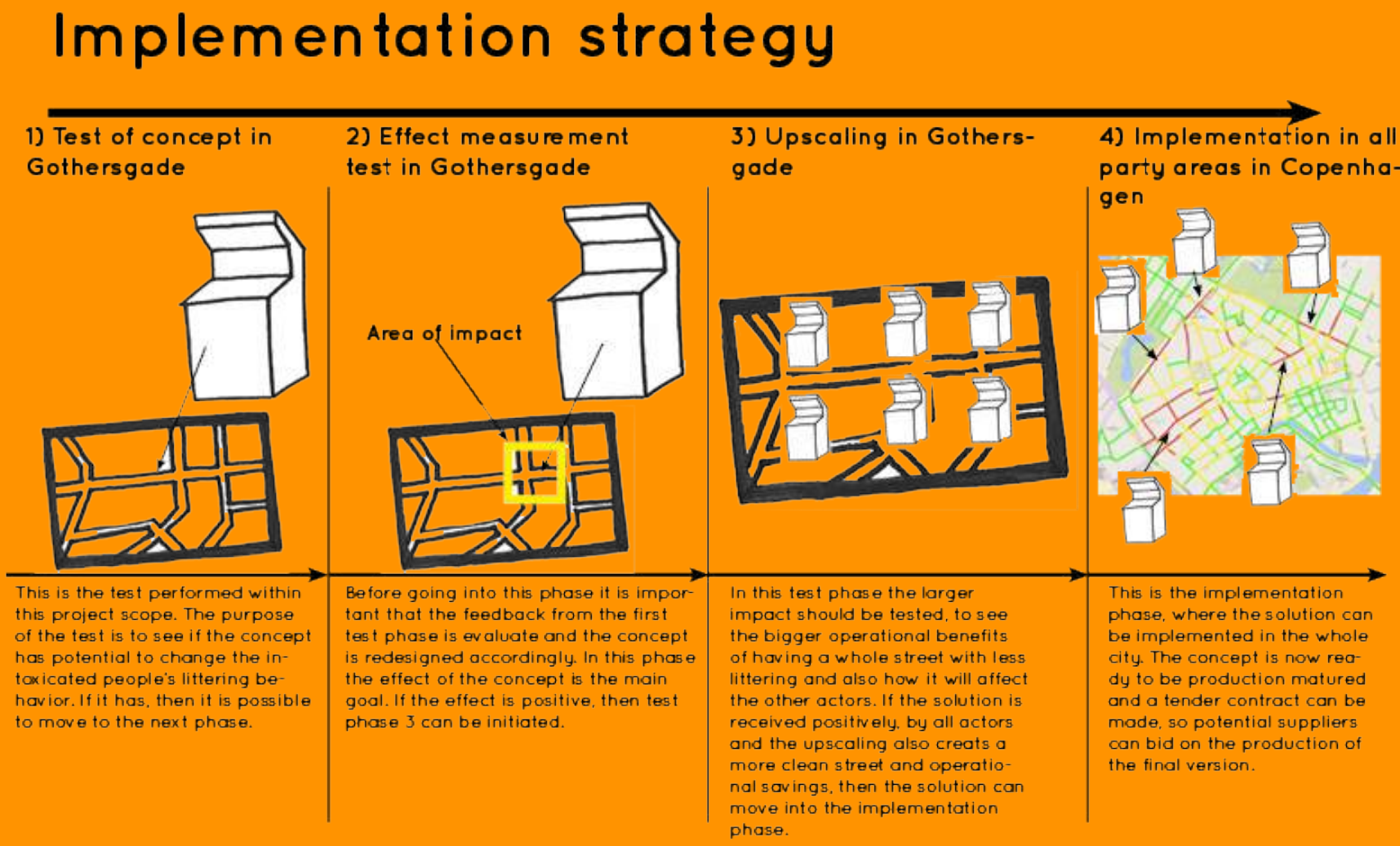


Figure 55. Summary of chapter 8, implement. Source: Made by authors

THE PRE-PROJECT (1 & 2)

This project is a part of a pre-project, where the goal is to see if there is any chance of changing intoxicated people littering behaviour. With the knowledge, we have about our concept and the intoxicated people ´s littering behaviour there is a chance that the litter bin might have a positive effect on the intoxicated people´s littering behaviour. However, the litter bin does also have some weaknesses, which will possibly also show in the test.
Both step 1 and 2 in the implementation strategy is included in the pre-project. Step 1 (our test) is already introduced in chapter 7. Step 2 is the measurement effect of the solution at it got its own step, because studying effect measurements from earlier projects, showed that many external factors influence the littering behaviour in Gothersgade. E.g. a sunny day will generate a lot more litter than a rainy day. It is, therefore, necessary to measure the effect of the litter bin through several weekends to get an average, then the measurements will be less dependent on single happenings in the street. The plan is to swap the prototype with an existing Tårnkurv.

The effect measurements should be performed as follows:

1. Mark a physical area around the existing Tårnkurv.

2. Make a baseline measurement through two weekends. Measure how much litter ends up in Tårnkurven and how much ends up in the marked area

3. Make the intervention (install the prototype). Measure through 2 weekends, how much litter that ends up in the prototype and how much ends up in the marked area.

4. Compare the results and calculate the improvement.

The more measurements that are made the more certain is the result, but these measurements require a lot of resources to make. The litter on the ground can only be counted, by being physically present in the street and count it. The litter in the bin can be counted with the sensors, however, to be certain that the sensors have no sources of error, such as people sticking their hand in to activate them, a physical counting of the litter inside the bin must also be made. As discussed in chapter 3, capacity also plays quite an important role in behaviour. To be sure that a full bin, does not interfere with the results, the litter bin should be emptied during the night, both during baseline test and intervention.

The economics of the solution

The economic impact of a new solution is quite important for the implementation. As one project manager state:

"*If we invest in something and scale it up, it has to make sense for the citizen's money. If it is cheaper for us to hire more employees to sweep the streets, we won't invest in your solution.*" - Project manager DG 1 (prioritising game - 6/3)

That quote states the importance of making a solution that makes the operation of the city more efficient. But, also the importance of quantifying the solution, so the politician knows if they are investing in something that makes the operation of the city cleaner or more expensive.

A guesstimate of the potential

We have not yet tested our litter bin and we do therefore not know the potential of it, however, a qualified guess will provide an indication of the potential, if the test in step 2 is successful. These numbers are based on a case scenario, so we know what the potential of the litter bin can be, and if it will have any economical benefits, if we have designed a well functioning litter bin that is able to change intoxicated people's behaviour.

The case scenario is a scenario where the clean team spend the same amount of time on cleaning the streets during the weekend as they do during the week, where there is a very limited amount of intoxicated people in Gothersgade.

The data collection from PUMA shows that it takes approximately 21 minutes to sweep the street during a day in the weekend and 10 minutes during a week-day. The time of emptying the litter bins is the same during the weekend and the weekdays.

The yearly cost of cleaning Gothersgade is 270.000DKK, not including the cost of NCC that cleans the pavements (Appendix 21).

The potential economic saving is calculated to be approximately 16.000DKK on sweeping. This includes some important assumptions that simplify the calculations (Appendix 21).

1

The cost of the prototype we have made is 25.000DKK. It is relatively high because it includes development cost. Based on statements from the blacksmith, we have worked with, and on Seismonaut's offer of a solution, which includes a similar amount of electronics, the estimate of the litter bin, when set in production, will have a cost price of approximately 15.000DKK. If all 8 Tårnkurve of Gothersgade is swapped with the Arcade, then the total price will be 120.000DKK. If the savings are related to the guesstimate (16.000DKK) the payback time of the investment will be 7,5 years, not including service and maintenance. Purely based on the above guesstimate, an investment in the Arcade is a poor investment.

However, relating the economical saving of the litter bin to sweeping alone is a huge simplification of the problem and many other factors play a role on the cost of cleaning Gothersgade because the street is merely a small part of the cleaning route for the garbage truck and the sweeping machine. Thus we need to dig a little further into how the litter bins and cleaning of the street affects the cleaning situation.

OTHER FACTORS THAT IMPACT THE CASE

The capacity problem

In the calculated example above we assumed unlimited capacity in the litter bins. This is of course not the case and we know from observations in the street that the litter bins do get full. If we are able to get more litter into the litter bin, it will require nightly emptyings, which will increase the cost of cleaning the street or a third solution that might arise from other actors in the street. At a Smart City Conference at Gate 21 (Gate 21, 2019), where the topic was IoT and litter handling, one of the project managers was a keynote speaker and presented our idea. In the presentation, he suggested that maybe, if this prototype had a good effect, it would also be possible to get the local businesses on board and get them to empty the litter bin through our the night.

The machines are a part of a bigger system

The machines do not only clean up Gothersgade but the whole city and when they get full they need to go back to Herjedalgade on Amager to get empty. The Garbage trucks can contain a lot more litter than the sweeping truck. We have not been able to get the numbers for the impact of having to drive fewer times to Herjedalgade, if less litter is collected in the sweeping machine, but due to the low volume, compared to the garbage trucks, it is more expensive to collect litter in the sweeping truck and there is a potential saving achieve, if we create a successful litter bin.

The difference in the cost of disposal of litter

There is a difference in the cost of disposal of litter from the sweeping machine and the garbage truck. Because the litter in the garbage truck has a higher quality than the litter in the sweeping machine it cost 43% less to dispose of. We do not have the numbers (in tonnes) for how much litter is collected in Gothersgade and we do therefore not know the economical potential of collecting more litter with the garbage truck, but during a year it can be quite a lot.

UPSCALING IN GOTHERSGADE (STEP 13)

To determine if it is possible to save money on these factors that are a part of a bigger system a large scale test is needed. By installing the new solution throughout Gothersgade, and testing it for maybe a year. It will be possible, through the PUMA system and sensors installed in the litter bins to get a more trustworthy picture of the actual time and cost saved on cleaning, but also the potential of less driving and saving money on disposal of litter.

IMPLEMENTATION IN ALL PARTY AREAS IN COPENHAGEN (STEP 4)

Finally, if the concept should pass the first three steps of the implementation strategy the prototype can be production matured and a contract tender can be made multiple suppliers can bid on the production of the new bin. Development from Tårnkurven and Pizzakurven shows that this will decrease the price of the bin and at this time, the concept should also have been through many iterations, where the best electronics have been selected, so a minimum of service and maintenance is required.

SUB-CONCLUSION - IMPLEMENTATION STRATEGY

Calculating the economic potential of implementing a new solution is not easy as it can be seen above in step 1, it is very difficult, if not impossible to get a grasp of the economical effects of implementing a new solution. However, making the streets cleaner is not only about saving money on the operation of the city. A clean city does also have wider effects on society as described in chapter 2 - The field. E.g. a clean city can create an increase in tourism, or decrease crime rates. Perhaps, it is still worth investing in a solution even though it does not provide an instant economical saving. The municipality will also have to invest in new solutions if they want 2/3rds of the citizens to experience the city as clean. However, that being said there is clearly a long way from our concept to final implementation in the city. It is very likely that the concept as we have developed it, will not be the one that is being implemented and we will, of course, encourage DDUE to keep iterating the prototype. So if a concept is implemented, it might be very different from what we have developed, because there are many tests to pass.

CHAPTER

9 CONCLUSION

This chapter describes the main findings that we have gathered through this master thesis. Followed by a reflection of the uncertainties, that has occurred in the process of developing The Arcade.

MAIN FINDINGS

Research question

How can we develop a litter bin that supports the desired change of littering behaviour of intoxicated people in Gothersgade?

The overall purpose of this project was to develop a litter bin that supports the Copenhagen Municipalities desired a change of litter behaviour, namely, getting intoxicated people to throw their litter into the bin instead of the ground.
This has been a challenging process, mainly because intoxicated people are using the reptile part of their brain. Meaning, that we had to appeal to specific emotional aspects of the people.

The conclusion of this master thesis project, we have developed a new type of improved litter bin aimed at intoxicated people in the party area of Gothersgade. This new littering bin has been developed by using Participatory Design, which allowed us to design *with* the users. We believe it has the potential to be the first, in a new generation of interactive litter bins through the use of gamification elements. Not primarily on the technical aspects, but on the aspects of using an interactive litter bin to change intoxicated people's litter behaviour, or at least create interest about litter, by making it a part of the party.

At the beginning of the project, a variety of ethnographic methods were used to understand the socio-technical arrangements and the problems related to littering in Gothersgade. This contributed to the exploring and empathetic understanding of actors' and objects' matters of concern, which resulted in an array of twelve thematics. Furthermore, we concluded that both DDUE and the Operation Department, together with the intoxicated people, are considered as important actors that have to be involved in a further co-designing process. The DDUE has control of the budget and is going to invest in the solution. The operation department has the power to oppose the solution if they do not like it.
Furthermore, it was discovered that intoxicated people cannot be categorised as one, but instead had to separate through the use of personas. The process leads to the definition of Mr Hyde as our main target group. Mr Hyde is characterised as a person that gets very emotional thinking when he becomes intoxicated. Even more, he has a decreasing intellect with tendencies of being aggressive. We, therefore, argue, that if we can design an adapted solution to his persona, the rest of the actors will be able to understand and use it as well.
Through gathered literature material we found, that to change the behaviour of this type of person, 'triggers' such as *sex*, *food* & *power* is of great importance. After staging and facilitating multiple negotiation spaces through the development and testing of rapid prototypes, we conclude, that a *reward*, *awareness* & *identity* have to be present to appeal to the Mr Hyde of the Copenhagen nightlife. Aspects such as *light* in the shades of blue placed in eye-sight, *sound* and elements of *gamification* seem to have the desired effect and feasibility in the context.
Through, the use of staging temporarily negotiation spaces and the implementation of intermediary objects, we have continuously iterated and further co-designed with a broad spectrum of actors such as; project managers of DDUE, The Operation Department, students, a blacksmith, intoxicated people and local businesses in Gothersgade. Multiple negotiation spaces were staged with the purpose of co-developing concepts with the selected actors. This resulted in a gradually more detailed and user-focused concept with the end result being a high-fidelity prototype name 'The Arcade'.

The Arcade is first and foremost a modular bin, which means that the top half can be customised for different types of events such as CPH Pride, Kulturnatten etc. This will also add a sustainability aspect of prolonging the lifespan of the bin, and continuously keep it motivating for the users to interact with since the gamification elements can be easily changed.

We conclude, that through our extensive research and choice of several iterations and staging of temporary negotiation spaces we have to build a comprehensive, holistic understanding of the field of study and actors within. This has enabled us to adapt 'The Arcade' to the specific needs of, firstly the Mr Hyde persona and other relevant actors in the environment of Gothersgade.
We have high hopes and faith that our solution will support the change of littering behaviour. This is based on the multiple iteration and co-creation process throughout the project. However, to actually conclude, if our solution will have the desired effect or not, requires further testing in the field of Gothersgade.

REFLECTIONS

In this section, we discuss the findings of the report and allow us to be self-critical of our project and discuss the impact we think this project will have. Furthermore, we will discuss what the project could also include and what will happen if the solution is scaled up, besides what is already introduced in the implementation section.

First, a short reflection of the design strategy we have used. A downside of the design method is that we have not been able to test the solution within the project period. After the project period, we will only be able to test the effect qualitatively, already introduced in Chapter 7. This means that we do not have the numbers of the effect of the solution, which means that the DDUE do not know if it is worth investing more resources in the project. However, using a human-centred design approaches, we have created multiple mock-ups and tested uncertainties before we send the final prototype to production, which has led us to make the right solution for our test. If we had kept a time schedule and tested the solution 1 month before project delivery, we would have tested the wrong concept, and the numbers of the effect would probably have been bad and not encouraged any investment.
The project has attempted to create a solution that can change intoxicated people's littering behaviour. The final result, if the Arcade actually can change anyone's litter behaviour, is yet to come. However, to discuss the broader impact of the solution if it gets implemented, this requires that we open up a discussion about what a change in behaviour really is. Starting this project, we were looking for literature that describes intoxicated peoples behaviour in relation to littering. The literature on this topic is very limited, and only a few articles have been produced on the topic such as the article describing

'types of drunk' (Winograd et al., 2016), which does not even relate to littering, but to intoxicated behaviour types. It was, therefore, necessary to look into the essential behaviour of the human brain, and primary literature from behaviourism was introduced (Pavlov & Thompson, 1902; Baum, 2017; Skinner, 1938). This literature mainly draws on experiments with animals, they argue that human behaviour is basically the same. In Pavlov's experiment with his dogs, he was able to create a long term change in behaviour, because he trained his dogs to expect food every time they heard the bell. Our goal was to make a litter bin that creates an instant change in litter behaviour which requires other methods, than Pavlov's training methods, because Gothersgade is a street with a high variation of people who visit the street. Here, our Design Thinking approach came in very handy, through rapid prototype testing we quickly discovered that if the intoxicated people never knew that they could get a reward, they would never throw anything out in the first place and thus, not get the reward. However, because the litter bin has a high level of awareness, which is created through light and sound, the user's attention is drawn towards the litter bin. This is very much in line with the theory of nudging, which states:

"*Nudges are ways of influencing choice without limiting the choice set or making alternatives appreciably more costly in terms of time, trouble, social sanctions, and so forth. They are called for because of flaws in individual decision-making, and they work by making use of those flaws*" - (Hausman & Welch, 2010)

Our research has shown that it is possible to get the attention from intoxicated people, by using "heavy" triggers, e.g. lights and sound, as simple green footsteps guide the user to the litter bin (a classic example of nudging) will not reach the reptile part of the brain. By making a litter bin with heavy triggers we have thus created a litter bin that is capable at changing short term litter behaviour, but because of the reward element, there might be an element of long term change in behaviour. Since the user gets a reward, he might also expect to get it the next time he sees a litter bin with lights on. Thus, it is very interesting to do more research on this topic, because a long term change in litter behaviour could have a positive impact on the nightlife in the cities. We, therefore, suggest further testing through a more extended period, to see what happens when the intoxicated people return to the street and identify the litter bin again. Will they use it right away? Or will they not care about it because they have already tried it?
A scale-up of our litter bin to other areas in the city of Copenhagen, according to DDUE in TMF, Havneparken at Islands Brygge is another one of their main concerns regarding littering in public;

"*There are 30 red containers with room for 600 litres of garbage in each which was half-filled. Still, used cardboard plates, plastic jars, cigarette lids and broken Dannebrog flags were everywhere else than in the big containers*" - (Mollerup, 2018)

Just like in Gothersgade, the visibility and availability of the litter bins are a high priority for TMF, so people can throw their litter in the bins. However, some of the people using Havneparken still seems to have an incorrect behaviour regarding littering. During summertime, Havneparken is generally used as a recreational area, and the primary reasons that attract people to the area are to meet with friends, organising a picnic or relax (Appendix - Report E ; KK, 2018a). The context of Havneparken, Islands Brygge is different from Gothersgade. Though our solution is designed to be a part of the party supporting the desired change in the behaviour of intoxicated people. It is designed to be flexible enough to change the interface(gamification concept). It would be relevant to test the solution in the context of Islands Brygge.

However, it is a priority before the test to explore the area of Islands Brygge to identify the flow of people using the area, as well as behaviourism and categorise the users in order to develop the interface of the bin that fits the users at Islands Brygge.

To take it to a even broader scale. If the solution is showing tremendous results and gets implemented over the whole city, how may that affect the operators' practices and the way the municipality maintains the city?
The Arcade is build to fit into the existing practices as much as possible. There are still a few challenges in regards to making it self-sufficient and getting it online. However, inserting this amount of electronics on a litter bin will require more maintenance and service. This is a type of service and maintenance the operation department is not used to do and thus requires a change in practices. That being said, TMF is already working with smart city solutions and have installed about 800 sensors in litter bins around the city (Gate21, 2019). Through our many talks with operators, we have talked with them about the newly installed sensors, and they do not like them, because they do not trust them, sometimes they get dirty and show the wrong results. Implementing our solution with a lot more electronics require more cooperation with the operation, to discuss how it can be maintained. It might also involve the hiring of new people that can take care of the software and hardware behind the solution and upgrade and modify the solution, so it fits with different events in the city, e.g. pride or culture night. This is expensive infrastructure behind the solution which we have not accounted for in this project and which is heavily depended on the results that are yet to come from the testing.

Furthermore, an upscaling of several litter bins with electronics is a contribution to a dark path of the use of more energy. As an article in the Danish newspaper called Ingeniøren states:

"*IoT has the potential to become the most energy consuming system globally, that mankind has ever created*" - (Hovgaard, 2019).

Seen from an environmental perspective and the municipality's dream of becoming CO2 neutral (KK, 2018d), means that the solution should only be implemented if it has the potential to save energy in other ways, e.g. contributes to less driving (garbage trucks) or litter of higher quality. These are issues we have not addressed in this report, but it requires further research to know the real impact of the developed solution.
A search on the internet for the cleanest city in the world will show cities such as Calgary in Canada and Singapore and the explanation is that they use huge fines, public humiliation and even prison or community service (Mourby, 2015). E.g. littering in Singapore will result in a fine of 1000 dollars, and a third-time violation will result in community service and if the violations are repeated the violator may be forced to wear a t-shirt that says "I'm a litter lout" (ibid.). Such laws do, of course, require law enforcement and tourist visiting Singapore are reporting stories of law officers whose sole job is to enforce the litter laws (Mourby, 2015). This is in contrast to Denmark, where littering also can result in a fine, but only 32 fines have been given since 2008 (Windström, 2014). If you visit Singapore, you won't find any chewing gum on the street either, that is because they have completely banned the import of chewing gum and if you are caught selling it, you can be fined up to 100 000 dollars (Benedictus, 2015). Since Singapore and Calgary is considered some of the cleanest cities in the world, bans and fines could be one way to achieve a clean city. However, in our opinion, we would prefer a more livable city, where you are gently pushed to making the right decisions even when you are intoxicated in Gothersgade.

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