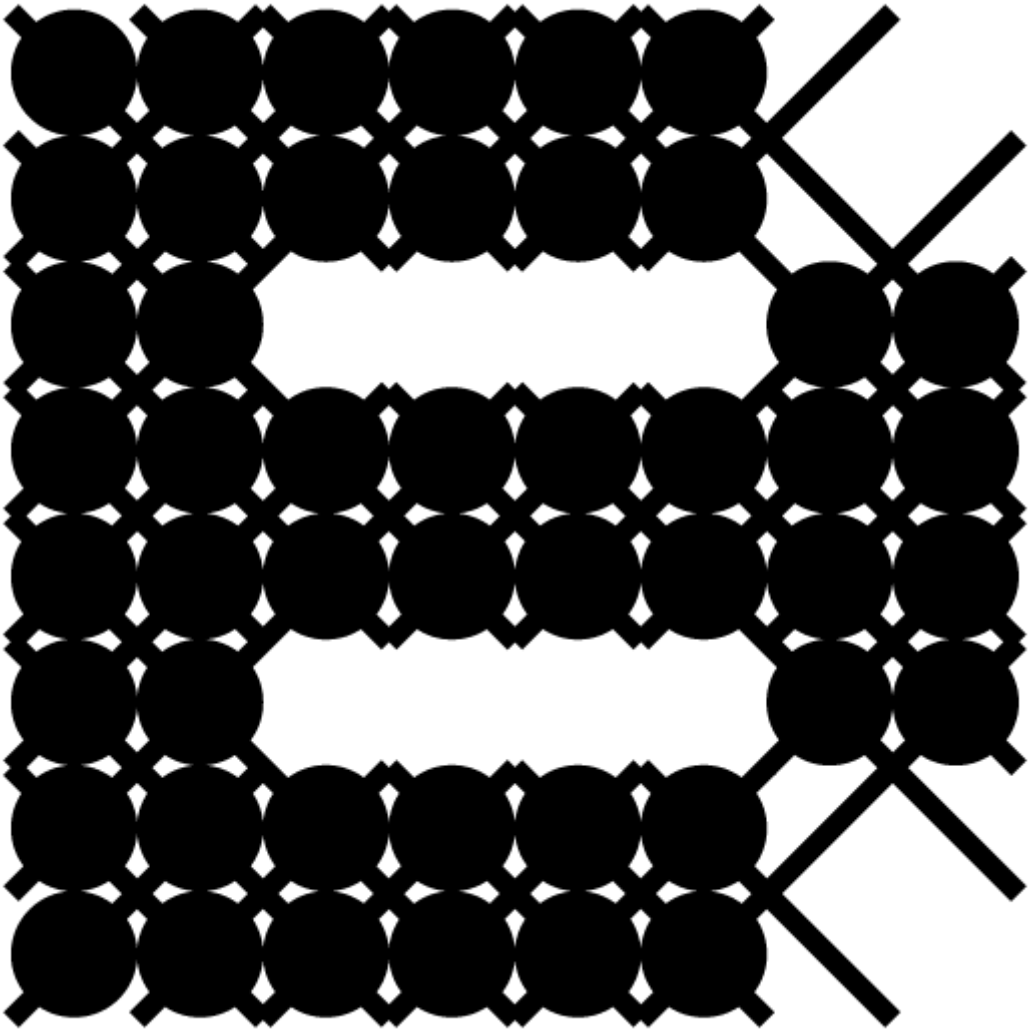
Binned Light

Preventing marine litter in Stockholm

R.19-02



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Preface

The report that you are about to read is the result of a creative and in some ways chaotic project, where students from different disciplines and universities worked with challenges that Stockholm, as a county and a city, is facing.

The city is our lab! - is the motto for Openlab. Students worked with challenges provided by Stockholm City and Stockholm Council in a wide range of areas. Within the framework of a 15 credits master-course, students worked in project-groups of 6-8 persons for one semester. To develop an understanding of the issue at hand, students engaged with the set challenges though the use of various research methods such interviews and observations, as well as literature studies. Students then developed a number of proposals for solutions, one of which has then been pursued to create a more concrete solution that is tested within real-world situations.

Whilst working together at Openlab, students from different disciplines met and interacted with each other – not always without complications.

However, in these meetings something new and exciting can emerge. Students carry with them experiences of interdisciplinary discussions and solutions - a very important competence for meeting the challenges of the future.

The result of all discussions, analysis, and synthesis's is here documented in the report. Of course the report can only cover some parts of this dynamic and creative process. We who have worked as teachers in this course have our main function as coaches, providing tools during different phases of the project. The students work according to a process model based on *Design Thinking* and *SCRUM*. Creative ideas and systematic thinking merge together to a final project.

For us this is learning at its best – Freedom, Creativity, Social interaction, Engagement and FUN! But it is also based on real challenges in society – the idea is that Openlab's project should contribute to a better Stockholm for its inhabitants. **The city is our lab!**

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The Openlab Master's Course Report Series

13:01
Hitta rätt i vården
Ett värdigt åldrande

13:02
Vårdombud och Vårdagram
Rätt bil i rätt ruta
Hem & Vision

14:01
Levande stadsrum
LivsLabbet
Alla kan falla

14:02
Spira
Södersken
Zon 164

15:01 (English)
Increasing Patient Involvement in the Healthcare System
Stockholm in Motion
Green Power of the Ecoflower

15:02 (English)
Grassroots Movements & Stockholms Stad: Bridging the Gap
BikeMeSTHLM
The Step-Up! Planning Tool

16:01 (English)
Inside out
Elderly people & warmth
EduAction

16:02 (English)
Jobbtorg
Helping Hearts
Inspiring the Youth of Husby

17:01 (English)
The process wheel
Childish solutions
MindTrip-Making nursing homes more like homes

17:02 (English)
Cykelbanan+
Finns I Sjön
Culturama
Stockholm Water Tap

18:01 (English)
The Dinner Dome
The Magic Button

18:02 (English)
Revival
SpiderWoman 2:0
Fireplace
Smart Square
DiContrast

Abstract in English

In this Openlab master course innovative solutions are created by using design thinking approach in multicultural and multidisciplinary groups. In our “Marine team”, we are students who come from different backgrounds to work together to solve the marine waste problem in Stockholm. Our challenge giver, Stockholm Vatten och Avfall, is responsible for marine waste management, and also, the “end-waste” management. During the project, there was also another municipal organization involved; The Office of Traffic and more specifically the department of urban environment and management, which is actually responsible for the waste management and garbage bins in the public areas in the city.

During the double-diamond design process, we first looked into the problem by learning about the context and facts related to it and also empathized with our challenge giver and end users to gain more personal and in-detail aspects to the challenge. Then, by using different tools we came up with five different solutions, of which we ended up choosing with both of our challenge givers, Stockholm Vatten och Avfall and the municipal Office of Traffic, two ideas to continue developing on.

Throughout using the method, tools, by testing and learning, we aimed as a team at creating a game-changing solution on the wicked and complex problem of marine waste. We chose the approach of preventing the waste ending up to the sea in the first place and to do so by developing the concept of garbage bins from the point of view of improving the end user experience and making waste management something positive and even rewarding. We believe that our interactive and attractive bins will provide an innovative solution against littering and thus, preventing marine waste.

Sammanfattning på svenska

Open lab-kursen möjliggör skapandet av kreativa lösningar genom att använda en dubbeldiamant-lösning inom multikulturella och multidisciplinära grupper. I vår “marina grupp” kommer vi från olika bakgrunder för att arbeta tillsammans mot det marina avfallsproblemet i Stockholm. Vår utmaningsgivare, Stockholm Vatten och Avfall är ansvariga för den marina avfallshanteringen, de är även ansvariga för den “slutliga” avfallshanteringen för hela staden. Projektet har emellertid involverat ännu en kommunal aktör; Trafikkontoret och avdelningen stadsmiljö och drift som även är ansvarig för avfallshanteringen och papperskorgar på offentliga platser i staden.

Under dubbeldiamantprocessen började vi med att fördjupa oss i problemet genom att lära oss om kontexten och fakta som är relaterade till ämnet, dessutom diskuterade vi tillsammans med uppdragsgivaren för att lära oss mer om detaljerade och i viss mån personliga aspekter av utmanignen. Genom att använda olika verktyg kom vi fram till fem olika lösningar som vi efter konsultation med Stockholm Vatten och Avfall samt Trafikkontoret avgränsade till två lösningar. Dessa två lösningar fortsatte vi att utveckla.

Genom att använda metoden och genom att testa och lära oss har vi som grupp siktat på att skapa en revolutionerande lösning på det komplexa problemet marint avfall. Vi valde tidigt en infallsvinkel på lösningar som inkluderar att förhindra att avfallet hamnar i vattendrag från första början. Detta gör vi genom att utveckla koncept på papperskorgar med utgångspunkten att förbättra upplevelsen för slutanvändaren samt att göra avfallshanteringen till något positivt och möjligen belönande. Vi tror att våra interaktiva och attraktiva papperskorgar kommer skapa en innovativ lösning mot nedskräpning och därigenom motverka marint avfall.

Table of Content

Introduction

We are a multicultural and multidisciplinary group of students and young professionals: Andrew, Carl, Elda, Jenni and Ronja. As a part of the course at Openlab we were given a task by Stockholm Vatten och Avfall under the name of “Marine Waste Management”. Notably we are students coming from diverse educational backgrounds, essentially not directly related to our project, we found it challenging to get out of our comfort zone and undertake new themes and material we were not familiar with. That is the reason why it was necessary for us to learn more about this broad topic that “waste” and more specifically “marine waste” is. We realised that we have a lot of experience with waste since we are in contact with trash every minute of our lives and yet it sounded foreign at first.

A lot of data has been collected in Sweden and the city of Stockholm, which is our main focus for the study. Essentially, it is known that an average Swede is generating about 470 kg of trash per capita and that at the beginning of the century this figure corresponded to 25-30 kg per capita. Needless to say, the country and the whole world has gotten through enormous changes during this period, but the exponential increase of waste in our households is a trend that will probably continue in the future too (Avfall Sverige, 2019).

However, trash is not only generated in households. Waste in Stockholm is found on the streets, squares, parks and on the beaches, too. In such high-density cities, there are usually 4 to 6 pieces of trash every 10 m2, of these most is cigarette butts 67%, pouches/small bags 11%, paper 7% and plastic 7%. Last but not least, litter is found in the oceans and seas, where most of it is plastic, about 150 million tons, raising with 5-13 tons per year floating litter islands as the famous Great Pacific Garbage Patch and in the bottom of the seas (Havs- och Vattenmyndigheten, 2019).

Different types of plastic, followed by materials like wood, metal and glass are mostly transported by water streams, sewage systems and wind, into the water. Essentially, in Sweden, 92% of storm water is usually untreated and ends up in the lakes, seas or the soil (Swedish EPA, 2017c). In the Baltic sea, according to Havs- och Vattenmyndigheten they found out that there was 75 pieces of trash/100 m. (Havs- och Vattenmyndigheten, 2019). According to Håll Sverige Rent about 240 pieces of trash was found both in rural beaches as well as urban beaches facing the Baltic sea every 100 meters, most of it was plastic 73% (icecream, candy bags, fast food packages, plastic bags, plastic cutlery amongst others) (Håll Sverige Rent, 2019).

The amount of existing data can make it possible for society to take action and work preventively to find long term solutions in order to prevent, reuse and when not possible reduce and recycle waste while avoiding it getting into seas and oceans. Notably, this is the aim in this course with our challenge: How to reduce marine waste in the city of Stockholm in an innovative and game changing manner, by using the design thinking method.

The challenge and the challenge giver

Our challenge giver Stockholm Vatten och Avfall is a municipality-owned non-profit water and waste company in Stockholm. It is the largest company in Sweden of its kind. One of the company's aim is to provide drinking water and treat the wastewater in the city of Stockholm and in the municipality of Huddinge. The company is also responsible for municipal waste management in the city of Stockholm. In the waste management plan for Stockholm 2017-2020, it is stated that "The occurrence of litter in the marine environment is to be reduced" (Stockholm Vatten och avfall, 2019). The company also states that littering, both marine, and land-based, is a shared responsibility between many actors in the city. Lastly, Stockholm Vatten och Avfall has a mission from the city to initiate collaboration on marine littering.

This is where OpenLab and our group of students become initiated to the challenge. The challenge that has been given to us is to help the city reduce marine littering. From here, there were many options and paths to choose between since the subject is broad. The reason for marine littering is that trash travels from the land through streams and wind into the oceans. Upwards of 80 % of the trash found in oceans comes from land-based activities so we decided to focus on this.

Further, we had to choose if we were going to focus on companies, households or people in public spaces. After a quick scan of the situation, we found that the waste management for households was relatively well managed and well operated. We also found out that regulations towards companies are relatively tough in Sweden concerning waste management. However, we found a gap in the perspective of people in public and littering. After some investigation, we found that there is work to be done about people in public spaces and littering.

A crucial part of our research was to understand how the littering ends up into the sea. We tried to track down the journey of the litter from the moment it is created until it ends up in the water. It starts with humans. The moment we unwrap a product or light a cigarette we become a potential danger for adding litter to our environment. In today's consumerism spread societies flicking the cigartte buts and throwing any kind of waste into the ground due to inconvenience to find the nearest bin has almost become socially accepted. At this moment, nature takes over. Urban water from rain washes the streets to storm drains, rivers and waterways that serve as the perfect mode of transport and sea water splashes the shores to end up into the intoxicated microplastic, food poisoning and endangerment of waterworld. And as rule of karma works at its best we end up having these food on our table endangering ourselves.

Part 1

Empathize

To ensure that we had a better understanding of the task and the magnitude of the problem, we decided to undertake several approaches at this stage.

Interviews/Questions

Interviews provide a better understanding of the position or feeling of the stakeholder towards the problem. Essentially, as we had decided to focus on preventing littering in public spaces, we chose to undertake interview sessions with different people in Stockholm.

The interviewee was mainly posed with two questions:

- Why do you think that people litter in public places?
- What do you think should be done to solve that?

Additionally, we had also visited the challenge giver where we engaged in a conversation to clearly understand the problem.

Picture 1.

Research and Analysis

Research and analysis of the publicly available information from different sources enabled us to understand the task. Notably, extensive research has been undertaken by different organisations on marine waste management. However, some of the information is not available to the public.

Picture 2.

Observations

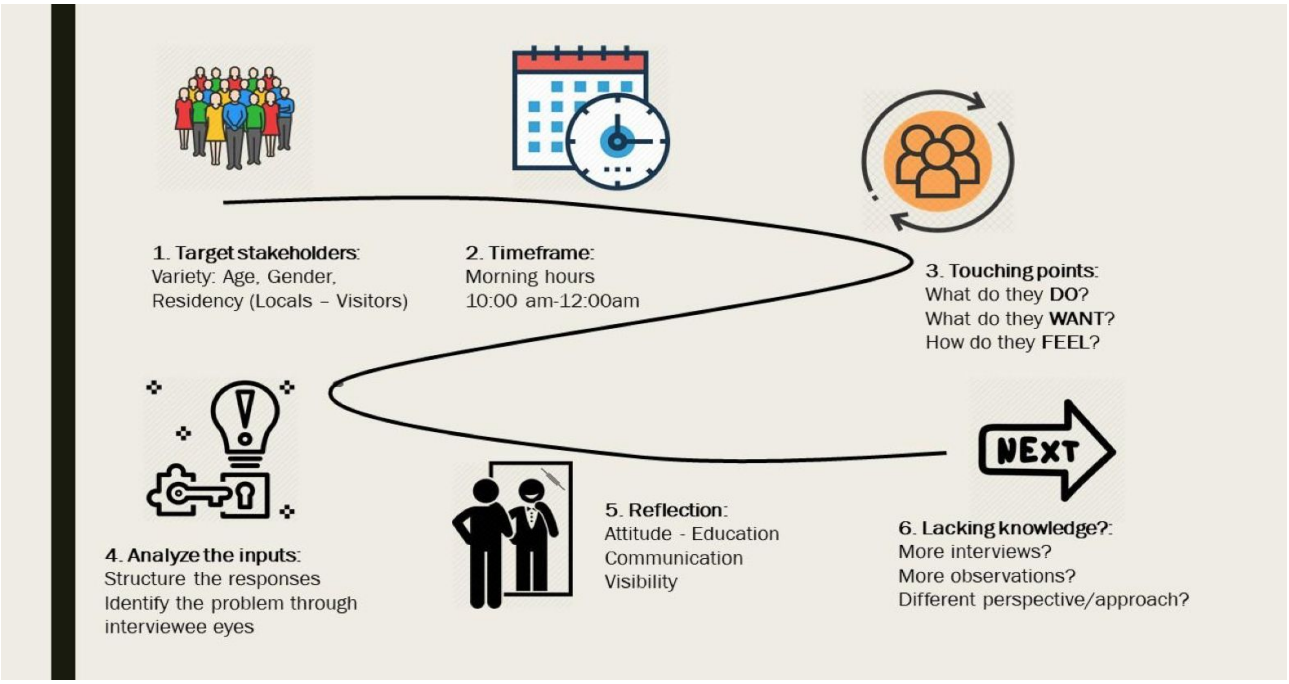
Observations provide insights on the behavior of people and the environment. Notably, observing people provided unbiased inferences on their motivation towards solving or reducing the problem. Further, this also added more knowledge to the already gathered knowledge by the other approaches.

Picture 3.

Insights related to the personas

In order to “walk in the user's shoes” we designed our step-by-step journey map. This helped us through the process of synthesizing the needs and insights that we obtained during the empathy stage.

Presented with the challenge and research done so far, our next question was “Who is our user/persona, the one that litters, the one that is affected by littering and how they litter?”.

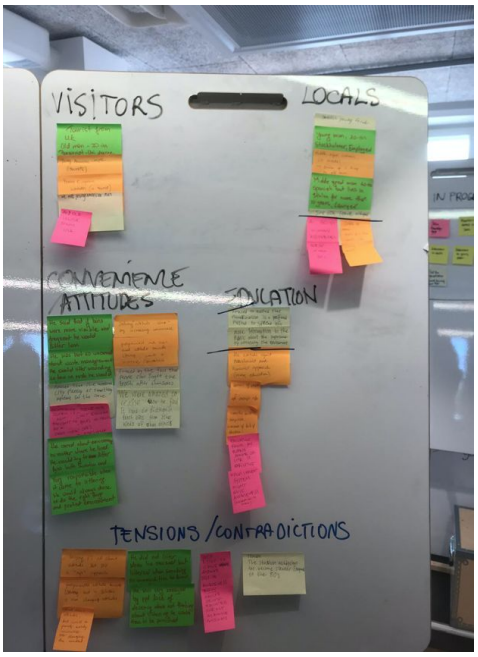


Picture 4.

We focused on an all-inclusive approach to target our stakeholders with the motto “Everyone can litter”, including factors like age, location, gender, culture, education, background. We performed interviews with a focus on identifying touchpoints where the users interacted with the problem of littering. Evoking stories referring to third personas we tried to explore emotions, observe attitudes and get their statements regarding why the littering problem occurs, what can be done to improve the situation and how would they behave when presented with the issue.

Our journey touchpoints, focused on highlighting the current problematic situation, aimed to help us understand the experience from the user's eyes, identify their needs and design an actionable problem statement. After our first data collection, interviewees responses we tried to infer from the insights by categorizing the responses according to:

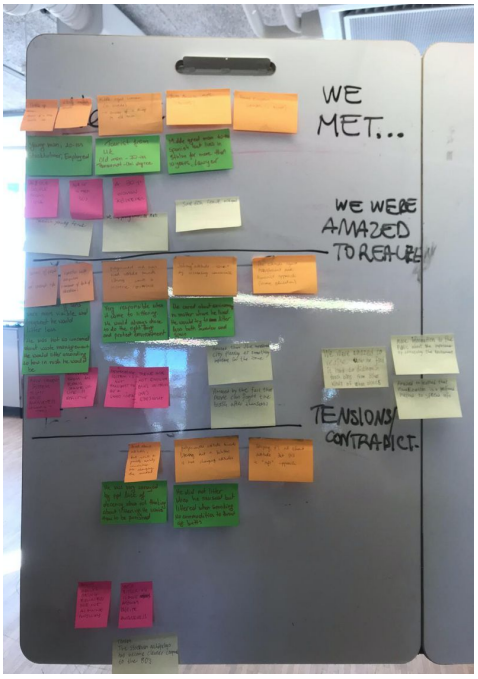
- Who we met…
- We were amazed to realize…
- It would be game-changing to…



Picture 5.

By organizing the information in this structure, we were able to create points of view in order to harmonize the three elements of our point of view (POV): user, needs, and insights. What do they mean?

1. Is communication of littering problem too old school? Should it be more interactive and stimulating?
2. Should the bins be more visible/attractive? Are they suitably designed for waste of all types/sizes, eg. cigarette butts?
3. Is the control by authorities effective enough to discourage littering?
4. Does waste size affect the attitude towards littering?



Picture 6.

In accordance with the outcomes of our discussion based on the insight provided we chose to extract three personas out of all our interviewees based on their different attitudes and insights towards littering like the design of the bins, communication and waste size matters.

Value system

In parallel of this design thinking work, we analyzed the value system of Swedish society in order to ideate later contextualized solutions. The value system is here defined as "the system of established values, norms, or goals existing in a society" (Merriam Webster, 2019). Indeed, we believe that if we get a clear image of the dominant values in a given society, it will help us to find contextualized solutions that will be embraced by the whole society.

Our group analyzed some situations and repetitive behavior which helped us to understand the Swedish main values. As mentioned in the introduction, our different personal and educational backgrounds but also our different time in Sweden gave us plural experiences and feelings of the Swedish society. We identified three main values reflecting today's Swedish society according to our perceptions:

- The need to be within the collective and share experiences: The ability to meet people through groups that have been predefined (like in organizations). This specific context to exchange with other Swedes and share experiences help them to develop their ability to share with other specific experiences within the collective with a defined framework.

- The social pressure on the fact of being deviant: We all observe that Swedes have to erase themselves to the profit of the collective and to keep the established order. This notion is accompanied by the fact to blame easily people for not being part of this common story. However, punishing is not necessarily an option that accompanies this blame. Indeed, the social pressure is high enough that people change themselves in order to still be part of this system.

- A natural sensitization to the environment: The vast Swedish landscape and the fact that nature is covering a major part of the country has helped to root that sensibility. With a profound history linked to farming, it led to having a sense of respect for nature. The 'right to nature' called allemansrätten helped to institutionalize this notion.

These three views aided us to analyze the data and generate new solutions.

Interviews and Personas

In order to get a broader image of what people think and do about littering, we made interviews. As previously explained, during our empathized phase we did 15 interviews with different kinds of people, since we deduced the fact that everyone can be a litterer after our own experience. We came up with lots of interesting outcomes. They helped us to later define our point of view on the challenge that has been given to our team early September. We posed two main questions and one optional question during our interview:

- Why do you think people litter in public places?

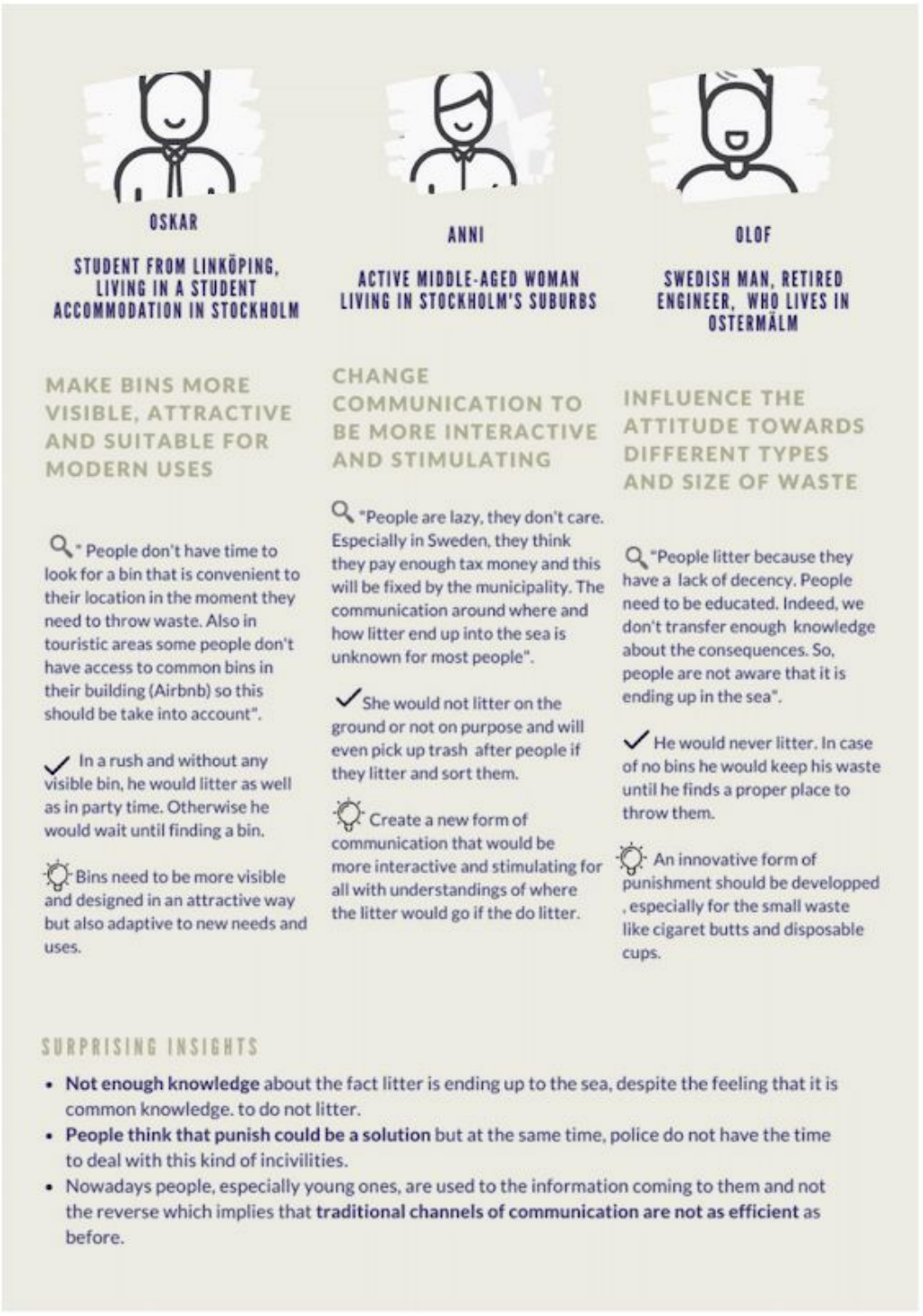
- What do you think should be done to solve that?

As identified with the value system analysis the Swedish society has quite a high value on the success within the society which is accompanied by a form of social pressure. Since we did not want to feel the interviewee attacked by our questions and his/her potential shaming regarding the question of being a litterer we decided to shape our question differently. The first question projects the interviewee to an exterior point of view which enables them to not feel persecuted on this topic but more on a global level and their observations regarding this topic.

The second question was related to the value of sharing a collective and common history. Indeed, this question is linked with the fact that what is needed at the collective level to change in order to see a real global shift toward the issue of littering. Also, by enabling the interviewees to develop their point of view on concrete solutions was different regarding their own experiences. This was rich in outcome since the everyday life of the interviewee was very different and helped us to develop a wide scope of littering situations.

After we collected the data we developed three main personas that are representative of three trends after analyzing the data. We decided not to include tourists as personas for two reasons. Firstly, they were not really talkative and not really keen to develop their answer maybe because they were not comfortable to be interrogated during their travel. Also, we believe that if a solution has to be found and change profoundly littering should be firstly accepted by the Swedish society. Indeed, if Swedes develop a sense of belonging to this solution that is in accordance with their values, this would develop real leverage to change.

We developed three personas that are representative of our main outcomes. The first persona is Oskar, a teenager that recently moved to Stockholm to study. The second is Anna a middle-aged woman who is working downtown but living in suburban areas. Finally, Olof is a retired engineer living in Ostermälm. Coming from three different socio-economic backgrounds, they all agree on the fact that people are littering but for different reasons. Notably, there were some contradictions that were found, for instance, the fact that they agree that littering is bad but they do not understand the consequences of cigarette butts washed down to drainage inlets.


OSKAR
STUDENT FROM LINKÖPING, LIVING IN A STUDENT ACCOMMODATION IN STOCKHOLM
MAKE BINS MORE VISIBLE, ATTRACTIVE AND SUITABLE FOR MODERN USES
" People don't have time to look for a bin that is convenient to their location in the moment they need to throw waste. Also in touristic areas some people don't have access to common bins in their building (Airbnb) so this should be take into account".
In a rush and without any visible bin, he would litter as well as in party time. Otherwise he would wait until finding a bin.
Bins need to be more visible and designed in an attractive way but also adaptive to new needs and uses.
ANNI
ACTIVE MIDDLE-AGED WOMAN LIVING IN STOCKHOLM'S SUBURBS
CHANGE COMMUNICATION TO BE MORE INTERACTIVE AND STIMULATING
"People are lazy, they don't care. Especially in Sweden, they think they pay enough tax money and this will be fixed by the municipality. The communication around where and how litter end up into the sea is unknown for most people".
She would not litter on the ground or not on purpose and will even pick up trash after people if they litter and sort them.
Create a new form of communication that would be more interactive and stimulating for all with understandings of where the litter would go if the do litter.
OLOF
SWEDISH MAN, RETIRED ENGINEER, WHO LIVES IN OSTERMÄLM
INFLUENCE THE ATTITUDE TOWARDS DIFFERENT TYPES AND SIZE OF WASTE
"People litter because they have a lack of decency. People need to be educated. Indeed, we don't transfer enough knowledge about the consequences. So, people are not aware that it is ending up in the sea".
He would never litter. In case of no bins he would keep his waste until he finds a proper place to throw them.
An innovative form of punishment should be developped , especially for the small waste like cigaret butts and disposable cups.
SURPRISING INSIGHTS
Not enough knowledge about the fact litter is ending up to the sea, despite the feeling that it is common knowledge. to do not litter.
People think that punish could be a solution but at the same time, police do not have the time to deal with this kind of incivilities.
Nowadays people, especially young ones, are used to the information coming to them and not the reverse which implies that traditional channels of communication are not as efficient as before.

Picture 7.

Re-defined challenge and POV

After gathering broad knowledge and insight on the challenge through empirical data and new personas, it was time to continue re-defining our POV. Based on the data and the interviews, we had created three diverse personas. Each persona represents a different Point of View, that was recognized from the empirical data. The re-defined POVs are:

- *How can we use innovative bin design to influence the attitude towards proper waste disposal?*

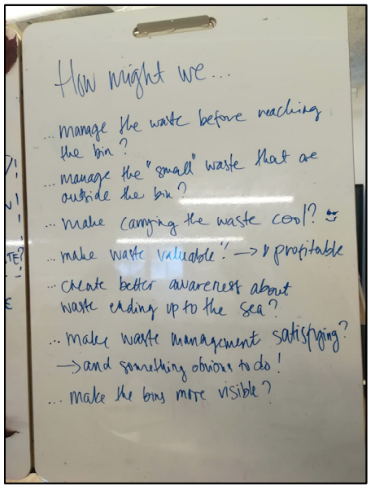
- *How can we change the communication to be more interactive and stimulating to influence the attitude towards different types of waste and littering?*

Once the POVs were re-defined, we continued into Ideation-phase. In the Ideation-phase, we took a "*step back"* from our work so far, and broke our re-defined POVs into more detailed and specific "*How might we..*" -questions. These "*How might we..*" -sentences generated lots of new ideas and when they were written into post-it -notes, we could perceive four new categories within our re-defined POVs, which all included certain themes.

These categories were:

- Bins (visibility, recycling/sorting, attractive, interactive)
- Carrying waste (product concept, attractive carrying design, convenience)
- Collaboration (circular economy, inclusivity, brands for visibility, influencers)
- Communication (increasing awareness, coordinated communication, using influencers and brands, attractive to different target groups, shame vs. success and proudness, education to different target groups)

When replacing the categories with themes into "WOW-HOW-NOW" -chart, we realized through "Superhero"- and "Dark horse" -exercises, that we had some very exciting new ideas for solutions.



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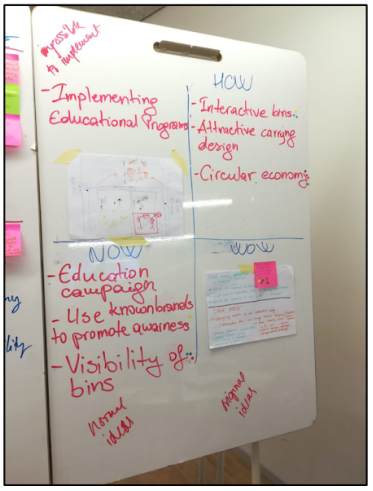

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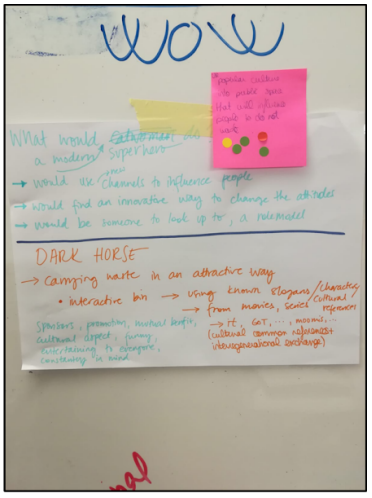


Picture 10.

New Solutions

The new solutions are based on the idea of increasing the attractiveness of everyday waste management, but they use different approaches.

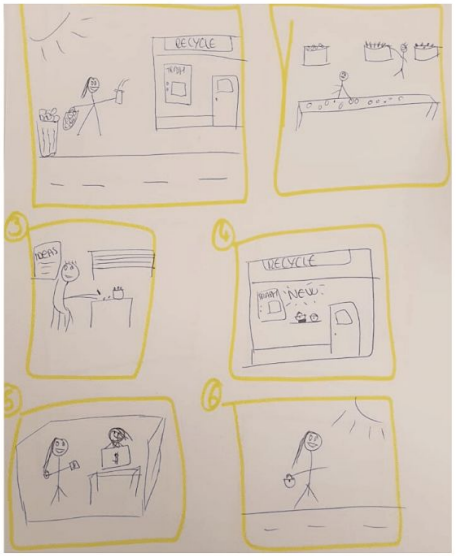
Solution 1: Carry away trash -product

Creating a product, in which carrying the litter before reaching the garbage bin is not only convenient and practical but actually “cool” and even preferred. When using this product the user is demonstrating openly being environmentally aware and trendy.

Picture 11.

Solution 2: Circular economy

In modern society recycling materials in product creation and production is more than a trend - it has gained almost a position of a standard. Nonetheless, establishing socially and society-wise not only responsible but also in long-term sustainable solutions is something, that makes the solution one-of-a-kind. By creating a new product collection made out of marine waste material, the city creates new vacancies to the whole life cycle of the products, which can be considered hiring in the first instance groups, that are in a weaker position in the job market. Also, around the production - from designing to selling - can be related cafes for meeting places to everyone and to enhance and support the community spirit within Stockholm.



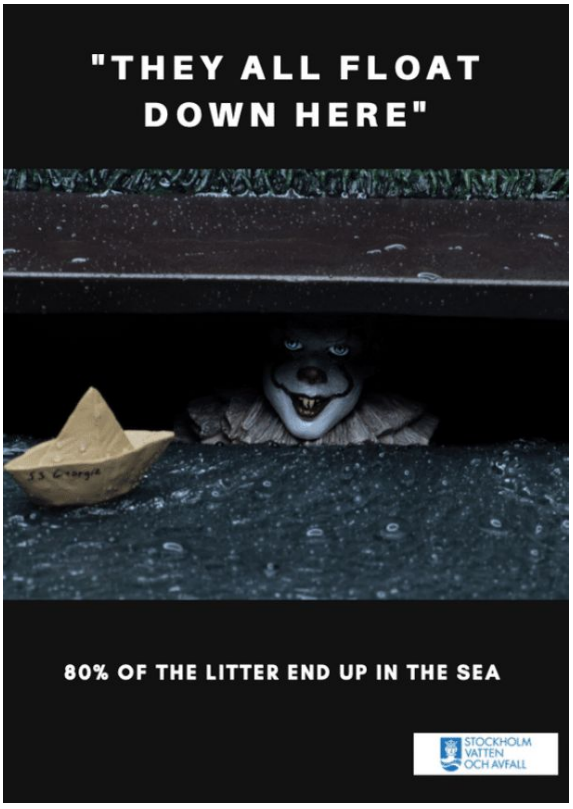
Picture 12.

Picture 13.

Solution 3: Movie slogans

“Pinocchio also said that he never litter” - and you see him sitting below with his long nose. By using the commonly well-known characters, slogans and stories from popular culture, waste management is taken closer to individuals in their everyday life. Through memorable pieces waste management is staying in people’s eyes - so also in their minds. By choosing different characters and sayings it is possible to reach several different target groups through culture, humor and positivity.

Picture 14.



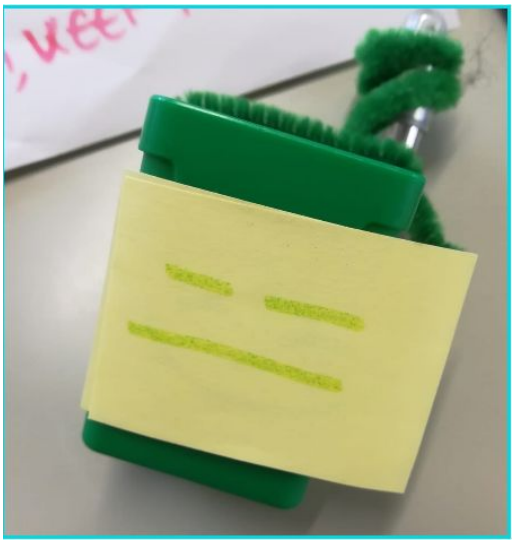
Picture 15.

Solution 4: Educational programs

During the emphasizing phase in the interviews, it turned out, that according to the public opinion “everyone knows that littering is wrong”. However, when asked what should be done to end the littering, the common opinion was to increase knowledge. As conflicting this may sound, there can be a lot to be learned of this - there is a demand for more knowledge in waste management within the public spaces, but also, targeted and told in a way that it is easy to comprehend and absorb. Through carefully targeted educational programs it is possible to increase awareness and therefore make an impact on the attitudes of the people in Stockholm.

Solution 5: Interactive and/or visible bins

There are several garbage bins in the city center, but still, more and more garbage ends up to the sea from land every year. By increasing the attractiveness of the garbage bins, waste management becomes more pleasant and even gives a positive feeling about it. If the bins’ looks are standardized they will be easier to recognize and notice, and/or it gives a smiley or a positive sound when receiving trash, it makes it more attractive or even tempting to drop the garbage to the bin.



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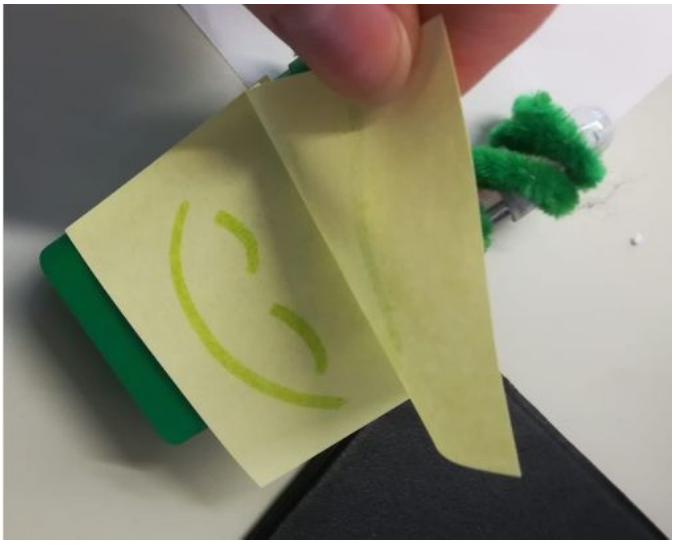


Picture 17.

Part 2

Proposed Solutions

After presenting the five solutions, we had a meeting with our challenge giver and at that meeting we also met the representative of the Trafikkontoret from Stadsmiljö Adrift, which is actually the organization that is also responsible for the garbage bins in the public areas in the city. Both our challenge givers liked all the five solutions of ours and there was a fruitful discussion on possibilities implementing each solution. Nonetheless, eventually the challenge givers chose the combination of interactive and attractive bins to be the best solution, which they wished us to work on more. It turned out that Stadsmiljö Adrift had already created previously a prototype of an interactive garbage bin with an audio feature, but it had not been yet tested. However, the challenge givers emphasized that we should not limit ourselves only around that idea but explore different kinds of solutions and use our innovativeness.

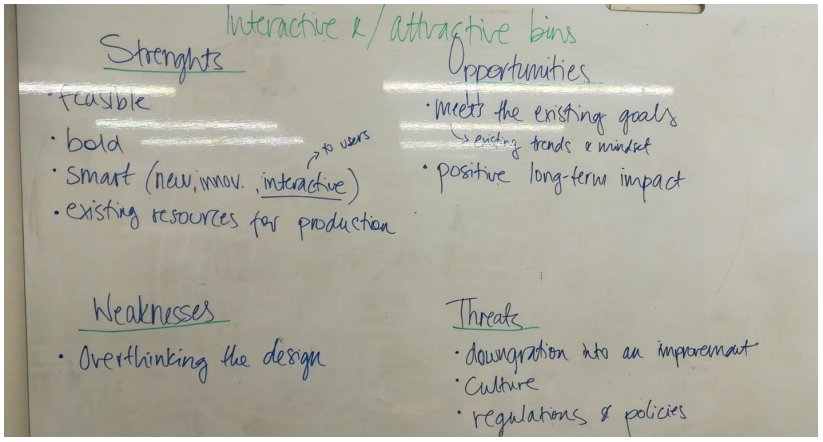
Proposed solution	**Pros**	**Cons**
Carry away trash -product	Interesting and completely new idea, something different.	Requires lot of designing & planning thus hard to create & launch
Circular economy	Social sustainability & responsibility is important, as well as recycling of the materials, possible positive societal impact.	This aspect has already been taken into consideration in many public institutions that is already existing and taking it further would require significantly more resources, therefore it is not innovative enough.
Movie slogans	Interesting & fun, awakes attention and encourages to waste management through positivity.	The copyrights are very challenging. However, the solution can be used later on by using the local or completely new characters. Nonetheless, the solution is not innovative enough for our aims.
Educational programs	By increasing knowledge the understanding is increased and people would do more often right decisions with waste management.	The solution is already in use and there is also coming new programs in collaboration with other local operators. Therefore, the solution is not innovative or game-changing in the way we are aiming for it to be
Interactive and/or visible bins	Interesting and innovative idea, where the end-users' convenience is taken into consideration. This way the bins will become more attractive to use and encourage for better waste management. Also, the challenge givers are already having a prototype of an untested interactive bin, so there are already resources and interest for this solution.	The challenge is to keep up the innovative and game-changing aims and mindset, whilst utilizing and developing further the already existing idea.

Table 1. Pros and cons of each proposed solution based on the meeting with the challenge givers

After the meeting we started to develop the concept of interactive and attractive bins. First, we created a SWOT analysis about the concept. We considered as strengths the practicality and usability of the idea, but also, that it can be something completely new and brave, which can actually make a change with the current situation. As we found the idea to be something smart and innovative, but we also want to believe, that the interactive features will bring the end users closer and give them the important client experience, which will hopefully be rewarding enough to motivate them to “do the right thing” in the future and not to litter. Also, it can be seen as a significant benefit that the challenge givers have already existing resources and interest towards our solution. We see this solution to be an opportunity to meet up with the already existing global trend of environmental thinking and fulfilling the general request to work together towards sustainable long-term solutions.

In the end, we saw as the only weakness our lacking knowledge on the technical aspect, which has shown itself in overthinking when it comes to enabling the features and designing the bin itself. This creates a possible threat of not fulfilling the innovative potential, but reaching only the level of moderate improvement to the current existing solutions and therefore downgrading our expectations on the innovativeness and ability to create something game-changing. Also, other possible threats were seen to be the existing culture of publicly judging littering and considering it as a civic duty not to litter, but still having the phenomena of ordinary people littering daily public areas. This is something challenging to grasp and change. Besides the culture, we think there exists some laws and regulations that might restrict our solution.

After the SWOT, there came the time to think what does interactivity and increasing visibility could mean in a bin design. We did a lot of brainstorming exercises, built on each others’ ideas and discussed on the different opportunities. We came up with many ideas: an underground bin with movement sensor and instruction screen, a bin for cigarette butts located to traffic lights and streetlights with interesting design, a changing color to indicate the fulness of the bin, a talking bin, bin with a game in it, an innovative design to a bin with different enters for different types of waste, and all the different ways to combine these ideas in a new way. However, at this point, we had no idea yet what the users think about our ideas and therefore, next we needed to return on empathising.



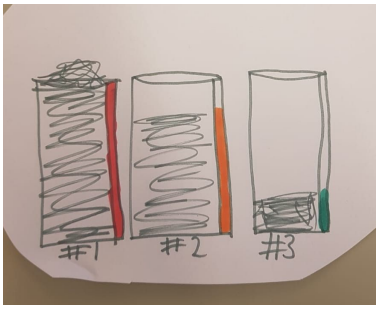
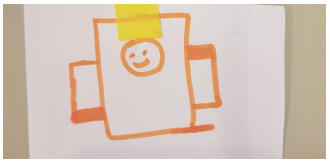
Picture 18. The SWOT analysis on the concept of interactive and attractive bins

Empathise 2

Essentially, after brainstorming the different ideas that we thought could be incorporated to bin designs, we had to get feedback from the users on the proposed ideas. As such, we chose to conduct interviews to understand the views from users. Notably, to ensure that the users clearly understood the proposed ideas or solutions, we provided pictorial representation for some of the ideas. The questionnaire below served as a guide for the empathize phase:

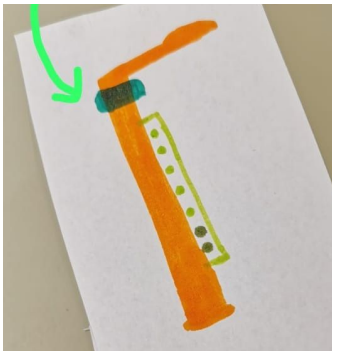
Questions

Do you find the following features interesting or useful?

Features	
Audio Feedback	 *Picture 19.*
Gamified bin	 *Picture 20.*
Color indicating fullness	 *Picture 21.*
Screen instructions	 *Picture 22.*

Movement Sensor	 *Picture 23.*
Other ideas	

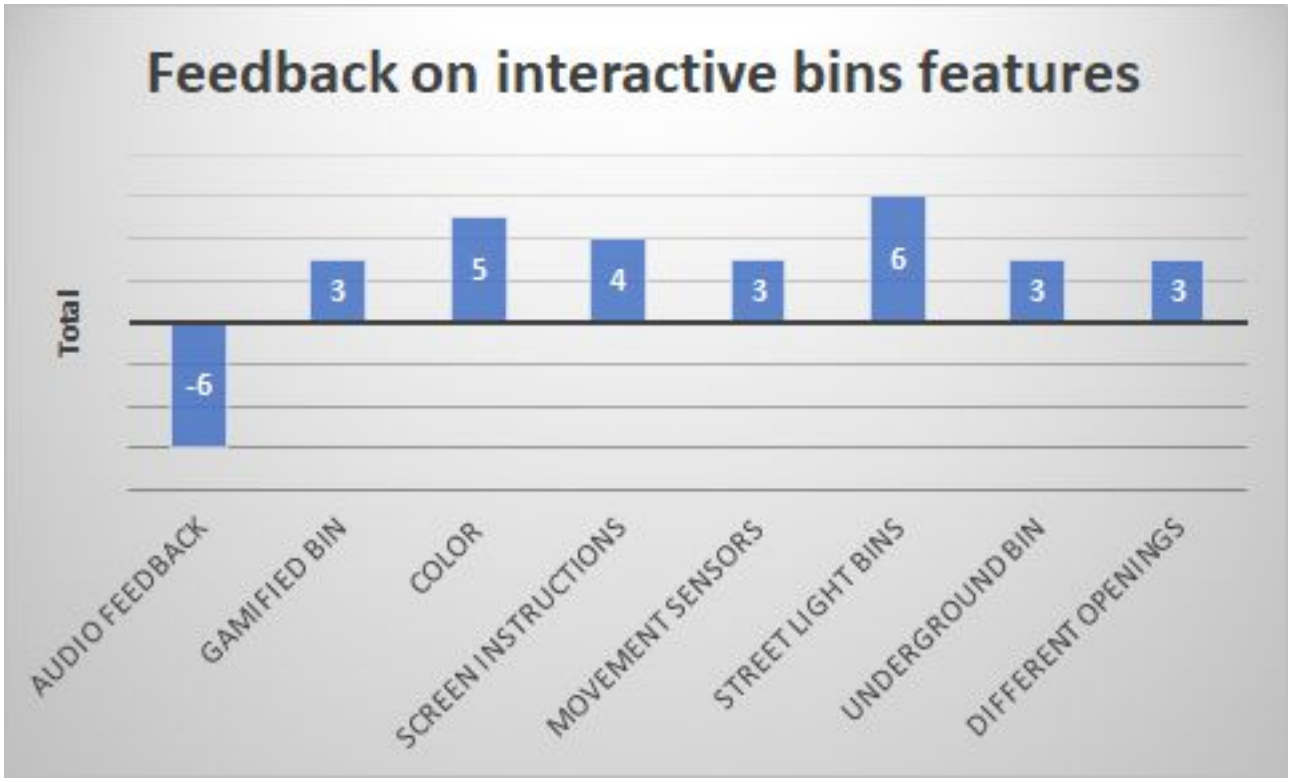
What do you think about these ideas?

Design	
Bin on street/traffic	 *Picture 24.*
Underground bin	 *Picture 25.*
Different openings for different waste	 *Picture 26.*

How will this kind of bin change your attitude toward littering?

Insights and Analysis

The scope of the second empathizing phase was kept the same as in the first one including the same methodology and targeted stakeholders. We aimed to get the perception and evaluate the acceptance of the bins design features among youths, middle aged people to those above 60's and visitors. After data collection through qualitative interviews we tried to quantify them in order to sort out the most preferred features and discard those that would result as not convenient or unnecessary. Our approach was on sorting all the features and appraise with +1 if one feature was considered significant towards acceptance, -1 otherwise and 0 for neutral responses meaning that the interviewees were hesitant on whether they liked or did not like the feature. Afterward the results were summed up and they are presented in the graphic below:



Graph 1. Feedback on the interactive bins features and design

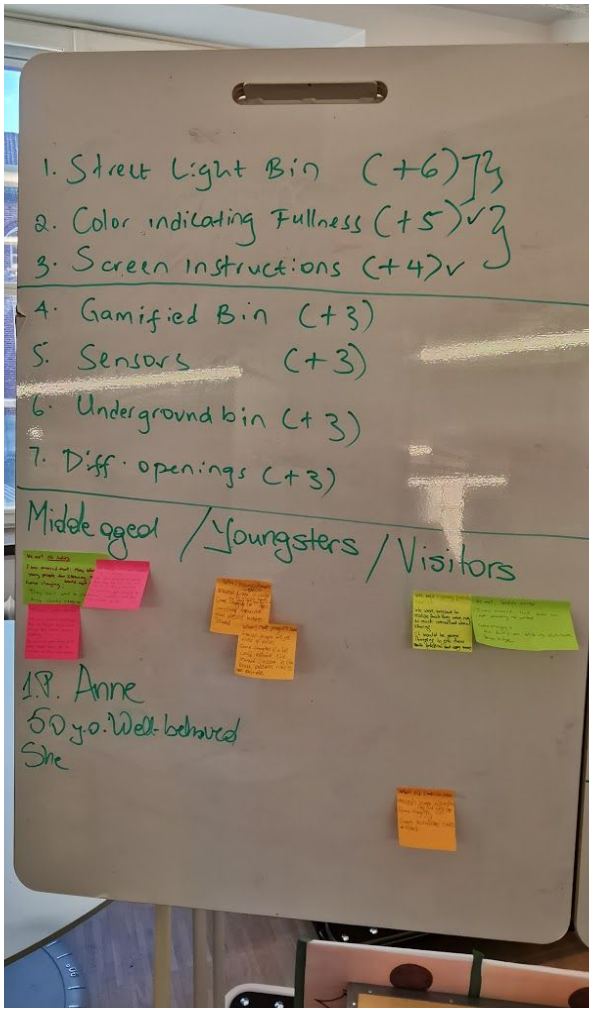
As seen from the graph the most liked features were 1. Street light bins, 2. Color indicating fullness and 3. Screen instructions.

We continued our analysis further by trying to explain these outcomes. We used the Point of View madlib, the essential tool of design thinking in order to guide ourselves through the process of distilling a variety of needs and insights into a single point of view categorized in three stakeholder groups. There were various noteworthy opinions, point of views, that needs to be kept in mind for the upcoming proceeding, briefly described. There was almost unanimous response that audio feedback on bins would be disturbing and noisy. They would like to have a pleasant walk through the park without hearing a noise coming

from nowhere and bother them where it came from. The idea of gamified bins was not favourite either. The interviewees said that it might be playful and interesting for the kids but that they would not allow their kids to play around a dirty bin nor would they stand and waste their time around a bin. On the other hand the idea that a simple game indicating fullness each time a waste was dropped into the bin without waiting, like the completion of a figure like a puzzle, would be rewarding to change the attitude towards littering. Color indicating fullness was well received and they also requested that such a featured to be integrated with the bins located in the street lights. Screen instructions or fun facts were appreciated mostly from the visitors since they perceived the city as clean and would like to know more about how this was achieved. For them this would be game changing, so they would be informed on how the locals perceive and behave towards littering. Movement sensors, underground bins and different openings were the features with an even distribution as preferences. However underground bins received contradictory responses. As among youngsters it was considered convenient, practical and time saving so they would look around to find a bin for the middle aged and older people it was considered rewarding for the current bad attitude on throwing waste on the ground and impractical because they would have to be careful where they walk. Based on all this insights we created the Point of Views per each stakeholder.

Personas

Based on the insights we gathered through the earlier explained interviews, we were able to develop new personas. We sorted the different opinions and grouped them; we found three different age-groups that could each be captured in a persona. In the following picture, you can see our analysis of the interviews to create the personas. We summarized our insights on post-it notes by collecting who we interviewed, what we were amazed to find out, and what would be game-changing for this person.



Picture 27.

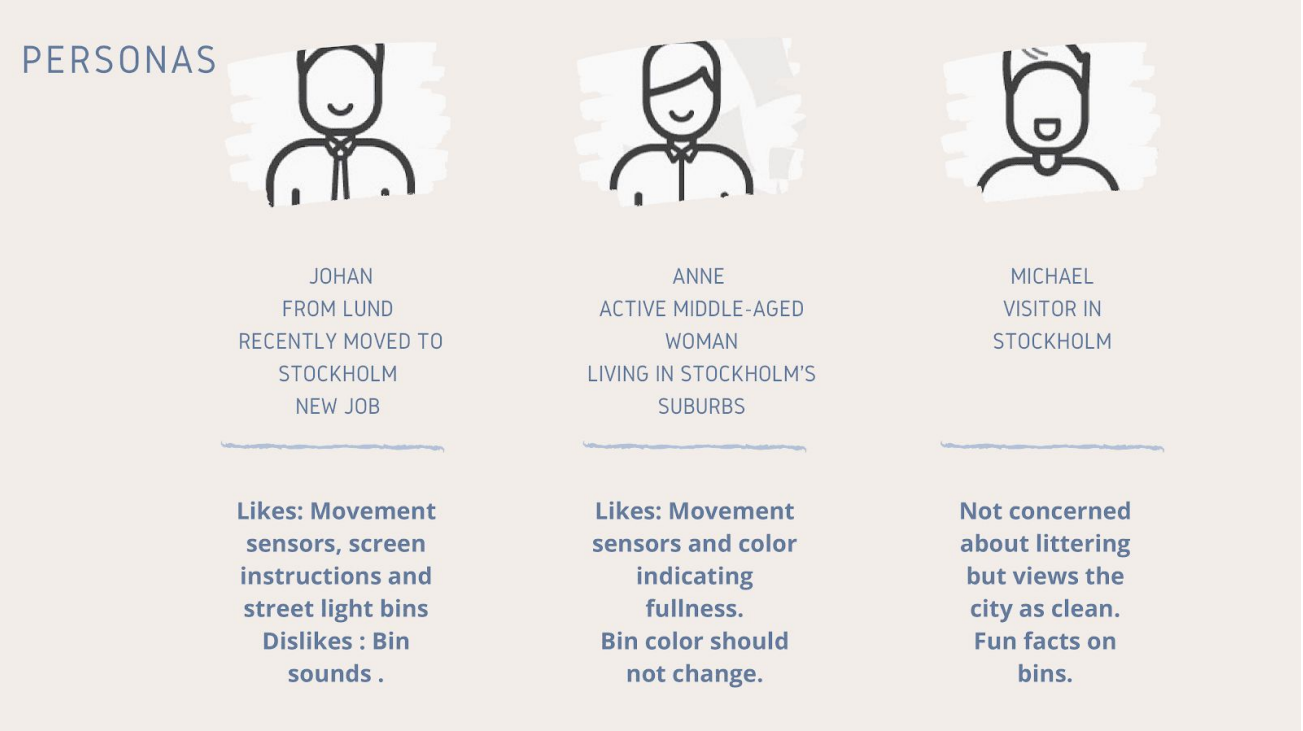
This let us to the following three personas:
The first persona is Johan, a young adult of the age of 24. He recently moved to Stockholm for his new job. He would **not appreciate sound or voice feedback** from a public bin. First of all, he would find it annoying and ridiculous. Secondly, he would most of the time not hear it because he is wearing his noise-cancelling headphones when he is taking public transport to his new job or his friends. However, he would like to **open bins without having to touch them**. Most of the time he has his phone in his hands and using a movement sensor to open the bins would make it easier for him. Furthermore, some **information on a screen** attached to the bin would **get his attention**. Sometimes he has **trouble to find the next available bin** in Stockholm. The colour of them that blends into the surrounding does not help him to find them. He needs his hands free for his phone. Therefore, he has dropped some waste onto the streets before. If bins where to find more easily for example on street lights he would probably carry the waste a couple more meters to the nearest available bin.

The second persona is Anne, an active middle-aged woman who is around 60 years old. She lives in the outer suburbs of Stockholm and regularly goes for a walk in the park. She loves to visit her young grandchildren and to take them with her out on a stroll around the park and city. **She believes the younger generation is responsible for littering** and would **like her grandchildren to be educated about it**. Some useful information on a bin could be a possible solution for this. Additionally, she would **really like a movement sensor** to open the bins so her grandchildren wouldn't have to touch the gross bins. She also believes that more bins should be placed around Stockholm. However, she does not realize that there are enough bins, but she can not spot them because of their colour blending into the surroundings. Nonetheless, **she definitely does not want the bin colour to change** to make the bins more visible. A small **colour indication to visualize the**

fullness of the bins on a street light or the bin directly **would** however **not bother her** and be even of use.

The third persona is Michael, who is currently visiting Stockholm. He does not know about how the waste is managed in Sweden. Generally, **he finds the city very clean** and **is not worried about littering**. However, we would like to see the city as clean as it is now when he comes back the next time. Therefore, even though he does not worry or think about littering if it would increase, he would not like it. **He would find it useful to get some more information** or especially fun facts about the city of Stockholm and their waste management and recycling. If there was some helpful information on the bins **he might feel enabled to care more about littering**. Additionally, to **place bins at street lights** and to visualise this **would help him recognize where to throw his trash** in a city he has not been before.

The most important information and insights about the personas are summarized in the graphic below.



Picture 28.

Based on these personas we were able to develop a solution that fulfills people's needs, avoids their dislikes and tries to enable them to litter less.

The Final Solution

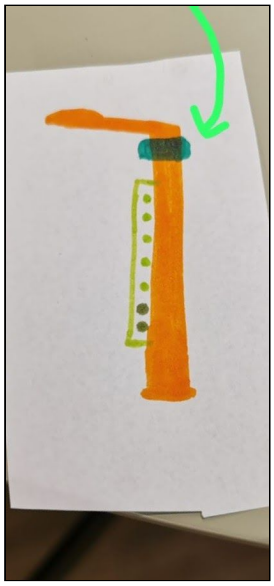
Based on the results from our second phase of insights and personas we created the solution which were most valued, this is about to be presented.

Solution

For our final solution we created two bin designs. After the second empathise phase we came to the conclusion that a bin that is mounted on street lights would be optimal for visibility reasons and due to the fact that it is already in the urban environment, thus making it visible without adding anything into the urban environment which was stated as one of the disadvantages on one of our first solutions which had a sign above it. This is also one solution that could fit our persona of Johan, if one sees the marked lamp post from a distance he could hence be encouraged to carry it a few extra meters instead of throwing it on the ground. If this bin design is ought to be implemented we would strategically mount these on many street lights close to pavements so that one could easily spot the nearest trash bin without having to change direction. We have also provided the street lamps with a trash bin with a mark high up on the lamp post. This would change color depending on if the trash bin is full or not, in this way one could see it from far away and if it is available for trash or not. This also makes it possible to see if the trash bin is full without opening or touching it. The fact that one does not want to, or are able to, touch the bin was one example of something expressed in the second empathise phase and is gathered in all three personas.

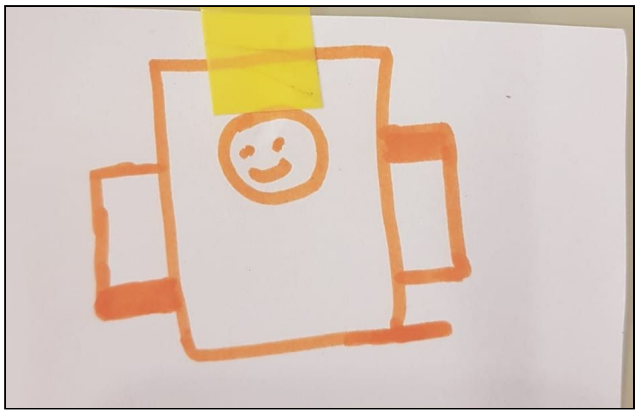
Picture 29. Street lighting in Stockholm

Picture 30. Traffic lights and an idea of how one can illustrate the fullness in bins.



Picture 31. Illustration of a street light with a trash bin and how it can be "marked" (see green arrow) when there is a bin on it.

The second bin design we created is a trash bin with fullness indication and with a motion picture display. The display will feature multiple language selection with information on waste in general and also present fun facts to provide awareness on the waste management issue in an attractive way. It is also interactive with touch sensitivity so one can push buttons and get info on the product one is about to trash. So, the display can inform and give instructions for the person about to trash. This will aim at ensuring that people can easily understand how to easily sort the trash. The fact that the screen also attracts attention with light and movement is also something that correlate to our persona of Johan. The knowledge aspect is also something we got from the empathize phases and is expressed in the persona of Anne. She could show with the display design and instruct her grandchildren on how to properly manage waste.



Picture 32. Trash bin with screen interaction represented with a smiley.

Picture 33. Conceptual illustration of our solution.

Discussion

The problem with marine waste is that it is invisible. Humans run their everyday routines on land, making their direct interaction with water limited to seasons or leisure activities, hereby hiding the ugly reality of marine life endangerment from littering. Through all our journey from understanding the problem to visualizing it and come up with solutions we realized that people in Stockholm have a great understanding that there exists a littering problem, but on the other hand, none of the interviewees referred to themselves as a contributor to the problem. The dilemma of knowing what is wrong and not doing what is right was the core of our research project. There was an overall perception that littering comes due to lack of convenience to do the right thing. To look for the proper bins, lousy attitude towards consideration of the problem and lack of adequate communication on how our bad manners on waste management lead to risk consequences for the environment and marine life. Faced with the question of what can be done to improve the situation the finger was pointed out that the "other person" should take this and that action but no finger was put on the persons themselves. So how do we make individuals to reflect and change their behaviour? We proposed five solutions each of them based on different outcomes from the three different stakeholder groups that were in our research focus. The design thinking of our products had to channel the society's values in an acceptable, convenient and easy way to understand. The transition has to come smoothly but showing a significant impact.

After a consultation with the challenge giver a final solution was chosen, the interactive bins. After a second phase of emphasizing we were amazed and surprised to realize that there was still confusion between that, there is a problem of littering and that the solution proposed to improve the issue should not be too “focused/visible”. We kept the same group of stakeholders throughout the study. Middle-aged and above 60-years old people expressed positiveness over some minor changes like motion sensor and colour/light indicating location. However, overall they were pleased with the current bins design/situation and new innovative ideas will not change their attitude because they always do the right thing. They also showed disapproval on too much visible distraction like sound, colour, and gamification; they hence preferring more natural tones and the advantages of peaceful enjoyment of the surroundings. If we take the responses from this group as a reference, then we have two questions:

1. How can we send the message that everyone litters by starting to point the finger on ourselves?
2. How can we improve the littering situation if we fade the bins from peoples eyes?

The group of youngsters were somehow more vague on their reaction. They said that what we proposed sounds good but that they do not think it will make a significant impact on their attitudes because bins as a location were not interesting to pay attention to. No one would spend time in front of a bin to read new information or let their children play around them. On the other hand, they liked the idea of bins that would fit their everyday routine like the bins placed on street lights since it will help them throw litter on the way they are walking or underground bins for the same reasons. However, some questions arise with such designs. Should we make the bins easy by adjusting them to the attitude of throwing litter on the ground (like underground bins) which is interesting for the youngsters? Or should we design something that is convenient for the city and other groups with little more effort on walking a couple of meters but which might not have a significant impact on

the youngsters? By making it more comfortable, do we make a change or we preside the current attitude? This is a topic of further investigation but essential when implementing the current solution.

Another group that we interviewed in our second phase was tourists/visitors. It was interesting to see their point of view as they perceived Stockholm as a relatively clean city. When visiting a new town, tourists tend to go to the most frequented places, historic attractions and famous locations. And they tend to stay for shorter periods, meaning that they have a partial view of the situation and see only the “good part”. From their point of view, we can ask: “How does a “clean city” impact the littering behaviour? Does it mean; because it is clean, it is not an issue to throw something on the ground because it is something “small” or; they should not litter because they should respect the values of the city they are visiting? Also, by considering Stockholm as a clean city, how come that we have a problem with marine waste? Where does this waste come from? Does it mean that we are putting priority to attractions and locations considered beneficial as touristic places, forgetting to put the same effort on areas behind prominent facades like parks and public places frequented often by locals?

As we can see, the same interactive bin design is seen from different perspectives from the three different stakeholder groups. What is seen beneficial from one is considered not significant from the other one, each of them making us as design thinkers to arise more questions. Is it convenient to implement one bin design that is minimalistic by satisfying something from all stakeholders requests but not returning too much impact? Or should we go with two different models with high impact on the three groups but that requires more efforts in terms of implementation, logistics and costs?

Notably, the different bin designs aim at solving the littering problem within Stockholm city that leads to marine waste. The first bin design that is street/traffic light with trash bin aims at improving the visibility of trash cans within the town for new visitors/tourists, thereby promoting a proper littering culture for the tourists. Additionally, it also ensures that the people living in Stockholm have some incentives to litter, as it would be easy to identify a bin which motivates a person to take the trash to the bin. Further, with the colour indicating fullness functionality, people can quickly identify bins that are already full, thereby placing their trash in other bins, thus ensuring that there are less overflowing bins. This also ensures that a person is motivated to place their trash into a bin that is empty or not yet full. The second solution that is the trash bin with an interaction screen focuses on disseminating information to the public with the provision of fun facts and littering instructions in different languages. As highlighted earlier, the public should be informed/reminded of the adverse effects of littering. Therefore, this solution would act as a communication channel by continually informing the public. Furthermore, the solution also ensures that the visitors understand how to properly dispose of their trash with the integration of universal/different languages. As such, we feel that the implementation of one of the bin designs may not comprehensively address littering. Therefore we propose the integration of the two bin designs as one comprehensive solution that aims at addressing littering within Stockholm.

Our future steps are to further evaluate our solution. We have started to conduct further interviews which can be found in the Appendix.

Conclusion

Marine waste management is a global challenge that requires a multi-faceted approach for the provision of comprehensive solutions. Stockholm Vatten och Avfall waste management plan aims at ensuring the reduction of waste disposal in the Baltic Sea. As highlighted earlier, research shows that 80% of the waste in the sea originates from land based activities. The waste journey begins with an individual putting out a cigarette and dropping the cigarette butt on the path. Rain or wind pushes the cigarette butt down a storm water drainage system, which may or may not lead to a treatment facility. In Sweden, 92% of storm water is usually untreated and ends up in the lakes, seas or the soil. Notably, this serves as part of the core challenge in solving marine waste management.

Essentially, in Stockholm over the years, cigarette butts ranked as one of the top waste found in the sea among other different types of waste found in the sea. As such, this outlines the underlying problem of littering within the Stockholm archipelago and its effects to the Baltic Sea. Notably, this highlights the need to address land waste management within the city. Household waste and company effluents have well enforced regulations that properly govern proper waste disposal. However, we noted that public spaces and parks do not have a well structured/well adhered to waste management plan. Additionally, this coupled with the fact that most of the storm water drains untreated in water bodies serves as a challenge to marine life.

Over the years, people from all over the world tour to Stockholm city. As such, there is an increase in the number of people in the town who are in public spaces and parks. Notably, we realised that people in Stockholm have enough knowledge on the adverse effects of littering and the incentive towards proper disposal of trash. However, most people do not take the initiative or are not motivated enough to put their trash in the available bins within the city. Therefore, this means that people in the city do not have a positive attitude towards proper waste disposal mostly in public spaces and parks. Interestingly, they seem to adhere to rules that govern proper waste disposal in their households. Noteworthy, people advocated for more education on proper waste disposal which in contrast is a contradiction to the fact that they understood the adverse effects of littering. Further, people emphasized the need to ensure the visibility of bins within the city and the proper enforcement of littering penalties. Advised by the Stockholm value system, enforcement of littering penalties to citizens may not entirely promote a change in attitude for the citizens. Therefore, educating the public, positively influencing the public and ensuring the visibility of bins served as the core issues to the development of our solutions.

Essentially, guided by the design thinking paradigm, we brainstormed on different ideas that could aid in solving tackling the issues. We developed five revolutionary ideas that aimed at tackling the issues. Firstly, a carry away trash product that seeked to promote people to carry their trash instead of dropping it to the ground. Secondly, a circular economy that aimed at motivating people to convert the trash to some useful products. Thirdly, the incorporation of movie slogans to posters/campaigns thus evoking the thought and reminding people the adverse effects of littering. Fourthly, the integration of educational programs to curriculum thereby emphasizing on the need to stop littering. Lastly, the introduction of interactive bins to motivate the people to proper waste disposal and positively influence their attitude. Further, undertaking a SWOT analysis on each of the solutions coupled with deliberations from Stockholm Vatten och Avfall and Trafikkontoret led to the selection of the solution on interactive bins for further development. The solution

was developed further into the incorporation of two bin design features: Street/Traffic light bins and Trash bin with instruction screens. The bin on the street lights aims at ensuring that people tackles visibility of the bins and positively influencing proper waste disposal while the trash bin with instruction screens ensures proper dissemination of information on waste management to the public. This ensures that people are constantly reminded of the advantages of disposing of their trash properly.

We believe the proposed solution will positively impact the attitude of people to encourage proper waste disposal in public spaces and parks. Evidently, the solution seeks to prevent littering as a stop gap measure rather than focus on collecting trash already disposed in parks. Essentially, this will promote the culture of people living in Stockholm to stop littering in public thus immensely reducing the task of Stockholm Vatten och Avfall and Trafikkontoret in combating marine waste management and waste collection in outdoor areas respectively.

Appendix

Feedback from latest interviews

Currently we are in the second testing and validation phase of the design thinking. Below you can find the feedback we got from multiple interviews we conducted with each multiple people. If we were to continue with this project we would take this feedback into account to further develop our solution.

Interview 1	**Interview 2**	**Interview 3**	**Interview 4**	**Interview 5**
Screen solution: Good for tourists with additional language selection	Most favorite is the motion sensor and fullness indicator.	The screen would be good, might increase interest. Also, the light would make it more easy to notice.	The green light is too high, hard to notice and it will even be hard to know what it means, should be closer to the bin or even on the bin	Motion sensor: Really good idea. It facilitates the process and makes it more convenient to use the bins
Screen solution: “How do you know it’s a trash bin?”	Do you need the lid (movement sensor) - does it really add a benefit?	I like the screen idea, especially maybe with the colour that draws attention but would be discreet	The LED is not clearly visible.	Motion sensor: On the other hand it concerns on how it will work, what will be a “safe” walking distance so the movement sensor does not create a disturbance.
Also good to show pictures! Not everyone in Sweden can read their native language.	Location of the bin is useful. During the night for example you don’t find a bin otherwise in the dark.	Movement sensor for opening is great, it’s more hygienic. There could be also a screen, that doesn’t need touching.	Add a reflective trim on the bin so it's easily recognisable when it's foggy, or at night in case the light is temporarily not working.	Screen solution: Really nice idea to inform people on the litter problem.
Put the screen on the other solution so it’s combined.	Full empty indicator is not that helpful because the person would	I think that all combined would be good: the movement sensor, screen	I like the idea that the streetlight has a green light. But maybe the	Screen solution: Sounds good but not sure if it makes an

	not try to find an empty bin if one is full already.	and the light	screens will be to costly. Maybe they can be in paper? Like a post and you can change the post like they do with advertisement.	impact. Wont stop to read or see an ad on the bin screen.
Good with a visible indicator!	Seeing the bin from far away is helpful.	The light would make the bin more easy to see		Indicator of fullness: Good idea but not for the public. I think it is more useful for organization who deals with cleaning.
Good with a movement sensor for opening the lid!		I like all the ideas, but there could be also an app to show where the bins are, especially in parks and so on		The light/color indicating location: Really good one. It will be helpful to see where the closest bin is.

Table 2.

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Illustrations and Photos

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Picture 2. Flaticon. Retrieved from https://www.flaticon.com/free-icon/qualitative-research_1935840?term=research&page=1&position=48.

Picture 3. Flaticon. Retrieved from https://www.flaticon.com/free-icon/observation_2196168?term=Observations&page=1&position=15.

Picture 4. Illustrated by Elda Shurdhaj.

Picture 7. Illustrated by the whole group with pictured from https://www.interaction-design.org/literature/article/personas-why-and-how-you-should-use-them.

Picture 11. www.kicrwang.ga. Retrieved from

https://www.google.com/url?sa=i&source=imgres&cd=&cad=rja&uact=8&ved=2ahUKEwjyj7DrwvHmAhVB2aYKHahoBBIQjRx6BAgBEAQ&url=https%3A%2F%2Fwww.kicrwang.ga%2Fdamer%2Faccessories%2Fvesker%2Frumpetasker%2F%3Fmt%3D7.5&psig=AOvVaw0Jd0X8yQcCxpw07Jljw357&ust=1578487633885786.

Picture 13. Pinterest. Retrieved from https://i.pinimg.com/originals/98/d0/67/98d0676839f611f88f3889ab487d1f68.jpg.

Picture 14. Illustrated by the whole group.

Picture 15. Illustrated by the whole group.

Picture 28. Illustrated by the whole group with pictures from https://www.interaction-design.org/literature/article/personas-why-and-how-you-should-use-them.

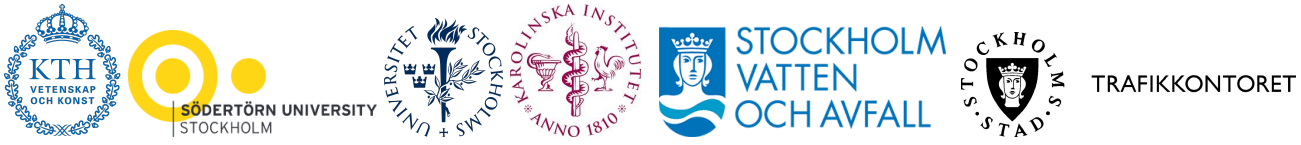
Picture 29. Holger Ellgaard.Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=16005034.

Picture 30. Photo by Harshal Desai on Unsplash. Retrieved from https://unsplash.com/s/photos/traffic-light?utm_source=unsplash&utm_medium=referral&utm_content=creditCopyText.

Picture 33. Conceptual illustration of our solution. Illustration by Ronja Jösch, picture from https://c8.alamy.com/comp/F53NTE/slottsbacken-stockholm-sweden-scandinavia-F53NTE.jpg.

Marine waste management in Stockholm

In this report we present the challenge given on marine litter. We first had to identify what sectors we were able to impact; companies, households or individuals in public spaces. After identifying that the issue lies within the area of individuals in public spaces we chose the approach of preventing the waste ending up to the sea from public spaces and to do so by developing the concept of garbage bins. This would then improve the end user experience and making waste management something positive and even rewarding. We believe that our interactive and attractive bins will provide an innovative solution against littering and thus, preventing marine waste.



Openlab is a creative centre that provides opportunities for finding solutions to challenges in society. In cooperation with our partners and other actors, we create proposals for innovative solutions for the Stockholm region. We do this across the lines between different disciplines and professions. The reports from Openlab are results from students interdisciplinary cooperation within the framework of a 15 ECTS master course.