

# LIGHTHOUSE

## INTERACTIVE PLAYGROUND



### **Department**

Eindhoven University of  
Technology, Bachelor College  
Major Industrial Design

### **Description**

DPB210 - Project 2 Design  
Play & Learn: Vitality  
2017/2018, Semester A

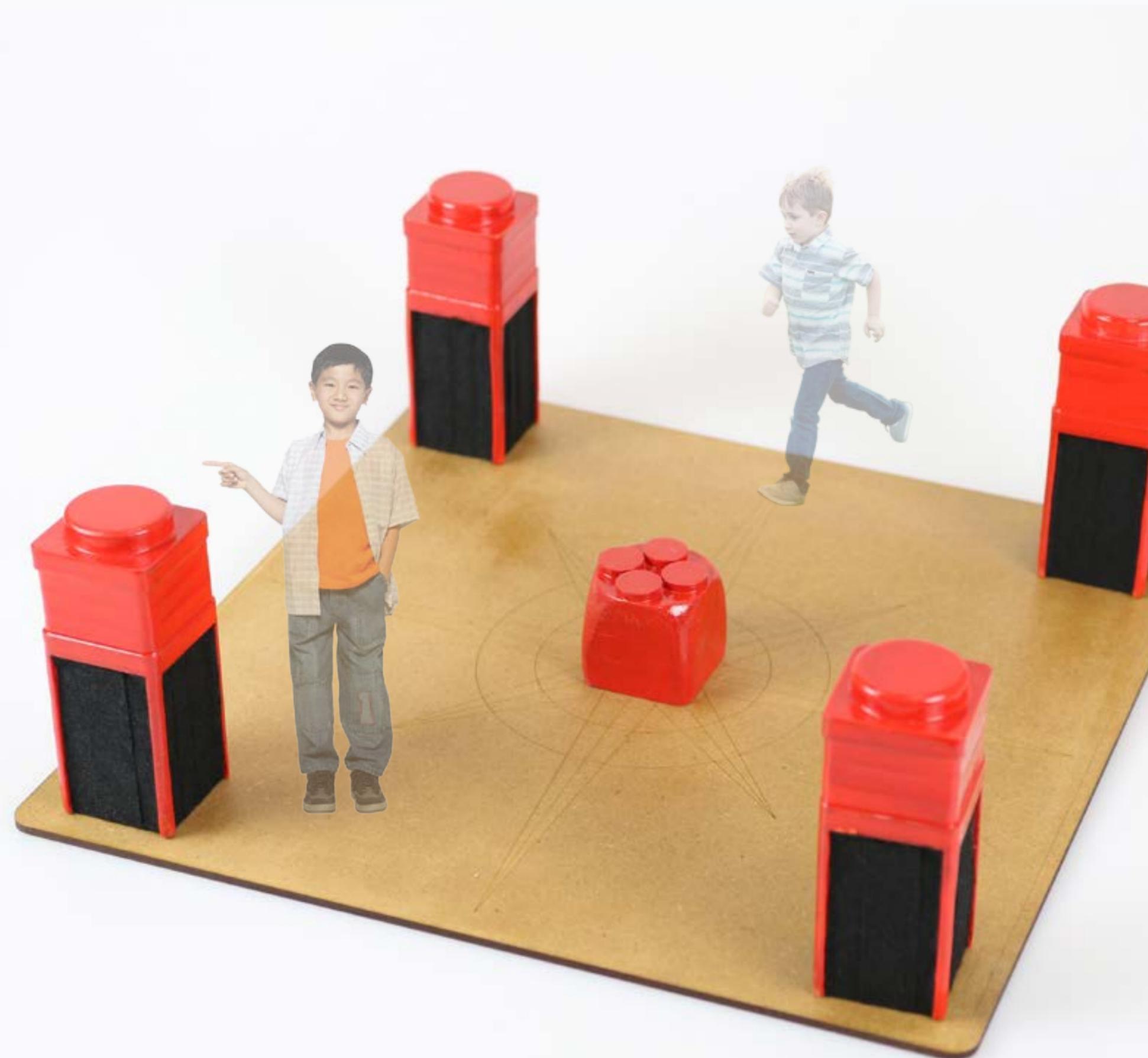
### **The Team**

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## Introduction

Nowadays many children are playing games on their smartphones or computer at home, instead of going out to play with friends. As a design team, we were inspired by the playground, a place where children come together and play together. A place where games, social interaction and physical activity are combined. However, most equipment in a playground is still static. In our design project, we wanted to make playing in a playground more interesting by creating an interactive playing environment.

## LIGHTHOUSE

Lighthouse is an interactive playing field for children in which they can use their creativity to create their own games. This playing field consists of several pillars with a light that can be switched on and off on the pillar itself, and with buttons on the panel in the middle of the field. The system has a basic on-off option, random option and music option.

## Vision and goal

Our vision is to bring children together at the interactive playing field where they create games by doing. In order to make the playing equipment interesting to children, we aim to stimulate interactivity between the child and the playing equipment. The design stimulates open-ended play, working together (social activity and team building) and physical activity. Thus, it is up to the children to create their own games which fit their own needs. We aim to produce a sustainable product which fits the needs of children of several age groups.



## SYSTEM

The basic design of Lighthouse consists of four pillars in total (the amount of pillars could be adapted). The hardware and software of the pillars is identical, only the painting of the housing is optional and could be different between the pillars. The pillars have one button on top (Z) and four sides that react to shock, for example a kick or hit with ball (A, B, C and D).

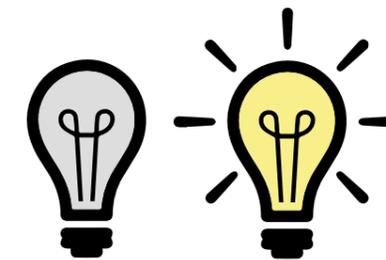
In the middle of the field, a panel is located. This panel has four buttons (E, F, G, H) which are linked to one pillar each.

The system consists of three open-ended game options, which are described next.



### On-off option

The first open-ended game in our design is the on-off option. The buttons on the pillars (Z), as well as the sides of the pillars (A, B, C, D) turn the light on or off when pressed or hit. The four buttons on the panel in the middle (that belong to one pillar each) can also turn the light of the linked pillar on or off. All buttons are input and the lights give direct feedback/output. If one of the buttons is switched on and off repeatedly in a short period of time, the congruent light will go to a flicker mode, instead of the normal continuous burning mode. When one of the congruent buttons of this light is being held for three seconds or longer, the light will switch back to the continuous mode. This gives children more open-ended play options and will additionally prevent children from constantly turning lights on and off.



### Random option

When the open-ended game 'random' starts, the light on one of the pillars will burn in one colour, for example red. When one of the congruent buttons of that light is pressed, this light will turn off and a light on a random other pillar will turn on in the same colour (red). This way, some kind of path is created. When a congruent button of a light that is NOT burning is pressed or hit, that light will turn on flickering in another colour, let's say green. Plus, yet another light (on another pillar) will turn green, and will burn continuously. The flickering of the first light indicates the creation of a new path and it will go out at the same time the continuous light is turned off. If one path (one colour) is not used for longer than 30 seconds (that means: the buttons of the congruent light of that colour are not pressed or hit), the light will first flicker for ten seconds and then turns off. At that moment, that path disappears.



### Music option

The last open-ended game option is the music game. The four pillars can play five versions of a music loop of the same style, when one of the buttons is pushed or hit (so Z, A, B, C or D can play one music loop each). This can be for example five different foreground melodies (pillar 1), background melodies (pillar 2), base lines (pillar 3) or second base lines (pillar 4). When a button is pushed or hit, the pillars play a music loop until the next button on the same pillar is pushed or hit. Thus, one music loop can be played per pillar, but the music loops of different pillars can be combined to form a real track. The buttons on the panel in the middle of the playground can be used as master options; mute, the low-pass filter, high-pass filter and chorus (E, F, G, H).



# DESIGN PROCESS



## Our steps

After brainstorming the possibilities of stimulating physical activity within the target group of children, we thought that a playground was the perfect location to do this. We went to a playground where we noticed some interactive playground equipment, designed by Playnetic. Next, we brainstormed from which an interactive open-ended playing equipment followed. We built a small maquette which explained two different feedback systems from which the child could create his or her own games.

After doing low-fidelity user tests with children, we found out that they did not fully understand the concept. We concluded that we needed a high-fidelity prototype to test if children like to play with an interactive and open-ended system. The high-fidelity prototype was tested at a primary school. After analyzing our test, we could draw the conclusion that the children understood the prototype and enjoyed creating games together.

With this confirmation of our hypothesis, we added more feedback systems to give the product more dimension, and to make it more interesting to relevant stakeholders. Besides, we have visited InnoSportLab and Playnetic to learn from existing interactive playground equipments. Finally, we could demonstrate our redesign at the Demo Day by means of various scale models to show the different aspects and explorations of the design.





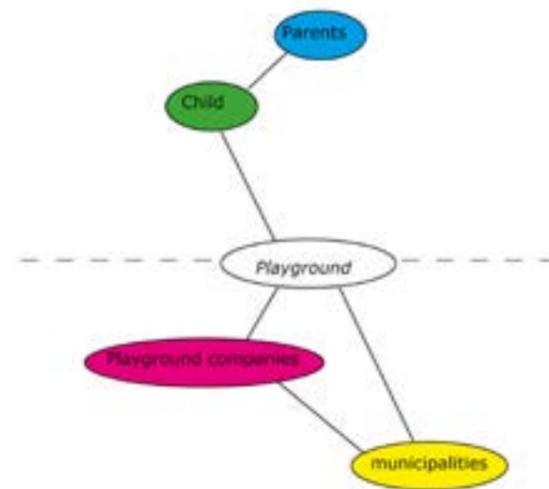
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# BUSINESS & ENTREPRENEURSHIP

In this chapter, the stakeholders and their values are described. Next, the competitors Yalp and Playnetic are described. Finally, the business strategy, including a business calculation, is presented. In appendix IV, some worked out business model aspects can be found.

## STAKEHOLDERS

Since our end user (the child) is different than our client (playground companies and municipalities), it is important to map the values of each stakeholder. Here, we will describe the values and needs of each stakeholder.



### Child

Children want a playground to be fun and get rid of their energy. As observed in our user test, children like to create games in a team. By working together all children are included within our design and thus this playing equipment is also fun for children who do not regularly practice sport. Open-ended play is fun for the child, because children are in charge of their games and open-ended play makes the playing obstacle more alive according to Playnetic.

### Parents

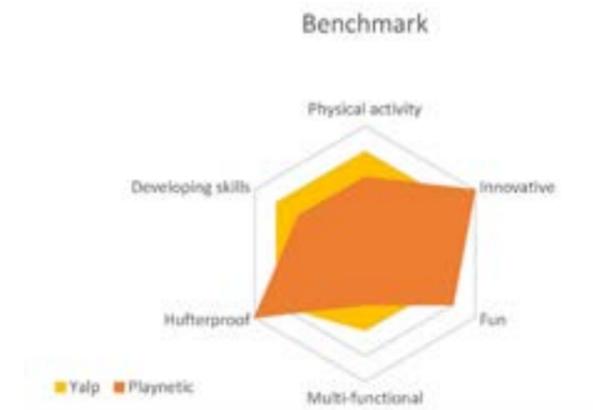
Parents of the child aim the best for their child. They probably do not understand open-ended play, so therefore we have introduced the music option. This option is recognized by the parents as a contribution to the child's development. Another important part of the design, is that it motivates children to get physical active which is good for the child's health. Besides, while playing, the child develops life skills such as communicating, decision and social skills.

### Companies and municipalities

Playground companies like innovation, because they want to be leading the market of playground equipment. They are interested in equipment which teaches the child for example counting. Municipalities are interested in environmentally friendly playground equipment. The municipality of Eindhoven is especially interested in encouraging physical activity in open spaces as well as using open space for multiple purposes.

## COMPETITORS

We have visited InnoSportLab Sport & Beweeg and Playnetic. Here we learned that only two companies are developing interactive playground equipment, so there is a market for interactive playground equipment which is able to extend. However, they have no (successful) products addressing open-ended play. Here, we will describe our competitors and explain our business strategy.



### Yalp

Yalp has developed the product Yalp Sona Play arch, which is an interactive playground equipment. This interactive playground equipment detects when a child walks by and invites them by means of sound to select a game. These games are programmed and include learning activities such as counting as well as physical activities such as dancing. Children find this product fun, because it is according to labmanager Harmen Bijsterbosch always used whenever children are around.



### Playnetic

Playnetic has developed numerous interactive playground equipments, all human-powered which means that their products are sustainable and they do not need to worry about energy supply. Because their focus is on human-powered devices, they have decided to use sound instead of light, since sound is more energy efficient than light. Their products have also pre-programmed games which focus on physical activity and learning activities.



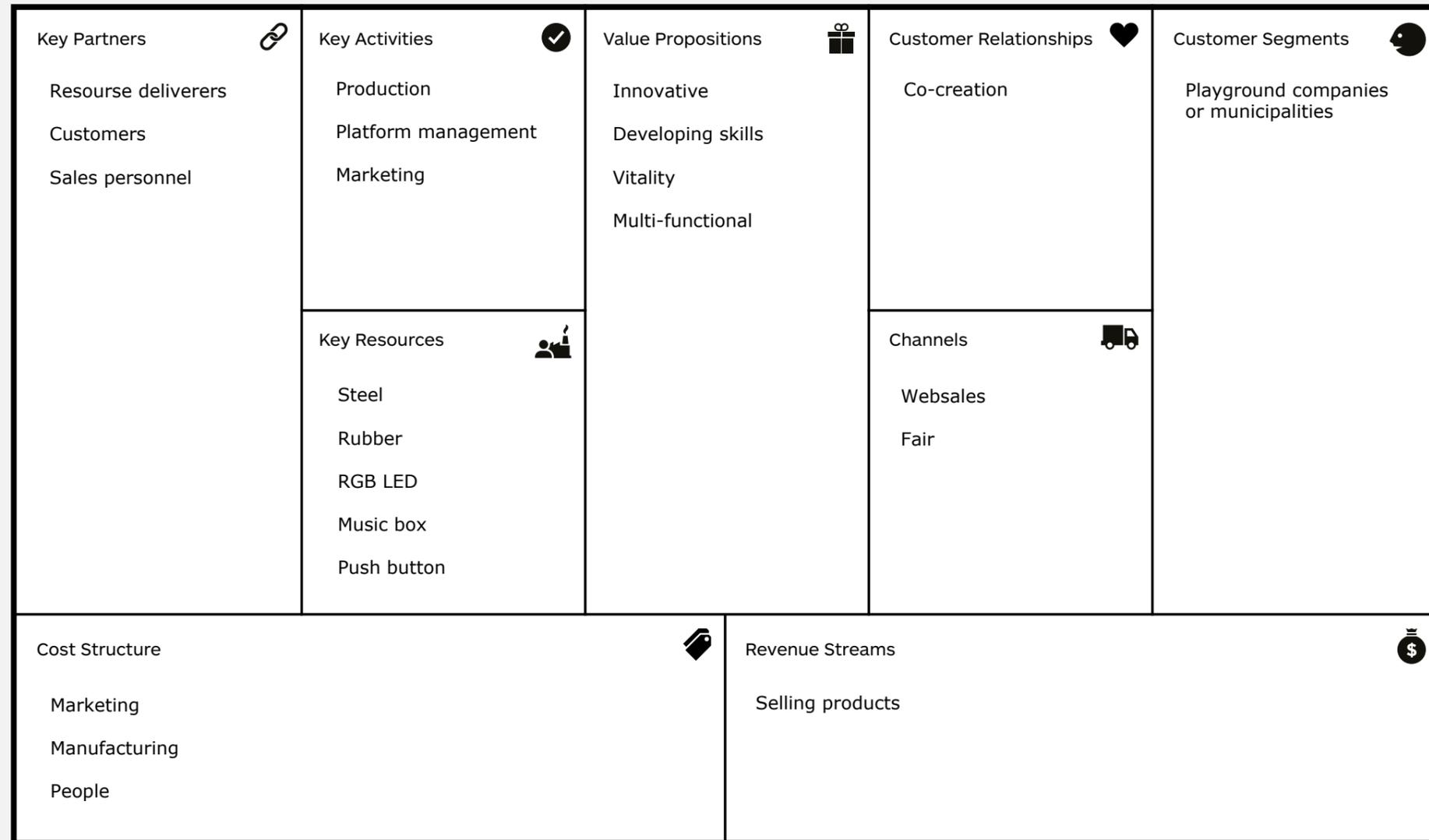
# The Business Model Canvas

Designed for: Project 2

Designed by: Naomi Swagten

Date: 6-12-17

Version: 1



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**DESIGNED BY:** Strategyzer AG  
 The makers of Business Model Generation and Strategyzer

  
 strategyzer.com

## Business strategy

Our strategy involves producing our interactive playground equipment and selling it to playground companies and municipalities. To make our design accessible, a website will be published with all information of the values and possibilities of the interactive playground equipment. Besides, we want to visit playground fairs to show our product and attract clients. While Playnetic sells products and do not improve products if they failed, we aim to learn from our clients. So therefore, we want to create a platform where stakeholders are able to give feedback, because we think this helps us to improve the product which also benefits the stakeholders. In addition, we want to gather anonymous data on how often a child plays a game to gather a better understanding on which game works and which game should be kept out of the design.

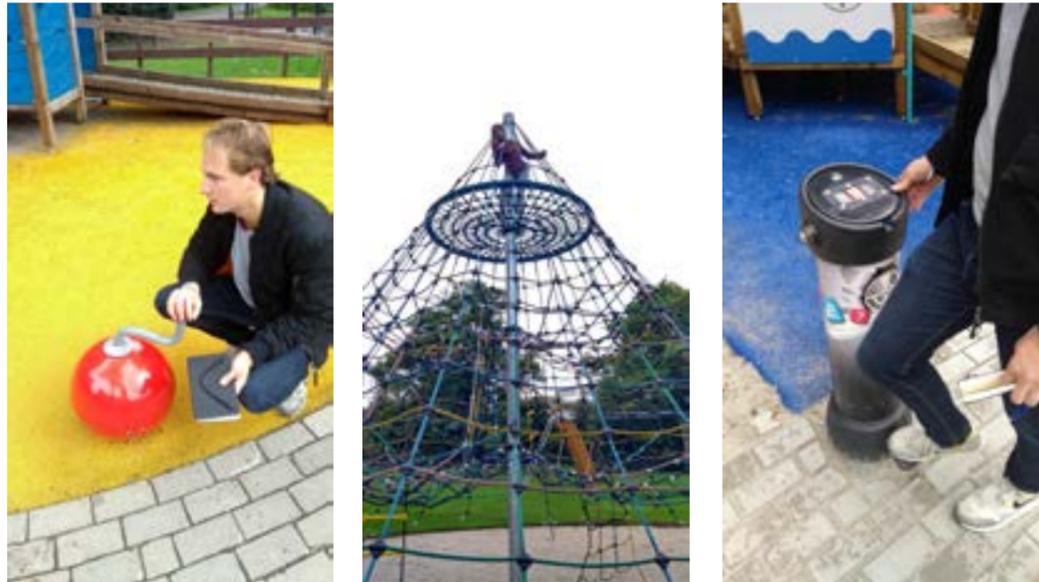
With a profit of 2000 euros per playground equipment, we want to sell the playground equipment for 8570 euros (the calculation of the costs can be found in appendix IV) This may seem expensive, but regular playground equipment costs vary from 7000 euros to 15000 euros. By selling our product within the range of prices of regular playground equipment, we aim to compete with regular playground equipment. Our main clients will be China and Scandinavia because these countries are most interested in interactive playground equipment according to Playnetic.



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# CREATIVITY & AESTHETICS

This chapter describes our brainstorm steps, like visiting a playground, making a state chart and morphological chart. Also, the used materials are explained and the aesthetics is described in more detail.



### Visiting Playground

In order to get some inspiration, we went to visit a playground. At the playground, we noticed some interactive playground equipment which was integrated with sound. Also, we saw that most playground equipment was static and prevented young children from climbing. Visiting a playground helped us while ideating about how to contribute to an existing playground. We were inspired to create playing equipment which is based on open-ended play to make the playground an interesting place for all children.

### Inspiration GlowSteps

GlowSteps is an open-ended playing product, so therefore we wanted to experience how such a product works. Some games were integrated within GlowSteps, which switched while playing. One game included music, which we found a very interesting element and decided to add this to our concept.

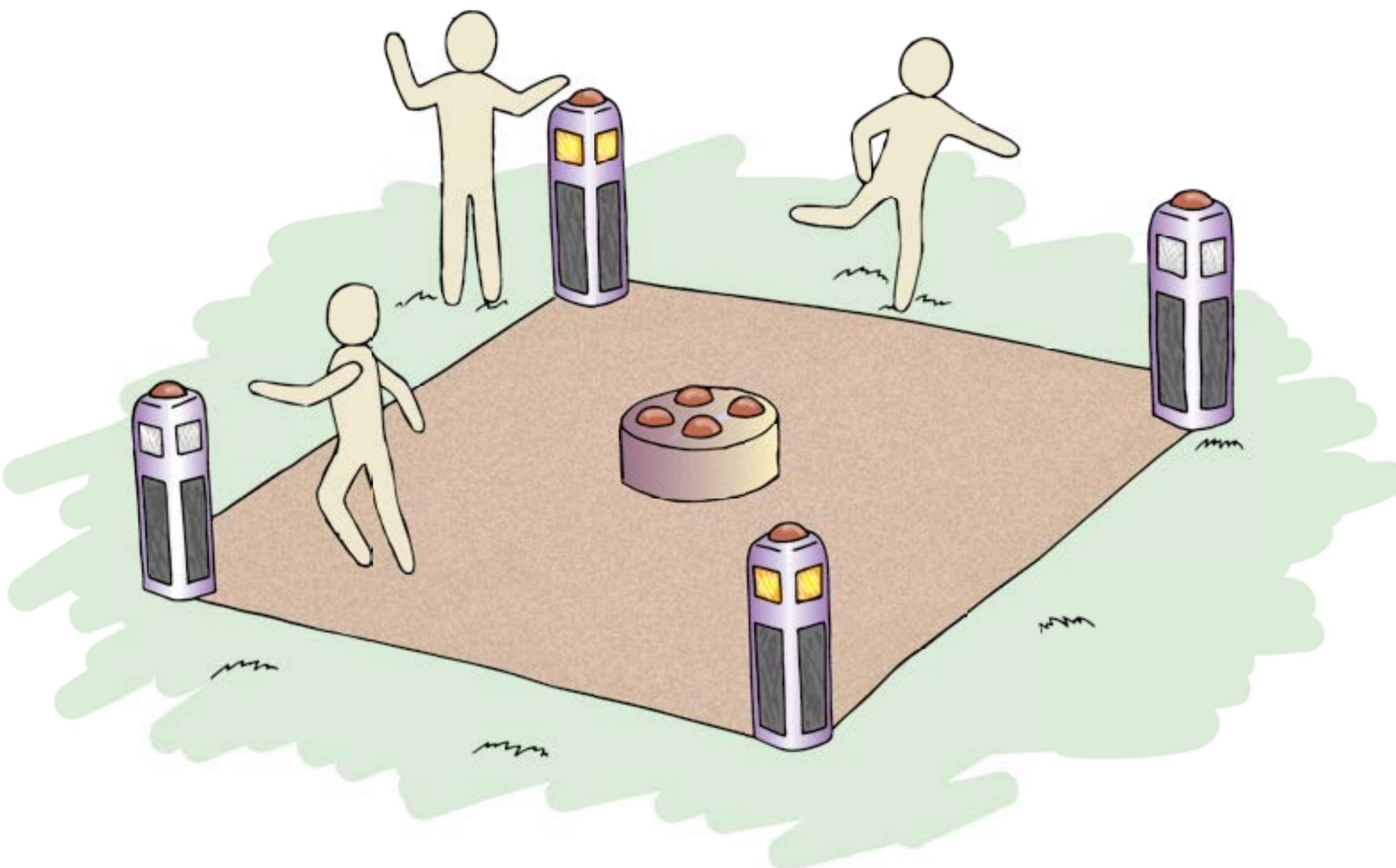


Feedback	INPUT							
Haptic	Consistent Vibrations	Vibration in shocks / pulses	Pushing a button	Deforming object	Kicking object	Hit with a ball		
Lights	Blinking/Flashing	On or off	Glowing					
Sound	Melody	Music	One sound	Recording				
Form								
	Round pillar	Rectangular pillar	Pillar with curve	Arch	Deformable	Climbing frame	Trampoline	Fantasy figure
Material								
	Wood	Plastic	Foam	Steel				
Field					CONTEXT			
	Round	Ellipse	Rectangular	On a hill	lighthouses	Fantasy world	'spenkoolen'	

### State chart and morphological chart

We used a morphological chart when brainstorming about form and feedback. We wanted a round field, because then all pillars have an equal distance to the middle panel. We chose to use rectangular pillars, because we wanted the sides of the pillar to be used for soccer games as well. Design exploration sketches can be found in appendix VII.

A state chart (see appendix V) was used to map all possible interactions of the child and the system. By doing this, we learned that we should try to convince all children to push a button on the pillar. The child could be convinced by a sound, light or an aesthetically pleasing button. The state chart also gave a clear overview of all games that could be played. Direct feedback such as turning the lights on and off led to many possible open ended games. Therefore, we wanted to include this option within our design. A random option was also included within the design, to make the games more competitive. By adding a music option, even more games could be created by the child.



## Aesthetics

In order to make a sustainable product, we chose to use strong and durable materials. Since our playground equipment will be located in public space, the equipment needs to withstand different weather conditions. In addition, the product needs to be strong so that it is hufferproof. The materials which were chosen to be used in the final design are steel and rubber, because Playnetic used these materials to make their products hufferproof and withstand different weather conditions. Steel is used to build the pillars and rubber is used for goals. The steel is spray painted in the admired colour of the client.

The key elements of our design are a playful and safe appearance, that invites children to play with the interactive playground. This is done by giving the pillars round edges and a colourful look. The buttons are big, round and inviting. Direct feedback in the form of light (or sound) will be given when a child pushes the button. This direct feedback is an important element that encourages open-ended play, because children can interact with the system and keep creating new games.

The design could be extended by giving the whole playground more context by means of a theme. The client could choose between different designs for different contexts. A primary school for example would need a different design than a playground within public space. A few of these design explorations can be found in the morphological chart and in the appendix VI. Giving the playground more context can encourage especially younger children for more story-like open-ended play, using fantasy and creativity.



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## USER & SOCIETY

This chapter focuses on the user and argues why Lighthouse fits their needs. Besides, insights of the low fidelity user test and high fidelity user test are described.



## Personas

By creating the personas Furqan, Nick, Sam and Yasmin (appendix III), we tried to fit the needs of all children. Open-ended play does not exclude children like Furqan, because every child can play his or her own game. This playground equipment is interesting for him and Nick, a boy who prefers gaming, because of the interactivity which is unusual for a regular playground. Children like Sam could create competitive games and use soccer within their games. Besides, children like Yasmin could use the compass on the floor and pillars while creating stories.

The age of the child influences how a child plays with the interactive playing equipment. Younger children (+/- 8 years) like to explore the different options while older children (+/- 12 years) find it more difficult to create their own games. Children who are approximately 10 years old immediately try to create their own games. Also, children of different age groups prefer different games, so therefore our design may use different games depending on the location and the time. For example, while older children are at school, younger children may create fantasy stories.

## Low fidelity user test

Our concept consists of lights, which is difficult to program straight away. So therefore we decided to do a low-fidelity user test at a scouting group. Coloured cards were used to represent the feedback of the light. However, it turned out that the low-fidelity of the user test did not encourage the children to explore different options. As a result, the children preferred already made up games. In addition, the age group could be too young to form a discussion about new made up games. Moreover, in this setting (scouting) they were not used to making their own games, because their group leader creates games for them every week. More details about the low fidelity user test can be found in appendix VIII.



## High fidelity user test

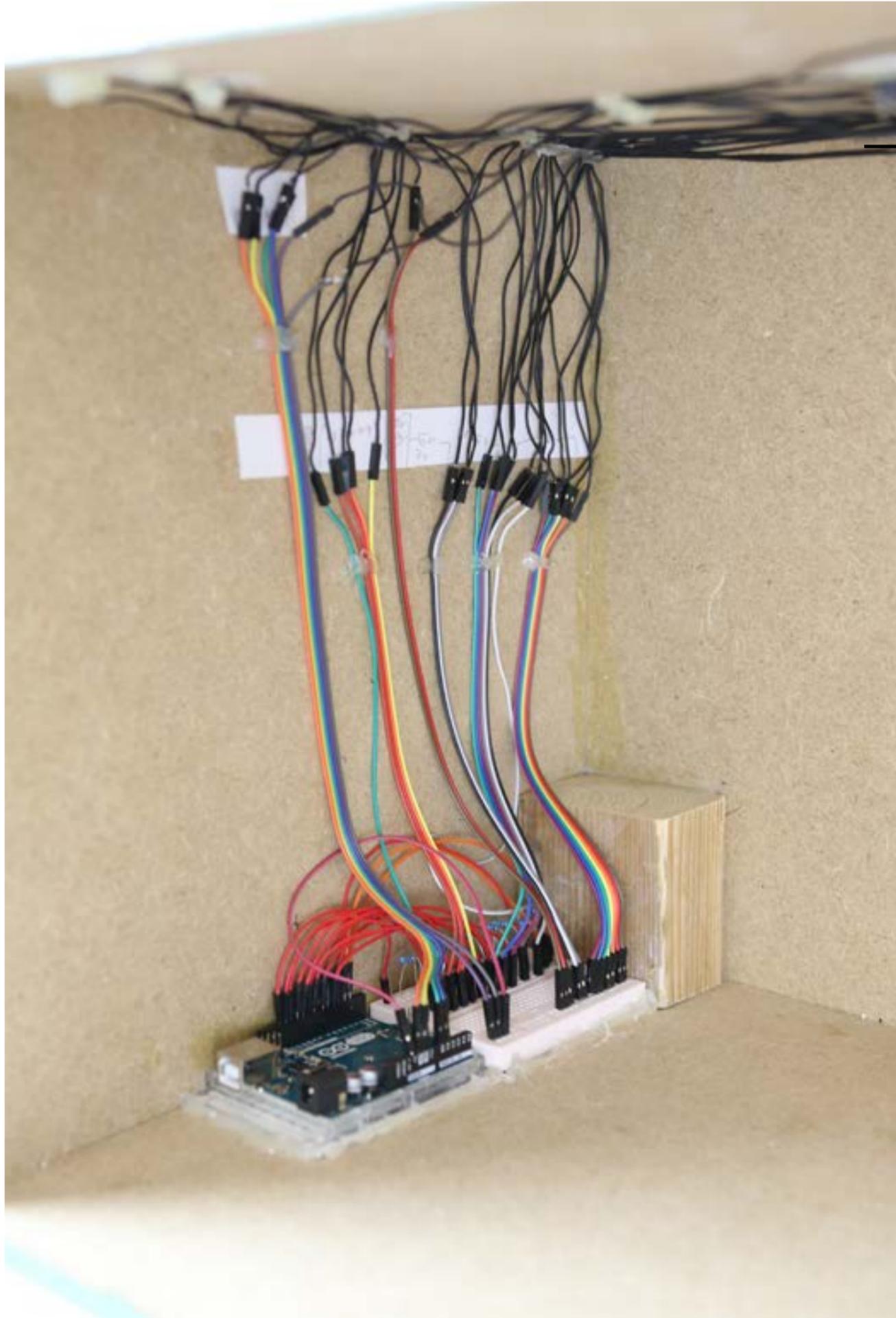
Since our low-fidelity user test did not give us useful feedback, we decided to build a high-fidelity prototype which could be used to get better feedback. We tested our prototype at a primary school. The children were asked to test the product which gave us many insights.

The children used the pillars immediately when noticing the design and they soon created their own games. These games were played including the whole group and contained running. When someone was tired, he or she was allowed to stand next to the middle panel so that he or she could still play along. Sometimes a child was teasing, but the other children propose him/her to stop bending the rules.

The children switched roles of being a leader, the one who is in charge on deciding the game to be played. The children listened carefully to the one who creates games and tried their best to follow the rules. The games of the children varied a bit, because they had a different game in mind, however, they did not notice this. When playing competitive games, the children did not know who was winning.

However, the children could be more excited to play games, because the user test took place during their mathematics lessons. Also, the fact that the children were chosen randomly could have influenced the results since most children normally go to a playground together with friends. Besides, the user test took place at a primary school which is a different context than a regular playground.

More details about the low fidelity user test can be found in appendix IX.



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## TECHNOLOGY & REALIZATION

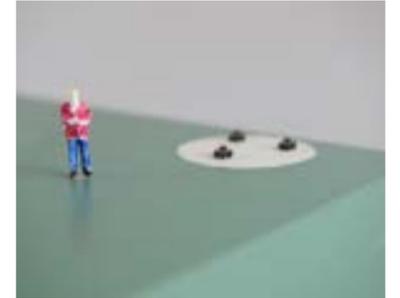
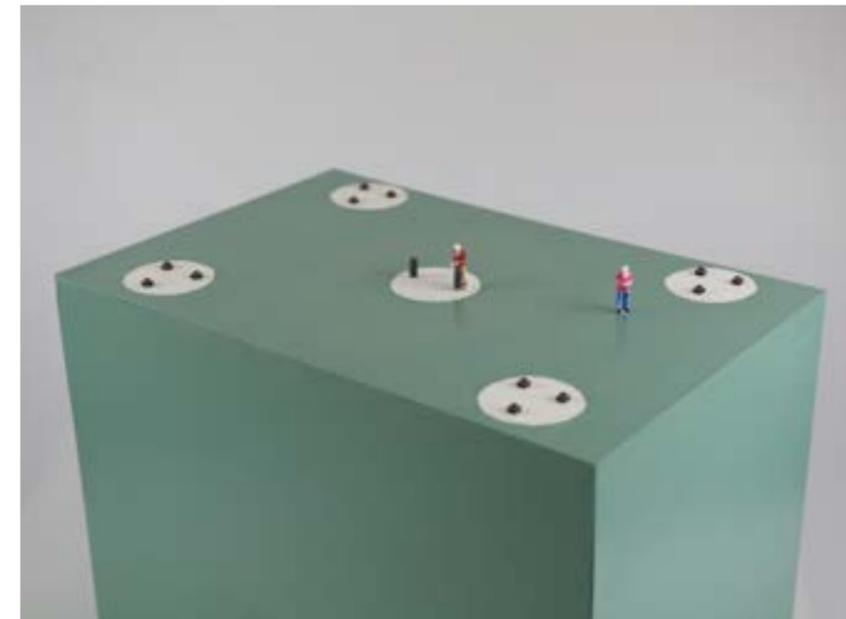
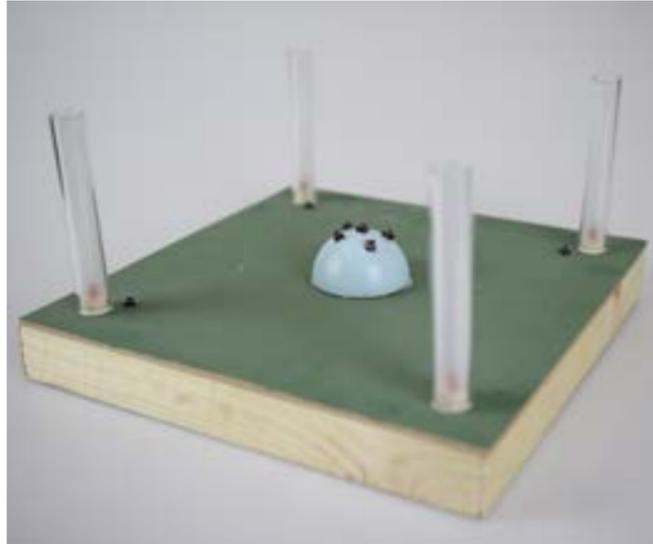
This chapter focuses on the technical part of the design. First, different prototypes are described which are embedded with electronics. Next, some technical aspect are explained such as electronics, electricity and time slots.

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## PROTOTYPING

### First prototype

We decided to build a maquette of our first concept, because we wanted to get feedback on our design concept. This prototype explained the on-off option as well as the random option. Both options were programmed and electronics were integrated to make interaction possible.



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### High-fidelity prototype

A high-fidelity prototype was made because our low-fidelity user test did not give us useful feedback. This high-fidelity prototype was used to gather feedback from both the user as well as colleagues during midterm demo day. This prototype illustrated the on-off option on a real scale.

These pillars were made of wood. A two-way switch was used to connect the different pillars to the middle panel. The electronics were covered to prevent children from hurting themselves while testing our high-fidelity prototype.



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### Music prototype

We decided to build the music prototype, because music is an important element of the design to convince both parents as well as playground companies. This prototype was especially made to explain the music option of the design, since the other options could be explained by the first prototype and the high-fidelity prototype.

In this prototype, we made use of Arduino and a hardware model of the playground on which buttons represented the buttons on the pillars. A midi controller on a laptop was the software used to control the program Fruity Loops. This program could play various sound loops when the buttons were pressed. The buttons on the middle console of the prototype could be used to mute or low-pass filter the music. This way, a sound composition could be made with the prototype, using the different buttons and the middle console.

## TECHNICAL ASPECTS

### Software

Sustainability is an important aspect of playground equipment, so therefore we want the product to be fun for several generations. Thus, the playground equipment is designed in such a way that games are easily uploaded and adapted if necessary. A central computer is placed in the middle panel, with a USB port to upload new versions of games. The computer is only accessible to the client, since they have the identical screwdriver to open the screwable panel on the middle panel.

### Electronics

As already stated, Lighthouse exists of four pillars with one button on top and four sides that react on shock (kick or hit with ball). A speaker is placed within each pillar, facing the center of the field to prevent disturbance of sound. LED lights are used, because these lights are energy efficient and thus fits our vision of a sustainable playground.

In the middle of the field will be a panel with four buttons, linked to one pillar each. The computer which is located in the middle panel is connected to the four pillars by means of cables. These cables will be located underneath the rubber floor.

The electronics of Lighthouse are deeply embedded in the pillars, so that it is safe for children to play with. The (LED) lights and electronics in the pillars and panel are molded in matte plastic so that the whole design is hufferproof and can easily be installed in a public environment. In addition, using matte plastic results in a more diffuse light.

### Light intensity

The lights of the pillars need to be visible during dark and sunny days. Also the lights should not be too bright during night or cloudy days. The light intensity of the surroundings is measured to adapt the light intensity of the lights within the pillars to make sure that Lighthouse can be played within different weather conditions.

### Electricity

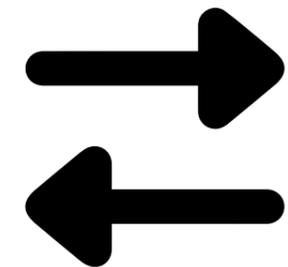
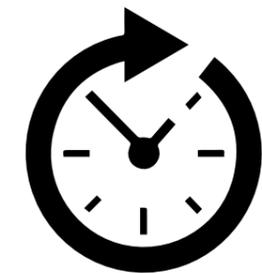
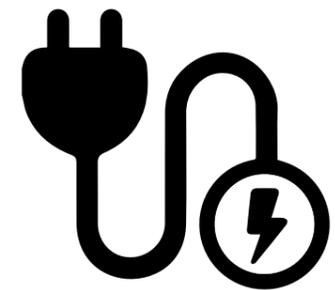
Lighthouse would work on mains power, as Yalp's Sona Play arch also does. Lighthouse does not use much electricity, because the maximal power the playground uses is 18 W. Using sustainable, human generated energy like Playnetic does could be the next step in the design process, because then the playing equipment could be placed anywhere. Also, sustainability is an important value of playground companies and municipalities which are our main clients.

### Time slot

Lighthouse will work with a timeslot, so the games can only be played between 9:00 and 20:00. Municipalities can change these time slots to optimize the playing time; for example when children only come to the playground after school, the municipality can decide to switch on the power at 15:00. Also, the municipality can have an influence by using time slots to prevent sound, light and playing children from disturbing a neighborhood. Time slots for sound are commonly used in the playground equipment industry, and not difficult to program according to Playnetic. These time slots will also prevent teenagers to wander around in the playground and misuse the equipment during night.

### Switching between options

The system will automatically switch between the various options, because this will prevent children from switching while others are in the middle of a game. It also creates an element of surprise which keeps the playing equipment interesting for a longer period of time. When the system recognizes an activity drop, the system switches to another game and visualizes this change by means of a wave of light. By switching between games and visualizing this, the system tries to grab the child's attention to keep playing for a longer period of time.



# APPENDIX I

## Personal Reflections

### Iris van Vugt | s162523

Project two was the second design project I worked on as an Industrial Design student at the TU/e. This meant I already had some knowledge on how to go through a design process, and how I could organize and plan the project. I was confident starting the project, and eager to develop myself as a designer. I planned to broaden my knowledge in the competency area I was least developed in: business and entrepreneurship. Moreover, I wanted to integrate my personal interest in user and society into the project.

Soon after the start of the project, I noticed that this project was very different from my first project. Doing a lot of design research in order to make substantiated design decisions fits me as a designer. However, working in the play and learn squad, it is important to go out and try if design concepts work in real life (eg. do they really simulate children to play?). As designer, one can come up with all kinds of ideas and be very enthusiastic about it, but it can also lead to a so-called tunnel-vision; when the designer forgets to consider if the user actually likes the design. Especially when designing for children, it is crucial to try out if children like to play with your design. During the first weeks of the design process, I learned to change my view: despite the fact that I still think research is important for a design process, going out into the real world and meet users, companies and other stakeholders is even more important in many cases.

In line with this, my design team started the realization of our concept quite soon in the design process. The project helped to overcome the hesitation to start building a prototype soon after a brainstorm. This was a vital step in my development as designer, because this will prevent me from getting stuck during a design process in the future. I learned that a quick realization is good for exploring your concept ideas. Immediate feedback can be given, which helps to discover possible disadvantages of the concept.

#### **Technology and realization; math, data and computing**

This project, I did not focus on technology but learned nevertheless a lot new skills. Helping to write the code of the first prototype gave me the chance to practice with programming, so that my skills would not decrease over time. At the end of the project, a more challenging task was appointed to me, namely to program a Wi-Fi connection between the pillars of our playground (with a ESP8266 module). Even though it turned out to be too complex and too time-consuming to use the Wi-Fi modules in our final prototype, I gained new skills in programming electronics which I can now use in the future (eg. I learned how to turn on a LED light from distance when pushing a button in a webpage on your mobile phone).

#### **Creativity and aesthetics**

As already mentioned, I learned that it is very valuable to go quickly to the realization of a design concept after brainstorming. For me, it was meaningful to experience how I can continue sharing ideas and thinking about the concept while simultaneously working on a prototype. Furthermore, during this project I worked a lot Adobe Illustrator and InDesign when working on the posters for the demo day and the final report. This gave me the opportunity to gain more professional skills in working with Adobe programs, which was something I planned to do a lot during my studies. More importantly, the audience at the

demo day and my group members could give me feedback on my work, with which I could continue improving myself.

#### **User and society**

The project really helped me to experience going out in the real world, test and validate your design. By doing multiple user tests, I came in contact with the user group, and I learned a lot from them to base my design decisions on. The children as well as teachers and parents gave us sincere and direct feedback and inspired me with new insights and ideas. This gave me motivation to continue the project and improve the design. In line with my vision, I will certainly continue this user-centered design approach in projects in the future, because I encountered the great advantages when meeting stakeholders of my design concept.

#### **Business and entrepreneurship**

As the other elements of the design process, I focused mostly on the practical side of business, and less on the theoretical. Instead of reading literature about writing business models and so on, I went out with my project group to visit a research center (working closely together with all kinds of companies) and a company that makes interactive playing equipment. When meeting the businesses, we elaborately talked to people and had the opportunity to ask questions. This was immensely valuable for our design process. I learned about costs, fabrication and design processes from highly experienced people. It was undoubtedly a great and motivational way to learn more about business in the field, because it gave me an insight in the design from a 'real world' perspective. Lastly, during the project alumni Michell Jacobs gave a business workshop, from which I learned various tools to make a good business model, such as creating a benchmark and making a value ladder.

## Naomi Swagten | s160307

### Goals

I joined the Play and Learn squad, because it suits my vision. In this project, I wanted to develop my program skills as well as becoming better in prototyping. During the project, I wanted to involve users and verify whether the product fits the user's needs. I also aimed to find potentials for business. This project would also be a good opportunity to improve my presentation skills and visual skills.

### Learning points

During this project, we went into the field to get a better understanding of our design challenge. First, we started looking at existing playground equipments which helped me in understanding what we could contribute as designers. By visiting competitors I learned that this helped me both to improve the concept as well as having a better overview on business potentials. In addition, a user test at a primary school gave many new insights to improve our concept.

I learned that when designing for children, it is important to test the concept in an early stage. Therefore, I took the responsibility of organizing the user test which helped me to improve my communicating skills. When testing a concept, I learned that it helps to think about the possible actions of the child beforehand. By doing a user test, I learned that it shows how children interact with the prototype which helped me to improve the concept.

By applying business tools to our design, I learned to find potentials for business. The business tools helped me to include stakeholders and their values. When working on the canvas business model, I learned that it is important to include a financial calculation. These business tools helped me to create a good business strategy which was especially important to our project since our client is not the end-user.

Finally, by making the process booklet which was demonstrated during Demo Day, I learned how to visualize our iterative process. Also, I improved my visual skills by designing the visual booklet. I learned that visual material such as the process booklet and many prototypes helps me when presenting. Besides, this visual booklet gave me a clearer overview of the process and thus helped me to write a structural report.

### Future steps

In conclusion, I learned that involving competitors and stakeholders helps me during a design process. In this project I focused on the business part, organizing the user test and visualizing our process, because I was not confident about my programming skills in the short period of time we had left. In future projects, I want to do more programming and I want to be more involved in building aesthetically pleasing prototypes. Improving both skills will contribute to my development as designer and will contribute to a better user experience.

## Maxime Vallentin | s150071

During project two I learnt a lot. I also gained a lot of new experiences and developed many extra skills. During the project I focused a lot on my own PDP goals. And with results. An important goal from my PDP was Business and entrepreneurship. I have learnt a lot during this project about this. Because my fellow group mates had the same PDP goal, we made an extended business plan and applied new methods we learnt during this project. I also participated to the business workshop of Mitchell Jacobs, which was very interesting. We learned new techniques and examples. Also because we had a lot of contact with a real company and I got the chance to ask a lot of my questions to them and got more insights. I really improved this skill and extended my knowledge a lot.

Another PDP goal was getting more knowledge about Production Lines. During my visit at PlayNetic I have learned a lot about this as well. The employee of PlayNetic had explained me everything about their production line and give me much more insights in this particular subject. When making our business calculation I could easily apply everything I had learned. This made me much more confident about this skill and about the results of the business calculations.

Besides this, I also focused a lot on programming, this is also an important PDP goal of me as well. We made a lot of prototypes, three with a program. So I put many hours in this part of the project to get everything working and with success. With the result, all the prototypes are working properly and I improved this skill a lot by asking a lot to Google and a couple fellow students. I now know much more about how to program and I am much better in reading codes and finding errors.

Beyond those PDP goals, I improved many design and communication skills. In my previous projects I learned that working in a group can be difficult. And I learned a lot from these projects, this was the first time I used so many from my learned skills in practice. Using those skills gave me a lot more self confidence while leading a meeting. In all our meetings we set a goal and had an agenda of that meeting. So working in such a structured way was very pleasant and I learned from it how group work sometimes can be. Working this structured makes making decisions also much more easy, because there is a much better overview. We also have had difficult times. When the group found it difficult to not doubt on the joined goal we made. Here I learned that sometimes doubt is dangerous and it is better to finish a goal you set as a team, than reconsider a goal and start all over while you are already are busy to finish the goal. Most of the time you, as a group, are going in the right direction. Turning back is can be dangerous.

Working in this group was very pleasant, we all respected each other and worked nicely together. Everyone took his own responsibility. I like the end result a lot and think we made something nice.

## Moos van der Bijl | s164299

A reflection about my personal development during this semester and project. Through this project I learnt a lot. Furthermore I got closer to accomplishing my PDP goals and got to improve my vision and identity by the experience of this project. The personal focus of everyone in the group was on accomplishing his/her own goals by doing a lot of group work and visiting other related companies. There are things that went well for me personally, things that I have to improve on for the upcoming projects and things that I have learned from my team members and the design process itself. In this reflection I will take the past, present and future into account.

Almost right after the start of the project, we already knew what we wanted to design for. I found it quite rare for that we had chosen a problem and a corresponding design this quickly. We went through a few design brainstorm sessions and got to the idea of creating an interactive playground. In this design process I had the feeling that we were free choose how often we wanted to go through the cycle of design. We went multiple times through the cycle of design and that was something which I found far more interesting. I like the idea of going through a design process multiple times, to spot the main flaws of the design and reshape them in the best possible way. In this way it differed from last year's project, since I feel like that project was more so to give us a feeling of what it is like to go through an entire design process.

There were multiple different skills (with corresponding goals) that I wanted to develop in this design project. I wanted to develop my sketching skills (C&A). Mostly in the first stages of the project, with deciding on what form and so on, I made a lot of sketches which gave me more experience in the different forms. I developed my knowledge about the different design programs (T&R), I mainly worked with Adobe Illustrator. I needed this program for laser cutting most of the parts of the final prototype. I enormously enjoy laser cutting, since everything exactly fits and it gives an amazing look. I still want to develop my programming skills. In this project I barely programmed something, since I was very busy with finishing the prototypes, which also gave me a lot of experience with different materials and laser cutting. I also made a video (C&A), which probably will be shown at the end presentation. This was already a goal of mine last year and so far I have edited four videos, two videos for Design Research, one for my USE line and one for Project 2. I think I have developed myself quite a bit in this area, since I barely had any knowledge about it last year.

As you can see I have developed myself in C&A and T&R a lot, however I have also developed my B&E and U&S. I have developed myself on business side of design a lot. This was mainly by visiting the company Playnetic. By visiting them and getting the chance to see how they handle a design process, what their production line is, how they sell their products to other companies and how they do user tests, was really inspiring. Asking questions and everybody being excited, caused that we all gained a lot of knowledge about the business side of design. They were quite enthusiastic about our product, which boosted our confidence.

We did two user tests and evaluated them both, which gave me more insights in how to handle kids with user tests and how to treat them. The user tests were a big part of our design, since we really needed the approval, that kids would immediately play with it and would start making their own games right away. I learned that user tests are key when you want to upgrade your old prototype to something better and more understandable.

I learned that a good pitch can seal the deal. With which I mean, that a good pitch and a structured pitch is vital to deliver your concept in the best way possible. I didn't have

any problems with the team work, I found that we all worked really hard to deliver something we were all proud of. It was nice that sometimes someone took the lead in the meeting to make it more comfortable. Sometimes, we didn't know how to continue, however it was due to a schedule and good meetings that we made it. I learned that you sometimes think you have enough time to make a whole prototype. In our case, we wanted to make four different beacons again, however it was best to show every detail of the entire design in a different way: making one beacon to show the functions and the look of just one beacon and using a drawing to show the entire playground.

All things considered, I learned a lot in this project. I have adjusted my identity and mainly my vision in such a way also by the experience of this project. I went further in accomplishing most of my goals and got a little bit closer to a good designer in my eyes. I am very excited to use all the different experiences in other projects to become a better designer.

# APPENDIX II

## Problem Definition

### Questions to answer:

#### What is the problem?

- a) Children are sitting too much inside nowadays (eg. due to games and electronics).
- b) The playground (outside) becomes boring, because in comparison to computer games, there is not much interaction between the play equipment and the child. Children might not be (enough) challenged in the playground, play equipment might not be interesting enough.

#### Who has the problem?

Children, age 8-12

#### What are relevant context factors?

Playground and playing equipment in the playground, other children playing in playground, computer games at home, social media, distance from home to playground, weather

#### What are the goals?

Making playing in playground more interesting (and perhaps more social). Using space efficiently, creating more 'layers of play' for different ages.

#### What are the side effects to be avoided?

Different age groups playing at the same time and disrupting each other's game, some children might be excluded from the game, interaction not interesting enough, children do not understand interaction, interactive playing equipment might get damaged (not 'huffer-proof')

#### Which actions are admissible?

Creating an interactive playing environment for children in the playground. Test if children like/understand it. Create more 'layers of play' so that different (groups of) children can play together as well as alone.

# APPENDIX III

## Hypothetical Personas

### Background interviews

#### Interview 1

This girl likes to play on her own. She prefers to be on the swing when she is in a playground, because she likes to go up and down through the air. She points out that the slide is difficult to enter for her small brother who is 3 years old.

#### Interview 2

This girl is sitting on the seesaw with her younger sister. She likes to go to the playground in her neighborhood. There she enjoys doing somersaults. She also enjoys the swing, because it goes really high into the air. She often plays with friends in this playground or they come up with games played on the street. She likes to come up with her own games, because she is very creative. They also play existing games such as hide-and-seek.

#### Interview 3

This boy likes to play soccer with his friends at school. Also, he plays together with his friends in a parc. They play games using a football like "baltikkertje". They do the same kind of games each time. So they do not come up with new games, but keep playing their old fun games. He would like a place where he could play football.

The father of this child really liked our concept, because the children could decide what to do with the product. Also, he points out that he found playing on the street more fun than the predefined playing equipment such as a slide which is designed to slide. When he was young, they had fun with just a football, playing together. However, children using static playing equipment often play individually. He also thinks that children will be eager to find out how the lights work.

He joins the other children during lunch breaks. Probably this is because he cannot play games at school. Nick thinks the games are good, because he likes the stories which he could not have created on his own.

# PERSONAS

## Furqan

Furqan is a ten year old boy who likes to go to the playground. However, sometimes he is not allowed to play along because he is not that good in sports. As a result, he watches the game instead of playing in the game which he would have loved to. He is not good in making his own story and he thinks he is too old to use the equipment in the playground. If he was a bit tougher, he could have joined the game. Instead, he just stands there not able to improve his skills.

## Yasmin

Yasmin is a nine year old girl and she likes to create her own stories. She is a very popular girl with lots of friends. She is not good in sports, so she likes to use her fantasy while playing. She can play with others as well as on her own. The location does not really matter to her, it is the story that matters.

## Sam

Sam is a five year old boy and he is good in sports. He likes to play soccer. He is very competitive and likes to be in the winning team. He sometimes dismisses someone of his team, because this person is not good in playing soccer. So he likes to play with other children, but not all of them. He prefers playing in a field near the playground, because of the goals which they can use to play soccer. He could always join the game, because of his good soccer skills.

## Nick

Nick is a seven year old boy and he does not like to play at a playground, because he prefers gaming. He is not good in sports and does not practice these skills. Instead, he sits behind his Ipad and his parents give him money to buy the games. However, at school he joins the other children during lunch breaks. Probably this is because he cannot play games at school. Nick thinks the games are good, because he likes the stories which he could not have created on his own.

# APPENDIX IV

## Business Aspects

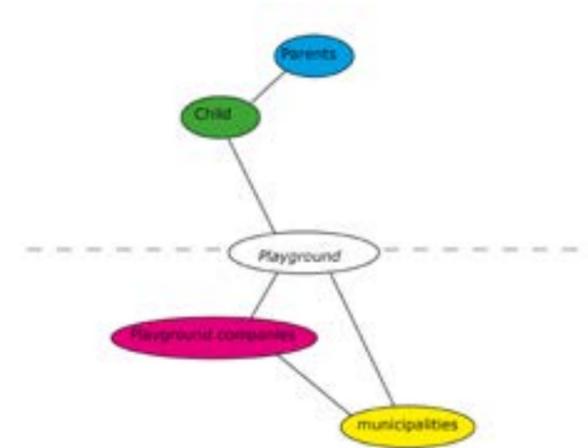


Fig 1. Map of stakeholders

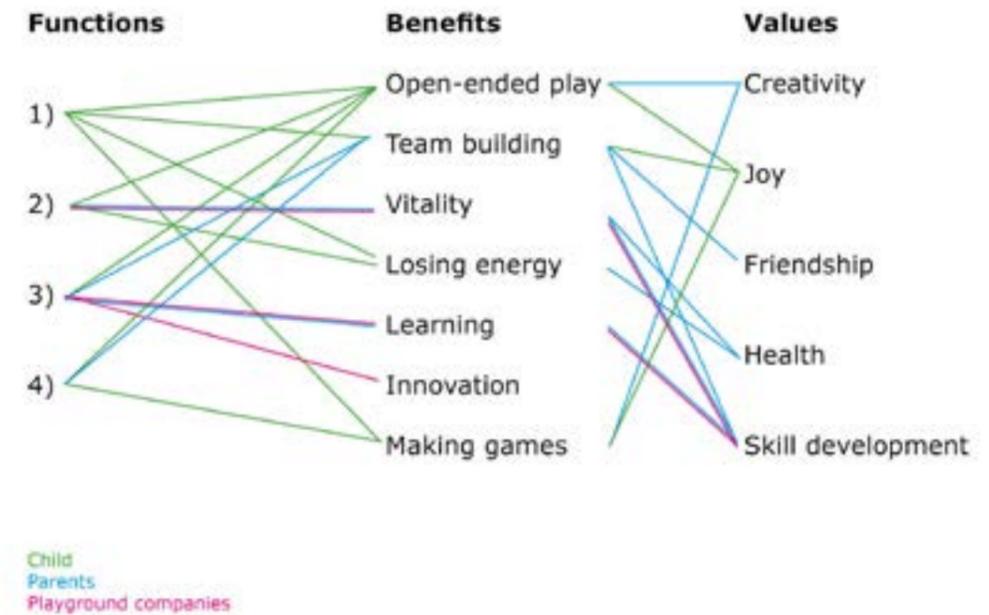


Fig 2. Value ladder



Fig 3. Benchmark

### SWOT analysis

#### Strengths

- Multi-functional
- Encourages physical activity
- Developing skills
- Team building
- Assembly place

#### Weaknesses

- Not yet environmentally friendly

#### Opportunities

- Adaptable
- Not many comparable products

#### Threads

- Too expensive
- Not recognized as playing object
- Too difficult
- Could get damaged
- Becomes boring over a period of time

Fig 4. SWOT analysis

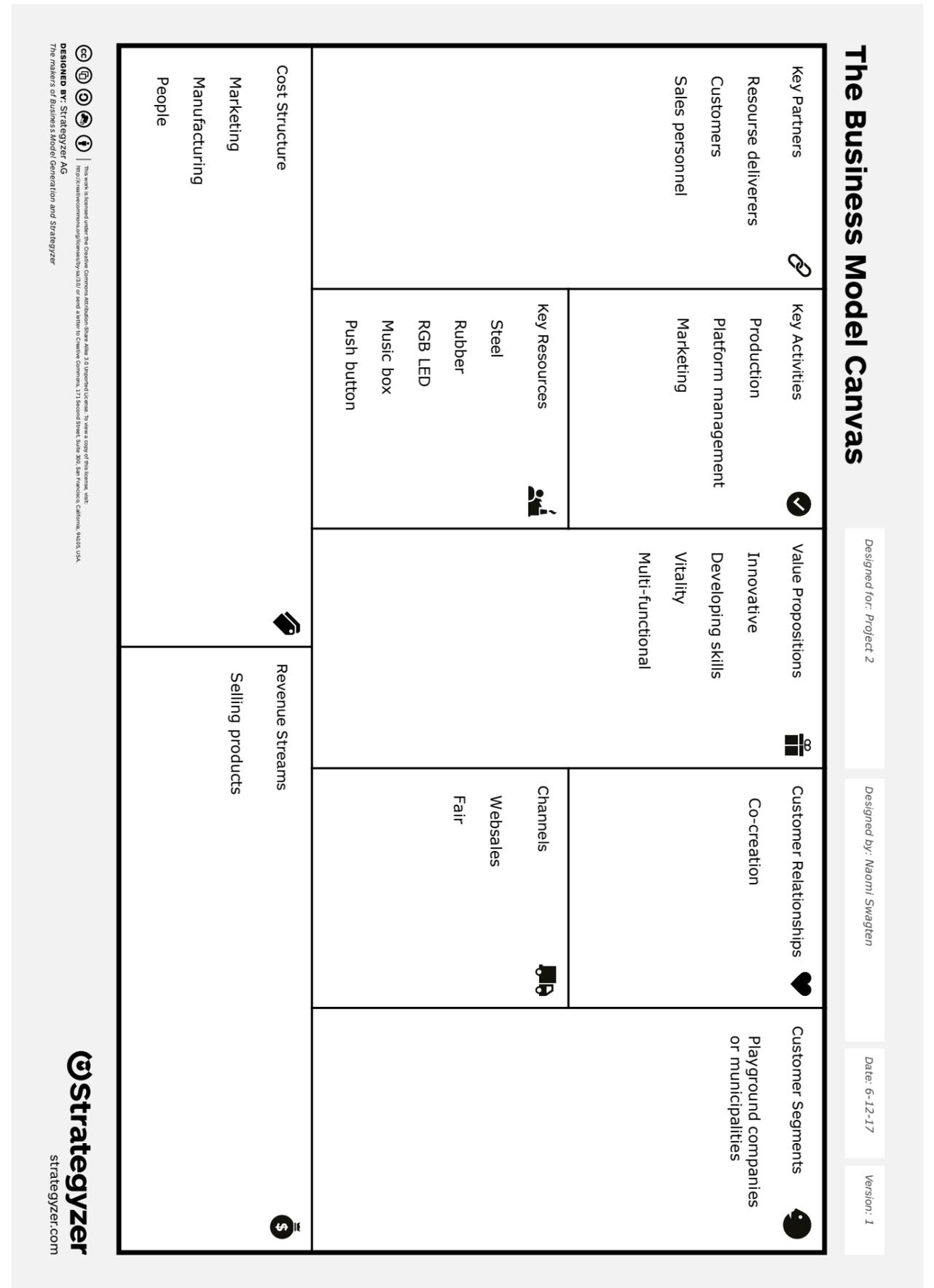


Fig 5. Business Model Canvas

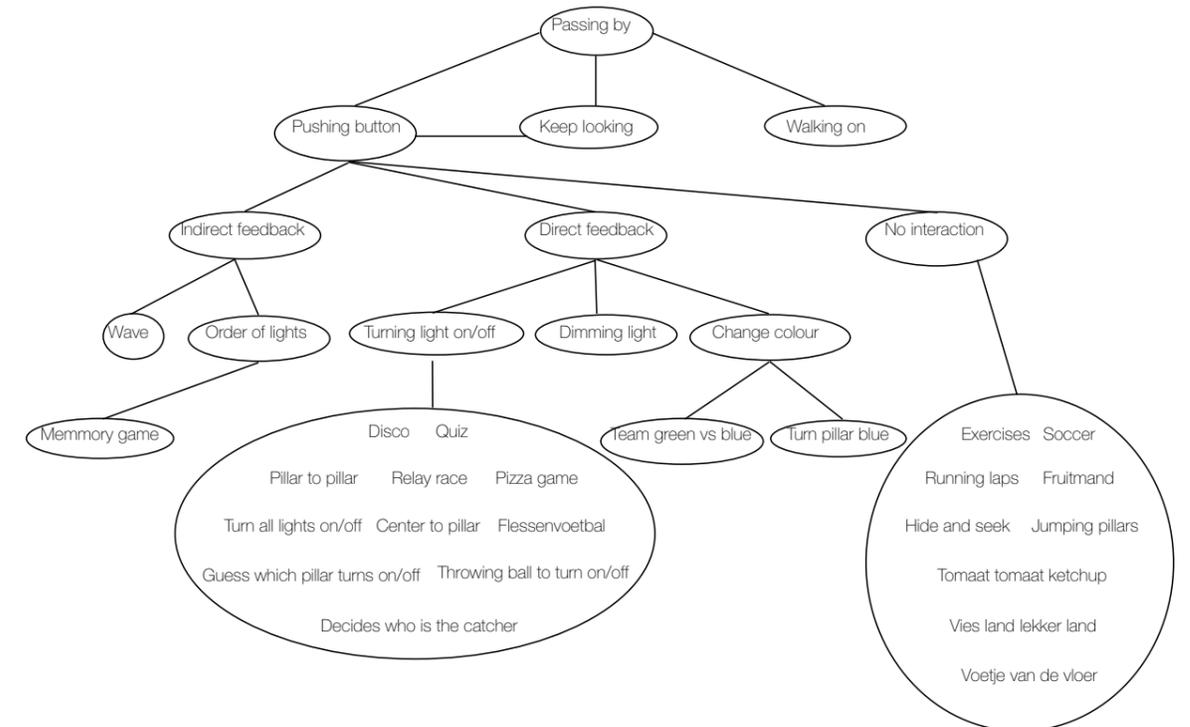
## Business Calculation

	Euro inc. VAT
Painting	€ 275,00
Synthetic resin (Poly-pox-uvg 503)	€ 150,00
Central computer + light meter	€ 110,00
4x LED Light 2 Watt	€ 30,00
4x 5meter Cabling	€ 150,00
Rubber heavy duty outdoor floor 100m2	€ 2.200,00
Metal Housing	€ 3.000,00
Buttons	€ 335,00
Sound System	€ 80,00
<b>Material + labor costs</b>	<b>SUB-total: € 6.330,00</b>
<b>Assembly costs</b>	<b>€ 240,00</b>
<b>Development costs</b>	<b>€ 2.000,00</b>
<b>TOTAL:</b>	<b>€ 8.570,00 incl VAT</b>

Fig 6. Business calculation

# APPENDIX V

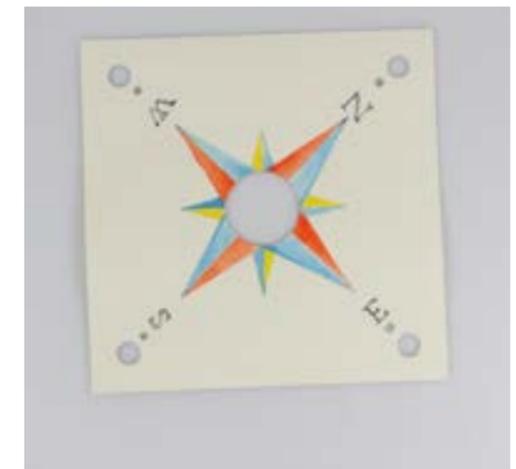
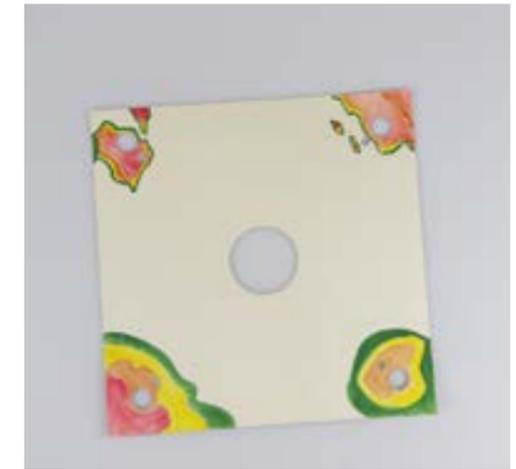
## State Chart



The state chart gives an illustration of the possibilities of action a child can encounter when playing with Lighthouse

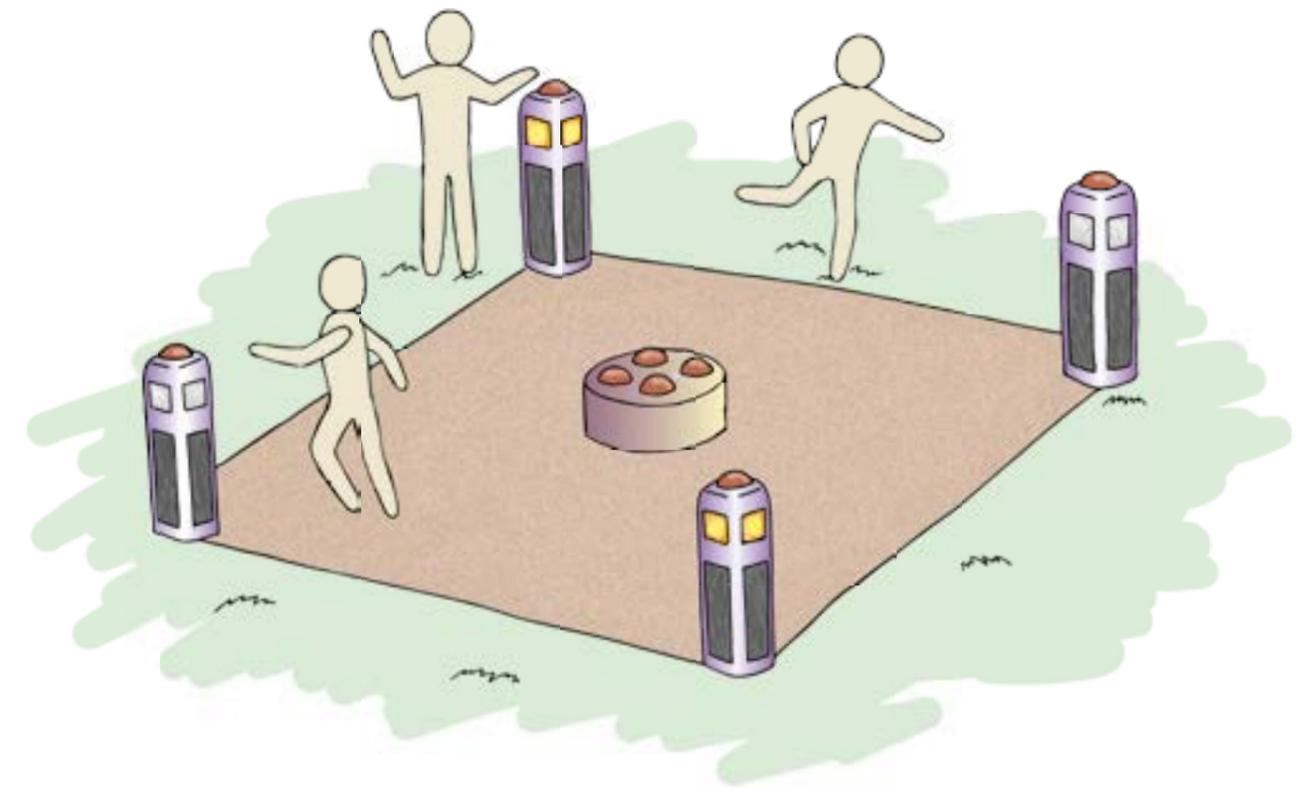
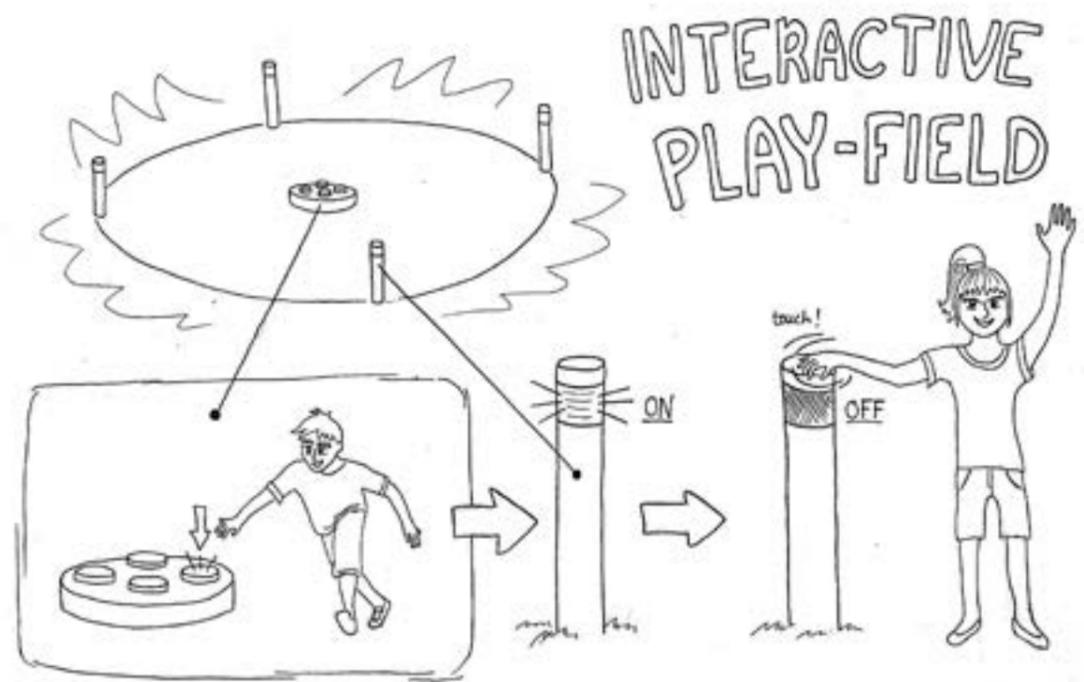
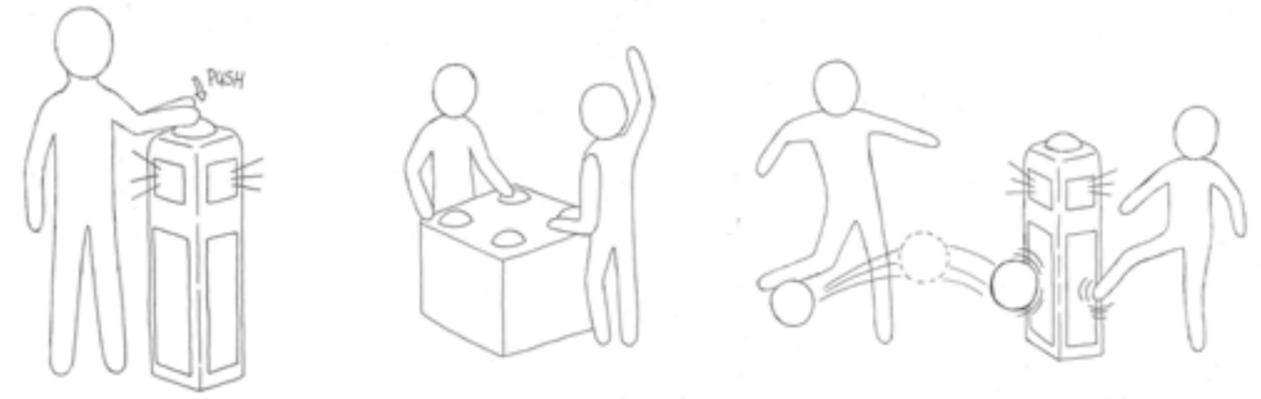
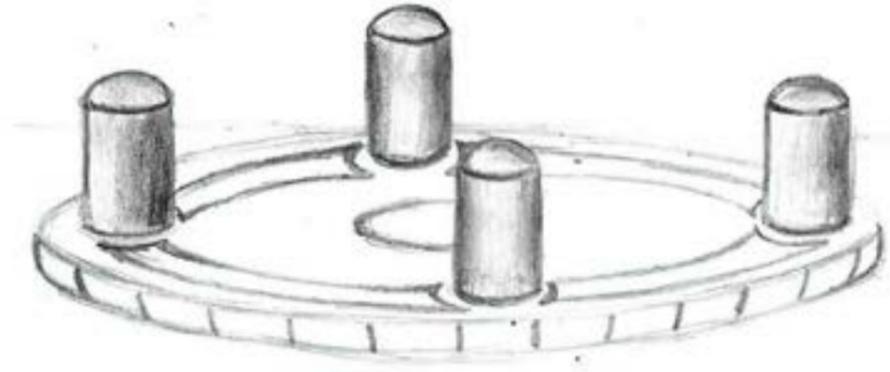
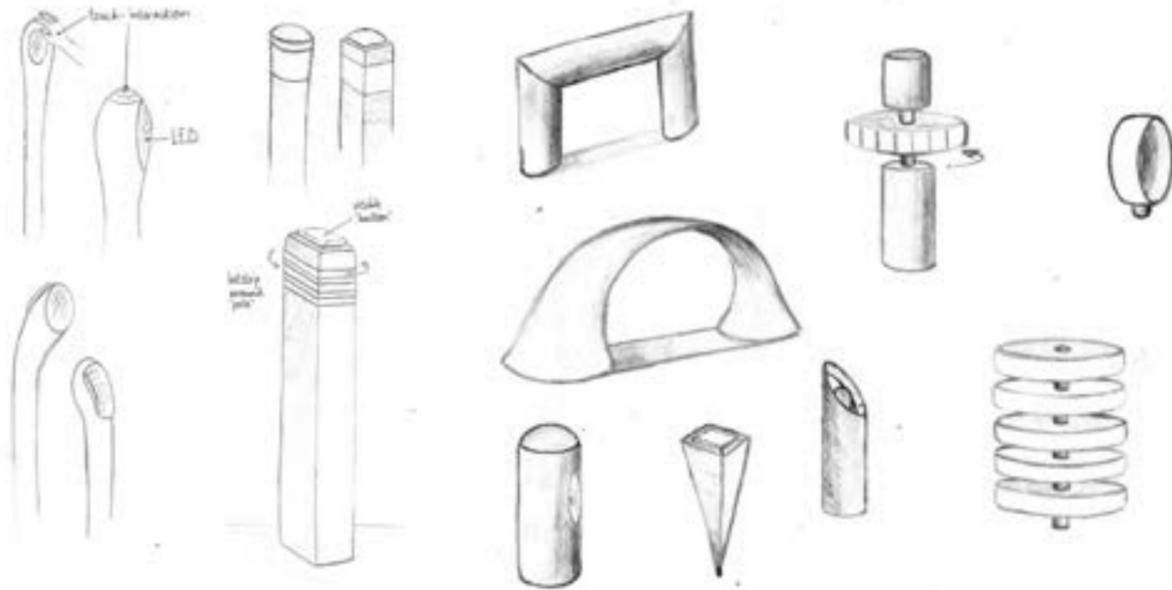
# APPENDIX VI

Adding context to design | exploration



# APPENDIX VII

Sketches



# APPENDIX VIII

## Low fidelity user test | scouting

### Low Fidelity User Test

14 oktober 2017 - children 5-6 years old

#### User group

Four children, two girls and two boys. The children were 5-6 years old

#### Game 1: run to the light

Description for prototype

Lights of the pillars from our playing field go on at random. Children are supposed to stand in the middle of the field (next to the panel, see description concept 1) and run to the pillar that goes on.

Description simulation with low-fi prototype

Children are in the middle of a round field. Four group leaders at the same distance from the middle (the children), about 20 meters. They all have one large coloured piece of paper in their hands, they hold low. In turns, they will hold the piece of paper up, clearly showing them to the children. Then the children should run to that group leader. Perhaps: child who is last should quit the game, until one is the winner.

Goal: trying to reenact the random function. Observe whether children understand the random function. Do children make mistakes? (usability)

#### Game 2a: pushing the buttons to change the colour

Description for prototype

Lights of the pillars can be turned on by pushing on the button, and they can be turned off by pushing again. Children should play in two teams, one team 'on' and one team 'off'. Six pillars are 3/6 on. The 'on' team should try to make them all on, the 'off team' should make them all off.

Description simulation with low-fi prototype

On-off is replaced by cards with two sides: one red side and one blue side. The children can turn the cards to the other colour. Children in teams: one team red and one team blue. Teams should start at the same time and try to make all the cards their own colour. At the beginning, 3/6 card is red and 3/6 card is blue. Cards are in a large circle.

Goal: trying to reenact the on-off function. Observe whether children understand the on-off function. Do children make mistakes? (usability)

Small interview:

(pleasure)

Which game do you prefer? And why?

Which game was more easy to understand?

#### Game 2b: making your own game

Description

Children should come together and get the task to be 'the group leader for one time!' That means that they can make their own games. First, two questions are asked:

Which games do you like?

What games could you come up with to do with the two-sided cards?

Children should discuss and in the end decide a game which can be done with the cards (making decision with help of the team leader). This game can be carried out.

Goal: observe whether children of this age make up their own games.

- how long does it take for the children to come up with a game? Do they need a lot of help from the group leaders?

- Is there one child who takes the lead in this? Or is there a clear 'discussion' between all the kids.

-What kind of game do the children come up with?

-What do the children like more: making their own game or playing the games we made up?

#### Hypothesis

Bias: children might be familiar with playing this kind of games

Children of this age will find it difficult to make up their own games in a group setting. Also, the scouting children are used to listening to the group leader and following his/her instructions for games.

Because the element of 'interaction technology' misses in this low-fi user test, this test does not give us a realistic view on how children will interact on our high fidelity prototype. Children this age might find the lights more 'magical' or amusing, and that might encourage them to behave in a more exploring way and come up with more new games.

## Results

#### Game 1: run to the light

Observations

At the beginning, the children understood the game well. However, it took a few try-out round before the children fully understood the game. In this period, a few mistake were made, such as 'not running' or doubting whether to run or not. After this period, the children became more playful. They were looking attentively to the group leaders acting as the pillars. The children became more competitive when the dropout game was introduced after about two minutes. It was noticeable that the children did not seem to mind when they dropped out, they liked it as part of the game. The fastest kid was not always (though often) the first to reach the group leaders, because attention was also of great importance. After a few rounds, the children participated every time and did not stand still in the middle. The dropout game was repeated multiple times, and after the third time, they became less interested and the game was stopped.

#### Game 2a: pushing the buttons to change the colour

Two-coloured cards were replaced by cards with a cross on one side, and no cross on the other.

Observations

After explanation, the children immediately understood the game. They did not make mistakes and constantly turned the cards right. At the beginning, the children were com-

petitive and tried to run as fast as possible. The circle made had a diameter of about 10 meters and it seemed to be not too small or too big. After about 2 minutes, the children began to lose interest in the game, but they did not stop with it. Thirty more seconds were given before the game was stopped. When it finished, the children were eager to see which team had won.

#### Comparison

The children liked the first game better, because it was less monotonous. They had to keep attention in the first game, in the second game they had to do the same thing for the whole period. They liked the second game at the beginning, but not at the end. In the first game, the end might even be more exciting, because it revealed the winner. However, the second game was more easy to understand for the children.

### **Game 2b: making your own game**

#### Observations

The children immediately started to come up with already-known games, but they were out of the context of the circe with cards (for example, hide and seek). At some point, one of the children came up with a swap-place game, but none of the children was enthusiastic to discuss it and form a new game. The children were quiet when asked if they had any idea for a new game with the cards. They did not form a discussion, but only shouted individual answers. There was not one child who took the lead or came up with more answers. Even with the help of the group leaders, they did not want to make their own game and play it.

### **Conclusion and discussion**

#### Game 1 and game 2

Games were relatively easy to understand with an explanation of the group leaders. It is not known if the children would understand the games if there was no explanation given.

What do the children like more: making their own game or playing the games we made up?

The children did not understand the idea behind game 2b. They did not want to make their own game with the cards in the circle. Therefore, they preferred already made up games. Thus, it turned out that the low-fidelity of the user test did not encourage the children to explore different options. As a result, the children preferred already made up games. In addition, the age group could be too young to form a discussion about new made up games. Moreover, in this setting (scouting) they were not used to making their own games, because their group leader creates games for them every week.



# APPENDIX IX

## High fidelity user test | primary school Eindhoven

### Purpose

We wanted to improve our prototype based on the results we gathered at the user test. We wanted to get to know what children do with our product in the different phases and how we can improve this experience. The question which we wanted to answer is whether children like creating games by using this product.

### Set-up

#### Participants and Method

Twenty children, aged approximately 10 years, took part of the user test. Groups of four children were asked to test the product which gave us a better understanding on which games were created and whether this open-ended playing object works. Next, a small interview took place to gather a better understanding about whether children enjoyed creating games.

#### Observation

The children were asked to play with the product. When a child asked what he or she needed to do, we told him or she to just play. During the observation (which is 20 minutes per group) we made notes about whether the children noticed the design, what they did in the exploration phase and what games were created.

#### Observation questions

- Do children use the pillars?
- Do children notice the design?
- How much time does it take to come in action?
- What do the children do in the exploration phase?
- Do they try out the action?
- Do they try out different actions?
- Do children create games?
- Which games were created?
- Were these games played individually or in a group?
- Do children get bored?
- Do they get back to the exploration phase?

### Open interview

After the observation, the four children were interviewed in a group. The following questions were asked (Dutch):

1. Wat vond je leuk aan het speeltoestel? Wat vond je niet leuk?
2. Vond je het moeilijk? Wat vond je moeilijk?
3. Kon je zelf spelletjes verzinnen? Vond je het leuk om zelf spelletjes te verzinnen of vond je het leuker om instructies te krijgen van ons?
4. Zou je dit in de speeltuin willen bij jou in de buurt?
5. Zou je het leuker vinden als het wordt aangepast? Bijvoorbeeld door een geluidje/muziekje erbij?

### Results

After asking the children to play with the product, children were already pushing buttons to try to figure out what he or she could do with the product. In the exploring phase, children also look at others to try to figure out for themselves what to do.

In total, nine games were created. These games included a lot of running and were played within a group. Most common games were running from a pillar to pillar, or pushing the buttons while running.

Four different roles were distinguished; a leader creates games, a listener listens carefully to the rules the leader comes up with, a competitive teammate is really enthusiastic about a game and finally an individual player comes up with his or her own games.

### Discussion

When observing children, we noticed that the children used the pillars immediately when noticing the design. The children liked playing with the lamps because they were not allowed to do this at home and it gave quick and easy feedback. Also, it did not take long before they began to create rules and games. The children were enthusiastic about the playing rules and tried to create new games. These games were played including the whole group and included running. When someone was tired, he or she was allowed to stand next to the middle panel so that he or she could still play along. Sometimes a child was teasing, but the other children propose him/her to stop bending the rules.

Sometimes only one child was in charge to create the games, but children also switched roles so that they can all be in charge of creating games. The children listened carefully to the one who creates games and tried their best to follow the rules. Since they were all playing their own games and thought the other children were playing the same games, they did not know that their games varied a bit. Besides some games were competitive games, but they did not know who was winning since they all played their own game. In addition, there were a few conflicts when choosing a game.

However, the children could be more excited to play games, because the user test took place during their mathematics lessons. Also, the fact that the children were chosen randomly could have influenced the results since most children normally go to a playground together with friends. Besides, the user test took place at a primary school which is a different context than a regular playground.



# APPENDIX X

Consent form | primary school Eindhoven

Contact:  
[n.swagten@student.tue.nl](mailto:n.swagten@student.tue.nl)  
[i.g.c.v.vugt@student.tue.nl](mailto:i.g.c.v.vugt@student.tue.nl)



## User test toestemmingsformulier

### Doel van de test

Het design team wil door middel van deze test een idee krijgen of het design concept van een interactief speeltoestel werkt in de juiste context, namelijk een speelomgeving voor kinderen. De resultaten en observaties van de test worden uitsluitend gebruikt voor het verbeteren en/of veranderen van elementen van het ontwerp.

### Wat wordt er van de kinderen verwacht?

De test zal ongeveer 25 minuten duren per groepje, waarin we de kinderen het interactieve speeltoestel zelf laten gebruiken. Het design team zal de kinderen eventueel een opwarmingsspel geven aan het begin van de test. Daarna zal het team de kinderen een aantal vragen stellen over hun ervaring met het speeltoestel, dit zal ongeveer 5 minuten duren. Van de kinderen wordt verwacht dat ze instructies van het design team opvolgen en het speeltoestel gaan gebruiken op een explorerende manier. Er wordt ook van de kinderen verwacht dat ze de vragen van het design team beantwoorden (mits ze zich daarbij op hun gemak voelen).

### Is er enig risico gerelateerd aan de test?

Er is geen risico gerelateerd aan de test, het speeltoestel is opgesteld op een veilige manier. Alle elektronica zijn op een veilige manier geïnstalleerd.

### Wat is de doelgroep voor de user test?

De doelgroep voor de user test is kinderen (leeftijd 5-12) die vrijwillig willen meedoen aan de test.

### Wat gebeurt er met de resultaten van de test?

De resultaten van de test zullen uitsluitend gebruikt worden voor design evaluatie en mogelijk voor een presentatie aan de TU/e.

### Leden van het design team

Naomi Swagten, Moos van der Bijl, Maxime Valentin en Iris van Vugt

### Foto en video materiaal

Tijdens de test kunnen de kinderen gefotografeerd of gefilmd worden om het design team te helpen met het analyseren van hun gedrag.

- Hierbij geef ik toestemming voor het filmen en/of maken van fotos die gebruikt mogen worden tijdens presentaties.
- Hierbij geef ik toestemming voor het filmen en/of maken van fotos, alleen het verbeteren van observaties en persoonlijk gebruik.
- Ik geef GEEN toestemming voor het filmen en/of maken van fotos.

Naam van test locatie:

De Bijenkorf

Naam contactpersoon:

Stephanie Derjpeeh

Datum:

21-11-2017

Handtekening: