The design of conceptual interactive play sets for the outdoor public environment

Appendices master graduation assignment

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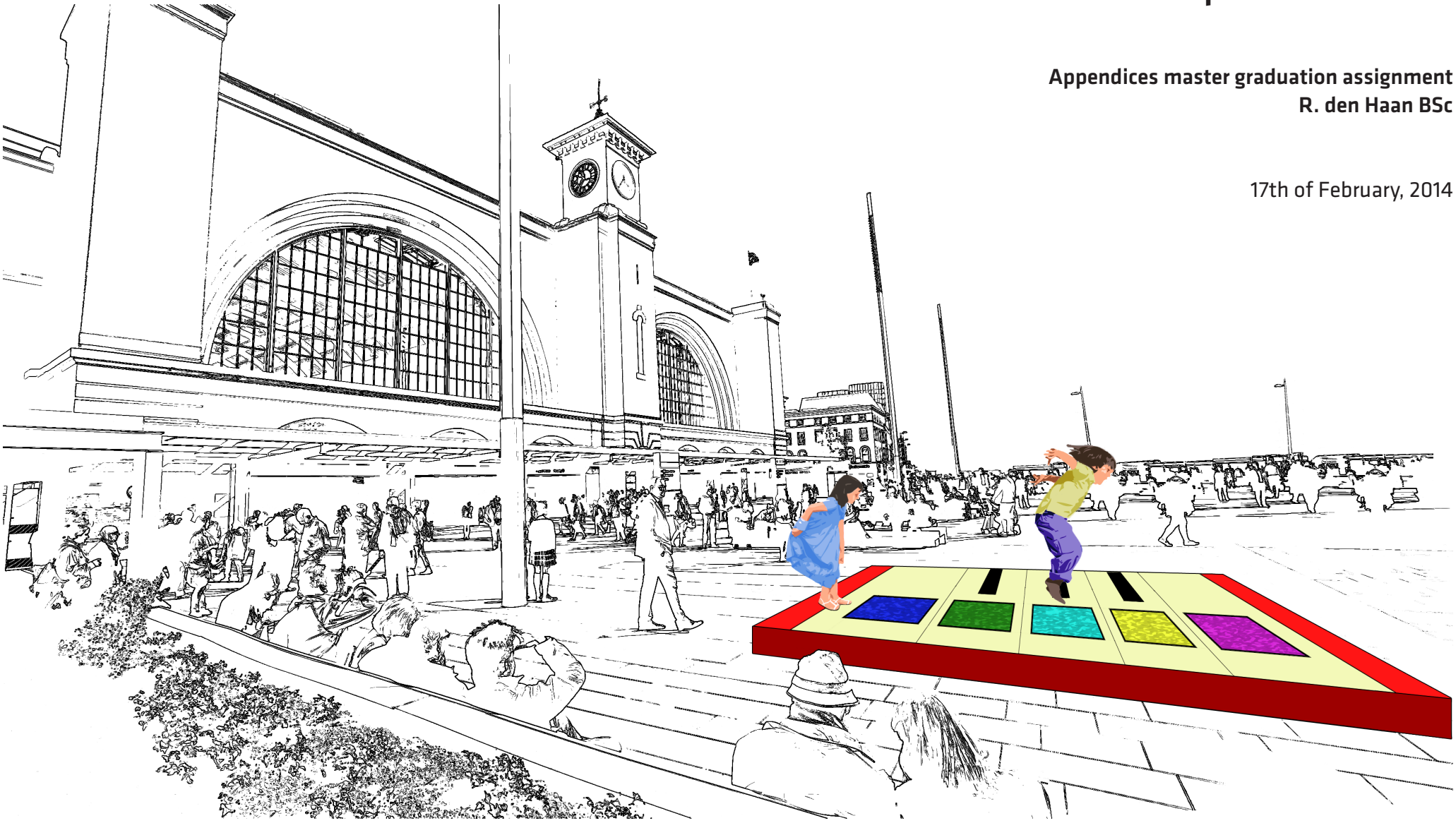

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Actor Analysis

Playnetic is a company located in Zutphen, The Netherlands. Playnetic is currently a manufacturer of as well as supplier and partner for innovative products for use in the public environment. It is Playnetic's mission to become a platform of knowledge and development with solutions for social issues relating to the public environment.

Playnetic's expertises lie within interactive playing and supplying audio information in the outdoor public environment. These two expertises are also the market segments in which Playnetic is currently active. Within these market segments, Playnetic currently offers three products. Unique selling point of these three products are the use of kinetic energy of the user to produce the electrical energy for the products; they are 'human powered'. Furthermore, since the products are placed in the public environment, they are all designed to withstand weather conditions and to be 'vandal proof'.

- The Audionetic provides audio messages in the public environment. It can for example be used to provide information on interesting locations alongside a walking or cycling route or provide playing ideas at playgrounds to children.
- The Audiotile also provides audio messages in the public environment. The Audiotile differs from the Audionetic in its shape; where the Audionetic is shaped as a column rising above the ground, the Audiotile is integrated in the ground in the form of a single tile. As such, the Audiotile can be used for the same places and provide the same functions as the Audionetic, but it can for example also be used as marketing tool for companies. It is however not a human powered product; it runs on batteries.
- The Gamenetic is in essence a product extension of the Audionetic. Where the Audionetic uses the generated electrical energy to play audio messages, the Gamenetic uses this energy for playing games.

Playnetic is currently prototyping a fourth product within the segment of interactive playing. Furthermore, Playnetic also provides custom solutions to third parties within their areas of expertise.

Playnetic looks at the outdoor public environment as an important part of our lives; a large portion of our life is spent outside, on our way to work, to friends, to do grocery shopping or simply for playing and relaxing. Playnetic wants life in the public environment to have a positive effect on our well-being. As a manufacturer, Playnetic's products should contribute to a better public environment; life outside should, besides being functional, be enriching our intellect as well as supporting better personal health.

The interest of Playnetic in this project is to create a 'product plan', a concrete plan for developing a range of products

within the market segment of interactive playing in the public environment. Playnetic has a vision on where the company wants to be within this segment in a couple of year's time, the plan that is to be created should function as a guide to go alongside Playnetic's business plan.

Project Framework

Research of TNO has shown that 14% of the boys and 17% of the girls aged four to fifteen in the Netherlands are overweight (TNO, 2006). This percentage is twice as high as it was in 1997. This situation in The Netherlands is considered to be a good representation of other western countries as well. The western societies recognise this problem and are looking for solutions to tackle it. Stimulating physical exercises is one of the main accepted solutions. More and more funds are made available to finding these types of solutions at different levels of society; from schools to municipalities. One of the main reasons why children are exercising less is the (gaming) computer. Children spent more and more time behind the computer or gaming console.

Furthermore, Playnetic believes that conventional play sets are no longer in connection with the perception and the need for incitement of children. Their perception has rapidly evolved and the playing industry has not followed this evolvement.

Playnetic wants to solve these two problems by bringing the gaming computer to the outdoors and incorporate it in the public environment by developing interactive play sets. Play set manufacturers are starting to develop interactive play sets and the market is gradually opening up to these types of play sets. There are a few competitors on the market in The Netherlands, but they are operating at a higher price range than Playnetic is and at the same time do not support the unique selling point of 'human powered' that Playnetic offers. Playnetic currently has no direct competitors; in fact, the previously mentioned play set manufacturers in the Netherlands are also partners of Playnetic. Playnetic does expect competition in the near future and wants to stay ahead of this competition by using its technological advantage to have more products on the market than its competition.

Ultimately, Playnetic wants to become the market leader in the segment of interactive play sets in The Netherlands, which also requires Playnetic to expand its product portfolio and to become active in other western countries.

Assignment Goal

The purpose of this project is to develop a range of conceptual interactive play sets for Playnetic in order to be introduced between now and ten year's time. The range of these new concepts aims to push Playnetic's interactive play sets to the next level of interactivity.

The goal will be reached by analysing the past, present and future of playgrounds and play sets, by observing children playing outside, by analysing child development, by analysing the market developments and using these to create an outlook on the future for Playnetic. Using this outlook, as well as concept ideas generated in parallel, product ideas will be created. Global product requirements will be stated by analysing the technology that Playnetic currently has as well as will likely have available in the future, both for their products and for their production methods, by

analysing the ISO/NEN requirements on the safety of play sets and by defining the brand 'Playnetic'. These product ideas and global product requirements will be translated to a range of conceptual products with the support of innovation techniques such as 'Platform Driven Product Development' (PDPD), 'Innovative Design & Styling' (IDS) and 'Theory of Inventive Problem Solving' (TRIZ). The range of conceptual products will be supported by a step by step introduction plan of the products themselves.

These activities will be performed between January 2013 and October 2013.

The deliverables of the project will be:

- A future outlook on the public environment with respect to playgrounds and its play sets
- A range of conceptual products presented in the form of a catalogue
- A road map on how to further develop and introduce these products over time

Ultimately, the range of conceptual products and the road map will aid Playnetic in staying ahead of its competition and in becoming the market leader in the market segment of interactive play sets. Additionally, with the future products mapped out for Playnetic, the requirements for parts such as the electronics will be known. The electronics can subsequently be developed in such a way that they are able to function in multiple products.

Research Model

Figure A.1 shows the research model of the project.

Inquiries

1. How will playgrounds look in ten year's time?
   a. What has been the development of playgrounds up until now?
   b. What factors contributed to the development of playgrounds in the past?
   c. What factors are expected to influence the development of playgrounds in the future?
   d. How are these factors going to develop in the future?
   e. What developments in society can be observed?

2. How will play sets look in ten years time?
   a. What has been the development of play sets up until now?
   b. What factors contributed to the development of play sets in the past?
   c. What factors are expected to influence the development of play sets in the future?
   d. How are these factors going to develop in the future?
   e. What developments in society can be observed?

3. What are the opportunities for interactive play sets between now and ten years?
   a. How do children use the playground right now?
   b. How do children use play sets right now?
   c. How are children evolving physically?
   d. How are children evolving spiritually?
   e. How are children evolving socially?
   f. What excites children?
   g. What types of interaction are children familiar with at different ages?
   h. How can children be encouraged to perform physical exercise?

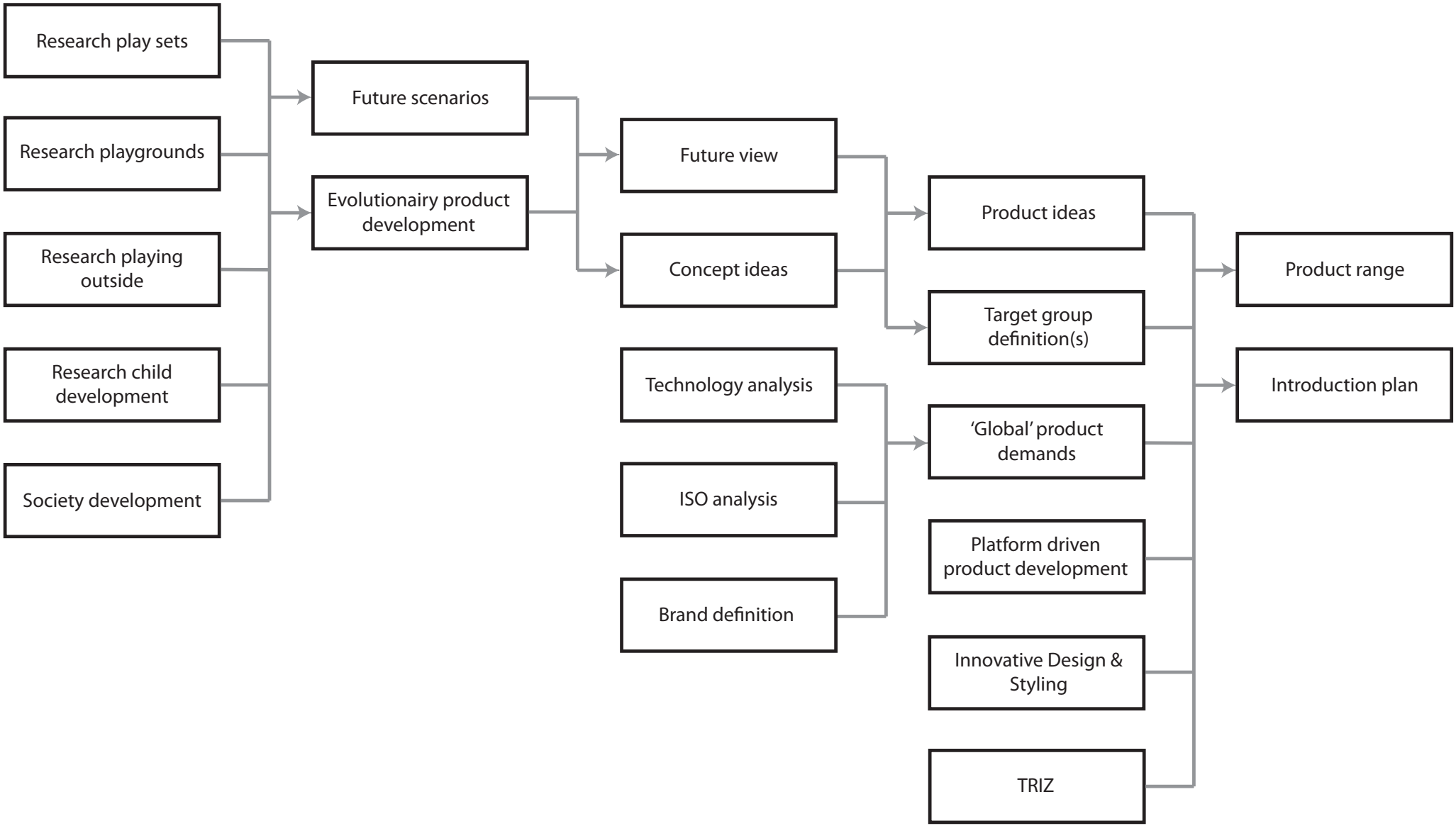

figure A.1 Original research model of the project

4. What will the requirements for Playnetic's interactive play sets be?
    a. What is the available knowledge and technology of Playnetic?
    b. What knowledge and technology will become available to Playnetic?
    c. What are the available production methods of Playnetic?
    d. What production methods will become available to Playnetic?
    e. How is the brand 'Playnetic' defined?
    f. What are the safety requirements of play sets in Europe?
    g. What requirements can be expected to become necessary in the next ten years?
    h. What other requirements does Playnetic have for its products?

Definitions

- Outdoor public environment: any outdoor location which is open to the public.
- Global product requirements: requirements applicable to all products within the market segment of interactive play sets.
- Product range: the range of conceptual products that is to be developed during the project.

Strategy & Materials

1. How will playgrounds look in ten year's time?
    a. What has been the development of playgrounds up until now?
        - **Strategy:** Thorough research on the development of playgrounds based on the theory of Evolutionary Product Development.
            - In-depth, qualitative, non empirical
    b. What factors contributed to the development of playgrounds in the past?
        - **Strategy:** Isolating and determining the importance of the factors that contributed to the evolution of playgrounds.
            - In-depth, qualitative, non empirical
    c. What factors are expected to influence the development of playgrounds in the future?
        - **Strategy:** Research what major developments are expected to occur within ten year's time and assess how they could have an impact on the evolution of playgrounds.
            - In-depth, qualitative, non empirical
    d. How are these factors going to develop in the future?
        - **Strategy:** Research on the factors based on future expectations, trend analysis and assessment of uncertainty.
            - In-depth, qualitative, non empirical
    e. What developments in society can be observed?
        - **Strategy:** Research on factors of society development based on future expectations, trend analysis and assessment of uncertainty.
            - In-depth, qualitative, non empirical

2. How will play sets look in ten years time?
    a. What has been the development of play sets up until now?
        - **Strategy:** Thorough research on the development of play sets based on the theory of Evolutionary Product Development.
            - In-depth, qualitative, non empirical
    b. What factors contributed to the development of play sets in the past?
        - **Strategy:** Isolating and determining the importance of the factors that contributed to the evolution of play sets.
            - In-depth, qualitative, non empirical
    c. What factors are expected to influence the development of play sets in the future?
        - **Strategy:** Research what major developments are expected to occur within ten year's time and assess how they could have an impact on the evolution of play sets.
            - In-depth, qualitative, non empirical
    d. How are these factors going to develop in the future?
        - **Strategy:** Research on the factors based on future expectations, trend analysis and assessment of uncertainty.
            - In-depth, qualitative, non empirical
    e. What developments in society can be observed?
        - **Strategy:** Research on factors of society development based on future expectations, trend analysis and assessment of uncertainty.
            - In-depth, qualitative, non empirical

3. What are the opportunities for interactive play sets between now and ten years?
    a. How do children use the playground right now?
        - **Strategy:** Observations at different types of playgrounds such as a playground at an elementary school, at a municipal park or a skate park and through video research on the internet.
            - Broad, qualitative, empirical
    b. How do children use play sets right now?
        - **Strategy:** Combined with the observations at different playgrounds, through video research on the internet and through available knowledge at Playnetic.
            - Broad, qualitative, empirical
    c. How are children evolving physically?
        - **Strategy:** Literature research and trend analysis.
            - In-depth, qualitative, non empirical
    d. How are children evolving spiritually?
        - **Strategy:** Literature research and an interview with an expert.
            - In-depth, qualitative, non empirical
    e. How are children evolving socially?
        - **Strategy:** Literature research and an interview with an expert.
            - In-depth, qualitative, non empirical
    f. What excites children?
        - **Strategy:** Literature research and observations and/or participatory design.
            - Broad, qualitative, empirical and non empirical
    g. What types of interaction are children familiar with at different ages?
        - **Strategy:** Literature research and observations and/or participatory design including research on the use of different senses.
            - Broad, qualitative, empirical and non empirical

h. How can children be encouraged to perform physical exercise?
    - **Strategy:** Literature research, observations and/or participatory design and an interview with Roy Stein and Erik Siebelt.
        - In-depth, qualitative, empirical and non empirical

4. What will the requirements for Playnetic's interactive play sets be?
    a. What is the available knowledge and technology of Playnetic?
        - **Strategy:** Assessment through analysis of the current products and an interview with Roy Stein.
            - In-depth, qualitative, empirical and non empirical
    b. What knowledge and technology will become available to Playnetic?
        - **Strategy:** Cost trends of technology and an interview with Roy Stein.
            - In-depth, qualitative, empirical and non empirical
    c. What are the available production methods of Playnetic?
        - **Strategy:** Assessment through analysis of the current products and an interview with Roy Stein.
            - In-depth, qualitative, empirical and non empirical
    d. What production methods will become available to Playnetic?
        - **Strategy:** Research on existing and upcoming production methods which are affordable or will become affordable to Playnetic as well as suitable for the number of products Playnetic manufacturers.
            - In-depth, qualitative, non empirical
    e. How is the brand 'Playnetic' defined?
        - **Strategy:** Analysis of the current products as well as Playnetic's business plan and an interview with Roy Stein and Erik Siebelt.
            - In-depth, qualitative, empirical and non empirical
    f. What are the safety requirements of play sets in Europe?
        - **Strategy:** Research on the ISO/NEN standards for play sets.
            - Broad, qualitative, non empirical
    g. What requirements can be expected to become necessary in the next ten years?
        - **Strategy:** Synthesise requirements based on possible future developments found in the future outlook. This will also include stating indicators on how to identify these future developments.
            - Broad, qualitative, non empirical
    h. What other requirements does Playnetic have for its products?
        - **Strategy:** Analysis of Playnetic's business plan and an interview with Roy Stein and Erik Siebelt.
            - In-depth, qualitative, non empirical

	Strategy	Material	Source
1a	Desk research	Media	Internet
		Literature	Books
			Articles
	Observations	Products	Museums
1b	Desk research	Media	Internet
		Literature	Books
			Articles
1c	Desk research	Media	Internet
		Literature	Books
			Articles
1d	Desk research	Media	Internet
		Documents	Statistic databases
		Literature	Books
			Articles
1e	Desk research	Media	Internet
		Documents	Statistic databases
		Literature	Books
			Articles
	Interview	Persons	Playnetic experts
2a	Desk research	Media	Internet
		Literature	Books
			Articles
	Observations	Products	Museums
2b	Desk research	Media	Internet
		Literature	Books
			Articles
2c	Desk research	Media	Internet
		Literature	Books
			Articles

2d	Desk research	Media Documents Literature	Internet Statistic databases Books Articles
2e	Desk research Interview	Media Documents Literature Persons	Internet Statistic databases Books Articles Playnetic experts
3a	Observations	Media Persons	Movies Ethnography
3b	Observations Interview	Media Persons Persons	Movies Ethnography Playnetic experts
3c	Desk research	Media	Internet Statistic databases Books Articles
3d	Desk research Interview	Media Person	Internet Statistic databases Books Articles Expert
3e	Desk research Interview	Media Person	Internet Statistic databases Books Articles Expert

3f	Desk research	Media	Internet Books Articles
	Observations	Persons	Ethnography Participatory design
3g	Desk research	Media	Internet Books Articles
	Observations	Persons	Ethnography Participatory design
3h	Desk research	Media	Internet Books Articles
	Observations	Persons	Ethnography Participatory design
	Interview	Persons	Playnetic experts
4a	Observations	Products	Playnetic products
	Interview	Person	Playnetic experts
4b	Observations	Products	Playnetic products
4c	Observations	Products	Playnetic products
	Interview	Person	Playnetic experts
4d	Desk research	Media	Internet Statistic databases Books Articles

4e	Observations Desk research Interview	Products Documents Person	Playnetic products Playnetic business plan Playnetic experts
4f	Desk research	Documents	ISO/NEN standards
4g	Desk research	Documents	Future outlook
4h	Desk research Interview	Documents Person	Playnetic business plan Playnetic experts

Table A.1 Materials and their sources behind the chosen strategies

Planning

Figure A.2 shows the original planning of the project.

Task	Duration	January					February				March				April					May				June				July					August				September					October			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
Writing plan of approach	1w																																												
Preparing research	1w																																												
Gathering research material	3w																																											
Analysing playgrounds & play sets evolution	4w																																											
Training camp Spain	10d																																											
Determining evolution factors	3d																																											
Determining market trends	2d																																											
Trend analysis on factors	1w																																											
Create uncertainty matrix	1d																																											
Create future scenarios	2w																																											
Writing report	1w																																											
Extra time in case needed	1w																																											
Cycling stage race (thu - sun)	2d																																											
Ethnography playing children	1w																																											
Analysing use playgrounds & play sets	2w																																											
Analysing interaction use - participatory design sessions	1w																																											
Processing participatory design sessions	3d																																											
Analysing what excites children	2d																																											
Interview child development expert	1d																																											
Analysing child development	1w																																											
Analysing child exercise stimulation	2d																																											
Writing future outlook	1w																																											
Writing report	1w																																											
Extra time in case needed	8d																																											
Analyse current Playnetic products	3d																																											
Assess Playnetic's current and future technolgy	2d																																											
Assess Playnetic's current and future available production methods	2d																																											
ISO/NEN analysis	3d																																											
Brand definition	1d																																											
Determining future requirements	4d																																											
Vacation	2w																																											
Converting concept ideas into product ideas	3w																																											
Define ranking system and paramters	1d																																											
Apply innovation techniques	2w																																											
Rank and choose product ideas	1d																																											
Apply innovation techniques	2w																																											
Finalise product range	4w																																											
Write introduction plan	1w																																											
Extra time in case needed	1w																																											
Writing final report	3w																																											

figure A.2 Original project planning

APPENDIX B: PLAY LITERATURE ANALYSIS

The function of play

Article 31 of the United Nations Convention on the Rights of the Child, adopted by the United Nations in 1989, states:

> *"That every child has the right to rest and leisure, to engage in play and recreational activities appropriate to the age of the child and to participate freely in cultural life and the arts.*
>
> *That member governments shall respect and promote the right of the child to participate fully in cultural and artistic life and shall encourage the provision of appropriate and equal opportunities for cultural, artistic, recreational and leisure activity." (International Play Association, 2009)*

Hence, play is a right which all children have. Play is in fact in the nature of us all. From a pedagogic viewpoint, play is probably the most, important tool for children to learn and, therefore, essential in a child's development. But how exactly does play contribute to a child's development and more related to the project, what role do playgrounds and play sets have in this development?

What is play?

What exactly is playing, how do we define play? According to the Oxford dictionary (2013), the definition of play is to "engage in activity for enjoyment and recreation rather than a serious or practical purpose".

Going beyond the definition of the dictionary, Brown and Vaughan (2010) define play as "any kind of purposeless, all-consuming, restorative activity". They go as far as stating that is the most significant factor in determining our success and happiness. What is very interesting in this viewpoint is that they state that play is purposeless and yet so important. Within this definition, Brown and Vaughan state seven properties of play:

- Apparently purposeless
- Voluntary
- Inherent attraction
- Freedom from time
- Diminished consciousness of self
- Improvisational potential
- Continuation desire

Play is apparently purposeless as the act of play has no immediate value to our survival. It is voluntary as we choose to engage in it. Inherent attraction means that it makes you feel good, it provides psychological arousal. Freedom of time makes us lose sense of the passage of time. A diminished consciousness of self allows us to stop worrying about whether we look good or awkward, smart or stupid. Improvisational potential means that we are not locked into our normal way of doing; we are open to change and willing to include seemingly irrelevant elements into play. Lastly, there

is a continuation desire; we do not want to stop and thus we find ways to keep on playing.

Brown and Vaughan continue their vision of play with various examples of play in the animal world. Although they state that play is apparently purposeless, meaning it has no immediate value to our survival, they also state that if so many animals are playing, there must be some purpose to it after all. Yet, play uses up energy while not providing animals with food or water in return. Natural selection would suggest that such acts should be eliminated; species that play would become extinct. Therefore play must have some importance towards our survival. They refer to statistical proof showing that Alaskan bears which played more had a higher survival rate.

Similarly to Brown and Vaughan, Rubin, Fein and Vandenberg (1983) state six characteristics as a definition of play behaviour:

- Intrinsically motivated
- Controlled by the players
- Concerned with process rather than product
- Non literal
- Free of externally imposed rules
- Characterized by the active engagement of the players

These characteristics are in line with Brown and Vaughan's definition. Intrinsically motivated implicates all-consuming, while being concerned with the process rather than the product suggests that the activity is purposeless. However, being concerned with the process rather that the product also seems to suggest that it is in fact a learning experience.

Play is learning?

Jones and Reynolds (1992) write on the viewpoint of play as learning experience that:

> *"Young children learn the most important things not by being told but by constructing knowledge for themselves in interaction with the physical world and with other children – and the way they do this is by playing." (Jones & Reynolds, 1992, p. 1)*

By climbing and running around, a child will develop its gross motor skills, while through crafting, building and tinkering, a child will stimulate the development of its fine motor skills. Through play, a child will learn to think about what it is doing, learns to think ahead and to solve problems, thus developing its cognitive skills. Other examples of cognitive development are learning to recognise shapes and symbols or training reaction time through play. A child also develops its social-emotional skills by gaining insight in its own as well as others' feelings by playing. Children can experiment with actions and behaviour in play which they would otherwise be too afraid to try (Hughes, 2010).

Simply put, play comprises physical, cognitive, social and emotional development. Elkind (2009), in line with Jones and Reynolds, states that playing is a way for children to learn about themselves and the world through self-initiated experiences. He therefore advocates that self-initiated child's play, for example children thinking up their own games and rules, should not be replaced by adult-organised sports or by academic activities disguised as games. Child-initiated play learns children mutual respect for one another; a child creates a set of rules and another child must follow them. In return the initial rule maker must follow the rules created by another child later on.

This child-initiated play is what the International Play Association (2009) means with the term 'free play'. They state that play should be controlled by the child, not by the adult; it should not be organised recreational and learning activities.

Wardle (2009) talks about an experience of seeing young girls being bored while helping their mothers wash clothes in a river and who start to throw the soap bar to each other in order to try and catch the slippery object. They create a game for themselves, one in which concentration, agility and creativity is needed. As Elkind stated, children will create new rules. Wardle explains that the girls made their game more complex and kept enjoying themselves for a long period of time. This is also the continuation desire which Brown and Vaughan (2010) speak of. Wardle continues on how these girls used the bar of soap as a piece of open-ended play material. Open-ended play materials are materials which offer children many different ways to engage with them. He concludes that such materials spark creativity and ultimately create more flexible and creative thinkers who come up with more abstract ideas and concepts.

Elkind (2009) also states that adults think of a child playing as an activity which is the opposite of what we do as work. In other words, we consider playing in the adult term of play. For a child it is different. Clemens (2009) writes for example that adults measure playing in units of time, while a child measures playtime in a unit of joy. That is why children can zone out on the beach with just a bucket and a shuffle for hours, but become impatient for waiting in a line at the checkout of a supermarket. This is the freedom from time as well as diminished consciousness of self which Brown and Vaughan (2010) mention. Lewis (2009) backs this up by stating that play is an act of imagination. He says that:

> *"It is creating, pretending, performing, and bringing children into a space of their unique knowing and understanding". (Lewis, 2009, p. 8)*

He reflects on our adult experience of imagining, where dream and reality start to intertwine and so do time and space as well as feeling and thought. Adults zone out of reality when daydreaming just as much as the previously mentioned child on the beach; we lose track of time as well as our surroundings.

Lewis states that playing and imagining are instinctive capacities for a child:

> *"They are not only crucial to a child's sense of wellbeing, but also, if encouraged and supported, the path to envisioning possibilities, discovering new ideas, enlarging experience, and questioning and expressing the delicate boundaries of the known and the unknown." (Lewis, 2009, p. 8)*

He concludes that children are capable of integrating play and imagination instinctively into one activity in which the mind and body are in dialogue with one another. Brown (2009) states that this instinctive capability of play is not only limited to humans, but to all mammals. Brain research has shown that a certain part of brain is activated while playing, which is in fact the same part of our brain organised for survival. In a presentation, Brown (2008) advocates that play is vital for a child's development and ultimately its success later in life. He states that play prepares us for the later stages of our life; it is a way to practise without suffering consequences. Bekoff et al (2001) write that playing is training for the unexpected and that this training is universal for all mammals. Brown (2010) mentions studies

supporting this theory; a study where one group of kittens were allowed to play and another were not. The group that was allowed to play turned out to have a higher chance of survival in their adult life. Instinctively, we would think that the reason behind it is, with the statement of playing being a way to practise without suffering consequences, that the kittens which were not allowed to play had not practised their hunting skills. The kittens turned out to be equally good hunters, but the kittens that did not play were unable to socialise successfully. They lacked the ability to clearly delineate friend from foe; they misread social signals. They reacted excessively aggressive or retreated and did not engage in 'normal' social patterns. The kittens simply did not have the ability to perceive others' emotional states and lacked the ability to appropriately respond to them. Brown refers to this being a lack of what Goleman (2006) describes as emotional intelligence.

Another argument which Brown (2009) brings forward is the fact that NASA's Jet Propulsion Laboratory found that their best problem solvers were in fact master tinkerers in their youth. NASA has even altered their hiring policy because of these results. He concludes that children need "free, hands-on play that is kid-organised" in order to maximise their potential.

Bodrova and Leong (2003) explain how this type of play evolves from toddlers to children in the age of kindergartners. They describe how a toddler can enjoy the repetitive action of rocking a baby doll, whereas an older child would call herself "Mommy" when engaged in the same activity, adding 'mommy activities' to the play experience. As they grow older, children will engage themselves in more complex 'pretend play', adding for example multiple roles and symbolic props to their play. Past this stage of play, children become engaged in sports as well as board and computer games. While these types of play also contribute to the development of a child, for example motor and concentration skills, the children have the follow the rules of the game and rarely have a chance to create or negotiate the rules of play. In pretend play they can, which allows children to develop their social and self-regulation skills. Bodrova and Leong conclude that if pretend play is completely replaced by sports and organised activities, children might not fully develop these skills.

Different types of play

The viewpoints and examples already illustrate how play is important for the development of a child. It is a way for a child to explore itself as well as the world. It helps the child develop physically, socially, emotionally and cognitively. There are clear links between quality of play during a child's youth and its later success in life. But how exactly does play aid a child's development?

Hughes (2002) created a taxonomy of play types, differentiating 16 types of play:

1. Rough and Tumble Play – close encounter play which is less to do with fighting and more to do with touching, tickling, gauging relative strength. Discovering physical flexibility and the exhilaration of display.
2. Socio-dramatic Play – the enactment of real and potential experiences of an intense personal, social, domestic or interpersonal nature.
3. Social Play – play during which the rules and criteria for social engagement and interaction can be revealed, explored and amended.
4. Creative Play – play which allows a new response, the transformation of information, awareness of new

connections, with an element of surprise.

5. Communication Play – play using words, nuances or gestures for example, mime, jokes, play acting, mickey taking, singing, debate, poetry.
6. Dramatic Play – play which dramatizes events in which the child is not a direct participator.
7. Symbolic Play – play which allows control, gradual exploration and increased understanding without the risk of being out of one's depth.
8. Deep Play – play which allows the child to encounter risky or even potentially life threatening experiences, to assess risk, develop survival skills and conquer fear
9. Exploratory Play – play to access factual information consisting of manipulative behaviours such as handling, throwing, banging or mouthing objects.
10. Fantasy Play – play which rearranges the world in the child's way, a way which is unlikely to occur.
11. Imaginative Play – play where the conventional rules, which govern the physical world, do not apply.
12. Locomotor Play – movement in any or every direction for its own sake.
13. Mastery Play – control of the physical and affective ingredients of the environment.
14. Object Play – play which uses infinite and interesting sequences of hand-eye manipulations and movements.
15. Role Play – play exploring ways of being, although not normally of an intense personal, social, domestic or interpersonal nature.
16. Recapitulative Play – play that allows the child to explore ancestry, history, rituals, stories, rhymes, fire and darkness. Enables children to access play of earlier human evolutionary stages.

The descriptions alone provide considerable insight in how the different types of play allow the child to learn and develop. Rough and Tumble play aids a child's physical development, but also teaches children how far they can go towards other children, thus aiding its social development. Dramatic play will give the child more insight into emotional states and teaches the child to recognise emotional signals in a social environment when playing with other children.

Designer role

Ferrara, Hirsh-Pasek and Golinkhoff (2009) capture how exactly play aids a child's development in its simplest form:

> *"As children pick up and feel the rigid angles and smooth curves of wooden squares, circles, and triangles, they are learning the fundamentals of shape and proportion. When they distinguish the green block from the red, they refine their ability to note patterns and compare features. And when they build towers by masterfully balancing one block atop another, they are registering principles of physics and support." (Ferrara et al, 2009, p. 14)*

They further state that research suggests that if a four and five year old are given 15 minutes of free play time, a third will be spent on spatial, mathematical, and architectural activities. These activities come naturally; there is no need to disguise educational goals within play by adults. In fact, Hewes (2006) states:

> *"If play always and exclusively serves adult educational goals, it is no longer play from the child's perspective. It becomes work, albeit playfully organized." (Hewes, 2006, p. 7)*

Similar to Hewes, Vandenburg (1998) concluded, after extensive observations, that:

"The excitement of play results from the sheer exercise of freedom over necessity." (Vandenburg, 1998, p. 303)

Vandenburg argues that if children are forced into play, they may not experience the activity as play at all. King (1979) found out through a study that if a kindergarten teacher assigned children to play through a certain activity, the children saw the activity as work; they had to do it. After performing the same activity voluntary, they described the activity as play.

If play is a large learning experience and spatial, mathematical as well as architectural activities come naturally while playing, as stated by Ferrara, Hirsh-Pasek and Golinkhoff (2009), and if we should not force play on children, what exactly is the role of the adult, or more specifically for this project, the role of the designer? Hewes (2006) writes:

"The developmental literature is clear: play stimulates physical, social, emotional, and cognitive development in the early years. Children need time, space, materials, and the support of informed parents and thoughtful, skilled early-childhood educators in order to become "master players." They need time to play for the sake of playing." (Hewes, 2006, p. 1)

As explained, especially free play is held in high regard. Interestingly enough, Hewes states that uninterrupted free play is under threat in the Western World, both indoors as well as outdoors. The physical and social environments have changed drastically under the influence; outdoor play opportunities in natural environments are vanishing within city neighbourhoods under the influence of new technology, more traffic and new land use patterns. The research on playground evolution has shown this exact development. Another development which has come forward in the playground evolution is the focus on safety. Hewes writes that parents are focussed more and more on the safety of their children. The children find themselves in carefully constructed outdoor playgrounds, limiting challenge under the influence of safety. She exactly describes the development as found in the playground evolution.

According to Hewes, one of the most important roles of the adult in child play is simply facilitation:

"The adult designs an environment with hands-on, concrete materials that encourage exploration, discovery, manipulation, and active engagement of children. The quantity, quality, and selection of play materials influence the interactions that take place between children. The adult protects the time needed for exploration, discovery, and uninterrupted play." (Hewes, 2006, p. 5)

Playground design

Specifically for this project, facilitation in the form of playground design is interesting to explore further. Playgrounds should be the place for children to be able to 'free play' outdoors. Kalliala (2006) states that adult facilitation in regard to play environments should be:

"Supporting children's play is more active than simply saying you believe that it is important. When children's play culture is taken seriously, the conditions which make it flourish are carefully created. Children's play culture does not just happen naturally. Play needs time and space. It needs mental and material stimulation to be offered in abundance. Creating a rich play environment means creating good learning environments for children." (Kalliala, 2006, p. 139)

Interestingly, she writes that play does not happen naturally; certain conditions are needed in the form of time, space and mental as well as material stimulation. The play environment should therefore be rich in all of these areas, in line with Hewes's statement on the subject of outdoor play environment facilitation. She writes that play environments should provide:

- rich, diverse, multisensory experiences
- opportunities for noisy, boisterous, vigorous, physically active play
- opportunities for physical challenge and risk-taking that is inherent in the value of play;
- rough, uneven surfaces, with opportunities for the development of physical strength, balance, and coordination
- natural elements and loose parts that children can combine, manipulate, and adapt for their own purposes

She concludes by saying that outdoor play environments should be designed with equal care and attention as indoor environments.

Grob (2009) states that outdoor play is essential in a child's development; it offers a wide range of options for exploration as well as experimentation. She quotes landscape architect Nicholson saying:

> *"In any environment, both the degree of inventiveness and creativity, and the possibility of discovery, are directly proportional to the number and kind of variables in it." (Grob, 2009, p. 18)*

She continues on the outdoors as a great play environment by quoting Moore, another landscape architect:

> *"The indeterminacy of rough ground allows it to become a play-partner, like other forms of creative partnership: actress-audience, potter-clay, photographer-subject, painter-canvas. The exploring/creating child is...using the landscape as a medium for understanding the world by continually destructing/reconstructing it." (Grob, 2009, p. 18)*

She concludes by stating that research has shown that converting play areas from asphalt to a more nature-like environment lowers the incidents of aggression while increasing imaginative play and creative social interaction between children.

Conclusion

From the literature study, it is concluded that play is essential for the overall development of a child. From a pedagogic viewpoint, play is probably the most important tool for children to learn and therefore essential in the development of a child. Figure B.1 shows a visualisation on how play contributes to a child's development, mapping examples of how play helps a child develop physical, cognitive, emotional and social skills.

Play is a safe way for children to develop their skills and processes illustrated in figure B.1; children can experiment with actions and behaviour in play which they would otherwise be too afraid to try (Hughes, 2010). Playgrounds are, therefore, an ideal place for stimulating free play in the outdoor environment. Playgrounds provide a safe environment for children to explore and experiment.

Interactive play set design guidelines

Based on the literature study, ten design recommendations

for interactive play sets are created. These should be kept in mind while designing:

- First of all, play should be fun! The play sets should first and foremost be pleasurable to use.
- The interactive play sets should further stimulate 'free play' or 'child initiated play'. Although children are free to use interactive play sets, they are bound by the rules of the game(s) programmed within them. Seek for ways to hand over (some of) the game control to the children.
- Allow the children ways to manipulate the play set. This could be in the form of construction or through imagination.
- Stimulate children playing together to aid children's social development.
- Seek for ways to stimulate different types of play while using interactive play sets in order to support all four categories of development; physical, cognitive, emotional and social.
- Enable multisensory experiences, in order to create rich and diverse play sets.
- Look for ways to stimulate active play; noisy, boisterous, vigorous and/or physical.
- Possibly add a physical challenge to the play sets.
- Do not deliberately add educational goals to the play sets.
- Try to create play sets where children are not bound by games within a specific duration. Rather allow the child to play and decide for itself when the play is over; take away fixed time frames as a factor within the play set design.

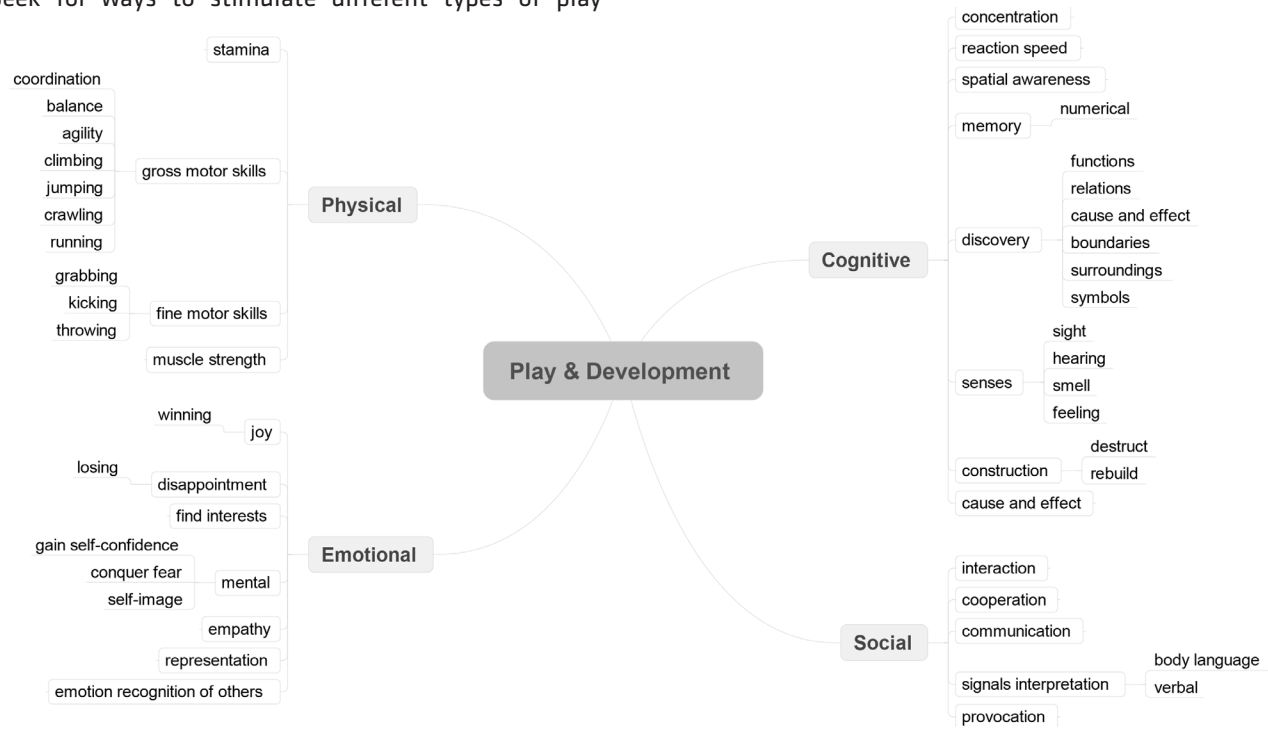

figure B.1 Mindmap play and development

APPENDIX C: PLAY EVOLUTION LITERATURE ANALYSIS

Social play evolution

Appendix B describes play behaviour and provides guidelines on how to approach play in play set design. However, while the characteristics of play remain applicable, does play itself develop or remain the same as children grow older? It is expected that play develops as children grow older. Therefore, it is important to take this development into account for the design of new interactive play sets; the approach towards new interactive play sets should perhaps not be the same for children of all ages within Playnetic's target group. This was addressed by first performing literature research and subsequently verifying the findings through own observations. Goal of this research was to understand the development of play with age, and how this should be taken into account when designing new interactive play sets.

In this appendix, play is described from a social interaction perspective or a sensory/behavioural perspective.

Social play

Hughes (2010) explains play from the perspective of social interaction. Hughes continues on Parten's (1932) studies and states how play evolves as children grow older. Hughes explains how two year olds are often observed engaged in solitary play; the lowest level of social play. When engaged in solitary play, the child is playing in a world of its own, even if surrounded by other children. Another form of solitary play which is explained is onlooker play, which basically describers a child being a spectator and watching someone else play without any active participation. The next step within social play is parallel play; children playing separately but performing the same activities at the same time and location. Hughes states that it is a genuine point of transition from solitary to eventually cooperative play; the children are aware of the other child's/children's presence and it does have meaning to the child, but the children are still playing separately. As children reach the age of three and four, children take the next step in social play: associative play. In associative play, children are still focussed on separate activities, but they are engaged in sharing, lending, taking turns, attending to the activities of other children and expansive communication. An example given is two children painting and creating separate work of art while sharing brushes and paint as well as discussing the paintings. There is an interest in socialising between the children, an interest which is perhaps more important than the activity of creating a painting. The highest level in social play is cooperative play. It is play where two or more children are engaged in an activity with a common goal. Only if all the children carry out their individual roles can the overall goal be achieved. The example which Hughes describes is a group of children deciding to build a city in the sand box. One child

constructs the buildings, another builds the roads and a third creates a tunnel. Cooperative play is, according to Hughes, present among children of four years and older.

The last social play type to be included is competitive play. This type of play is not discussed by Hughes, likely as that part of the book describes play for preschool children. Being competitive comes in various different ways and does not necessarily mean that a child has to win. Simply wanting to be the best at a certain activity is also a form of competitiveness. Although not exclusive to competition, rules do form the basis of being competitive. Understanding of rules is mainly attributed to children aged five and onward.

In turn, Hewes (2006, p. 3) states different types of play in relation to a child's age, explaining them from the sensory/behavioural perspective. The sensory/behavioural perspective describes play as the way in which a child is playing and engaging its environment (Hewes, 2006). A young child might be grabbing wooden blocks of various shapes and sizes, simply to explore or examine them; a form of exploratory or object play. An older child might use the same blocks to build a castle; a form of construction play.

The play types and their description can easily be related to the social play types of Hughes. Table C.1 on the next page shows Hewes's assessment in relation to the five previously stated social play types. As can be seen, Hewes's play types follow the order of Hughes's social play types.

Two things have to be noted when looking at table C.1. First of all, the ages presented are not necessarily true for all children. Children develop at different rates and have personal interests. Children do not have to participate in certain social play types at specific ages at all. Secondly, older children are still engaged in the mentioned play types. It does not necessarily end after the mentioned ages in the table; those ages simply reflect when the play types have its greatest incidence.

Group size

Parten (1932) describes how there is a noticeable decline in solitary play activities as children develop between the age of two and four. An example mentioned is the sand box. Among the younger children, play in the sand box is very solitary, mostly comprised of feeling the sand, pouring it from one container to another or created moulds with them. Children around the age of four and older show cooperative play within the sand box; constructing roads, bridges and tunnels together. It shows development within the social maturity of the children. Parten concludes that cooperation becomes increasingly more important in preschool years.

Furthermore, Parten noticed in her studies that the preferred group size of the young children was two, while this increased to a group size preferably between three and five for children between four and four and half years old.

Gender differences

Pellegrini (2010) states that boys play in larger groups than girls, mostly under the influence of boys' interest in competitive games. According to Pellegrini, girls tend to be drawn to dyads or small groups as they have an underlying preference for 'intimacy-enhancing activities' which require small groups. Competitive games on the other hands require larger groups. Belle (1989, cited in Pelligrini, 2010) turns this

Kind of Play	Description	Age range of greatest incidence	Social play type
Exploratory play/ object play/ sensory play	Very young children explore objects and environments – touching, mouthing, tossing, banging, squeezing. Sensory play appears in children's early attempts to feed themselves. As they get older, materials like play dough, clay, and paint add to sensory-play experiences.	0–2.5 years	Solitary play
Dramatic play (solitary pretense)	Many young children spend a lot of time engaged in imaginative play by themselves throughout the early-childhood years. They invent scripts and play many roles simultaneously. Toys or props, (e.g., dolls, cars, action figures) usually support this kind of play. As children get older, they create entire worlds in solitary pretense, often with large collections of small objects or miniature figures.	3–8 years	Solitary play
Construction play	Children begin to build and construct with commercial toys (Lego, Tinkertoys, blocks), with found and recycled materials (cardboard boxes, plastic tubing) and with a variety of modelling media, (clay, playdough, plasticine). Older children play for extended periods with complex commercial model sets. Children across the age range engage in this kind of play by themselves and in groups, often combining it with episodes of solitary pretense or socio-dramatic play.	3–8 years	Solitary, parallel, associative and cooperative play
Physical play	Sensorimotor play begins as young infants discover they can make objects move; e.g., kicking the figures on a crib mobile or crawling after a rolling ball. Physical play in the preschool years often involves rough-and-tumble play, a unique form of social play most popular with little boys. Rough and tumble play describes a series of behaviours used by children in play fighting. Adults often mistake it as aggression. Older preschoolers engage in vigorous physical activity, testing the boundaries of their strength by running, climbing, sliding, and jumping, individually and in groups. This kind of play often develops spontaneously into games with invented rules.	3–8 years	Solitary, parallel, associative and cooperative play
Socio-dramatic play	Pretend play with peers – children take on social roles and invent increasingly complex narrative scripts, which they enact with friends in small groups.	3–6 years	Cooperative play
Games with rules	Children begin to play formal games in social groups. These games have fixed, predetermined rules; e.g., card games, board games, soccer, and hockey.	5 years and up	Cooperative and competitive play
Games with invented rules	Children begin to invent their own games and/or modify the rules of traditional playground games in their self-organized playgroups; e.g., tag, hide-and-seek, red rover, hopscotch.	5–8 years	Cooperative and competitive play

table C.1 Hewes's sensory/behavioural perspective in relation to Hughes's social interaction perspective

idea around by stating that boys are more drawn to play in larger groups as they are more interested in competitive games. Pelligrini continues this line of thought by stating that "participation in and the opportunity to be promoted up through a competitive social hierarchy might require a need for larger social groups where boys can demonstrate their prowess or become associated with those considered popular" (Pelligrini, 2010, p. 272). Pelligrini also states that boys play games with different portions of their peer group and thus sustaining an overall group which, on occasion, comes together for a team game. If team games are eliminated from observations concerning group size, it would result in similar sized play groups for both boys and girls.

Conclusion

There is a clear development in the social play style of children when they grow older, evolving from solitary to cooperative and competitive play. Furthermore, the group size during play increases as children grow older, which is only logical as young children play solitary and older children play cooperatively. Table C.2 shows what this development looks like based on the age of children.

Two things have to be noted when looking at table C.2. First of all, the ages presented are not necessarily true for all children. Children develop at different rates, have personal interests. Children do not have to participate in certain social play types at specific ages. Secondly, older children might still engage in play types which are allocated in table C.2 to younger children. The play types do not necessarily stop after the mentioned ages in the table; those ages simply reflect when the play types have their greatest incidence.

Age range	Group size	Social play type	Sensory/behavioural type of play
0–2.5 years	Solo	Solitary play	Exploratory play/ object play/sensory play
3–8 years	Solo	Solitary play	Dramatic play (solitary pretense)
3–8 years	Solo – dyads – small groups	Solitary, parallel, associative and cooperative play	Construction play
3–8 years	Solo – dyads – small groups	Solitary, parallel, associative and cooperative play	Physical play
3–6 years	Dyads – small groups	Cooperative play	Socio-dramatic play
5 years and up	Dyads – small groups – large groups	Cooperative play and competitive play	Games with rules
5–8 years	Dyads – small groups – large groups	Cooperative play and competitive play	Games with self-invented rules

table C.2 Child play evolution

One aspect not reflected in this table is the group size difference between boys and girls; boys play in much larger group sizes than girls. This is influenced by their interest in competitive games and preference for intimacy-enhancing activities respectively (Pelligrini, 2010).

For the design of new interactive play sets, table C.2 provides a good overview of how to approach the design towards a specific target group. For example, design an interactive play set for a specific age category, or towards a specific use situation; two five year old boys looking for a physical challenge.

The findings presented in table C.2 as well as the mentioned gender difference are evaluated through observations.

APPENDIX D: ETHNOGRAPHY STUDY OF CHILDREN PLAYING

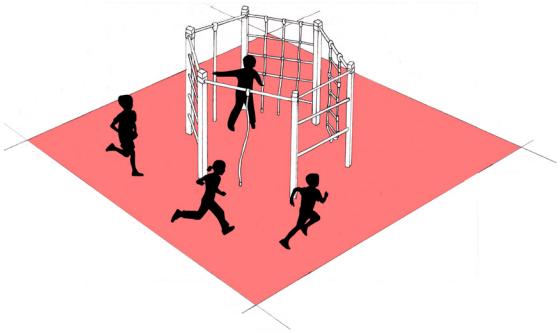

figure D.1 Unintended use: climbing rack with boundary surface

figure D.2 Unintended use: football table tennis

Ethnography study of playing children

For this study, children were observed while being in their own habitat: schoolyards and their playgrounds. On six occasions, children were observed during playtime at schools. As the ethnography study was performed at schoolyards of primary schools, children younger than four were not observed. The observations therefore did not entirely cover the complete target group of Playnetic; three to twelve year olds.

Goal of the study was to gain qualitative insight in children's behaviour while playing. Besides general observation, two things were specifically looked at:

- What are the group sizes during play? Do they evolve as found in appendix D?
- What are the actual use situations of the available play sets? Do children use play sets as they are designed to be used, or not. When are they using the play sets as intended and when as unintended?

As for the group sizes, it was expected that the group sizes increase as children grow older. Furthermore, it was expected that the group sizes of boys observed would be higher than those of girls, especially when looking at the older half of the children. As for the actual use situations, it was expected that children use play sets differently from how they are designed to be used. However, attention was given to observe intended use of play sets as well to exclude a biased outcome of the observations.

Actual use - unintended

Based on the literature research, the expected outcome of the observations was observing children using play sets in a different way than the designer's intention and fit them into their own made up play. The performed ethnography did not disappoint; it showed exactly how play sets are made into something completely different by the children. A few examples of observed use of play sets are described.

Tag with obstacle

During one observation, a climbing frame was spotted, which had a hexagon shape when looking at it from the top. Each side offered children a different way to climb. The entire frame was placed on a square of rubber tiles. During the observation, no children climbed into the frame. Instead, a group of seven children were playing tag around it. They used the square of rubber tiles as their playing field, while the climbing frame served as an obstacle to run through and avoid the child who had to tag someone else.

Football table tennis
Multiple schools that were visited have a ping-pong table on their schoolyard. On only one occasion were children observed to use the ping-pong table to actually play table tennis. Mostly, the table was used in a totally different way. One example was two boys, estimated to be around ten years old, which were playing table tennis, but with a football instead of a ping-pong ball. Instead of hitting the ball back over the net with their arms or with bats, they were heading the ball back towards each other.

At another school, children played 'around the table' with a football. Around the table means that after hitting the ball back to the other side (with the rules of general ping-pong), the child needs to run to the other side before it is his/her turn again to hit the ball back. If you miss the ball or do not hit the table when you hit the ball back, you are out. There is no limit to the group size of this game, the game ends with one child remaining; it is a last man standing type of game.

Ping-pong on the football field
While the two boys were occupying the ping-pong table and playing their football table tennis game, two younger boys with the ping-pong bats and ball were playing their own game on a small football field. They took turns in trying to score a goal by hitting the ping-pong ball with their bats roughly four meters from the goal, in the way which ping-pong is meant to be played. The other boy tried to stop his opponent from scoring by blocking the ball with his bat.

Elastic last man standing
Children often do not need more than just the simplest of objects. One example was observed where groups of between four and eight children, mostly girls, played with an elastic string. They stood in a circle, facing each other, with the elastic string behind their ankles and one child counted down. Once the countdown ended, they all jumped up. As they jumped up, the elastic string came loose. Under the influence of the tension on the string, it went towards the person who responded the slowest; that person lost. Ironically, the person was not eliminated nor received any penalty; they simple played the game again and again.

Lookout tower
All but one schoolyard featured a climbing rack of some sort. On all occasions, children were observed to use the top of the climbing rack as a lookout tower or as a place to hang out in small groups of two to five, away from the busy schoolyard. It can be questioned if this is intended or unintended use.

Wave boarding
At one school, wave boards were available to play with on the schoolyard. This was most likely the cause of a new favourite place within the schoolyard. In a corner of the schoolyard, there was a ramp leading to a storage facility. Not surprisingly, the ramp was observed to function as a way for the children to gain speed on their boards.

Actual use - intended
To avoid a form of cognitive bias, meaning that if you are convinced you will see something, you will see it no matter what, the observation was also performed to spot intended use of play sets and play materials. The previous examples show play sets or play materials being used differently from its original intention, some clear examples of intended use were observed as well.

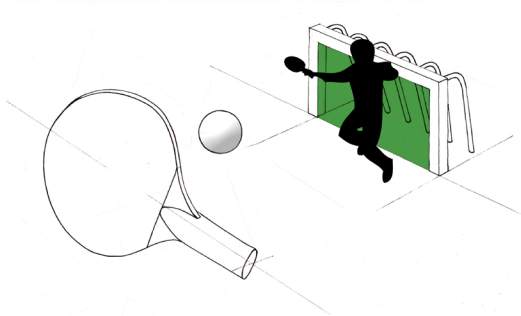

figure D.3 Unintended use: ping-ping on the football field

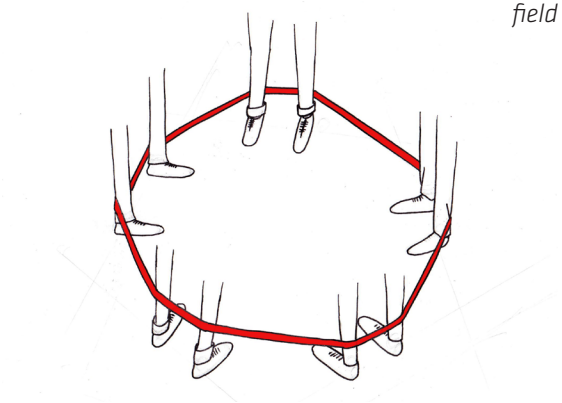

figure D.4 Unintended use: elastic last man standing

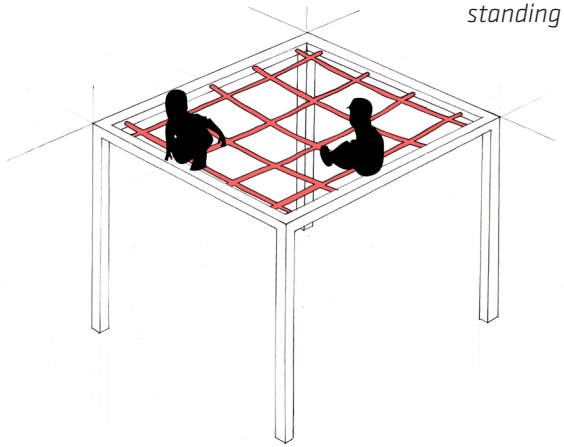

figure D.5 Unintended use: lookout tower

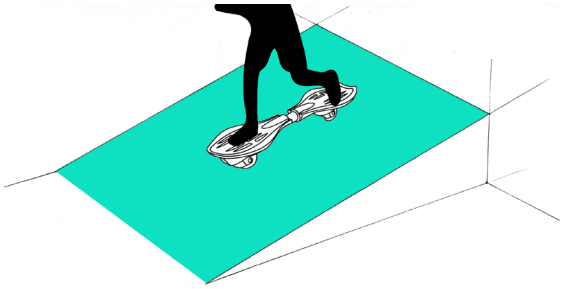

figure D.6 Unintended use: ramp and wave board

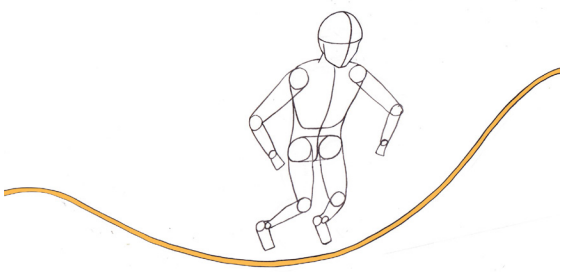

figure D.7 Intended use: jumping rope

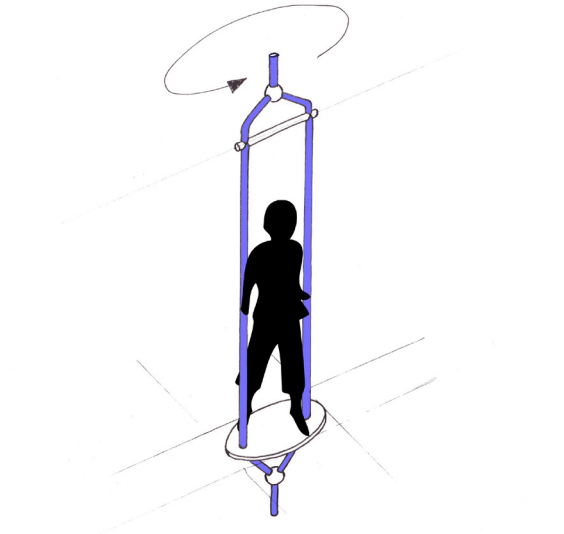

figure D.8 Intended use: spinning ropes

Jumping rope

On multiple occasions, children were observed playing with jumping ropes. Solitary, in small groups with one child jumping over to rope as well as groups of up to eight children where six children simultaneously jumped over the same rope were spotted. Although the games were not understood, it was clear that the children were sometimes using the jumping rope in a bigger game, but used the rope as intended.

Spinning ropes

Another intended use was spotted as part of a large play set combining multiple physical elements such as climbing and sliding. On the side, there were two small platforms, just large enough for a child to stand on. Each platform was connected to a bearing both at the top and bottom of the play set by two ropes. A child would stand on the platform, hold the two ropes in its hands and start spinning. Multiple children were observed to jump on this element and spin for roughly a minute. There was no game involved, their play was purely based on spinning and the play was performed solitary. Children even mentioned it later on while being inside as one of the most fun elements of their schoolyard.

Slide

Slides were interesting to look at while observing intended and unintended use. A grey area between the two was observed. Children were observed running up the slide, or trying to stand on the steep slope, but more often than not, children were actually observed sliding down the slide. However, they only once, or sometimes not even once, went down the slide the way we would consider intended. Mostly, they went down headfirst or sideways, with their feet hanging out the sides. It is arguable if this intended or unintended.

Sand box

Sand is one of the play materials described by the term 'open-ended', meaning that it can be engaged in many different ways. During the observations, the sand box was clearly a popular place to play, especially for the younger children (estimated between 4 and 6 years old). Older children stayed well clear of the sand box. The children were not observed to play a particular game in the sand box. They were generally playing next to each other, seemingly engaged in their own activity, possibly (perhaps likely) combined with a form of fantasy.

Tumbling rack

Another play set which was observed to be used as intended is the tumbling rack. Simply, horizontal bars provide children with the means to tumble around them, spinning their bodies. Especially girls seemed to enjoy this type of play.

Actual use conclusion

Goal of the actual use observation was to gain insight into the actual use of play sets. Which play sets are used as intended and why? What sparks unintended, creative use of play sets? To approach this use on an abstract level, both the intended and unintended use situations were sketched in a simplistic way. Yet, the sketches show a lot of similarities.

All the intended use situations, except for the sand box, are concerning physical play. These are situations where children feel the effect of their play behaviour through their bodies and/or situations that provide the children with a physical challenge.

The unintended use, except for the elastic last man standing, all include surfaces. The surfaces are used as boundaries,

creating a play field or part of a play field that functions as a goal or aid in other types of play (like a ramp).

Group sizes

Appendix C describes the evolution of social play. During the observations, attention was given to the group size of playing children. How large were the children's groups, in what type of play did they engage and at what age (the latter through estimation). The children observed were in the age range of children attending primary schools; four to twelve years old. The evaluation is stated from young to older children. Table C-2 shows the expectation.

4 ~ 5 years old

4 to 5 year olds were observed to play from solo to small groups. Solitary play was observed using play objects such as carts and tricycles or while playing in the sand box. In dyads, four to five year old girls were mostly observed to engage in some form of socio-dramatic play; two girls playing out a scene where they are parents of children, resembled through dolls. As for boys, playing in dyads was mostly seen in physical or construction play. An example is racing around or trying to bump into each other using carts or tricycles. Groups up to four children were observed to work together in the sand box in order to construct something together; sometimes in the form of simply covering one child's body with sand entirely. No difference in group size while playing was observed between boys and girls within this age category.

These observations combined show that the social play types of four and five year olds range from solitary to cooperative play. The most observed play style is cooperative play in dyads or small groups. Overall, the observations are consistent with the expectations.

6 ~ 8 years old

As for six to eight year olds, roughly grade three to five, they were observed to play mostly in groups of varies sizes ranging from three to eight. On occasions the children were spotted playing in dyads, but it seemed this can mostly be allocated to the play being limited by the play object or game. For example, two children played table tennis using a football; the table is only set up to support two children. Playing solitary was not seen at all during the observations.
The children in this age category were almost exclusively observed to play games, mostly with invented rules, but also with fixed rules. As such, play mostly supported cooperative and competitive play. It must be said that the competitive side was not necessarily observed as a need to win. Within the games with invented rules, hardly any way to actually win was spotted; it was all about the continuation of play.

The group size of girl's play groups was estimated to be slightly lower (three to five) than boys (three to eight) during the observations. At the same time, a mix of boys and girls were observed to play together regularly, in which case they were always spotted engaged in a game of some sort and in a group size of around six to eight children.

No solitary play and hardly any dyad play was observed in the age category of six to eight. It cannot be concluded that they do not engage in such play; they could still engage in construction play with for example Lego on their own. As for playing on the schoolyard though, six to eight year old children were only seen engaged in cooperative and competitive play. Similarly, children within this age category were only observed to play in groups and engaged only in games, either with or without fixed rules. As it was expected that the children in this age category engage in solitary, dyad and group play, the observations reflected some of the expectations, but not all.

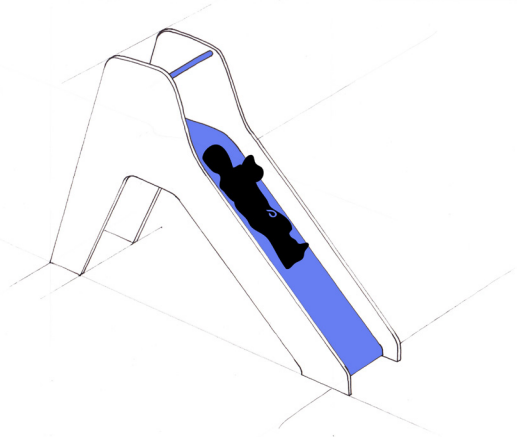

figure D.9 Intended use: slide

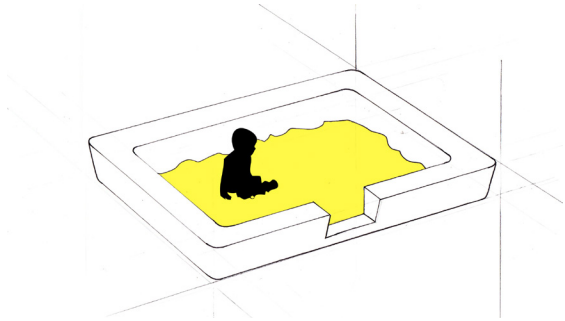

figure D.10 Intended use: sand box

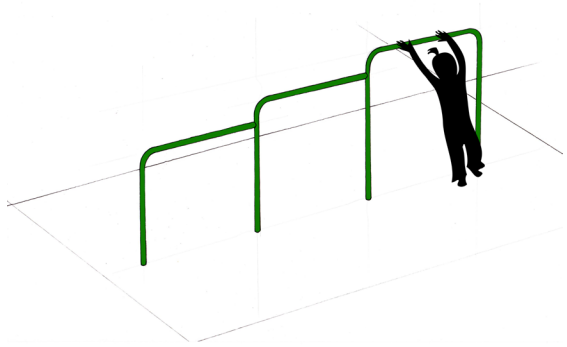

figure D.11 Intended use: tumbling rack

9 ~ 12 years old

Nine to twelve year olds showed a remarkable difference between boys and girls. A mixed group between the two sexes was observed much less than among six to eight year olds. The majority of the time, boys were observed playing football in large groups. The group size while playing their football match sometimes exceeded the normal football team size of eleven. Girls engaged in other activities such as simply chatting with one another in groups of two to five, not necessarily showing clear play behaviour. The games with invented rules were observed much less among this age category; mostly they were engaged in games with rules. As such, play focused mainly on competitive play.

With the observations mainly showing games with fixed rules, competitive play and in group sizes of small to large, the observations are consistent with the expectations. A clear difference was also spotted in group sizes between boys and girls.

Conclusion

In general, the ethnography study shows exactly what was expected; children are very good at creating their own play and, while doing so, use play sets totally different from their intended use. Nevertheless, there were also observations showing intended use of play sets. This knowledge can be used in the design process. The two main design guidelines that determine intended and unintended use of play sets are therefore:

- In order to allow intended use of a play set, include a way for children to feel the play in their bodies; a type of physical play
- In order to allow unintended use of a play set, use surfaces that children can exploit for their play creation

Design guidelines

Comparing the literature research to the observations, it is concluded that the outcome of the observations reflects most of the literature conclusions. Therefore, table C.2 is considered accurate and applicable for the design of interactive play sets. Based on this table, some further design guidelines for interactive play sets can be formed specific to different types of play:

- Interactive play sets aimed at a child engaging in exploratory/object/sensory play should:
  - Target at children aged roughly three years and younger
  - Be aimed at solitary play and
  - Ideally incorporate open-ended play materials such as sand and water

- Interactive play sets aimed at children engaging in socio-dramatic play should:
  - Target children aged roughly between three and six years
  - Allow play in dyads and small groups of up to roughly four children and
  - Enable cooperative play

- Interactive play sets aimed at children engaging in physical play should:
  - Target children aged roughly between three and eight years
  - Allow playing alone, playing in dyads and in small groups of up to roughly eight children and
  - Enable solitary, parallel, associative and cooperative play
- Interactive play sets aimed at children engaging in construction play should:

- Target children aged roughly between three and eight
- Ideally, allow playing alone as well as in small groups and
- Ideally, allow solitary, parallel, associative and cooperative play

- Interactive play sets aimed at children playing games with invented rules should:
  - Target children aged roughly between six and eight
  - Allow playing in groups of three to a maximum of eight and
  - Enable to incorporate play surfaces for children into their games in some form or way

- Interactive play sets which are designed around games with known rules should:
  - Target mainly boys aged roughly between six and twelve
  - Allow playing in groups of eight and larger
  - Incorporate physical play

APPENDIX E: WHAT CHILDREN LIKE TO PLAY WITH

figure E.1 Top Gear cool wall

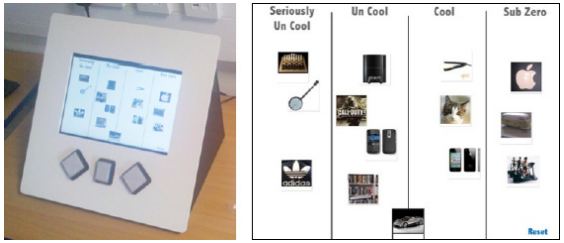

figure E.2 Fitten et al's Cool Wall implementation

What really is fun?

Part of the overall approach of the design project is to find out what exactly attracts children. Therefore, research is performed on what children like. Goal of this research is to find out what children like to play with and why they find these play objects fun. Based on the results, interactive play sets can be designed that match the children's perception.

Particularly for this project, the designer as well as employees at Playnetic could be assuming to know what the interests of children are based on the fact that they have been part of the target group. While there is likely common ground, there are likely differences between generations; society, culture, values, technology, knowledge of the technology and individual motivations are ever changing.

Therefore, incorrectly incorporating users' needs and wishes based on biased opinions or assumptions had to be avoided. To gain the needed insight, a child could be asked if he or she finds football fun. The answer to this question would be yes or no. Asking how much fun football is, would likely not yield a usable result. Asking if they like football more than cycling would provide an answer that is comparable, but not measurable. Yet, to find out what children like to play with, multiple play objects would have to be compared and be measurable in comparison. Therefore, a simple, effective and low-cost tool was developed to map a child's interest.

Inspiration

The created tool was inspired on an article where scientists used the 'Cool Wall' concept of the popular television show Top Gear (figure E.1) to measure the 'coolness' of products amongst teenagers (Fitton et al., 2012). Fitton and his fellow researchers implemented the Cool Wall on a touch screen based system where teenagers were asked to drag different objects to the cool category of their liking, based on how cool they find the object. Using the Cool Wall from Top Gear allowed the teenagers to quickly understand what the categories represented and what to do. Teenagers could subsequently move images to the category of their liking by simply dragging them on the system: 'seriously uncool', 'uncool', 'cool' and 'sub zero'. After many teenagers had completed their Cool Wall, the positions of the images were statistically analysed in order to derive the coolness of the images.

Implementation

While the 'Cool Wall' tool deployed by Fitton et al. was very successful, the concept had to be adapted to the goal of this design project as well as simplified; a touch screen system was

not an option from the perspectives of costs and complexity. Secondly, the study in the United Kingdom focused on similar products, measuring the coolness of an iPhone against a Blackberry or fast food franchises against supermarkets. The Cool Wall concept itself is well known in the United Kingdom since Top Gear is so popular there, but it is less known in the Netherlands, let alone amongst younger children. The Cool Wall encouraged collaboration while deciding the coolness of the pictures. After extensive discussion, it was decided that the new tool would be completed by individual children in order to avoid a dominant child deciding for a group. Lastly, the categories had only one value in their statistical analysis. While the system allowed pictures to be placed on the border of a category, the relative score over a picture placed in the centre of a category would be lost.

Basically, the concept had to be adapted to the goal of the design project as well as simplified. The solution was found in using a board in combination with pictures glued to magnets. The different categories which placed on the white board were converted from 'cool' categories to 'smiley' categories. Five columns were made, each with a smiley ranging from very sad to very happy. Each column was also given a colour to further enhance the expression of the smiley. Goal of the smiley and colour approach was easy recognition of what the columns stand for. Figure E.3 shows the created board.

The board was created in such a way that children have to think about how much fun an object is compared to another. To refer back to the introduction of this chapter, the board basically asks children to compare football and cycling, but does so for multiple play objects. Furthermore, the board provides children with a scale for their answer as well; children have to weigh up how much they like to play with a specific object in relation to other objects.

Pictures

Rightfully so, Fitton et al. discuss the importance of the objects on the pictures used and the way in which these are presented as well as their meaning. Therefore, ample attention was given to choosing the correct objects and their pictures. The objects were chosen on four main parameters: boy versus girl, the main type(s) of development the play stimulates (physical, cognitive, social and emotional), outdoor versus indoor play and individual versus group play. Twenty objects were selected representing different kind of fun products or activities based on creating a good mix amongst the parameters. The pictures were discussed extensively and, as a result, were changed a few times over before becoming final.

An example is the doll, which was first represented by a Baby Born doll. After consideration, this could be considered childish by the older children. The older children could be more drawn to a Barbie doll, while the younger children could still consider it to be a doll. Other changes that were executed created combinations, for example combining the cat and dog into one picture (presented separately at first) to represent pets in general and the combination of the guitar and flute to not create a distinction of musical instruments for boys and girls.

The twenty selected objects are found in table E.1 on the next page, along with their classification amongst the parameters.

The pictures were created in a uniform way. They were placed on a square of roughly 90x90mm, in order to be narrower than a single column and to accommodate 5 pictures on the board vertically while the pictures themselves are still clearly visible, and they were all given a white background. Figure E.4 shows the pictures placed on the board (note: picture

figure E.3 Smiley board

figure E.4 Pictures placed on the board

		Gender			Development type					Location			Individual	
Number	Object	Boy	Girl		Physical	Cognitive	Social	Emotional		Inside	Outside		Individual	Group
1	Nintendo Wii	x	x		x	x	x			x			x	x
2	Tablet / Smartphone	x	x			x				x	x		x	
3	Computer	x	x			x				x			x	
4	Television	x	x			x		x		x			x	x
5	Swing	x	x		x						x		x	
6	Efteling	x	x			x		x			x			x
7	Lego	x			x	x				x			x	x
8	Doll / Barbie		x				x	x		x	x		x	x
9	Football	x			x		x	x			x			x
10	Ballet		x		x		x	x		x				x
11	Bicycle	x			x		x				x		x	x
12	Jumping rope		x		x		x				x		x	x
13	Pedal car	x	x		x		x				x		x	x
14	Inline Skates	x	x		x	x					x		x	x
15	Pavement chalk	x	x		x	x	x				x		x	x
16	Dog / Cat	x	x		x		x	x		x	x		x	
17	Guitar / Flute	x	x			x		x		x			x	x
18	Drawing / Pottering	x	x		x	x		x		x			x	x
19	Reading	x	x			x		x		x			x	
20	Board games	x	x			x	x	x		x				x
		17	17		12	12	10	10		12	11		16	15

table E.1 Twenty chosen objects of play

figure E.5 Final object illustrations

shows the board while the pictures were not finalised yet).

Pilot

A pilot of the test was performed with one younger (four years old) and one older child (eleven years old). Both children understood the test without any explanation, apart from asking them to place the pictures based on how much they find them fun.

The pictures themselves were not all understood correctly. For example the picture with a tablet and smartphone was correctly understood by the 4 year old child, but the 11 year old child thought it was about listening music, as the tablet displayed two singing persons on its screen. The younger child did not understand the pictures showing Lego, ballet and the jumping rope. Furthermore, the picture showing a board game was interpreted as the exact game displayed instead of board games in general.

Therefore the pictures were adjusted to accommodate these findings. For example, the picture showing a tablet and a smartphone was changed to both show an Apple product and an Android based product. Only the picture showing Lego was not changed. Figure E.6 shows the changes.

The final 20 pictures can be seen in figure E.5.

Expectation

The tool was created so that children had to put their liking of a play object in perspective to other objects. Therefore, it was expected that the tool would provide clear and interpretable data to gain insight into what children like to play with. Based on Playnetic's approach of bringing the computer to the outdoor environment as well as personal expectations, it was expected that the tablet / smartphone, Wii and computer would be among the most fun objects. The football was expected to be a competitor for the most fun object, especially in the boys' population. As for the differences between boys and girls, it was expected that Lego, football and cycling would do well among the boys, while the doll / Barbie, ballet and jumping rope would do well in the girls' population. Lastly, it was expected that some object would show increasing or decreasing trends when dividing the total population in different age categories and comparing the results of these age populations.

Execution

The test as described under setup was executed on 6 primary schools. The schools were chosen based on their location and their school type to create as much differentiation as possible. The locations were chosen in order to create a good representation of The Netherlands. Initially, only one school in Twente was targeted to execute the study, while the 6th school that was to be visited was located in Assen. Unfortunately, the visit at the school in Assen fell through and as the May vacation was at hand, the choice was made to not find another school in the northern part of the country. Alternatively, a visit to an additional school in Twente (Enschede) was agreed through a direct contact. Enschede therefore became the 6th school within the study instead of Assen.

The test was executed during the lunchtime of each school. The children that 'stayed over' (Dutch: overblijven) were asked to participate. At each school, children of different age groups were involved in the test. The only explanation given to the children was that they were asked to classify the pictures from least fun to most fun based on their own preference.

While a child performed the test, its group number (representing age), gender and school was noted down on a paper and the child was given a participant number. After a child finished the test, a post-it note with a number was attached to the board and a photograph of the end result was taken. Subsequently, each child was asked why the pictures placed in the most fun category were considered to be most fun in order to gain inspiration for the design phase.

figure E.6 Picture changes resulting from the pilot

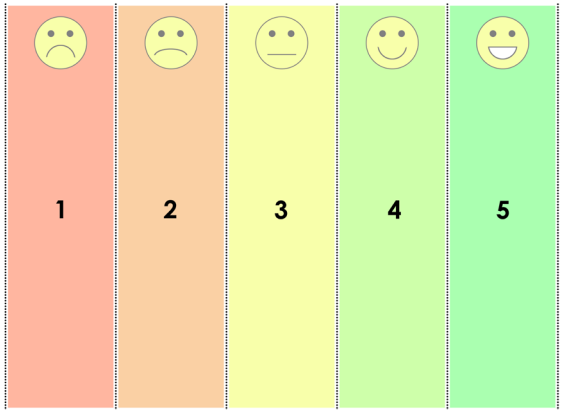

figure E.7 Statistical analysis scoring

Analysis

The results of the tests were analysed statistically. Each picture was scored with a number between one and five, based on the column it was placed in, as illustrated in figure E.7.

Results

A total of 115 children participated in the study. Of these 115 children, 60 were boys and 55 were girls. When the test was executed, 23 children were group 1 and 2 pupils, 46 were part of the group 3 and 4 population, 23 were in group 5 and 6 and the remaining 23 were in group 7 and 8. The fact that 23 children participated in three age groups while one age group has exactly double that amount is a coincidence.

To verify if the double amount of children in the age group of 3 and 4 has any influence on the overall result, a Monte Carlo simulation with 100 trials was performed, picking 23 random entries from the 46 in this age category per trial. Figure E.8 shows the mean scores and standard deviations, represented by the range bars, of the total population and the Monte Carlo simulation.

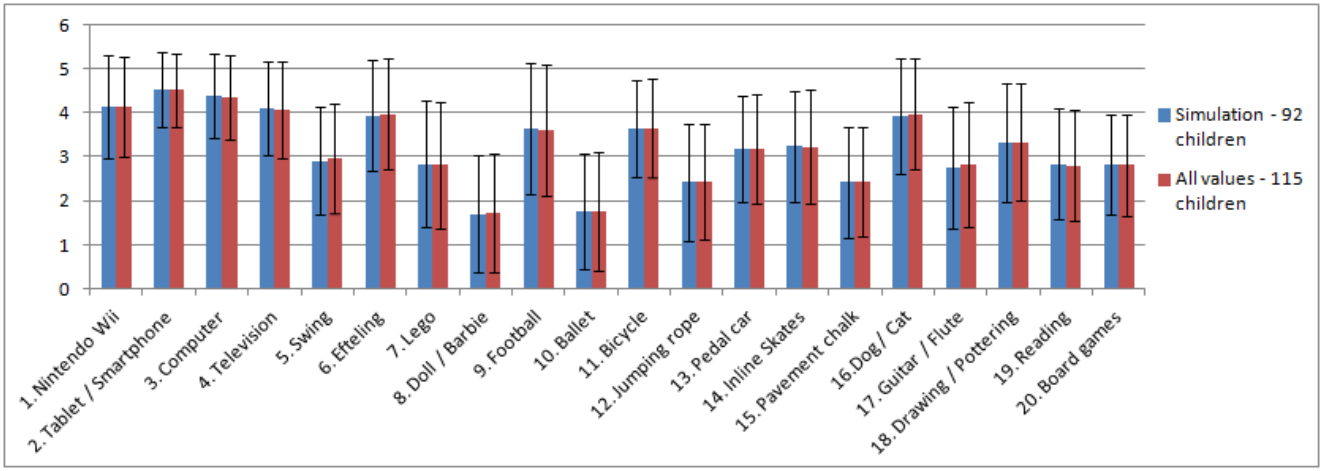

figure E.8 Total population and Monte Carlo simulation comparison

The values shown in figure E.8 are very close to each other. Based on this simulation, it can be concluded that including all 46 children from the 3rd and 4th grade does not change the outcome of the overall study. At the same time, there are some minor differences that can be seen. Using the numbers generated through the simulation does reflect the overall population of the study better.

The data resulting from all the performed tests is found in table E.3 at the end of this appendix.

Overall object scores

Figure E.9 shows the mean scores as well as their respective standard deviations of the Monte Carlo simulation children per picture on the board. The colours of the bars in the graph resemble the height of the bar, if the mean value falls between 4 and 5, it is displayed in green, between 3 and 4 in yellow, between 2 and 3 as orange and 1 and 2 as red.

The first thing that catches the eye is the four pictures representing technology, the Wii, tablet / smartphone, computer and television, scoring the highest. The tablet / smartphone has the highest mean score with 4.52. It also has the lowest standard deviation with 0.84, meaning the variance of the position of the tablet / smartphone is the lowest in this study. The computer is a good second with a score of 4.37 and standard deviation of 0.95. These results indicate that children find technology to be very fun. More fun, on average, than playing with attributes aimed at playing outdoors, like a football, bicycle, jumping rope, pedal car, inline skates or pavement chalk.

Behind the four pictures showing technology, the Efteling and the Dog / Cat, representing pets, are almost similarly

scored. Yet these represent totally different types of play; the Efteling embodies physical thrills as well as fantasy, thus being physical and cognitive play, while playing with a pet is much more aimed at the social and emotional aspect of play. The football and the bicycle are just behind the six mentioned objects so far, which both resemble physical, outdoor play.

Two pictures are clearly at the bottom; doll / barbie and ballet. Their respective standard deviation is mediocre compared to the other pictures, meaning their variance is about the same as the other pictures; they truly score lower.

The rest of the pictures are fairly close together, between 3.33 and 2.42; they form the 'bulk'. Their respective standard deviations are also in the same region, ranging from 1.20 to 1.37.

Gender differences and similarities

Figure E.10 shows the mean scores and their respective standard deviations of boys and girls. In total, 60 boys and 55 girls participated in the study.

Overall, the mean scores look fairly similar. In fact, the average mean score of boys and girls is equal at 3.23. The average standard deviation of girls is higher at 1.29 compared to the 1.04 of boys, indicating that girls had more variance while placing the pictures than boys.

Before jumping to conclusions, it is imperative to realise that the study does not incorporate the actual reasoning behind the scores on a qualitative level; boys and girls might like an object equally for totally different reasons.

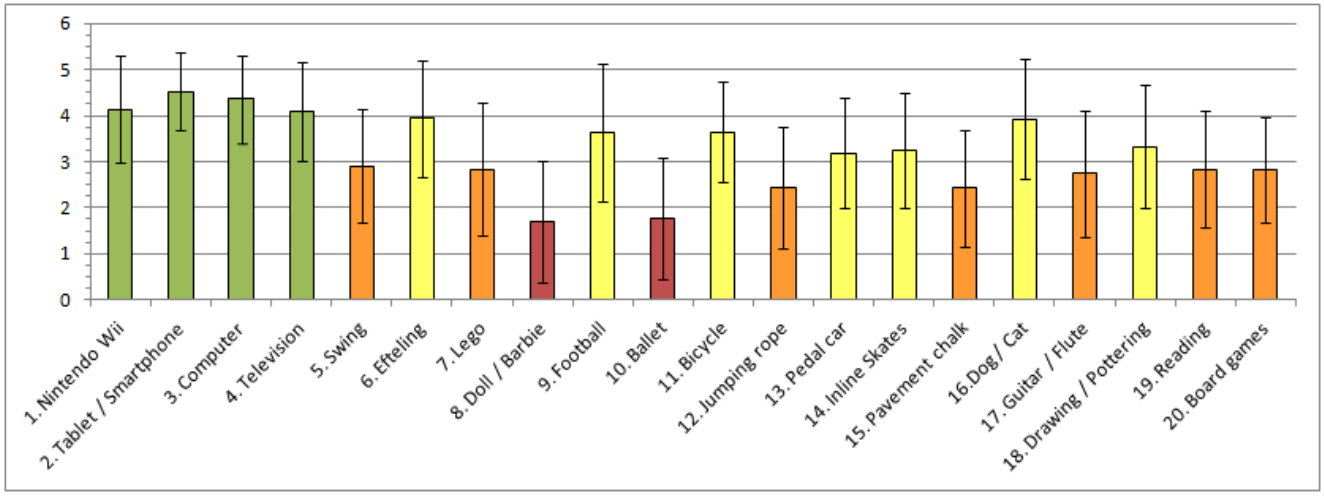

figure E.9 Mean scores and standard deviations of each object within the Monte Carlo simulation

There are also differences to be spotted. Boys clearly like Lego, football and the pedal car more. They like the Wii (higher mean and lower spread), tablet / smartphone (same reason) and board games slightly more. Girls clearly like the doll / barbie, ballet (but compared to other objects, those two still score low even among girls), jumping rope and drawing / pottering more. They like inline skates and pavement chalk slightly more.

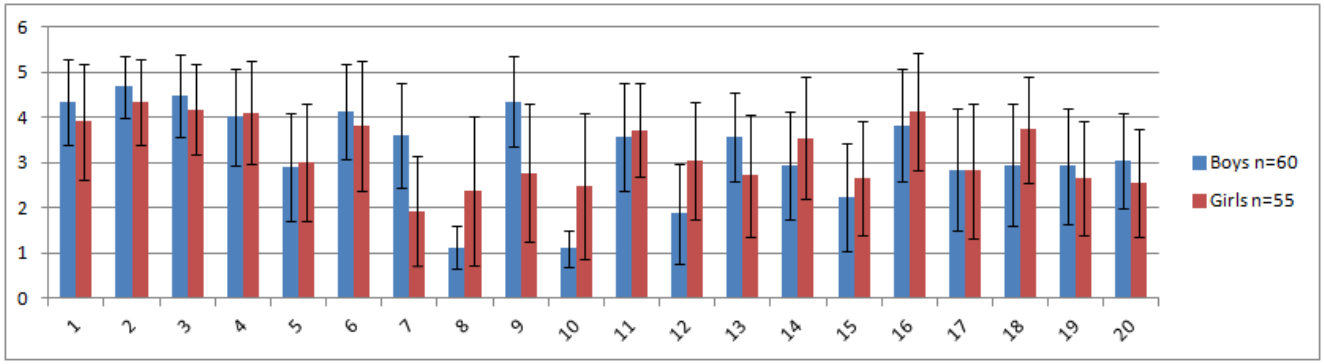

figure E.10 Mean scores and standard deviations of each object for the populations of boys and girls

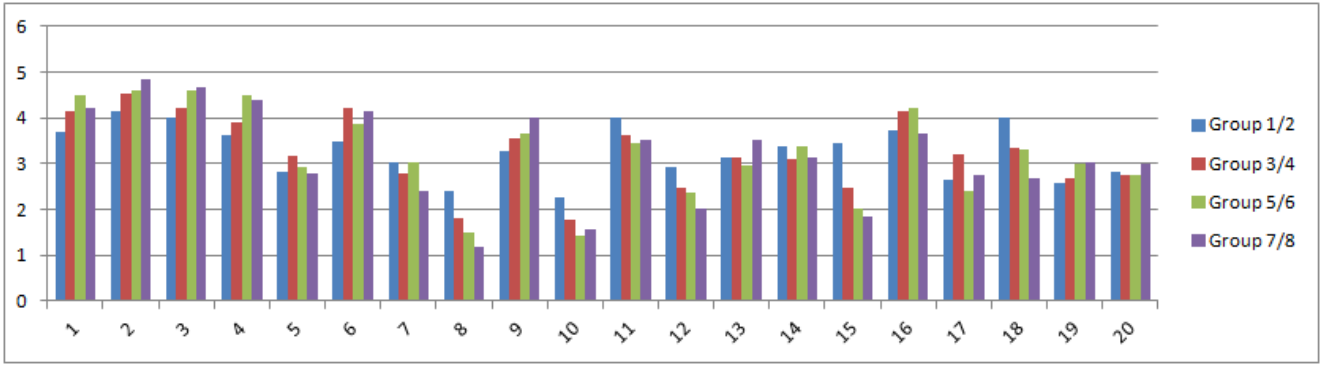

figure E.11 Mean scores of each object for the four different age populations

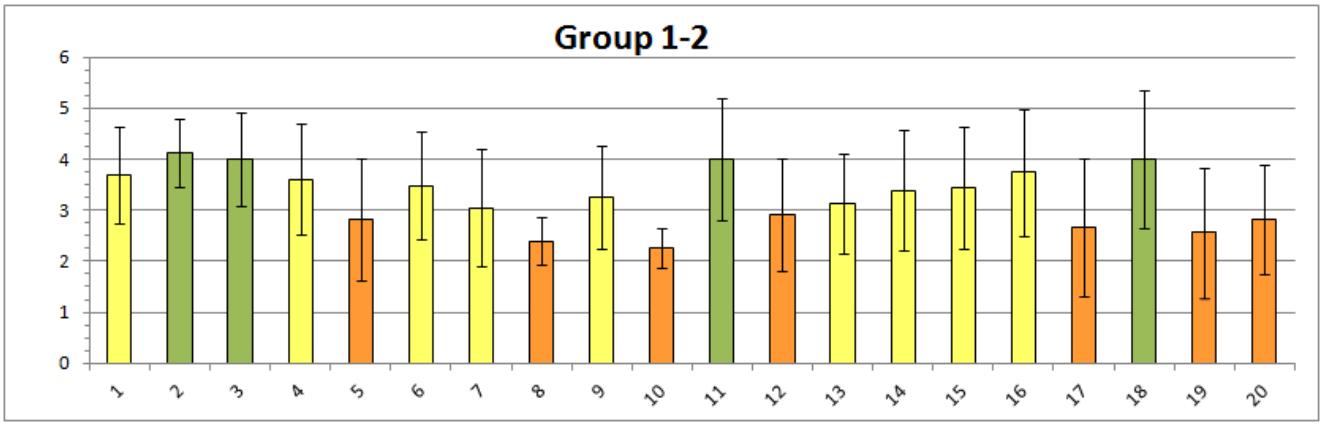

figure E.112 Mean scores and standard deviations of each object for the group 1 and 2 population

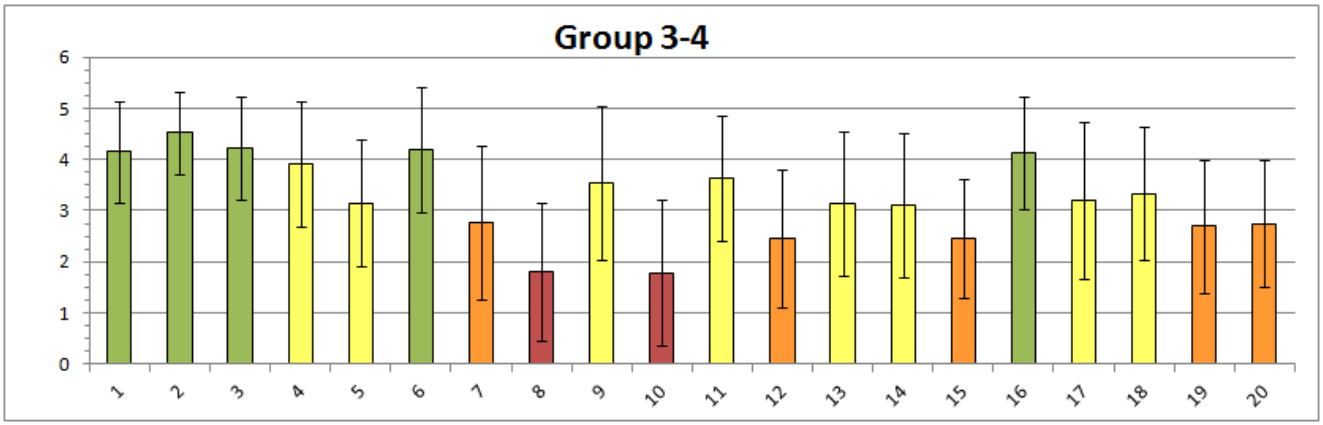

figure E.13 Mean scores and standard deviations of each object for the group 3 and 4 population

Off the objects, it was assumed that Lego, football and the bicycle could be considered for boys, while the doll / Barbie, ballet and the jumping rope could be considered for girls. The scoring verifies this except for the bicycle. Girls actually rate the bicycle higher than boys.

Age differences and similarities

The mean scores of the different age categories, represented through dividing up the grades in primary school into four groups of two grades each, is shown in figure E.11. For each category, the mean scores and their respective standard deviations is shown in figures E.12 through E.15.

Looking at figure E.11, it shows that there are also quite some similarities among different age categories. Many objects score around the same mean value for all age groups. Yet, similarly to the comparison between genders, there was no qualitative research as to why a certain age group likes something.

There are also some changes which can be spotted. The mean scores of figure E.11 indicate a decreasing appeal in the doll / barbie, ballet, pavement chalk and drawing / pottering as children get older. At the same time, the Wii, tablet / smartphone, computer, television (all technology), football and reading become more appealing. The other objects show similar scores or no indication of a clear increase/decrease.

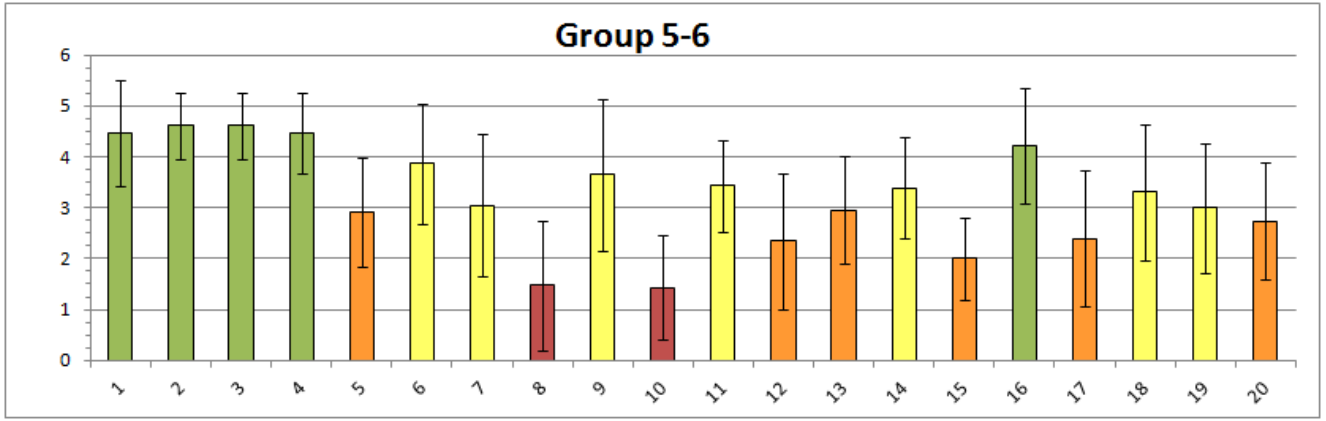

figure E.14 Mean scores and standard deviations of each object for the group 5 and 6 population

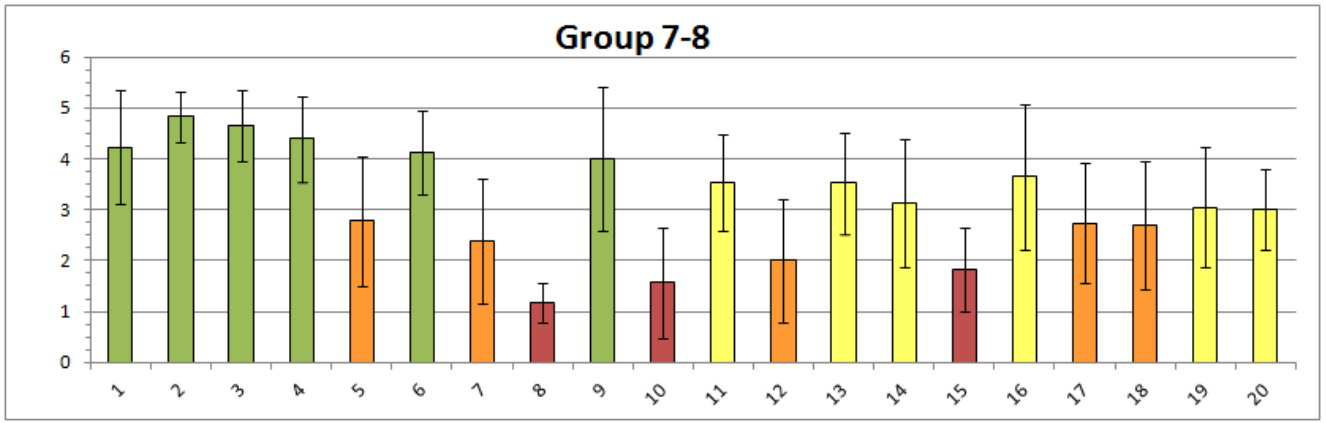

figure E.15 Mean scores and standard deviations of each object for the group 7 and 8 population

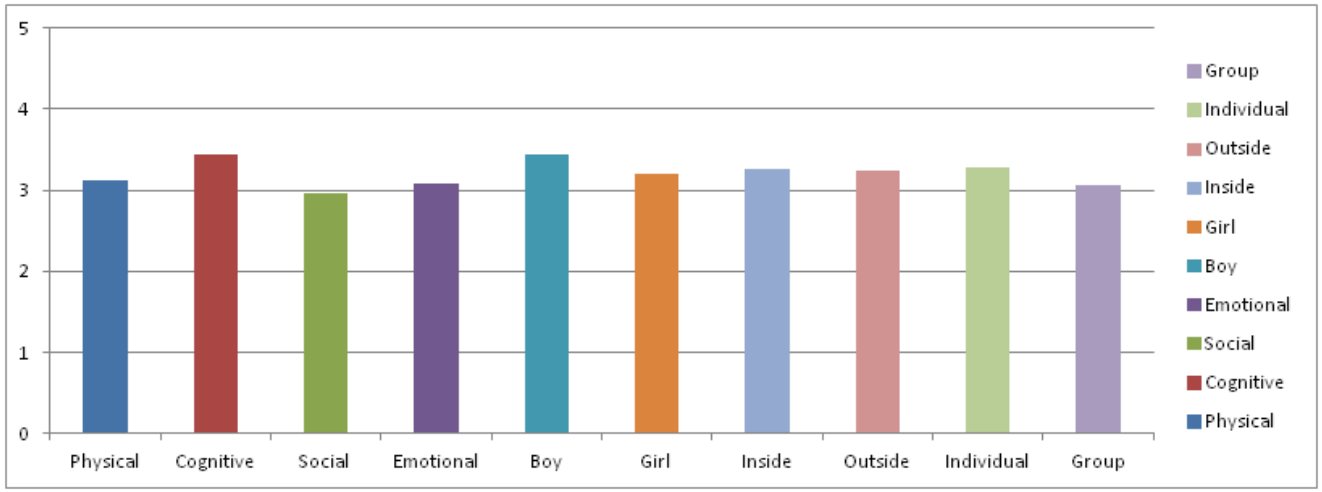

figure E.16 Play attributes scores without weighing factors

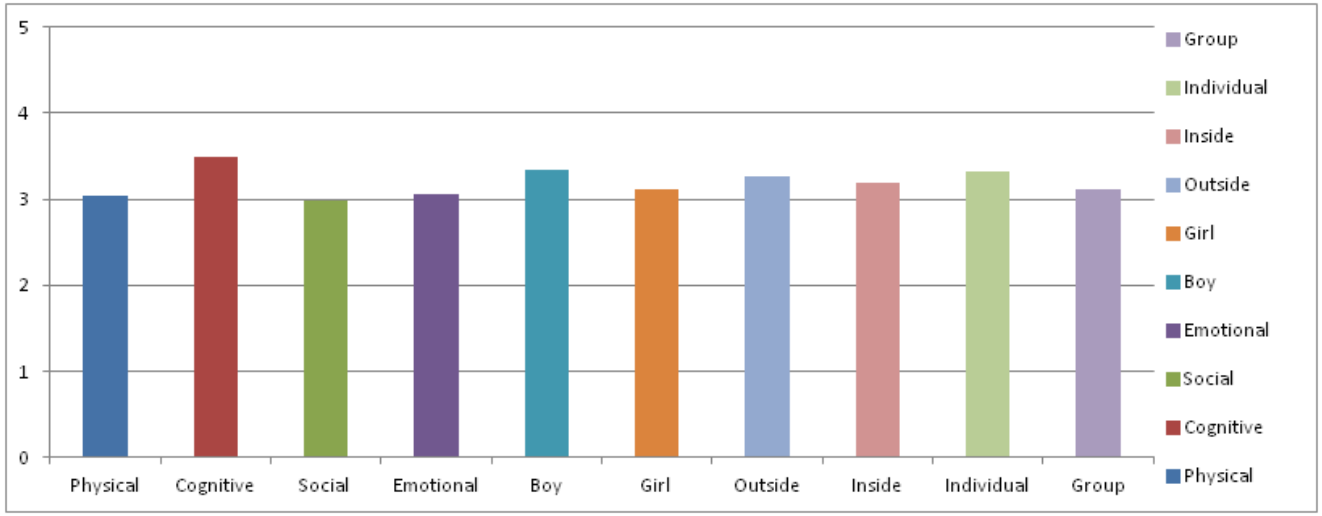

figure E.17 Play attributes scores with weighing factors

Play attributes

Figures E.16 and E.17 show the scoring of the attributes as explained in table E.2. The difference between the figures is that figure E.16 shows scores which are not weighed; each object is either allocated to the attribute or not, 1 or 0. Figure E.17 includes weighing factors, meaning that, after allocating an object to the respective attribute, it is given a value between 1 and 5 for how much it allocates to the attribute. This ranking is shown in table E.2. The figures show the sum of all scores allocated to the attributes, divided by the amount of objects allocated to the attribute in case of the unranked figure. As for the ranked figure, it is divided by the total ranking points allocated to the specific attribute, meaning the sum of a row in table E.2.

Figures E.18 and E.19 show the same attributes and scoring, but with separate age categories.

It is impossible to create any concrete conclusions from this figure. Between physical, cognitive, social and emotional, cognitive scores highest in all figures and throughout all age categories. Another interesting observation that can be seen is the fact that physical play seems to become less appealing as children become older. Alternatively, this could be an indication of proof for the trend of children choosing computer games over playing outside, but it is a stretch to state that as a conclusion.

Additionally, boys score higher than girls, which could indicate that the objects allocated to boys score higher than those allocated to girls; the objects allocated to boys are considered more fun (by both genders combined). However, the difference can easily be explained by the false assumption of considering the bicycle as an object for boys.

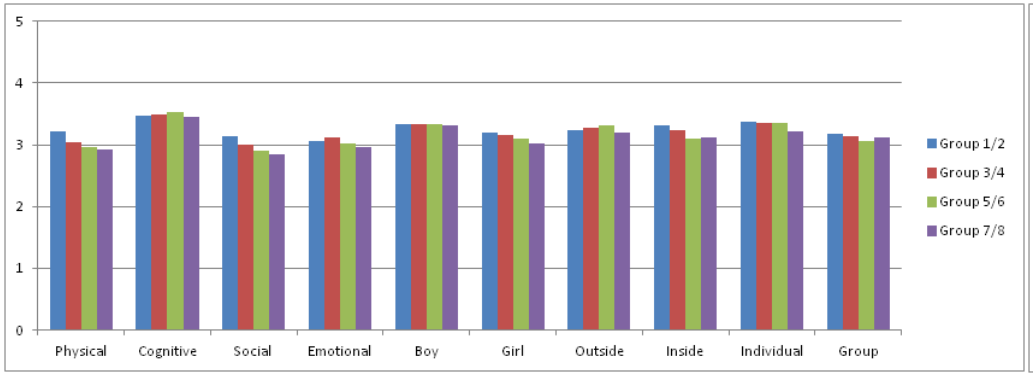

figure E.18 Play attributes scores without weighing factors for the four different age populations

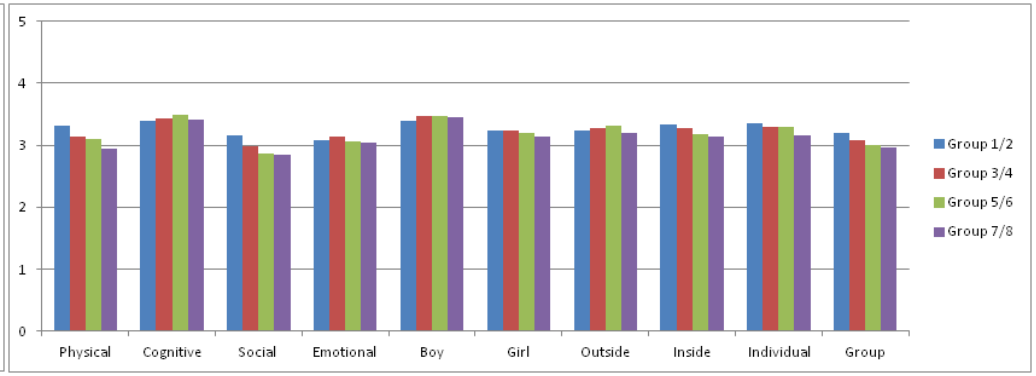

figure E.19 Play attributes scores with weighing factors for the four different age populations

Individual play has a higher score than group play, both in total and between each age category. The differences are roughly the same across the board; group play scores between 5 and 7 percent less than individual play. The difference is therefore not significantly greater and with the simple comparison of the objects (both weighed and not weighed) it is not possible to state that individual play is considered more fun than group play; there are too many assumptions and changing one parameter could completely change the outcome.

Weighing seems to have little influence on the scores. Differences are very hard to spot. Physical scores slightly lower when weighed, so does boy. On the other hand, cognitive scores slightly higher when weighed. The reason behind creating a weighed was to view if it would drastically change the results. Since it does not, it can be concluded that the created comparison is accurate enough to base conclusions on. For most comparisons (Physical – Cognitive – Social – Emotional, Boy – Girl, Outside – Inside, Individual – Group), the differences are however not significant.

	1. Nintendo Wii	2. Tablet / Smartphone	3. Computer	4. Television	5. Swing	6. Efteling	7. Lego	8. Doll / Barbie	9. Football	10. Ballet	11. Bicycle	12. Jumping rope	13. Pedal car	14. Inline Skates	15. Pavement chalk	16.Dog / Cat	17. Guitar / Flute	18. Drawing / Pottering	19. Reading	20. Board games
Physical	2				4		2		5	5	5	5	5	5	2	1		2		
Cognitive	4	5	5	3		2	4							1	4		4	5	3	3
Social	1							2	3	3	2	3	1		2	5				4
Emotional				3		4		4	1	3						3	2	2	3	1
Boy	3	3	3	3	3	3	5	1	5	1	4	2	4	3	3	2	3	3	3	3
Girl	3	3	3	3	3	3	1	5	1	5	2	4	2	3	3	4	3	3	3	3
Inside	5	5	5	5			5	5		5						5	5	5	5	5
Outside		1			5	5		1	5		5	5	5	5	5	1				
Individual	3	5	5	4	5		4	4	1		3	2	2	3	4	5	4	5	5	
Group	3	1	1	2		5	2	2	5	5	3	4	4	3	2		2	1		5

table E.2 Weighing factors allocated to the play attributes

Questioning

Originally, the intention was to ask children why they placed the pictures in the most right column, the most fun column. It would be asked for all the pictures. It was thought that the study would be conducted at schools during class hours, thus having a lot of time to perform the study. As schools were hesitant to cooperate with such an approach, the approach was changed to perform the study during the lunch time of the children. This meant only one hour per school, if the full hour was made available to begin with. Therefore, the questioning was changed to asking which picture they liked the most and why. Even with this approach it proved hard to keep track of all the responses.

Nevertheless, some clear trends were spotted. The two pictures were clearly most mentioned; the tablet / smartphone and the Efteling for 'games' and 'rollercoaster' respectively.

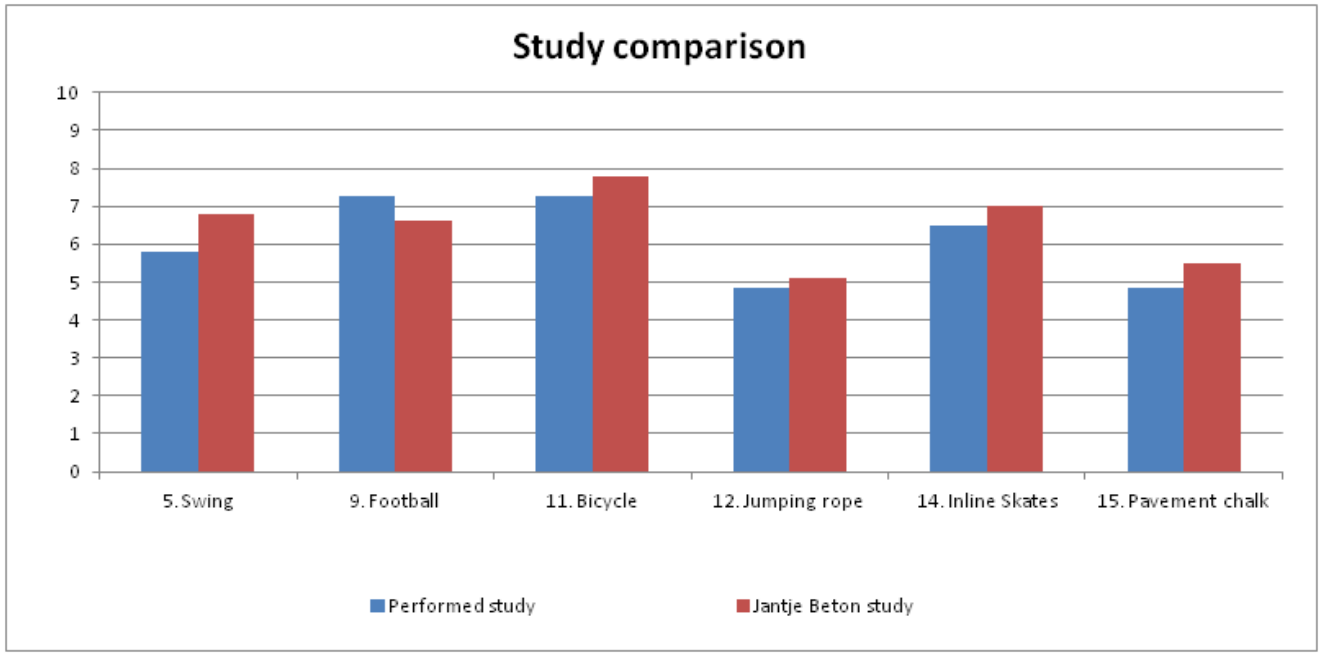

figure E.20 Results comparison of the performed test to a Jantje Beton questionnaire

Another common reason for the tablet / smartphone to be the most fun was 'listening to music', while 'the Droomvlucht' was also mentioned a few times as a reason for the Efteling. The last answer was especially answered repeatedly at the school in Valkenswaard, which is close to the Efteling (yet the Efteling was not often mentioned as most fun at this school, perhaps the children did not consider it so special for them). Especially boys mentioned football too as most fun with the most named reasons 'enjoy running' and 'playing together'. Girls mentioned the dog / cat as most fun repeatedly, but had trouble explaining why; it mostly came down to 'petting'. The computer was the next most named object, for the same reason as the tablet / smartphone; 'games'.

Comparison study Jantje Beton

In between the school visits, while working on a different subject, a study performed by the Jantje Beton foundation (a foundation proclaiming the importance of playing outside and aimed at improving the outside playing options for children in the Netherlands) was found (Snel, 2010). The study is based on an online enquiry, filled out by both children and parents. Within the study, participants were asked to rate certain outside play activities from 1 to 10. A total of 12 activities were given as options. Football, swinging, cycling, jumping rope, inline skating and drawing with pavement chalk were among these options. The scores which the children gave to these six activities have been compared to the mean scores generated in this study. In order to do so, the mean scores of this study have been multiplied by 2 to create a scale of 2 to 10. This is not exactly the same scale, but enough to create a simple comparison. The resulting scores are shown in figure E.20.

In order to make a more solid comparison between the two studies, the means of the studies should be compared

to each other using the confidence interval based of the standard deviations. This was not executed simply because the comparison of the two studies would have no influence on the overall conclusions of the performed study itself. Secondly, the intervals would be hard to compare even if they would be calculated; the scales of the two studies are not the same (1-10 in the Jantje Beton study versus 2-10 in the performed study after multiplying the original scores by 2) and the standard deviations of the Jantje Beton study are unknown.

Overall, this comparison shows the scores generated in this study are comparable to the study of Jantje Beton. It is an indication that the performed study is a good representation of what children really like and how they rate them.

Conclusion

Before stating the design conclusions, it is important to understand that these should be considered guiding principles and thoughts to pursue. Overall, the results match the expectations. An easy conclusion would therefore be to state that incorporating users' needs and wishes based on biased opinions or assumptions are not an issue. While the immediate results seem to support such a claim, it is not possible to draw this conclusion.

The tablet / smartphone object is a good example to illustrate why. It has the highest mean score in all populations; total, boy, girl and all age categories. It is also the most mentioned object during the questioning for the reasons 'games' and 'listening to music'. The reason of listening to music illustrates that the study does not incorporate how children use the objects. After concluding that the tablet / smartphone is the most fun object within the study, this would serve as a guideline for the design phase of the project. But the conclusion does not state which attributes or features of the tablet / smartphone should be incorporated in the designs. For example, the reason for tablet / smartphones to be fun was expected to be games. Playing games on the tablet / smartphone was considered individual, thus the object was allocated to individual play in table E.2. Moreover, the way in which children use tablets and smartphones for listening music, which was also observed during one of the primary school visits, makes it an object for use in groups.

This example around the tablet / smartphone shows exactly why the tool was created; to avoid incorporating users' needs and wishes based on biased opinions or assumptions. The reason for the tablet / smartphone being fun was expected to be different than the mentioned reason; the expectation was an incorrect assumption. Therefore, it is hard to base any concrete conclusions on the direct test results towards the design project.

Object scores

The following conclusions can be stated in regard to the object scores:

- The tablet / smartphone can be considered most fun. It scores the highest mean scores within all populations, while also having the lowest standard deviation in most
- The 'technology four', the Wii, tablet / smartphone, computer and television, are high scorers in general
- Among boys, the football has to be added to the most fun objects
- For girls, the dog / cat, or pets as its representation, is in the top 5 of the girls
- Even in the youngest age category (roughly 4 and 5 year olds) the Wii, tablet / smartphone, computer and

television are scoring high, but still competing with the bicycle and drawing / pottering
- Among the age category of 6 and 7 year olds, the 'technology four' are competing with the Efteling and dog / cat (or pets)
- Within the two oldest age categories, the technology four are the top four scorers
- Play objects assumed to be aimed at girls, like the doll / barbie and ballet, clearly score higher at girls, but compared to other objects, girls do not rate them highly at all
- There is some correlation visible at play objects between the different age categories; the mean scores of figure E.10 indicate a decreasing appeal in the doll / barbie, ballet, pavement chalk and drawing / pottering as children get older. At the same time, the Wii, tablet / smartphone, computer, television (all technology), football and reading become more appealing.
- Interestingly enough, the other play objects score similarly throughout all age categories.

The fact that the 'technology four' score high was expected. However, it was not expected that they would be rated so much fun even in the youngest category or that they would necessarily score higher than almost all other objects within every population.

Play styles / play attributes

- Between physical, cognitive, social and emotional play, cognitive scores the highest
- 'Boy' and 'girl' play objects are, on average, rated equally. The difference between the two which can be seen in figure E.16 (not weighed) and figure E.17 (weighed) can almost fully be allocated by the wrong assumption of the bicycle being a play object for boys
- Indoor and outdoor play is, on average, rated equally
- Individual play seems to be rated higher than group play. It is however not significantly greater to create that conclusion and the example of tablet / smartphone shows that the analysis on this point is sensitive to errors.

Between physical, cognitive, social and emotional play, it was expected that cognitive play could score the highest, since the expectation was that the 'technology four' would do well and these were all allocated to cognitive play. No expectations were created for the other play attribute comparisons.

Design conclusions

Before stating the design conclusions, it is important to understand that these should be considered guiding principles and thoughts to pursue. Overall, the tool and its results proved to be very useful, but hard to base any concrete conclusions on towards the design project. The tablet / smartphone object is a good example to illustrate why. It has the highest mean score in all populations; total, boy, girl and all age categories. It is also the most mentioned object during the questioning for the reasons 'games' and 'listening to music'. The reason of listening to music illustrates that the study does not incorporate how children use the objects. After concluding that the tablet / smartphone are the most fun object within the study, this would serve as a guideline for the design phase of the project. But the conclusion does not state which attributes or features of the tablet / smartphone should be incorporated in the designs. For example, the reason for tablet / smartphones to be fun was expected to be games. Playing games on the tablet / smartphone is considered individual, thus the object has been allocated to individual play in table 1.2. The way in which children use tablets and smartphones for listening music, as has also

been observed during one of the ground school visits, makes it an object for use in groups.

A more elaborate explanation and direct conclusions on the results, for example related to the object scores, can be found in appendix E.

The following design conclusions can be stated:

- The study supports Playnetic's current approach of playing in the outdoor public environment. Their current products bring technology to the public environment and make use of sound and music. This corresponds to the most mentioned reason for the tablet / smartphone being fun; listening to music.
- The three objects representing computer technology, the tablet / smartphone, Wii and computer itself have the highest three scores in the overall object scores and score high among all categories. Therefore, the study also supports the previously mentioned statement of bringing computer games to the public environment. It is a line of thought which should be continued.
- Within the new product ideas, the cognitive side of the play concepts should be considered as an important design aspect. While listening to music was given one of the reasons for the tablet / smartphone being fun, so were games. Furthermore, more reasons were given for other objects which indicated that a cognitive challenge is considered fun.
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Insight

The most important useful effect of this study cannot be explained in words. Almost all children who participated in the study experienced the test and use of the board as a type of game in itself. On multiple occasions was this observed, especially in the younger age categories. Therefore, the test provided qualitative insight into how children approach play, today.

The best example concerns a girl who did not yet attend ground school, she was slightly too young (and her results have therefore not been included in the results of this study). When executing the test, she started as intended, placing the objects on the board according to her preference. By accident, she turned one of the objects upside down and noticed the coloured magnet glued to the backside of the object. Subsequently, she removed the objects from the board and turned over all objects. After taking a moment to look at the backside of the objects, she started to place the objects on the board upside down. The objects were placed that objects with a matching coloured magnet connected; she seemed to be deliberately arranging the objects based on the colour of the magnets. After all the objects were placed, she took a moment to look at them, only to look unsatisfied with her results and removing all the objects from the board. She then proceeded to rearrange the objects on the board again, still based on the colour of the magnets on the backside of the objects. After completing her object arrangement the second time, she seemed happy with it. The next thing she did was turn over the objects to make their front side face up, but leaving the objects in the same position on the board as they were when upside down. Afterwards, she looked at the objects and started switching objects one by one to finally create her arrangement on how much she liked playing with an object, just as the tool intended. She created her own game around the tool and engaged in a form of exploratory and object play.

Number	Gender	Group	Objects																			
			1. Nintendo Wii	2. Tablet / Smartphone	3. Computer	4. Television	5. Swing	6. Efteling	7. Lego	8. Doll / Barbie	9. Football	10. Ballet	11. Bicycle	12. Jumping rope	13. Pedal car	14. Inline Skates	15. Pavement chalk	16.Dog / Cat	17. Guitar / Flute	18. Drawing / Pottering	19. Reading	20. Board games
1	J	6	4	5	5	5	4	5	3	1	5	1	5	2	4	3	1	3	1	3	3	4
2	J	4	3	3	4	1	1	5	3	2	4	1	5	2	4	5	1	3	2	5	2	4
3	J	4	4	4	4	3	3	5	2	1	5	1	5	3	4	5	3	3	4	2	4	3
4	J	2	4	5	4	2	4	3	5	1	5	1	2	2	5	4	1	1	4	2	3	3
5	M	3	4	4	5	4	5	2	1	4	3	4	5	3	5	3	2	5	1	2	1	2
6	M	3	5	4	1	2	2	5	4	2	3	5	3	3	1	1	1	4	2	5	4	3
7	M	3	4	3	4	5	3	4	1	5	2	2	5	3	1	3	2	5	1	2	4	1
8	J	2	5	5	5	4	2	4	4	1	5	1	3	1	4	2	1	2	3	3	3	2
9	J	2	2	5	2	4	2	1	5	1	2	1	5	3	4	3	4	5	1	3	3	4
10	M	1	2	4	5	2	3	3	1	5	1	4	5	4	3	4	2	1	3	5	2	1
11	M	1/2	5	5	4	1	2	1	1	5	4	2	4	3	3	5	2	5	4	5	1	4
12	J	1/2	5	5	5	3	4	4	4	1	5	1	3	1	3	2	4	3	2	5	5	3
13	M	1/2	5	5	5	4	1	5	2	3	2	4	4	4	1	5	3	5	2	3	4	2
14	M	1/2	4	5	1	4	4	5	3	5	5	5	5	4	1	5	4	5	2	4	4	4
15	J	3	5	4	5	5	4	5	4	1	5	1	4	3	3	2	2	5	3	2	1	3
16	M	4	3	4	5	4	4	5	2	1	3	1	4	2	5	5	2	5	3	4	1	1
17	J	4	5	5	5	4	5	4	4	1	1	1	4	1	4	4	3	5	5	4	4	5
18	J	4	5	3	3	2	3	5	4	1	4	1	4	1	2	2	2	3	5	5	4	5
19	J	4	5	5	1	3	2	5	4	1	4	1	1	1	2	4	1	3	3	3	2	2
20	J	4	3	5	4	3	2	4	2	2	5	1	1	2	3	1	1	5	5	3	2	2
21	M	4	4	5	5	5	2	5	1	1	2	1	2	1	5	3	1	5	4	3	3	1
22	J	4	3	5	5	5	4		3	1	5	1	4	2	5	1	3	1	2	4	3	4
23	J	4	5	5	5	5	4	4	4	1	5	1	4	1	4	5	2	5	4	4	3	1
24	M	3	4	5	5	5	4	5	1	1	1	1	5	5	3	4	2	4	2	5	5	1
25	J	3	5	5	5	2	3	5	3	1	4	1	5	4	4	3	2	4	5	3	2	3

Number	Gender	Group	Objects																			
			1. Nintendo Wii	2. Tablet / Smartphone	3. Computer	4. Television	5. Swing	6. Efteling	7. Lego	8. Doll / Barbie	9. Football	10. Ballet	11. Bicycle	12. Jumping rope	13. Pedal car	14. Inline Skates	15. Pavement chalk	16.Dog / Cat	17. Guitar / Flute	18. Drawing / Pottering	19. Reading	20. Board games
26	J	5	5	5	5	4	4	5	5	1	5	1	3	1	5	4	2	4	2	2	2	2
27	M	5	5	5	5	5	4	5	3	1	5	1	4	1	3	4	3	5	1	4	3	1
28	M	5	5	5	5	5	3	5	3	1	1	1	3	4	3	4	3	5	4	4	4	4
29	J	6	5	5	5	5	1	5	5	1	5	1	4	3	5	4	2	5	4	1	5	4
30	M	5	5	5	5	5	3	3	2	1	1	2	3	4	1	1	3	5	2	4	3	4
31	M	2	2	2	4	5	4	1	4	1	5	1	5	3	2	2	4	5	3	5	1	4
32	J	1/2	1	5	5	5	2	5	3	1	5	1	2	5	3	4	1	4	1	3	4	4
33	J	7	4	5	5	5	4	5	3	1	5	1	4	2	4	3	2	1	3	3	2	2
34	J	8	5	5	5	5	5	4	2	1	5	1	4	1	5	4	2	1	2	1	1	3
35	M	7	5	5	5	5	4	5	1	1	5	1	4	1	5	4	2	1	2	2	2	3
36	M	7	5	5	5	5	5	5	3	1	5	1	3	4	5	4	4	3	1	4	1	3
37	M	5	5	4	4	5	5	2	1	5	2	1	4	1	1	4	3	3	3	3	2	2
38	J	6	5	5	5	5	3	4	3	1	4	1	3	1	3	2	2	4	1	4	3	2
39	J	5	5	5	5	4	2	4	4	1	5	1	3	1	3	2	2	5	1	4	3	2
40	M	6	5	5	5	5	1	2	4	4	4	1	4	3	3	4	2	5	1	5	1	3
41	J	3	4	5	5	4	3	1	4	1	5	1	5	3	5	3	4	2	1	3	2	4
42	J	3	3	5	5	4	3	5	2	1	4	1	5	1	3	3	2	4	5	4	1	2
43	J	3	5	4	4	3	5	5	4	1	5	1	4	1	5	5	4	4	3	4	5	2
44	J	3	5	5	5	2	4	4	5	1	5	1	1	2	5	2	4	5	1	4	1	4
45	M	3	2	5	5	2	2	1	1	5	1	3	4	4	3	3	2	4	4	5	4	5
46	M	2	2	4	4	5	2	1	3	5	3	5	1	2	3	4	2	4	3	5	1	1
47	M	2	3	4	4	4	5	1	1	5	1	5	4	5	1	3	5	3	4	5	3	2
48	M	2	4	4	4	3	3	2	1	1	2	1	2	3	4	1	5	5	2	5	5	3
49	J	2	4	4	5	4	2	2	2	4	3	1	5	2	3	3	5	3	1	5	1	1
50	M	4	3	5	4	5	5	5	2	5	4	1	4	1	5	4	3	5	5	4	2	4

Number	Gender	Group	Objects																			
			1. Nintendo Wii	2. Tablet / Smartphone	3. Computer	4. Television	5. Swing	6. Efteling	7. Lego	8. Doll / Barbie	9. Football	10. Ballet	11. Bicycle	12. Jumping rope	13. Pedal car	14. Inline Skates	15. Pavement chalk	16.Dog / Cat	17. Guitar / Flute	18. Drawing / Pottering	19. Reading	20. Board games
51	M	4	2	4	4	3	4	3	1	4	4	5	4	5	1	5	3	5	5	5	2	3
52	M	4	5	5	5	5	5	1	3	1	5	1	3	4	5	5	5	5	5	5	1	4
53	J	7	3	5	4	4	4	4	2	1	5	1	3	1	4	3	2	5	2	4	3	3
54	J	7	5	5	4	4	4	4	2	1	5	1	5	1	4	3	2	1	2	4	5	5
55	J	5	5	4	4	5	3	4	3	1	3	1	2	3	3	3	2	5	2	5	1	2
56	M	5	5	4	4	4	3	4	3	1	1	1	2	3	3	4	2	5	2	5	5	2
57	M	4	2	4	3	2	2	3	4	5	1	1	3	5	1	5	4	4	5	1	3	2
58	J	4	3	2	4	5	5	5	1	1	3	1	2	4	5	1	1	4	2	2	2	1
59	J	4	4	5	4	5	2	4	5	1	5	1	4	2	1	2	2	5	3	1	3	3
60	M	6	5	5	5	5	3	4	5	1	5	1	3	1	3	3	1	1	1	1		1
61	J	6	5	5	5	5	4	5	5	1	5	1	2	1	3	4	1	4	2	1	1	3
62	J	6	5	5	5	5	4	5	4	1	5	1	3	3	3	4	1	2	2	1	4	3
63	M	2	5	2	5	1	4	5	2	4	2	3	4	3	4	1	5	1	1	3	3	2
64	M	1	3	2	3	3	1	5	5	1	1	2	5	4	2	4	5	3	4	4	2	1
65	J	2	3	3	4	4	2	3	5	1	4	2	5	2	4	1	1	5	5	1	2	3
66	J	3	5	5	3	4	4	5	5	2	3	1	4	2	4	2	4	5	1	1	1	3
67	M	3	5	5	5	5	3	5	3	1	4	1	4	2	4	3	4	2	1	2	1	3
68	M	3	4	4	2	5	3	4	1	1	1	2	5	3	1	1	3	5	5	4	3	1
69	M	2	5	5	5	5	4	5	1	2	1	4	5	2	4	5	4	5	1	3	1	1
70	M	3	2	4	4	3	3	5	1	3	2	5	5	5	3	1	2	2	5	4	1	4
71	M	3	5	5	4	5	1	5		2	5	5	1	3	1	1	1	1	5	1	1	1
72	J	4	5	5	5	4	3	2	1	1	5	1	4	1	3	4	2	4	3	2	3	2
73	J	4	4	5	5	4	2	5	4	1	5	1	3	1	3	2	2	4	2	1	3	3
74	M	4	5	5	4	5	1	5	1	2	1	3	3	2	2	4	2	4	1	3	3	3
75	J	4	5	5	5	5	2	4	4	1	4	1	3	1	3	1	2	4	3	2	2	3

Number	Gender	Group	Objects																			
			1. Nintendo Wii	2. Tablet / Smartphone	3. Computer	4. Television	5. Swing	6. Efteling	7. Lego	8. Doll / Barbie	9. Football	10. Ballet	11. Bicycle	12. Jumping rope	13. Pedal car	14. Inline Skates	15. Pavement chalk	16.Dog / Cat	17. Guitar / Flute	18. Drawing / Pottering	19. Reading	20. Board games
76	J	8	5	4	5	5	2	3	4	1	5	1	3	1	2	2	2	4	3	1	3	4
77	J	8	5	4	5	5	2	4	3	1	5	1	3	1	3	2	1	4	2	2	4	3
78	J	8	5	5	5	4	2	3	4	1	5	1	3	1	2	2	1	3	4	2	4	3
79	M	5	3	5	5	3	2	5	1	1	4	1	3	4	2	4	2	3	2	4	5	1
80	M	5	4	3	4	2	3	3	1	5	1	5	4	5	2	2	1	5	1	4	2	3
81	M	5	5	3	3	5	3	2	1	1	4	2	4	1	5	3	1	5	2	4	4	2
82	J	4	4	5	5	1	3	2	5	1	5	1	3	1	2	3	3	4	2	4	4	2
83	J	4	4	5	4	4	3	4	5	1	5	1	3	1	3	3	2	5	2	2	1	2
84	J	5	5	5	5	5	2	2	4	1	4	1	3	1	3	2	1	4	3	2	4	3
85	J	7	5	5	5	4	1	5	3	1	4	1	2	1	3	3	2	3	4	2	4	2
86	J	7	5	5	5	4	2	3	3	1	4	1	2	2	4	3	1	4	5	1	3	2
87	M	8	3	5	2	4	2	4	1	2	3	3	3	5	4	5	1	4	5	1	1	2
88	M	8	5	5	5	4	2	4	1	2	3	1	3	2	3	5	1	4	1	4	3	2
89	M	4	5	5	5	4	3	4	1	1	4	1	3	2	2	3	1	5	2	4	3	2
90	M	4	5	2	4	4	3	5	1	1	4	1	3	2	2	3	2	5	5	4	3	1
91	M	4	5	5	3	5	1	5	2	1	1	2	3	2	3	4	1	4	2	4	4	3
92	J	4	4	5	5	4	2	4	2	1	5	1	3	1	3	2	1	4	3	3	5	2
93	J	7	5	5	5	5	2	4	4	1	3	1	3	1	3	2	1	4	3	2	4	2
94	J	7	2	3	4	2	4	4	4	2	1	3	5	3	3	5	3	5	3	4	4	4
95	J	7	4	5	5	3	1	4	1	1	3	1	3	2	4	2	2	5	2	5	4	3
96	M	7/8	1	5	4	3	1	2	1	2	1	3	2	4	4	5	3	5	3	4	2	3
97	M	7/8	5	5	4	5	4	4	1	1	5	1	4	2	3	4	2	3	2	2	3	3
98	J	7/8	4	5	5	5	2	4	4	1	5	1	4	2	4	3	1	5	1	2	5	4
99	J	7/8		5	5	5	3	5	4	1	5	1	5	4	4	4	2	5	4	2	4	4
100	M	7/8	4	5	5	5	2	5	1	1	4	5	4	2	3	2	3	5	4	4	3	3

Number	Gender	Group	Objects																			
			1. Nintendo Wii	2. Tablet / Smartphone	3. Computer	4. Television	5. Swing	6. Efteling	7. Lego	8. Doll / Barbie	9. Football	10. Ballet	11. Bicycle	12. Jumping rope	13. Pedal car	14. Inline Skates	15. Pavement chalk	16. Dog / Cat	17. Guitar / Flute	18. Drawing / Pottering	19. Reading	20. Board games
101	J	7/8	4	5	5	5	4	5	2	1	5	2	5	1	4	1	1	4	3	2	3	3
102	M	7/8	4	5	5	5	2	5	1	1	1	3	4	2	1	1	1	5	2	4	2	3
103	J	1/2	5	4	1	3	2	5	5	1	3	1	5	3	5	2	4	2	5	5	2	4
104	M	6	5	5	5	4	3	4	1	1	3	1	4	3	3	4	3	4	4	4	3	2
105	M	6	1	4	3	4	4	2	2	1	3	2	5	3	2	4	3	5	5	4	4	5
106	M	5	3	5	5	4	2	4	3	1	4	1	5	4	3	4	3	5	4	4	2	4
107	M	5	3	4	4	4	1	5	4	1	5	4	3	1	2	5	2	5	5	3	2	4
108	J	3	5	5	5	5	5	5	5	1	5	1	5	4	5	5	4	5	5	5	5	5
109	M	3	4	5	4	5	5	5	1	4	1	5	5	4	1	5	4	5	1	5	4	4
110	J	4	5	5	4	5	2	5	5	2	3	3	2	2	2	2	5	5	5	4	2	3
111	M	3	5	5	4	5	5	5	3	4	2	5	5	5	3	5	4	5	4	4	4	4
112	M	1	1	2	4	5	5	5	1	4	2	4	4	4	1	5	5	5	1	5	2	2
113	J	2	5	5	4	4	5	4	4	1	5	1	4	5	5	4	5	4	4	5	4	5
114	J	2	5	5	5	4	1	5	4	1	4	1	5	1	3	5	3	5	1	5	2	4
115	J	2	5	5	4	4	1	5	4	1	5	1	5	1	4	4	4	5	4	3	1	5

table E.3 Test data

APPENDIX F: EVOLUTIONARY DEVELOPMENT OF PLAYGROUNDS

figure F.1: Opening playground Weteringschans 1880 (Kuijkens, 2011)

Introduction

The theory of Evolutionary Product Development (EPD) describes product phases which products go through during their development from the first product on the market until the product variants available today (Eger, 2007). Analysing a product using this theory shows how far the evolution of that product has progressed in the present day, as well as indicate what the next steps of the evolution will typically be. With the next steps in mind, a new version of the product can be developed, pushing the product into its next evolution phase.

The EPD analysis was performed based on books, articles and dated photo material. Each source was used to determine what playgrounds looked like at a certain point in time, to map societal influences on the playground and to determine other factors contributing to the evolution of playgrounds. The playground was assumed as a total product for the analysis. The swing was regarded for the evolution of play set design as part of the playground evolution. Based on the literature and photo material on the earliest of playgrounds to those of today, the analysis examined if playgrounds and its play sets follow the EPD theory and if so, when the transitions between product phases, as described by Eger, occurred. Subsequently, recommendations were adopted from the EPD theory on how to approach playground and play set design towards the future.

In addition, the goal of this analysis was to create a solid background on the history of playgrounds and its play set. This history was used to create a future outlook. Specifically, the EPD analysis was used to map the factors behind the evolution of the playground. What social, legal, economical, technological, environmental or legal factors (PESTEL) have contributed to the evolution? These factors were used as input for the creation of future scenarios by mapping them in an uncertainty/importance matrix and projecting them into the future.

Performance phase (1880 ~ 1905)

During the 19th century, play parks were available for the children of the bourgeoisie. These were generally located outside the cities. Children of the labour class were not allowed there, but even if they were, they lacked the means of transportation to get to these play parks.

In The Netherlands, playgrounds in the form that we know them today started to develop in the last two decades of the 19th century. The first playground was established by Nicolaas Tetterode, owner of a type-foundry, and opened its doors on the 8th of May 1880 at the Weteringschans,

Amsterdam (Selten et al, 1996). These playgrounds were considered public, meaning that access to the playground was available for everyone, not just to the children of the bourgeoisie. Another difference from the previously mentioned play parks was their location; the playground at the Weteringschans was located in the city itself, near neighbourhoods of the lower class. Similar developments could be seen in Rotterdam, Utrecht and The Hague. Selten et al write that these playgrounds were constructed out of charity of the bourgeoisie; it was the bourgeoisie who funded them.

There are two reasons stated behind this act of charity. Firstly, the streets were considered unsafe for children to play on. While Selten et al do not devote much attention to the background of them being unsafe; this point in time in the history of The Netherlands was right at its transition to becoming a modern society. Part of this transition was the growth of cities as industries were thriving and a booming population due to medical advances lowering child death and prolonging the average lifespan. At the same time, the cities still had open sewers running through the streets. Unsurprisingly, the streets became more crowded and were far from hygienic and thus considered unsafe for children to play on.

The second reason lies within increasing reports of wantonness of the labourers' children. The children were hanging about on the street and performed acts of vandalism as well as petty crime. Tetterode allocated this wantonness to the poor living conditions in the neighbourhoods of the lower classes. He saw the creation of a playground to be a step towards improving their living conditions. Although Tetterode saw the living conditions as the cause, many people of the middle class saw the labourers themselves as to blame. Selten et al do not explore this reason either, but the direct cause of the children hanging about on the street can easily be explained by a single event; 'Het kinderwetje van Van Houten' (Staten Generaal, n.d.). In 1874, this law abolished child labour. Children of labourers were suddenly presented with leisure time, but lacked means or ideas on how to spend this time. This directly underlines the primary function of the playground; getting children off the street and give them a safe place to play. In essence, this function has not changed between 1880 and now. The middle class saw it as their duty to 'correct' the lack of proper child raising by the lower class.

The playgrounds were a huge success at the start. Many children visited the playground directly after its opening. 500 children inside the playground at the same time was no exception (Selten et al, 1996). Entrance to the playground was granted through entree cards, which were given to schools in order to divide them among the children. On average, a child could go to the playground once every two weeks, provided the child did not receive a penalty for bad behaviour in the form of an entree card being refrained from the child. Later on, children who did not get an entree card could enter the playground by paying a small entrance fee.

Playing in the playgrounds was always under supervision. The playgrounds had a director, responsible for 'keeping order while retaining the freedom of playing'. Teachers were also supervising outside their working hours, while some children were appointed as attendants, who were supposed to allow each child in a play group the same time on a play set before they moved on to the next. The play groups were formed by separating boys and girls as well as with children of the same age. This underlines that 'freedom of play' had a total different interpretation than how we view it today. The

figure F.2: 18th century swing (Kerncollectie Fotografie, 1899)

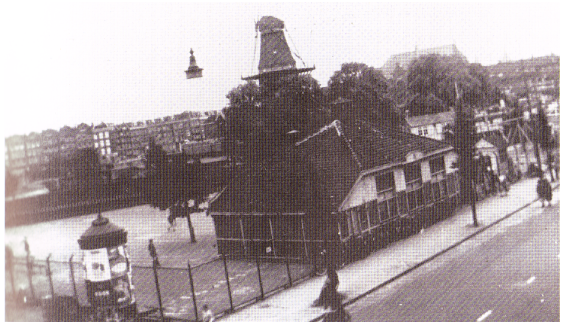


figure F.3: Oosterspeeltuin Amsterdam (Selten et al, 1996)

playgrounds in the late 19th century were all about discipline and order, as that is what would stop the wantonness of the children.

Inside the playgrounds, there were many different play sets and play tools. Examples are swings, seesaws, climbing racks, climbing poles, ladders, stilts, hoops, jumping ropes and wheelbarrows. Furthermore, the playgrounds usually had a skittle-alley and a gymnastics section. The play sets themselves were either directly copied from gymnastic equipment or constructed from basic materials such as wooden beams, supplied by sponsoring companies. Figure F.2 shows an example of a swing in that era. Clearly, it was built by using the beams available for construction and the construction itself was only focussed on functionality, not on styling. The playgrounds themselves were surrounded by a large fence, separating it from the 'dangerous' street.

Although these public playgrounds were a success at the start, the number of children visiting the playgrounds started to decrease by 1893 (Selten et al, 1996). The main reason was poor maintenance, as they playgrounds were heavily supported by the bourgeoisie at the start, but their support declined after the first few years.

All in all, the playgrounds started from a 'societal push'. Although they served their function, the functionality itself was far from perfect. There were some attempts to improve the functionality, but the functionality declined mainly due to poor maintenance. Styling and shaping of the playgrounds at this point in time did not receive much, if any, attention at all. In fact, most play sets were copies of existing gymnastic equipment. Self constructed play sets were built using standard materials and production methods as well as constructed by hand. By 1900, the amount of public playgrounds in the Netherlands was just a handful, located only in Amsterdam, Rotterdam, Utrecht and The Hague. Entrance to the playgrounds was allowed for everybody, as long as you were granted an entree card or paid a small fee. As far as information has been found, there was no active promotion for the playground at this time.

Optimisation phase (1900 ~ 1950)

A new development in the playground evolution came around the turn of the century. While the first playgrounds were initially successful, their physical state deteriorated quickly after losing the financial support of the middle class. As such, they were no longer adequately performing their function of keeping children of the street and giving them a safe place to play.

At the same time, under the influence of the rise of socialism and communism, neighbourhoods were 'unionising'. The labourers received a voice through the unions and started to use it. In the playground world, Ulike Jan Klaren was quite angry at the middle class for faulting the labourers and their way of raising their children and them blaming the labourers for the wantonness of their children (Selten et al, 1996). He agreed with Tetterode that the living conditions were to blame; it was the fault of society, not of the labourers. At a meeting in 1899 he stated that:

> *"Not the children are guilty, but the society as she takes away all the possibilities for children to play and to have a good physical development. Give the children a way to physically develop and combine it with their spiritual development and it will uplift the children. Do not give them that option and leave them the street as their play*

area and it will demoralise them. (Selten et al, 1996)"

Boredom on the streets was the cause of the children's misbehaviour. Klaren therefore wanted to construct a playground, organised differently from the public playgrounds described in the previous product phase. Klaren's playground should not be run and maintained by the middle class. Instead, it should be completely organised by the neighbourhood; the labourers themselves. His vision was in line with the socialist way of thinking.

Although his plan did not receive any support from the labourers' unions at first, he eventually found a financer. Additionally, the Amsterdam municipality made a property available at the Czaar Peterstraat. Swings, seesaws and carousals were placed in the playground, which was named 'Oosterspeeltuin'. The different organisational approach meant that the playground became an association. Parents needed to become members in order for their children to be allowed access to the playground. The parents also had to spend some of their free time working at the playground in order to maintain it.

The Oosterspeeltuin opened its doors on the 23rd of April 1902. Within the first year, 1,500 members joined. Members in this case were families, not individual children. In 1905, 95,000 visitors were registered. This number went up to 155,000 by 1919. The playground association was a huge success which would spark more playgrounds based on its model all around The Netherlands (Selten et al, 1996).

Around this time, the pedagogic view on raising children changed. Within theories from Darwin and Spencer, the link was made between mental and physical health. Klaren's words clearly reflected these thoughts. In his eyes, spiritual and physical developments were one and the same within play. Therefore, the playground had to become much more than a safe place for children to play; it had to support their education. The playground expanded its function in relation to Tetterode's playground. The equipment inside the playground was similar to the playground Tetterode started in the 19th century. Mostly wooden play sets and gymnastic equipment, it would not be until 1920 that the play sets were 'modernised' in the form of wood being replaced by metal (VPRO, 2010). Figure F.4 shows a set of swings in the Bloesemstraat playground in Utrecht in 1937. The majority of the playgrounds were actually open areas. These areas were used for guided play. Outdoor play guided by an adult was considered to be a very important factor in raising children (Selten et al, 1996).

This expansion of the playground's functionality can also be noticed in another development. Since the Oosterspeeltuin was an association, clubs were formed inside the playground association. Examples of these clubs are singing clubs, gymnastics clubs and figure sawing clubs. The latter can be seen in figure F.5. These clubs were also aimed at the older youth, in order to bind them to the playground association as well.

Klaren started to promote the playground association in as early as 1903 in the form of a brochure, actively promoting the ordered way of play as main focal point of the playground. The brochure underlines the main goal, and thus the function expansion, of the playground association; general education.

A second and third playground association, the Westerspeeltuin and Noorderspeeltuin, started up following Klaren's vision in Amsterdam by 1908, followed by a fourth in 1910, the Zuiderspeeltuin. Combined with the public,

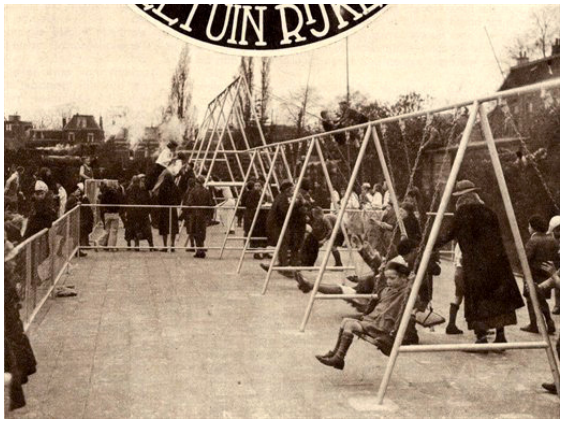


figure F.4: Bloesemstraat Utrecht (Utrecht in Woord en Beeld, 1937)

figure F.5: Figure sawing club Cremerplein (Kuijkens, 2011)

but deteriorated, playgrounds still open, Amsterdam had a total of around ten playgrounds. In order to receive subsidy, these all joined the 'Amsterdamse Bond voor Lichamelijke Opvoeding (ABLO) in 1911. Unhappy with the support from the ABLO, they left federation to form the 'Bond van Amsterdamse Speeltuinverenigingen' in 1917. Two more playground associations had emerged at that time. This newly formed federation was a platform for individual playground associations to cooperate. It started a flourishing period for the playground associations in general. The federation allowed the administration to be central; they supported the administration of the individual playground associations, helped in maintaining the facilities and acted as a mediator when requesting subsidies from the Amsterdam municipality or other institutions. Between 1917 and 1937, the total amount of playground associations grew to 36 in Amsterdam alone.

Until the late 1930's, Amsterdam was the place with the most evolved playground movement. For example, it was not until 1927 that the first playground association opened up in Rotterdam (Selten et al, 1996). Between 1910 and 1930, one or more playground associations were founded in cities like Groningen, Enschede and Arnhem as well as in towns near Amsterdam like Velsen, Zaandam and Haarlem. By 1927, there were twenty playground associations outside of Amsterdam. This sparked the first convention for playground associations in 1929. Similar to the Amsterdam federation of playground associations, Groningen created their own federation in 1930 (Hofman, n.d.). Seven playground associations became members at the time. Eventually, a national federation was founded in 1931; the Nederlandse Unie van Speeltuin-Organisaties (NUSO). At the moment of foundation, there were 110 playground associations in the Netherlands (VPRO, 2010), of which eighty joined the NUSO (Selten et al, 1996).

Most of the associations were located in the north of the Netherlands; in fact, the southern part was only represented with two playground associations in Eindhoven and Heerlen. The cause was simple; the Catholic Church. The playground associations were all focused on the general education of the children. Rightfully so, the church saw the playground associations as 'red'; socialism was at the core of these associations. The rise of socialism meant that the ties with the church became much less important. As such, the general education which the playground associations provided was considered to be 'neutral'. The church's point of view was that education should not be neutral; they feared children visiting the playgrounds would be exposed to non-Christian influences. As the Catholic Church remained more important in the south, playground associations were not widespread in this part of the country. Clearly, the Dutch 'Verzuiling' had an impact in the development of playground associations and playgrounds themselves.

In the next years, the playground association movement started to flourish in Rotterdam. By 1938, Rotterdam had seven playground associations connected to the NUSO. The NUSO itself had 110 members in the same year. An interesting development can be noticed in Rotterdam in 1935; the foundation of the Sint Odilia playground association. In essence it was a playground like any other in Rotterdam, with one major difference; it was a catholic playground association. The cause is the same as why the playground associations did not get a foothold in the south of the Netherlands. Over time, more catholic playground associations would be created. By 1949 they would start their own national federation with between forty and fifty associations (Selten et al, 1996).

Overall, this part of the playground evolution followed the path theory of evolutionary product development. With Klaren's

vision on the playgrounds supporting the general education as well as the formation of clubs inside the associations, the focus was clearly on increasing the playgrounds functionality. As far as newness of the playgrounds goes, this did not follow the path of the theory. Children as well as parents were well aware of the playgrounds. The fact that the Catholic Church was paying attention to the playgrounds, and eventually even started their own playgrounds, supports this. These developments were still driven from a 'societal push'. As far as image material goes, the styling of the playgrounds received little to no attention. Although a growth of playgrounds was spotted from a handful to over a hundred playgrounds, this number was the total amount of playgrounds in the entire country at the time. Assuming the number of playgrounds as the number of competitors, and taking into account that 'competition' was only present in cities, this development followed the theory as well. Play sets were still created through basic production methods and constructed by hand, in fact by the parents themselves. As for promotion, it was local, but started to use mediums like brochures. With the formation of the regional federation at first and national federation later, it can be concluded that the 'costumer service' of the playgrounds improved. Administration became centralised as well as a paid job; a first step towards professionalisation.

Itemisation phase (1945 ~ now)

After the Second World War, the approach for playgrounds changed drastically. There are many factors leading up to this change. First of all, European cities had to be rebuilt. Cities were in ruins and under the influence of the baby boom a few years later, cities needed to expand rapidly. As for architecture and city planning, functionalism was on the rise. Cities had to be 'functionally separated' (Oudenampsen, 2009), meaning city areas were allocated for specific functions like housing, work, traffic as well as recreation. Up until this point, municipalities had passively supported playground associations in the form of subsidies and by making land available for them. With the functionalistic approach of city planning, the municipality became active in the 'playground market', by allocating space and building playgrounds in the old and newly planned neighbourhoods. These became the truly public playgrounds as we know them today. The public playgrounds described in the functionality phase were only accessible with an entree card and were closed off by a large fence. The new playgrounds in the late 1940's and 1950's had no fence, were located in the middle of the neighbourhoods and were smaller in size but larger in number. The increase in number of playgrounds was also directly influenced by the baby boom itself; there was simply a larger demand for playgrounds. Lastly, the pedagogic view on raising children as well as the view on play in general changed. In 1938, the Dutch Historian Huizinga wrote his book 'Homo Ludens', a historical book on the element of play within culture (Oudenampsen, 2009). Constant Nieuwenhuys, an artist and architect who criticised functionalism, stated that the Homo Faber, the labourer from the industrial society, would be replaced by the Homo Ludens, the playful and creative man (1964).

Amsterdam was again a clear example of this development. At the time, Aldo van Eyck was an architect employed by the 'Amsterdamse Publieke Werken'. In 1947, he was given the assignment to design a playground for the Bertelmanplein (Oudenmapsen, 2009); the result is shown in figure F.7.

His boss, Jakoba Mulder, wanted a public playground to be constructed in every neighbourhood. Fallow land was used to construct these playgrounds, as shown in figure F.8.

figure F.6: Aldo van Eyck (VPRO, 2010)

figure F.7: Bertelmanplein playground 1947 (Bergen, 2002)

figure F.8: Dijkstraat playground 1954 (Bergen, 2002)

figure F.9: Aldo van Eyck's climbing rack (Koningsberger, 2012)

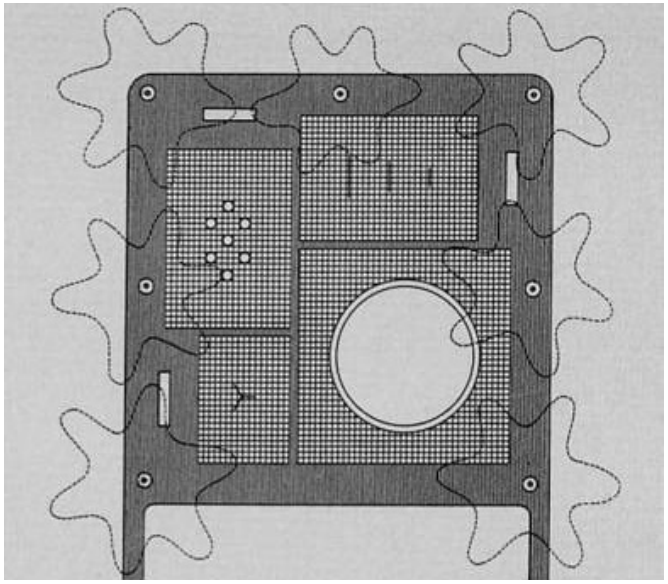


figure F.10: Aldo van Eyck Bertelmanplein playground design (Bergen, 2002)

While the Bertelmansplein was a test case, van Eyck would continue his work on designing playgrounds for the city. Each playground was specifically designed for the location. He started to design the playground without any hierarchic order within the play sets, actually breaking with functionalism at this point. Eventually he started to design the play sets themselves; shaping of the playgrounds and play sets became important. The play sets he designed shout functionalism, although his argumentation for the styling is based on children and free play; use the play sets as they see fit and have no associations in order to trigger the child's fantasy. For example his climbing rack (figure F.9) was designed for children to climb as they saw fit, but also to function as a lookout place or as a hut combined with a large carpet or sheet. This view radically broke with the Klaren's ordered way of playing; from strict discipline and guidance in play to total freedom. Van Eyck's work on the playground actually changed his view on functionalism. He stated in the Dutch magazine "Forum" in 1953 that:

> *"Functionalism has killed creativity. It leads to a cold technocracy, in which the human aspect is forgotten. A building is more than the sum of its functions; architecture has to facilitate human activity and promote social interaction." (Oudenampsen, 2009)*

His view on playgrounds and architecture was in line with Nieuwenhuys's statement on the rise of the Homo Ludens in society.

This social interaction can also be seen in figure F.9. In the background, benches can be spotted on the edge of the playground. These were deliberately placed at all playgrounds, as the playground also functioned as a social gathering location for parents in the neighbourhood. Whereas

the playground associations always had a supervisor, the supervision in van Eyck's playgrounds was taken over by the parents themselves.

Until around 1955, the playgrounds which van Eyck designed were built in the old city neighbourhoods. They were built on fallow land and were therefore mostly temporary constructions. As mentioned, he designed each individual playground, figure F.10 shows one of those designs. In total he designed around 60 playgrounds between 1947 and 1955 (Bergen, 2002). After 1955, the playgrounds started to be designed in series. 800 more playgrounds were built after van Eyck's design between 1955 and 1978, all of them with the same basic elements. Basically, the playground became a product of mass production based on a modular system.

Taking the swing again as an example for the play set evolution; more different types of swings emerged during the itemisation phase of the playground. Swings with a boat like seat (figure F.11) or so called 'family swings' where whole groups could swing together (figure F.12).

With the rise of the public playground as we still know it today, municipalities were reluctant to keep subsidising playground associations as long as they were not open to the public. Playground associations found it harder to survive, to the point where the associations started to pull back to inside the walls of their community house and basically became a neighbourhood association (Selten et al, 1996), although the associations and their playgrounds were not totally separated.

The initial approach of public playgrounds and playground associations showed a large contrast. Whereas the public playgrounds were focussing on the freedom of play and handing over the supervision to the parents, the playground associations focused even more on guidance. They feared that the children would start to rampage the streets again under the influence of their experiences during the Second World War. The NUSO held on to their values of order and discipline well into the 1970's. In their year report of 1973, it was stated that "playgrounds are changing in this dynamic era. Traditional playgrounds are modified into or replaced by more pedagogic responsible playgrounds" (NUSO, 1973). Child raising evolved from being very strict and with a high level of obedience, to raising with affection and permissiveness. On average, families had fewer children than before, while the increase in wealth caused by the economic growth resulted in parents spending more time and money on their children. The NUSO was slow to realise this development, in fact, the NUSO at the time could be considered stubborn and conservative. The statement in 1973's year report was made under the influence of younger people joining the NUSO association board as well as municipalities stimulating the development through subsidies. By that time, the playground associations were no longer growing in terms of members and by the 1980's most playground associations in fact started to shrink. The clubs within the associations lost their appeal to the older children.

This development cannot only be attributed to the conservativeness of the playgrounds associations; the rise of sports associations gave them a large competitor as well. In this era, sports evolved from pure competition to a form of recreation. At the same time, sports like tennis and hockey went from elite sports to common, while football also became a common sport whereas it was a lower class sport at first. Boundaries were fading; social movement became less restricted to the layers in society. The merge of the NUSO and the catholic national playground association in

figure F.11: 'Boat' swing (Blazer, 1950)

figure F.12: Family swing (Stege, 1969)

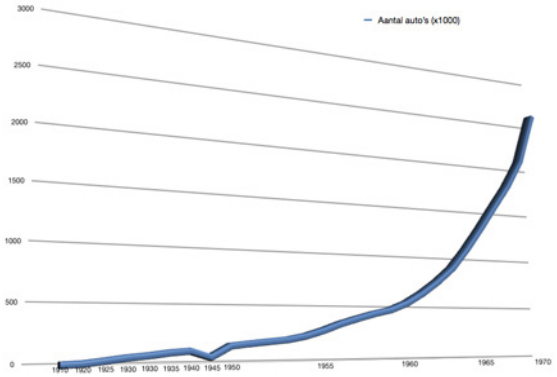


figure F.13: Number of cars per year in the Netherlands (Wal, 2008)

1968 underlines this development (Selten et al, 1996). Most municipalities subsidised the sports associations at this point in time, as well as created their own public playgrounds. Once the economic recession hit The Netherlands, caused by the oil crises, playground associations were one of the first things municipalities focused their budget cuts on.

The playgrounds and playground associations also gained competition from other sources. The rise of the television meant children had a new form of recreation. Instead of going to the playground in the evening, they stayed home and watched television. During the first decade after the Second World War, playground associations anticipated this development by organising television evenings in their community buildings (Selten et al, 1996), but once the television became a commodity product, children no longer attended these evenings.

Another rising 'competitor' of the playground was the car. The relation between the car and the playground was actually a very interesting one, at some points in time they were competitors, sometimes they were symbionts and sometimes they were both. After the Second World War, the car, similarly to the television, went from a luxury product to a commodity good. Figure F.13 shows the number of cars in the Netherlands over time (Mobiliteitsmuseum, n.d.). At first, the influence of the car was mostly visible in the development of city planning; meaning the new infrastructure was aimed at the car. The streets were considered to become less safe again for children to play on which stimulated the municipalities to create public playgrounds. At the same time, the increasing number of cars meant that people gained more mobility. Families would seek their recreation further away from home. An example was the Efteling; founded in 1933, it was a large playground with traditional play sets and large open fields (Efteling, 2013). In 1950, R.J.Th. van der Heijden, Peter Reijnders and Anton Pieck founded the 'Stichting Natuurpark de Efteling'. With the opening of 'Het Sprookjesbos' in 1952, the Efteling converted from a playground to an attraction park. The development and its success were only made possible by the increased mobility under the Dutch families.

By the 1970's, the car became so dominant on the streets, that new built neighbourhoods were planned with a new approach. The 'woonerf' was created, residential areas closed off from the main roads and where cars were only allowed to drive 15 kilometres an hour as well as allowed pedestrians to walk, and play, on the entire street. Playing on the street became an option again; the 'woonerven' increased the safety of the street for children. Therefore, the street became a competitor of the playground. Later on, the 30 kilometre zone would be introduced as well.

The functionalistic approach of rebuilding the cities had a major side-effect. As the areas were created in a time where the car was on the rise, but not yet dominant in the streets, the city centres were not designed for the traffic flow of the later decades. Especially parking spaces were an issue. As many of van Eyck's playgrounds were located on interesting, and by that time expensive, ground, many of them were replaced with parking spaces over time. This development was further stimulated by the 'Attractiebesluit' in 1997 (Volkskrant, 1997), as explained later.

By the 1980's, the number of playground associations started to decrease under the influence of the budget cuts and the increased competition.

As the year report of the NUSO states, play sets were evolving too during the 1970's. In line with van Eyck's approach of

allowing more freedom of play and triggering the fantasy of the children, new play sets were designed to further encourage this development. Play sets were created which did not force children to use it in a specific way, but rather allowed them to be used in many different ways. As an example, figure F.14 shows a play set made out of sewage tubes while its shape creates an association with a locomotive. Over time, play sets were combined; a slide would be included in a climbing rack, as shown in figure F.15.

A major shift in playground design occurred between 1995 and 1997. In 1984, there were 45,000 reported accidents of children getting injured in the playground (VPRO, 2010). However, there were no guidelines on playground safety, while playgrounds were the first to be hit when municipalities had to cut their budget. The situation of public playgrounds drastically worsened, until it went wrong in 1995. Similar to other playgrounds, the Nieuw Pekela municipality ordered the play sets of one of their playgrounds to be removed as their state was horrific, as shown in figure F.16. Between the order given and the actual clearance of the playground, an accident occurred, resulting in the death of a little girl (VPRO, 2010). The municipality was sued for responsibility and the judge did hold them responsible. As a result, the national government had to act. The 'Attractiebesluit' law was passed and took effect in 1997. The law forced play sets to be inspected and certified as safe (guidelines were created). It also stated that the owner of the playground is responsible for how the playground is set up as well as maintained. The 'Keuringsdienst van Waren' had to conclude that one in three play sets in the Dutch playgrounds were unsafe under the new guidelines. Some of the play sets were repaired or replaced, but most were simply removed as there was no budget to repair them. It also speeded up the process of turning older playgrounds in city centres into parking spaces (Volkskrant, 1997).

With the new guidelines, the playground design went further than just the overall setup of play sets in playgrounds and the design of play sets themselves. Landscaping started to receive more attention as well, particularly the surface of the playground. The surface was either sand or tiles in the very early playgrounds. Grass was not used at first as it was simply destroyed by the playing children. Later on, the surface was usually a combination of sand, tiles, grass or gravel. With the new guidelines, woodchips started to be used around play sets. More recently, rubber (tiles) and artificial grass were introduced as playground surfaces. These two types of surface are more flexible, which lowers the impact of a child's fall, while they also have an anti-slippery function.

The focus on safety started a new debate. At this point in time, the playground still had its function of a learning environment. Whereas this was physical development through active play in the early playgrounds, the function of the playground had expanded to teach children to find their boundaries. It was accepted that children could receive a bruise while playing; it taught them the consequence of falling and how to prevent the bruise next time. The 'Attractiebesluit' showed that the development steered away from this mindset and towards safety; it was unacceptable to have so many accidents in the playgrounds. Although recent numbers show that the number of accidents in playgrounds has gone down drastically, 12.000 in 2009 (VPRO, 2010), the number of playgrounds has gone down as well. Children living in the old city centres had no playground nearby anymore, thus they were forced to play on the street again. Accidents which happen while playing there were not taken into account. Furthermore, it was questioned how many accidents occur as a result of the children no longer learning 'how to fall' in the

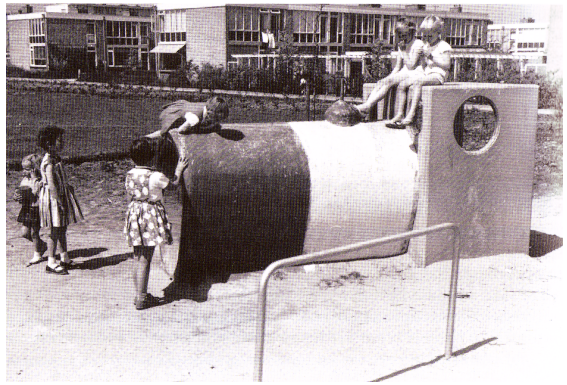


figure F.14: 'Sewage locomotive' (Selten et al, 1996)

figure F.15: Combination of play sets (Selten et al, 1996)

figure F.16: Poor maintenaince around 1995 (VPRO, 2010)

figure F.17: 'Safe' swings (AVO Speeltoestellen, 2013)

figure F.18: Skate park Hulsbeek (Derkink, 1979)

playground. In fact, not long after the 'Attractiebesluit', the 'Consument en Veiligheid' institution started 'leren vallen' courses on primary schools. There was a need for it as that part of the playground's functions had been removed.

The safety guidelines can also be seen when looking at the swings built around the turn of the century (figure F.17). Rubbers were placed over the swing chains at the positions where children grab the chains while using the swing. As the figure shows, the swing construction became very basic, the number of parts was reduced, while the parts themselves were standardised.

Further on in the itemisation phase, playgrounds started to be designed specifically for certain target groups. An example are skate parks, which are in essence playgrounds aimed at a specific target group; the skater. Skaters are generally teenagers or even adolescents. Before the skate park arrived, they were forced to 'ride' the streets. By creating a skate park, they received a safe place to skate, exactly the function of a traditional playground. The first skate park in the Netherlands was built in 1979 in the 'Hulsbeek' (figure F.18), a recreational area in Oldenzaal (Koster, 2009). Other examples are the creation of 'bouwspeelplaatsen', playgrounds with a supply of wood and tools, where children were allowed to build whatever they wanted. These developments can also be seen as the first indicators for the transition into the segmentation phase.

It can be concluded that the playground evolution followed the theory of evolutionary product development during this phase, although there were some deviations. Similar to the other phases, the parameter newness did not apply completely. Pretty much all children were aware of playgrounds. Playgrounds fulfilled their function very well, although the functionality itself changed too. Product development was mostly aimed at better functionality, ergonomics (from a pedagogic viewpoint as well) and safety. Nearing the end of the phase, playground development also started to be aimed at more specific target groups, the skate park being an example. The overall styling became more important, while the parts were adjusted to match (both from a styling and safety point of view). The number of playgrounds in general was higher than in the optimisation phase, although the peak of the number of playgrounds was somewhere in the middle of the itemisation phase. Production and assembly clearly became more automated as play sets were standardised. As far as information goes, there was no promotion of the play sets at all, at least not towards the general public. On this point, the playground did not follow the theory. As for servicing, the level of maintenance increased drastically after the legislation of 1997, while a governmental institution checking the safety of the playgrounds themselves.

Segmentation & Individualisation (2000 ~ now)

Overall, the playgrounds have not evolved in terms of function since the turn of the century. Playgrounds themselves have become more expressive in terms of association. An example is 'de Ruige Speelplek' in Amsterdam, built in 2008. Figure F.19 shows two pictures of the playground. Interesting to note is that the children of a nearby school were involved in the design process (Koert, 2008), an indicator of the individualisation phase.

A development which is somewhat similar is the 'Speeltuinbende'; a group of handicapped children who visit playgrounds and test them on accessibility. They started in 2010 under a three year plan scheme of the 'Nederlandse

Stichting voor het Gehandicapte Kind' (NSGK, 2011). Halfway through 2010, the first playground was made accessible through the involvement of the 'Speeltuinbende'. Although the children were somewhat involved in the re-design of playgrounds, it is better explained as a form of segmentation as design for a specific target group.

Other segmentations can be seen as well. Indoor playgrounds are an example, as seen in figure F.20. These types of playgrounds have started up in recent years and are now widely available. Another example is the floating playground, as seen in figure F.21, which are actually offered as a complete modular system (Wibit, 2013). The floating playground has a wider target group from the traditional playgrounds in terms of age; it is much more attractive to teenagers.

Modularity can nowadays also be found in traditional playgrounds. Lappset, the parent company of the Dutch company Yalp, offers complete modular systems for its playgrounds as shown in figure F.22. It allows the company to quickly act upon new trends as can be seen by the 'Angry Birds' playground example (figure F.23).

At the same time, playgrounds are designed to fit in the environment, for example playgrounds that fit in a natural environment, as figure F.24 shows. The playground in the picture is located in The Hague (Yalp, 2011). Besides the 'design for the environment', the playground features two more interesting aspects. First of all, the playground was completely designed by a company, Yalp. There was no association or architect responsible for the set up of the playground. Secondly, Yalp included the neighbourhood children in the design process. They were involved by creating collages of elements which they wanted to find in their playground. According to Yalp, they are involving children in

figure F.19: 'De ruige speelplek' Amsterdam (Koert, 2008)

figure F.20: Indoor playground (Kids Playground Almere, 2013)

figure F.21: Floating playground (Wibit, 2013)

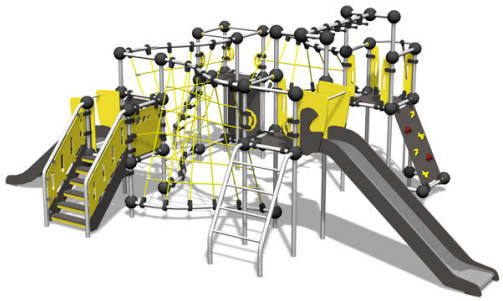


figure F.22: Cloxx play set (Lappset, 2013)

figure F.23: Angry Birds playground (Lappset, 2013)

figure F.24: Natural playground (Yalp, 2010)

figure F.25: Two type of swings (Houtplezier, 2010)

figure F.26: Natural looking swing frame (Unknown, 2010)

design projects regularly.

Similar developments can be seen when looking at the swing. Figure F.25 shows two types of swing, one with normal seats and another with a 'bird nest' seat, which are constructed on a basic frame. The system allows a modular build up of the play set. Figure F.26 on the other hand, shows the same bird nest seat, while the frame has been shaped to look more natural.

Another major trend in playground development is the introduction of electronics to create interactive playgrounds. In 2006, Lappset introduced the SmartUs (figure F.27). The SmartUs consists of a centre console, where you can identify yourself with an 'iCard', and different play sets connected to the console. Each play set has different game options for the children to play. The SmartUs has its own website with a login, where you can see your progress on the different games (Lappset, 2013). It is rumoured that the use of an ID card proved to be an obstacle for the children, resulting in the SmartUs being only remotely successful.

The number of individual electronic play sets is increasing. Yalp offers a couple of interactive play sets like the 'Geluidsboog Sona' (figure F.28) and the 'Voetbalmuur Sutu' (figure F.29). The last product is a nice example of a public play set aimed at older children, another indication of segmentation. There are more companies developing these kinds of play sets in the Netherlands alone.

The Gamenetic (figure F.30), developed by Playnetic, is another example of an interactive play set. Differently from Yalp's or similar companies, the Gamenetic is developed specifically for production in series. There are customisation options, but the product is standardised as much as possible.

All the interactive play sets have one thing in common; they emphasise the learning element of playing. Like the very first playgrounds, it brings back learning as a function of the playground, either in a physical way (movement stimulation) or in a cognitive way (like reaction time), or both. Another thing to note is that whereas playground and play set development has evolved from strict and disciplined playing to free play, the interactive play sets limit the children to playing the pre-programmed games. Generally though, the interactive play sets are updated with new games and options after their release, an advantage of software programming.

Especially the stimulation of movement has become important in recent years. Obesity is becoming more and more common among children in the western world. One of the publicly accepted causes is the lack of physical exercise. Whereas the television has been a competitor of playgrounds since the itemisation phase, the computer and gaming console has become a fierce competitor in this evolution phase. In fact, the increase of obese children could suggest that the computer and gaming console are more appealing to the children than the playground. The playground does not live up to the expectations of the children anymore, they are not stimulated by the play sets to go outside and play. One of the thoughts behind interactive play sets is therefore to take the computer to the outdoors. Besides obesity, another health argument for persuading children to play outside is vitamin D. Vitamin D is produced under the influence of sunlight. It is proven that if children get their daily dose of sunlight, they are far less likely to get diabetes type one later on in their life (Klein Haneveld, J., 2001).

The companies behind the play sets, both interactive and traditional, are all using interactive media to communicate

with their users extensively, Yalp and Playnetic for example can be found Facebook and Twitter. Traditional media are also heavily used for promotion. As for service, as far as research allows it, most companies have their own employed mechanics to quickly be able to fix problems with a product; it can be considered well organised.

Consumer awareness is starting to play a role within playgrounds. The previously mentioned Gamenetic for example, can be described as a standalone computer console. It does not use electrical energy from the power grid. Instead, the child has to generate the required energy by 'pumping' on the foot pedal. The Gamenetic converts the kinetic energy into electrical energy which can subsequently be used to play games. This is one of Playnetic's unique selling points for their products. It goes hand in hand with today's trend of focussing on sustainability. This could indicate that the playground is reaching the awareness phase, but there are currently no other indicators found that the awareness phase is reached. Therefore, especially since sustainability is 'hot' at the time of writing, it is assumed to be an indicator of the individualisation phase, in order to differentiate from the competition.

The path of evolutionary product development is again followed. Everyone nowadays knows what a playground is, although when thinking about a playground, adults still associate it with for example swings and slides. The new interactive play sets are not well known yet. When considering play sets separately, interactive play sets should be considered as a segmentation of traditional play sets or as a new archetype starting in the functionality phase. The playgrounds are all safe and they are designed with ergonomics in mind. The functionality is questionable though; while playgrounds do function, their appeal to children seems to be decreasing. The interactive play sets provide a potential to alter this development, but it is relatively new, the functionality needs to be developed further. Product development is mostly aimed at different types of playgrounds for different target groups as well as mass customisation. The overall parts are well matched with one another (modularity within both the playground and the play sets), while the styling is either more expressive or very sober. As far as competitors go, if the competitors are considered as the playgrounds themselves, there are many competitors. An interesting development is that play set manufacturers nowadays replace architects in designing playgrounds; they are offering a complete design. There are not so many companies offering this design option and most of them are connected to a large international parent company. Fabrication is done completely automated through the use of modular systems in play sets, which furthermore allow mass customisation. Interactive and traditional media are heavily involved in the promotion of both the playground and their new play sets. Lastly, the manufacturers distinguish themselves from the competition by societal behaviour, sustainability being an example.

figure 27: Smart Us playground (SmartUs, 2006)

figure F.28: Sona Geluidsboog (Yalp, 2013)

figure F.29: Sutu Voetbalmuur (Yalp, 2013)

figure F.30: GameNetic (Playnetic, 2013)

Conclusion

Playgrounds as well as the play sets within these follow the path of evolutionary product development. As table F.1 shows, most of the points match what the theory describes for the respective phase (+), a few times it matches partly (+/-) and on only one occasion does it not match (-). The price was not included in the analysis as a factor. Research was performed on subsidies given to, for example, playground associations. However, the amount of documented subsidies found was low and the documented subsidies that were found lacked context to be able to interpret and use them for the evolutionary product development study.

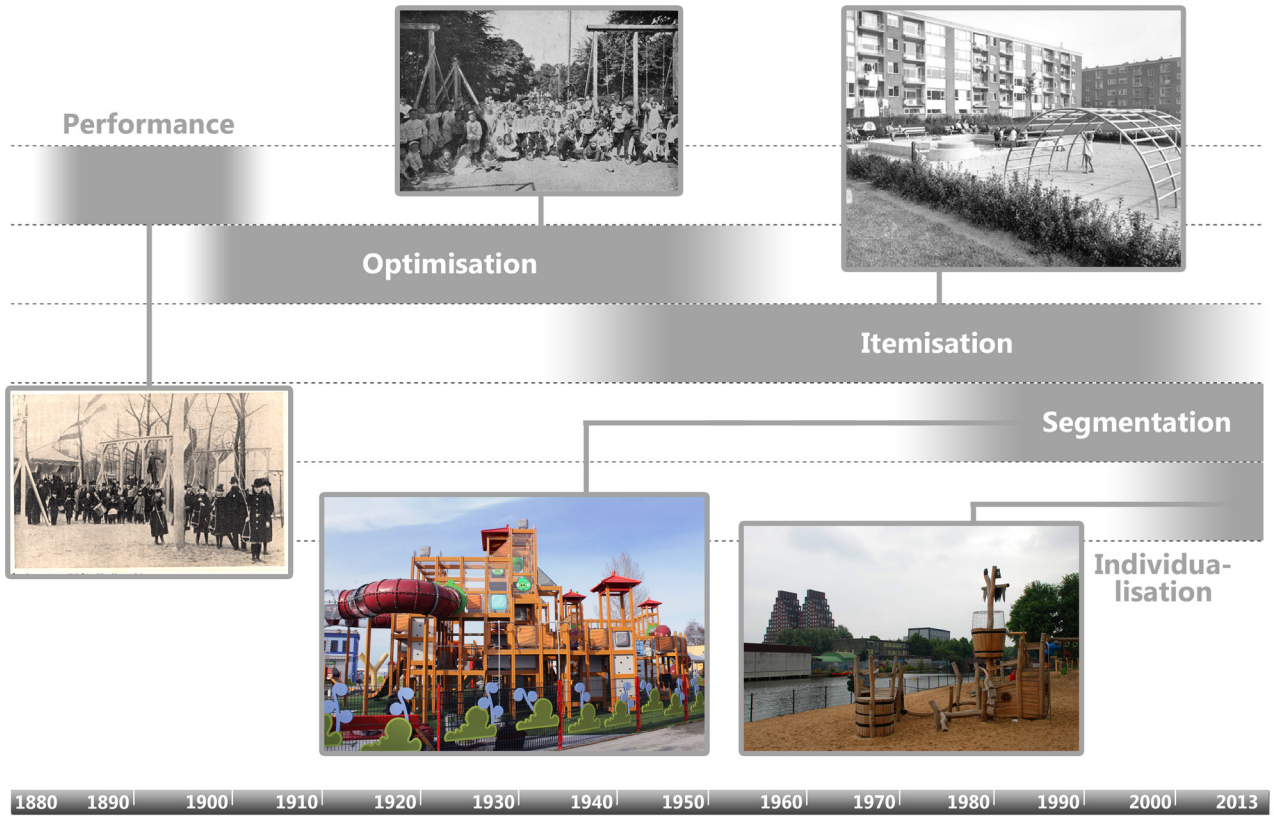


figure F.31 EPD phases timeline

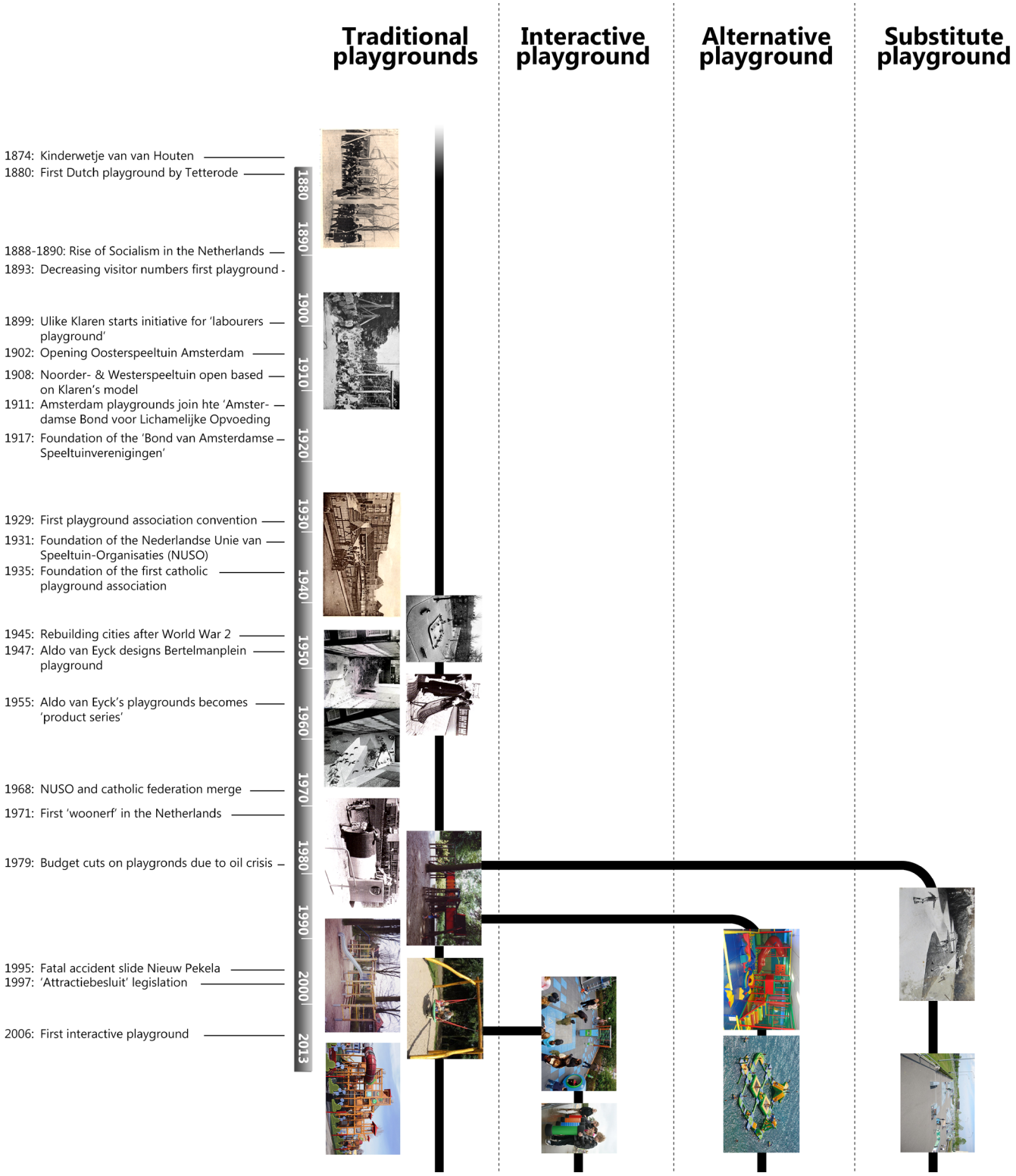
Product phase / Product characteristics	Performance	Optimisation	Itemisation	Segmentation	Individualisation
Newness	+/-	+/-	+/-	+	+
Functionality	+	+	+	+/-	+/-
Product development	+/-	+	+	+	+
Styling	+	+	+	+	+
Number of competitors	+	+	+	+/-	+/-
Pricing	?	?	?	?	?
Production	+	+	+	+	+
Promotion	+	+	-	+	+
Service	+	+/-	+	+	+
Ethics	+	+/-	+	+	+

table F.1 EPD score overview

Figure F.31 shows the timeline of the product phases. As the figure illustrates, the current phase is both the segmentation and the individualisation phase. There are signs that the awareness phase might soon be reached or perhaps that it has been reached. Figure F.32 shows a product tree of the playground in order to visualise how the product phases timeline is constructed. Four categories are determined in order to differentiate playgrounds:

- Traditional playgrounds: Playgrounds as they started and how we all know them; swings, slides and climbing racks.
- Interactive playgrounds: Playgrounds based on interactive play sets. They could become a new type of playgrounds or an integrated part of the traditional playground.

figure F.32 EPD product tree and events timeline



- Alternative playgrounds: Playgrounds which are essentially the same or similar to traditional playgrounds in terms of set up and play sets, but are for example located indoors or on a lake (floating playground).
- Substitute playgrounds: Locations which have the same primary function of a playground, supplying children with a safe place to play, but are aimed at a different or a more specific target group. Skate parks are an example.

The study was performed with two goals in mind. Firstly, the future direction of playground evolution, which can be predicted based on the EPD theory. As it is concluded that playgrounds and play sets follow the EPD theory, the next steps in its evolution can be predicted based on the theory. The second goal was to determine the major factors behind the evolution up to this point. These factors were used as input for the creation of the future scenarios later on. Both the future directions and evolution factors are summarised in the next paragraphs.

Future directions

Using the EPD theory, the future direction of the product can be mapped out, especially the direction in the short term. Below, a few design recommendations are stated in different categories with each header stating the category. The recommendations are based on where the product is now and where it should be going towards according to the EPD theory; they are adopted from the theory. Most recommendations are therefore general recommendations following the EPD theory. Specifically, the stated design recommendations result from recommendations which are focussed on the last three phases of product evolution; the segmentation, individualisation and awareness phase. Only the recommendations on functionality are not direct interpretations from the EPD theory, these are based on information found in during the analysis itself.

Functionality

Playgrounds are losing its effectiveness in fulfilling its primary function; providing them with a safe place to play. Especially for the older youth, playgrounds do not seem to connect with the demands and wishes of today's children and thus they seek other locations to play at. Therefore, thought should be given on how to bring back this primary function.

Playgrounds provide a learning factor for children, from physical to cognitive and social development. Interactive play sets have the potential to extend the learning factor, especially in the cognitive direction. Therefore, map out options of adding a learning factor to the interactive play sets, both from a demand point of view (society development) as well as an opportunity point of view (potential interactive play sets).

Product development

Allow the costumer to customise products by offering adaptable products to suit specific needs. A step further is to include the customer in the design process of new play sets; participatory design.

Standardise parts as much as possible in order to lower costs and allow more customisation through, for example, modular design.

Shaping & Styling

The integration of form of the products should be high.

Styling should be expressive or go towards a simple, sober look.

Promotion
Look at ways to increase the promotion of the products by involving the customers through, for example, social media.

Ethics
Communicate on the ethic goals such as social goals or environmental goals of the company as well as of the products.

Evolution factors
In parallel with the research on the development of playgrounds, key factors were determined which have influenced its evolution. Below is an overview of the factors. These are classified under the macro-environmental factors political, economic, social, technological, environmental, and legal (PESTEL).

Political

Municipalities
Construction, maintenance and sometimes ownership of the playgrounds are all connected to municipalities, either through direct construction or in the form of subsidies to parties such as schools or associations. Budget changes for municipalities are therefore highly influential for playgrounds. Furthermore, municipalities often state recommendations for the playgrounds.

Urban landscaping
As shown under the factor of the car, it has had a huge influence on urban landscaping. Architectural styles, such as functionalism, have greatly influenced the approach as well. The approach of urban landscaping has greatly influenced the evolution of the playground.

Economical

Economic growth
On average, wealth is increasing at times of economic growth. The playground is directly influenced by the economic growth. In times of economic growth, playgrounds are flourishing, while during economic recession, playgrounds are to first to receive budget cuts.

Social

Society demand
With young children causing trouble on the street as well as the streets being unhygienic at the start of the twentieth century, the middle class wanted to create a solution. It can be argued if their motive was to prevent property damage or out of charity or a combination of the two, but the fact remains that society demanded a way to 'lure' children off the streets as well as provide them with a safe location to play; a function which playgrounds are still fulfilling today.

Pedagogic perspective
Research on child development changed the perspective on how children were raised. The link between a healthy mind and a healthy body influenced the initial creation of the playground for example. The importance of strict discipline and obedience held at the time caused the adults to guide the play of children. Later pedagogic perspectives, as well as other factors like the parents themselves, turned discipline and obedience into permissiveness and affection. It transformed guided play into freedom of play.

Learning factor

The first playgrounds were focussed on a strict belief that playing should support a child's physical development. Over time, and under the influence of freedom of play, this evolved into a more adventurous learning factor; to explore boundaries. The learning factor nowadays is present in the form of cognitive and social development as well as movement stimulation.

Parenting

In the early days, parents in the lower classes of society had little time for their children. With the economic growth after the Second World War, parents had more time for their children and more money to spend on them; buying them more toys. On one hand this stimulated the family visiting the playground. On the other hand though, it offered alternative options of recreation, from their own toys to, especially under the influence of increased mobility due to the car, recreation further away from home.

Recreation competition

There are many forms of recreation competition nowadays. The car made other types of recreation available to families, like attraction parks or as simple as a visit to a lake. Other forms of recreation competition have been the television, recreational sports and the computer or gaming console more recently.

Neighbourhood composition

The composition of neighbourhood inhabitants is ever changing. The older neighbourhoods of cities generally have a fairly high average age as opposed to the newer neighbourhoods. Changes can be seen in the composition of neighbourhoods when it comes to the percentage of immigrant families. Lastly, the lower number of children on average per family has greatly reduced the total amount of children per neighbourhood in general.

Public health

Public health has been an important factor behind the playground evolution. First of all, the overall hygiene of the streets and the scientific proof of the link between a health body and the mind was one of the sparks to create playgrounds to begin with. Nowadays, this factor is regaining importance in the form of playgrounds being a way to stimulate movement and thus a way to counter obesity amongst children. Another active discussion is started around vitamin D. Children produce too little vitamin D as they do not get enough sunlight on their skin.

Awareness

Although it is questioned if the awareness phase is reached when it comes to playground, there is no denying that sustainability is now an issue in playground design. Therefore, awareness is a fairly new evolution factor.

Child perception

Over time, children have been experiencing much more freedom in their play behaviour. More options of play, more competition for the playground, have made the children more demanding of the playground itself. The playground competition, especially gaming, seems to have changed the perception of the children towards playgrounds and thus what they expect from it today.

Technological

Product interaction

Gaming and the development of touch screen products has started a trend of interactive products. Playgrounds are no exception, a complete interactive playground already exists

and more and more interactive play sets are being developed.

Technology

Technology has played an important role in the evolution of the playground. Obvious influences have been the material use, both for play sets as well as the underground of playgrounds, and the production methods, which allowed the playgrounds to become a product of mass production and more recently, mass customisation. The introduction of electronics in play sets opened up a whole new chapter in the development of playgrounds as well as play sets.

Environmental

Supervision

In the first playgrounds, a paid supervisor was present to look after the children while they were in the playground. Later on, the supervisor became a volunteer, an adult from the neighbourhood, who rotated with other supervisors. After the Second World War, the parents themselves became the supervisors at the playground. Finally, no supervisors were looking after the children in the playgrounds.

The car

The car has had a dominant role in the evolution of playgrounds, both in a positive and a negative way. First of all, the car changed the approach of city planning, which, under the influence of functionalism, stimulated the need for playgrounds; the street had the function of transportation, not of playing. Later on, the car allowed families to seek recreation further away from home; it contributed to the competition of the playground. Afterwards, the car became so dominant that the streets were considered simply too unsafe to play on again. It in turn changed the approach of city planning in the form of 'woonerven', which stimulated the creation of playgrounds in new neighbourhoods. In the older city centres though, parking spaces were limited to the point where many playgrounds were turned into parking spaces.

Legal

Legislation

Initially, the law to abolish child labour contributed to the societal need for the playground. Later on in the evolution, the law which forced playgrounds and play sets to become safe by following strict guidelines has greatly influenced both the number of playgrounds today as well as how they are set up.

Safety

Safety is one of the parameters looked at in order to see if a product follows the theory of evolutionary product development. In the case of playgrounds, it has played a more dominant role than in other products. Safety was lacking completely in the last part of the 20th century. Legislation ended that to the point where playgrounds are considered very safe in the present day. Interestingly, it has sparked a discussion if it is not too safe.

Evolution factor extrapolation

The eighteen evolution factors described above were used as input for the creation of future scenarios (appendix G).

APPENDIX G: TREND DEVELOPMENTS ON THE EVOLUTION FACTORS

This appendix describes the expected development of the eighteen evolution factors determined through the Evolutionary Product Development study towards the next ten years. The expectations are based on trend analysis and literature research. These expectations are used in the creation of future scenarios.

Political

Municipalities

Construction, maintenance and sometimes ownership of the playgrounds are all connected to municipalities, either through direct construction or in the form of subsidies to parties such as schools or associations. Budget changes for municipalities are therefore highly influential for playgrounds. Furthermore, municipalities often state recommendations for the playgrounds.

Development

Play space

A couple of combined foundations such as Jantje Beton, the Johan Cruyff Foundation and the Richard Krajicek Foundation recommended that 3% of each residential built environment is allocated to play space (Platform 31, 2008). In a response, the SP political party handed in a bill to force municipalities of allocating the 3% to play space (SP, 2008). As of yet, the bill has not passed, but many municipalities are now using the 3% as a standard for new built environments as well as a measure of play quality within their city. Additionally, the 3% play allocation is recommended by the former Infrastructure and environment ministry to the municipalities (Vereniging van Nederlandse Gemeenten, 2006).

Maintenance free play sets

With the implementation of the Attractiebesluit law in 1997, municipalities are responsible for most of the play sets in their municipality area. Under the influence of budget cuts, municipalities are looking to replace play sets which require heavy maintenance with low maintenance or maintenance free alternatives, or replace them with informal play attributes such as a slope or a concrete shape (Gemeente Amersfoort, 2011; Akkerman, 2004).

'Brede scholen'

With the change in legislation of 2007, schools are new responsible for offering adequate facilities for children to 'stay over' (Dutch: overblijven) at school during recess. At the time, 'brede scholen' were already present, but the new legislation sparked an increase in the total number of 'brede scholen', as can be seen in figure G.1. The linear and exponential

trendlines indicate that the growth is likely to continue. 'Brede scholen' are essentially schools working together with daycare institutions for outside school hours, such as lunch recess. Under the influence of this development, newly built schools are often placed together with other schools and the daycare facilities in one building or at one location.

Public schoolyards

A current trend which has started a few years ago is that of public schoolyards. Schoolyards usually cover a considerable area, offer play sets and are located conveniently for the children. The Jantje Beton foundation supports schoolyards becoming public (2012). Schools themselves are hesitant, they are afraid of property damage when the teachers are not at school. Especially new built schools, also under the influence of the 'Brede school', are based around the concept of a public schoolyard. More and more municipalities and umbrella organisations are looking at options of making schoolyards public (Geeve, 2011; Gemeente Barendrecht, 2013).

Natural playgrounds

Lastly, municipalities are more and more constructing natural playgrounds in locations on the outskirts of neighbourhoods where a green environment is already present (Bros, 2008; JSO, 2013). The introduction of these natural playgrounds is influenced by the belief that nature sparks creativity and playfulness.

Possible directions

- 'Brede scholen' & public schoolyards, resulting in centralisation of play areas
- Maintenance free or low maintenance play sets
- Natural playgrounds, possible indication of the awareness phase (Evolutionary Product Development)
- 3% surface guideline for play areas in new built neighbourhoods

Importance: average-high

Uncertainty: low-average

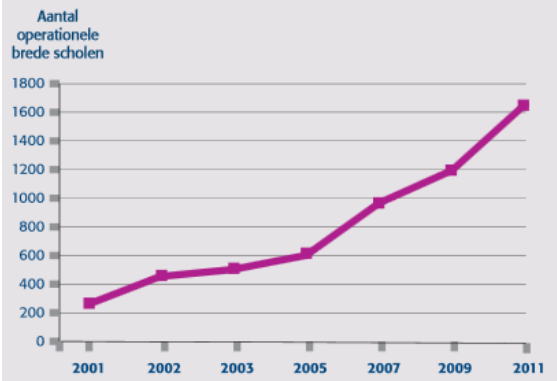


figure G.1 Number of 'brede scholen'

figure G.2 Brede school development

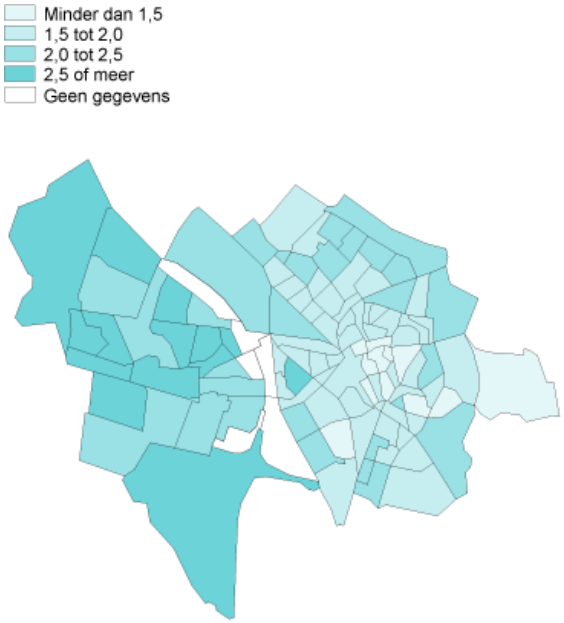


figure G.3 Average family size per area in Utrecht

Urban landscaping

As shown under the factor of the car, it has a huge influence on urban landscaping. Architectural styles, such as functionalism, have greatly influenced the approach as well. The approach of urban landscaping has greatly influenced the evolution of the playground.

Development

New built approach

More and more cities are made 'car free' (Dutch: autoluw). Especially new built housing areas are constructed in such a way that they offer no passage for cars without a destination within the area itself. These new built housing areas are generally constructed on the outskirts of cities and larger towns; places which offer above average facilities. They are especially attractive to families, while city centres are often composed of more people living alone. Figure G.3 (CBS, 2012) shows how large, on average, a household is per area in city of Utrecht. The western part of the city clearly has the larger households. This part of Utrecht is called 'Leidsche Rijn' and is a large newly built part of the city. Other Dutch cities show the same type of figures when looking at the average size of households per neighbourhood.

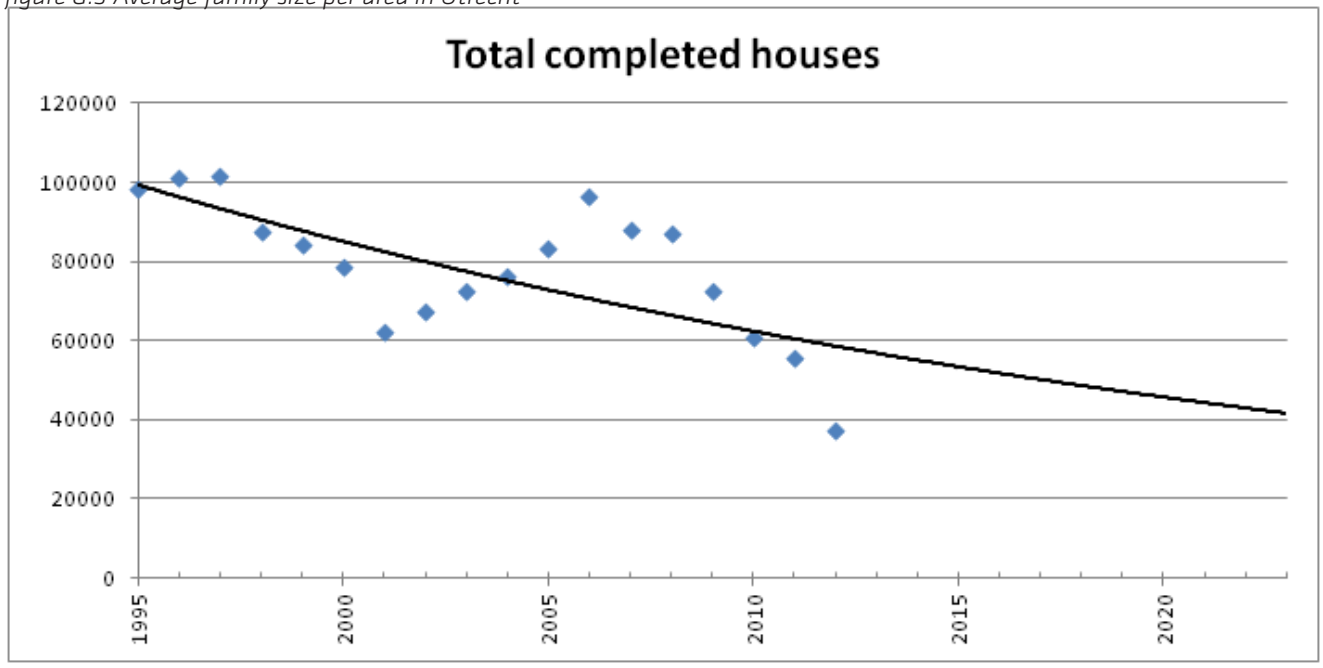


figure G.4 Trendline total completed houses

Under the influence of the economic recession, these large scale projects such as the Leidsche Rijn are being postponed. Figure G.4 (CBS Statline, 2013a) shows the number of houses completed per year between 1995 and 2012 as well as a trendline towards 2023.

When looking at the average project size, shown in figure G.5 (CBS Statline, 2012b), the trendlines show that there are two clear different directions of future developments.

The lineair trendline shows a minor growth, while the exponential trendline shows a decreasing trend in average project size. The decrease can be explained by the economic recession; especially the construction sector is being hit and the housing market in the Netherlands is currently a hot debate topic. When the economy starts to grow again, it is possible that the average project size will increase again to a value around or above the horizontal trendline. Another factor has to be kept in mind; the overall population growth. Two-third of the population growth will occur in cities and larger regional towns. These are currently adding up to one-third of the total population (CBS Statline, 2013b), as shown in figure G.6. This should spark the need for new housing projects in these locations.

Currently, projects are becoming smaller scaled and/or aimed at renovating/rebuilding parts of existing neighbourhoods.

This could continue to be the trend towards 2023 or shift back towards large scale new built projects under the influence of economic recovery or the simple need for it because of the population growth.

Play space

As explained, municipalities are following the 3% play area allocation as a guideline. Therefore, new built large scale projects generally have plenty of play area allocated. The smaller scale renovation type of project hardly supports this allocation if at all; that is up to speculation. The 3% recommendation is not a law.

Informal play space

Recent studies (TNO, 2010) have shown that the children's play space is not limited to playground (formal play space), but also to the streets and squares (informal play space). The TNO study shows that, on average, children spend two hours per day playing outside. Over half of it is spent playing at informal play space. Municipalities are interested in increasing the quality of the informal play space (Gemeente Leidschendam-Voorburg, 2004; Gemeente Vlaardingen, 2012), not just from a view point of construction, but also in terms of accessibility and maintenance. Some municipalities argue that if enough informal play space is available, there is no need for formal play space (Gemeente Haarlemmermeer, 2013).

Possible directions

- Focus on new built projects versus neighbourhood reconstruction
- Large scale projects versus small scale projects
- Expanding cities and towns with regional facilities
- Formal play space versus informal play space

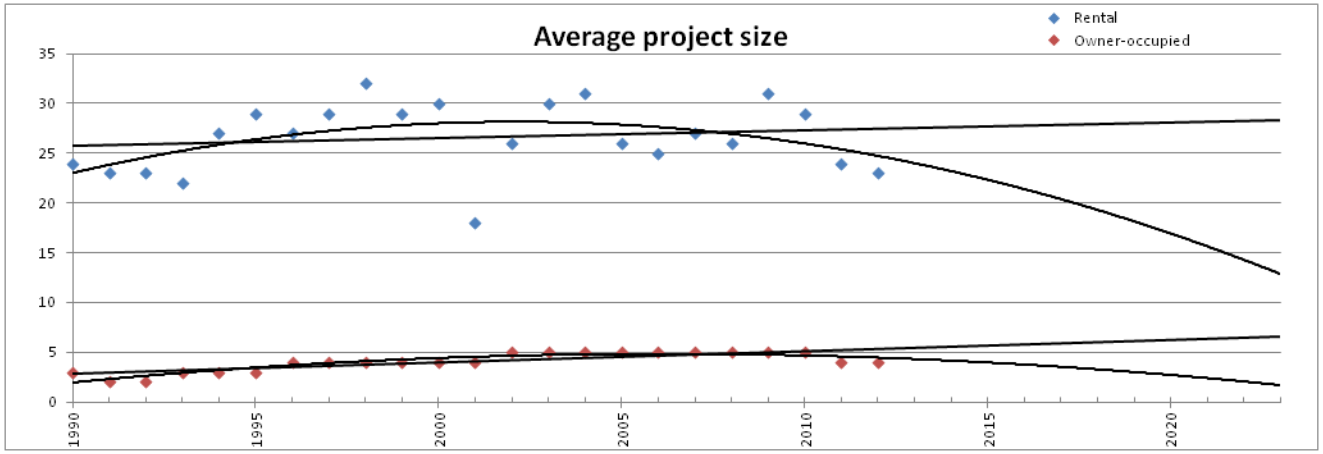


figure G.5 Average size of residential new built projects

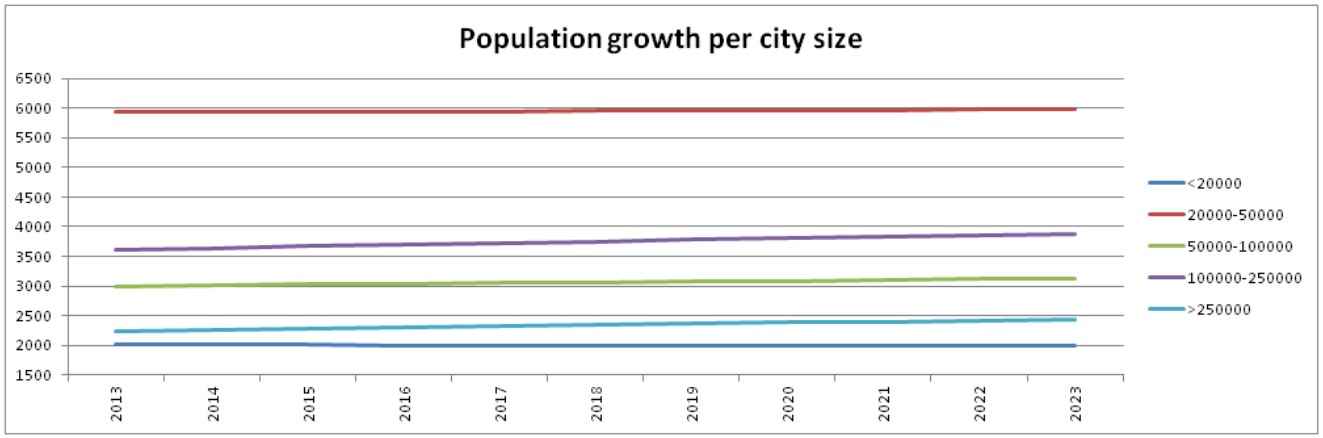


figure G.6 Expected polulation growth divided over current city/town size

Importance: high

Uncertainty: average-high

Economical

Economy growth

On average, wealth is increasing at times of economic growth. The playground is directly influenced by the economic growth. In times of economic growth, playgrounds are flourishing, while during economic recession, playgrounds are to first to receive budget cuts.

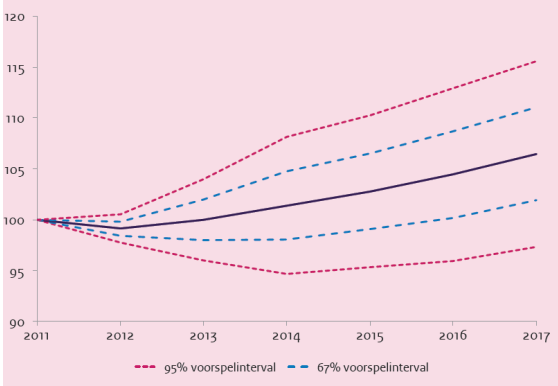


figure G.7 Economic growth interval predictions between 2012 and 2017

Development

Economic recession

Currently, we are still experiencing an 'economic crisis'. At the time of writing, the Dutch national bank (DNB) just announced that it expects a more negative result for 2013 in terms of economic contraction and a smaller growth for 2014 as previously expected (NOS, 2013a). The Rabobank stated two days later that it does not expect any economic growth for 2014 at all (NOS, 2013b).

On the middle long term, the Centraal Planbureau (CPB) created a scenario based around the Dutch economy between 2012 and 2017 (2012). Figure G.7 (CPB, 2012, p. 16) shows the change in the Dutch GDP (Gross Domestic Product). The percentage of GDP change, corrected for inflation, basically resembles the economic growth. As figure G.7 and the two statements of the DNB and Rabobank show, even for just five years in advance, the uncertainty of the economic growth is high. Predictions for a longer period are not even available. The influence of the factor economic growth of playgrounds is however indirectly through other factors such as municipalities and urban landscaping. The importance of the factor therefore is much lower.

Possible directions

- Stagnant economy versus economic recovery

Importance: low
Uncertainty: high

Social

Society demand

With young children causing trouble on the street as well as the streets being unhygienic at the start of the twentieth century, the middle class wanted to create a solution. It can be argued if their motive was to prevent property damage or out of charity or a combination of the two, but the fact remains that society demanded a way to 'lure' children off the streets as well as provide them with a safe location to play; a function which playgrounds are still fulfilling today.

Development

Neighbourhood function

Over time, playgrounds became a social meeting place, not just for the children, but for the entire neighbourhood. This function faded away in more recent years, but can still be seen in the form of benches placed on the borders of playgrounds. NUSO called for a return of the neighbourhood function (Kleuver et al, 2010). With the development of centralised play facilities mentioned under municipalities, this return of the function is a realistic thought.

Stimulation playing outside

In the last decade, there has been a growing call from society for the stimulation of physical exercise among children (Both & Bogaard, 2008; Platform 31, n.d.). Both & Bogaard argue that physical exercise is not limited to participating in sports; the public environment plays an important role as well. The main motivation is the trend of obesity and more recently the deficiency of vitamin D (see public health factor). A definite development towards 2023 is the societal demand of stimulating playing outside and especially stimulating physical exercise.

Possible directions

- Stimulating more physical exercise

- Stimulation of sports versus importance of playing outside
- Social neighbourhood function

Importance: high
Uncertainty: low-average

Pedagogic perspective
Research on child development changed the perspective on how children were raised. The link between a healthy mind and a healthy body influenced the initial creation of the playground for example. The importance of strict discipline and obedience held at the time caused the adults to guide the play of children. Later pedagogic perspectives, as well as other factors like the parents themselves, turned discipline and obedience into permissiveness and affection. It transformed guided play into freedom of play.

Development

Challenging playgrounds
Playing outside has been considered healthy since a very long time. Similarly, pedagogues have argued its importance in regard to a child's development. In more recent years, pedagogues have advocated a more challenging playground; in an environment where a child is to develop, it should be given challenges (Snel, 2010).

Acceptable risk
For children to work on their development, they should be challenged. Challenge inevitably means risk; from the risk of injury to the simple risk of failing. Pedagogues have advocated the need for risk in playgrounds for quite some time. Recently, policymakers are starting to adapt to this view (Valck, 2013); from avoiding risk to accepting a certain level of risk. Moreover, policymakers are moving from pure facilitation to children participation and from play sets to play stimulating objects. The development is influenced by this pedagogic perspective as well as the fact that such moves imply less responsibility and maintenance cost for municipalities.

Nature
"More can be achieved with less" (Valck, 2013). Pedagogues are stimulating play in nature; large fields of grass, sand, tree logs, water, rocks, a hilly surface or a pit, bushes or hut made out of branches all offer challenges to children, they stimulate children's creativity in play. Pedagogues therefore support the creation of natural playgrounds.

Possible directions
- Make playgrounds more challenging
- From facilitation to participation
- From pure play sets to play stimulating objects
- Stimulation of natural playgrounds

Importance: average
Uncertainty: average

Learning factor
The first playgrounds were focussed on a strict belief that playing should support a child's physical development. Over time, and under the influence of freedom of play, this evolved into a more adventurous learning factor; to explore boundaries. The learning factor nowadays is present in the form of cognitive and social development as well as movement stimulation.

Development

No change

"No child plays in order to develop itself. It develops itself through playing" (Valck, n.d.). The playground or public environment is the ideal place for children to explore the world and to push their limits. This learning factor is not likely to change in the near future, only how the playground or public environment provides this function is changing, as is explained under the factor pedagogic perspective.

Importance: average
Uncertainty: none-low

Parenting

In the early days, parents in the lower classes of society had little time for their children. With the economic growth after the Second World War, parents had more time for their children and more money to spend on them; buying them more toys. On one hand this stimulated the family visiting the playground. On the other hand though, it offered alternative options of recreation, from their own toys to, especially under the influence of increased mobility due to the car, recreation further away from home.

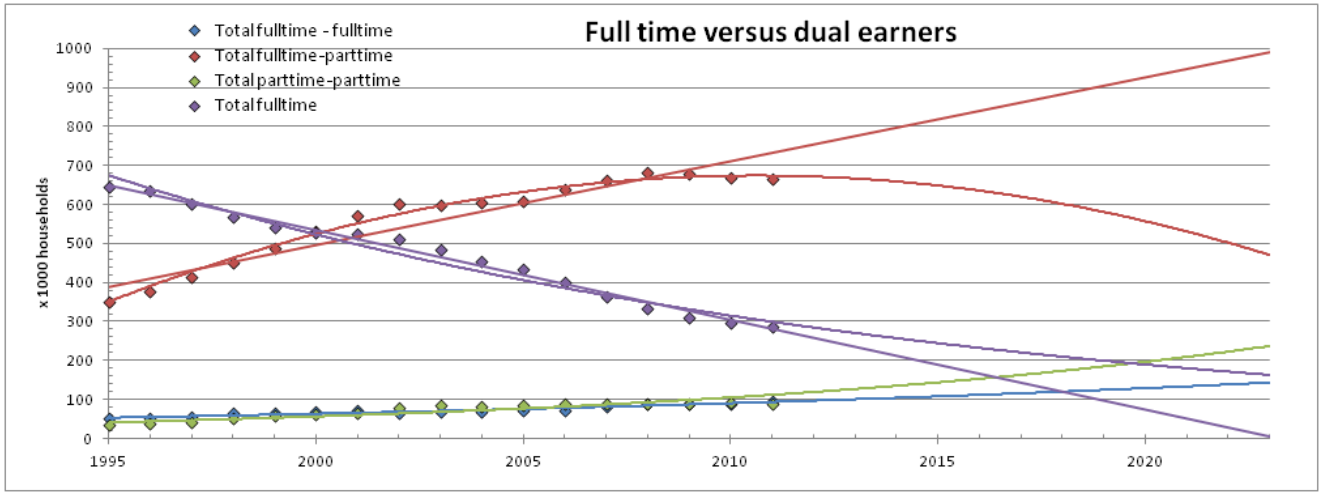


figure G.8 EPD phases timeline

Development

Dual earners

In the past, it was common for households to have one breadwinner; usually the man. Nowadays it is becoming more and more common for households to have two breadwinners instead, either both full time or one full time and the other part time or both part time. Figure G.8 (CBS Statline, 2013c) shows the distribution of a single full time breadwinner versus dual earners for households with one or more children between the age of zero and eleven.

As the trendlines show, the single breadwinner is 'dying out'. The number of two full time breadwinners as well as two part time breadwinners is likely to go up, while the number of a full time and part time breadwinner household can go either way; up or down. The development has two effects; less time available to spend with their children, meaning childcare facilities become even more important than they are today. Secondly, these households generally become more prosperous. Parents are able to spend more money on the toys, and thus recreation competition of playgrounds and the public environment, of their children. This development is further illustrated by the statistics and trendline of toy shop turnover, as illustrated in figure G.9 (CBS Statline, 2013d); By 2023, toy shops are expected to create between 20% and 40% more turnover than in 2005 (index year of the graph).

Digital stimulation

The previous trend explains that parents spend more money

on their children's toys, but that does not take electronics into account. Current young parents are part of the digital generation; they are well known with computers and handheld electronics. In fact, most own a smartphone or a tablet. Moreover, they allow their children to use them. In fact, they are stimulating their children to use them as they see it as an opportunity for their children to learn and get familiar with the technology (Stichting Mijn Kind Online, 2013).

Possible directions

- Increased spending on play competition; toys and such
- Digital media versus playing outside

Importance: low-average
Uncertainty: average-high

Recreation competition

There are many forms of recreation competition nowadays. The car made other types of recreation available to families, like attraction parks or as simple as a visit to a lake. Other forms of recreation competition have been the television, recreational sports and the computer or gaming console more recently.

Development

Digitalising

Our society is digitalising. Especially smartphones and tablets have altered our view on technology. Children are using these types of products at a very early age (Stichting Mijn Kind Online, 2013) and schools are starting to use tablets in their education as well (NOS, 2013). Before the tablet, it was the (game) computer fulfilling this role, and the television before that. It is expected that this trend of a digitalising society continues.

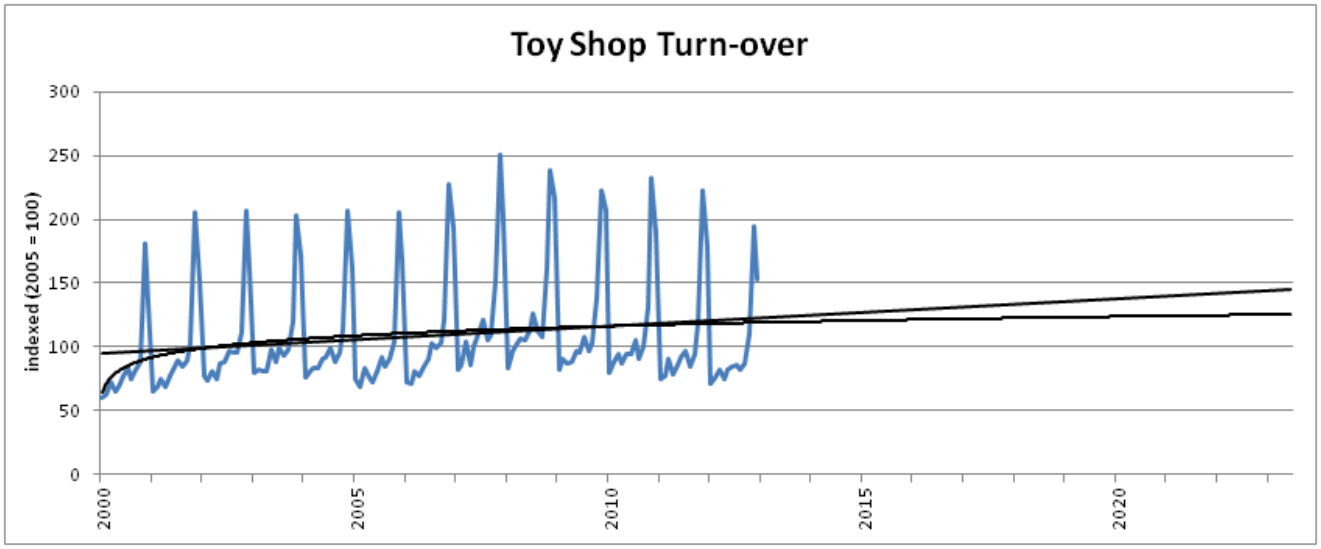


figure G.9 Toy shop turn-over trendlines

Informal play space

Other factors show that the focus is shifting from pure formal play space to a combination of formal and informal play space. Informal play space can therefore be considered as a direct competitor to playgrounds (formal play space) or its play sets.

Possible directions

- Digital focus
- Informal play space

Importance: high
Uncertainty: low-average

Neighbourhood composition

The composition of neighbourhood inhabitants is ever

changing. The older neighbourhoods of cities generally have a fairly high average age as opposed to the newer neighbourhoods. Changes can be seen in the composition of neighbourhoods when it comes to the percentage of immigrant families. Lastly, the lower number of children on average per family has greatly reduced the total amount of children per neighbourhood in general.

Development

Status quo – city renewal

As explained at the urban landscaping factor, families with children are moving to the edge of cities; to new built neighbourhoods. City centres have more single households or households with no children. Older neighbourhoods generally have more immigrant households. In general, the living conditions in these neighbourhoods can be considered poorer. The only change that can be seen is some focus on improving these poor neighbourhoods through city renewal programs.

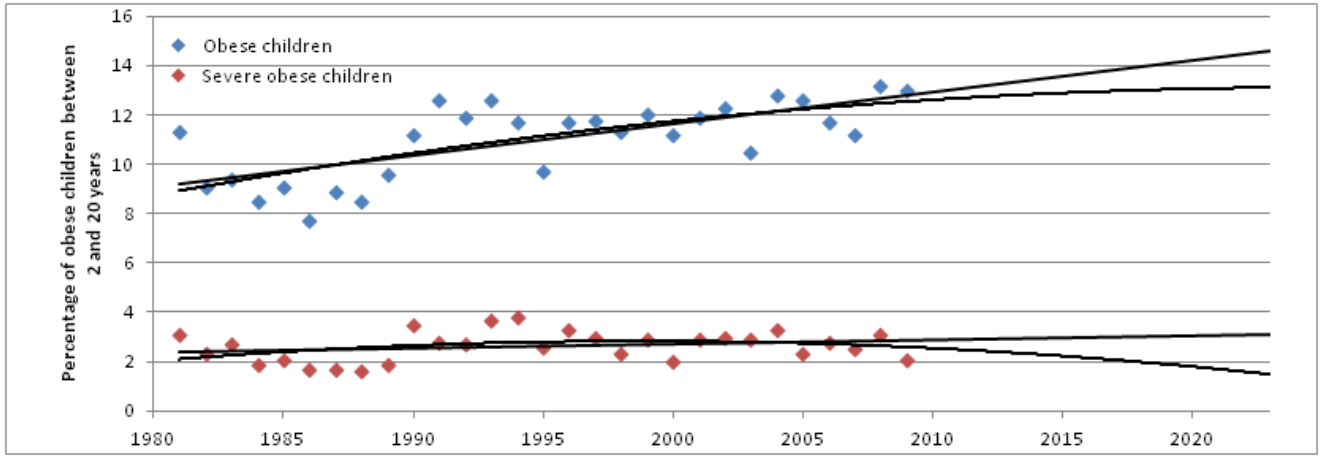


figure G.10 Obesity trendlines

Possible directions

- No change in current trend

Importance: low-average
Uncertainty: low-average

Public health

Public health has been an important factor behind the playground evolution. First of all, the overall hygiene of the streets and the scientific proof of the link between a health body and the mind was one of the sparks to create playgrounds to begin with. Nowadays we can see this factor regaining importance in the form of playgrounds being a way to stimulate movement and thus a way to counter obesity amongst children. Another active discussion is started around vitamin D. Children produce too little vitamin D as they do not get enough sunlight on their skin.

Development

Obesity

A trend common in the western world is that of obesity. Figure G.10 (CBS Statline, 2010) shows the percentage of obese and severe obese children aged two to twenty years old and their respective trend lines. While the percentage of severe obese children can be expected to remain stable or even decrease, the percentage of obese children is likely keep rising. There is plenty of focus on lowering this percentage, through stimulating healthier food and more physical exercise. It can be expected that these two approaches will continue to be focused and pursued.

Vitamin D deficiency

A more recent trend that is allocated to public health is

that of vitamin D deficiency. It is a problem which is getting more and more attention (Opstal, 2009). Vitamin D is produced by the skin under the influence of sunlight and is especially produced between eleven o'clock in the morning and three o'clock in the afternoon; exactly the time of day when children are indoors, shielded from the sun. Especially children spending the majority of their time indoors, think about recreation competition, are vulnerable to a vitamin D deficiency. As the attention for vitamin D deficiency grows, it can be expected that the focus on stimulating children going outside increases.

Possible directions

- Focus on stimulating children going outdoors
- Focus on stimulating physical exercise for children

Importance: average-high
Uncertainty: low

Awareness

Although it is questioned if the awareness phase is reached when it comes to playground, there is no denying that sustainability is now an issue in playground design. Therefore, awareness is a fairly new evolution factor.

Development

Sustainability

Sustainability is hot. Under the influence of many factors such as global warming, sustainability is a major issue in product and environmental design in general. As such, it is a channel for companies to express their social behaviour and ethical beliefs. Playground and play set design is no different.

Playground and play set styling

Playgrounds and especially play sets are built efficiently. Play sets from for example Lappset are based on modular build-ups, allowing easy customisation and different styling (see also Appendix F). Whereas this styling was mainly expressive until a few years ago, more and more play sets and playgrounds are styled much simpler and more sober. It might be stimulated by the trend of natural playgrounds, or it can be seen as a way for competitors to distinguish themselves from the competition, in which case it is an indication of playgrounds and play sets reaching the awareness phase as explained in the Evolutionary Product Development analysis.

Possible directions

- Focus on sustainability
- Possible transition into the 'awareness phase' as explained by the Evolutionary Product Development theory

Importance: average
Uncertainty: average

Child perception

Over time, children have experienced much more freedom in their play behaviour. More options of play, more competition for the playground, have made the children more demanding of the playground itself. Although this needs to be investigated further, the playground competition, especially gaming, seems to have changed the perception of the children towards playgrounds and thus what they expect from it.

Development

Digitalising

Current generation of children are all growing up with computational systems all around them. They are learning to interact with products such as a tablet and smart phone from a very young age. It shapes their expectations of product interaction. It can be expected that it will continue to influence children's perception in the next years.

Gamification
Gamification is a general trend in society (Teunissen, 2013). It covers the use of gaming elements, game design or just game thoughts into non-game applications. The most important part of this approach is the feeling of achievement; if you win or finish a level, you feel good about it. However, it also teaches children to expect rewards. In fact, they expect it (Enk-Wielemaker, n.d.) and thus gamification influences children's perception of play.

Possible directions
- Children focussed more and more on digital objects
- Expectance of quick achievements and rewards

Importance: average-high
Uncertainty: average

Technological

Product Interaction
Gaming and the development of touch screen products has started a trend of interactive products. Playgrounds are no exception, a complete interactive playground was already created and more and more interactive play sets are being developed.

Development

Interactivity
The level of interaction we experience online today is high. The current trend goes towards digital artifacts; physical objects which increase the level of interaction in the physical world to that of the digital world (VanBerlo, 2011).

Technology control
Extrapolating the course of technology points to the direction of the 'smartphone 2.0'. Whereas smartphones are now considered 'smart', it can be expected that they become 'smarter'. Imagine talking to a friend or colleague and verbally agree on a meeting next week. One week later, one hour before the meeting, your phone reminds you of the meeting you agreed upon; the phone added the meeting into your agenda just by 'overhearing' your conversation.

Possible directions
- Phyiscal versus cognitive technology interaction
- Multisensory interaction
- Digital artifacts
- Human controlled versus technology initiated technology

Importance: average-high
Uncertainty: high

Technology
Technology has played an important role in the evolution of the playground. Obvious influences have been the material use, both for play sets as well as the underground of playgrounds, and the production methods, which allowed the playgrounds to become a product of mass production and more recently, mass customisation. The introduction of electronics in play sets opened up a whole new chapter in the

development of playgrounds as well as play sets.
Development

Digital artefacts
In line with the product interaction trend of 'interactivity', the next step is for digital and physical interaction to be combined in one: digital artefacts (VanBerlo, 2011). A current example of the direction of this trend is the Reactable, shown in figure G.11 (Reactable, n.d.).

Upcoming technologies
Besides the development of digital artefacts and 'smarter' phones, there are a couple of technologies which can be expected to deliver their potential to the market in the next ten years. Examples are augmented reality, 3D printing technology, solar power (both small and large scale), smart grids and self-healing materials.

Possible directions
- Continuation of current trends

Importance: average
Uncertainty: low

Environmental

Supervision
In the first playgrounds, a paid supervisor was present to look after the children while they were in the playground. Later on, the supervisor became a volunteer, an adult from the neighbourhood, who rotated with other supervisors. After the Second World War, the parents themselves became the supervisors at the playground. Finally, no supervisors were looking after the children in the playgrounds.

Development

CCTV
A common use practise in the United Kingdom is CCTV. In the Netherlands, use of camera surveillance is much more limited. There is no concrete evidence that camera surveillance is in demand in relation to (public) playgrounds. It is however considered a possibility as there is continued question on who should be in charge of the supervision of playgrounds, especially at public schoolyards. Public schoolyards in general are places where camera surveillance is much more likely to occur, as the major issue for schools to make their schoolyards public is the easy access to the school buildings for burglars.

Possible directions
- No supervision versus technology supervision

Importance: low-average
Uncertainty: average

The car
The car has had a dominant role in the evolution of playgrounds, both in a positive and a negative way. First of all, the car changed the approach of city planning, which, under the influence of functionalism, stimulated the need for playgrounds; the street had the function of transportation, not of playing. Later on, the car allowed families to seek recreation further away from home; it contributed to the competition of the playground. Afterwards, the car became so dominant that the streets were considered simply too unsafe to play on again. It in turn changed the approach of city planning in the form of 'woonerven', which stimulated the creation of playgrounds in new neighbourhoods. In the

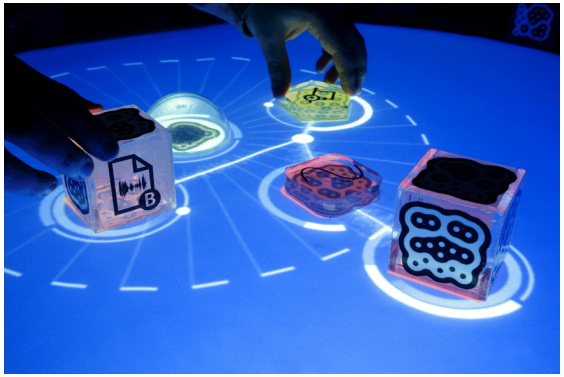


figure G.11 Reactable

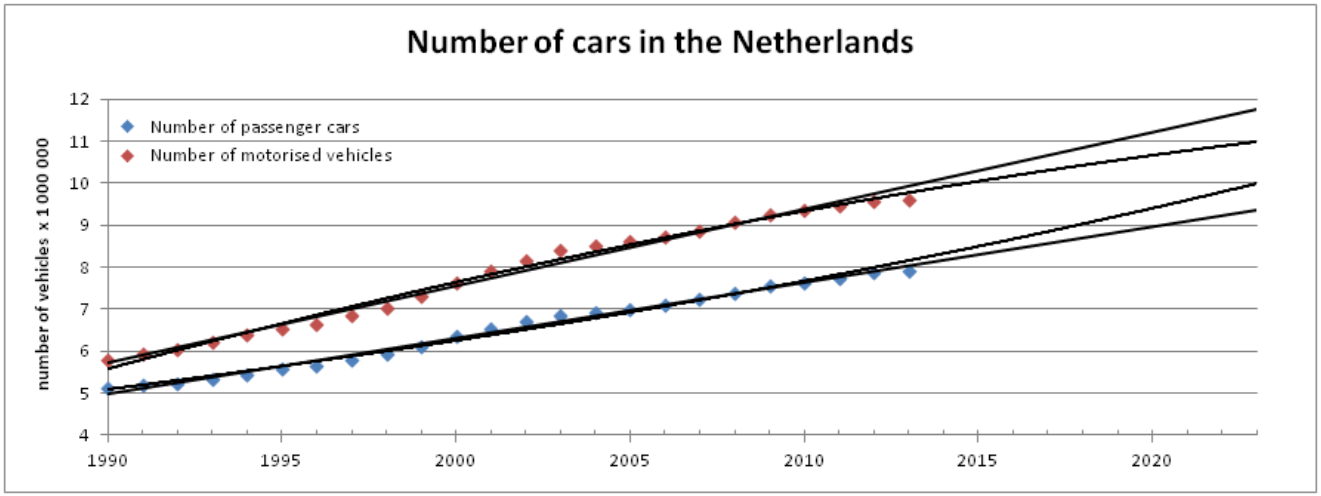


figure G.12 Total amount of cars trendlines

figure G.13 City vehicle: Renault Twizy

older city centres though, parking spaces were limited to the point where many playgrounds were turned into parking spaces.

Development

More cars

An inevitable development is the overall increase of the number of cars, or motorised vehicles in general, in the Netherlands. The car developed from a luxury good to a commodity good during the 20th century and with the population increase as well as the decrease of average household size, there simply is a continuous need for more cars. Figure G.12 underlines the expectations through trend lines (CBS Statline, 2013e). In the next ten years, 10% to 25% more passenger cars can be expected.

Small cars

With fuel prices ever rising and city centres clogging up, the small car market is growing. Car makers have identified this trend (Zenlea et al, 2010). The trend is visible in the car sales of the Netherlands (RAI vereniging, 2013). This trend is stimulated by the government through financial benefits for more economical, environmental friendly cars.

City vehicles

Whereas small cars are still functional passenger cars for four to five people, car makers recently started to create city vehicles; vehicles aimed at supporting just one or two people in urban areas. An example is the Renault Twizy, an electric city vehicle (Renault UK, 2013). This could be the next step in the development of small cars as well as city transportation, but it is unknown if these type of vehicles are going to be a success.

Possible directions

- Number of cars ever increasing
- Small cars versus city vehicles

Importance: low-average
Uncertainty: average

Legal

Legislation

Initially, the law to abolish child labour contributed to the societal need for the playground. Later on in the evolution, the law which forced playgrounds and play sets to become safe by following strict guidelines has greatly influenced both the number of playgrounds today as well as how they are set up.

Development

Municipalities WAS revoke demand

WAS stands for 'Warenwetbesluit Attractie- en speeltoestellen' (Keurmerkinstituut, n.d.). It is legislation which is a direct consequence of the 'Attractiebesluit' of 1997 (Volkskrant, 1997). The legislation made municipalities focus on preventing any possible legal claims as a result of 'unsafe' play equipment. When following the legislation on safe play equipment, safe placement and safe maintenance, municipalities are safe from claims. Yet, the number of accidents in playgrounds has not decreased, while there have been no claims at all (Valck, 2013). The legislation makes play sets and maintenance more expensive and requires additional needs such as safe play surfaces. Under the influence of budget cuts and renewed pedagogic perspective, the focus is shifting towards informal play spaces. But that brings the question, who is responsible? Municipalities would therefore like to see the WAS legislation revoked. This is unlikely to happen, but it does support the approach of informal play space and of accepting some levels of risk while playing in the outdoor public environment.

Possible directions

- No change is expected

Importance: average
Uncertainty: low

Safety demands

Safety is one of the parameters looked at in order to see if a product follows the theory of evolutionary product development. In the case of playgrounds, it has played a more dominant role than in other products. Safety was lacking completely in the last part of the 20th century. Legislation ended that to the point where playgrounds are considered very safe in the present day. Interestingly, it has sparked a discussion if it is not too safe.

Development

Safety

The focus on safety is not just limited to playgrounds. In the western world, everything has to be safe and someone has to be responsible for guaranteeing the safety. Playgrounds are no exception and the 'Attractiebesluit' bill of 1997 proves this. However, there is a debate going on about how playgrounds should offer some forms of risk, as it is an environment where children should be able to develop themselves (Valck, 2013). The aspect of safety might therefore develop from avoiding risk to accepting a certain level of risk.

Possible directions

- No change versus allowance of more physical challenge

Importance: average-high
Uncertainty: low-average

APPENDIX H: ORIGINAL PLAYNETIC VISION STATEMENT

This appendix provides Playnetic's original vision statement as found in Playnetic's businessplan. The vision statement is written in Dutch.

Playnetic visie.

Een groot deel van ons leven zijn we buiten de deur: op weg naar school, werk, vrienden, boodschappen doen of gewoon spelen en ontspannen. Deze 'openbare ruimte' is dus erg belangrijk voor ons.

Playnetic wil als fabrikant van innovaties bijdragen aan een goede openbare leefomgeving. Playnetic wil dat het leven in de openbare ruimte een positief effect heeft op ons welzijn. Het leven buiten de deur moet naast functioneel zijn, onze geest verrijken en onze gezondheid bevorderen. Een veilige en goed ingerichte openbare ruimte beschouwen wij als de basis hiervoor.

APPENDIX I: TRIZ EXECUTION

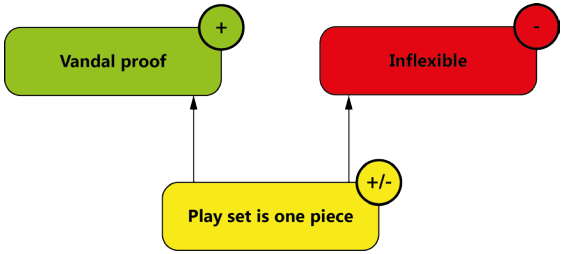


figure I.1 Vandal proof versus inflexibility contradiction

The brain storm sessions for each search field created some direct concept directions to explore, but also created mind restrictions in parallel. Similarly, the sketch sessions generated and explored interesting design directions, while creating additional mind restrictions. To overcome these mind restrictions and to generate solutions for them, TRIZ was applied in parallel with the sketch sessions. Normally, TRIZ is used as an innovation tool to solve technical contradictions in a design. In this case, TRIZ was used as an inspiration tool to guide the thought process and to overcome mind restrictions towards concept directions and subsequently concepts itself.

Part of the TRIZ technique applied here generally use an in-depth analysis of the contradiction in the form of a root-cause analysis (although this is not mandatory for the technique) as well as a comparative ranking of the generated solutions for the contradiction. However, since TRIZ was used as an inspirational tool in this project, these two parts were not included. Creating a root-cause analysis would be hard to do as the contradictions result from mind restrictions, not from concrete technical problems which would be easier to analyse. As for the comparative ranking, the context of the solutions was not yet known; it was therefore impossible to determine the best solutions. Instead, a selection of feasible solutions to explore was made.

Inflexibility versus vandal proof

As Playnetic's products are placed and used in the outdoor public environment, making the products vandal proof is one of the main focus points of Playnetic. In order to achieve this positive effect, the created products are sturdy and robust; they are created as one single piece. As a result, the products are inflexible. If a goal such as options for manipulation is to be achieved, this contradiction (figure I.1) has to be overcome.

Using TRIZ, the contradiction of vandal proof (positive) versus inflexible (negative) was analysed. The contradiction matrix and 40 inventive principles were applied to create abstract design solutions.

The following attributes were allocated to the positive and negative consequences of the contradiction:

- **Vandal proof:** strength, ease of manufacturing and stability
- **Inflexible:** Adaptability and complexity of device

Using the contradiction matrix, the following inventive principles were looked at to solve the contradiction:

Positive		Negative	Inventive principles
Strength	vs	Adaptability	15, 3, 32
Strength	vs	Complexity of device	2, 13, 25, 28
Ease of manufacturing	vs	Adaptability	2, 13, 15
Ease of manufacturing	vs	Complexity of device	27, 26, 1
Stability	vs	Adaptability	35, 30, 34, 2
Stability	vs	Complexity of device	2, 35, 22, 26

Abstract design solutions to solve the contradiction are shown in table I.2.

The next step when normally using the 40 inventive to solve technical contradictions would be to create a ranking between the generated abstract design solutions. As TRIZ was used as an inspirational tool here, a pre-selection of interesting design solutions was made to explore further while creating new concept ideas. These are:

- Use shape memory alloys/polymers
- Use flexible joints (e.g. desk lamp)
- Manipulate the environment instead of the play set
- Create optical copies (e.g. light/shadows)
- Change the colour of the play set through light/shadow (photo chromatic), temperature (thermo chromatic) or electricity (electro chromatic)
- Use a 'raster-like' approach of the environment
- Convert kinetic energy of children's play directly into electricity for changing the environment
- Create a play set based on multiple objects
- Consider inflexibility as a positive effect
- Use acoustics

	TRIZ principle	Solutions
2.	Taking away	
35.	Parameter change	• Use shape memory alloys/polymers • Use carbon fibre • Use liquids, like hydraulics (e.g. balancing/weighing scale)
15.	Dynamisation	• Use gel fillings • Create a type of adjustable suspension • Use a telescope principle • Use flexible joints (e.g. desk lamp)
13.	The other way around	• Manipulate the environment instead of the play set
26.	Copying	• Create optical copies (e.g. light/shadows) • Use virtual reality
3.	Local quality	• Make the shape temperature dependent • Make the appearance temperature dependent
30.	Thin films and flexible shells	• Use the principle of inflation/deflation • Use shells filled with liquids
32.	Colour change	• Change the colour of the play set through light/shadow (photo chromatic), temperature (thermo chromatic) or electricity (electro chromatic) • Use transparency • Use the principle of a smoke screen • Use glow in the dark materials
25.	Self-service	• Use a 'raster-like' approach of the environment • Convert kinetic energy of children's play directly into electricity for changing the environment • Convert kinetic energy of the environment into electricity for changing the environment (e.g. traffic)
1.	Segmentation	• Use 'web-like' structures (e.g. bubble wrap) • Create a play set based of multiple objects
22.	Blessing in disguise	• Make the play set appear as if it is already broken • Consider inflexibility as a positive effect
28.	Mechanics substitution	• Use acoustics • Use optical illusions

table I.2 Vandal proof versus inflexibility contradiction abstract solutions

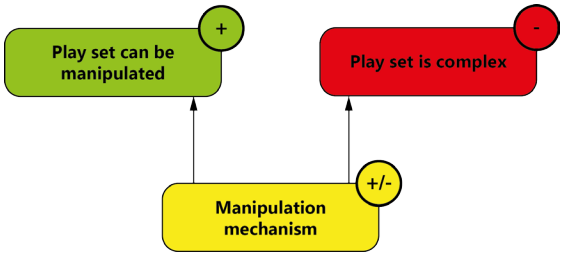


figure I.2 Play set manipulation versus play set complexity contradiction

Play set complexity versus play set manipulation

During the execution of the first TRIZ approach and with Playnetic's vision statement in mind, a new contradiction appeared in the form of adding manipulation to a play set also increases its complexity. The vision statement however states that the new play sets should be simpler rather than complex. TRIZ was therefore used to generate abstract design solutions on how to keep the new play sets simple.

The following attributes were allocated to the positive and negative consequences of the contradiction:

- **Play set can be manipulated:** Shape, adaptability and convenience of use
- **Play set is complex:** Complexity of device

Using the contradiction matrix, the following inventive principles were looked at to solve the contradiction:

Positive		Negative	Inventive principles
Shape	vs	Complexity of device	16, 29, 1, 28
Adaptability	vs	Complexity of device	15, 29, 37, 28
Convenience of use	vs	Complexity of device	32, 26, 12, 17

Abstract design solutions to solve the contradiction are shown in table I.4.

Interesting design solutions to explore further are:

- Divide the play set into multiple parts capable of relative moment to each other
- Change the colour of the play set instead of creating a physical change
- Change the transparency of the play set instead of creating a physical change
- When using multiple objects, replace some with copies
- Use optical, acoustic or other principles instead of a mechanical one
- Base the play set on multiple simple objects
- Limit the need for manipulation by redesigning the environment
- Consider manipulation on a line or plane instead of three dimensional

	TRIZ principle	Solutions
16.	Slightly less or more	• If the object is too complex, reformulate the problem and take a step back in complexity
15.	Dynamisation	• Make the play set mobile • Divide the play set into multiple parts capable of relative moment to each other
32.	Colour and Transparency change	• Change the colour of the play set instead of creating a physical change • Change the transparency of the play set instead of creating a physical change
29.	Use of gases and fluids	• Use liquid surfaces for shape manipulation
26.	Use of copies and models	• Use virtual copies • When using multiple objects, replace some with copies
28.	Principle replacement	• Use optical, acoustic or other principles instead of a mechanical one
1.	Segmentation	• Base the play set on multiple simple objects
37.	Expansion effects	• Use thermal expansion/contraction for manipulation (e.g. bi-metals)
12.	Equipotentiality	• Limit the need for manipulation by redesigning the environment • Eliminate the need for manipulation
17.	Another dimension	• Consider manipulation on a line or plane instead of three dimensional

table I.4 Play set manipulation versus play set complexity abstract solutions

Noise versus Fun

The concept direction of creating musical instruments in the street pavement is very promising. The concept is feasible

to develop; the necessary technology is already developed by Playnetic. The concept itself is relatively simple, provides children with a fun play concept which offers them options to create their own play. One possible problem for this concept direction was determined beforehand. For the instruments to be a success, they need to produce an adequate sound level. While children would perceive the sound as fun, other people might perceive it as noise, especially at night. For the concept to work, this contradiction should be solved.

The following attributes were allocated to positive and negative consequence of the contradiction:

- **Fun:** Convenience of use, productivity
- **Noise:** Harmful side effects, Amount of substance

Using the contradiction matrix, the following inventive principles were looked at to solve the contradiction:

Positive		**Negative**	**Inventive principles**
Convenience of use	vs	Harmful side effects	All
Convenience of use	vs	Amount of substance	12, 35
Productivity	vs	Harmful side effects	35, 22, 18, 39
Productivity	vs	Amount of substance	35, 38

Abstract design solutions to solve the contradiction are shown in figure I.6.

Interesting design solutions to explore further are:

- Adapt the volume of the play set to the sound level of the surrounding

	TRIZ principle	Solutions
35.	Parameter change	• Adapt the volume of the play set to the sound level of the surrounding
12.	Equipotentiality	• Redesign the environment to lower the level of annoyance of the noise
22.	Blessing in disguise	• Use counter noise to eliminate sound levels at a distance
38.	Enriched environment	• Create a 'dome' around the play set • Create a different atmosphere around the play set
18.	Vibrations	• Use resonance to counteract the noise
39.	Inert environment	• Isolate the play set from the environment • Remove the rest of the neighbourhood • Isolate the environment (e.g. thicker glass) • Place the play set at an isolated spot in the environment
19.	Periodic action	• Turn the play set off at certain times when it is unwanted (e.g. at night)
16.	Slightly more or less	• Make the volume adjustable and find the right volume levels at each location
3.	Local Quality	• Change the volume levels for different times of the day (e.g. lower at night, higher during the day)

table I.6 Fun versus noise abstract solutions

- Place the play set at an isolated spot in the environment
- Turn the play set off at certain times when it is unwanted (e.g. at night)
- Make the volume adjustable and find the right volume levels at each location
- Change the volume levels for different times of the day (e.g. lower at night, higher during the day)

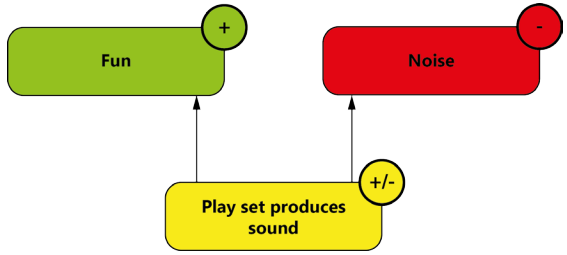


figure I.3 Fun versus noise contradiction

Chance of injury versus randomiser

The concept direction around an environment which can be reorganised, the concept idea which can be associated with a maze, offers children a way to change the shape of the play set. The play set itself provides a play environment rather than a single play set. The concept idea therefore offers children a way to manipulate the physical environment to create their own games and rules. Thought behind the concept is that children can adjust different pillars and by doing so, create a different play environment. Downside of this concept's idea

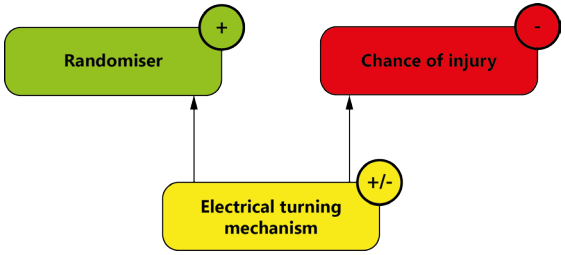


figure I.4 Randomiser versus chance of injury contradiction

is that turning a random pillar might make the bulkheads attached to the pillars hit another child and cause an injury. This has to be prevented.

The following attributes were allocated to positive and negative consequence of the contradiction:

- **Fun:** Productivity, adaptability
- **Noise:** Harmful side effects, complexity of control

Using the contradiction matrix, the following inventive principles were looked at to solve the contradiction:

Positive		Negative	Inventive principles
Convenience of use	vs	Harmful side effects	All
Convenience of use	vs	Complexity of control	All
Productivity	vs	Harmful side effects	35, 22, 18, 39
Productivity	vs	Complexity of control	35, 18, 27, 2
Adaptability	vs	Harmful side effects	All
Adaptability	vs	Complexity of control	1

Abstract design solutions to solve the contradiction are shown in table I.8.

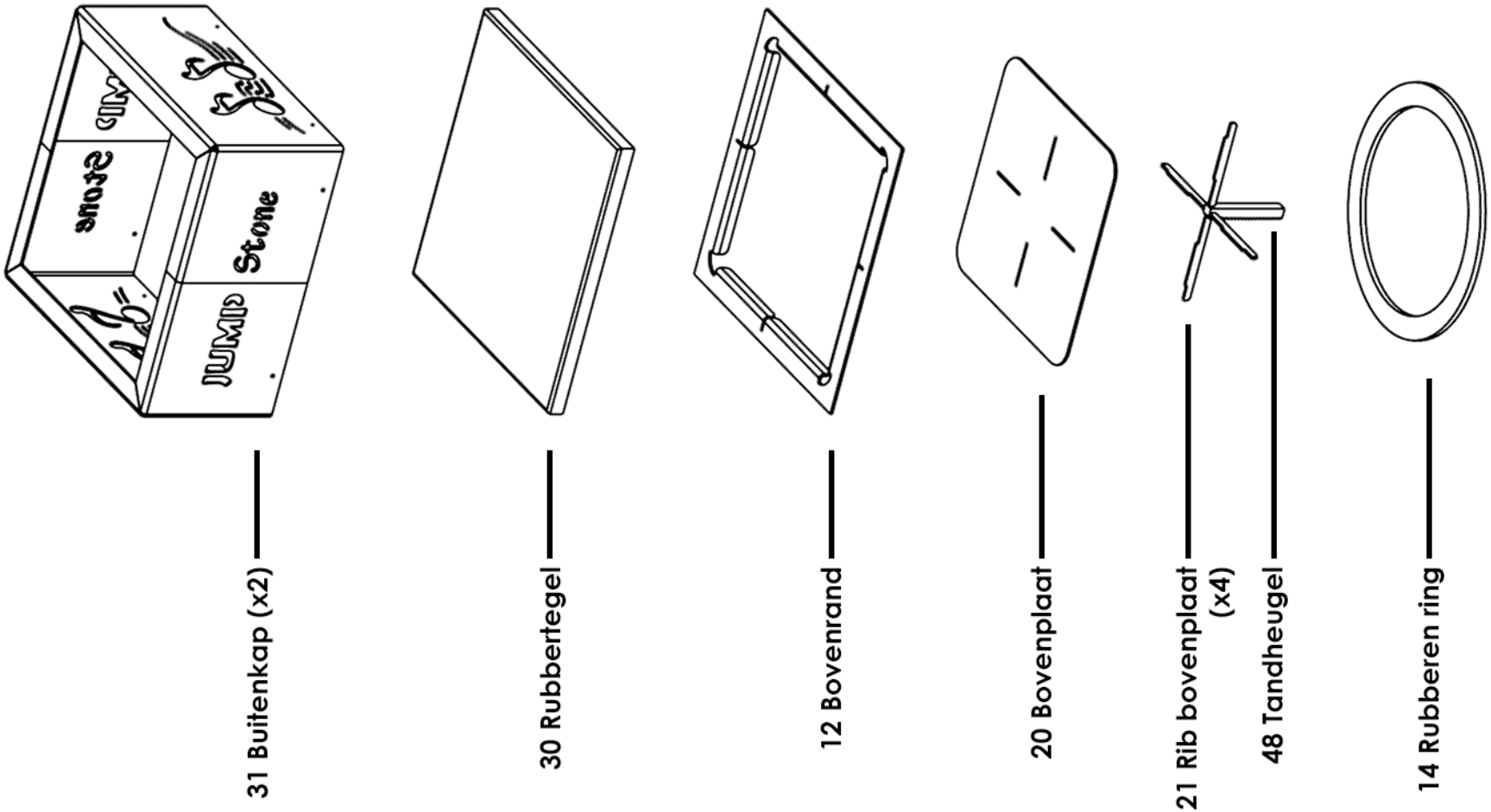
Interesting design solutions to explore further are:

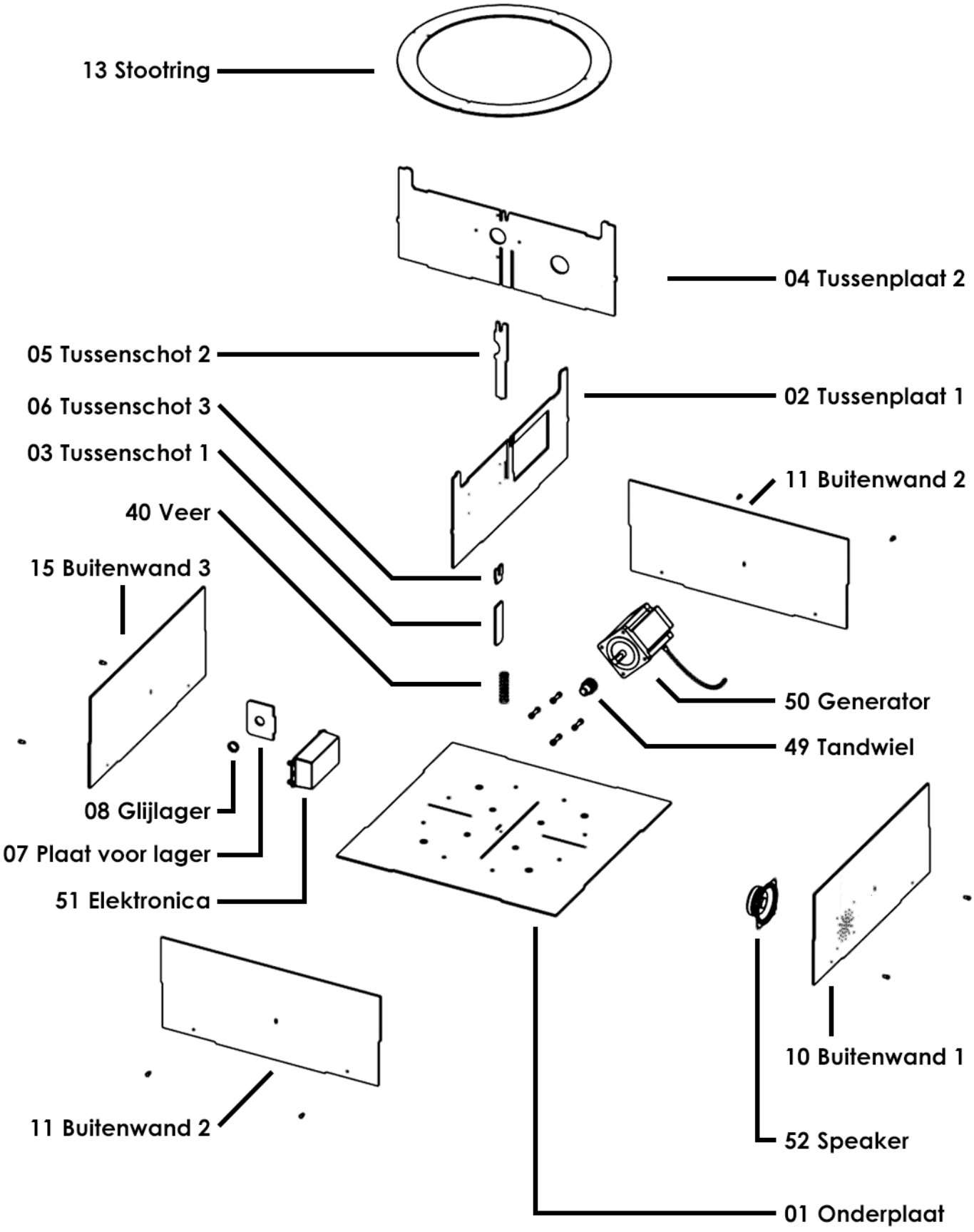
- Use flexible bulkheads (e.g. rubber or foam)
- Fragment the bulkheads into multiple, flexible parts
- Use sound to warn for a turning pillar
- Redirect the resistance from a bulkhead pushing a child to another pillar
- Use rubber tiles to allow for better fall protection
- Apply a breaking system which slows the maximum rotating speed
- Turn pillars in phases
- If a counter-pressure is found while a pillar is turning, block the pillar from rotating further
- Use multiple layers of thin, flexible bulkheads instead of one thick bulkhead

	TRIZ principle	Solutions
35.	Parameter change	• Use smokescreens instead of physical bulkheads • Use waterscreens instead of physical bulkheads • Use flexible bulkheads (e.g. rubber or foam)
1.	Segmentation	• Fragment the bulkheads into multiple, flexible parts
18.	Vibrations	• Use sound to warn for a turning pillar
22.	Blessing in disguise	• Redirect the resistance from a bulkhead pushing a child to another pillar
27.	Cheap and short life	• Use cheap bulkheads which break when hitting a child (e.g. Styrofoam)
39.	Inert environment	• Let children wear protective garment • Use rubber tiles to allow for better fall protection
2.	Taking away	• Place the bulkhead on a hinge
3.	Local quality	• Add cushion-like material at the parts of the bulkheads which turn the fastest
10.	Prior action	• Use a loud noise to scare children away when a pillar starts rotating • Apply a breaking system which slows the maximum rotating speed
16.	Slightly more or less	• Shorten the bulkheads, this ensures the edges turn slower
17.	Another dimension	• Use bulkheads which have a 3D shape that does not allow injuries to occur easily
19.	Periodic action	• Turn pillars in phases
23.	Feedback	• If a counter-pressure is found while a pillar is turning, block the pillar from rotating further
30.	Thin films and flexible shells	• Use multiple layers of thin, flexible bulkheads instead of one thick bulkhead

table I.8 Randomiser versus chance of injury abstract solutions

APPENDIX J: JUMPSTONE DESIGN

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03 Tussenschot 1
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40 Veer
15 Buitenwand 3
50 Generator
49 Tandwiel
08 Glijlager
07 Plaat voor lager
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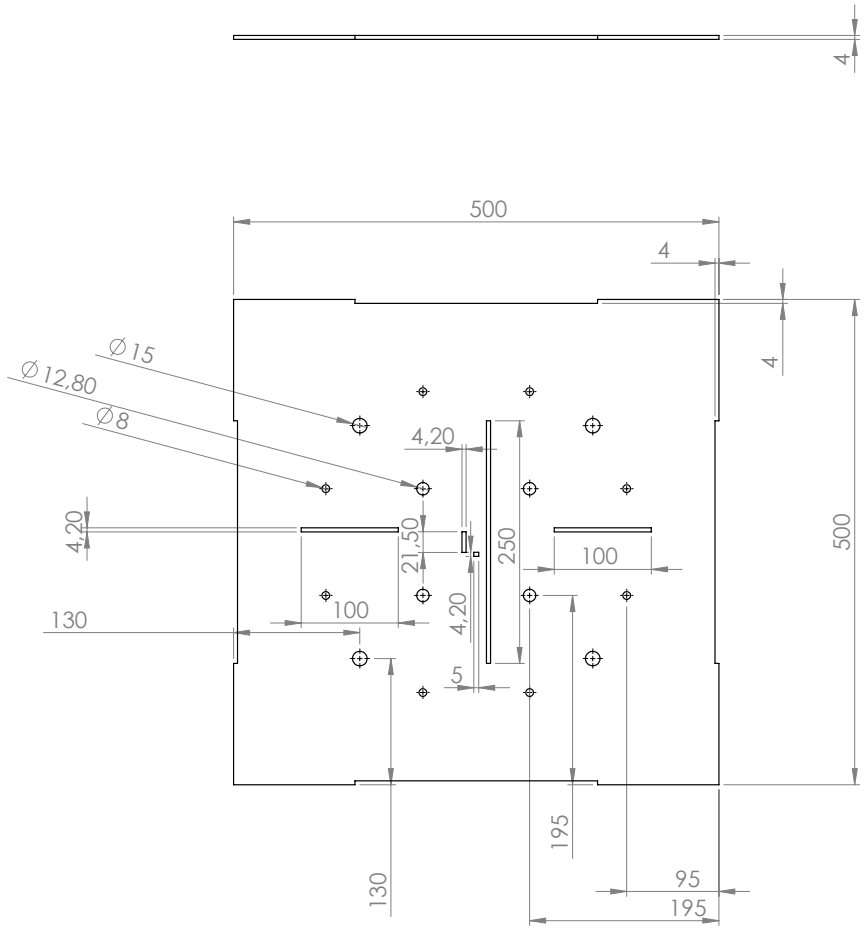
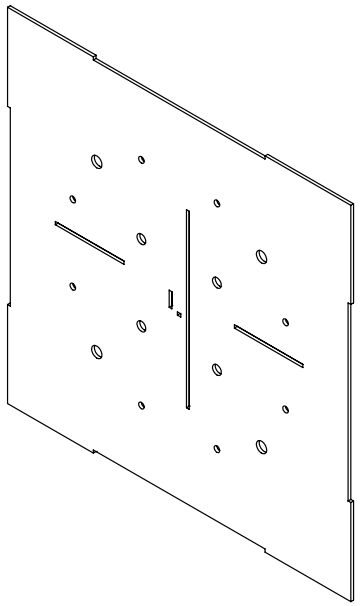
11 Buitenwand 2
52 Speaker
01 Onderplaat





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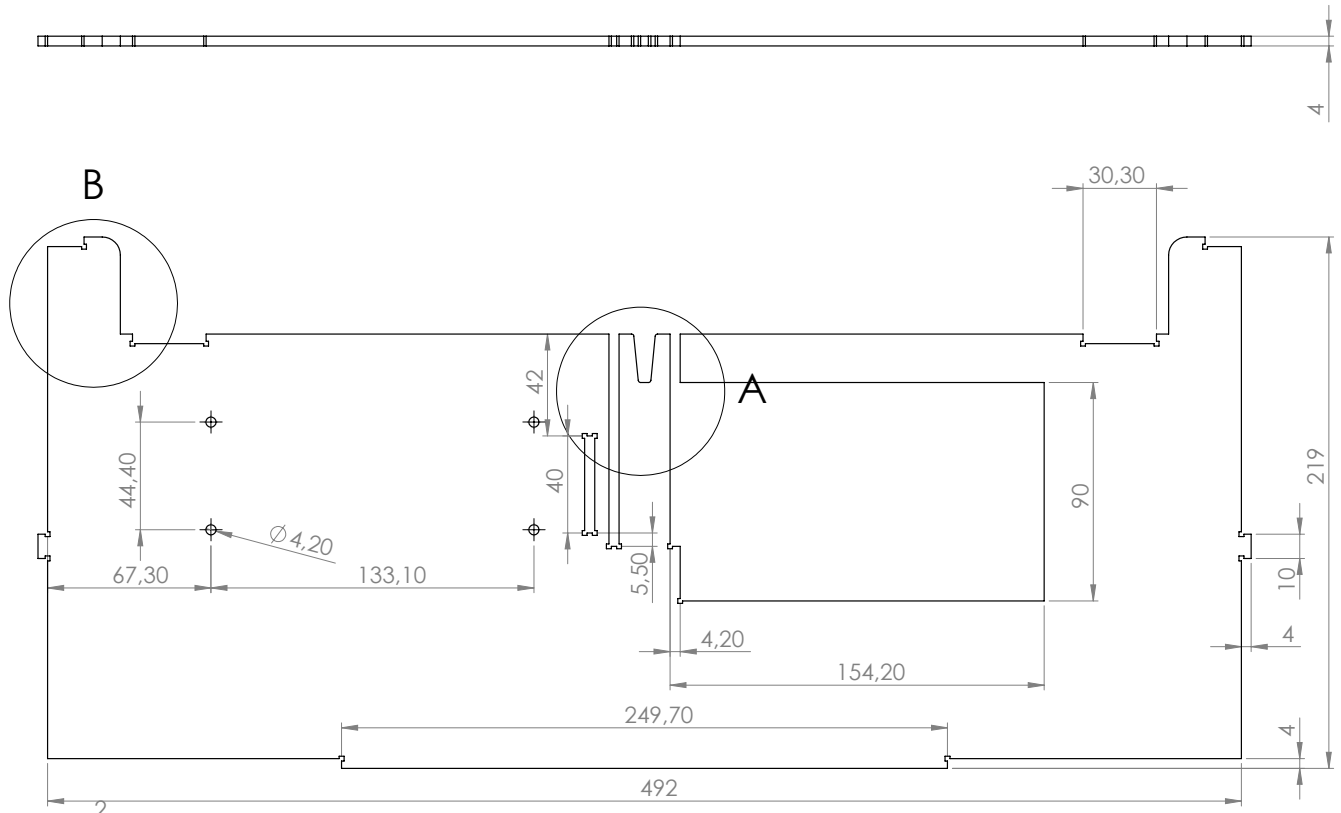

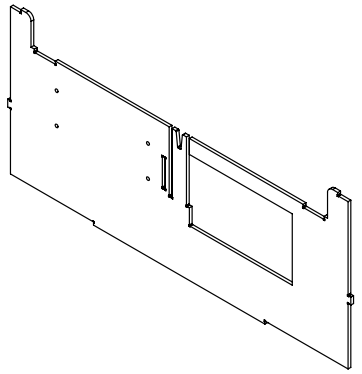

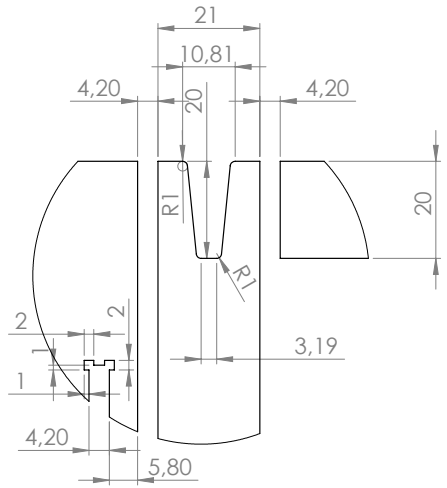

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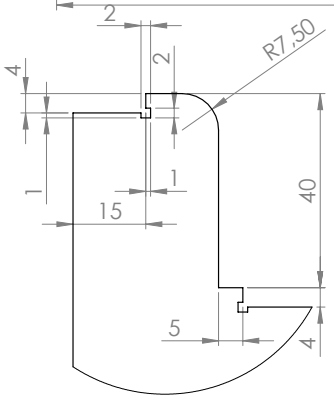

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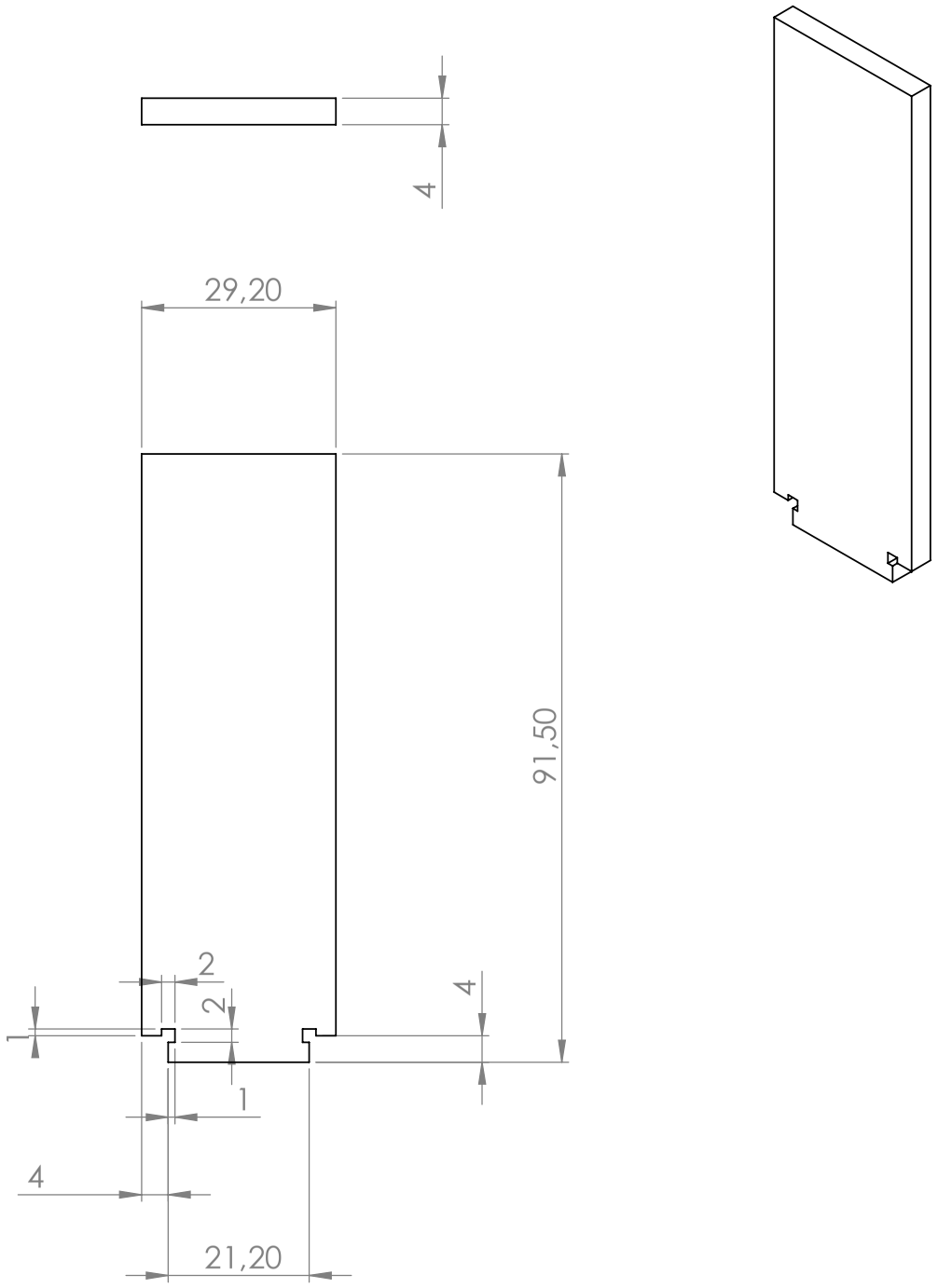

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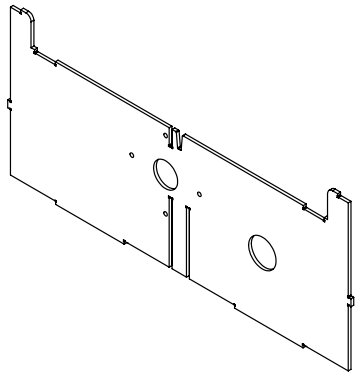

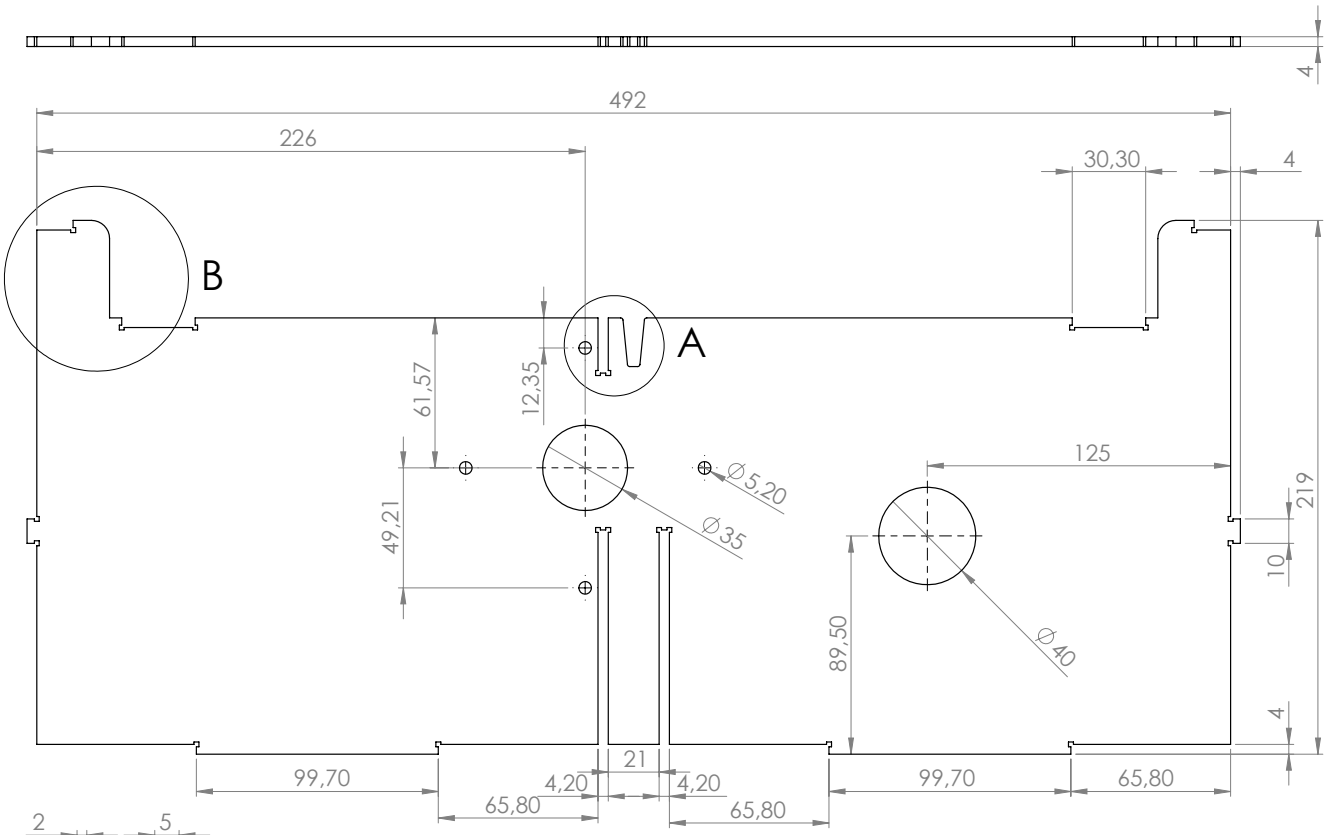

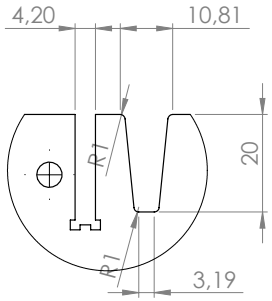

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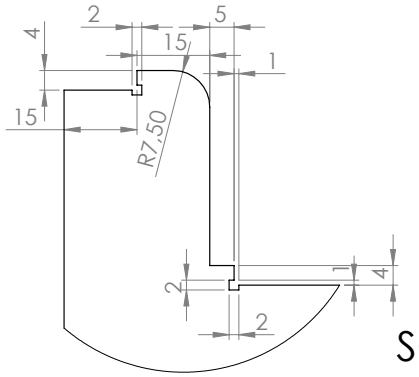

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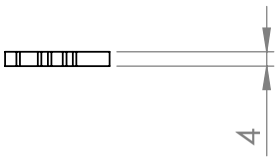

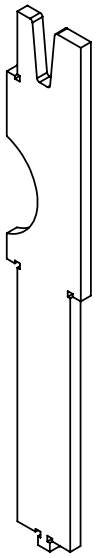

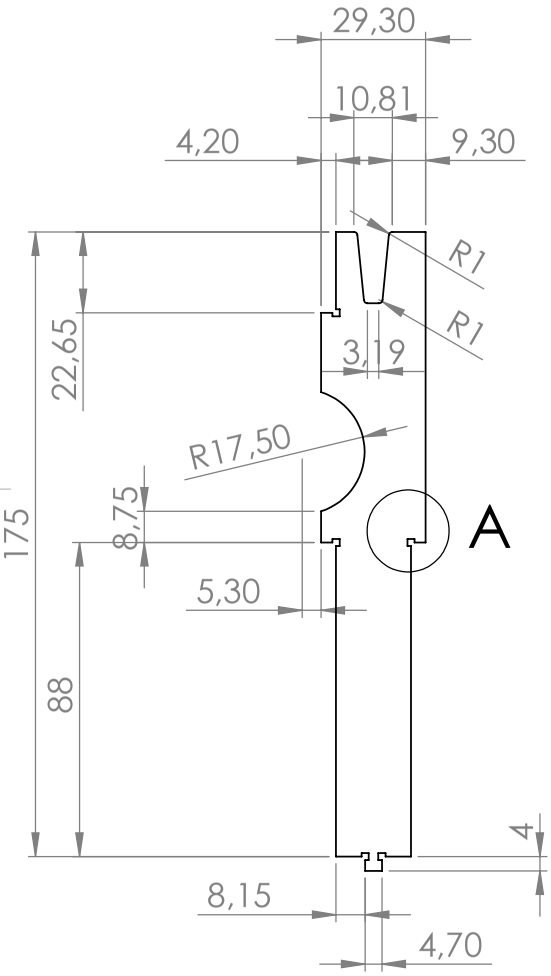

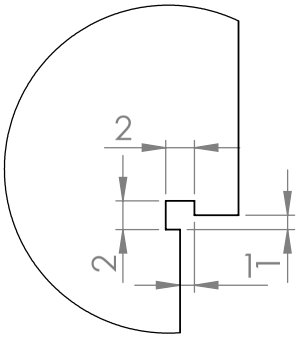

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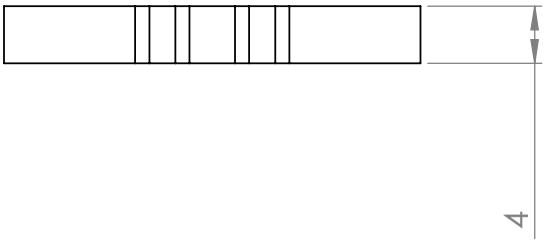

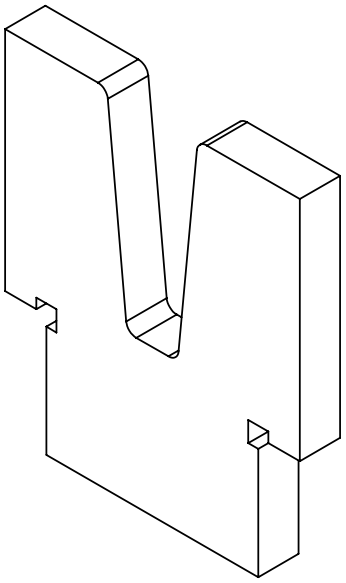

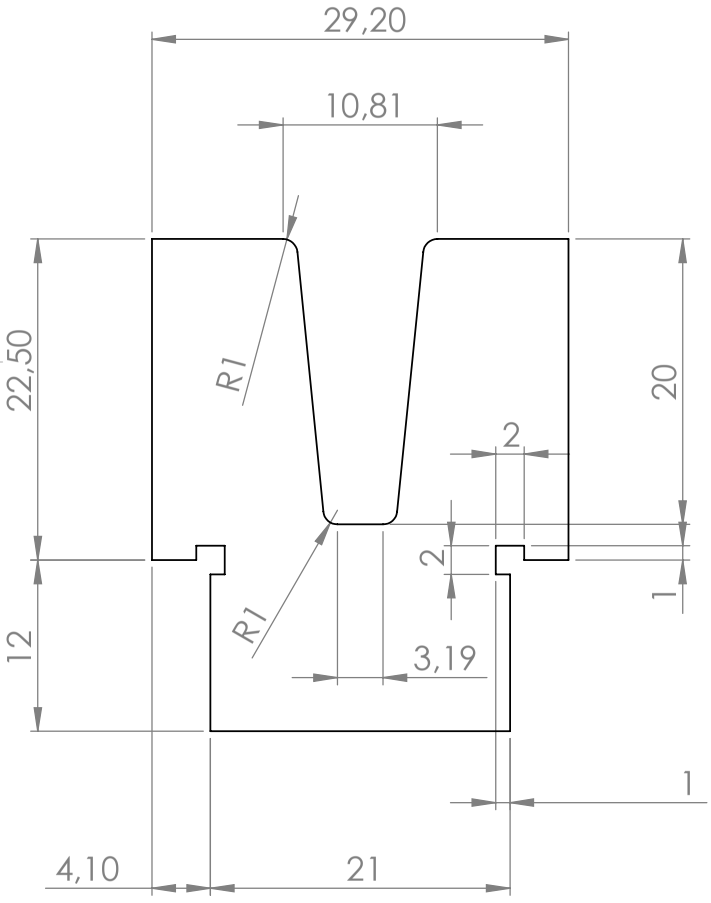

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Drawn:	RJdenHaan		9-10-2013		
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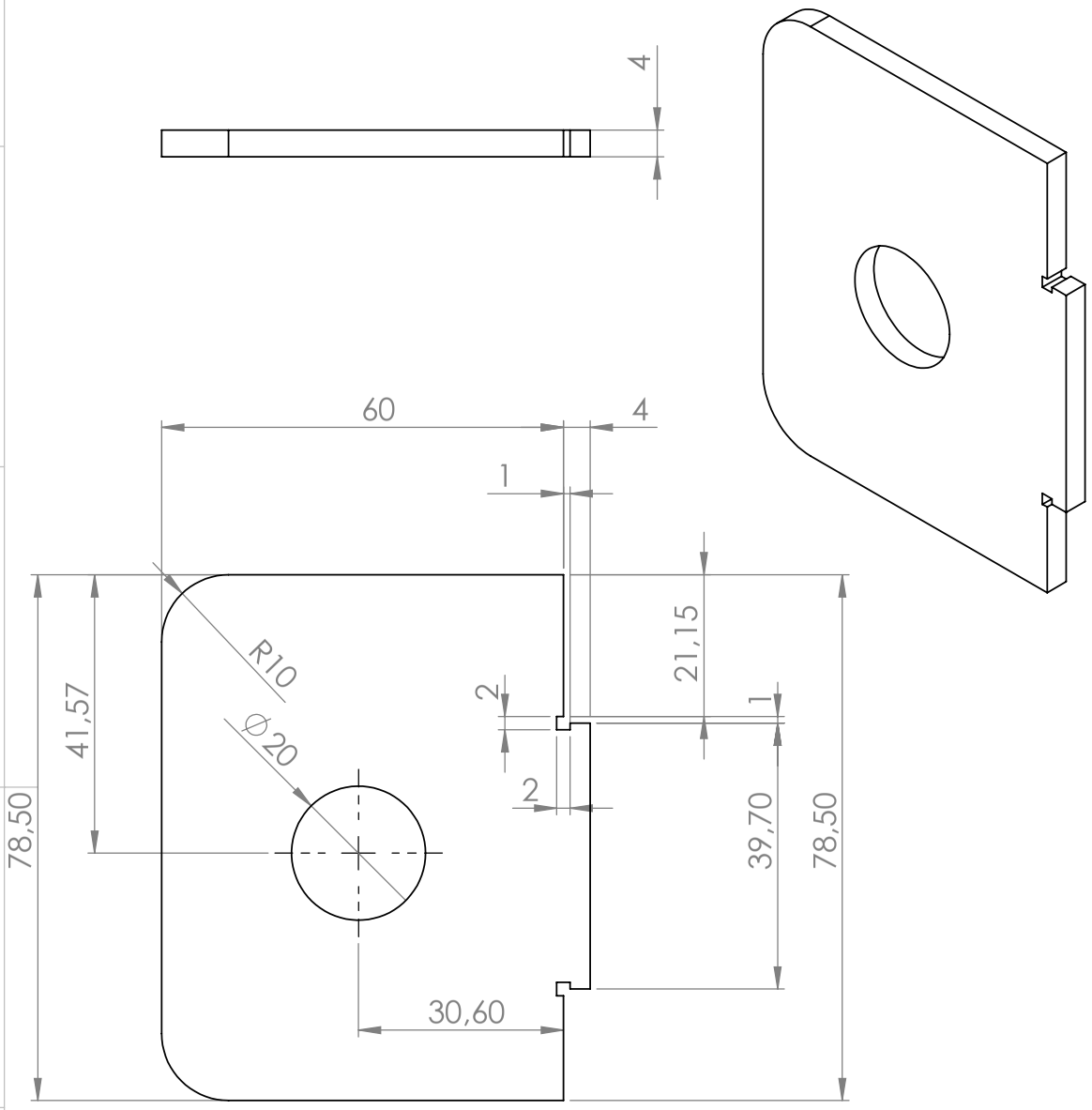
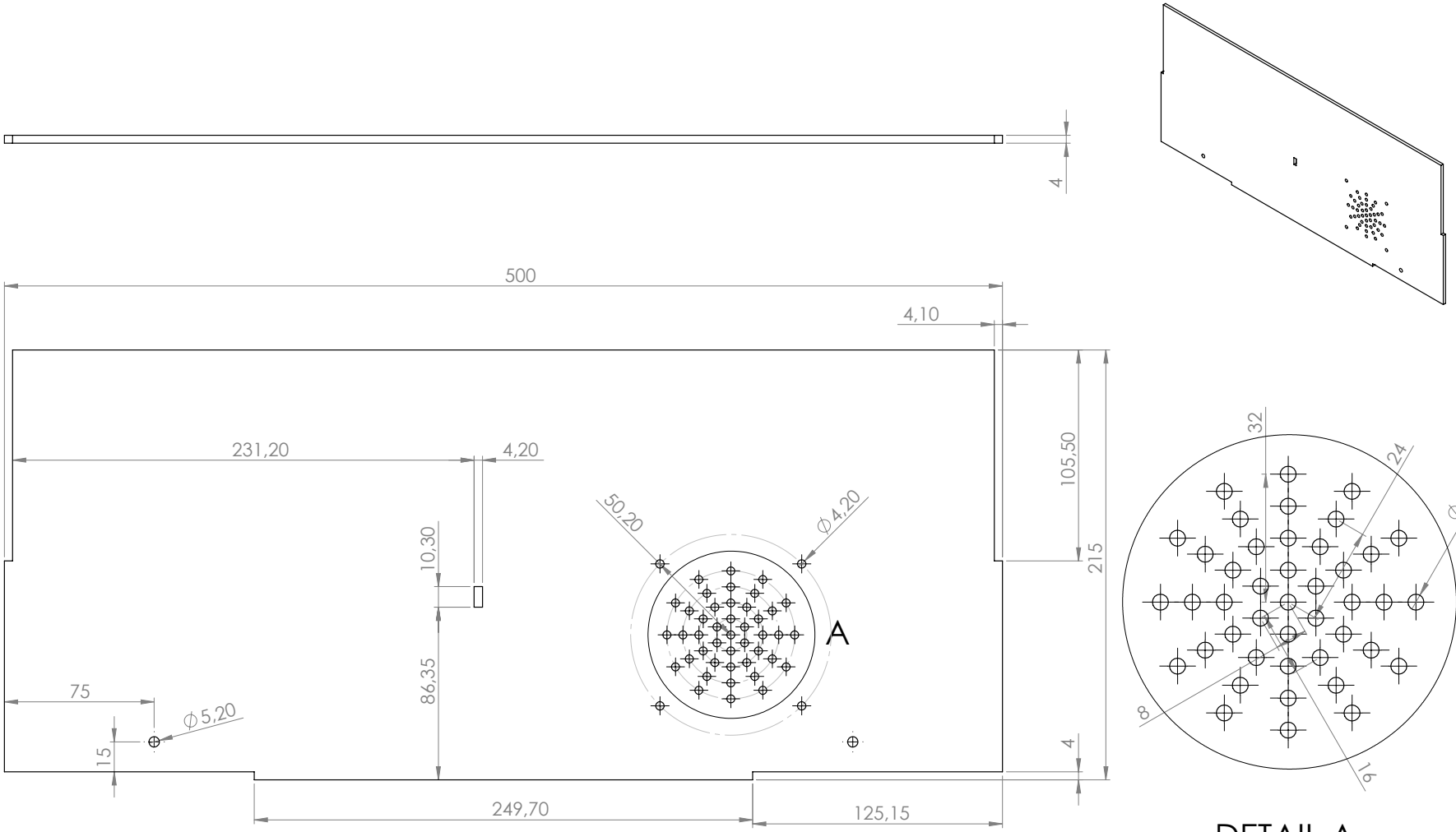
Material: Staalplaat 4mm				PLAYNETIC B.V. LOOHORST 2A 7207 BM ZUTPEN TEL:(31)575 843612 MAIL: info@playnetic.nl	Weight: / SCALE: 2:1 / SHEET: 1 OF 1

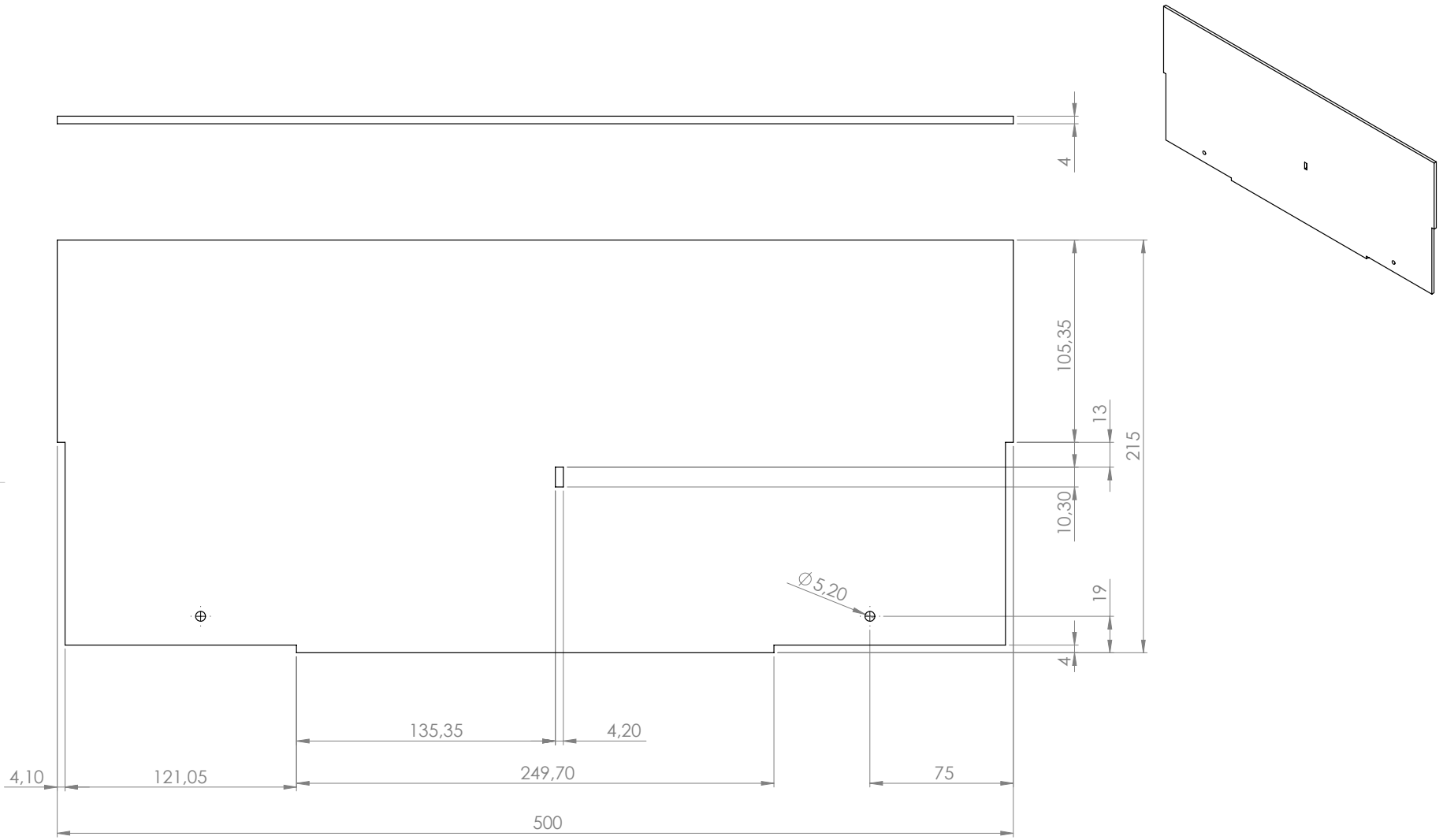


DO NOT SCALE DRAWING		DEBUR AND BREAK SHARP EDGES		UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS TOLERANCES ACCORDING TO: ISO 2768-mK	Description: Plaat voor lager
	Name	Signature	Date	playnetic bv playing with energy	Part of:
Drawn:	RJdenHaan		9-10-2013		
Checked:					Drawing number: / Revision: / Format: A4
Material: Staalplaat 4mm				PLAYNETIC B.V. LOOHORST 2A 7207 BM ZUTPEN TEL:(31)575 843612 MAIL: info@playnetic.nl	Weight: / SCALE: 1:1 / SHEET: 1 OF 1

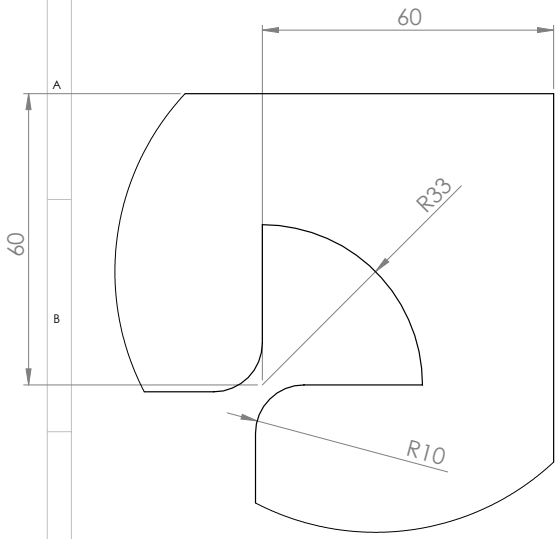


DETAIL A
SCALE 1 : 1

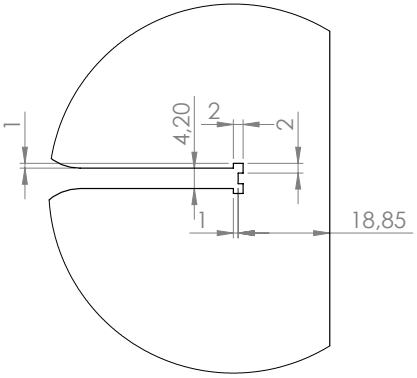
DO NOT SCALE DRAWING		DEBUR AND BREAK SHARP EDGES		UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS TOLERANCES ACCORDING TO: ISO 2768-mK	Description: Buitenwand 1
	Name	Signature	Date	playnetic bv playing with energy	Part of:
Drawn:	RJdenHaan		9-10-2013		
Checked:				PLAYNETIC B.V. LOOHORST 2A 7207 BM ZUTPEN TEL:(31)575 843612 MAIL: info@playnetic.nl	Drawing number: / Revision: / Format A3
Material: Staalplaat 4mm					Weight: / SCALE: 1:2 / SHEET: 1 OF 1



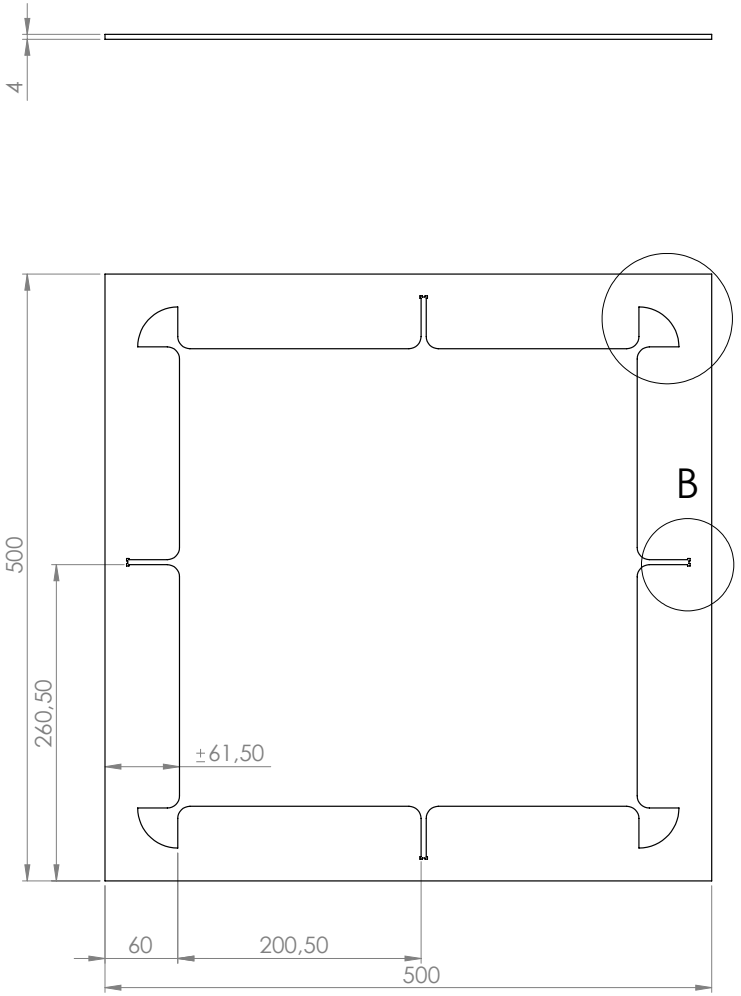
DO NOT SCALE DRAWING		DEBUR AND BREAK SHARP EDGES		UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS TOLERANCES ACCORDING TO: ISO 2768-mK	Description: Buitenwand 2 (2 maal per product)
	Name	Signature	Date	PLAYNETIC bv playing with energy	Part of:
Drawn:	RJdenHaan		10-10-2013		
Checked:					Drawing number: / Revision: / Format A3
Material: Staalplaat 4mm				PLAYNETIC B.V. LOOHORST 2A 7207 BM ZUTPEN TEL:(31)575 843612 MAIL: info@playnetic.nl	Weight: / SCALE: 1:2 / SHEET: 1 OF 1

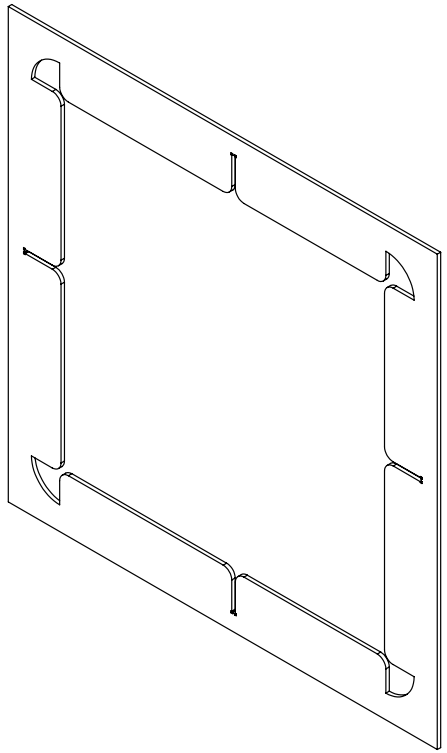


DETAIL A
SCALE 1 : 1

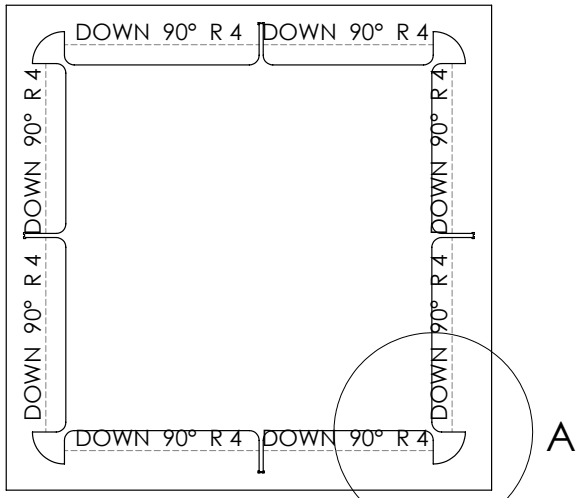


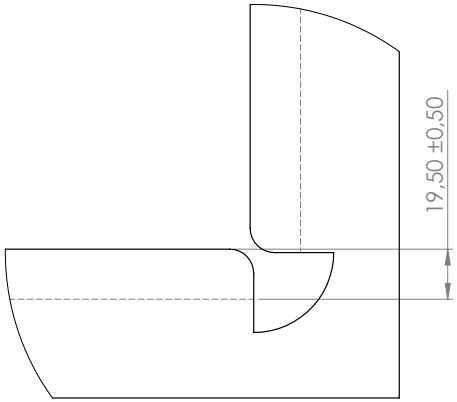
DETAIL B
SCALE 1 : 1



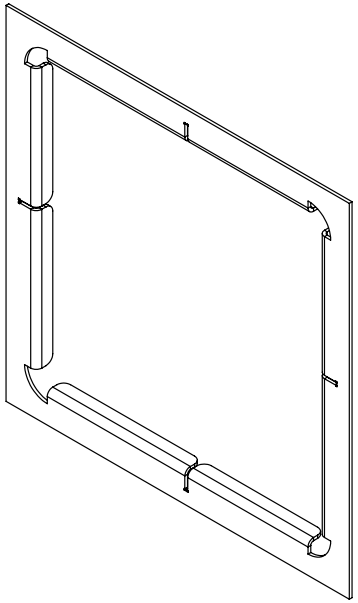


DO NOT SCALE DRAWING		DEBUR AND BREAK SHARP EDGES		UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS TOLERANCES ACCORDING TO: ISO 2768-mK	Description: Bovenrand
	Name	Signature	Date	playnetic by playing with energy	Part of:
Drawn:	RJdenHaan		10-10-2013		
Checked:				PLAYNETIC B.V. LOOHORST 2A 7207 BM ZUTPEN TEL:(31)575 843612 MAIL: info@playnetic.nl	Drawing number: / Revision: / Format A3
Material: Staalplaat 4mm					Weight: / SCALE: 1:4 / SHEET: 1 OF 1

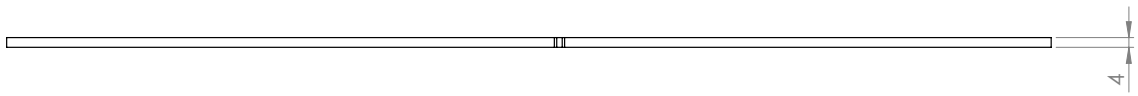


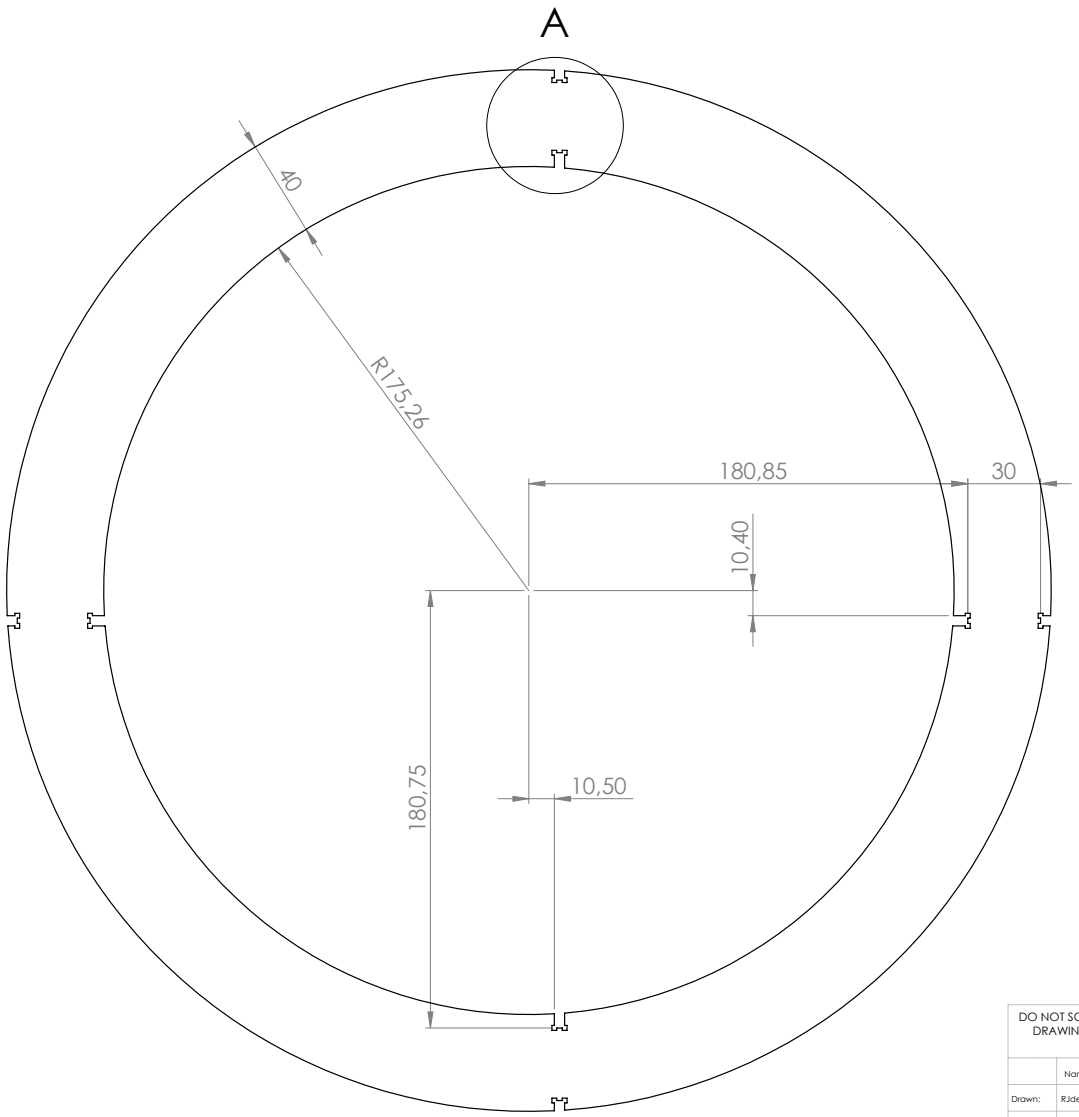


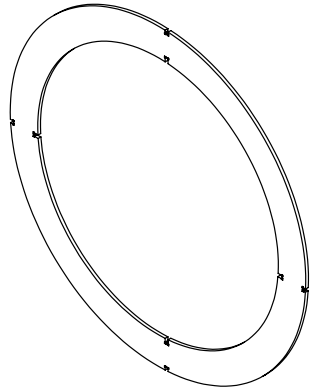
DETAIL A
SCALE 1 : 2

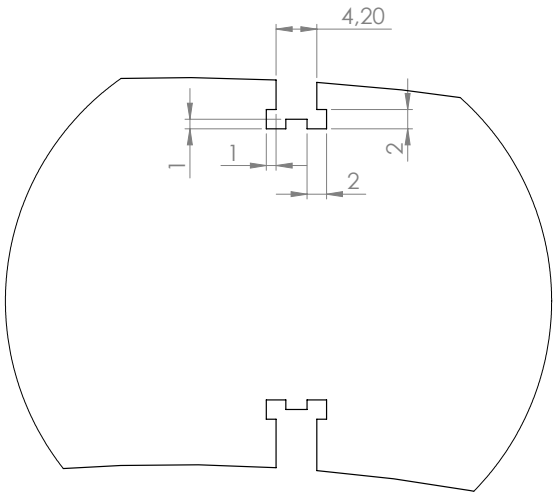


DO NOT SCALE DRAWING		DEBUR AND BREAK SHARP EDGES		UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS TOLERANCES ACCORDING TO: ISO 2768-mK	Description: Bovenrand kanten
	Name	Signature	Date	playnetic bv playing with energy	Part of:
Drawn:	RJdenHaan		10-10-2013		
Checked:					Drawing number: / Revision: / Format A3
Material: Staalplaat 4mm				PLAYNETIC B.V. LOOHORST 2A 7207 BM ZUTPEN TEL:(31)575 843612 MAIL: info@playnetic.nl	Weight: / SCALE: 1:5 / SHEET: 1 OF 1









DETAIL A
SCALE 2 : 1

DO NOT SCALE DRAWING	DEBUR AND BREAK SHARP EDGES	UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS TOLERANCES ACCORDING TO: ISO 2768-mK		Description: Stootring	
	Name	Signature	Date	playnetic by playing with energy	Part of:
Drawn:	RJdenHaan		10-10-2013		
Checked:					Drawing number: / Revision: / Format A3
Material: Staalplaat 6mm				PLAYNETIC B.V. LOOHORST 2A 7207 BM ZUTPEN TEL:(31)575 843612 MAIL: info@playnetic.nl	
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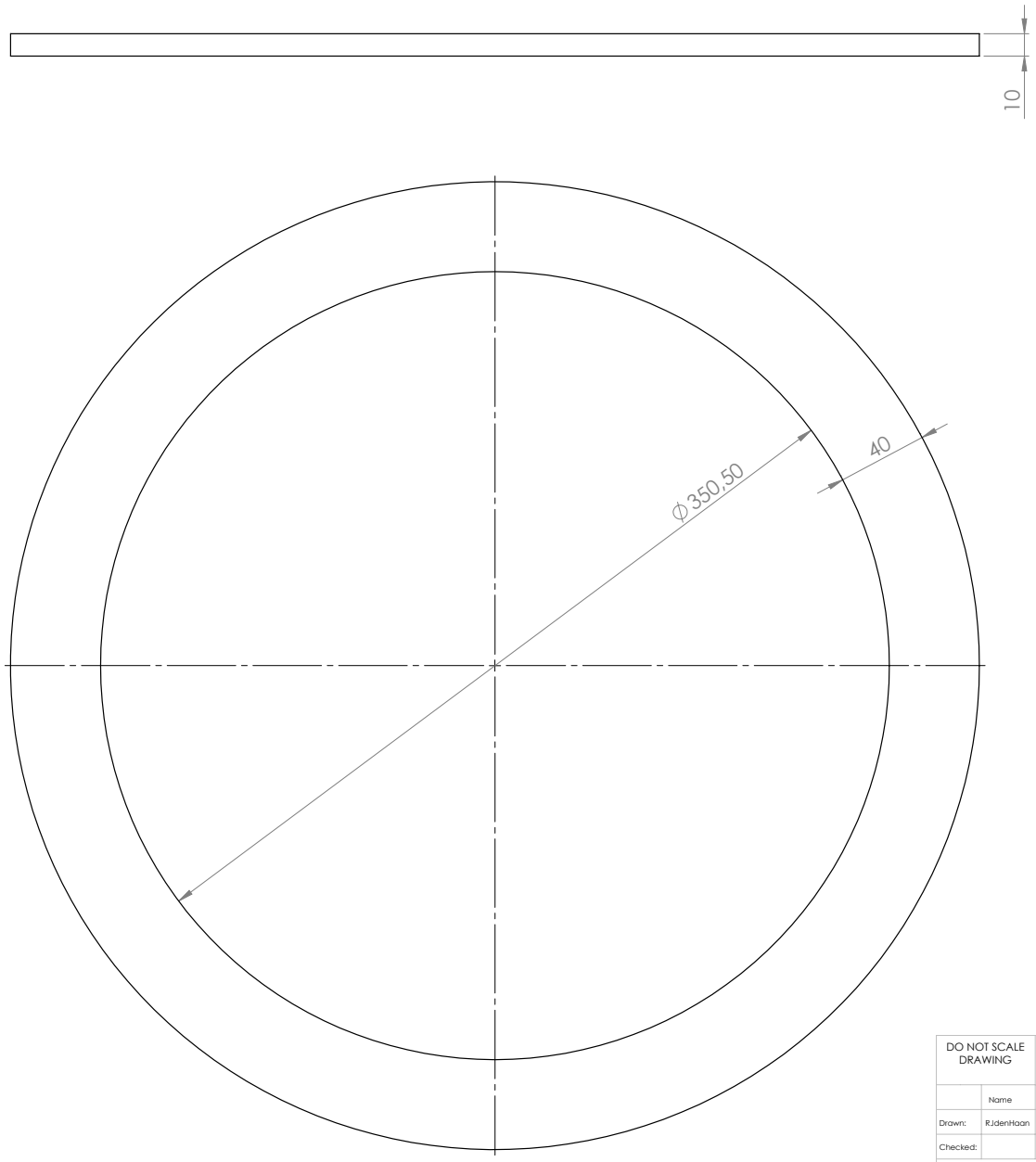

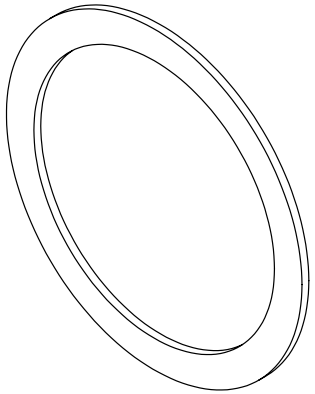

DO NOT SCALE DRAWING		DEBUR AND BREAK SHARP EDGES		UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS TOLERANCES ACCORDING TO: ISO 2768-mK	Description: Rubber stootring
	Name	Signature	Date	playnetic bv playing with energy	Part of:
Drawn:	R.JdenHaan		10-10-2013		
Checked:					Drawing number: / Revision: / Format: A3
Material: Rubber				PLAYNETIC B.V. LOOHORST 2A 7207 BM ZUTPEN TEL:(31)575 843612 MAIL: info@playnetic.nl	
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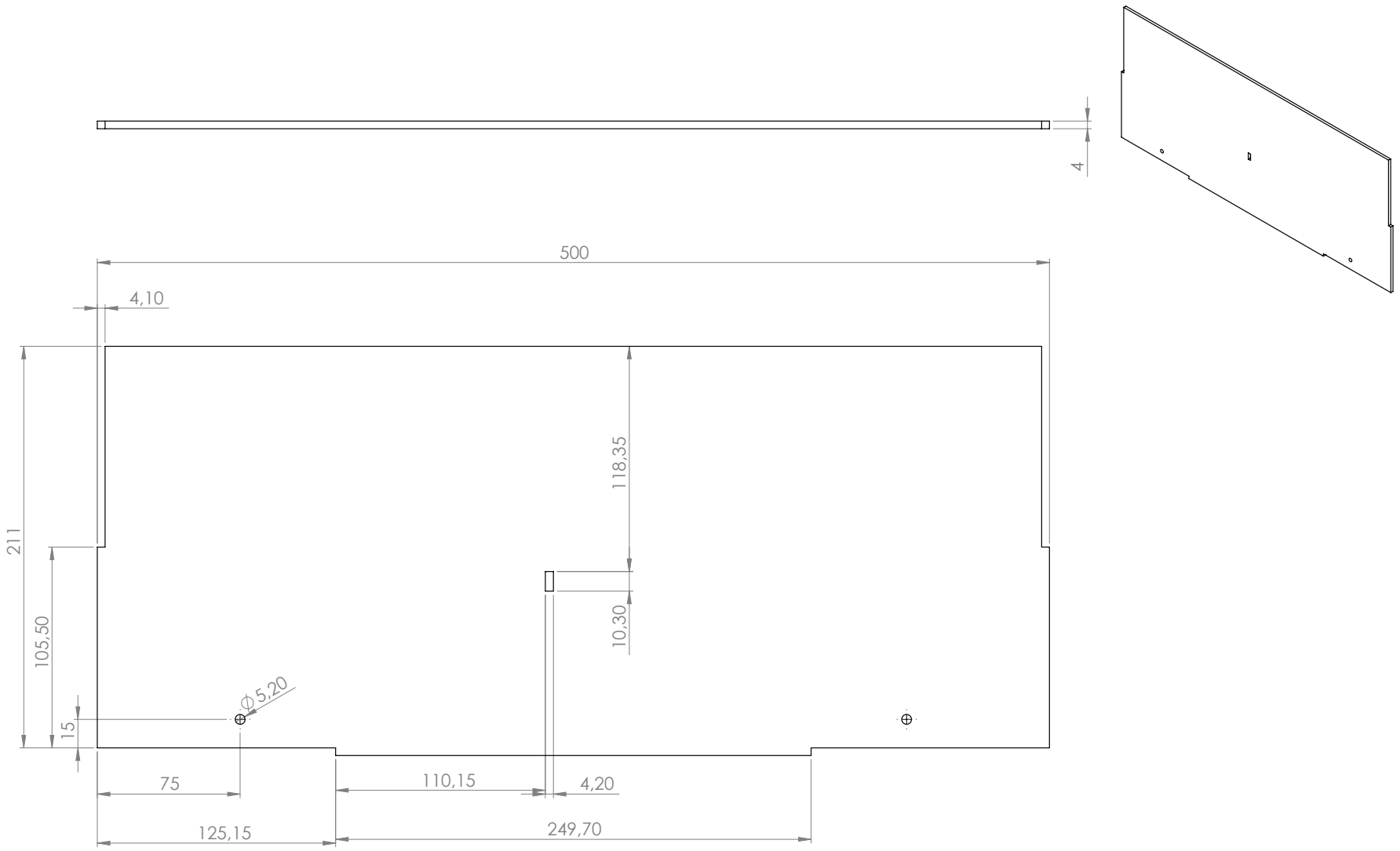
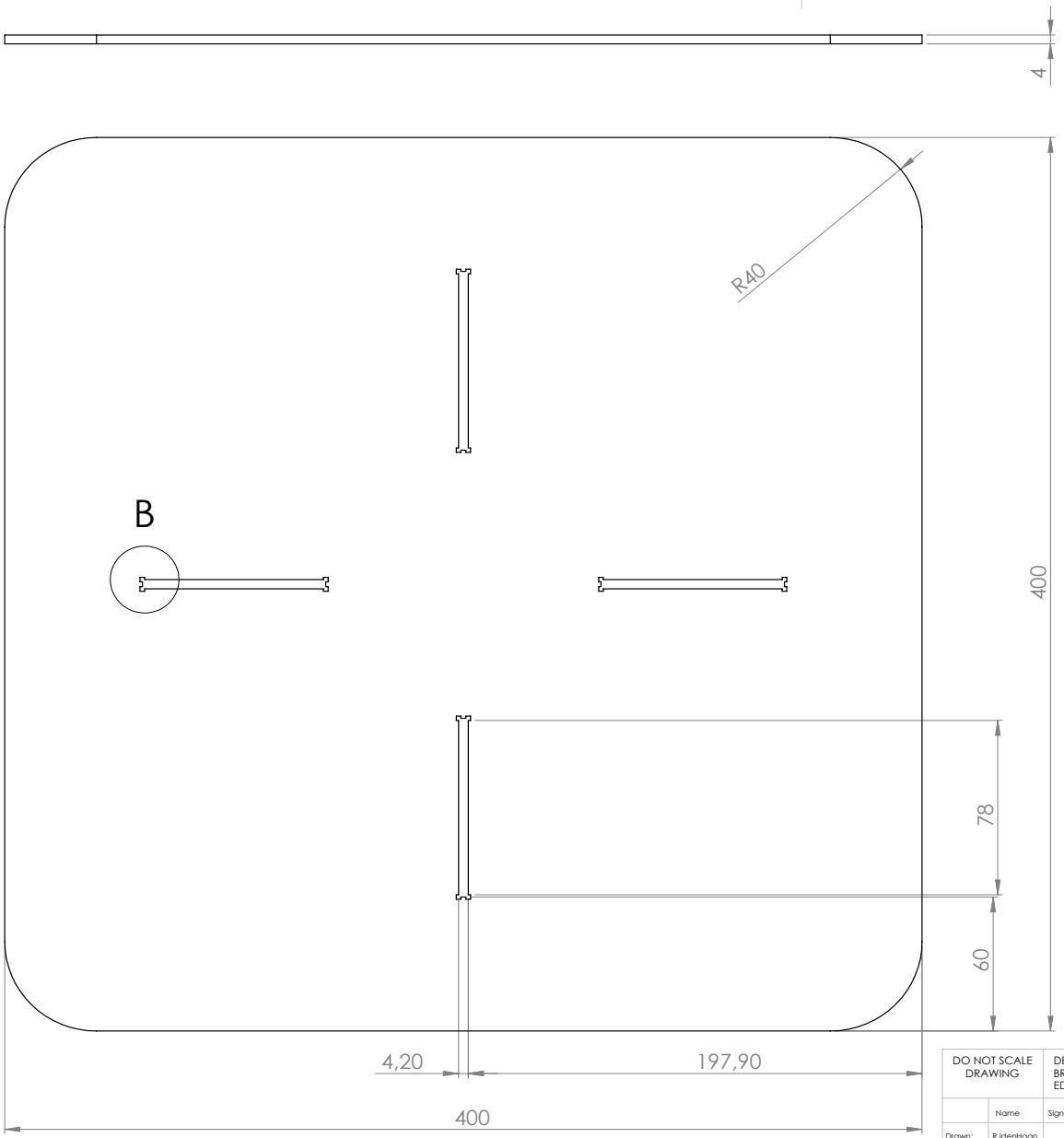
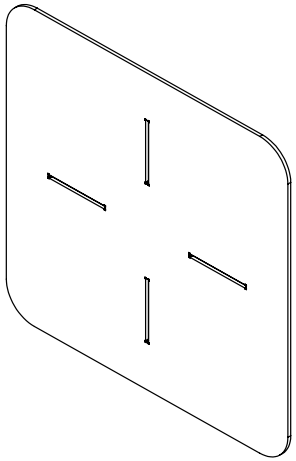
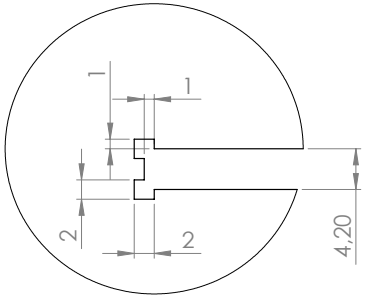


DO NOT SCALE DRAWING		DEBUR AND BREAK SHARP EDGES		UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS TOLERANCES ACCORDING TO: ISO 2768-mK	Description: Buitenwand 3
	Name	Signature	Date	playnetic bv playing with energy	Part of:
Drawn:	RJdenHaan		10-10-2013		
Checked:				PLAYNETIC B.V. LOOHORST 2A 7207 BM ZUTPEN TEL:(31)575 843612 MAIL: info@playnetic.nl	Drawing number: / Revision: / Format A3
Material: Staalplaat 4mm					Weight: / SCALE: 1:2 / SHEET: 1 OF 1

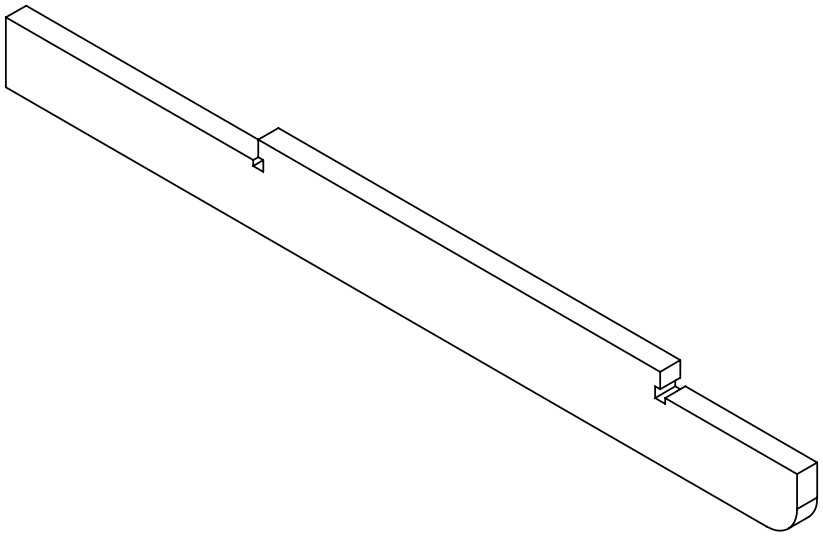


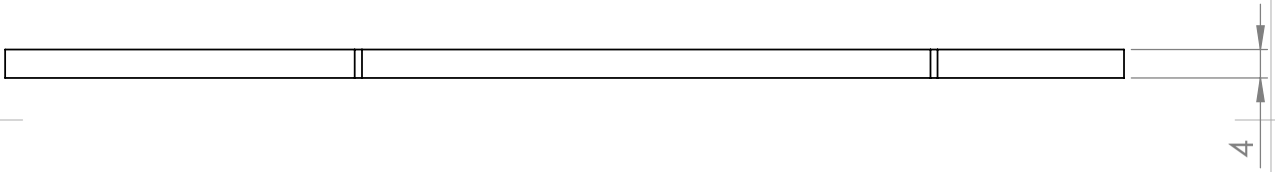


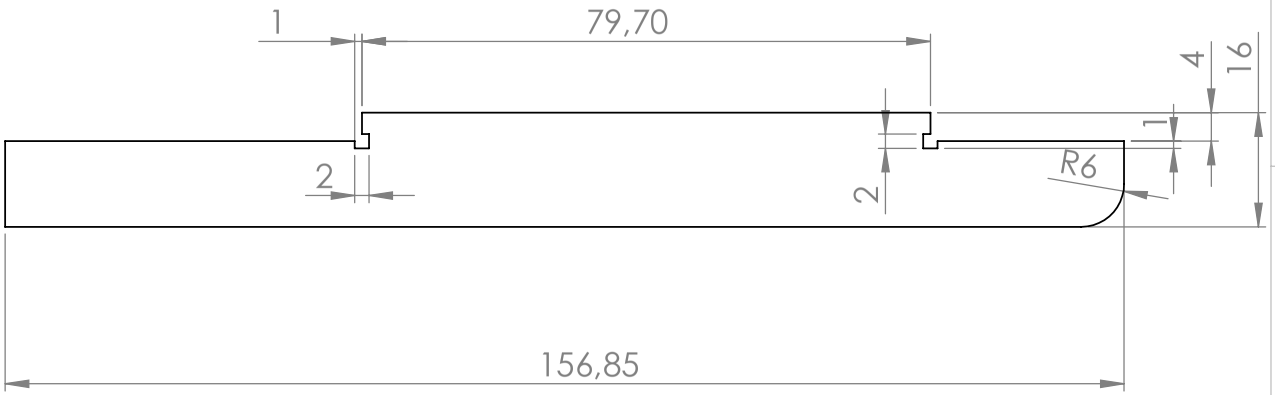


DETAIL B
SCALE 2 : 1

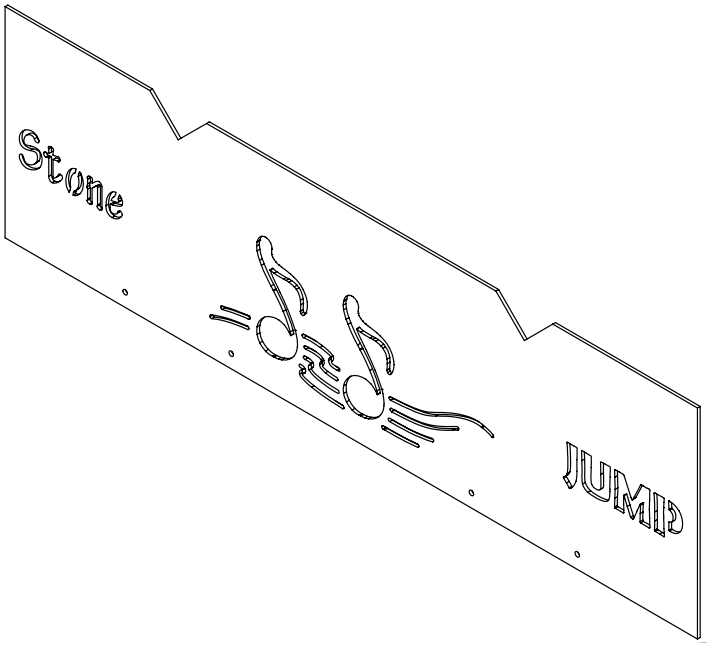
DO NOT SCALE DRAWING		DEBUR AND BREAK SHARP EDGES		UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS TOLERANCES ACCORDING TO: ISO 2768-mK	Description: Bovenplaat
	Name	Signature	Date	playnetic bv playing with energy	Part of:
Drawn:	RJdenHaan		10-10-2013		
Checked:					Drawing number: / Revision: / Format: A3
Material: Staalplaat 6mm				PLAYNETIC B.V. LOOHORST 2A 7207 BM ZUTPEN TEL:(31)575 843612 MAIL: info@playnetic.nl	Weight: / SCALE: 1:2 / SHEET: 1 OF 1

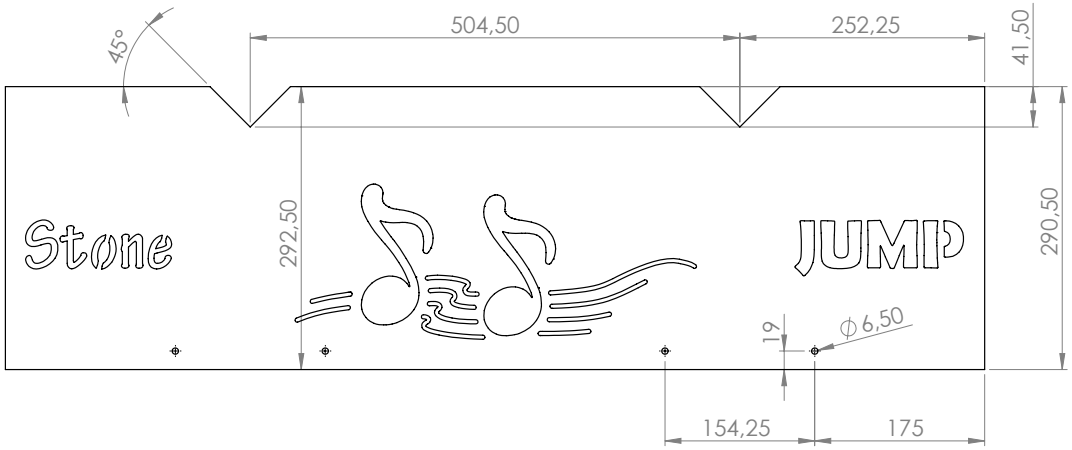




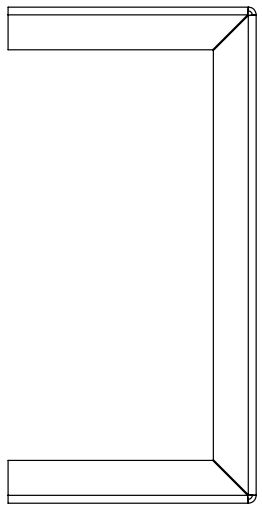


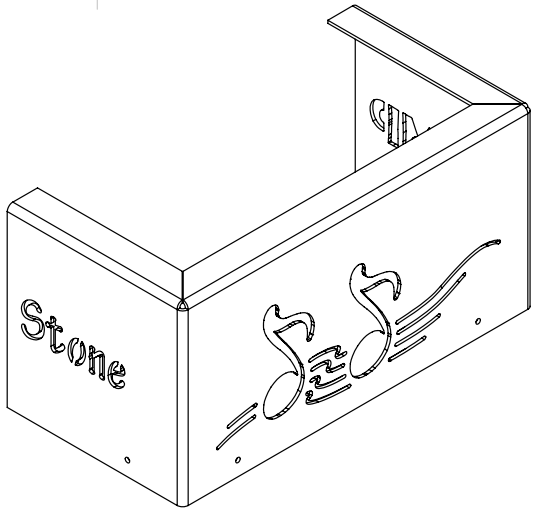
DO NOT SCALE DRAWING		DEBUR AND BREAK SHARP EDGES		UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS TOLERANCES ACCORDING TO: ISO 2768-mK	Description: Ribben bovenplaat (4 per product)
	Name	Signature	Date	playnetic bv playing with energy	Part of:
Drawn:	RJdenHaan		10-10-2013		
Checked:					Drawing number: / Revision: / Format A4
Material: Staalplaat 4mm				PLAYNETIC B.V. LOOHORST 2A 7207 BM ZUTPEN TEL:(31)575 843612 MAIL: info@playnetic.nl	Weight: / SCALE: 1:1 / SHEET: 1 OF 1

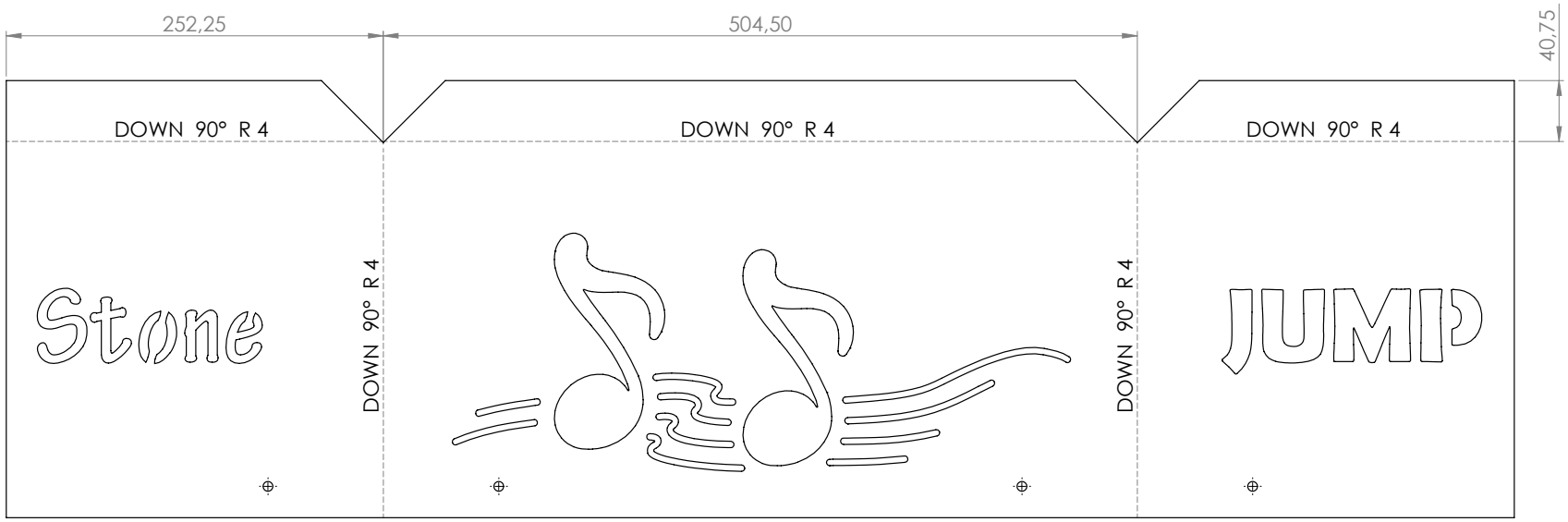




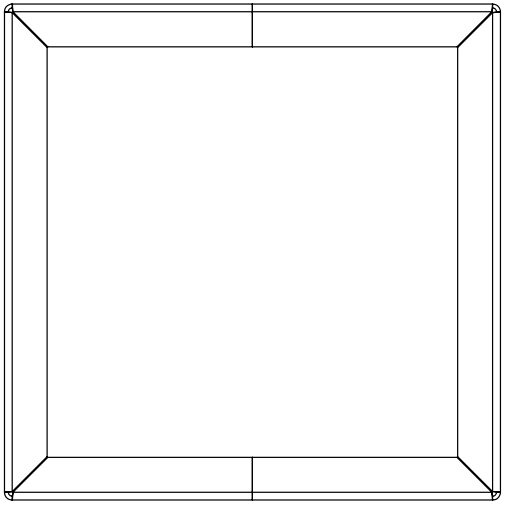
DO NOT SCALE DRAWING		DEBUR AND BREAK SHARP EDGES		UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS TOLERANCES ACCORDING TO: ISO 2768-mK	Description: Helft buitenkap (2 per product)
	Name	Signature	Date	PLAYNETIC by playing with energy	Part of:
Drawn:	RJdenHaan		10-10-2013		
Checked:					Drawing number: / Revision: / Format: A3
Material: Staalplaat 4mm				PLAYNETIC B.V. LOOHORST 2A 7207 BM ZUTPEN TEL:(31)575 843612 MAIL: info@playnetic.nl	Weight: / SCALE: 1:5 / SHEET: 1 OF 1

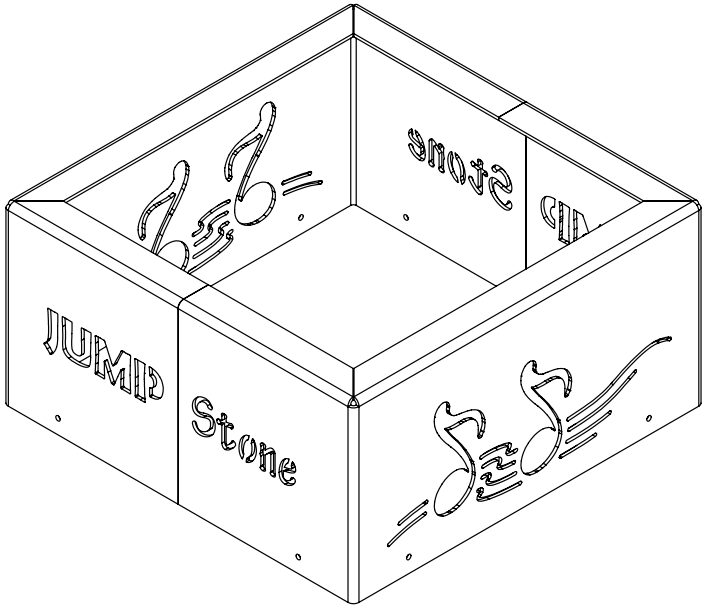


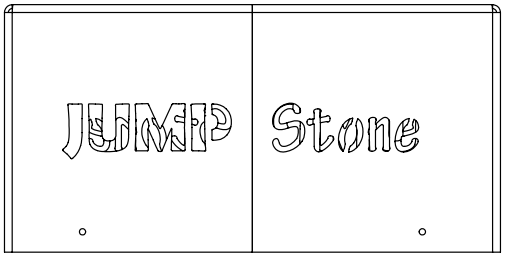




DO NOT SCALE DRAWING		DEBUR AND BREAK SHARP EDGES		UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS TOLERANCES ACCORDING TO: ISO 2768-mK	Description: Buitenkap kanten
	Name	Signature	Date	playnetic by playing with energy	Part of:
Drawn:	RJdenHaan		10-10-2013		
Checked:					Drawing number: / Revision: / Format A3
Material: Staalplaat 4mm				PLAYNETIC B.V. LOOHORST 2A 7207 BM ZUTPEN TEL:(31)575 843612 MAIL: info@playnetic.nl	Weight: / SCALE: 1:3 / SHEET: 1 OF 1







DO NOT SCALE DRAWING		DEBUR AND BREAK SHARP EDGES		UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS TOLERANCES ACCORDING TO: ISO 2768-mK	Description: Buitenkap lassen
	Name	Signature	Date	playnetic bv playing with energy	Part of:
Drawn:	R.IdenHaan		10-10-2013		
Checked:				PLAYNETIC B.V. LOOHORST 2A 7207 BM ZUTPEN TEL:(31)575 843612 MAIL: info@playnetic.nl	Drawing number: / Revision: / Format A3
Material: Staalplaat 4mm					Weight: / SCALE: 1:5 / SHEET: 1 OF 1