

KARELIA UNIVERSITY OF APPLIED SCIENCES
Degree Programme in Design

Fanxi Kong

SUBSEQUENT DESIGN DEVELOPMENT OF IPA BOOSTER
SEAT BASED ON THE STUDY OF USABILITY AND TESTING

Thesis
April 2013



THESIS
April 2013
Degree Programme in Design

Sirkkalantie 12A
80100 JOENSUU
FINLAND
Tel:+358 50 4412 229

Author
Fanxi Kong

Title
Subsequent Design Development of IPA Booster Seat Based on The Study of Usability and Testing

Commissioned by
Joen Erikoiskaluste Oy

Abstract

This thesis conducts with a subsequent phase of design development project of IPA booster seat. According to the need of Joen Erikoiskaluste Oy, a local furniture manufacturer company located in Joensuu, Finland, the first round of the design development was completed by Saara Newton in the year of 2011. To develop it further, the second round, which is to say, the subsequent design development is confided to the author.

The refinement of the user-oriented design is based on a deep study of usability, including the MDF material, the ergonomic, and the European standard safety requirement. Moreover, the user testing is the important basis to examine the design.

Last but not least, besides the MDF and pine wood seat models, the logo and the user guide design also has been developed as the complement of branding. In conclusion, the IPA booster seat design development is a comprehensive application of both 3D programming and graphic design skills.

Language

English

Pages 40

Appendices 4

Pages of Appendices 7

Keywords

children, booster seat, usability, usability testing

CONTENTS

1 INTRODUCTION	4
2 THESIS FRAMEWORK	5
2.1 Iterative Development Cycle	6
2.2 Project Timeline	7
3 USABILITY STUDY	8
3.1 User-oriented design.....	8
3.2 Emphasis of Design Thinking.....	9
3.3 Design Material	11
3.4 Ergonomic Study.....	12
3.5 Safety Requirement	14
4 DESIGN AND DEVELOPMENT.....	16
4.1 Previous Design.....	16
4.2 Subsequent Design Concept	17
4.3 Prototyping.....	21
4.4 Logo Design.....	23
4.5 User Guide Design.....	25
5 USABILITY TESTING	28
5.1 User Testing.....	29
5.2 Testing Conclusion	30
6 DISCUSSION.....	31
REFERENCE	33

APPENDICES

- Appendix 1 Legal agreement
- Appendix 2 Body Measurement research form
- Appendix 3 Dimension figure
- Appendix 4 User testing feedback form

1 INTRODUCTION

This thesis conducts with a subsequent phase of design development project of a children booster seat named IPA. Booster seat in this thesis refers to a chair-mounted seat intended to be fixed onto an adult chair and to be designed specifically to properly position and protects an infant or a child when using standard dining table (Official Journal of the European Union 2013). The booster seat helps the child to sit at the correct height at the table without kneeling or sitting on a cushion, which may slide off so as to cause danger. It is easier for them to focus on the meal, as well as to get involved with what is happening around the table.

The project is carried out in accordance to the need of Joen Erikoiskaluste Oy, a local furniture manufacturer company located in Joensuu, Finland. The company mainly engaged in producing kitchen furniture, office furniture, and industrial fixtures. In order to extend the range of product, the company Joen Erikoiskaluste Oy is seeking for development of new products or product lines.

To achieve a profitable development, the company has been aware of breaking their old production mode, and creating innovative products based on the customer's real needs. The early stage of the product development process has been implemented by Saara Newton, a graduate of Karelia University of Applied Sciences (KUAS, formerly NKUAS). Newton believed that potential customers play an important role to the product development process, in which the company and designer ought to keep the customers' need in mind from the beginning. Designer's task is to find out problem, and to solve it nicely. Thus, Newton started to seek for problems through observing the Finnish customers in daily life. The elderly people and children became her focus of attention, since there was always lack of care about the vulnerable groups in the market.

As a mother of two children, Newton soon found out that her children have difficulties to reach the table when eating with the family. Both her four-year old daughter and two-year-old son were too big to use the ordinary high seat, but

still too small to use the adult chairs. She attempted to find something that not takes up much space, and could be easy to move and store, for example, a seat which could be mounted onto an ordinary dining chair. Yet the result is that nothing like that could be found in the whole Finnish market. Instead of ordering it from abroad, why would not a local company develop such a product to benefit more Finnish families?

This is how the project triggered. If the product could finally get into the market, not only the company will get a profit with an innovative revolution, but also the gap of the market would get filled. After discussion with the company, the project was officially established. The primary phase of the development lasted for 6 months, during which the design concept, prototype and marketing issue has been achieved. The project was suspended because of bottle-neck coming across to the design.

After nearly a year, the project was restarted, and the responsibility of the development of design and marketing has been switched to the author. The goal of the subsequent phase of the development is to set the stage for mass production - modify and refine the original design, complete the product test and approach to branding and marketing issue.

2 THESIS FRAMEWORK

Gould and Lewis (1985) give us four principles for developing usable products:

- Focus early and continuously on users.
- Integrate consideration of all aspects of usability.
- Test versions with users early and continuously.
- Iterate the design.

Inspired by Gould and Lewis's principles, the author has rationally organized the thesis framework. This thesis contains six chapters, and half of them describe the progress of this project. As mentioned in the former chapter, the starting

point of this project is to solve the problem of the target users. The third chapter mainly interprets the user-oriented design principle, and the studies on several emphasis aspects of usability. The process of design and development has been deeply illustrated in the fourth chapter, while chapter five tells about how the model has been tested. Accordingly, the method of design has demonstrated that it is a typical iterative development.

2.1 Iterative Development Cycle

All products progress sequentially through basic stages of creation. Understanding and using effective for each stage allows designers to maximize a product's probability of success. There are four basic stages of creation for all products: requirements, design, development, and testing. (Lidwell, Holden & Butler 2003, 62.).

Although progress through the development cycle is sequential, it can be linear or iterative. The linear model (also known as the waterfall model) proceeds through the development cycle once, completing each stage before proceeding to the next. The iterative model (also known as the spiral model) proceeds through the development cycle multiple times, completing an increasing percentage of each stage with each iteration. (Lidwell et al. 2003, 63.)

Figure 1 displays a visual presentation of the linear model and the iterative model. Look at the linear model, as time goes by, "Requirement" as the first stage goes through the first quarter of the timeline, and then, the second stage "Design" begins right away from the second quarter of time. On the other hand, an iterative design development contains more than one development cycles. The process in this figure contains three development cycles in total. The first cycle progresses through all the four stages in turns, and ends up at the first third of time. Thereafter, the second cycle starts again from "Requirement", and finishes again with "Testing". The third cycle continues immediately, and repeats in the same way.

In the case of IPA seat design development, the process typically progressed through an iterative development cycle, which is also the framework followed by the thesis. To use the figure as aids, Saara has completed the first cycle of the

design development by May, 2012. This thesis deals with the second cycle, as the project goes into the subsequent phase.

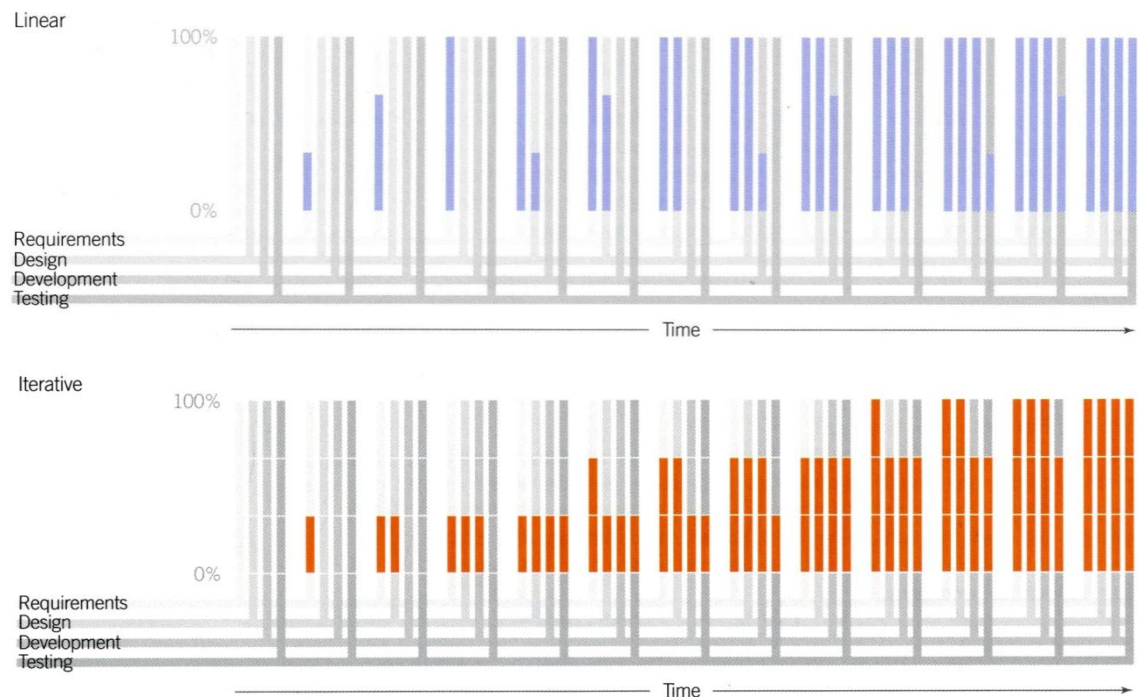


Figure 1. Linear model and Iterative model.

2.2 Project Timeline

The project was offered to me at the beginning of November, 2012. At that time, Newton was looking for someone to take over this case, for the reason of a shortage of time with herself. The early stage of the progress went smoothly until the time when problems with the production of prototypes occurred. Thus, the schedule went different than what had been planned, due to the Christmas holiday and a busy season of production at the factory. The work of branding matter was brought forward when I was out of Finland. Prototypes making and testing were finally managed in early May, 2013 (Figure 2).

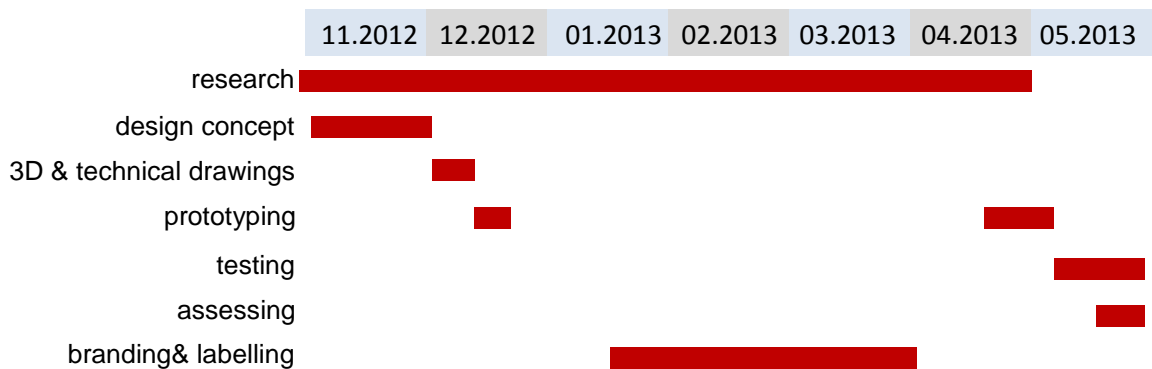


Figure 2. Project Gantt Chart.

3 USABILITY STUDY

3.1 User-oriented Design

The customers of IPA seat are most likely to be the carers of the children. If the children are the ones who actually “use” the product, then the persons who purchase it, assemble it and take care of it are their parents, relatives or childcare staffs.

A great number of parents will admit such a fact that everything gets extremely messy and dirty when their kids are eating. Children have more curiosity than adults, especially in their early childhood. Young children learn things by seeing, hearing and touching. Few of them can seat steadily until they finish their meal. Children from 2 years old would like to learn to eat by themselves. They would grab the food by hands, or try to snatch other’s tableware. It is very common that they play with the food, throw it on their own or on the table and floor, touch everywhere around them with dirty hands, or refuse to be fed and swing their heads vigorously.

In this case, an essential factor that customers need to consider when purchasing a booster seat is whether it is easy to clean. Thus, a smooth surface and an integrated structure will help to reduce the working load of cleaning and

caring. Booster seat made out of plastic owns the most advantages in this respect. With regard to materials such as wood or panel, the quality of this performance will mainly rely on the choice of the coating. Additionally, a minimum use of grooves, protrusion and seams is the key of solution in terms of structure design itself.

3.2 Emphasis of Design Thinking

Since the company mainly engaged in medium density fibreboard (MDF) products, the material that will be utilized in IPA seat is MDF board. According to the simplicity of both the material's property and the producing condition, the design of the structure and appearance of the product shall be rather restricted. A difficult point will be how to balance the material and function to maximize usability.

To save the cost of storage and transportation, a flat packaging of the product is required. Meanwhile, to reduce waste, designer has to think about how to most effectively utilize the panels with certain specification. Besides, the ease of assembling needs to be taken into account. Product components will need to be reduced to the minimum. Joints should be designed so that it can be easily handled by adult or younger, while preventive for the child to dismount. How to balance the convenience and safety becomes another emphasis.

One issue that the previous design of the seat has not completely achieved is the adjustment function. IPA seat has been designed to serve a target user group of children from 2 years old up to 6 years old or even older. To adapt to the physical changes of children, correspondingly, the seat need to be able to adjust. In many people's illusion, the most need to be changed is the height of the seat, as children grow taller and taller. However, when they sit, the length of their leg becomes the depth of the sitting area. Therefore, seeking for a proper solution for the adjusting system is the key point of the design.

Newton's former design concept has achieved its requirement of functionality, which has been proved by the former prototype. Users have the right to decide

whether a product is good enough to be used. To make it a more usable product, the design concept ought to not only function correctly, but also maximize users' satisfaction. Therefore, in the subsequent development phase, the design concept will be developed towards a usability approach.

According to Dumas and Redish (1999, 4), usability is an attribute of every product – just like functionality. Functionality refers to what the product can do. Usability refers to how people work with the product. The right functionality – working correctly – is critical, but not sufficient, for a product to be successful. A product by itself has no value; it has value only insofar as it is used. Use implies users. Therefore, the way that users will work with the product is a basic issue for product designers and developers....

Usability means that the people who use the product can do so quickly and easily to accomplish their own tasks. This definition rests on four points:

1. Usability means focusing on users.
 2. People use products to be productive.
 3. Users are busy people trying to accomplish tasks.
 4. Users decide when a product is easy to use.
- (Dumas&Redish1999.4.)

Usability is not a surface gloss that can be applied at the last minute. Usability is deeply affected by every decision in design and development. Therefore, usability has to be built in from the beginning. (Dumas&Redish1999.4).

Indeed, in the case of IPA booster seat development, the requirement of usability has been considered as the point of departure. That is to say, the subsequent development of the design is intended to achieve the purpose of a stronger usability. As Dumas and Redish (1999) said, usability is ensured by involving users throughout the process, and allowing the users' need to drive design decisions. To this product, the user includes both the children and their carers (the customers). Thus, an early focus on the needs of both of them is mainly based on the study of the Children's Ergonomic, user-oriented and requirements of safety.

3.3 Design Material

IPA booster seat is offered in two versions, a MDF version and a pinewood version.

According to the identity from the website madehow (2012), medium density fibreboard (MDF) is a generic term for a panel primarily composed of lignocelluloses fibres combined with a synthetic resin or other suitable bonding system and bonded together under heat and pressure.

Medium-density fibreboard has brilliant physical properties and process abilities, which offer it various advantages over other wood products. It can be cut into a wide range of sizes and shapes, thus it becomes an excellent substitute for solid wood in many interior applications. The surface of MDF is flat, smooth, uniform, dense, and free of knots and grain patterns, making finishing operations easier and consistent. The homogenous edge of MDF allows intricate and precise machining and finishing techniques. Improved stability and strength are important assets of MDF, with stability contributing to holding precise tolerances in accurately cut parts.

Based on the site of compositepanel (2013), "trim waste is also significantly reduced when using MDF compared to other substrates". The frequent applications of MDF include furniture and cabinets, wall panelling and industrial packaging.

Pinewood is one of the most abundant natural resources of Finland. Pine's soft wood makes it easy to work with and is the primary material used in building. Pine is inexpensive and easy to work with. These facts alone make it a favourite for furniture manufacturers. Its distinctive colour gives any room a rustic appeal.

When applied to a booster seat for children, either of these two materials has its strengths and weaknesses. MDF is enough dense, steady. Comparing to pine wood, MDF has better performance on dimensional stability. Kitchen is a place usually with high temperature and humidity, where booster seats are most likely to be used. The specific additives applied during MDF's manufacturing improve

its tolerance of moisture. The smooth, uniform surface makes the product easy to be cleaned. However, MDF products are always heavy. In case of falling from the high, it may cause injury to children. Moreover, the release of formaldehyde can be harmful to the children's health, even with a standard quantity.

Apparently known, wood may crack or shrink due to the environment and time. According to the website of [homeandofficefurniture](#), "The wood itself is one that can experience dents and scratches more easily than other types of wood." The soft nature of pinewood is its biggest disadvantage.

Wood is a healthy nature material, and it is more acceptable to Finnish customers. However, for the same product, the cost of pine wood version is nearly four times higher than the MDF version. Although some may think it is worthy to pay more for a long-lasting product with better quality, concerning of the competitiveness on the price, it is necessary to have the MDF version as well.

3.4 Ergonomic study

As mentioned before, the adjustment function of the booster seat is supposed to be developed to a more usable level. The foremost that needs to be adjusted is the seat depth, according to the growth of children. In order to get actual measurements data of the target group of children, a quantitative research has been handled by Newton. The object of study - 71 children ranged from 2 to 6 years old - has been measured with the help and permission of two day-care centres. As shown in image 1, the three indexes that are mainly taken under consideration here are the length of the upper legs (L), the width of the buttocks (W), and the height of the upper legs (H), all in a sitting position.

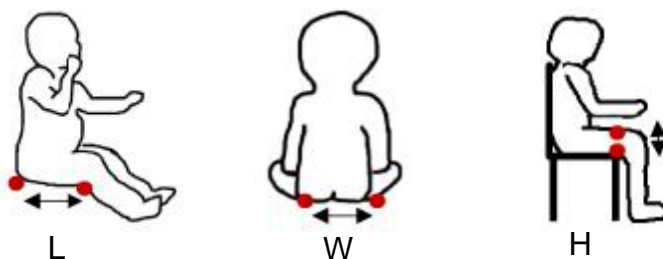


Image 1. Three indexes of children's measurement.

Table 1 describes the three measurements of children in different ages and its distribution. An average measurement in each age has been calculated by equilibrating the minimum and maximum measurements, although the numbers of measured children in each age differ.

Age	Numbers	Measurement (mm)	L	W	H
2	4	min	195	180	55
		max	270	200	100
		average	232.5	190	77.5
3	21	min	240	170	55
		max	300	220	110
		average	270	195	82.5
4	20	min	240	180	60
		max	380	250	110
		average	310	215	85
5	19	min	260	190	60
		max	320	250	100
		average	290	220	80
6	7	min	320	210	90
		max	430	280	140
		average	375	245	115

Table 1. Children's Measurements Data.

Figure 3 is a line chart that indicates the average value of each index from each age and their trend of growth. The actual data proves the fact that the length of upper legs (L) increases the most from 2 years old to 6 years old, yet the width of buttocks (W) and the diameter of upper legs (H) keep a gradually raise. In other words, the adjusting system will function on changing the depth of the seat, while the width and height of the seat may stay fixed.

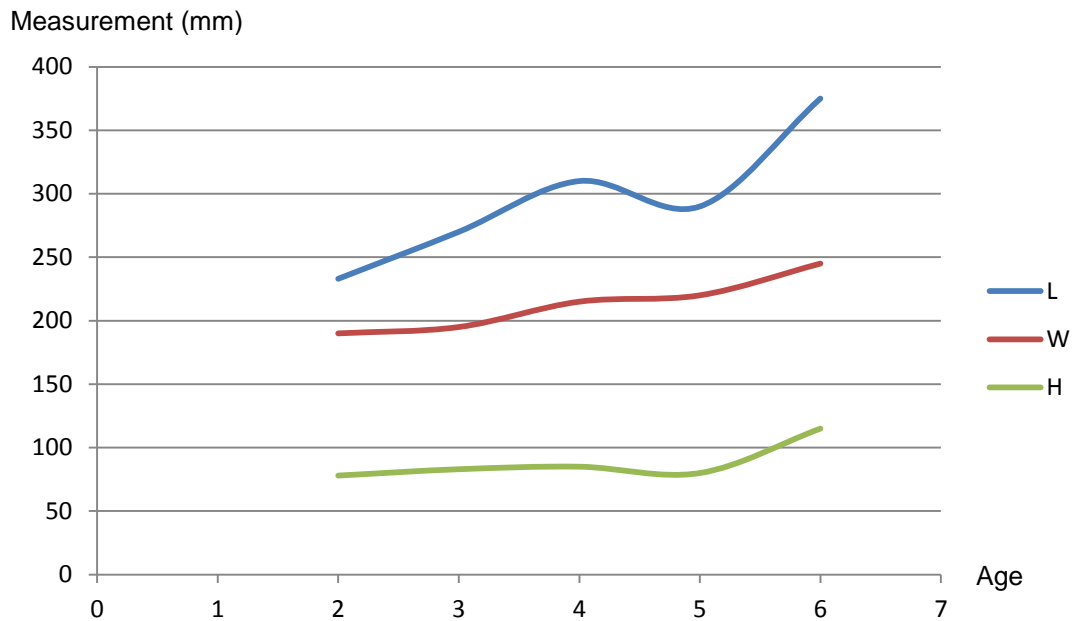


Figure3. The trend of growth.

3.5 Safety Requirement

The Finnish Safety and Chemicals Agency (Tukes) (2013) has published the definition of children articles and the safety requirements for children article products. Childcare articles are products designed to facilitate the sleep, carrying, transport, feeding or hygiene of children. These include prams, carry cots, car seats, high seats, dummies, bottles and bibs. (Tukes 2013.) As being the same kind of product as high seats, booster seats also belong to children article and satisfy the requirement as well. The safety of childcare articles is particularly important because children are a vulnerable group of consumers (Tukes 2013).

The safety requirement set for children article (Tukes 2013) is clearly explained as following:

Childcare articles must meet the general safety requirements set in product safety legislation. In other words, they must not pose a risk to consumer health or property (Act on the Consumer Safety 920/2011). (Tukes 2013.)

In addition to general product safety legislation, there are specific pieces of legislation on issues such as phthalates, formaldehyde and nickel (REACH regulation 1907/2006) as well provisions regarding specific items such as dummies. (Tukes 2013.)

As well as legislation, detailed safety features and testing methods have been specified for certain childcare articles in product-group specific standards.... (Tukes 2013.)

Product testing and test findings in conformity with standards can prove the product is safe with respect to the issues covered by the standard. References of some standards are published in the Official Journal of the European Union. In the assessment of product conformity referenced standards have a higher status than non-referenced ones (section 11 of the Act on the Consumer Safety). In practice this means that products must be in conformity with referenced standards. (Tukes 2013.)

A detailed safety requirement for “chair-mounted seat” has been published in the latest version of the official journal of European Union (2013). According to its definition, “chair-mounted seat” means a product intended to be fixed onto an adult chair to raise the sitting position of a child up to 36 months old who is able to sit up unaided (Official Journal of European Union 2013). In general, IPA booster seat is ought to adopt the safety requirement of chair-mounted seat, as it conforms the definition, except the range of user has been extended to 72 months old.

According to the official journal of European Union (2013), a chair-mounted seat must comply with both the General Safety Requirement and the Specific Safety Requirement of the certain kind. The General Safety Requirement includes chemical requirement, flammable properties, packaging and identification of the manufacturer and importer. Furthermore, the Specific Safety Requirement for chair-mounted seat has listed all the requirements and potential hazards in detailed. The full copy of the safety requirement for chair-mounted seat from the official journal of European Union can be found in the appendices of this thesis.

In terms of IPA booster seat, there are several safety requirements that need to be particularly concerned before the progress of design, and to be strictly complied when it comes with testing. First of all, as it intended to serve children up to 6 years old instead of 3 years old, the maximum bearing load of the seat must be raised to 30 kg, instead of 15 kg mentioned in the requirement.

Additionally, in the light of the Specific Safety Requirement, the design should avoid the entrapment of any part of a child's body from gaps and openings (Official Journal of European Union 2013). Also, falling of either the seat or the child who is sitting in it should be utterly prevented. Chair-mounted seat must not contain any small parts, in order to prevent choking hazards. Besides, the hazardous edges, corners, surface, as well as the structure, should be designed by following specific requirements to meet the need of safety. Last but not least, safety information must be marked on the product and included in the instructions to the user (Official Journal of European Union 2013).

4 DESIGN AND DEVELOPMENT

4.1 Previous Design

Image 2 shows the MDF prototype of the previous design. As seen, the seat was built up by five pieces – two armrests, a low backrest, a bearing part at the front bottom and a seating surface. They were glued together except the seating surface, which was removable. One edge of the seating surface left an open gap. The adjusting of the seat depth could be realized by rotating the seating surface by 180 degrees. A pair of clip belts was used to attach the seat onto a standard dining seat.



Image 2. Previous prototype of the design.

The prototype had been tested by four families including Newton's. It was reported that people found the attachment system surprising steady, as they doubted it at first.

The problems were mainly about the sitting surface. It slide forward and backward when children move, since there was not a locking system. Food residue easily went in the gaps where it was hard to clean. Besides, the attachment straps were a bit too short for most of the testers. It was hard to fasten it to the tightest position.

The subsequent design is meant to solve these problems, and improve its usability to create a user-friendlier booster seat.

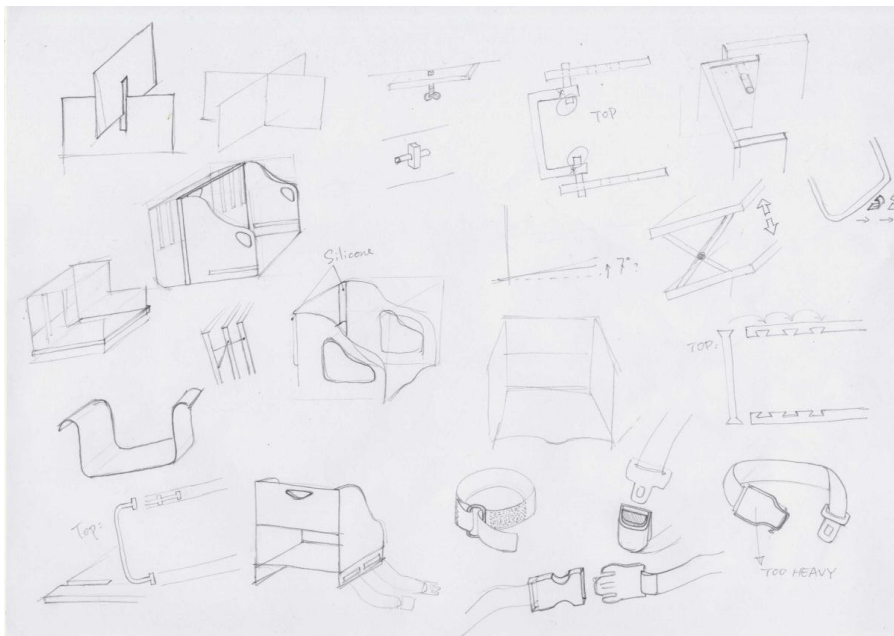
4.2 Subsequent Design Concept

Inspiring by a toy truck, the idea of the appearance of the seat flashed upon my mind immediately after I learnt about the project. The rounded outline gives the seat a friendly and safety look, for which children would like to have it. The emphasis of the design is to find out the method of locking the adjustment systems, including the sitting surface and the backrest.

Three feasible ideas came out after a brainstorm (image3). The first idea was to use a kind of mortise and tenon joint structure. The tenon-and-mortise work is a very smart and traditional Asian method of combining wooden pieces. It does not need any metal piece or chemical glue adhesive to join the panels. Its specialities of environmental friendliness and security became the biggest superiority. Nevertheless, the torsion resistance of medium density fibreboard is not as good as wood. The mortise and tenon joint might have the risk of fracture.

Another idea was to use screws and hand screw-adjusting nuts. A salient advantage is that the users could readily loose and fasten the locking system so as to adjust the seat. Meanwhile, to make the sliding track, there must be grooves on both sides of the sideboards. It would drive the carers crazy to clean up the food residue inside the grooves. Thus, this plan was also rejected.

The most mediocre but practical method is employing wood pegs and screws. In order to keep the steadiness, in the mean time, to reduce the metal parts to the minimum, one screw has been retained on the upper of each side of the backrest board, and one wood peg on the lower of each side.



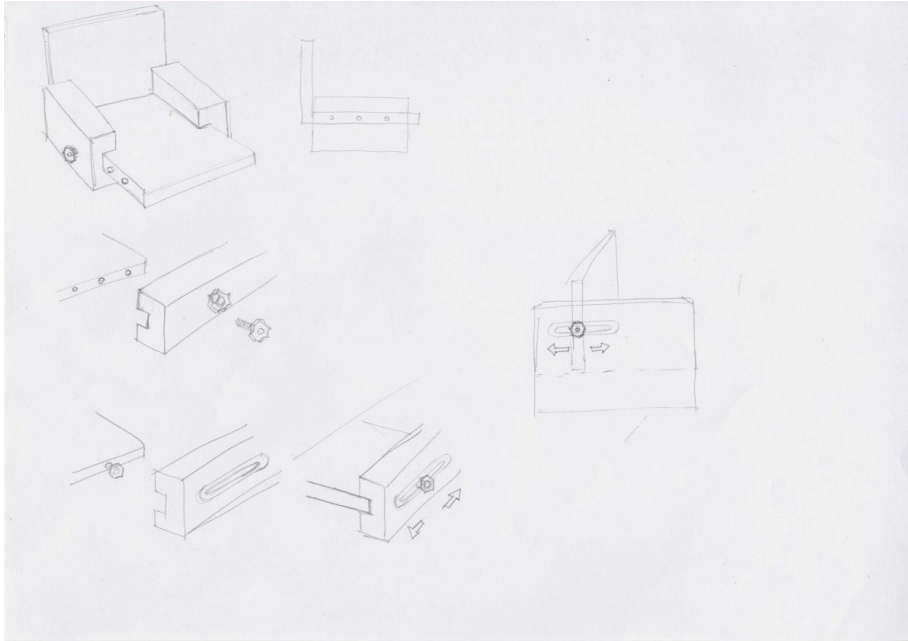


Image 3. Sketches.

When deciding the dimensions of IPA booster seat, a determining factor is the dimensions of dining table and chair. When used, the seat will be mounted onto an adult dining chair. Thus, the area of the seat should not go beyond the area of the dining chair's seat pan. To make the front armrests of the seat fit underneath the dining table, the height between the dining table and chair will limit the height of the front armrests of the seat.

Certainly, the dimensions of chairs and tables vary greatly. It is fair to design the product depending on standard dimensions of chair and table. Even though, the "standards" also slightly differ in different resources, it is not hard to assume a typical average dimension by considering synthetically.

In the web site of Chair Source (2012), it is revealed that for dining chair, "the seat height averages 18" to 20", seat width averages about 15-1/2" in back and 18" in front, and average seat depth is 16" to 18"". To convert inch into millimetre, it means that seat height averages from 457.2 mm to 508 mm, seat width averages about 393.7 mm in back and 457.2 mm in front, and average seat depth is 406.4 mm to 457.2 mm. Meanwhile, the average height of dining tables is "28"-30", which means 711.2-762 mm.

In accordance with Corky Binggeli (2012, 393), the average size of the seat pan of a dining chair is 406x406 mm (Figure 4).

SEATING TYPE	OVERALL DEPTH	SEAT DEPTH	WIDTH
Large	22" (559 mm)	18" (457 mm)	18" to 20" (457 to 508 mm)
Average	19" to 20" (483 to 508 mm)	16" (406 mm)	16" (406 mm)
Compact	17" to 18" (432 to 457 mm)	15" (381 mm)	14" (356 mm)

Figure 4. Dining Chair Dimensions (Binggeli 2012, 393).

Additionally, Jim Postell (2012, 33) also points out the overall dimensions of dining table and chairs "based on industry standards":

The standard height of dining table is 29 inches (73.6 cm).

The standard seat pan height of mass-produced dining chair for western market is 17 inches (42.2 cm).

In short, the average depth of a dining chair is more than 406 mm, the average width of a dining chair is no less than 394 mm, and the average height between dining table and chair ranges from 254 mm to 314 mm. From what has been discussed above, the final dimension of the seat after assembled has been determined to be 370 mm's high, 340mm wide and 400mm deep. And then, the width of the seat pan is 300mm, while the depth could be adjusted from 220mm to 290mm then to 360mm. The height of the seat is 120mm from the feet to the seat pan.

In order to create a lighter structure, a less wide backrest is intended to leave a gap between it and the seat pan. To avoid the entrapment hazard, the distance between the two pieces is 70 millimetres, that is a safe dimension which is larger than children's arms or legs, yet smaller than their heads.

The dimensions of the two sides are designed based on the golden ratio. Short legs with round corners make it easier for people to lift it up, and reduce the massiveness feeling of the seat as a whole.

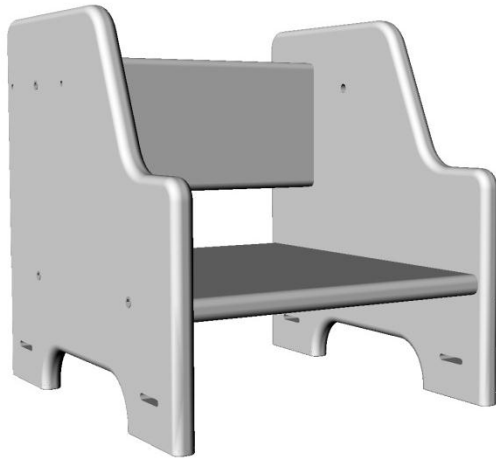


Image 4. 3D model.

4.3 Prototyping

Three MDF models and a pine wood model have been created at the university design studio. In general, the prototyping is quite easy to be applied, except that the MDF produce quite a lot power and particles during the process of cutting and sanding.

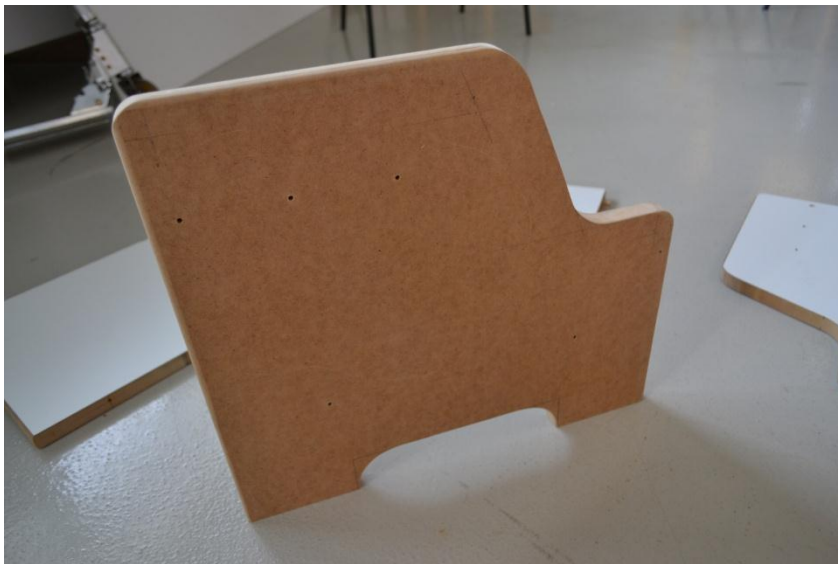


Image 5. Outline shape.

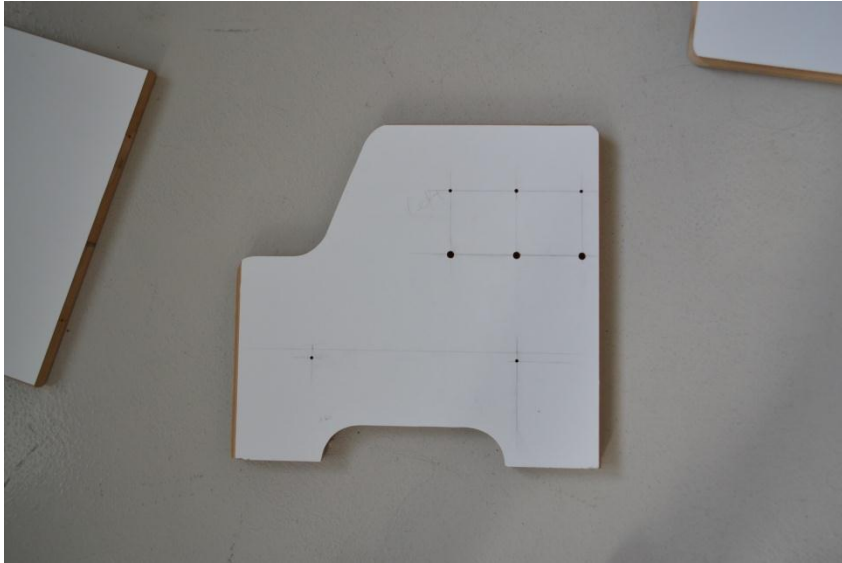


Image 6. Side board.

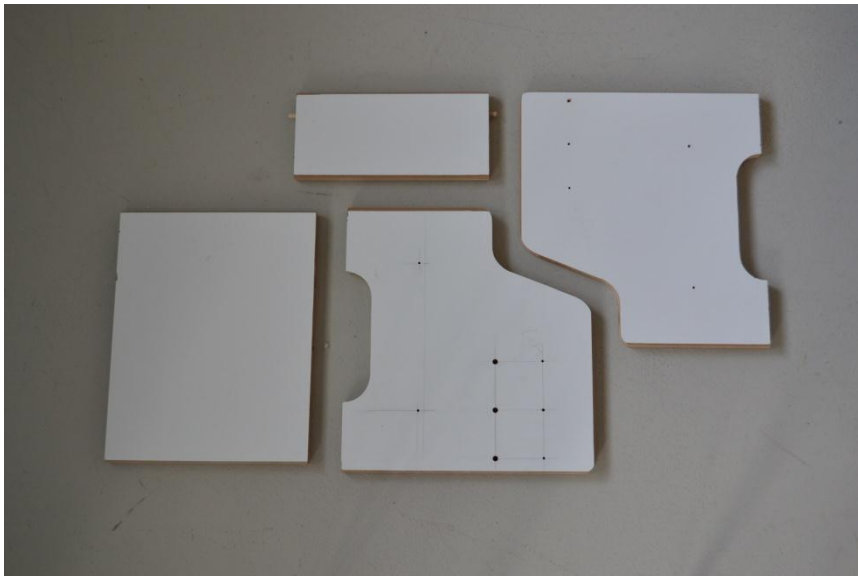


Image 7. Cutting from the panel.

Once, a problem occurred when tightening the screws (image 8). Since the density of the MDF is higher than most of the wood, a screw could be very difficult to tight by hand power. Making the hole slightly bigger than the screw's diameter has solved the problem.

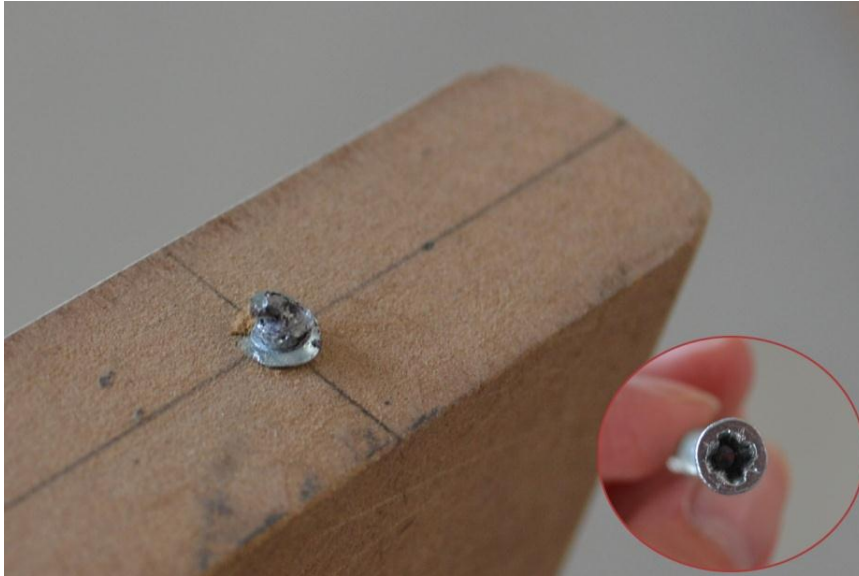


Image 8. Broken screw

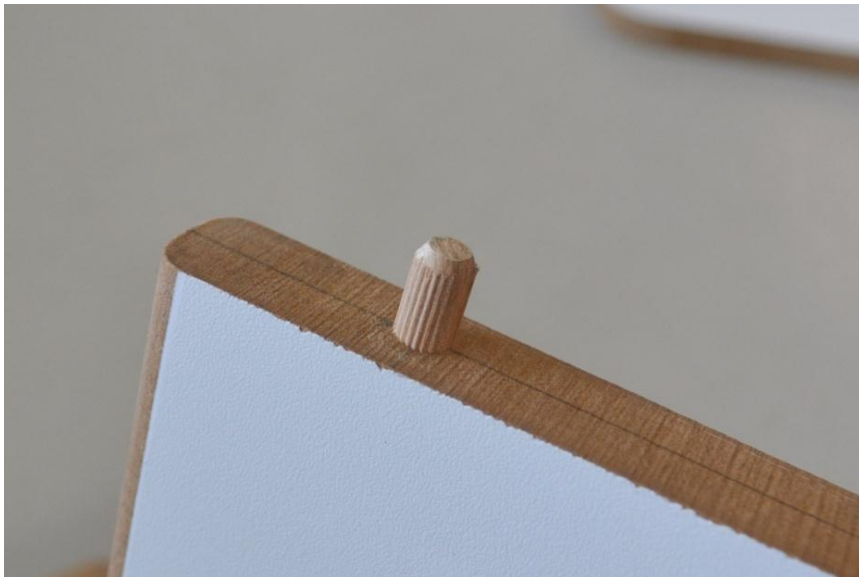


Image 9. Wooden cork.

4.4 Logo Design

The name of the seat was first created by Newton. “IPA” comes from the word “Ipana”, which means “child” in Finnish. Since the product is designed for the Finnish market, a short, sensible name was needed. “IPA” meets the requirement, and when it is followed by the word “istuin” (which means “seat” in Finnish), it leads customers to understand that the target it serves and the function it provide. Besides, the name has been used since the beginning of the

previous design phase and was accepted by Joen Erikoiskaluste Oy. Thus, we agreed to keep it as the formal name of the product.

In terms of designing the logo, instead of creating any geometric pattern, a simple use of the name plus a short subheading is preferred. Two concepts were attempted to present the letters with different forms and contexts.

The main three letters in concept A is real handwritings written with a red crayon by a child (image 10). The naive stroke and the red colour give a sense of fun and liveliness, expressing the feeling of childhood. The booster seat would probably become one of the very first furniture that a child own in his/her life. Thus, it also could be interpreted as that it is a mark that the child creates for his/her own furniture.



Image 10. Logo concept I.

The advantage of this logo is that the “ownership” can be strikingly figured out by the first sight. Yet, the look is a bit rough. It is hard to control the quality in terms of printing. Moreover, there was one opinion saying that red handwriting reminds of horror movies. Hence, this idea was suspended and then the other came out.

The other concept of the logo is a relatively modern and refined design. In concept B (image 11), the typeface was evolved from the original font of Arial, of which the structures and ratios have been adjusted to fit each other. The horizontal strokes have been moved downwards, thus the location of the centre of the typeface has been brought down. If the upper parts of letter P and A can be seen as the heads of the typeface, then the logo has a big head and a small body, same as children. The round corner in the letter "P" and "A" has the same

arc from the leg of the seat, which brings a visual connection between the logo and product. A short description “istuinkoroke”, which means “booster seat” in Finnish, has been added along the right side of letter A. When designed, there were other colour options such as pastel green and red. Figuratively, pastel blue is intended to symbolize clean and sturdiness; pastel green is a tint of health and growth; while red represents joy and liveliness. After discussion, the pastel blue was decided finally to be utilized in the logo, since it has been selected by the customer as the best one.



Image 11. Logo concept II.

4.5 User Guide Design

Without a doubt, the user guide design also has to follow certain rules and standards. Childcare articles must carry the information necessary for their safe usage throughout their useful life. This information must be provided in a clear and comprehensible format and, as a rule, in both Finnish and Swedish (tukes 613/2004).

Childcare articles and their packaging must feature details including:

- the product's name in accordance with commercial practice;
- the manufacturer, its authorized representative or importer;
- user, maintenance and care instructions, such as cutlery, cleaning and washing instructions for textiles and any warnings.

The user guide design is inspired by the IKEA product manual. As shown in image 12, it is designed to be a leaflet folding from a half of an A3 paper. The rendering models of IPA seat are placed on the front and back covers. Opening the user guide, there are illustrations vividly indicating what are included in the pack, and how to assemble the seat. Besides, there is also a page reveals the fundamental information of the product, such as the material, the dimension and the product care instructions. Unquestionably, a safe usage notification is pointed out strikingly. Due to the law of the Official Journal of European Union, the user guide would be provided in English, Finnish and Swedish languages.

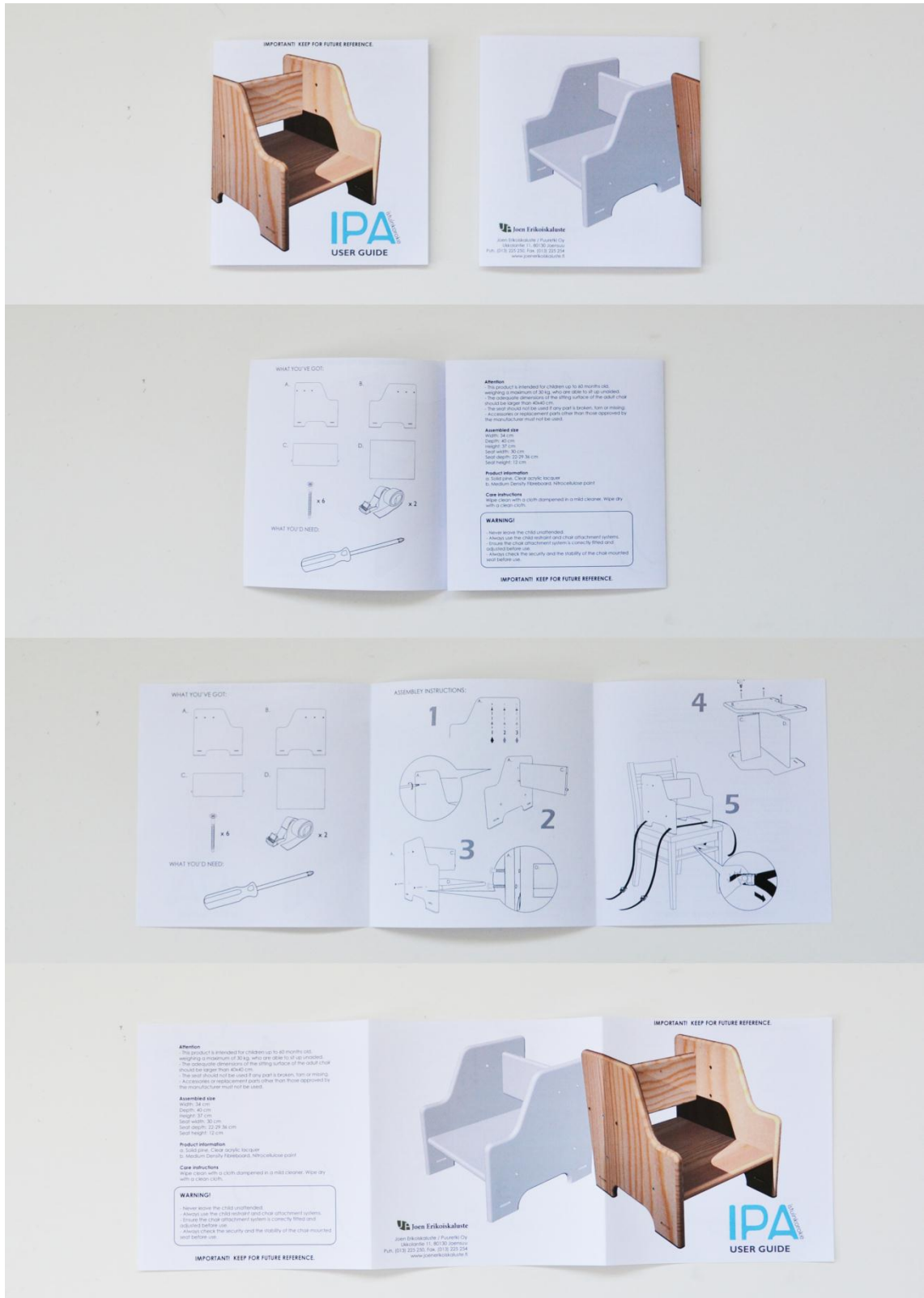


Image 12. User guide prototype.

5 USABILITY TESTING

Usability testing is a systematic way of observing actual users trying out a product and collecting information about the specific ways in which the product is easy or difficult for them (Dumas & Redish 1999, 12).

The safety requirement set for children article (Tukes 2013) is clearly explained as following:

Product testing and test findings in conformity with standards can prove the product is safe with respect to the issues covered by the standard. References of some standards are published in the Official Journal of the European Union. In the assessment of product conformity referenced standards have a higher status than non-referenced ones (section 11 of the Act on the Consumer Safety). In practice this means that products must be in conformity with referenced standards. (Tukes 2013.)

5.1 User Testing

Four families have been invited to try out the seat. Together with each model, a feedback form has been delivered to them as well. The children who have tested the seat range from 1 year and 9 months old to 7 years old.

Almost all of the parents give positive evaluation of user guide booklet. The illustrated guidance is easy to follow, and the assembling is easy to operate, too. The seat performs very well in its stability. Even a 7-year-old girl can sit steadily. The seat indeed raises children to a proper height, and the adjustment of the backrest allows children in different sizes sit in comfort.

The parents are happy because of the fact that the seat does not take extra room on the floor. It is easy to install and remove, convenient to carry out for travelling use.

Even so, problems have also been found out soon after use. Not every family is using dining table and chairs with standard dimensions. Thus, to some users,

the front part of the seat cannot fit underneath the table. Testing also found that the edges of side panels were a bit too high for smaller children. Image 13 shows that the 3-year-old boy puts his arms totally outside the seat, and part of the side panels is under his armpits. In a way, the side panels may hinder their arms from moving freely. Although, the seat depth fit him perfectly well when the backrest was fixed in the middle level. Last but not least, the strapping system makes them feel unsafe or not handy, even though nothing had happened during the testing.



Image 13. Testing with users.

Reassuringly, to all of the testers, the product testing is a pleasant process. They show big interests and kindness to do the favour. There are many thanks to all of the testers who have given sincere opinions and suggestions.

5.2 Testing Conclusion

An unexpected situation occurred when making the mechanical testing. The testing machine was failed to work (image 14), that is to say, the user testing result would be mostly considered in this thesis.



Image 14. Failed to use the testing machine.

For the reason that the age of target children users ranges over five years, their figure size varies. It seems not very easy to meet all the needs simply within one seat.

One testing user commented that when children grow older, their self-awareness become stronger. They want to be treated as grown children, thus sometimes they refuse to use baby products or continue use the products they have used when they were babies. Using the same booster seat for ages may cause their boredom.

Considering the two points above, a rough direction of future development has emerged. The structure of the product will be changed due to the children's growth, as well as the method of functioning. A fundamental idea is to prepare two sets of the sideboards with different shapes and dimensions, yet keep one set of the seat pan and the backrest. That is to say, the changing of the seat's size and the appearance will be realized by switching the sideboards. In this way, either the size or the appearance of the product would be refreshed, whereas part of the materials could be reused. Furthermore, to deeply design and test this new creativity, there ought to be another round of iterative development in the future.

6 DISCUSSION

The IPA booster seat project has last for three month and finally led to an end of the second iterative development cycle. The work result has mostly identical with the original expectations of the project.

The reason why the IPA booster seat project has been chosen as the final thesis project is that furniture design is the personal interest of the author, and also the working field that the author would like to specialize in the profession.

Chair or seat design is always the most fundamental and integrated design practice for an industrial designer. It requires plenty of knowledge and skills to complete such a task. Hence, the IPA project is quite suitable for a thesis.

The most attractive fact is that this project is based on a real product line development of a local Finnish furniture company. The problem was discovered from the daily life of Finnish people. It becomes a scares chance to get to know Finnish people and Finnish lifestyles. Last but not least, there is no barrier to communicate in English with the former designer Sarah Newton, who is also the translator between the company and the author. It makes the sense of participation strongly for a foreign designer.

In addition, the IPA booster seat project has tested the designer's ability almost in all aspects. From the market analysis to target users' study, from learning the new materials to making ergonomic measurement, from graphic design to 3D programming, which make the project a great case to practice the entire design development process.

The greatest gain that achieved from the project is still the study of usability and testing. Before that, it was hard to expect that to design such a small seat need to collect so much information and data before the "design" really get started. It has taken so much time to do the research about the usability test methods,

and the safety standard of the European Union. Products for children especially have more safety constraints than adults' products. It has been an opportunity to learn the safety issue of chair products across the board. In summary, the IPA booster seat project has systematically and comprehensively studied the furniture product design development process.

REFERENCES

- Dumas, J. & Redish, J. 1999. A Practical Guide to Usability Testing. Revised Edition. Paperback, Great Britain: Intellect Books.
- Lidwell, W., Holden, K. & Butler, J. 2003. Universal Principles of Design. Massachusetts, USA: Rockport Publishers.
- The Finnish Safety and Chemicals Agency (Tukes). 2013. Childcare articles. <http://www.tukes.fi/en/Branches/consumer-safety/Safety-requirements-for-products-/Childcare-articles/>. 06.02.2013.
- 2001/95/EC. [Commission Decision] <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:065:0023:0034:EN:PDF>. 20.03.2013.
- Chair Source. 2012. Designer Advice: How to pick a chair. http://www.chairsource.ca/design_howto_chair.asp. 10.11.2102.
- Binggeli, C. 2012. Interior Graphic Standards: Student Edition. New Jersey, Canada: John Wiley & Sonn, Inc.
- Postell, J. 2012. Furniture Design: Second Edition. New Jersey, Canada: John Wiley & Sonn, Inc.

Legal Agreement

Mallioikeussopimus

1. Sopimuksen tarkoitus ja kohde

1.1 Tämä sopimus koskee suunnittelijan opinnäytetyöhön liittyviä mallien/tuotteiden omistus-, valmistus-, markkinointi- ja myyntioikeuksia.

1.2 Tällä sopimuksella vahvistetaan suunnittelijan oikeudet kaikkiin hänen opinnäytetyönsä aikana tehtyihin malleihin/tuotteisiin.

2. Sopimuksen voimassaolo

2.1. Sopimus on voimassa opinnäytetyön tekemisen ajan sekä puoli vuotta opinnäytetyön valmistumisen jälkeen (puoli vuotta lasketaan siitä päivästä alkaen, kun opinnäytetyö on luovutettu arviointiin) ellei sitä kirjallisesti irtisanota viimeistään (1) kuukautta ennen sopimuskauden päättymistä.

2.2. Suunnittelijan irtisanoessa sopimuksen irtisanomisaika on (1) kuukautta.

Valmistajan / markkinoijan irtisanoessa sopimuksen irtisanomisaika on (1) kuukautta. Irtisanomisaika lasketaan sen kuukauden viimeisestä päivästä, jonka aikana sopimus on irtisanottu.

Irtisanominen on tehtävä kirjallisesti.

3. Oikeudet

3.1. Osapuolet vakuuttavat, että tämän sopimuksen tekohetkellä kummankaan tie-dossa ei ole, että tämän sopimuksen täyttäminen rikkoo kolmansien osapuolien oikeuksia.

3.2. Suunnittelijalla on sopimuksen kohteina oleviin Malleihin kaikki oikeudet.

4. Oikeuksien edelleen luovuttaminen ja käyttäminen

4.1. Ilman eri sopimusta kummallakaan osapuolella ei ole oikeutta luovuttaa tässä sopimuksessa tarkoitettua valmistus- ja myyntioikeutta kolmannelle osapuolelle sopimuksen voimassaolon aikana.. Tämän sopimuksen päätyttyä suunnittelijalla on oikeus luovuttaa tässä sopimuksessa katettavien mallien/tuotteiden valmistus- ja myyntioikeudet kolmannelle osapuolelle.

4.2. Ilman eri sopimusta Valmistajalla / Markkinoijalla ei ole oikeutta käyttää sopimuksen tarkoittamia Malleja / Tuotteita, niiden osia tai Suunnittelijan suunnittelempia komponentteja tai niiden osia muissa tuotteissa.

4.3. Suunnittelija luovuttaa erillisellä sopimuksella Valmistaja / markkinoijalle yhdessä sovitut mallit/tuotteet ja kaikki niihin liittyvät tarpeelliset asiakirjat.

4.4. Suunnittelija myötävaikuttaa osaltaan Mallien tuotantoon soveltamiseen.

4.5. Suunnittelijalla on oikeus hakea sopimukseen liittyvän Mallin tai Tuotteen mallisuoja-, patenti- tai vastaavia muita teollisoikeuksia suunnittelijan nimiin. Valmistajalla / Markkinoijalla on oikeus hakea sopimukseen liittyvän Mallin tai Tuotteen mallisuoja-, patenti- tai vastaavia muita teollisoikeuksia suunnittelijan nimiin vain erillisellä sopimuksella.

5. Tuotekehitys, tuotantomallit ja tuotteiden valmistaminen

5.1. Valmistusta ei ole lupa aloittaa ennen kuin suunnittelija on erillisellä sopimuksella luovuttanut mallien valmistus- ja myyntioikeudet, sekä molemmat osapuolet ovat kirjallisesti hyväksyneet Mallien tuotantomallit.

5.2. Valmistaja / Markkinoija on velvollinen huolehtimaan siitä, että Tuotteet kaikilta osin niiden valmistusaikana vastaavat hyväksytyä tuotantomallia.

5.3. Tuotekehityskustannuksista ja Tuotantomallien valmistuskustannuksista vastaa Valmistaja / Markkinoija, ellei osapuolten välillä toisin sovita.

6. Mallien ja tuotteiden muutokset

6.1. Kaikki Malleihin ja Tuotteisiin kohdistuvat muutokset tehdään molempien osapuolten yhteisellä kirjallisella suostumuksella. Ns. taiteellinen johto säilyy kuitenkin kaikissa olosuhteissa Suunnittelijalla.

6.2. Valmistajan / Markkinoijan on hyväksyttävä kirjallisesti Suunnittelijalla kaikki muutokset tai modifikaatiot, jotka johtuvat toiminnallisista, arkkitehtonisista tai kaupallisista syistä ennen niiden toteuttamista.

6.3. Muutoksista huolimatta Suunnittelija säilyy Mallin luoja ja kaikkien oikeuksien haltijana.

7. Menettely oikeudenloukkaustapauksissa

7.1. Osapuolilla on velvollisuus aktiivisesti valvoa ja tarvittaessa puuttua Malleihin tai Tuotteisiin kohdistuvia oikeuksien loukkauksia sekä ilmoittaa havaitsemistaan loukkauksista heti toiselle osapuolelle.

7.2. Mikäli kolmas taho loukkaa Mallia tai Tuotetta, on kumpikin osapuoli oikeutettu kustannuksellaan yksin vaatimaan menettelyn lopettamista sekä ryhtymään tarpeellisiin toimiin loukkaajaa tai sanottua kolmatta tahoja vastaan.

7.3. Mikäli sopimuksen tarkoittama malli loukkaa kolmannen osapuolen oikeuksia, vastaavat osapuolet oikeudenloukkauksen johdosta kolmannelle maksettavasta korvauksesta saamansa taloudellisen hyödyn suhteessa. Suunnittelijan korvausvelvollisuus ei ylitä hänen saamaansa kokonaispalkkiota.

8. Palkkiot

8.1. Ellei toisin sovita, Suunnittelija ei vaadi rahallista korvausta itselleen yhden Mallin/Tuotteen valmistus- ja markkinointioikeuksien luovuttamisesta Valmistaja / Markkinoijalle. Toisen tai useamman Mallin/Tuotteen valmistus- ja markkinointioikeuksien luovuttamisesta tulee Suunnittelijalle maksaa niiden mallien luovutusta koskevien sopimusten mukainen korvaus.

8.2. Valmistaja / Markkinoija sitoutuu maksamaan kaikki valmistukseen ja tuotantoon liittyvät kustannukset.

8.3. Jos Mallin lisäksi suunnitellaan uusia malleja täydentämään tuoteperhettä, on niiden osalta palkkiot sovittava erikseen erillisellä Mallikohtaisella sopimuksella.

8.4. Muottien yms. työkalujen, piirustusten tai 3D mallinnusten sekä jälkepäin Mallia täydentävien lisäosien suunnittelusta ja suunnittelupalkkioista sovitaan osapuolten kesken erikseen.

8.5. Viivästyskorko on korkolain mukainen.

10. Markkinointi

10.1 Suunnittelijan nimi ja tuotemerkki on aina ilmoitettava tuotteissa ja niiden markkinoinnissa, ellei toisin ole kirjallisesti sovittu. Valmistajalla on oikeus Valmistajan merkin liittämiseen tuotteeseen.

10.2. Valmistaja / Markkinoijan pyynnöstä Suunnittelija avustaa mahdollisuuksien mukaan Malliin perustuvien tuotteiden myynninedistämisestä.

Tähän liittyen Suunnittelijalle maksettavasta erilliskorvauksesta osapuolet sopivat tapaus-kohtaisesti erikseen.

10.3. Suunnittelija on oikeutettu saamaan Valmistaja / Markkinoijalta valokuvia sekä 1 kpl Malleista valmistettuja Tuotteita korvauksetta käyttöönsä esittelykappaleiksi.

10.4. Tuotteisiin liittyvät messuosastot, esitteet, valokuvat, ilmoitukset ja muu sen kaltainen markkinointi- ja mainosmateriaali suunnitellaan ja toteutetaan yhteistoimin ja yhteisymmärryksessä osapuolten kesken. Tähän liittyvästä erilliskorvauksesta osapuolet sopivat tapauskohtaisesti erikseen.

11. Lisenssivalmistus ja alihankinta

11.1. Valmistaja / Markkinoijalla on oikeus solmia lisenssisopimuksia Suunnittelijan erillisellä kirjallisella suostumuksella. Lisenssisopimus on aina erillinen sopimus.

11.2. Valmistaja / Markkinoija vastaa siitä, että mahdollinen alihankkija tai lisenssinsaaja noudattaa tätä sopimusta.

12. Salassapito

12.1. Osapuolet sitoutuvat pitämään salassa tämän sopimuksen toteuttamisen yhteydessä tai muuten tietoonsa saamat liikesalaisuudet.

13. Sopimuksen purkaminen

13.1. Mikäli jompikumpi osapuoli olennaisesti rikkoo tätä sopimusta taikka muilla tavoin loukkaa toisen osapuolen oikeuksia on toisella osapuolella oikeus purkaa sopimus.

13.2. Valmistaja / Markkinoijalla on oikeus purkaa sopimus , jos:

Suunnittelija ei noudata tai rikkoo tämän sopimuksen ehtoja

Tässä sopimuksessa tarkoitetulla Mallilla Suunnittelija on rikko-nut tahallaan kolmannen osapuolen oikeuksia

13.3. Suunnittelijalla on oikeus purkaa sopimus, jos:

Valmistaja / Markkinoija lopettaa toimintansa tai asetetaan konkurssiin

Jos Valmistaja / Markkinoija joutuu saneerausmenettelyyn

13.4. Ilmoitus sopimuksen purkamisesta on tehtävä kirjallisesti.

14. Sopimuksen päättymisen vaikutukset ja menettely sopimuksen päättyessä

14.1. Kun sopimus päättyy, kaikki tässä sopimuksessa tarkoitetut oikeudet palautuvat täysimääräisinä suunnittelijalle. Selvyyden vuoksi todetaan, että jos Valmistaja / Markkinoija joutuu konkurssiin, tämä sopimus voidaan välittömästi päättää, eikä konkurssipesällä ole oikeutta ilman Suunnittelijan erillistä suostumusta jatkaa sopimusta.

14.2. Sopimuksen päättyessä Tuotteiden valmistuksen eteenpäin vieminen on heti lopetettava. Keskeneneräiset, tilatut ja valmiit Tuotteet on lupa saattaa

valmiiksi sekä myydä. Myynti on saatettava loppuun (2) kuukauden ku-luessa sopimuksen lakkaamispäivästä.

14.3. Valmistaja / Markkinoijan on palautettava mallipiirustukset, prototyypit ja kaikki tuotekehitykseen liittyvä muu materiaali (2) viikon kuluessa sopimuksen päättymisestä takaisin Suunnittelijalle.

14.4. Sopimuksen päättyessä Mallien ja mallistojen nimet jäävät Suunnitteli-jan vapaaseen käyttöön.

14.5. Valmistaja / Markkinoija ei saa ilman Suunnittelijan kirjallista suostu-musta itse käyttää, myydä tai luovuttaa Tuotteiden valmistamista varten tehtyjä työkaluja ja muotteja.

14.6. Suunnittelijalla on oikeus lunastaa Tuotteen valmistustyökalut ja – muo-tit vuoden kuluessa sopimuksen päättymisestä. Lunastushinnan perus-teena on työkalujen ja muottien arvo Valmistajan kirjanpidossa.

15. Erimielisyydet

Tästä sopimuksesta johtuvat erimielisyydet, joita ei voida ratkaista osa-puolten kesken ensisijassa käytävissä neuvotteluissa, ratkaistaan (paik-kakunnan) käräjäoikeudessa suomenkielellä soveltaen Suomen lakia.

Sopimusta on tehty kaksi yhtäpitävää kappaletta, yksi kummallekin sopi-jaosapuolelle.

Päiväys ja allekirjoitukset

Paikka ja aika

Nimi (Valmistaja / Markkinoija)

Asema yhtiössä

Yhtiö

Nimi (Suunnittelija)

Yhtiö

Epäselvissä tapauksissa asiakirjoja noudatetaan seuraavassa järjestyksessä:

1. Tämä sopimus ja siihen kuuluvat liitteet

2. Konsulttitoiminnan yleiset sopimusehdot KSE '95 (RT 13 – 10574)

Body Measurement Research Form

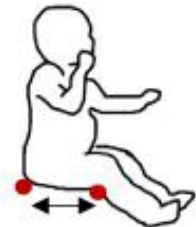
LAPSEN MITTASUHTEET ISTUINKOROKETTA SUUNNITELLESSA

Opinnäytetyötäni varten, jossa suunnitellaan lapsille tarkoitettu istuinkoroke, olen pyytänyt päiväkotia mittaamaan lapsilta tietyt mitat, jotka näette alla. Kaikista saamistani mitoista tulen tekemään yhdistetyn ns. keskivertomitta -laskennan, jolla määritän korokkeelle vaadittavat mitat. Yksittäisiä mittoja ei missään julkaista, vain keskivertomitan saatan mainita opinnäytetyöni kirjallisessa osiossa. Mitään nimiä ei myöskään julkaista tai mainita missään muodossa.

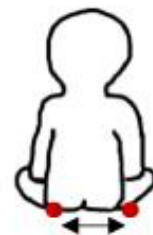
Ystävällisin terveisin

Saara Newton, Teollinen muotoilija

Lapsen ikä: _____



Mitta istuessa: pakarosta polvitaipeseen (cm): _____

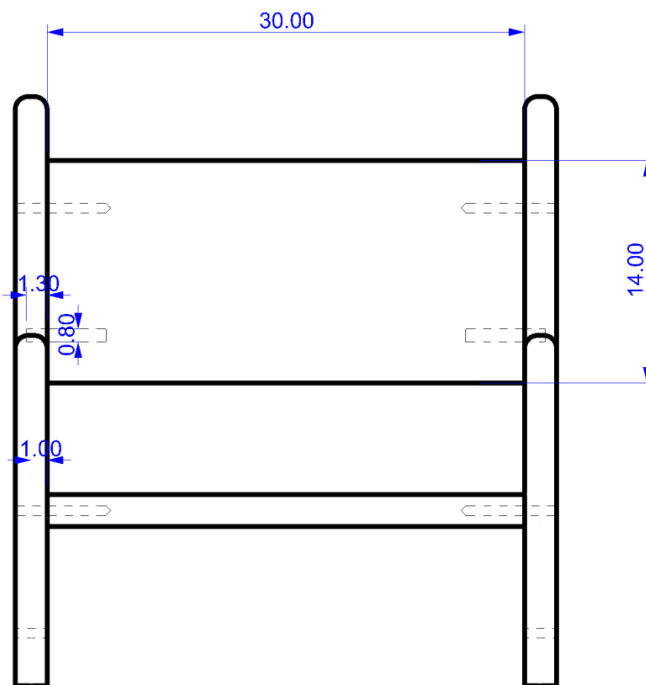
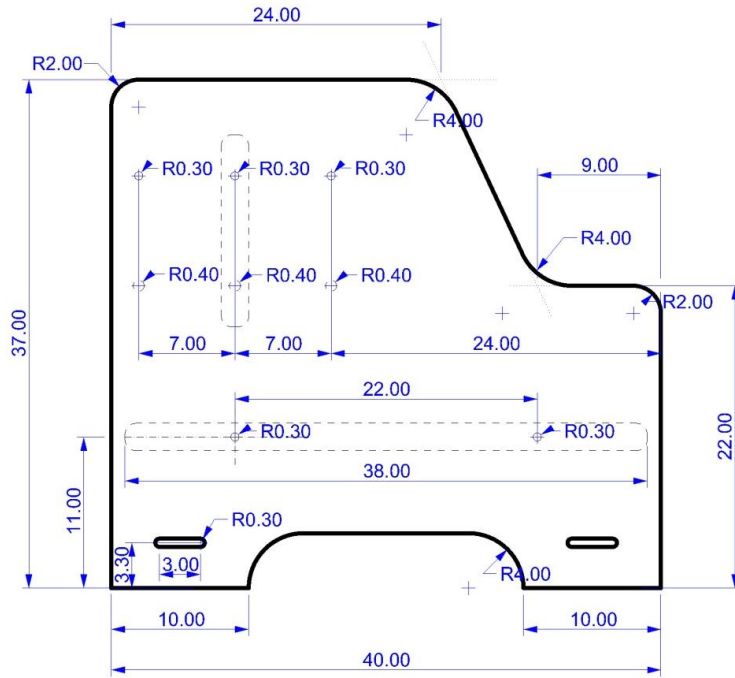


Mitta istuessa: pakaroiden leveys (cm): _____



Mitta istuessa: tuolin kannen päältä reiden yläpintaan (cm): _____

Dimension Figure



User Testing Feedback Form



USER TESTING FEEDBACK

1. Child's age:
2. How long did it take you to assemble the seat?
 - about 10 mins about 15 mins
 - about 20 mins > 20 mins
3. Did you assemble the seat with the help of the instruction?
 - Yes- Is it clear and understandable?
 - No
4. Did the seat fit in your dining chair?
5. Was the front of seat able to be pushed underneath your dining table?
6. Can your child climb in the seat by himself/herself?
7. Which level of the backrest did you use?
8. Did the seat raise the child to a proper position to eat?

“Please read this questionnaire form before using the product.

Thank you for helping us to improve the design.”

9. Did the seat hinder his/her body from moving freely?
10. Did the child feel uncomfortable when sitting in it?
11. Did you find any safety hazard when the seat was used?
12. How did you like the material?
13. How much do you think it values?
14. If the price was acceptable, would you like to buy it?
 - Yes-Why would you choose this seat from the products of the same kind?
 - No -Why not?
15. What needs to be improved?
16. Other comment?