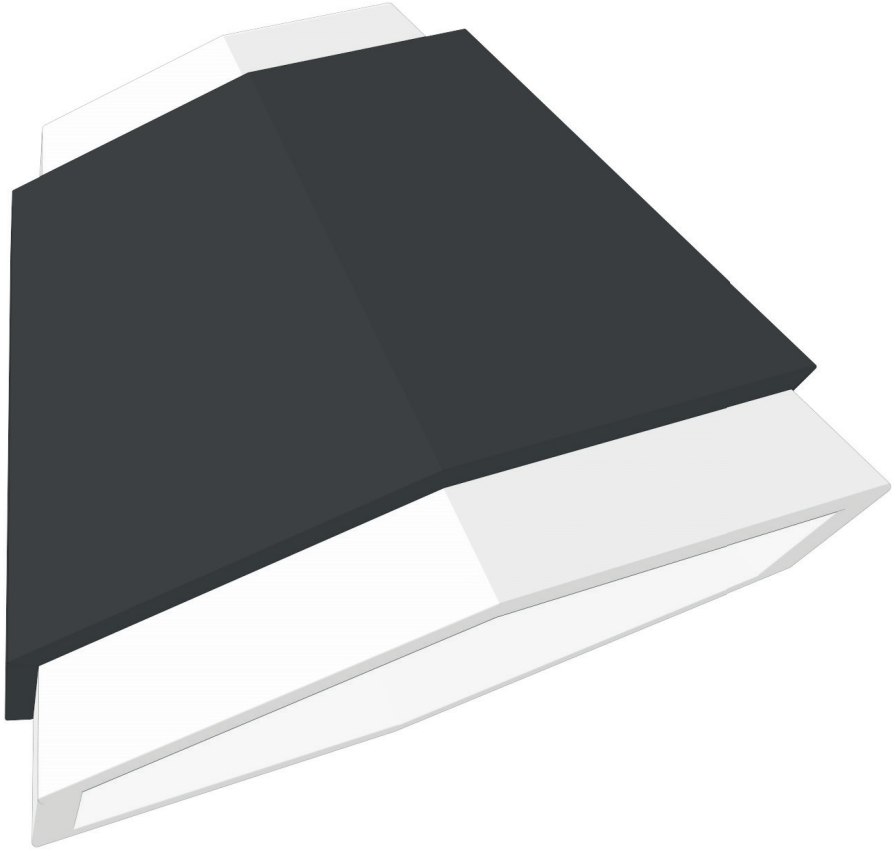
Torben Hove Larsen

"Lacuna" | MA4-ID5 | June 2014



PART 1: PROCESS REPORT

DIGITAL CONTENT

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MSc4-ID5

Industrial Design AD:MT

Torben Hove Larsen

Intro

This report is part 1 of 2 in the presentation of the results from an industrial design master thesis project, developed between February 3rd and May 28th.
From an initial concept of using the potential in crowdfunding in an industrial design context, the project has been through a wide exploration of potential and qualities from areas related to both toys and lighting design.
The developed product is presented in part 2 of the presentation. The two parts are collected in a single report and part 2 can be accessed by flipping this report over.

The two reports are available in a digital format on the attached CD along with appendix.
Technical drawings are further attached as well as being available digital.

PROCESS REPORT

Summary

This project deals with the potential in using crowdfunding in industrial design. From this basis an initial trend search on crowdfunded projects takes the direction through the development of designing a modular construction toy to ultimately combining this with, inter alia, qualities of lighting design.

In this process the prospect of publishing the the project through a crowdfunding platform, has led to including potential users as an integrated part of the development for both research and feedback.
This approach is reflected in the developed product through a structure inspired by open source development and expandable modularity.

CONTENT

Roadmap **7**

Preface **9**

Research **11**
Trend Search 12
Approaching Crowdfunding 13
Conclusion To Research 14

Framing **17**
Current Market 19
Deconstruction: Case studies 20
New Context 21
Market Analysis 22
Product Interaction 23
Product Qualities 24
Business Model Canvas 25
Conclusion To Framing 26

Design Brief **27**

Concept Generation **29**
Conclusion To Concept generation 31

Concept Development **33**
Lighting Principles 34
Modularity 36
Spherical Modularity 37
Customization & Add-Ons 38
Tectonic Concept 39
Co-Creation Process 40
Conclusion To Concept Development 41

Concept Detailing **43**
Size References 44
Module Size 45
Module Composition 46
Magnetic Assembly 47
Tectonic Details 48
Using The Tectonics 49
Light Quality 50
Customization 52
Add-On Modules 53
Materials & Production 54
Conclusion To Concept Detailing 55

Business Case **57**
Blue Ocean Strategy Canvas 58
Benchmark 59
Porter's Five Forces 60
SWOT 61
Business Model Canvas 62

Preparing For Crowdfunding **64**

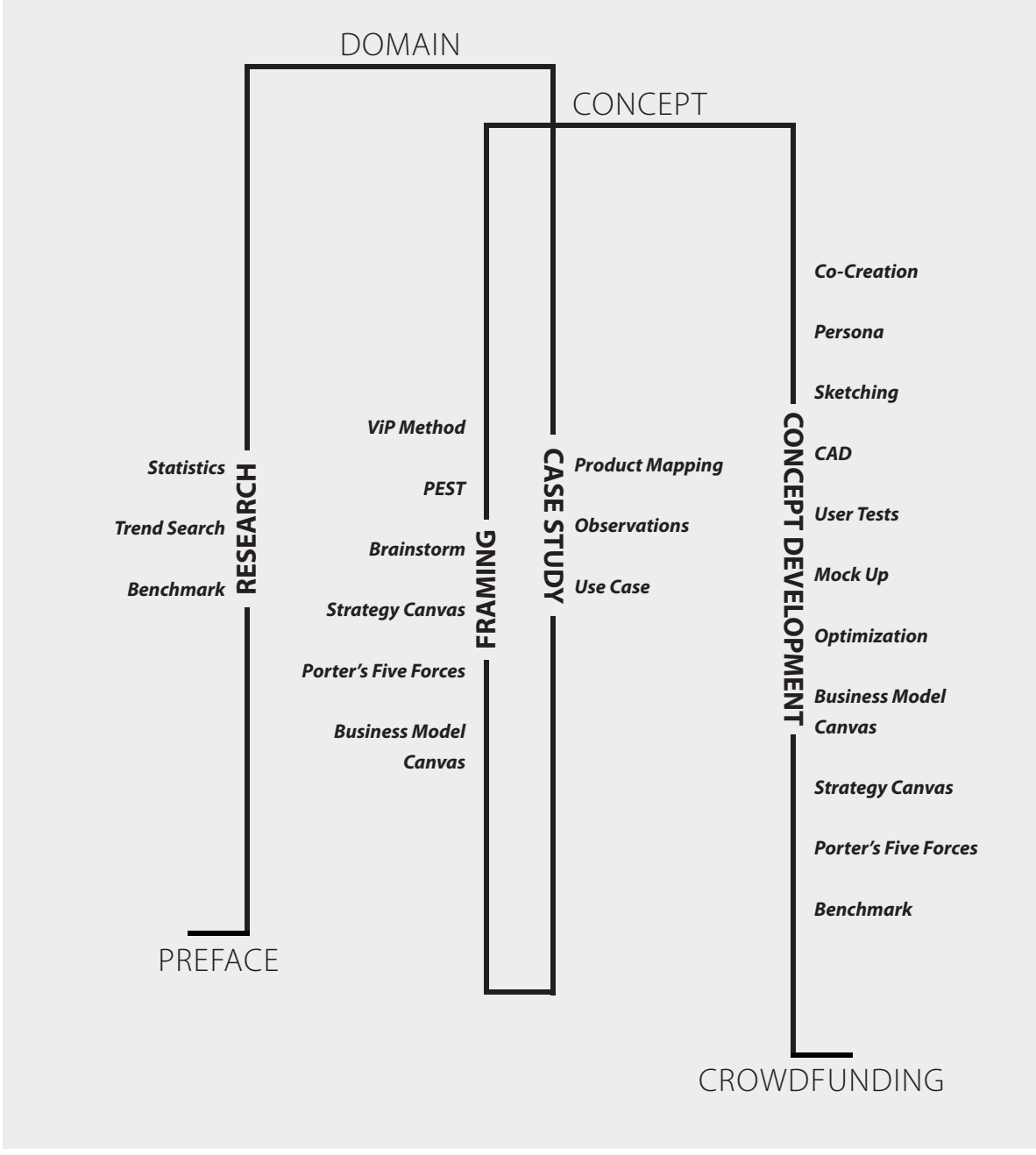
Branding **65**

Project Closing **66**
Design Freeze 67
Conclusion 68
Reflection 69
References 70

Flip to read Part 2: Product Presentation

ROADMAP

The roadmap lists the used methods in the individual stages of the process. Every bend on the map indicates a narrowing in on the project scope.



PREFACE

PREFACE

This section will cover the background of choosing the set subject. This includes discussing personal interests in relation to alternative directions. The vision and initial scope of the project will be discussed in relation to limitations set at the current state.

This project is based on the phenomenon of crowdfunding and using this in an industrial design context. From this an exploration of trends and statistics in the user segments is done to find a direction for the following development, that will be optimal in relation to the potential of using crowdfunding for reaching the market. This means the research will further cover how to act in relation to users to be ready for publishing the project on a crowd funding platform at the end of development.

The background for choosing this as the basis for a project involving product development is the potential of working within the frames of the initial market of selling a product before it's fully developed along with the possibilities of a subsidiary limitation related to personal interests. Alternatively the basis could simply be set by choosing a product with no connection to crowdfunding in the research stage.
By choosing the direction with crowdfunding integrated early in the process, the user needs can be integrated early on and the following funding stage should thus have a higher chance to succeed.

The initial scope of the project is set to be the development of a relative simple product in relation to needed development time, based on the combination of being a solo group and the prospect of publishing a near complete product on a crowdfunding platform at the end of the project period.

INITIAL DELIMITATION

+ *Limited Development Time*
+ *Publishing Through Crowdfunding*

SUMMARY

The project will be based on the development of a simple product for future funding through crowdfunding. The basis will be a trendsearch on existing crowdfunding platforms, to get inspiration for the further development.

RESEARCH

INITIAL RESEARCH

From an intial introduction to crowdfunding, an exploration of trends and user segments is done, to find a direction for the following development that will be optimal in relation to the potential of using crowd funding for reaching the market. This means the research will further cover how to act in relation to users to be ready for publishing the project on a crowdfunding platform at the end of development.

The Phenomenon Of Crowdfunding

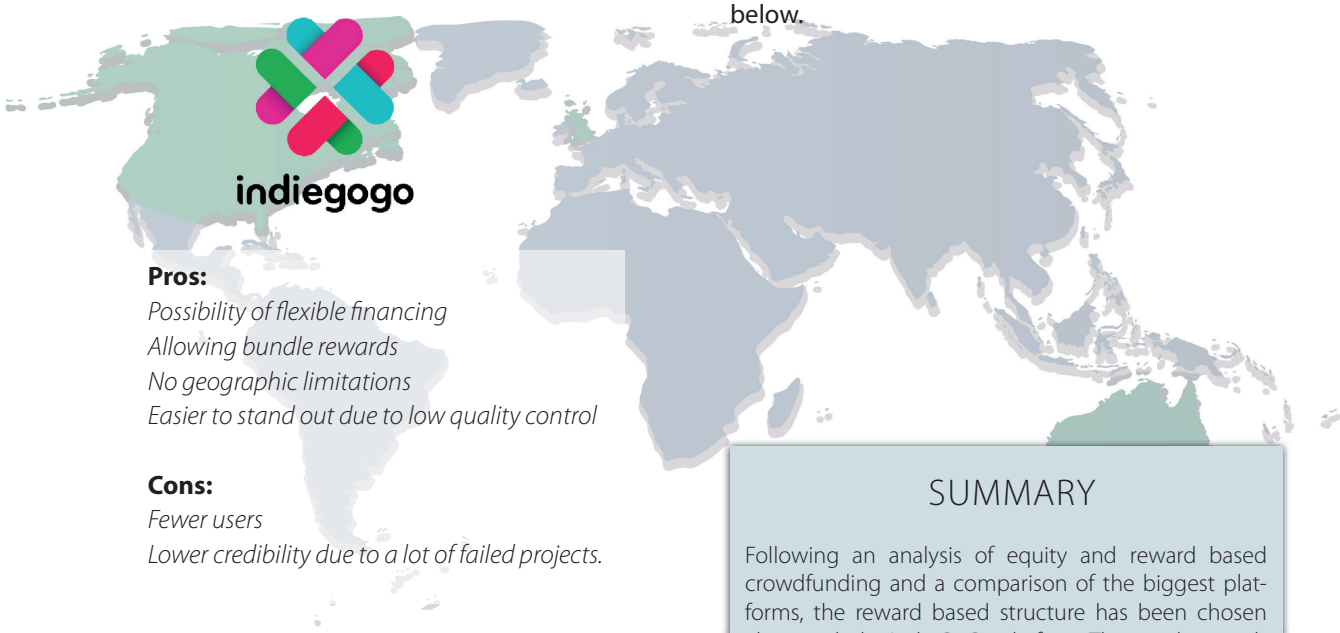
The model of delegating tasks to people interested in investing resources in the development, is known as crowdsourcing. Sourcing out tasks to an amount of people in the crowd.
Crowdfunding is a type of crowdsourcing where the crowds invested resources is solely related to the financial funding of a project. It is the practice of "asking the general public for donations that provide startup capital for new ventures" (Steinberg, Scott 2012, p. 2).

This could for example be 2000 people paying just 10 kr. each. These funders act as small scale venture capitalists, speculators who makes money available for innovative projects, with compensation for funding depending on the type of crowdfunding used.

Crowdfunding Platforms

The two main types of crowdfunding relevant to this project, are reward based and equity based (SterlingFunder 2014). Reward based where backers typically gets a product as a thank you for backing. Equity based where shares in the company are sold to private investors. From a comparison based on a subjective SWOT analysis and research on limitations in each, it is chosen to focus on reward based crowdfunding in this project [Appendix 1A].

The project will use Kickstarter.com as a basis for the performed research since it is the biggest platform, but aim at publishing through IndieGoGo.com. This move is mainly based the fact that Kickstarter is currently only available in USA, Canada, UK, Australia and New Zealand), but there are other pros and cons in using IndieGoGo, as listed below.



Pros:
Possibility of flexible financing
Allowing bundle rewards
No geographic limitations
Easier to stand out due to low quality control

Cons:
Fewer users
Lower credibility due to a lot of failed projects.

SUMMARY

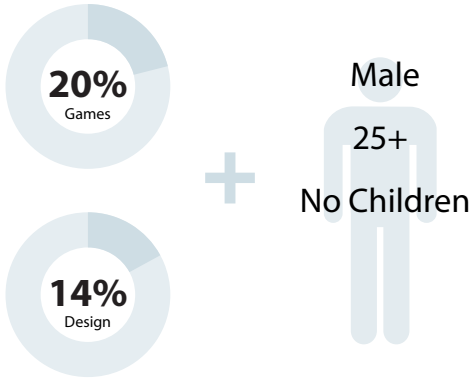
Following an analysis of equity and reward based crowdfunding and a comparison of the biggest platforms, the reward based structure has been chosen along with the IndieGoGo platform. The initial research is chosen to be done through Kickstarter based on quantitative potential.

TREND SEARCH

Trends and user segments are analyzed to find a direction for the following development, that will be optimal in relation to the potential of using crowd funding for reaching the market. This will be done by comparing statistics with popular products available on Kickstarter at the moment.

The 20 most popular products currently on Kickstarter under the category of product design are listed for a comparison of type, funding goal and reward price range [Appendix 1B].
Subsequently the list has been divided in clusters related to product type to search for potential within these groups [Appendix 1C]. This search led to doing a subjective rated benchmark, based on factors related to personal interests and the potential scope of developing a product in the given product category [Appendix 1D].

To back the decision of choosing a direction with financial justification, an overview on statistics related to Kickstarter was found.
This research showed a Kickstarter revenue nearing in on $1 billion from 5,5 million backers (Kickstarter.com 2014). Along with a combined share of "games" and "design" of 34% of this, the potential in developing a construction toy was chosen. This further takes advantage of the possibility of bundle rewards, which is only available on IndieGoGo, by delimitating it further to a modular construction toy.
This development will be based on a target segment consisting of the main users of Kickstarter, male users, aged 25+ with no children (Quantcast.com 2014).



SUMMARY

Research on statistics and trends combined with a benchmark on personal preferences has given a delimitation in product category in the direction of modular construction toys along with a specification of target users in the direction of male users, 25+ and with no children.

APPROACHING CROWDFUNDING

To prepare the later development for the finalizing, online publishing on a crowdfunding platform, research on advice and guidelines is performed in this section. This relates to both requirements for publishing and factors related to being optimally prepared.

Optimal Preparation

To prepare for crowdfunding, advice from successful campaigners have been researched.
Linda Liukas, whose children's book raised $100.000 in 24 hours, lists 7 key factors, listed below, to planning a successful crowdfunding campaign (Liukas, L.).

1. ***Pick a problem that won't leave you alone.***
2. ***Build a community around your project.***
3. Tell a story.
4. Plan your budget.
5. Focus on the video.
6. Launch.
7. Dedicate time to take care of the campaign.

Most of these are more related to launch than to the prior development, and thus they will be revisited later in this project. Her first two points, however, are related to this stage of the design process.

"Pick a problem that won't leave you alone".

The project should both have a reason for existence and be something you can dedicate your time to. In this process this will be covered through combining personal preferences with a market search. Using "ViP", a model that will be introduced later, the results from this will then be integrated in a new context.

Her second point is that you need to build a community around your project.

"Kickstarter works best when you understand either the existing or potential community around your project. Kickstarter is the last step, not the first."

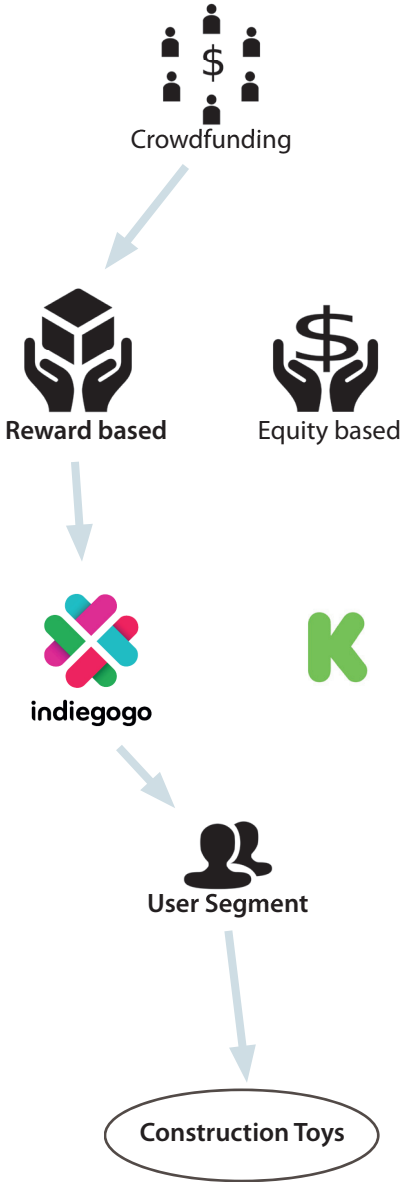
So in order to follow her advice, the product has to be related to personal interests, which is fulfilled in the chosen product category. Secondly a following will have to be made early in the process. This will be done when the product type is more clearly defined, to be able to reach the right audience.

SUMMARY

Though following 7 key factors, nothing in the project has directly changed at the present state. Most factors will become relevant from publishing online and forward, but one will be introduced early in the process, the setting of a following that could potentially have an interest in backing the future product funding.

CONCLUSION TO RESEARCH

Following the performed research, a conclusion will be derived along with an overview of the resulting changes to project delimitation. These changes will be illustrated through replacing outdated delimitations with new, updated versions as the narrowed scope has added new perspectives and clarifications.



SCOPE

CROWDFUNDING

CONSTRUCTION TOY

DELIMITATION

+ *Limited Development Time*
+ ~~*Publishing Through Crowdfunding*~~
+ *Publishing through IndieGoGo*
+ *Targeted Male Users, 25+, No Children*
+ *Construction Toy*
+ *Modularity*

CONCLUSION

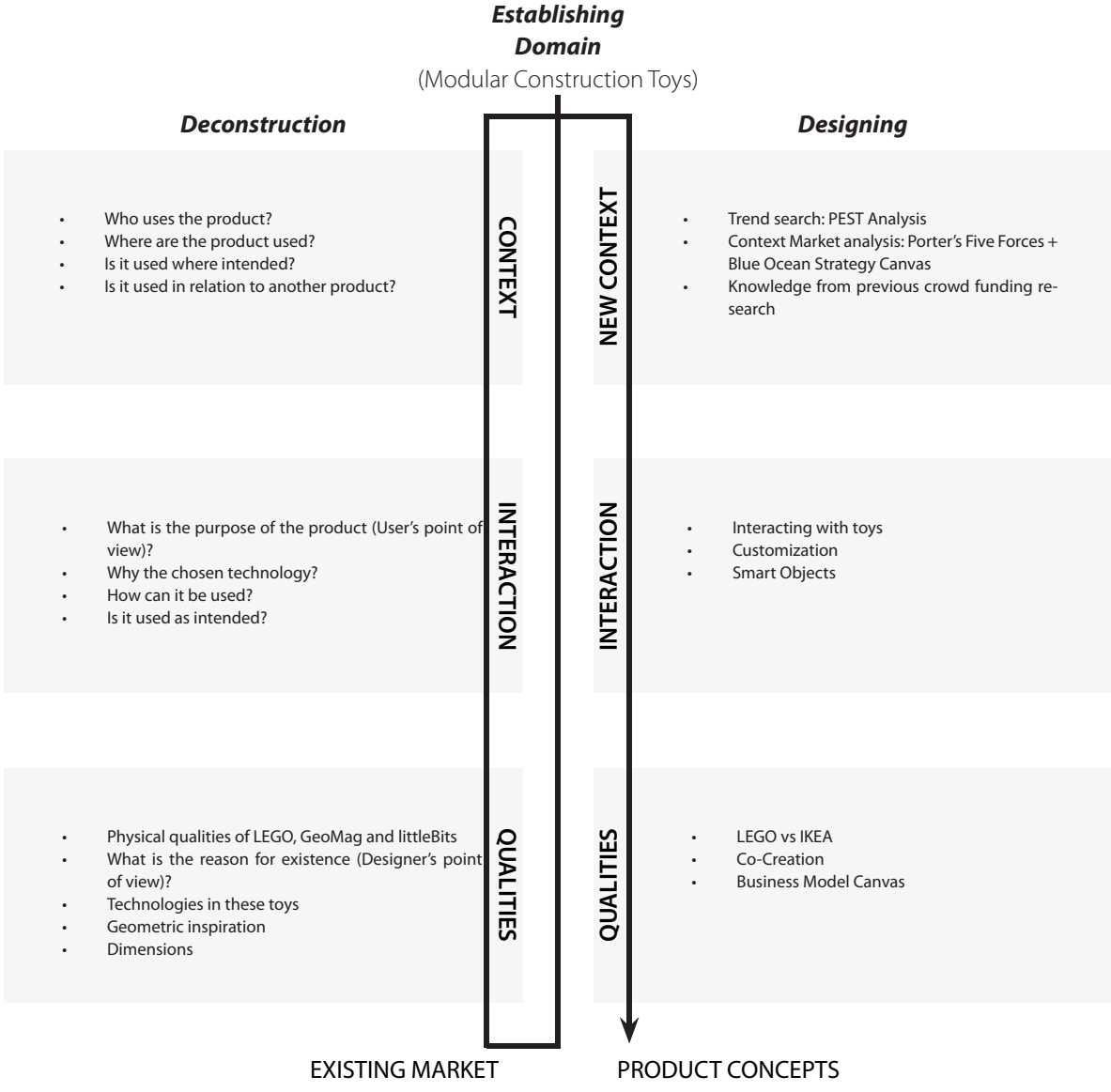
To integrate the prospect of future funding early in the product development, the overall type of product has been found through the performed research on the current state of the crowdfunding platform Kickstarter.
From this a direction in the form of "Construction toys" has been found, along with a target user segment in the form of males, 25+ and no children. Further the future platform for publishing has been set to IndieGoGo. The construction toy will be modular, to take further advantage of IndieGoGo's possibility of bundle rewards.

FRAMING

FRAMING METHODS

As an introductory stage of the project framing, the used methods will be introduced in a framing specific roadmap. The roadmap is based on the ViP method, which will facilitate the framing, but with further methods used to fulfill it.

This model illustrates the road through framing using the ViP Method (Hekkert, Paul 2011), starting with the domain of modular construction toys. A preliminary deconstruction phase sets off the designing phase.
The ViP method and other included models will be introduced in the next section.



The ViP Method

ViP is an approach to facilitate the design process with focus on a future context vision.

The model is chosen to facilitate this process based on the tight competition on crowdfunding platforms, which means a competitive product has to be innovative. The used model further has to be based on product oriented development, where for example "The Delft Innovation Method" (Buijs, Jan 2012) is based on business oriented development.

The model is based, by Lloyd, Hekkert & Van Dijk, on these three points:

1. *Design is about looking for possibilities, and possible futures, instead of solving present-day problems.*

2. *Products are a means of accomplishing appropriate actions, interactions, and relationships. In interaction with people, products obtain their meaning. This is why ViP is interaction-centred.*

3. *The appropriateness of an interaction is determined by the context for which it is designed. This context can be the world of today, tomorrow, or may lie years ahead. Future contexts demand new and different behaviours. This makes ViP context-driven.*

Applying The Methods

The framing of the design will overall be facilitated through the ViP model.
The model consists of two main stages, "deconstruction" and "designing". The deconstruction stage deals with case study research within the chosen domain.
The three levels will cover a case study of what the product is and can do, how it is used and in which context it is used.
Following this the designing stage will facilitate the reverse order to set a relevant context and make sure the designed product is based on interaction that fits this context.

To explore the different stages of this model, further methods will be applied, as illustrated on the previous page. To preliminary analyze the market in the designing stage, Porters Five Forces (Porter, Michael E. 1979) will be used.
To differentiate from the market, PEST (Mind Tools) and Blue Ocean Strategy Canvas (Chan Kim, W. 2005) will be used subsequently.
In the later stages of "ViP", in designing product interaction and product qualities, different parameters will be found by setting up a persona, to make sure it is relevant to the target users and by applying the Business Model Canvas (Osterwalder, Alexander 2010a), to make sure the concept has potential to generate revenue.
The use of these models is based on subjective evaluations and should as such be regarded as personal assesments.

SUMMARY

The use of the ViP method has been introduced, to create an overview of how the framing is kicked off by a case study that will set inspiration for the following framing, where relevant context, interactions and qualities will be explored.

CURRENT MARKET

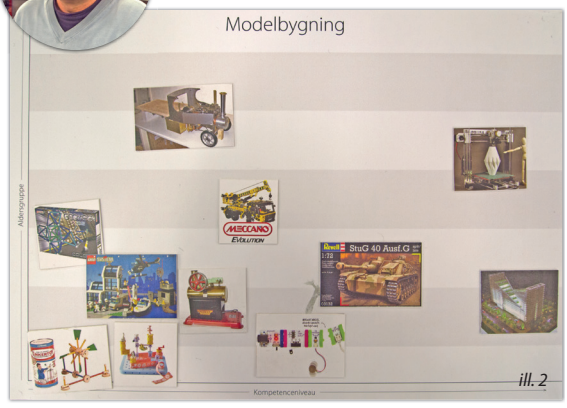
Preliminary to deconstruction, the case study, research on the current market of toys aimed at the chosen target users is undergone in this section. This will act as inspiration for the study and as an evaluation of the current competition on the market.

To test how the products on the current market relates to the target users, professionals from both a toy store (ill. 1) and a hobby store (ill. 2) were asked to map the products in relation to both what age and what level of advancement they would evaluate the products to be aimed at.

Mikael

ill. 1

Jan



ill. 2

Both mappings shows a tendency of construction toys targeted at a low age group and with fixed modeling sets more targeted an older segment. This shows a potential in the chosen direction, as a modular construction toy targeted adults would differentiate from the direct competition.

SUMMARY

The potential in the chosen direction is underlined through having professionals map existing products in relation to age and level of advancement.

DECONSTRUCTION: CASE STUDIES

The deconstruction facilitates the case study of an existing product. This deconstruction will be based on LEGO, GeoMag and littleBits. These will be evalueated in relation to how they were intended to be used, how they're actually used and in which context they're used. Research is done through observations and use testing.

Product Qualities

All product share product qualities related to tangibility. The size of modules fits easily between two fingers and are all made of plastics. While this can be related to weight, price and manufacturability, it also gives a warm feeling when touching the products and the simplicity gives an easy overview of the individual modules function.
In assembling, LEGO uses a "click" system, GeoMag relies on magnets and littleBits uses a combination. Similar in all these connection systems is the ease of connecting. No need for tools whatsoever.

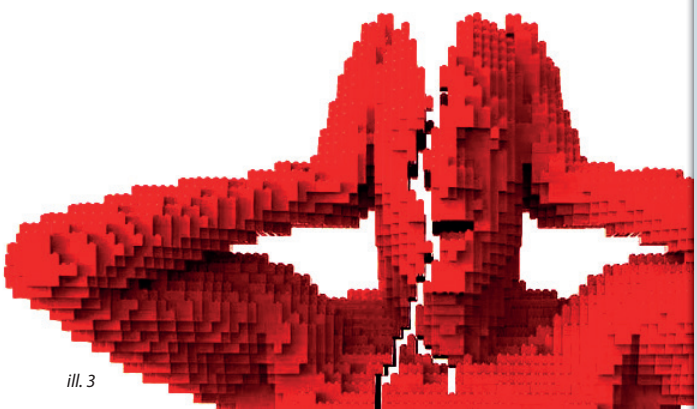
Product Interaction

The interaction with LEGO can be illustrated in the use of small "stations" at stores or banks, where children can play with them, while waiting. This means the usage is limited in relation to time, so the extend of a build will be limited. The interaction must be related to having something to touch, something to do with the hands, more than the creation of a complete structure.
Similarly with GeoMag, the modules are simple and come with no instructions of what to build. This must mean that there are two main scenarios of usage, this casual interaction of clicking random triangles together in the couch and the hobbyist level of building complex structures(ill. 3 & 4), which is also present with LEGO.

In relation to littleBits, the interaction is a bit more complex, but still related. There are still the two level of interacting, casual "clicking" and the use in model builds. The complexity is added from the fact that these modules are developed with learning in children as the objective. There are four types of "bits", power, input, wire and output, so in any interaction attention to the type of module has to be present.

Product Context

In all three products the intended use is related to creative development in primarily children. In addition to this there are the contexts related to casual use and hobbyist use.
Casual use without following any instructions is related to the intended use of creative development, while the more complex use at hobbyist level makes use of the modularity to build, as a mean to escape the triviality and for fulfillment when completing a structure.



ill. 3

SUMMARY

From the case studies two kinds of use scenarios, other than children's play, was found, casual and hobbyist. Further the simple assembly without tools is present in all involved products.
The casual use of the products shows an important factor in the quality of touching the products with no further agenda.

DESIGNING: NEW CONTEXT

This section follows the deconstruction to initiate the design phase by creating a new context. In this context, which is inspired by the case study's context,the product will be applied. This is done through finding trends and developments that may be relevant in the chosen direction of designing a construction toy

Result From Deconstruction

From the case study, the importance of a possible casual use of the product was highlighted. This could be the fiddling with the product while sitting in the couch, without focus on the product.
In the studied products, this casual feel can partly be related to material feel and partly to the ease of assembling two modules.
This factor will be included as a side quality in the same way as in the studied products, so a dominating context still has to be defined.

Further as a result from the previous research phase, crowdfunding will be taken in as a related context, since this is the initial market, the product will go through and with target users related to this.

Trends & Developments

Following contextual factors found in the deconstruction, a PEST analysis, based on subjective observations, will be performed to find other factors in trends and developments going on today.

Political

Focus on welfare
Focus on recycling
"Snowden era" – anti-surveillance

Economical

Financial crisis makes people more financial aware.
Crowdfunding makes everybody possible investors.
Crowdfunding makes it possible to raise startup funds.
Backers want to feel like part of the development process in crowdfunding campaigns.
Transparency is important to attract backers.

Social

Constant social contact through internet
Online access everywhere
Toys/Hobbies are a way to escape reality
Technology affect physical expressions
People like to work with tangible objects.
People want to customize their products.
People want to show off their work.

Technological

Microprocessors makes it possible to integrate small computers
Everything is wireless
Rising market of 3D printers
All shapes are possible through 3D printing
Open source raises development potential

The PEST analysis has led to a few combined, defining trends, which have further led to an understanding of what is going on in the world.
Technologically the world revolves around smart objects and information sharing and people want to feel special through customized products (Vong, Katherine 2012).
Following the financial crisis, risk awareness regarding financial investments is still high. This relates to the success of crowdfunding, but also underlines the fact that potential backers should be able to fully understand the process and products.

Customization and smart objects have been subjectual selected amongst the realized trends, along with casual context from the deconstruction and crowdfunding from research, as having potential in relation to this project.

- *Product Customization*
- *Crowdfunding*
- *Smart Objects*
- *A Casual Context*

SUMMARY

Using the PEST analysis following the deconstruction has given relevant contextual factors from a subjective analysis of current developments.
These are along with a factor inspired by the deconstruction stage taken further in the "ViP" process, to find interactions that will be fitting.

MARKET ANALYSIS

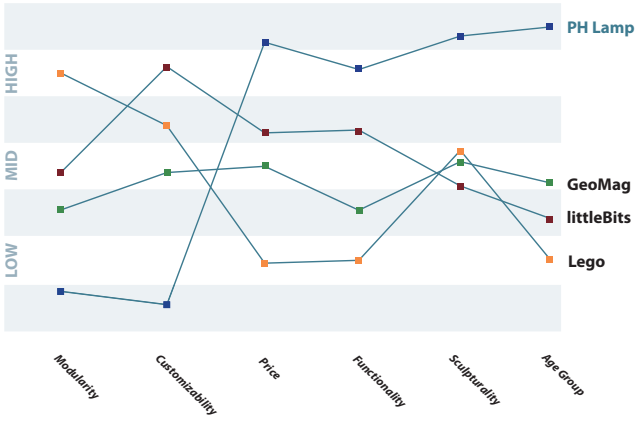
Following defining four initial contextual factors, a market analysis will be performed through using Porter's Five Forces and Blue Ocean Strategy Canvas. With the previous found factors based on trends, this will add a mean of testing if it is possible or necessary to differentiate further from the existing market before defining interactions that fit the contextual factors.

Porter's Five Forces (Porter, Michael E. 1979) tests the market in relation to suppliers, buyers and competition, while the subsequent use of the Strategy Canvas (Chan Kim, W. 2005) makes it possible to see where it would be possible to differentiate from the current market.

From the Porter's Five Forces [Appendix 2A] it can be derived that while there are few competitors aiming at an adult market, there are many substitute products marketed towards children.
As the competition is mainly marketed towards children, a mean of further differentiation could be added a further contextual factor, adding value related to the target users.

To find a contextual factor that makes the product differentiate further from existing products, the strategy canvas is plotted with the products used in the deconstruction phase set in relation to parameters that are considered to be most relevant in these products.

The canvas as shown below is further plotted with a PH lamp representing a product group that is evaluated to differentiate from the construction toys according to the Strategy Canvas. This has resulted in interior design having been added as a further parameter for the product context.



ill. 4

SUMMARY

The contextual factors of Casual Context from the deconstruction, Crowdfunding from research, Customization and Smart Objects from a PEST analysis are further expanded with Interior Design as a result of the performed market analysis. This way the further framing will be based on a basis that is more differentiated from the existing market of modular construction toys.

DESIGNING: PRODUCT INTERACTION

The interactions found in the following section indicates the intended use of the product to fit the found context. A brainstorm on each context factor initiated the exploration of a new interaction to explore the frame of possibilities. Subsequently selected interactions will be further explored and refined.

Contextual Factors

From the previous stage the context of the product being developed has been set as the following:

- *Casual Context*
- *Customization*
- *Smart Objects*
- *Interior Design*
- *Crowdfunding*

These factors have been explored through a brainstorm [Appendix 2B] and will now be further expanded with a fitting interaction.

Toys As A Metaphor - The IKEA Effect

With inspiration in the assembling related to building both a new piece of IKEA furniture and a new LEGO figure, the "playing" with toys has been investigated in relation to adding qualities to such products.
Studies shows people to have a closer relationship with furniture they have assembled themselves, than with furniture that was fully assembled when bought (Landers, Richards 2011).

This led to an angle of making the construction toy a piece of interior design, that can easily be assembled and disassembled by the user. Making the toy quality an interaction of assembling in an interior design product.

Taking in the factor of a casual context, the product interaction needs to be more than just assembling and disassembling the product. This could be done through having both a Module-Assembly relationship and a Module-Module relationship. Thus a module has to work as a product in its own, a toy, and as a part of a full assembly, an interior design product.

Customization Methods

The customization of a product can be done in many ways. To narrow this, methods that would be optimally used with interior design has been explored. This led to two directions, one related to modularity and one related to custom add-ons. Modularity customization is related to assembling the product individually, where a range of varied modules could be put together according the users wishes.
The other direction of customization is inspired from the previously performed PEST analysis, where the trend of 3D printing is present (Gobry, P 2011).
The potential of having 3D printed modules interact with the product is taken further to the next stage along with the customization possibilities of modularity.

Smart Objects

Following the addition of making 3D printed add-ons a part of the product, the exploration of smart objects has taken inspiration in the modularity in littleBits, where electronic modules that can be put together as needed in the individual context. The interaction of adding add-ons will thus be expanded to include electronic expansions in some way.

SUMMARY

Expanding the contextual factors with interaction qualities has added further delimitation in making it a modular assembly in an interior design product that has qualities from construction toys.
Customization will be possible from both assembling the modules in different ways and from integrating a system of custom add-on from 3D prints.
The quality of add-ons will further include electronic add-ons to make the product fit the trend of smart objects through it's modularity.

DESIGNING: PRODUCT QUALITIES

This stage will set parameters for the subsequent concept development, by exploring qualities that evoke the interactions found in the previous stage. These will be found through inspiration from existing products and from reaching out to the potential users.

Product Interaction

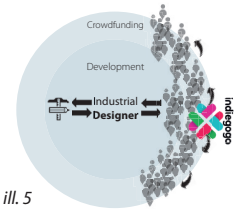
From the previous stage the following interactions has been set.

- Interchangable Modules
- Interior Design With Toy Qualities
- 3D Printed Add-Ons
- Electronic Add-ons

These will now be explored in relation to potential user and existing products.

Reaching Potential Users

The importance of customization in the product has, with inspiration from the research on how to prepare for crowdfunding, led to adding the quality of co-creation (Gouillart, Francis 2010) to the project.



ill. 5

Initially research has been done superficially in relation to users by looking at trends at different online communities related to 3D printing and model building, but with the prospect of custom add-ons, the step of including these users further through co-creation opens up for getting specific wishes and other feedback directly related to this project, including what kind of modules they wish to have included in the product. Along with this it will set up a basis of creating the essential following before publishing through crowdfunding (ill. 5).
A brainstorm on potentially related fields has been combined with a brainstorm on ways of reaching users in these fields. From this a combination of setting up a blog and creating posts on a wide variety of related communities is done.
This has further changed the target segment to include model builders of various kinds.

Qualities In Existing Products

To explore the product modularity in existing products, further studies on both LEGO and IKEA has been performed. While previous case studies explored the individual product qualities, this study will be based on exploring what makes the modularity in IKEA furniture different from that in LEGO toys and thus be able to apply qualities of toys in an interior design product.

From comparing the two from an outside view of boxes, show room and instruction booklets, an initial thesis of a main difference being that LEGO is presented and sold in individual boxes on the shelves of toy stores. IKEA presents their products in a context in their own stores. And from instructions that LEGO has a keen focus on the context and possibilities while IKEA is more of job that has to be done.

The users where then asked for input based on this thesis. While there were few answers it gave an indication that, in relation to target users, the main difference is the tangibility in the smaller module size along with ease of assembling [Appendix 4A].

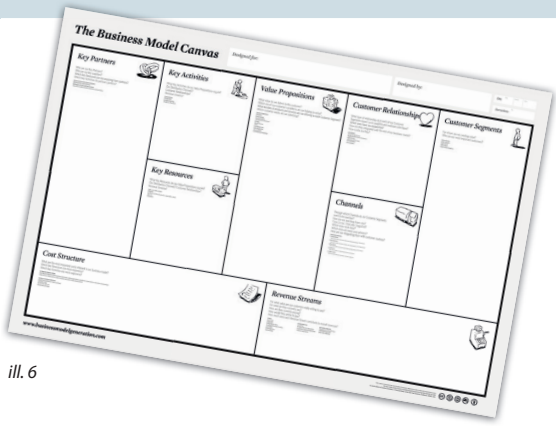
SUMMARY

The interaction related to customization along with the previous advice of building a following prior to launching a crowdfunding campaign, has led to an inclusion of users through co-creation. The target users has as a consequense of this change to "Model Builders, 25+"
Interaction related to the individual modules has through user input given an indication of a module size and interaction related closer to LEGO than to IKEA to make a modular interior design product with toy qualities.

BUSINESS MODEL CANVAS

To make sure the developed concepts will be based on a coherent business model, a business model will be partly defined based on the parameters found in the previous sections.

The Business Model Canvas (Osterwalder, Alexander 2010a) (ill. 6) is used to both support the product qualities in relation to value proposition and to make sure generated concept ideas have potential to generate revenue.
With crowdfunding closely integrated in the concept, the business model is, as with the project, initiated by defining the customer segment and customer relationship.



ill. 6

Customer Segments

The concept combines qualities of mass market with niche market, through reaching the mass market in construction toys and interior design with the niche of 3D printing. The concept development will however be focused on the niche market related to 3D printing and model building and will include users from these markets in the process..

Value Propositions

With the inclusion of 3D prints and modularity in the product qualities, the value proposition takes this concept and expands the qualities of interior design products. The users gets to make the product their own to greater or lesser extend through either just the assembly or additionally adding customized or electronic parts.

Revenue Streams

Since the 3D printed parts, created by the customer, don't generate any revenue in itself, the proposed product will be based on a core product with elements too advanced to be 3D printed in the main modules and through the electronic add-on modules.
Alternate revenue streams explored in this project includes the option of basing the business on selling 3D models for the user to print. This model was considered too fuzzy however, based on the competition from free online communities like Shapeways.com and wouldn't be able to include electronic modules.

Customer Relationships

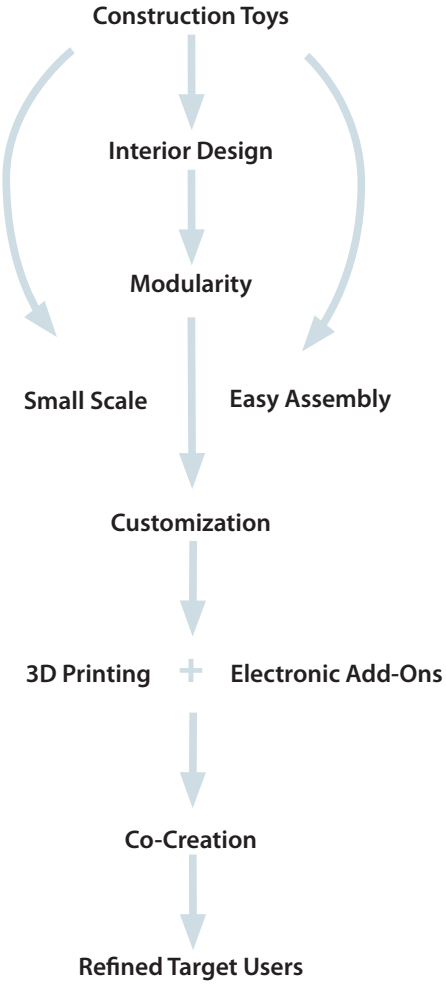
After buying the product the user can assemble it and expand it with 3D printed models. This way the product is finalized through co-creation. This relationship can be further emphasized through facilitating communities for the users to share their personal designed customizations.

SUMMARY

Through defining initial parts of the Business Model Canvas, both the relationship to the user and requirements to make the product able to generate revenue has been made clear. Customization has to be an added quality, so the users will pay for the core product and not just print the complete product on their own 3D printer.

CONCLUSION TO FRAMING

The steps included in the framing will be pointed out to get an overview of how the project has changed as a result from these. The project delimitation and scope will further illustrate the resulting changes from the framing stage.



DELIMITATION

+ *Limited Development Time*
+ *Publishing through IndieGoGo*
+ ~~*Targeted Male Users, 25+, No Children*~~
+ *Targeted Model Builders, 25+*
+ *Co-Creation Process*
+ ~~*Construction Toy*~~
+ *Toy Scale*
+ *Easy Assembly*
+ *Interior Design*
+ ~~*Modularity*~~
+ *Interchangable Modules*
+ *3D Printed Add-Ons*
+ *Electronic Add-Ons*

SCOPE

DESIGN BRIEF

The design brief will state the basis for the following development through defining parameters for the design based on the results from the previous stages. Further a mission and vision for the project will be defined.

Background

From a basis of using the potential in crowdfunding, the framing process has taken the project from a direction of developing a construction toy to a modular interior design product with the qualities of construction toys.
The product will include modularity with add-on functionality, of which details will be co-created with users of online model building communities.

Market Potential

The proposed target market is a "blue ocean" market, through combining qualities of two "red ocean" markets, the toy market and the interior design market. While this gives substitute products from two different fields, it doesn't give any direct competition and as such is creates a derived product category.
The product will include advanced, non-printable parts so that the whole product can't just be 3D printed as a whole.

Mission

The aim is to take the joy of building, known from children's construction toys, and add it to the context of an adult through interior design products.

A subsequent mission is the goal of reaching the proposed market through crowdfunding.

Vision

To both set the product in an adult context and have construction toy qualities. Modularity in the product will be based on tangibility of toys in the single modules, but on creating an interior design product in an assembled product.
Added value will be created through including qualities from adding custom made structures and integrating electronic modules, inspired from "littleBits".

Parameters

- *Limited Development Time*
- *Publishing through IndieGoGo*
- *Targeted Model Builders, 25+*
- *Co-Creation Development*
- *Toy Scale*
- *Easy Assembly*
- *Interior Design*
- *Interchangable Modules*
- *3D Printed Add-Ons*
- *Electronic Add-Ons*

CONCEPT GENERATION

INTRO TO CONCEPT GENERATION

This stage will revolve around developing the set parameters into a feasible concept within the delimitation, to take to the next stage of concept development.

Method

To give form to ideas that have formed as a result of the research and framing of the project, a session of generating loose concepts through a sketching brainstorm, first based on potential in interior design, to open up and subsequently narrow back in through adding the set parameters to the found potential.
Afterwards development will take the concept in a feasible direction.

Paramters

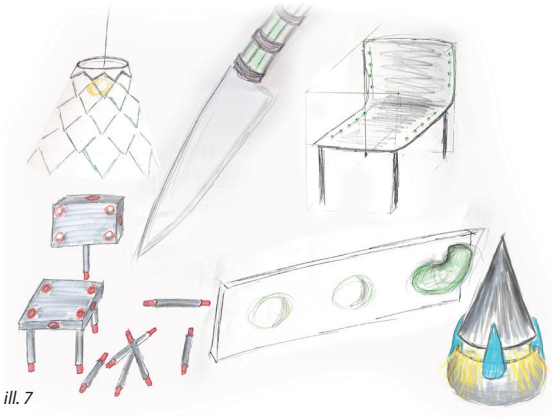
- *Limited Development Time*
- *Publishing through IndieGoGo*
- *Targeted Model Builders, 25+*
- *Co-Creation Development*
- *Toy Scale*
- *Easy Assembly*
- *Interior Design*
- *Interchangable Modules*
- *3D Printed Add-Ons*
- *Electronic Add-Ons*

Persona

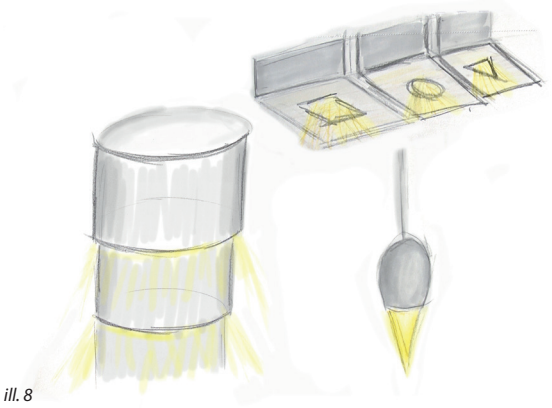
A target persona [Appendix 3A] that will represent the attributes of the combined group of users has been defined, based on subjective observations on the communities of the target users and subsequent written into an empathy map (Osterwalder, Alexander 2010b).
This persona will then act as a guideline in the following process of generating initial concepts based on the developed design brief.

Name: *Paul*
Age: *31*
Relationship: *Married*
Occupation: *Graphic Designer*
Location: *UK*

Model Building Interests: Have recently invested in a 3D printer, which is used in combination with an interest in LEGO. One way it is being used is as way of expanding LEGO structures with organic details such as a snow drift.
Being an AFOL, adult fan of LEGO, Paul has LEGO set placed on shelves around the house to the degree his wife lets him.



ill. 7



ill. 8

Concepts Generation

Ideas within the frame of interior design, without including the set parameters, found thorugh a brainstorm with a following sketching session (ill. 7), revolved around products like kitchen accessories, furniture and lighting.

Following this the parameters and persona was included in the sketching and ideation. This led to furniture and kitchen accessories being eliminated, after a subjective benchmark, due to lack of potential in including especially electronic modules.

Lighting (ill. 8) on the other hand showed potential in relation to a modular assembly with add-on possibilities and a potential high "wife acceptance factor", inspired by the defined persona.

SUMMARY

A persona based on subjective observations has been generated along with listing parameters for the design. These have set the basis for choosing, through brainstorms and sketching, to narrow the project to developing a lighting concept.

CONCLUSION TO CONCEPT GENERATION

As a result of the concept generation, the direction of the project has been further narrowed in scope. This change to scope and delimitation will be illustrated along with a summarizing conclusion.

SCOPE

DELIMITATION

+ *Limited Development Time*
+ *Publishing through IndieGoGo*
+ *Targeted Model Builders, 25+*
+ *Co-Creation Process*
+ *Toy Scale*
+ *Easy Assembly*
+ ~~*Interior Design*~~
+ *Interior Lighting*
+ *Interchangable Modules*
+ *3D Printed Add-Ons*
+ *Electronic Add-Ons*

CONCLUSION

Following the defining of a design brief, the set of parameters found through delimitation from the research and framing stage, have been the basis for a sketching workshop with the aim of narrowing the direction through defining the concept further.
Within the frames of interior design the sketching has revolved around kitchen accessories, furniture and lighting before being narrowed to lighting, based on a benchmark on both set parameters and the needs of the defined persona.

CONCEPT DEVELOPMENT

INTRO TO CONCEPT DEVELOPMENT

The concept development takes the defined concept from the concept generation and further defines it. This intro section will discuss the scope and focus in the furter development with the requirements and possible limitations in developing interior lighting design in mind

Scope

In the initial development there are two main areas in which challenges have to be resolved.

Modularity

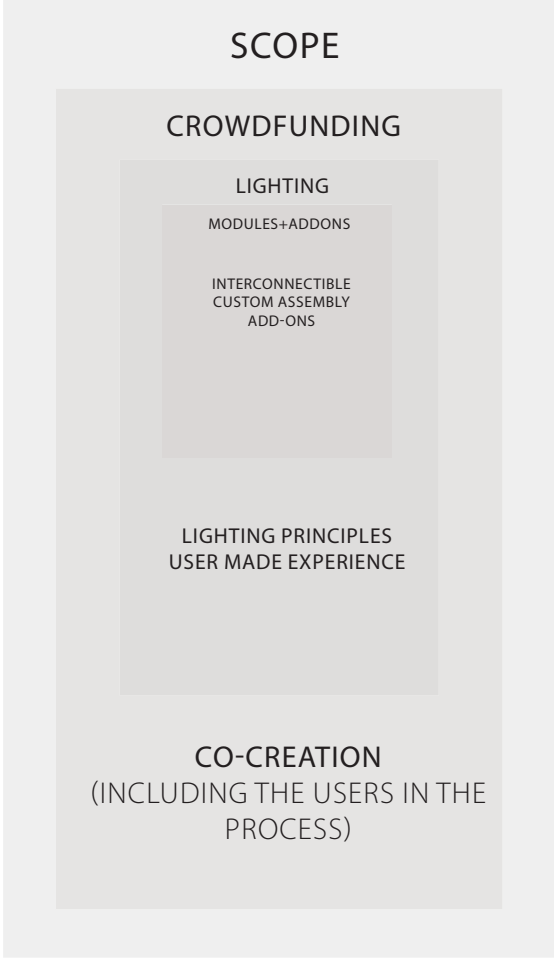
- *Connection type*
- *Scale*
- *Module shape*

Within modularity, the development has to have both the individual module, the assembled product and the connection between them in mind. Further as found in the framing stage, the scale has to represent that of a toy. This leads to the challenge in module shape, where a shape that both offers a fitting number of customization options, has a transparent way of connecting with other modules and can facilitate the addition of add-ons.

Context

- *Lighting quality*
- *User Made Reflection Filters*

The challenges in context are related to general lighting design. How it best lights up the context, offers a diffuse light while still is able to offer a user made experience through add-ons.



SUMMARY

The intro has given an overview of challenges that need to be adressed in the following development to combine the different qualtities with a lighting product.

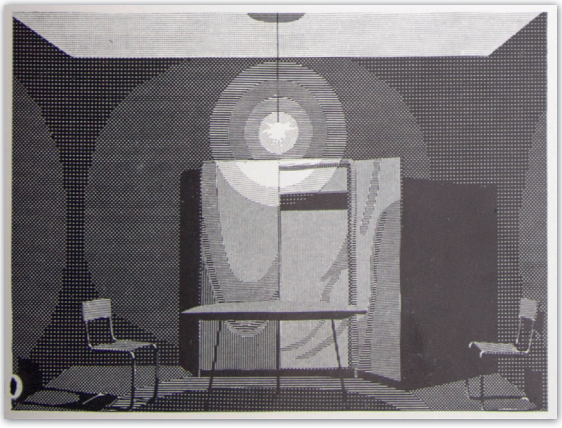
LIGHTING PRINCIPLES

Since the focus of the project is on developing modularity and add-on qualities in lighting design, with focus on light qualitiy a lesser part of the development, this section will cover the exploration of some basic principles that will be inspiration for covering this part of the product.

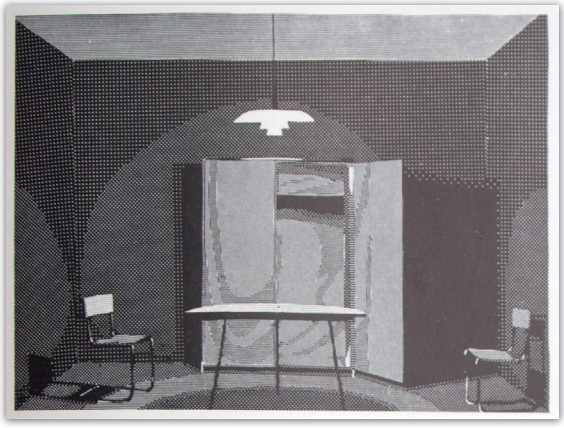
ill. 9

Inspired by the studies of PH and the fact that focus is on developing a modular system, the lamp basis will be focused on principles found in basic lamp designs.
This comes from PH's studies where he shows how a downward directed light will enhance the qualities of the light in the active living area (ill. 10 & 11), based on a need to utilize the available energy best possible at his time (Jørstian, Tina 1994).
These aspects are combined with the combination of a trend of exposed light sources, as seen in the muuto pendant lamp (ill. 9), and the wide range of bulbs with different qualities in relation to glare.
Along with the modularity in the lamp itself, this gives the users further options in defining the light quality to make a custom user experience according to each individual contexts demands.

The choice related to these light principles, is further based on the parameter of custom add-ons, which a downward directed shape could potentially facilitate on the top half, where add-ons like 3D printed sculptures could be integrated without disturbing the downward directed light.



ill. 10



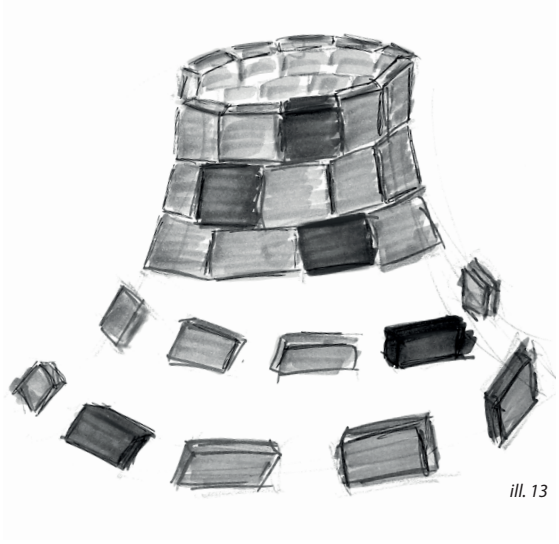
ill. 11

ill. 12

To derive a concept for the further development of modularity in a lamp, some basic shapes (ill. 12) with the potential for downward directed light is chosen for tests regarding breaking them up in modules.

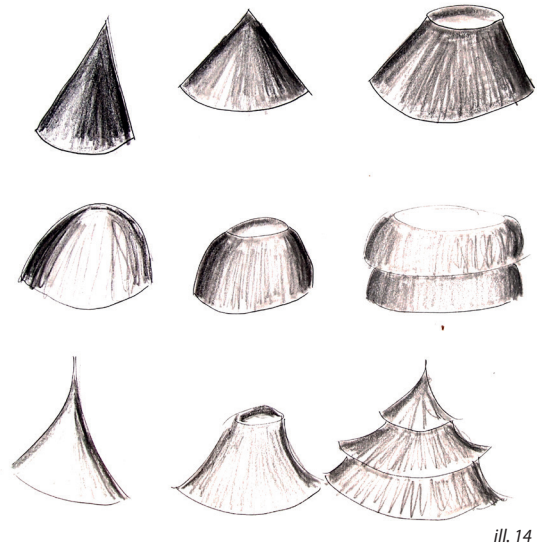
These basic shapes are the "Semi" pendat, a conic pendant and the opposite of the Semi, a spherical pendant.

Initial tests revolved around sketching potential ways of making these modular (ill. 13), either by subdividing them or through an additive system (ill. 14).
An obstacle in the conical and Semi shape appeared to be the growing diameter of the lamp shade. This meant that a subdividing modularity would require either a variety of modules, so that a bigger size can be added for each additional "ring" that is added to the shade, or a more advanced system for assembly. Based on this, a spherical shape is chosen.



ill. 13

While at a full sphere the spherical lamp gives a different look and effect than the alternatives, it could be developed to a modular system, with the, however limited, customization in letting the user decide how much of a sphere should be assembled.



ill. 14

SUMMARY

The principles of PH in having a downward directed light has given inspiration to basing the further development on a basic lamp shape with the potential of this quality. The two-sidedness further adds potential in using the upward directed half for customizations like 3D-Printed add-ons with sculptural effect.
A spherical structure was chosen among the tested lamps for modular development.

MODULARITY

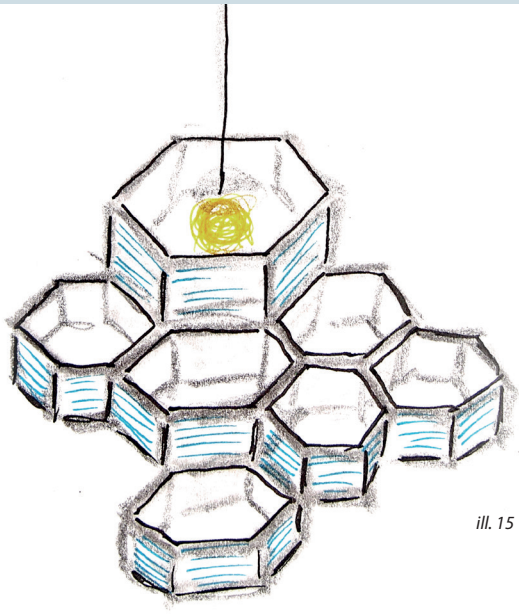
To take the chosen shape to the next level of modularity and create a way of integrated the product parameters, inspiration for an additive system will in the section set the basis for choosing a way of creating modularity and from this a way of integrating a system of add-ons.

Inspiration In Nature

With some initial sketches on the subject ending in a rod based composition, it soon became clear that this wouldn't be sufficient in a lamp structure, as more shade than what this provided were needed.
With GeoMag (ill. 16) consisting of rod that can form triangles and LEGO consisting of rectangular bricks, the direction of the modular system has been differentiated from these by looking for an alternative geometry. In the process of getting from a rod based composition to wider covering geometries, inspiration has been found in nature.

Scales as on snakes and fish, palm trees and pine cones all have a scale structure based on attaching them to a central base. If geometries for constructable modules should be developed from this, it would require a base "skeleton" to which the scales could be attached. For this reason further inspiration for creating modules another way was looked into.

The structure in honeycomb, created from hexagons (Pearce, Peter 1990a), inspired the development in a direction of how this structure or one with similar abilities could be adapted to an additive arrangement (ill. 15) where it would create a spherical shape through a modular system.



ill. 15

ill. 16

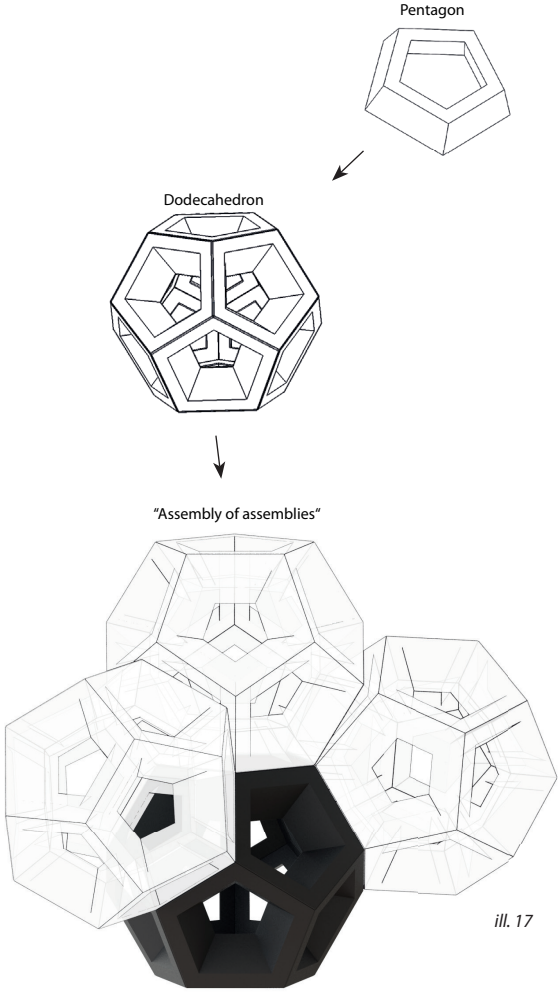
SUMMARY

The development has moved towards a potential in arranging hexagons or related polygons to create an additive system that could be adapted for a modular, spherical construction

SPHERICAL MODULARITY

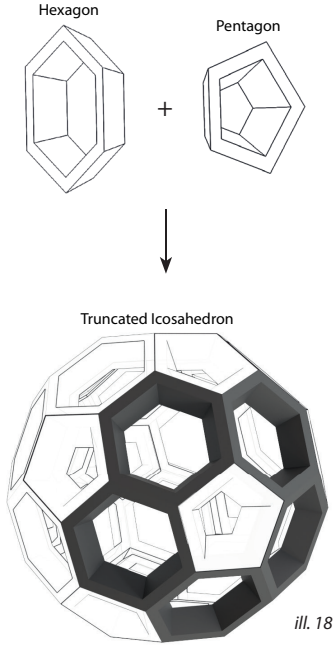
The previous found inspiration in hexagons will in this stage be further developed to an additive system from which the development of a modular system can be based. The ease of assembling through CAD has been used to easy test different additive systems from simple geometries.

Packing hexagons together gives a planar surface, while pentagons give a dodecahedron, a 12 sided dice structure. This realization gave inspiration to explore spherical construction made from similar polygons.
The tests in this exploration has been done digital, to make use of the ease of creating an assembly from a base 3D model.
Assembling 12 pentagons would give a spherical polyhedron as shown below, a dodecahedron.



ill. 17

To find a fitting polyhedron with more customization options than with the dodecahedron, other possibilities were evaluated. Some were too simple and other would require a variety of modules. Another possibility explored is the addition of assembling assemblies (ill. 17). While this would give many options it would give the spaciousness for facilitating a lamp. Instead a truncated icosahedron (ill. 18) (Pearce, Peter 1990b) was chosen, as it provides the required openness and enough polygons, with a mix of hexagons and pentagons for a variety of customization and modularity options.



ill. 18

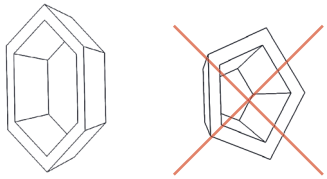
SUMMARY

Explorations made through digital tests and based on basic polygons, solids and polyhedrons has given a spacious structure in the form of a truncated icosahedron, on which the further development can be based.

CUSTOMIZATION & ADD-ONS

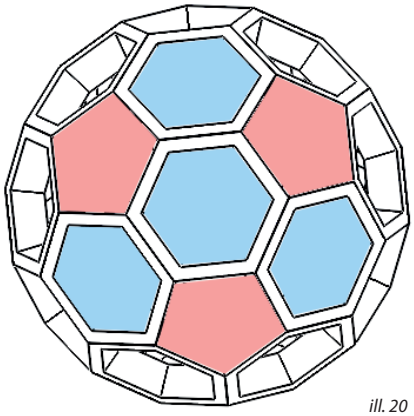
Having found potential in a truncated icosahedron structure for combining modularity with lighting, the parameter of customization and add-on potential has to be explored and integrated.

In the structure on which the development is based, a truncated icosahedron, hexagons and pentagons are combined. To make the use of both add-ons and of the modules on their own simpler, the pentagons are removed so that there will initially just be an open space in their place (ill. 19). This limits the shape the add-ons have to be adapted to, to one instead of two.



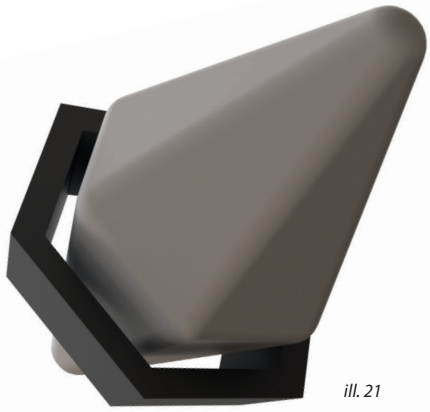
ill. 19

While there is just one polygon now, the add-ons could potentially fill the space of the pentagons instead of being placed inside the hexagons. It is however chosen to place them in the hexagons, as illustrated with blue below (ill. 20), since this would give a tighter integration where the modules can hold the add-ons in place.
A socket module will be made from a pentagon, so the other modules will attached around this as a basis.



ill. 20

This way add-ons with a hexagonal shape can be tightly placed in the modules (ill. 21). They can be held in place by gravity in the upward pointing modules, or get further integrated through the tectonics holding the modules together.



ill. 21

To hold 3D printed add-ons in place in the structure through more than just gravity, a system will have to be developed later in the process. This could potentially be through 3D prints shaped to grab the module or by an additional holding component.

SUMMARY

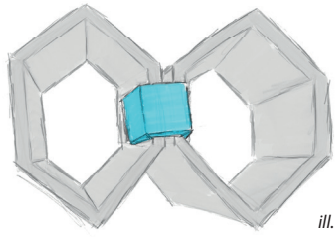
The structure has been reduced to solely consisting of hexagons to give a simpler product in both interaction and production.
Through excluding the use of pentagons, except for the socket module, the use of add-ons has been included in these hexagons, but might require further development to be tightly included in the modules.

TECTONIC CONCEPT

With the customization and concept of electronic add-ons combined in hexagonal modules, a system for connecting the individual modules to each other has to be found.

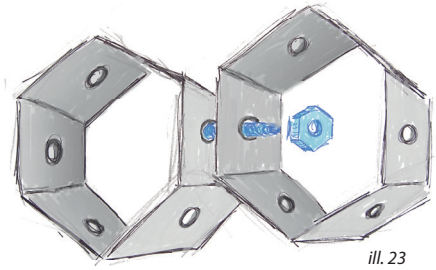
Different ways of making modules interconnectible has been explored through 2D test in a mix of sketching and making simple paper models.

The potential system that was tested includes adding a small clip (ill. 22) to clamp two modules together. This was abandoned since it would interfere with the simple composition of the sphere.



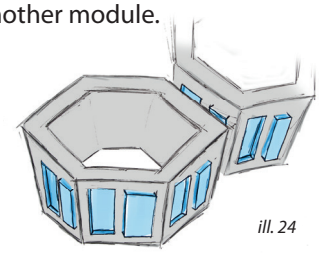
ill. 22

Another cheap and simple solution was using bolt and nut (ill. 23) or a similar system to hold modules together. This would however be to much work, as one of the product parameters is related to easy assemble.



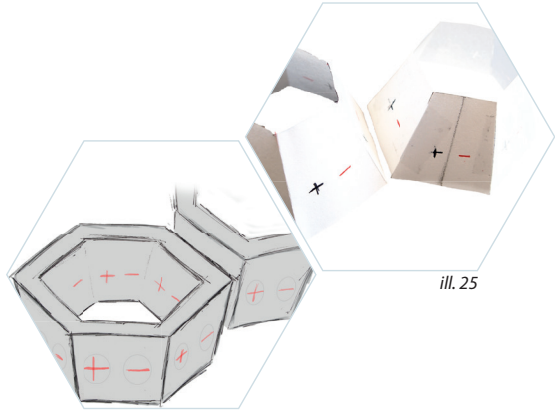
ill. 23

Instead a system inspired by LEGO bricks was tested. This would require both a male and female connector on each side (ill. 24), since one side would have to be connected to an identical side from another module.



ill. 24

The male-female connectors led to trying out magnetic connections (ill. 25). This would from the LEGO inspired system have further advantages in relation to potential strength and a smooth surface with the magnets hidden inside.



ill. 25

SUMMARY

Through exploring potential solutions for assembling modules, magnetism has been chosen, since it gives the freedom of easily connecting any modules with no use of tools or other external parts.

CO-CREATION PROCESS

A parameter set in the process is the inclusion of potential users from a variety of internet communities related to the concept. This section will reflect on the use of this and how it has affected the development.

The use of co-creation input have been very limited in this part of the process [Appendix 4A]. This is both related to not having been transparent enough in the process, which could have given more quality in the feedback (Belsky, S. 2010), and to not having been specific enough in the published posts.
Through the development the inclusion of users have been limited to presenting a concept rendering (ill. 26) with an attached explanation of the concept at the current state.
With the development having included technology and shape, the users could have further been included in the selection of an appropriate technology for connecting modules, with potential positive results.
Due to this realization the users will be further included in the next stage of detailing, where more specific questions will be asked, to make it more comprehesible to the users.


ill. 26

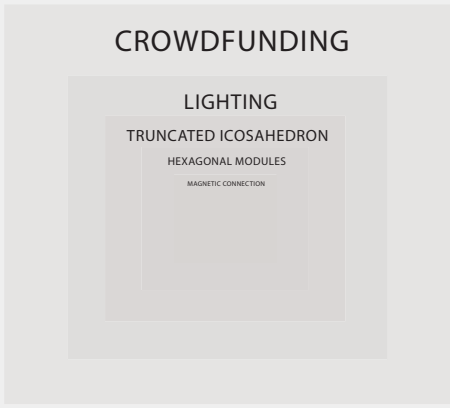
SUMMARY

The use of potential users in the process, has been partially unsuccesful, due to both being too untransparent in the development and a lack understanding the concept.
As a result the users will be further included in the coming stage, where more specific questions will be asked.

CONCLUSION TO CONCEPT DEVELOPMENT

Through the concept development a structure on which the further detailing can be based has been chosen, along with a technology for connecting modules. The changes made as a consequense of this is illustrated through an updated delimitation and scope.

SCOPE



DELIMITATION

+ *Limited Development Time*
+ *Publishing through IndieGoGo*
+ *Targeted Model Builders, 25+*
+ *Co-Creation Process*
+ *Toy Scale*
+ ~~*Easy Assembly*~~
+ *Magnetic Assembly*
+ ~~*Interior Lighting*~~
+ *Spherical Lamp*
+ *Truncated Icosahedron*
+ ~~*Interchangable Modules*~~
+ *Hexagonal Modules*
+ *3D Printed Add-Ons*
+ *Electronic Add-Ons*

CONCLUSION

Through the concept development, the concept of designing a lamp based on the qualities found in construction toys, have been narrowed in to a concept of a modular sphere consisting of magnetic, hexagonal modules.
A spherical lamp has the potential of including PH's principles of directed light downwards which can be optimized according to the users needs through add-ons.
The parameters of easy assemble and interchangable modules, based on the research on the differences between LEGO and IKEA, have affected the development in a direction of a single type of module, that can be assembled to form a truncated icosahedron structure.
The use of add-on modules will be integrated in this module, so that new add-ons can be added along with new modules.

CONCEPT DETAILING

INTRO TO CONCEPT DETAILING

Concept detailing will be launched with setting the focus of further detailing. The limited timeframe, before the project will be launched through IndieGoGo, will be discussed in relation to this focus, along with the overall vision for this stage.

Focus

The parameters from delimitation through out the project sets a basic guideline for what will have to be detailed and how it should be done.

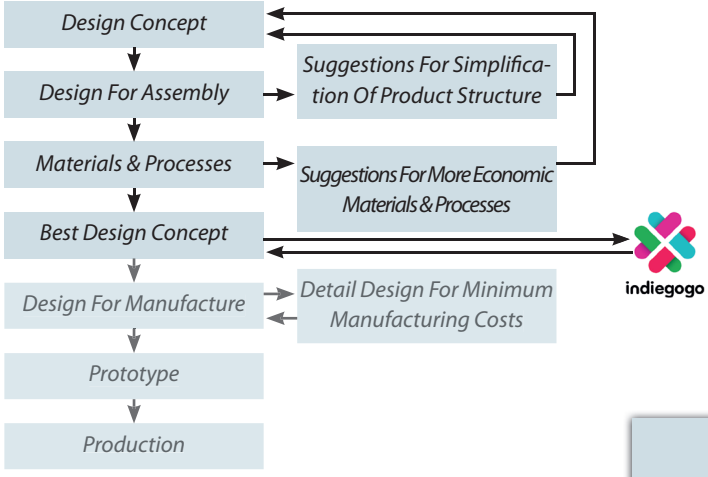
With the previous concept development focused on creating a feasible basis through developing a concept for a modular lamp, the detailing includes further integration of toy qualities to make the lamp include the qualities of modular construction toys.

The concept detailing will also include integrating the use of add-ons, for a holistic product, where these will be an essential part.

As the concept is to be based on magnetic assemblies, the inclusion of these has to be part of the composition, to make the final concept realistic in relation to production and price, as well as in tangibility of the modules.

The model shown below, which summarizes the steps in Design For Manufacture And Assembly (Boothroyd, Geoffrey 2001), has been used in the detailing process to structurize in relation to vision.
Steps related to aesthetic considerations have been taken in "Design Concept", after which considerations related to assembly and manufacture has been taken.

With the aim om publishing through IndieGoGo at the end of the project period, the vision is to have an optimized design concept with alternative possibilities in materials and processes available.



SUMMARY

The vision for the concept state at the crowdfunding launch, has been placed as a following step after the product has been optimized in relation to materials and processes.
Through the concept detailing the concept of magnets and add-ons will become an integrated part of the product.

SIZE REFERENCES

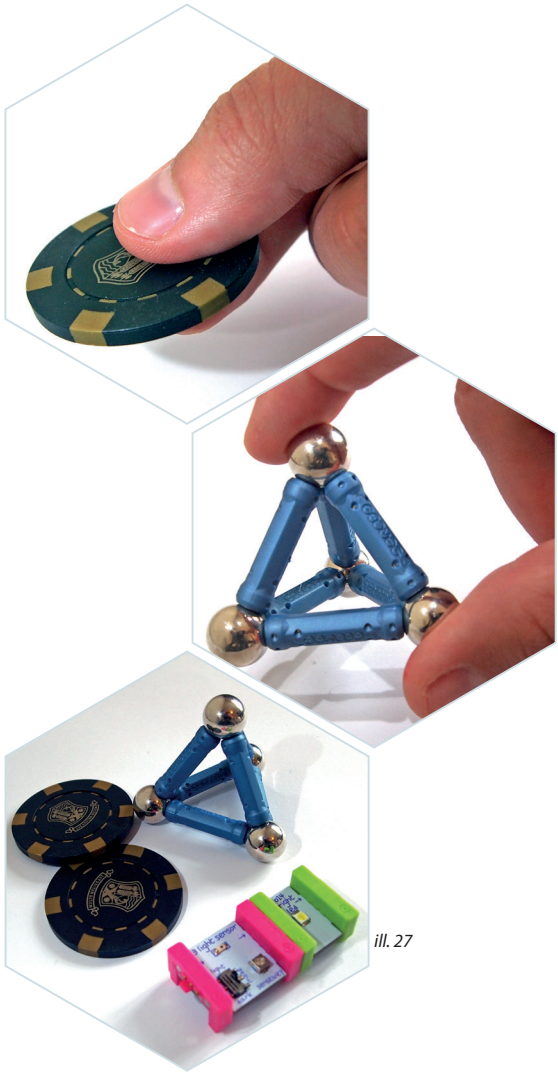
To get a base reference size for modules, parameters based on technical requirements and reference products with a similar tangibility, will initially be found.

Module size has been affected by factors from two sides, which has led to a combination of considerations [Appendix 4B]. On one side there is the toy factor in keeping the individual module tangible, inspired by toys (ill. 27). On the other side there are technical requirements related to both the socket and to the prospect of adding both custom and electronic add-ons.

To find an initial appropriate size with these factors in mind, some reference products have been used.
For tangibility a poker chip has been referenced for thickness, GeoMag has been used for width and the size of High Torque Knobs, which is 38-76 mm according to The Measure Of Man & Woman (Tilley, Alvin R. 2002) for overall module size.

3D prints sets limits regarding max size of a module, since add-ons should be printable on a regular 3D printer. This limit has been set at 20x15 cm in the wide end of a module [Appendix 4C], which is not a problem with the size found from tangibility and socket factors.

- *GeoMag width*
- *Poker Chips thickness*
- *Max. Module size of 20 x 15 cm*
- *Module size in the proximity of 38-76 mm*



ill. 27

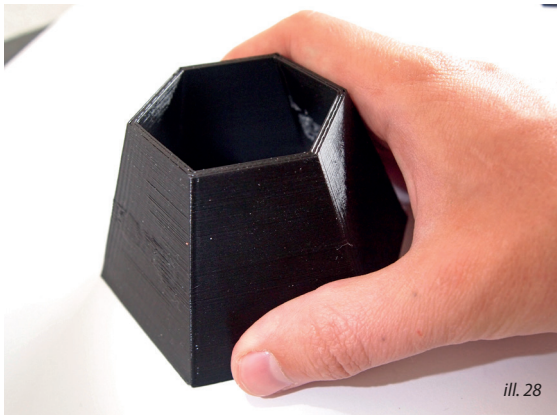
SUMMARY

A base size for modules have been found in reference products along with technical specifications from involved parts, including socket and add-ons.

MODULE SIZE

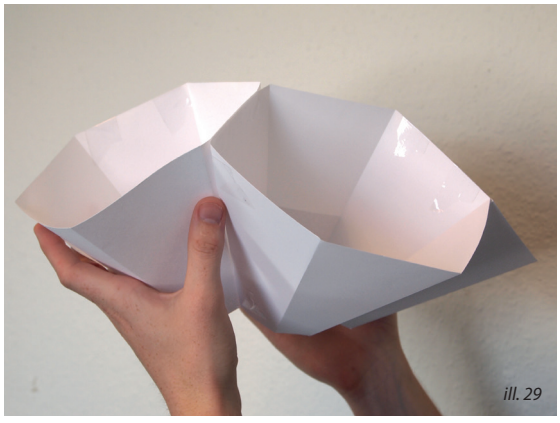
The setting of a base module size through reference products will be explored further in relation to tangibility through testing mock up modules.

Initial module size, based on an assembly size of 40 cm was first tested from 3D printed modules (ill. 28) to get a sense of tangibility along with a full assembly made from paper models.



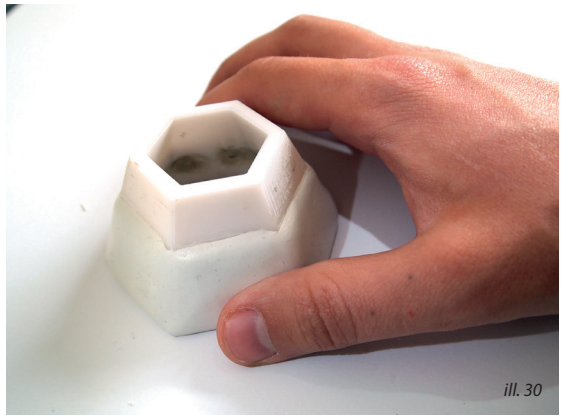
ill. 28

While this size could work in an assembly, the relation to a hand didn't fit that of the previously referenced products (ill. 29).



ill. 29

Instead smaller modules, based off GeoMag dimensions was tested.



ill. 30

These fitted the size of a hand (ill. 30) and previous reference products better and since it would still work as an assembly through switching from e27 to e14 socket, which would allow the wall width to be as low as 20 mm, this was chosen as future size reference through out concept detailing.

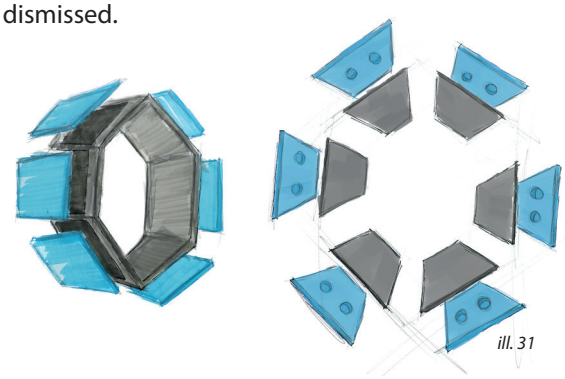
SUMMARY

A compromise between module size and assembly size have been found through testing the tangibility of mock ups of both individual modules and full assemblies.

MODULE COMPOSITION

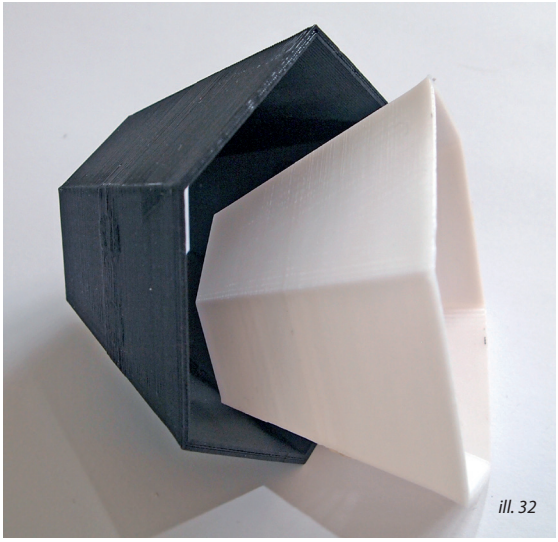
Using the tectonic concept of magnets, requires a way of integrating magnets in the module's composition. Different methods have been explored, with production, visual look and feel of the product in mind.

As with the reference construction toys, the tangibility aimed at in this product is related to a feeling of quality. Based on this compositions that would compromise quality of the modules have been dismissed.



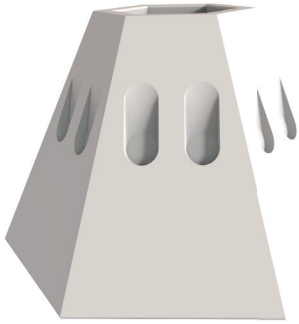
ill. 31

Instead options of opening the modules have been explored, to create an interior and exterior shell. Possible solutions include dividing the exterior shell in six parts or both the exterior and interior (ill. 31).
While this would optimize these parts in relation to production by injection molding (Lesko, Jim 2008), it would give less coherence in the composition and require more manual assembly.



ill. 32

To get a coherent composition in the product, the chosen division of parts consists of a "sandwich" structure (ill. 32) of two parts with magnets in the middle.



ill. 33

The challenges in this composition lies mainly in avoiding under cut in the molding process, since the modules are conical and need holes for placing the magnets. To deal with this, draft has been added (ill. 33) to make these holes able to come out of the mold. This means all edges have a draft angle.

The socket module, which will be the basis of an assembly, will include magnets placed similarly, but haven't been further detailed yet.

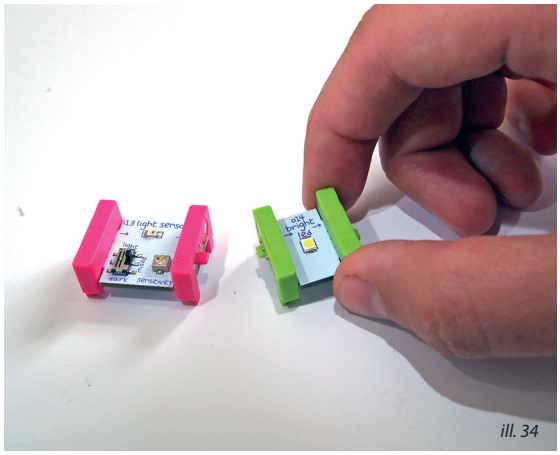
SUMMARY

A concept of dividing modules in a sandwich structure have been seleceted, to get coherence in the surface of both the interior and exterior parts. Initial production challenges have further been dealt with through adding draft to alle edges.

MAGNETIC ASSEMBLY

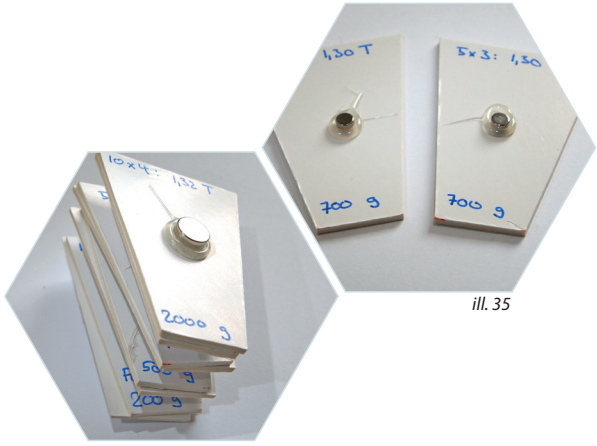
Using magnets for module connection requires a fitting strength, so that the modules can be easily pulled apart, but don't fall down when hanging in an assembly. Different strengts have been tested in relation with existing construction toys as reference.

To find a fitting magnet strength for a product in this category, a mix of testing existing product (ill. 34) and different kinds of magnets have been used as reference.



ill. 34

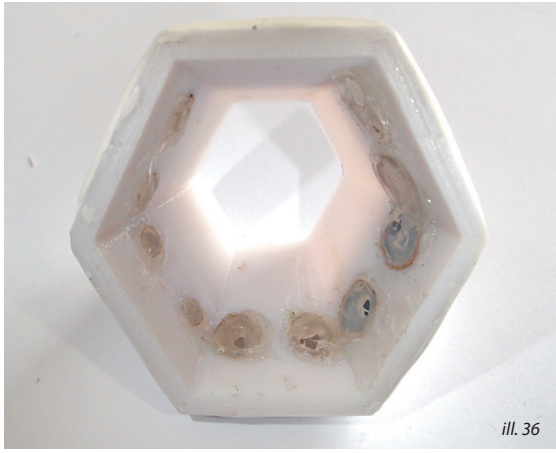
LittleBits and GeoMag has a strength close to 4N, so the initial vision was of a similar strength. To test different solutions a range of magnets from 2N - 20N was arranged in pairs (ill. 35).



ill. 35

As the magnets would be part of a composition, where they would be covered by a 1,5 mm wall, each pair of magnet was divided by two pieces of 1,5 mm cardboard.

To test how these strengths would further feel, when connecting real modules, 3D printed mock ups were manufactured (ill. 36).



ill. 36

A fitting strength was found in between 5N and 7N before the distancing, which gives a magnetic strength of approximately 4N over the distance. [Appendix 4D].

SUMMARY

Potential found in the tectonics have been used to integrate functions in the modules. The action of dis-assembling have been made easier and add-ons have been integrated through space to hold wires in place and making the surface of module and add-on flush.

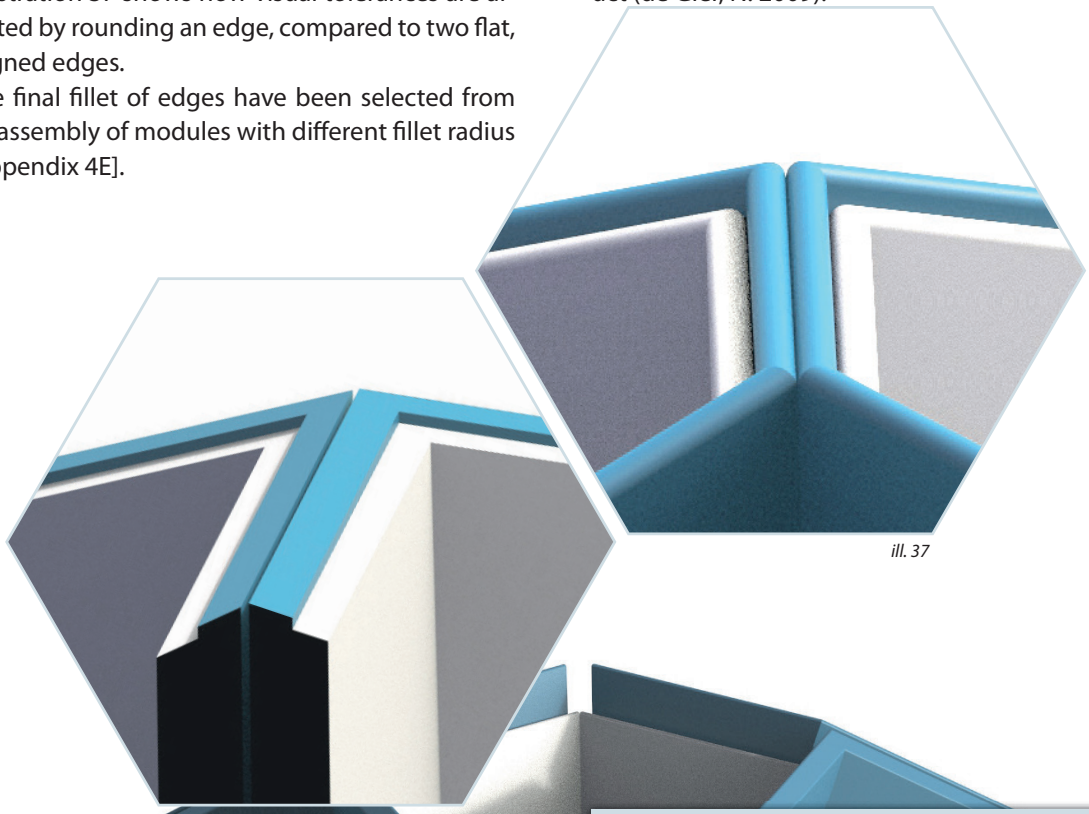
TECTONIC DETAILS

Following the setting of an appropriate module size, the tectonic detailing of the interaction between modules in the formation of an assembly, is explored.

As the modules are connected by magnets, there is a high tolerance in the technology when assembling. This tolerance has to be reflected in the tectonic composition of the modules however, so that an imperfect connection doesn't show through two edges that are visibly imperfectly aligned.
By including this in the composition, the production costs can be positively affected too from a higher tolerance regarding material deflections.
Illustration 37 shows how visual tolerances are affected by rounding an edge, compared to two flat, aligned edges.
The final fillet of edges have been selected from an assembly of modules with different fillet radius [Appendix 4E].

The tectonic detailed as shown in illustration 38 is called "Connection through distance" (de Gier, N. 2009). The use of this connection detailing is inspired by Poul Kjærholm's frequent use here of eg. in his PK0 and PK71 models.

This tectonic detail (ill. 38) lets each module preserve their own form, while they are at the same time perceived as a unity in the assembled product (de Gier, N. 2009).



ill. 37

ill. 38

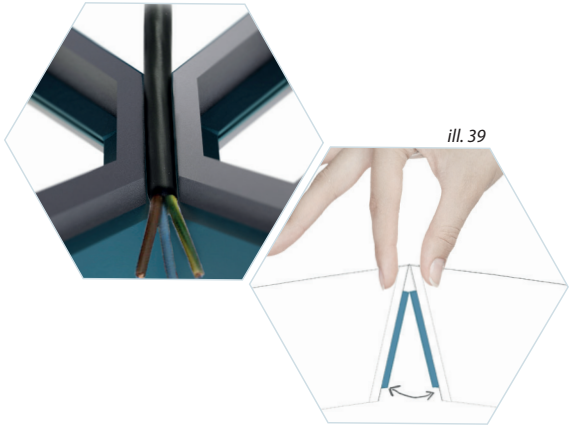
SUMMARY

Tectonics have been optimized in relation to both visual perception and production, through creating a "connection through distance".

USING THE TECTONICS

The distance made by the tectonic detailing opens up for integrating functionality related to both add-on modules and interaction in the created grooves. This potential will now be explored.

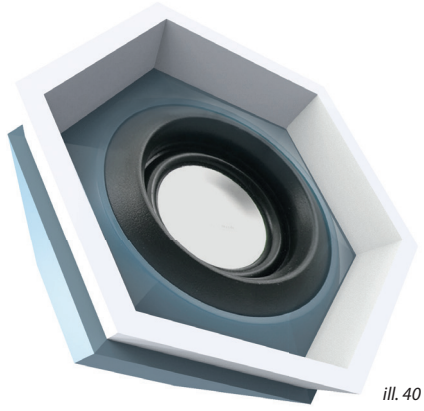
On one side the wire from an added transformer (as discussed on page 53) can be led through the grooves made by distancing the end of the modules. As the grooves are approximately 4 mm, using wire or a tube with a larger diameter than this, could make the modules hold the wire in place. Alternately a small clip could be developed to hold the wire in place between the modules.



ill. 39

In the other end of the modules, the distance between modules is 10 mm deep. This opens up for potential in relation to disassembling two modules. Clicking the modules together at the end would click the magnets away from each other and thus lower the magnetic pull (ill. 39).

The addition of add-on modules has further been included in the tectonic detailing, since these will be part of an assembled product. This has affected it in the direction of adjusting the angle of the outer module, so that the direction of the surface seems to be connected to that of an add-on, as shown with a speaker add-on module (ill. 40).



ill. 40

SUMMARY

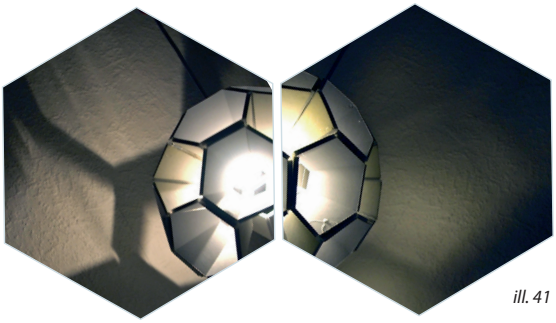
Potential found in the tectonics have been used to integrate functions in the modules and to create a coherent visual look of modules.
The action of disassembling have been made easier and add-ons have been integrated through a gap, to hold wires in place and by making the surface of module and add-on flush.

LIGHT QUALITY

With part of the concept being based on adding add-ons around a light source, the light quality from different bulbs have been tested, to test the effects made from this.

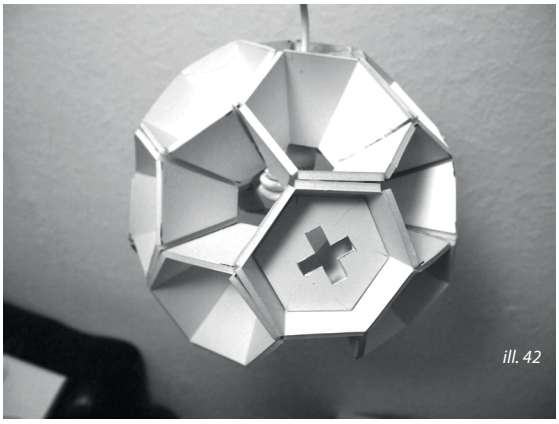
Reflective Quality

In a dimensional correct model made from cardboard (ill. 42), the lamps effect on the lights reflection on the surroundings have been tested [Appendix 5A].



ill. 41

Initial comparison of a halogen bulb and CFL bulb (ill. 41) shows how the reflections are sharp with halogen on the left and very diffuse with the CFL on the right.
Potential is seen in both scenarios, as it's a matter of how the user wants to use the lamp. For reflecting a custom made pattern on the wall halogen would be great, while CFL would be better for an even, diffuse light.



ill. 42

To test the effects of patterns further, a filter with a cross pattern was added to one module.

ill. 43

As illustration 43 shows a pattern is clearly reflected in the surroundings from a halogen bulb.

While a CFL gives a more diffuse reflection of the pattern it could give a more abstract reflection, without being as distracting as a sharp pattern from an halogen lamp.

These tests showed both a potential and a potential challenge in relation to light qualities. Potential to manipulate the light through reflections. A challenge in the creation of a diffuse light from a halogen lamp.

SUMMARY

The light from different light sources shows the potential to let the users create their own light quality through bulb selection, but also sets challenges in directing the use of this potential.

Filters and optimization

To explore the potential in both halogen and CFL, further tests have been done as a result of the initial test of light quality.

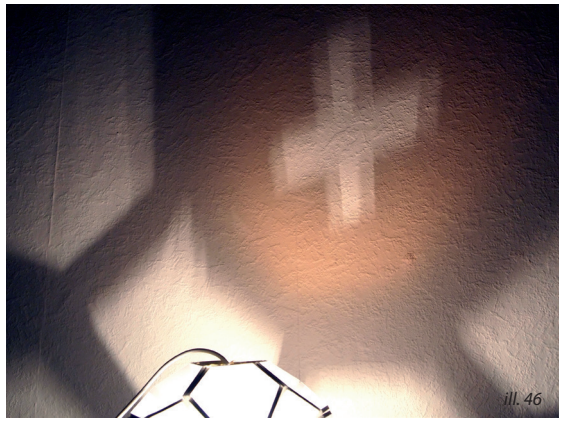

ill. 44

A variety of filters and inlays of different materials (ill. 44) is used to both test how the light can be enhanced and manipulated in relation to both colors, strength and sharpness [Appendix 5B].


ill. 45

Testing CFL with a reflective inlay (ill. 45) and the same filter as in the first test, showed only a minor improvement in strength compared to the results without inlay.

A halogen bulb with a semitransparent orange filter with a pattern, showed a clear reflection of the colors and a relatively sharp pattern (ill. 46). The semi transparent filter further made the light more diffuse, which could potentially be used in future add-ons to customize the light reflections according to the users needs.


ill. 46

All in all these different results shows that the use of the lamp relies on filters through add-ons to complete the product. Thus it's depending on co-creation through letting the user add filters or other add-ons.

SUMMARY

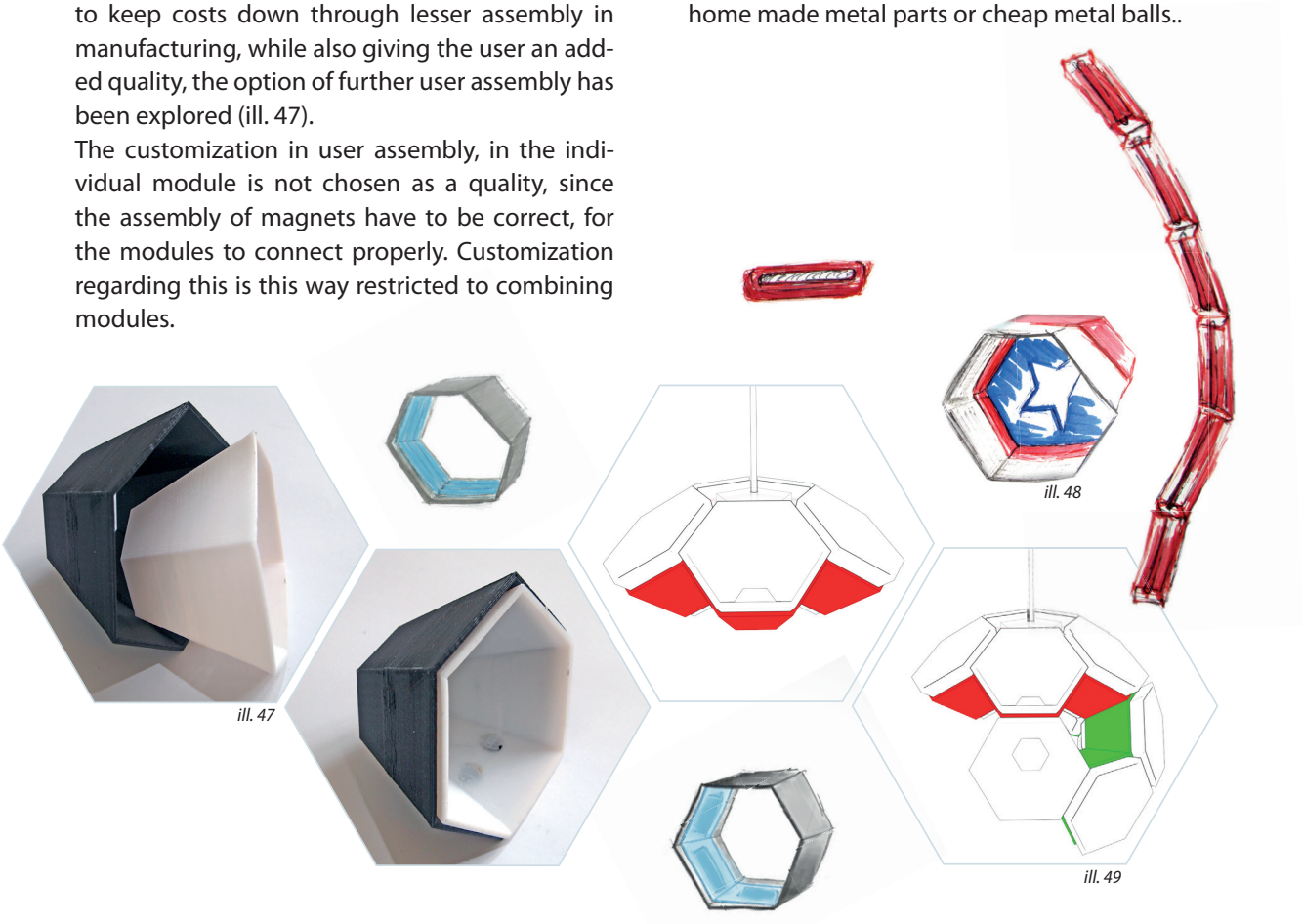
A way of making the light diffuse and remove glare is the addition of semi transparent add-ons. While further tests are required, it gives the user the ability to manipulate the light as needed.

CUSTOMIZATION

As the use of add-ons is a big part of the product, different ways of integrating these in the modules have been explored along with other potential ways of adding customization in the product.

The customization in the lamp is present in two areas, different colored and different numbers of modules (ill. 49) and in various add-ons.
To make use of the qualities of customization and to keep costs down through lesser assembly in manufacturing, while also giving the user an added quality, the option of further user assembly has been explored (ill. 47).
The customization in user assembly, in the individual module is not chosen as a quality, since the assembly of magnets have to be correct, for the modules to connect properly. Customization regarding this is this way restricted to combining modules.

Instead of adding retention grip in the composition, a solution of using the modules' magnets has instead been chosen. While this requires extra parts (ill. 48), these could potentially just be small, home made metal parts or cheap metal balls..



ill. 47

ill. 48

ill. 49

The addition of user made customizations have been explored in order to find ways of attaching these. A system of retention grips in the interior module have been explored, but isn't included in the product, to keep the surface, the area for touching, smooth and simple.

SUMMARY

The addition of user made customization, either in 2D or 3D printed, is integrated through the use of fitting them to the modules or additionally adding metallic parts that can hold them in place by connecting to the module's magnets.

ADD-ON MODULES

Add-ons are an essential part of the product, both user made and retail in the future. As the module of a lamp will facilitate these, it will not be an entirely complete structure until these add-ons are added. Possibilities in add-on modules will be discussed in this section.

Co-Creation

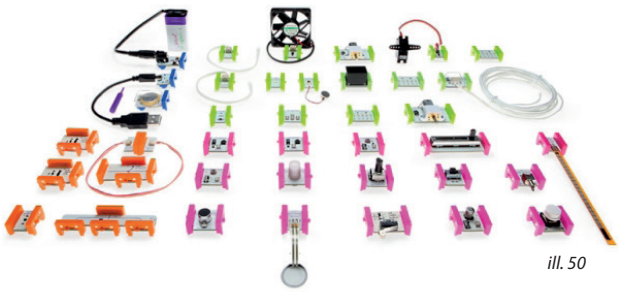
The ideation of possible add-on modules was an area where it would be obvious to integrate the potential users. To do this an explanation of the modularity and add-on functionality was posted to the users, with a specific question as a follow up. The questions was on how the users could imagine a lamp like this could be used, other than with speaker- or sculptural add-ons. Which add-ons they would like to see in the future.

While not a high quantity of answers, it gave some specific wishes and ideas to further use of the lamp. One such was the idea of expanding the system, to build more of these lamps together to one cloud-like structure.

User Made Add-Ons

The initial idea of user made add-ons revolved around using the potential in a growing market of 3D printers. The system for holding these in place is currently limited to letting the conical structure hold them in place, adding external parts containing metal the magnets can hold in place or a system of a platform/part for the 3D print that clicks into the hexagon and can be 3D printed by the user.

The potential of expanding the use is widened to include 2D made add-ons. Add-ons that manipulates the light or makes it more diffuse, from acrylic or similar materials. This further makes the lamp ideal for people who don't own a 3D printer.



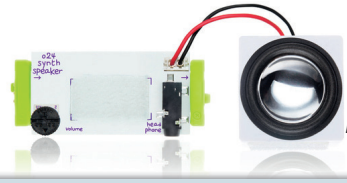
ill. 50

Electronic Add-Ons

The concept of electronic parts is greatly influenced by the concept in littleBits (Bdeir, Ayah 2014). This way inspiration for potential electronic modules has also been found here (ill. 50), along with through brainstorms and user input.

- 12v electronic transformer (for powering the add-ons)
- 2D light filters
- Sculptural 3D prints
- Speaker (Ill. 51 shows a littleBits speaker)
- Bluetooth receiver/transmitter
- Spot light
- Light sensor
- Fans
- Module for expanding/combining structures

Low voltage through a transformer is chosen for safety reasons (Sikkerhedsstyrelsen 2012) and with a transformer unit the feature of electronic add-ons can easily be added later by adding a 25W transformer on top of the socket. From this a system for leading connectors/wires from the transformer to the modules will have to be developed. Such a transformer will have fitting dimension in relation to the socket module, based on quotes from a supplier [Appendix 5C].



ill. 51

SUMMARY

While the detailing of the electric system regarding add-ons has only briefly been touched, it has been prooved realistic through the required size of a 12v system powering the modules and in the similar concept from littleBits.
User made 2D and 3D printed add-ons will further be possible.

MATERIALS & PRODUCTION

The material requirements in relation to both product feel and production is discussed, to find a material that works in the context of both being a toy and a lamp shade.

Material Requirements

From the initial research on construction toys, the material feel was inspired by smooth plastic surfaces. This direction has led to exploring potential solutions for a surface that would look inviting, to enhance the tangibility in the product, inspired by material use in mobile phones and computer mice.

Another material requirements, related to product specifications, is the potential heat generated from the light bulb. While this has to be further researched, the initial tests in this area showed a surface area of the bulbs used in the area of 100 degrees. With the modules having a distance of at least 20 mm, this would be an even lower temperature at the modules. Further thermal analyzes haven't been performed at this time of development due to time constraints.

Polycarbonate is chosen, based on a higher heat resistance compared to ABS (Lesko, J. 2008), and the material feel from inspiration products (ill. 52).

The current thickness of the material will create very durable modules, but a method for hollowing, adding ribs or another solution for lowering material thickness might have to be found. This is both due to costs from production, where the thickness will add extra production time and material usage and due to the current unevenness in wall thickness, which might cause sink in some areas (Arabe, Katrina 2002).

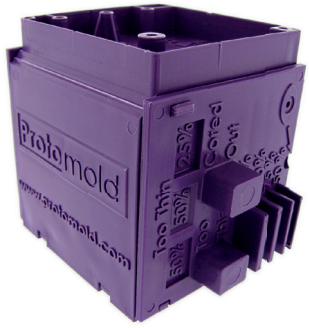
ill. 52: *Mobile phones have been amongst sources for material inspiration*

Material Specifications

- *Plastic*
- *Smooth, inviting surface*
- *Thermally stable at ~ 100 degrees*

Production Process

The parts will be injection molded, which sets some material requirements.
As mentioned earlier the thickness would optimally have to be lowered and further requirements related to production through inection molding is the requirement of draft angles when ejecting the part from the mold.
This has affected the module design, since all walls need to have a draft (Proto Labs 2014).



ill. 53: *Proto Mold's guide cube has been used as guide*

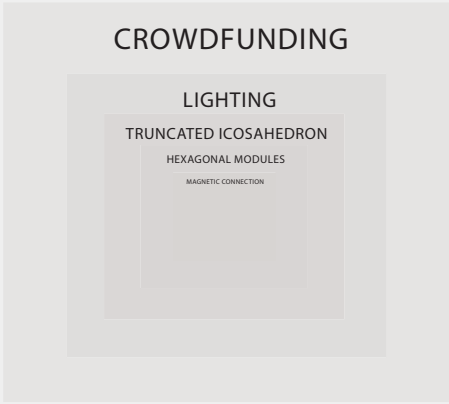
SUMMARY

Polycarbonate is chosen as material for the module and will be based on production through injection molding, but futher optimization have to be made before production can be started.

CONCLUSION TO CONCEPT DETAILING

Concept detailing has been an exploration of finding compromises between the user experience, the structural concept and the production related requirements. The conclusion will be discussed in relation to the preliminary delimitation and scope.

SCOPE



DELIMITATION

+ *Limited Development Time*
+ *Publishing through IndieGoGo*
+ *Targeted Model Builders, 25+*
+ *Co-Creation Process*
+ *Toy Scale*
+ *Magnetic Assembly*
+ ~~*Spherical Lamp*~~
+ *Truncated Icosahedron*
+ *Hexagonal Modules*
+ *3D Printed Add-Ons*
+ *Electronic Add-Ons*

CONCLUSION

From a concept of magnetic connected hexagonal modules, with the potential to form a truncated icosahedron. This has been detailed in relation to the interaction between lamp, modules and user.
The module composition is optimized for a tangible size, an aesthetic interaction with other modules and an ease in assembling and disassembling.
Add-on modules has been included in three groups; 2D filters, 3D prints and electronic modules. These have further been integrated in the visual look and magnetic concept of the main modules.
Material wise further development is needed to both find the optimal material.
The internal module composition needs optimization in relation to production, to take account of the thick walls needed to get the desired tangibility.

BUSINESS CASE

INTRO TO BUSINESS CASE

In the following section the business model will be defined, with the Business Model Canvas, which was initiated as part of the early development, to be fulfilled and with other strategic models revisited to both clearly define the relation to the market and to reflect on what could possibly be addressed in relation to this in future iterations.

Methods

These methods have been used to analyze the market situation in relation to the developed product.

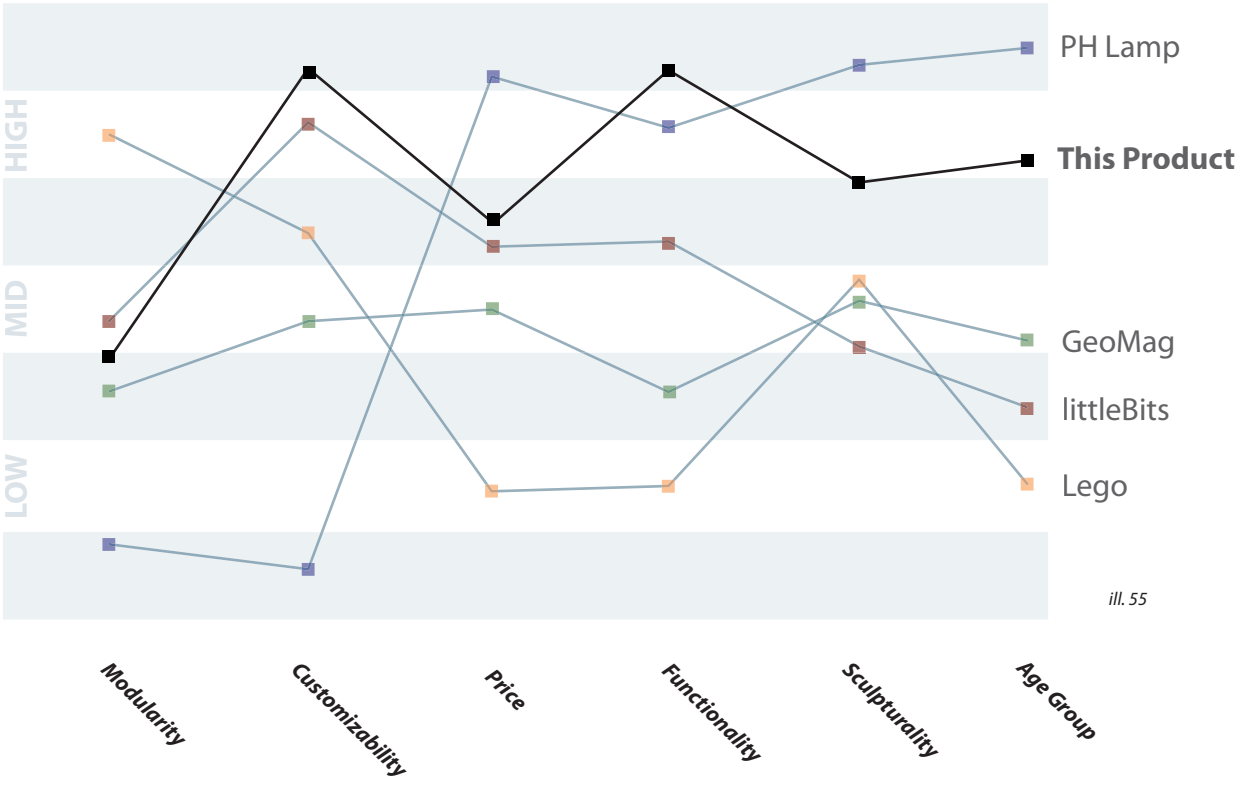
- *Blue Ocean Strategy Canvas*
- *Benchmarking*
- *Porter's Five Forces*
- *SWOT*
- *Business Model Canvas*

ill. 54

While the use of the models have been subjective in the analysis, the combination of these specific models is chosen to both evaluate the market situation and to find potential in the product, for future iterations to adapt to this.
The use of co-creation, letting the users evaluate the market too, for further validity of the results is not done, since this would include expansive introduction to the presented methods.

BLUE OCEAN STRATEGY CANVAS

The developed product is mapped on the strategy canvas that was developed as part of the framing process. This will give an idea of the market position in relation to the initially mapped products.



ill. 55

As the strategy canvas (ill. 55) shows, the developed product is evaluated to take a position between littleBits and a PH pendant lamp, as intended following the initial Strategy Canvas in the framing stage.
While it has relatively low modularity the customizing options adds potential for sculpturality in a product that has the functionality of a lamp, with further potential for adding functionality through add-ons.
The fact that the developed product doesn't follow another product closely, but instead differentiates from parts of all competing products, makes it a blue ocean market.

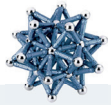
To compare specific functions with existing products a further benchmark is set up to expand the explanatory qualities of the strategy canvas.

SUMMARY

The strategy canvas shows how the developed product is assessed to lie near toys in some areas and near the PH lamp in other areas.
This gives an indication that it might be a blue ocean market it has entered.

BENCHMARK

This benchmark lists specific qualities in the individual products against each other to get an overview of competitiveness in relation to product quality. Some qualities are only present in some products, but are included anyway to illustrate how this product combines qualities of different fields to create a derived product category.

	 *This Product*	 *LEGO*	 *PH*	 *littleBits*	 *GeoMag*
Material	Plastic	Plastic	Metal	Plastic	Metal + Plastic
Connection	Magnetic	Stud-and-tube	Screws	Magnet + Snap Fit	Magnetic
Geometric Inspiration	Hexagon	Rectangle/Brick	N/A	N/A	Rod/Triangles
Light Quality	Filter Dependent	N/A	Diffuse	N/A	N/A
Durability	Mid	High	High	Low	High
Connection Strength	High	Mid (Direction Dependent)	Fastened	Low	Mid
Scale	Mid/Modular	Varied/Modular	Large	Small	Small/Modular

ill. 56

While the benchmark (ill. 56) is set up to get a direct comparison to the competition, the modularity makes the quality of most of the product individual in the different uses. Instead it can be derived from the benchmark, that there is further potential for further development based on qualities in competing products.
For example as ittleBits work with a similar structure of extensions, which has also been an inspiration in this project. The electronic integration in modules used by them, could further serve as a mean of integrating electronic add-ons more tightly in this product through integrated circuits. PH pendant lamps' diffuse light could similarly serve as inspiration for add-ons that could improve the light quality.

The fact that three toy related products are chosen and just one lamp related shows how the inspiration is in toys and the lamp relation is mainly as a facilitator.
Price range is not included, as the modular base of most of the products makes it hard to compare prices directly. A loose comparison of price ranges can instead be found in the strategy canvas.

SUMMARY

Since the benchmark is set against products that are very different in some ways, it gives an idea of how this product has the qualities of a mix of the other products, but lacks the intended qualities of a direct comparison.

PORTER'S FIVE FORCES

With a previous Porter's Five Forces analysis done on construction toys in the framing phase, this analysis will take the updated product and context to check for potential threats and pitfalls in the related industry.

THREAT OF NEW ENTRANTS

Both competing toys and lamp manufacturers could easily make a transition to become a direct competitor. This threat is enhanced by the fact that this project is based on crowdfunding, which means the vision and potential will be exposed to potential competitors even before it reaches the market. New entries from existing brands will further be a threat through their superior capital and brand equity.

BARGAINING POWER OF SUPPLIERS

The simple construction, aimed at production through injection molding and standard units in magnets and sockets, gives a low bargaining power of suppliers.

INDUSTRY COMPETITORS

Being in a blue ocean market, the direct competition in the industry is low.

Main competition is from substitute or new entrants.

BARGAINING POWER OF BUYERS

This threat in both substitute products and new entrants gives the customers a relatively high degree of bargaining power, even though the product is aimed at a blue ocean market with a differential advantage. The inclusion of potential customers through including users in the early development and the following publication through crowdfunding will potentially lower the bargaining power of customers, since it will make them feel connected to the product.

THREAT OF SUBSTITUTES

Existing lamps can substitute the lamp quality and existing toys can substitute the quality of building a product through tangible pieces. Some lamps on the market, particularly IKEA products, have the quality of personally assembling the product. In those the assembly is based on keep the costs down instead of adding the customization quality however. 3D printing could be used to not only print customization parts to the product, but potentially also to replace the main modules, though the magnetic assembly limits this.

SUMMARY

From the analysis it can be derived, that differenting from the current market has made direct competition almost non-existent. It has still however opened up for many substitute products by mixing qualities from different markets.

SWOT

With the initial product platform being mainly "Analog", but with a vision of including more electronic components in future iterations and through add-on modules, these SWOT analyses explores the potential in an analog platform vs. an electronic platform with integrated circuits.

ANALOG MODULES

STRENGTHS	WEAKNESSES
Short development time *Cheaper production*	*Less consistency between modules, add-ons and socket*
OPPORTUNITIES	**THREATS**
Custom effects through 3D prints *Customization through simple light filters* *Conversion through transformer module*	*Depends on user made add-ons for a complete look* *Heat from light source has to be below limits of materials and magnets*

ELECTRONIC MODULES

STRENGTHS	WEAKNESSES
Expanded with advanced modules *Less dependent on light source*	*Requires more developement* *Expensive production*
OPPORTUNITIES	**THREATS**
Potential for ongoing revenue through electronic add-ons *Can function analogy with analog version*	*Possible obstacles in approvals and certification* *Have to compete/replace analog version if introduced later*

From the two SWOT analyzes (Mind Tools) it can be derived that the current approach is advantageous in relation to keeping the initial development costs low. On the other hand however it requires user made parts to complete the product after buying it. This could be through including guidance in cutting acrylic add-ons or supplying models for 3D printed add-ons.

The potential in further developing the product towards a more integrated electronic solution, adds potential in relation to ongoing revenue, but can potentially be limited by obstacles in relation to approvals and development, related to applying an integrated circuit.

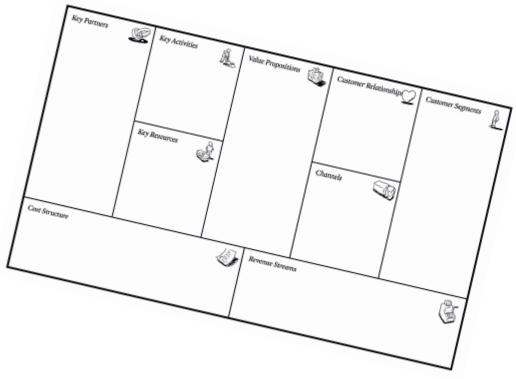
The following Business Model Canvas will be based on the model of developing an analog model with potential for adding a transformer module to the current socket. This way the modules can potentially be used electronically later, by leading a wire from the socket to electronic add-on modules.

SUMMARY

The SWOTs shows a definite potential in integrated electronics in the modules, but since it would require a longer development and more expensive production, the initial approach is that of analog modules.

BUSINESS MODEL CANVAS

The Business Model Canvas, which was initiated as part of the framing, will be revised and completed to describe the vision of how the developed product will create revenue through balancing the interaction with both resources and customers.



Key Partners

A partnership with a manufacturer is essential to set up production without investing heavily in production facilities.

Key Activities

Activities are related to both product development in further development, but also to set up a platform for both selling the products and co-creating expansions with the customers.

Value Propositions

The value proposition is based on a qualitative approach. It offers the possibility of adding a personal touch through assembly and custom add-ons, but also the potential in retail add-ons, adapting the product to any given situation. The product can this way be uniquely combined to each customer's personal needs.

Key Resources

With production of modules outsourced, key resources are mainly related to intellectual properties. In the further development of electronic modules human resources becomes an increasing asset, as this call for development in various technical fields.

Channels

The initial distribution channel is through crowdfunding and with previous awareness raised through interacting with potential users on online communities.

Future distribution will be done through a web shop, from which printable 3D models also could be made available. To make it more widely visible a partner store could be made through eg. Amazon.com.

As with research and funding, future distribution channels are projected to an online focus.

Customer Relationships

The concept of 3D printed add-ons opens for a co-creation platform, through which customers can share their fitted 3D models.
A community could be set up to facilitate this and to open up for user inputs on desired retail add-ons.

Customer Segments

The initial requirement of a high degree of user inputs through 3D prints or similar, makes it specialized towards a niche market. With further developing a retail add-on system this could potentially expand to covering the mass market related to interior design.

Cost Structure

Initially the production of components is the main cost in the business model. Following this a significant cost related to developing electronic modules and add-ons is added to this. With an established production, costs can be lowered through economies of scale, lower prices due to bulk purchases.

Revenue Streams

The revenue stream is based on asset sale, with both feature and volume dependent pricing, based on the number of needed modules and add-ons. This way there is a potential for an ongoing revenue stream through supplying previous customers with expansions through add-ons or modules in new color combinations.

SUMMARY

A potential for a continuous revenue has been set through using the development of modularity and with electronic add-ons as a mean for keeping the product growing.
As with both the basis of the project and co-creation, the future channels of the product will be based on online platforms.

PREPARING FOR CROWDFUNDING

As a follow up to the initial research on crowdfunding, this section will introduce both the approach and basis for the presented product, including both costs and focus points in presentation.

Approach

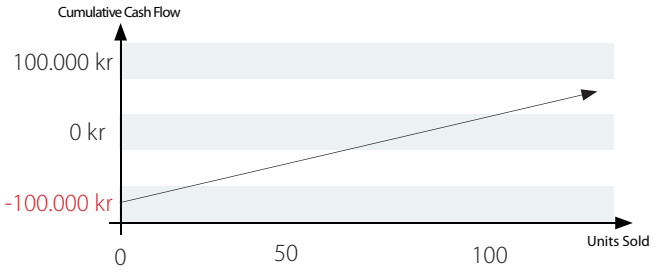
The approach to launching the crowdfunding campaign will be based on reaching out to the communities from which users have been involved in the project, to get the word out.
The funding goal will be based on an initial production of 1000 modules with a 100 % profit. This is low set, especially considering that assembly of modules isn't included.
Awards will be related to the modular construction. This way a small award will be just a single module and a bigger reward will be the full assembly.

1. Pick a problem that won't leave you alone.
2. Build a community around your project.
3. ***Tell a story.***
4. ***Plan your budget.***
5. Focus on the video.
6. Launch.
7. Dedicate time to take care of the campaign.

Estimated Costs

Estimated costs are based on a quote from Proto-Mold [Appendix 6A-C]. The current molding costs are very high primarily from the thick wall, combined with costs based on a prototype production of 1000 modules and the high cost from magnets. From this an initial price on 6 modules will be in the area of 160 euro.

Further possibilities for reduced costs will be explored before launching the crowdfunding campaign.
If a solution to bringing costs down, the current will have to be used as reference, to avoid ending in juristic or financial problems.
81 sets of 160 euros will have to be sold, to fund initial investments. Compared to traditional funding, this means operating with a loss from production related investments will be eliminated.



Presentation

The presentation on IndieGoGo will, inspired from the seven previous presented points, focus on telling the story of the product. How it adds quality to the user both when touching it, assembling it and while hanging, where it's inviting for adding further add-ons.

As there are still some development needed, the presentation will have to be transparent about this. Present both what is done, what needs to be done and why this needs to be done instead of just launching the production.

Inspired by the demands to launching on Kickstarter, risks and challenges related to the future production and development will made aparent.

SUMMARY

A plan for the crowdfunding launch has been initiated through finding estimated costs and having an approach to reach out to the initial user base.

BRANDING

Since the project is based becoming visible online through crowdfunding, some branding related qualities have to be established. This means a fitting name and accompanying logo will be developed.

Name

From a brainstorm of the essence of the lamp a series of thesaurus searches led to a variety of words describing essential qualities of the lamp [Appendix 6D].

Based on the visible gap between modules in an assembled lamp, the name Lacuna was chosen. The playfulness in the word and the catchiness in combination with related words of "Lamp" and "Light" made Lacuna ideal.

Logo

The accompanying logo (ill. 57) consists of two outline hexagons. The outline is added to highlight the gap between modules, which is an essential detail in both product and name of the product.
Blur has been added to represent the effect made from add-ons.
Both name and logo is kept black and white, to avoid associating it with a single color, since it comes in a range of colors (Gardner, Bill 2013).

ill. 57

SUMMARY

A name and logo based on essential qualities in the product have been found through brainstorms and sketches. With these based on the gap between modules, this will become a defining quality in the product.

PROJECT CLOSING

DESIGN FREEZE

The project closing will catch up on the current state of the product development through a design freeze, before a subsequent conclusion and reflection adds further perspective to the product and process.

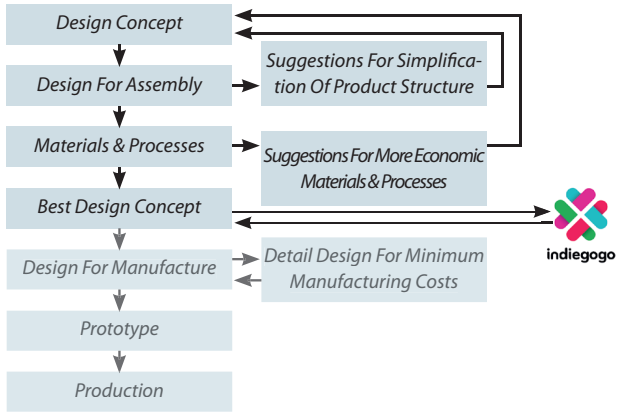
The developed product is, while facilitated in a lamp design, more a system of entertainment in different ways.
Like a toy or even a stress ball, the individual modules are developed with a high level of tangibility in mind.
The tangibility is enhanced through the use of magnets as the connecting technology. This way modules connects easily and almost like magic, both to each other and to add-ons with metallic parts.

The lamp functionality of works in collaboration with the potential in different add-ons. 2D hexagonal add-ons with either a cut in shape or made from semi-transparent material, can this way manipulate the light when inserted in a module and held in place by a part that connects to the modules magnets. This part can either come from a third party or be developed in future iterations.

Sculptural 3D prints can be added to a module in either the same way as 2D add-ons or by a 3D printed part that can hold it in place by clicking it into the module. This solution of a 3D printed add-on holder have yet to be developed.

While material have been specified, it has to be further optimized in relation to being able to withstand the emitted heat and to include the thickness of 4 mm.

Modules consists of an exterior and an interior part, in between which magnets are placed (ill. 58).
They are assembled around a socket module to create a lamp. The vision of the lamp is for a transformer to be developed and inserted in the socket module to power electronic add-ons like speakers, spot lights or gadgets of similar size.



From the previously used model, the set goal of reaching "Best Design Concept" isn't reached yet. To do this, and launch through IndieGoGo, materials have to be further optimized and the price has to be adressed based on these changes.
Current status is on the model around "Materials & Processes" from where "Suggestions" have to be explored.

SUMMARY

The design is near finalized in relation to interaction and connection, but still lack development in the areas of defining socket, electronic add-ons and material optimization, which will further affect price estimation.

CONCLUSION

The conclusion evaluates the final concept and state in relation both the initial vision and how this has evolved through changes made to delimitation and scope throughout the project.

The Concept

Lacuna is developed from the vision of funding a modular construction toy through crowdfunding combined with trends and developments found in both toys and in the related context.

The toy effect might not be dominating in the final concept, but it is present at an underlying level through size and feel. It is also present in a potential overall use of the product, since add-ons can be added to manipulate the light, through which the quality of "playing" is reflected onto the context.
From the delimitation that has set the basis of the concept development, all points are integrated in the final concept, while not all fully developed. The quality of lighting has only been part of the facilitation of the product, but still relates to potential in the product, since the addition of add-on to manipulate opens of for individual customized light.

Co-Creation

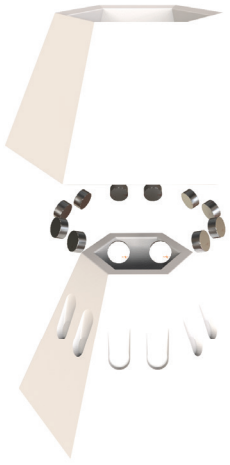
A quality in the product, that isn't actually part of the product, is the co-creation from the process. This is part of the product and not just the process, since the vision of add-ons opens up for a community of user made customization. While the co-creation hasn't been dominating in the development process, it has already given some insights in user wishes for the future and a mean for getting the word out to potential users, when the crowd funding campaign is launched.

The Future

As the use of Lacuna is very related to either user made customizations or the electronic modules, which have yet to be fully developed, the future is with high potential for growth and continuous development.

Some optimizations have to be done first however, to both lower the price and optimize the material in relation to heat.

In future iterations the concept of eletronic add-ons will be further integrated, with socket and transformer fully combined and with the use of wires totally eliminated, possibly through having connectors integrated in each module.



ill. 58

SUMMARY

An ambitious project has been inititiated, but requires further detailing before it's ready for production. The essentials in the product is however ready and have a high potential for further development in future iterations.

REFLECTION

The reflection discusses the outcome of the project in relation to both the basis and succesful use of the different methods. Areas where certain challenges have been found are further discussed in relation to how they have been handled.

Facilitation

The basis of the project was in the vision of ultimately launching it through crowd funding. This made the setting of initial delimitations lenghty, since research showed a potential in many different directions. This was solved by benchmarking potential in relation to personal preferences.
Another way could have been choosing a direction based on personal preferences alone, which would have avoided spending a big part of the project period on preliminary research and instead have more time for concept development.

The use of various models throughout the project has given the possibility of doing subjective analyzes from different perspectives. In the use of these an additional group member or other kind of third party inputs would have given a wider view and thus more comprehensive analyzes with a higher validity. This subjectivity means that, had any other person done the analyzes, the results would have been different.

Including Users

The use of co-creation was included as a way of reaching users who could potentially support the future crowdfunding. While the use of these has given some qualitative input throughout the whole process, it has had a minor role.
This is partly due to little feedback to the different posts made to update the users, which can be because of quality of the posts and quality of the chosen communities. The quality of the posts relates to the openness toward the users. Updates relied mainly on publishing breakthroughs, where as it might have been a bigger succes if more thoughts had been included, such as brainstorms, used methods and more sketches to make it more transparent, which would give better feedback (Belsky, Scott 2010).

Focus

Due to a limited time frame, focus of the development have been wide in order to make a holistic design. This means all product areas had to be included which made the development in certain areas relative superficial.
Since the concept is based on the interaction between user and product, if there had been more time, an obvious area to place a bigger focus earlier in the process would have been aesthetics, in order optimize the users perception and joy in use. Some considerations was done regarding this, but was eventually abandoned due to time constraints. Instead an aesthetic analyzes might be done prior to future iterations, to test the power of the current concept.

Complexity

The developed concept consists of few parts and can as such be considered very simple, compared to the lengthy process. The use of the modules is however more complex than initially estimated, through the various use cases combined with the technical specifications from combining plastics and a light source, integrated magnets in the modules, developing further electronical parts and optimizing for integration of 3D prints.
This wide range of qualities combined, can as with the limited time frame take some of the blame of the fact that a lot of development is still needed. Had the quality in the lamp been limited to modularity or manipulating light, through following the initial delimitation of limited development time, it would propably have fitted the project period better.

REFERENCES

A compilation of references, including sources, illustrations and a brief description of the appendices available digitally.
All illustrations are own unless otherwise noted.

Sources

Arabe, K. 2002, '5 Rules of Problem-Free Injection Molding'.
Available: http://news.thomasnet.com/IMT/2002/08/08/5_rules_of_prob/ [accessed 2014, 05/18].

Bdeir, A. 2014, 'littleBits™ Ayah Bdeir aims to democratise electronics'.
Available: http://littlebits.cc/bbc-littlebits-ayah-bdeir-aims-to-democratise-electronics [accessed 2014, 05/18].

Belsky, S. 2010, "Transparency Boosts Communal Forces" in *Making Ideas Happen*, pp. 128.

Boothroyd, G. 2001, "How does DFMA work?" in *Product Design for Manufacture and Assembly* CRC, , pp. 28.

Buijs, J. 2012, *The Delft Innovation Method*, eleven.

Chan Kim, W. & Mauborgne, R. 2005, "The Strategy Canvas" in *Blue Ocean Strategy* Harvard Business School Press, , pp. 25.

Cuffaro, D. 2006, "The Business Of Design" in *Process, Materials and Measurements*, pp. 13.

de Gier, N. & Buur, S.L. 2009, "Joinings" in *Chairs' Tectonic*, pp. 54.

Djajadiningrat, T., Overbeeke, K. & Wensveen, S. 2002, 'But how, Donald, tell us how?', *DIS2002*, pp. 285.

Gardner, B. 2013, "Considering Color" in *Logo Creed* Rockport, pp. 173-174.

Gobry, P. 2011, THE NEXT TRILLION DOLLAR INDUSTRY: 3D Printing'.
Available: http://www.businessinsider.com/3d-printing-2011-2?op=1[accessed 2014, 05/18].

Gouillart, F. 2010, 'What the heck is co-creation?'.
Available: http://francisgouillart.com/wordpress/?p=720 [accessed 2014, 05/18].

Hekkert, P. & van Dijk, M. 2011, *Vision in Design*, BIS.

Jørstian, T. & Nielsen, P. 1994, "Lysets Kvalitet" in *Tænd! PH lampens historie* Gyldendal, pp. 66-67.

Kickstarter.com 2014, 'Kickstarter Stats'.
Available: https://www.kickstarter.com/help/stats [accessed 2014, 05/18].

Landers, R. 2011, 'Unfolding the IKEA Effect: Why We Love the Things We Build'.
Available: http://neoacademic.com/2011/09/22/unfolding-the-ikea-effect-why-we-love-the-things-we-build/ [accessed 2014, 18/05].

Lauwaert, M. 2008, 'Playing outside the box – on LEGO toys and the changing world of construction play', *History and Technology*, vol. 24, no. 3, pp. 221.

Lesko, J. 2008, "Liquid State Forming" in *Industrial Design - materials and manufacturing guide*, Second Edition edn, Wiley, pp. 174.

Liukas, L., 'My Children's Book Raised 100k within 24 hours'.
Available: http://lindaliukas.tumblr.com/post/77372344314/my-childrens-book-on-technology-raised-100k-within-24 [accessed 2014, 05/18].

Mind Tools, 'PEST Analysis'.
Available: http://www.mindtools.com/pages/article/newTMC_09.htm [accessed 2014, 05/18].

Mind Tools, 'SWOT Analysis'.
Available: http://www.mindtools.com/pages/article/newTMC_05.htm [accessed 2014, 05/18].

Osterwalder, A. & Pigneur, Y. 2010a, *Business Model Generation*, Wiley.

Osterwalder, A. & Pigneur, Y. 2010b, "Customer Insights" in *Business Model Generation* Wiley, pp. 130.

Pearce, P. 1990a, "Closest Packing In Nature" in *Structure In Nature Is A Strategy For Design* MIT Press, pp. 10.

Pearce, P. 1990b, "Structures Derived From Truncations" in *Structure In Nature Is A Strategy For Design* MIT Press, pp. 171.

Porter, M.E. 1979, 'How Competitive Forces Shape Strategy', Harvard Business Review.

Proto Labs 2014, 'Draft In Plastic Molded Parts'.
Available: http://www.protolabs.com/resources/molding-design-guidelines/draft [accessed 2014, 05/18].

Quantcast.com 2014, 'Kickstarter.com demographics'.
Available: https://www.quantcast.com/kickstarter.com/demographics [accessed 2014, 05/18].

Sikkerhedsstyrelsen 2012, 'Belysning'.
Available: http://www.sik.dk/Forbruger/Elsikkerhed-i-boligen/Goer-det-selv-el/Belysning [accessed 2014, 05/18].

Steinberg, S. 2012, *The Crowdfunding Bible*, read.me.

SterlingFunder 2014, 'Equity Crowdfunding Tips For Investors'.
Available: https://www.sterlingfunder.com/blog/2014/04/ [accessed 2014, 05/18].

SterlingFunder 2014, 'Reward Crowdfunding As Business Confirmation'.
Available: https://www.sterlingfunder.com/blog/reward-crowdfunding-as-business-confirmation/ [accessed 2014, 05/18].

Tilley, A.R. 2002, "Manual Controls" in *The Measure Of Man & Woman*, pp. 43.

Vong, K. 2012, 'The Importance Of Customization In Brand Development'.
Available: http://www.trendreports.com/article/importance-of-customization [accessed 2014, 05/18].

Illustrations

Ill. 1 *Mapping according to toy salesman*
Ill. 2 *Mapping according to hobby salesman*
Ill. 3 *Lego Art. Property of Nathan Sawaya*
Ill. 4 *Lego Art. Property of Nathan Sawaya*
Ill. 5 *Co-Creation diagram*
Ill. 6 *Business Model Canvas*
Ill. 7 *Mixed sketches*
Ill. 8 *Initial sketches on lighting*
Ill. 9 *Muuto e27 pendant lamp*
Ill. 10 *PH's light studies*
Ill. 11 *PH's light studies*
Ill. 12 *Reference pendant light shapes*
Ill. 13 *Sketch on modularity in pendant light*
Ill. 14 *Sketch on modularity in pendant light*
Ill. 15 *Sketch on honeycomb composition*
Ill. 16 *Assembly of 5 GeoMag rods*
Ill. 17 *Exploration of pentagonal assembly*
Ill. 18 *Exploration of truncated icosahedron*
Ill. 19 *Restricting to hexagonal modules*
Ill. 20 *Openings in truncated icosahedron*
Ill. 21 *Add-on concept*
Ill. 22 *Connection through clip-on*
Ill. 23 *Connection through bolt*
Ill. 24 *Connection through male-female*
Ill. 25 *Connection through magnetism*
Ill. 26 *Rendering of initial concept*
Ill. 27 *Size references*
Ill. 28 *Size test*
Ill. 29 *Size test*
Ill. 30 *Size test*
Ill. 31 *Sketch on module composition*
Ill. 32 *3D printed mock up*
Ill. 33 *Interior part*
Ill. 34 *Test of littleBits magnets*
Ill. 35 *Test of various magnets*
Ill. 36 *Test of magnets in 3D print*
Ill. 37 *Digital test of tectonics*
Ill. 38 *Rendering of "Connection through distance"*
Ill. 39 *Exploration of integrating functions*
Ill.40 *Digital mock up of speaker add-on*
Ill. 41 *Halogen test left, CFL test right*
Ill. 42 *Mock up for testing light quality*
Ill. 43 *Test of halogen with patterned filter*
Ill. 44 *Mock up with various inlays for test*
Ill. 45 *CFL test with reflective inlay*
Ill. 46 *Halogen with colored filter*
Ill. 47 *Exploration of customization through user assembly*
Ill. 48 *Holding customizations in place*
Ill. 49 *Customization through different colored modules*
Ill. 50 *Selection of available littleBits modules*
Ill. 51 *littleBits speaker*
Ill. 52 *Polycarbonate from mobile phones*
Ill. 53 *Injection Molding guide cube*
Ill. 54 *Bulb. Property of Fotolia*
Ill. 55 *Strategy Canvas*
Ill. 56 *Benchmark*
Ill. 57 *Lacuna logo*
Ill. 58 *Exploded product module*

Appendices

1 A *Compilation of popular product on Kickstarter*
1 B *SWOT on crowdfunding: Equity vs Reward*
1 C *Comparison of popular products on Kickstarter*
1 D *Benchmark on potential directions*

2 A *Brainstorm on contextual qualities*
2 B *Porter's Five Forces on "construction toys"*

3A *Developed persona*

4A *Compilation of input from involved users*
4B *Exploration on initial size of modules*
4C *Limitations from popular 3D printers*
4D *Finding appropriate magnet strength*
4E *Comparison of different edge fillet radius*

5A *Initial test on light quality*
5B *Follow up test on light quality*
5C *Quote from supplier of potential transformer*

6A *Calculation of estimated costs*
6B *ProtoMold quote on exterior part*
6C *ProtoMold quote on interior part*
6D *Development of name and logo*

7A *Technical Drawings*