



SGM®

G-SIX

"Tiny dancer"

Title paper

Project

Battery powered moving head for the Event and Entertainment Business

Theme

Advanced electronic product design

Who?

René Petersen

Where?

Aalborg Universitet,
Institut for Architecture, Design og Mediatechnology

What?

4MA ID spring 2013
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Involved

Supervisor

Associate Professor: Kaare Riise Eriksen

Collaborators

SGM A/S

A stylized handwritten signature in black ink, consisting of a large 'R' followed by a horizontal line and a small 'P'.

René Petersen

Introduction

This project is derived from my internship period at SGM lighting in Aarhus, Denmark. SGM is making light fixtures for the event and entertainment industry. The company is run by former Martin Professionals founder Peter Johansen, along with a development team of key employees from Martin time, who in the late 80' revolutionized the whole business of stage lighting. Peter Johansen bought the company in February 2012, and moved the headquarters from Italy to Denmark. The new SGM builds on innovation parameters to differ from the rest of the industry, and in that way shoots it self into the market with new features, and standards, and a re-branding of the company [SGM].

On one of Peter Johansen' many travels he was visiting a customer in Dubai. Under that stay he saw a potential for a smaller fixture that was quick and easy to setup and install, for the many evening parties in the area. From weddings to garden and charity parties, that is held in sites that are not made for events. Many of these sites do as an example, not have electricity installed everywhere around, so a lot of cable is pulled around the area, to light up trees, and buildings, to set a certain mood. He went back with the idea, and in an ideation meeting with Peter Johansen, Head of development Finn Kallstrup and I, we came up with a theme for this project.

This assignment is to make an Ip65 rated Battery powered LED moving head. The LED technology with its low power consumption has made it possible to make a lamp that function in several hours on a battery pack and still make it powerful enough compared to conventional lighting fixtures. To minimize the need for pulling cables, and with the on-board power supply, the system have to be controlled wireless, with modules and electronic technology, that are available in the SGM research and development department, or used in other products. This opens for a system, with many open parameters and design elements. From hardware, mechanics, system and interface design. The product will take its point in the existing SGM product portfolio, the industry standards, use and working methods.

Motivation

I was not for no reason I contacted SGM for internship and master thesis. In 2006 I almost accidentally started in the event business as a freelance stage technician and rigger, and through the years, I have made almost 200 festivals, concerts and other events, from stadium concerts to smaller theatres. Both as technician on the stage, as climbing rigger, as light technician and project manager, and every time I had a lamp in my hand, or pulling it up in a robe, my studies have always made me think about the design, construction and products that we were using, and had ended up in many discussions about the pros and cons of many different products, from many different companies.

To combine my studies with my professional experience and knowledge, I contacted SGM for collaboration and to be a part of another side of the business, with my future career as an industrial designer.

To make this project a reality SGM will be a part of the process, as a kind of a customer where I have to deliver a concept and product, as close to "ready for production". They will be supporting with technical supervision, prototype facilities and knowledge of the business and their customers needs.

In the client role, they are putting time and money in to this project, to make a solution that will fit their market and customers, and therefore also have the power to push the button for production, when the solution match their philosophy, standards and product range.

For good and bad, this situation gives the client code-termination for the final output of this report. This is a fact that I will be aware of in the whole process.

The report and design process will document the outcome product, within the academic standards and methods.

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Additional files, technical drawings and appendices and can be found on this webaddress:

[Http://www.3style.dk/master](http://www.3style.dk/master)

Login: SGM

Code: GSIX

References for these files: [SERVER, "topic"]

Prerequisites

The solution spectra of this project are set by a company that expects a fruitful outcome, and a product that are expected to enter the market, there are some prerequisites, wishes and demands, that are set from the start of this process. The product has to fit the company, product range and the in-house know-how.

- SGM wants a reuse of an existing lamp head. An element that, in the house, has been spend a lot of time and money on. The product that the lamp head was designed for has never been set in production or sold to any customers, though the tooling for it was ordered. It was ended up in a box as a dead product. It has a maximum heat dissipation 30w, which is a key parameter for the light source that is going to be used.

- As a part of the rebranding of SGM, it was decided to build all future products with LED light sources. A 40w multicolour LED [LEDENGIN] that is used in another product will be one of the opportunities to consider, or a customer choice in a sales situation. The possibilities are RGB, RGBW or RGBA.

- Along with the LED, Ledengin produces an optic lens that is made for the LED. This shall be incorporated in the lamp head as well. The Optics comes in 9 and 13 degrees. [LEDENGIN].

- The product shall be battery driven and have a function time, with full power consumption in 5-10 hours. The technology of the battery depending on what battery cells that is available, that fulfils the demands.

- One of the modules that will be reused is the communication platform. DMX and WDMX (wireless DMX), that is a marked standard, and a technology that are used in all the SGM products.

- To actuate the movement of the lamp, it will be preferred to use the same stepper motors that are used in the newly introduced moving head, the G-spot. [G-spot]

- Along with all other products in the SGM product portfolio the solution shall have a higher rating on the IP rating scale [SERVER, IPrating]. Preferably IP65. This is one of the key features for all their products, and one of the parameters that SGM are innovating their product range to stand out in the market.

- It shall fit the marked standards and adapt to the present use of products in the event and entertainment business.

- The director of the company tells that the industry are very conservative regarding the functionality and technical and construction principals, so any unknown way of movements will scare of some potential customers. Regarding the looks, he is more open-minded. It has to stand out, and can be playful, but have to fit the design, quality and feel of the existing product range.

- Almost any products in the market are black or white, so they can be hidden in the scenery. It was mentioned from the director that can be possible to sell this solution in different colours or with colour marks, but there should be a black and a white version.

- SGM see them selves and their products as high range products compared to the market, and as the solution have to fit the product portfolio design it have to fit pricewise as well. Peter Johansen tells that he expect a fixture like this; have to cost 8000-10.000 DKK each as list price, but preferably cheaper.

- As a first guess and expectation SGM expects to sell 4.000 – 6.000 fixtures a year.

Intended market

- Event and entertainment business
- Primarily Rental companies and party planners

SGM are selling their products via an in-house sales department and a range of distributors around the world, both self owned and agents.

The product is intended to fit the present product assortment. It is not meant to enter a new market, but to be an addition to the product range.

Use and context

- Decoration lighting, Architectural Lighting.
- Quick'n'easy, Mobile lamp.
- Smaller concert setups.

The product is for quick installations where the operation time is in the functional limit of the battery. Often it can be expensive or time consuming to pull both data and power cables, on a bigger site.

Date of market introduction

- Winter 2013/spring 2014

First thoughts

As an established company they have a main market, customer base, knowhow to rely on. From a business and product development point of view, the company already have put a lot of money in developing their products, and in that matter it will make sense, to reuse some of the modules that repeats in the different products, to save the engineering salary for developing the same thing twice, like the lamp head.

The expected number of product a year can sound like a little overestimated, and there is a pitfall for this to happen, but production wise it still has to be considered as a mass production product, which influences the choice of material and production methods.

SGM are in a process where they are moving all assembly and some of the production to Denmark, where sometimes the price for the manpower handling the parts are more expensive. With the expected list price, the production and assembly has to be cheap, fast and easy, to still make a profit.

Derived from the prerequisites, it is possible to structure some of the controlling parameters for the outer boundaries of the hardware part of the product. The lamp Head limits the output of the light source, and in the same time they give an indication of the size of the product.

This gives a base for the external research, to find the user needs and demands, the market standards, and the general use and handling of the products.



The lamp Head that are going to be reused in the final product

What I have Learned In School - Project strategy

To design a product that adds value to the user, and not “just make one more candle holder to an overproduced market.” the industrial designers profession is not to make art, but to know the different user needs, aesthetic parameters that make it adapt to its intended environment, and the technology that is available to realize the product.

The “design for client” approach gives a lot of opportunities, but also a range of limitations and boundaries. A company will only pay, and set a product in production, if it generates a profit, either economic or other value to the company. You cannot build a business if you got no customers. In this optic the client is a co-worker with a certain amount of codetermination in the process. He is still the one who is going to pay the money.

In an established company, there are often a network of people and departments that have influence on the product. The sales department knows the customers, the service department, want the products to last, and if not, they should be easy to disassemble, and the procurement people want standard components with a range of different suppliers, as examples. This you have to satisfy, or use as active parameters in the design process.

To make a product for SGM as the outcome for this project, three of the main focuses will be, the user, the company and the technology.

The user, and the use of products.

- What makes the product useful and gives value to the user, and make the user want to buy the product?

Who are the primary users, what are their needs, and why do they buy one product instead of another? No doubt that the user, or the purchaser in a company are a strong factor if the product is going to be sold and become a success. When a company launch a product the goal is make as much money as possible, so if the intended user does not buy the product, it is not going to stay on the market.

The company

- Those who are paying for the development and production start. If they do not believe in the product, the chance of getting to do the next becomes smaller.

When a company decides to develop a new product, put it in production and sell, they often do it with a certain risk of losing money if it fails. For companies it is important to know their market, their customers, and their competitors, to calculate if a new product is worth spending money, on development and start production. This by knowing their key competencies, their internal resources and know-how, or research in new markets, strategies for future products.

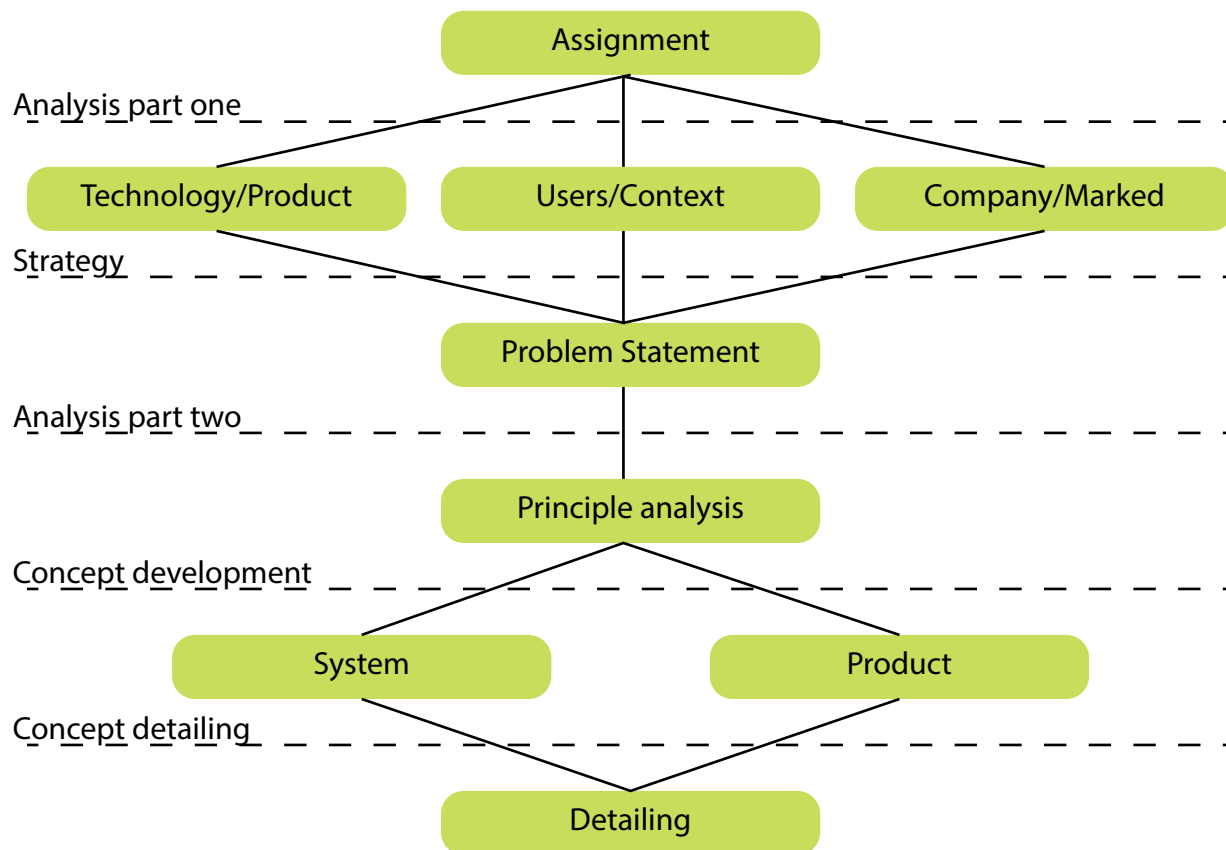
When you design products for companies, you are using other people's money, and to reach the goal of a successful service and outcome, you have to know the company and its values, customers and existing product portfolio as well, to identify the solution spectra that the product that you are designing.

The technical aspects of the product

- What makes the product function? Is it built to last? Will the user understand the functions? Or is the technology going to be outdated within the intended lifetime of the product?

Some of these aspects do not come natural in the education of industrial design, and no one can foresee the future. In this case some of the platform that the product is going to be built on, is standard modules and components available in the company.

As an industrial designer I think that it is necessary to know all processes of a product, and with a special interest for mechatronics, I think that it is important that you know how and why the electronics function as it does. As an example, if you know the specifications and parameters of different motor types, what electronics is needed to make it function, you know different possibilities to make the same motion with different components. This can strongly affect size, construction and performance of a product. Different technologies can make different products. Some components need cooling others are producing electrical noise that makes the product fail. If you know about all these processes, there is a possibility that you can design your way out of it.



The illustration shows an overview of the different phases of the product, and is a linear interpretation of a non linear process.

To work in collaboration with this company, with a very charismatic director, and the chance of the outcome of this project will be set in production, there will be some influence from the SGM. To use this in my advance, it is necessary to keep close contact with the company, and use all the experience and knowhow that is available in the research and development department, and get the most out of the process, both learning and experience wise.

“Always have a meek attitude to the job, the client and product.”

- A mantra by Professor Marianne Stokholm

“...And then Rock’n’Roll...”



***“if you
you can***

Analysis

***“You can’t see them,
can’t hear them”***

The Company - SGM A/S



illustrations- upper left: The headquarters in Aabyhøj. Upper right: The research and development department
Lower left: The head of company, Peter Johansen. Lower right: Test and commercial picture shooting of G-Spot.

To make a product for a company, you have to know about how the company are thinking, their product assortment and values. This chapter will describe the history, the marked position key values and focus of the company.

SGM was originally founded in 1975 in Italy, and have since made light fixtures of different kinds. Due to many different actors on the marked and rising competition, SGM, along with others, started production in Asia and started to sell OEM products. This gave SGM a bad reputation in both quality and innovation level, and the sales rate was decreasing.

In 2009 the company was bought by RCF group, and they hired Peter Johansen as head for the research and development.

Peter Johansen is a pioneer in the business. In 1987 he was the founder of Martin Professional, a world leading lighting company, where the products from he's period still sets the standards for event lighting.

In 2012 Peter Johansen bought the most of the company and moved the headquarters to Aabyhøj in Denmark, to start a whole new era, and product category and assortment, and re-launch the SGM brand. He brought in his old head of research and development from the Mar-

tin time, Finn Kallestrup, along with other key employees to make this re-launch a reality. [SGM]

One of Peter Johansen's main mantras is to keep the company in a size, where you always can make a quick response to marked changes, and respond to customers needs. He will follow the same recipe as he did in martin, and the other companies that he has founded that went big in a short time.

The company spirit are build around the SGM bible, that tells how for the employees to act around the company and in their work. And behave to customers and co-employees. The SGM bible can be found in [SERVER, bible].

The internal values should reflect in the external values and appearance, and be a solid base for company identity, mission and brand.

The New product range

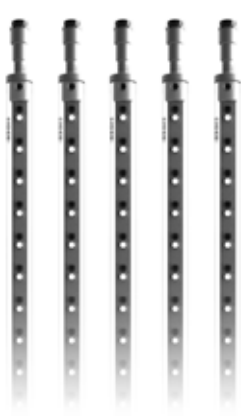
When the company moved to Denmark, it was a beginning of a new range of products. To stand out from the many competitors, the new product should have a clear red line trough function appearance and performance, the new products all build on:

- LED Light source.
- IP65 rating of all products.
- NFC Control and setup.
- High-range quality.

All new lamps are designed by Jan Pedersen who runs Design BIG. The product can be divided in to two main groups. The smaller pixel products, that are made for mapping of pixel to give a visual

effect of pictures, 3d structures and light effects. The other group are bigger stage and architectural fixtures. These products are used to light up the stage for concerts and TV-shows or to light up buildings, sculptures and public spaces. A marked analysis will be carried out later in the report.

Pixel products



LT-100



LB-100



LP-700



LD-5

The Pixel product are mainly made from plastic, and made for quantity. To get the most effect from these products, they are often mounted in grids and matrices, to map the pixels like a LED monitor.

Stage Lighting



X5



P5



G-Spot



SP-6 Sixpack

The staging products are made as professional fixtures for event and entertainment business. Due to the IP65 ratings, the fixtures are often used as outdoor architectural lights. The materials are mainly aluminium and steel.

The moving head in general

To get a basic understanding of a moving head, the following study will describe the most common features and terms. As stated in the prerequisites, the company suggested a rather conservative construction and look. Looking at the marked for moving heads, they all look very similar in general and has not changed much since the first mass produced moving head was introduced in 1986[MTS], so Peter Johansen might be right in what sells the best.

The moving head in the illustration is conventional lamp in a bigger size compared to final solution intended, but the same features. The main purpose of this lamp is to shoot the light in any possible direction, controlled in two axes.

Tilt rotation

The tilt rotation are driven by a stepper motor and makes it possible for the lamp to rotate in one axis.

This feature is necessary for the final product to make the movement possible.

Cooling grills

Some electronics are very heat sensitive, and need cooling. Inside there are fans leading heat away from the components and out of the lamp head.

Any electronics that produces heat, needs to be cooled. This lamp has holes through the body. This is not a solution for the final product, due to it has to be IP65 rated, so the electronics have to be cooled in a different way.

Handles

The handles are for lifting and handling the lamp.

Depending on the final design, weight and handleability the final solution will need handles as well. This will be decided from models and use scenarios.

Lamp base

In the base electronics like power supply and controller pcbs hidden. It makes the fixture stable when it is standing on the ground. Underneath there are mounting possibilities for clamps so it can be rigged in the roof of a stage.

The final solution needs some kind of base, to contain the main electronics. The design of this will be determined by all the key technical parameters.





Lens and optics

The lens is where the light comes out and the optics of this are controlling the spreading angle of the light.

The beam angle for the solution is a key parameter. The angle will be desited from technical aspects and form the user needs.

Lamp head

The lamp head contains the light souch and all the optics, like focus, colorfilter and gobos (lightpatterns).

As minimum a place for the light source is nessesary, but what else is needed will be derived from users and technical limitations.

Yoke

The yoke are moved by the pan rotation and holds the lamp head. It further more contains the cables for the lamphead.

Will be determined during the design process.

Pan rotation

The pan rotation are driven by a stepper motor and makes it posible for the lamp to rotate in one axis.

This feature is nessesary for the final product to make the movement posible.

Display and controle

From here it is posible to controle the different parametres of the lamp.

For adressing and mode selection, the final solution will need a kind of controle feature.

This lamp does also have a range of features designed for the general use. It can stand on the floor, be mounted horizontally and up side down depending on where and what it is used. It is fitted with business standards of mounting solutions. The quarter-turn Omega-bracket that makes it possible to mount it on stage trusses. It is possible to lock both pan and tilt rotation for transportation. It also has a mounting for a safety wire for when it is mounted in the roof of a stage.

Similar and competing products

The study of the moving head on previous page shoved the general feature. The many smaller lamps in the marked with a more compact construction will be the closest competitors and those the final solution will be compared to. These will be used as technical references.

For these smaller constructions of lamps the body has to be more compact around the light source and electronics, which sometimes can cause problems. Electronics are using energy, are many times also transforming energy to heat. For this project it is set from the company, that the final solution will be using a LED. LEDs are producing a lot of heat, and needs to cooled,

either by fans or heat sinks. If they do not have the right condition for function, the lifetime of a LED decreases very fast, compared to a conventional light source [INSTALL].

LED technology, has given many different types of light sources, where some LEDs are more effective than others, and a combination of LEDs can be designed so the output versus cooling can differ, depending on the product.

From the prerequisites, it is determined that the solution needs to be IP65 rated [SERVER, iprating]. Two of the lamps below do have that rating. The one made from plastic, the other made from both aluminium and plastic.



	Martin Mac101	Clay Paky GlowUP
Key selling points	Small, Fast	Quick and easy
Technology	LED, dmx	WDMX, Battery powered, ip65
Light output	2400 lm	1200 lm
Communication	DMX	WDMX
Construction	Plastic and metal	Plastic
Pan	Yoke	Fixed
Price	11.923,30 dkk	25 187.9671 dkk [DOKA]
	The 101 is a compact LED fixture for the event industry. It gives a moderate output and are often used in a bigger setup, with a high number of mac 101.	The GlowUP is a battery-powered IP65 rated fixture. It are often used as room or architectural light at corporate events. Clay Paky promis 10 hours function time at one battery charge. [PAKY]

Both with a lamp heat in injection moulded aluminium for cooling the LED.

These products will be the reference products in interviews, and concept development.

The only lamp of the four that are battery powered is the Clay Paky GlowUP, it is also one of the few successful products on the market that are powered by battery.

The SGM Genio Mobile is one of the old SGM Lamps, that are IP65 rated, and is present in the research and development department at SGM in Aarhus. To study the technical construction, of this lamp, it was disassembled for a technical analysis [SERVER, Genio Mobile].



Robe REDWash 2•36

Small and powerfull
LED,DMX
800-1000 lm
DMX
Plastic
Mono arm
8000 dkk

Robe REDWash 2•36 is a small fixture mostly used for small clubs and exhibition stands.

SGM Genio Mobile + IP65

Compact, IP65
IR, LED
1500 lm
IR
Moulded aluminium, plastic
Mono Arm
14 842.37 dkk

The Genio mobile is a small moving head made for architectural lighting and shoppingcenter instalations.

Event and Entertainment Business



***“Shake your aSS where
the money is”***

Some say, “Give away the music and sell the show” [LONG]. The music industry has changed a lot in the last ten years. For years ago artist made the money in the record sale, and concerts and touring was an extra income. With Internet being a part of the everyday life, music streaming services has overtaken the source of music distribution, the profit for music sales has fallen in a free fall [LONG]. This means that the number of festivals, concerts and events are increasing [DR]. This puts more money in to the event and entertainment business, and for the artists to stand out; they have to differ them selves in the show and their equipment.

The professional side of this business is an odd size, which spread in many different directions. All with the same purpose and the same equipment, but with many different kind of use, and handling of the gear. In many cases an overall lighting plot are made in col- laboration of a light designer and the promoter of the

event, to express a visual theme.

The setup are often based on the lamps that are in stock from the promoter, the rest are hired in from bigger rental companies. These rental companies are one of the big target groups for this project.

Those who have a smaller range of their own products are companies like theatres and TV-stations.

The different groups are described on the following page, along with their special characteristics for the general use. It will define the potential customers for the final solution, and thereby locate the different needs and demands from the different branches of the industry.



The rental company

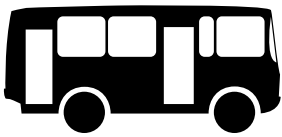
The rental companies rent out light equipment to promoters, both as dry-hire and including technicians to execute the show. Some of the key parameters from this business is technical reliability. The companies will lose money and respect if they rent out non-functional lamps. By renting out their equipment, they do not always control how the products are going to be treated.

Rental companies not only deliver products for concerts. Some specialize in corporate events, smaller parties, and architecture light during public events.



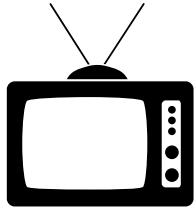
Theaters and concert venues

This group do have a range of standard lamps. At a theatre it is important that the moving heads are noiseless, and versatile. Theatres are often located in the city, in buildings with limited space. They do not have room for any type of lamp in their stock.



Touring and performing artists

On a tour the size and weight are a key factor. They need all their gear to fit in as few trucks as possible, within the weight limitation. Touring artists often rent their equipment from the rental companies, so that they can change the setup for the next tour.



Television and film industry

For TV it is important that it will render colours correct, it is easy to hide in the scenery, and again be noiseless.

The majority of this kind of lighting fixtures is sold as business-to-business, but as mentioned the money flow starts with the audience of a show or the concerts goers. Without any audience, there will be no artists to perform, no show to watch and nothing to put the light on. This means that no one will rent or buy the light fixtures. Illustration XX.



To cover some of the users needs and demands, to find out the industry “way-to-do-it”, the following section will take its base in interviews with different people, with different roles in the event industry. The Interviews will be used, as a base for the further research and concept development.



Profile

Name: Christian Byriel

Job: Product manager at SGM and former freelance light designer.

As a product manager, Christian's job is to guide customers in their choices, know the market, and streamline SGM product assortment to the market. In the freelance period he has more than 8 years in the business, and has worked with many different types of lamps, and often used the Clay Paky GlowUP.

Along with the prerequisites we talked about how this product should turn out, and how to make it enter the market as a relevant product.

The first thing Christian mentioned was: "We bought the GlowUPs because it was the only battery powered lamp at the time, but we were never fully satisfied. It felt like cheap plastic, and there was never enough output. We used a lot, because of the easy and fast setup. And the clients and the technicians were happy to save the money for manpower by pulling cables." He adds "The SGM product range should be of a higher quality, and we are trying to position the brand as high-range fixtures"

We talked about how the product should be in the perfect world. The product should be battery powered, and still be mobile and versatile.

"If we could get the output and performance of a Martin Mac101, in the size of the GlowUP, it would be perfect, but the goal should be to make a lamp close to a wired one.", but to the question of if the GlowUP had weight five to seven kilograms more, would it still have been quite as useful, he said: "Yes, but as a system of 6 or 12 fixtures there is a danger of it being heavy and difficult to handle, and there is a turning point of when it gets easier to just pull the cables, and as an example keep the product portfolio smaller in a rental company".

In his eyes, eight hours of battery time are enough, "we still have to keep the production cost as low as possible, and I will rate light output higher than battery time."

What he liked as features on the GlowUP, was the quick and easy handling and controlling. "I think it is the best solution with a display and simple control on every individual lamp, or something quite as easy. Every one, not

familiar with these types of lamps, should be able to turn it on, choose colour, and maybe some presents for the movement. And a battery indicator on every product are very important!" But he is still questioning if the movement feature is necessary or just an expensive feature. One of the important factors in a fixture is that it got enough power to make a colour on a wall, in daylight. Christian tells that he often used the GlowUP at corporate events to light up the walls in the room. "It has to be discrete, and look good in white, because that will be the preferred colour for this kind of jobs"

He suggests that there are components in other SGM products that will be reusable for this lamp, such as displays, LEDs and accessories.



Profile

Name: Emil Højmark

Job: Light technician and project manager at Nordic rentals

Experience: 6 years in the business both as touring light designer and as show technician.

Profile: Emil works in the rental industry, where the use of the products are more rough than as an example the theater business. In a rental company he gets in touch with almost all different kind of lamps, from many different companies, and his job is to make them all work together.

As a first impulse Emil said. That is a bad idea. No one will ever remember to charge the batteries! But after a little conversation, where he elaborated over the theme, he changed his mind, though with a couple of pitfalls that have to be avoided.

In a rental company all products need to be high occupancy rate, to make a profit, and that will make the possibility for the lamps not to get the time to get recharged. He says: "If we rent out these fixtures with a low battery, it will be the same as renting out a defect product" Along with the high occupancy rate, there will be a lot of abrasion on the product and the battery.

In the rental context he tells that the controller has to be very simple. "Products like these, will often be rented out as dry-hire" This means that they rent it out to people with out any technical knowledge. "If the customer can't operate the product, they often call me when I am most busy!" For those that not are familiar with a light console, he suggested a remote control.

In a procurement situation, the product has to have some key features that make it stand out. "When we buy lamps, we often look at what the competitors and other rental companies has. If we are in lack of products we need to rent it in. But if the lamp has some special features, we look at what we need, and what will fit in our product portfolio", and on the same topic he underlines that it was very important that it was build on a technology that will communicate with all other products in their warehouse.

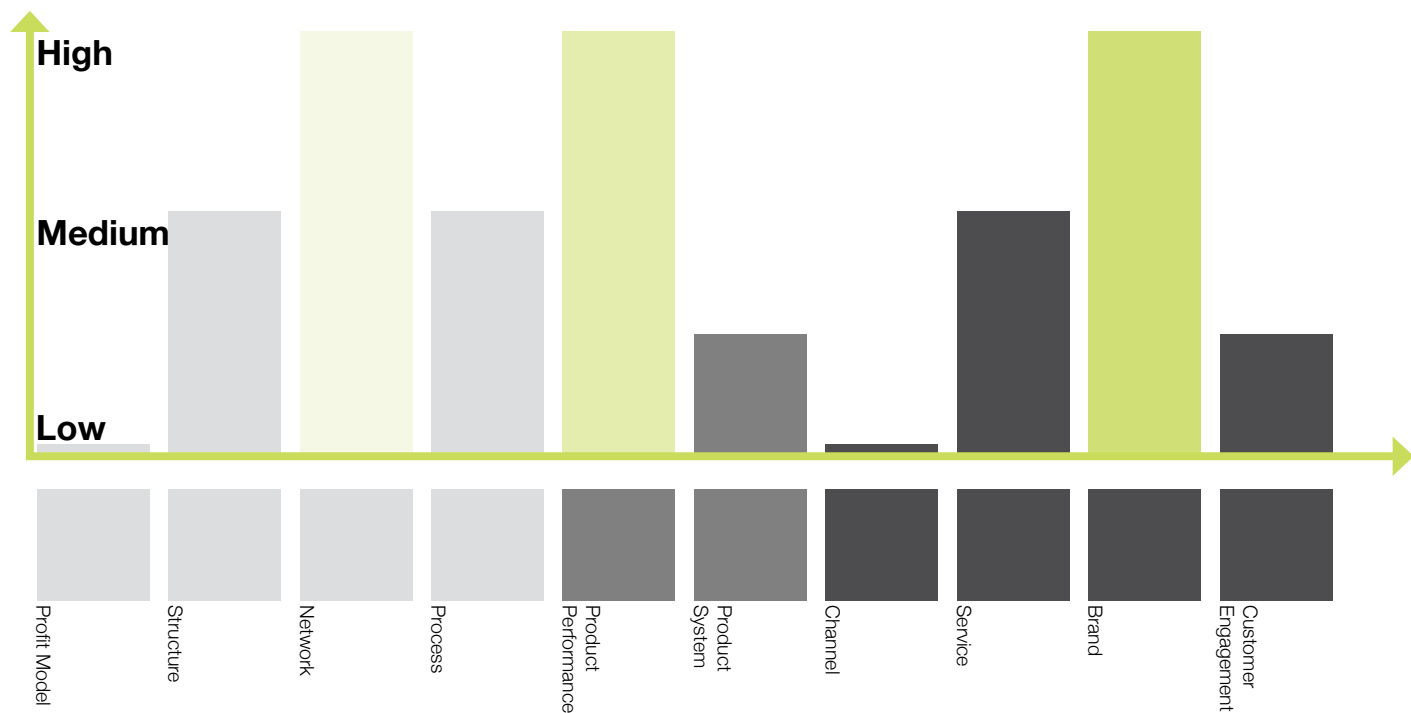
Through the conversation Emil elaborated over the theme and got really excited and the first impulse was turned to "I want twelve of these lamps on a job in au-

gust!" He came up with a couple of scenarios that will be described in a later chapter, but he mentioned some important parameters. "It needs to have a look that is nice for corporate events, where people where suits, and be robust enough, to be installed in the woods on a rainy day, on a festival.

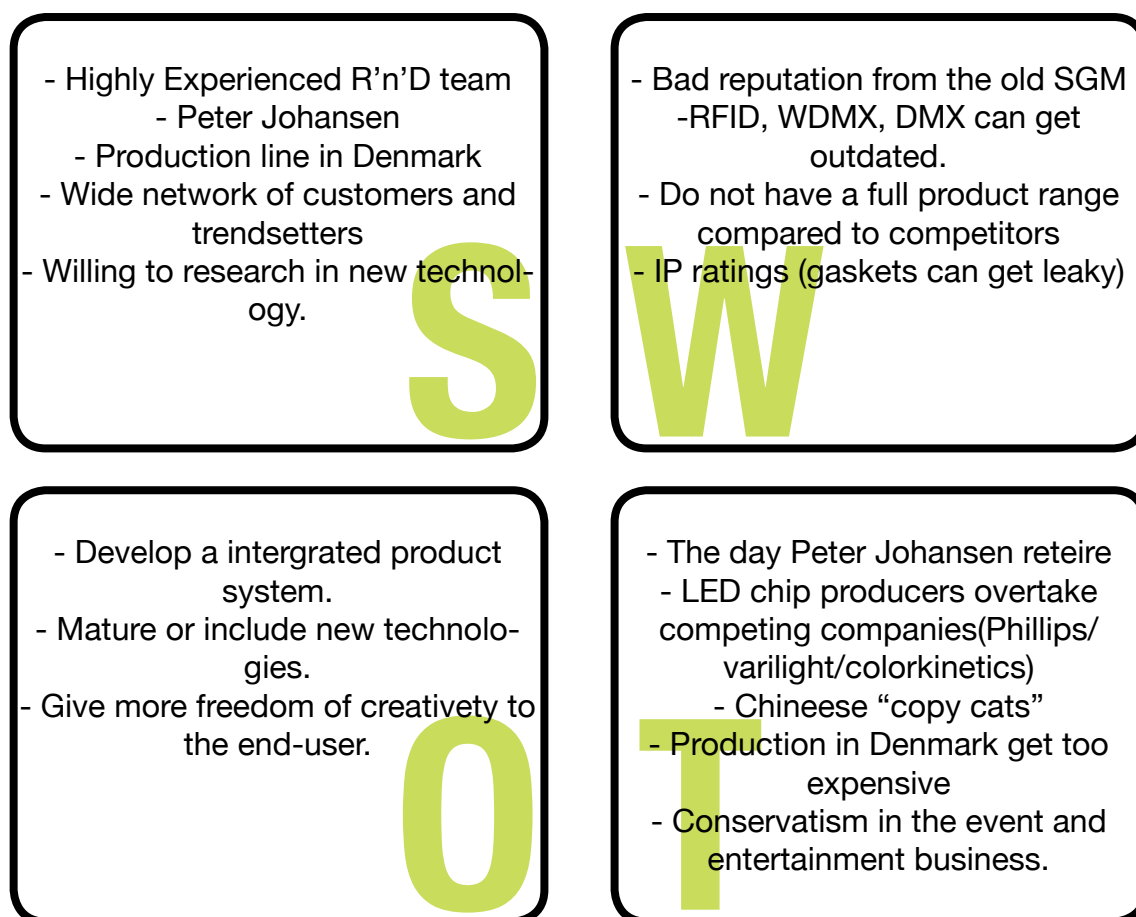
About the design, Emil likes symmetry and the right proportions, and to make versatile for the two different markets, it is important that it comes in both white and black. He said that it will be most useful, if the lighting emitter has a big area as possible, to make the best effect in his setup, and if it should be a moving head, the light emitter has to be round.

As an overall product he said. The main marked for this fixture will be "fast and easy in, fast and easy out". He also mentioned the paradox of battery products: "I want it to have a great light output, long battery time, and as small as possible."

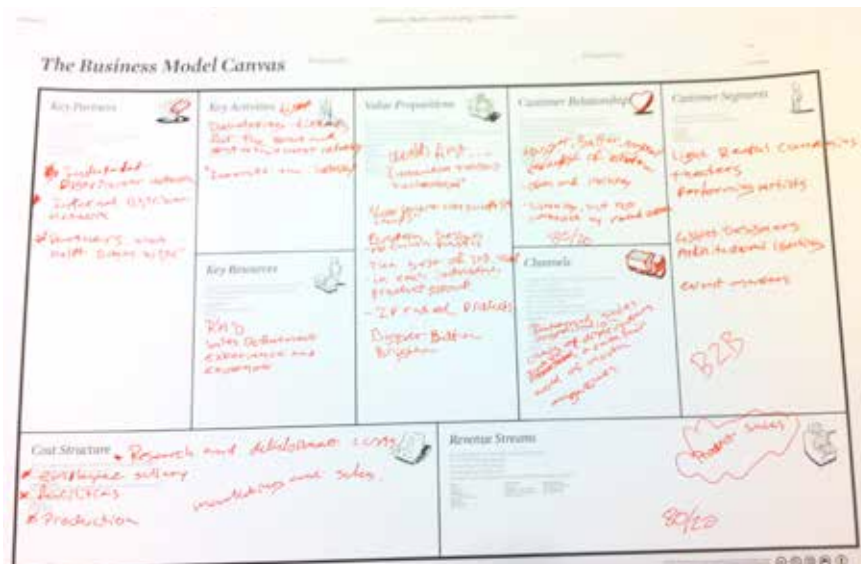
He suggested a feature where you can turn off the DMX mode, and make the stepper motors remember the position that you manually turn them to.



ILL#: Map of the 10 types of innovation model. The illustration shows, which key parameters SGM, are building their business and innovation on. Peter Johansen is one of the pioneers in the business, and along with other companies that he has started, he has a great network around the world, which are used for both selling and to identify customer needs for future products. As mentioned the new product range is build on new features and technologies, that are a key selling point in the rebranding process. [Doblin]



The SWOT analysis is made to get an overview of the company's strengths, weaknesses, opportunities and threats. It is made to find out the companies competitive position and strategy development opportunities. [MINDTOOLS]



The Business model canvas is a way to map and find new strategies and models. In this case the model are used to map out the existing business model, strategy and company DNA. The model in a full form can be found in [SERVER, canvas]. The outcome of the model shows that SGM goes for the “worlds first” when they are developing new products, and do not just make copies of the competitors lamps. Like one of Peter Johansen’ mantras, and strategies, is to fill the gap in the customers needs, and develop new concepts rather than just make what is expected. [Osterwalder, 2010]



To map SGM marked position, or the position that they strive to take is a high quality LED products, this also is reflected in the price. The rebranded SGM is still a rather new Constellation, so it is hard to put them in a marked leader position, but it is the strategy to reach that position within five years.

Customers have described the new SGM products as apple-like, because of its looks and plug’n’play features, which sets a mark for quality standard [PLS]. Like in many other product categories there is a lot of import lamps from the east, of different quality. The general impression of these lamps in the business is that the quality follows the cheap price. The well-developed lamps from the east are often sold as OEM to established companies.

Use context

Some of the outcomes from the interviews are that there is a marked potential for corporate events and architectural lighting. This supports the first impulse from the ideation meeting, where the thoughts were palm and three up-lights. Emil also suggested the product to be used on the red carpet. When he is decorating an entrance for an event, the red carpet is only used for a couple of hours. This solution will save him a lot of time in the setup.



Asian and eastern weddings

As the first request for this product, there are a marked for these types of parties. They are often, temporary sites, and not build for big lighting setups.



Red carpets

Easy in, and only have to light up in 2-3 hours when the cameras are on. This area can often be far away from the main show area, and it will be a faster solution to put up battery lamps than pulling power and signal cables.

The general context scenario can be described as:

- Temporary sites where electricity not necessarily is in a short reach.
- Limited time of event.
- Both indoor and outdoor.

The four context scenarios will be used as base for the concept development.



Architectural and effect light

To make a certain atmosphere for an event, the lightset can underline the feeling, by light up different planes. This could also be used in the decoration of urban space or a public park.



Corporate Events

Decoration light and effect all over a building, can be possible and easier to setup with this kind of fixture. Light the entrance with the company colour.

Conclusion and reflections

From my internship period I had my daily routines at the research and development department and worked close together with Peter Johansen. He is a man with a great entrepreneur mind, and relies more in his gut feeling than “fancy university models” as he says. They are forbidden in the company. I was witness to many episodes where very pragmatic values, are schoolbook examples of innovative business models. The collaboration of Finn Kallestrup as technical minded head of development, and the more playful Peter Johansen that gets new ideas every minute, colours the whole company and affects the products, the company spirit, internal and external values.

Based on the analysis it is possible to view the users from two different angles. The light technician, and the observer or the audience of a show.

For the light technician the products are more tools to make them do their job and impress their customers. The observers are the those who, the light setup are made for, and at last judges the visual impression.

The new SGM builds on getting the most out of the new technology, and make new concepts around what is possible. It is not blue ocean, but combination of known methods that makes the innovative drive. SGM describes their business as a classical organisation, where all employees share the full responsibility [BIBLE].

Research findings presented for the company

The fact that the answers from the user interviews, was that it will be preferable with a bigger lamp head and more light output, it chosen to continue basing the concept on the lamp head, that was listed in the prerequisites. The output from the interviews was presented for the company, in a meeting with Peter Johansen and Finn Kallestrup, where their point of view was their SGM business. They accepted that the results might be right, but, he was sure that he has enough customers for the 30w sized products, and will considered later if there is need to add a version II with a bigger light output.

About the appearance of the product there was consensus, of a well-proportioned lamp, which will set a limit for the battery size. The aim was still 8-10 hours of working time, but focus was changed, to find the right battery technology that could deliver the most power for a reasonable price, and that in cell form factor that will fit the product proportions, more or less controlled by the size of the lamp head.

Strategy



Problem Statement

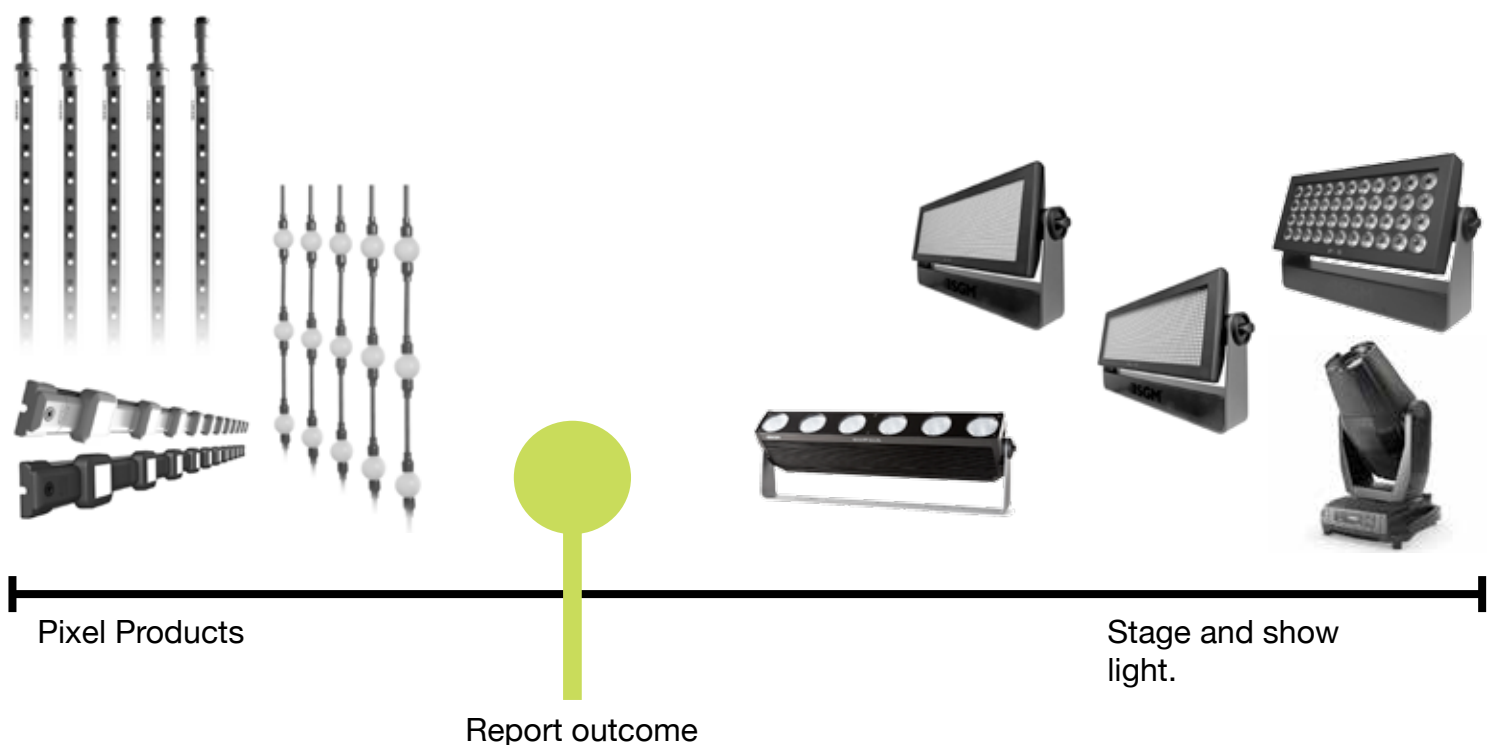
At the ideation meeting the theme of a battery powered moving head was decided. SGM saw a potential marked for this kind of lamp, but how to make a fixture that will fit the company?

- How to make an IP65 rated product, with movable parts?
 - How to make the product that will adapt to the existing product range?
 - How to design a product that adds value in the users daily work?
- All this framed by the prerequisites set by the company.

Direction and Focus

The goal for the outcome of this report is a product in the range between prototype and production stage. This topic of IP65 rating is a controlling parameter for the further development and is a subject to be investigated, to make the product development successful.

The predominantly mechatronic part of the product is big factor for the user experience of the solution, and is a topic to be incorporated in the construction.



The final product will aimed for the gab in the productrange, between the smaller pixel products and the bigger stage and architectural fixtures.

Demands and Wishes

This lamp will be the first ip65 rated battery powered moving head, in the world marked, and there for there ar no direct product competitors to match. As a product it will always be compared to its closests competitors on the marked, and as written the only one right now is the clay paky glow up [PAKY]. Therefore the technical specifications should match in light output, batterytime and ip rating. As a light fixture it has to be fall naturally in with other products in the lighting business and act en equal basis with existing products in a rental company existing product portfolio.

It shall be posible to control the lamp from a standard ligthing desk.

Because of the batterypack it shal be a mobile solution where it makes sense to use away from the stage or main event area.

SGM

- Low production price
- Reuse of existing components
- A natural addition to the existing products

Light technicians

- Quick setup
- Long battery lifetime
- High output
- Good looking

Light designers

- Colour render quality
- Smooth movements

Product

Production

- Mass production
- Low assembly time
- UV resistant material
- impact-resistant material

Technology

- 30w LED
- Battery Powered
- RFID
- WDMX

ME

- Symetric
- Well proportioned
- Can be opperated by non-light technicians
- Mobile and versatile

Design Approach

The key functionalities are given from the prerequisites, and that includes the most of the internal electrical components or component categories, their demands for functionality and their, and for some, the form factor.

These components set the limit for outer measurements of the final product.

It is chosen work “inside out” in the design phase, so that it is clear what it takes for the product to function. The first step in the development is to find, and declare the components that are needed and find out the size and if the whole system lives up to the demand and wishes and technical specs.

To make the product IP65 rated, the strategy is to investigate the different options to seal the different faces and connections of parts.

The interaction and setup of the product should be quick’n’easy, so a user with no experience of show light, are able to turn the light on, and make it function.

Product Identity

Mobile

Dynamic

Fast Movements

Versatile

Quick'n'easy

Manageable

Product system

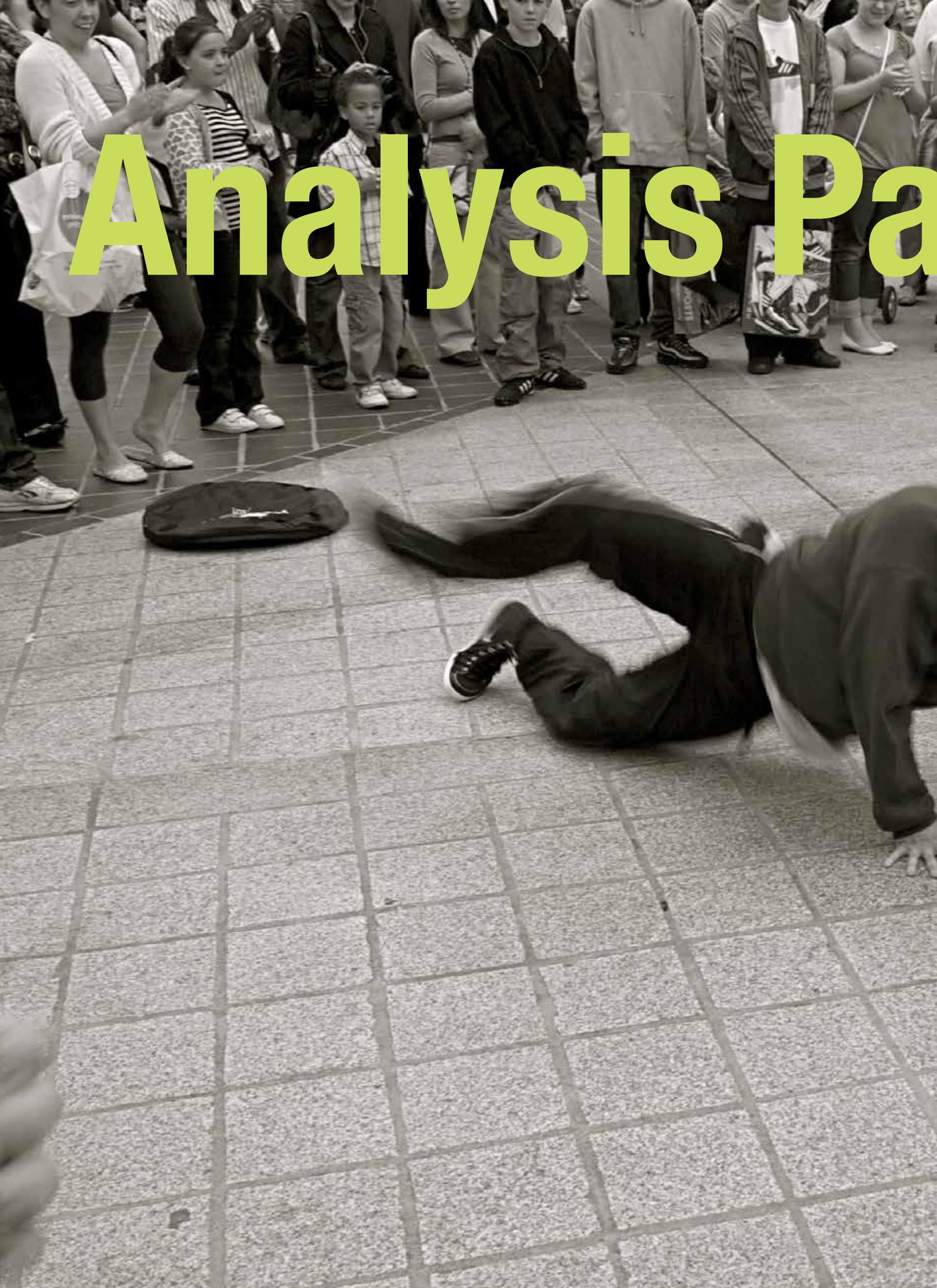
Compact

Independent

G-6

The

Tiny Dancer



Analysis Pa



Part Two

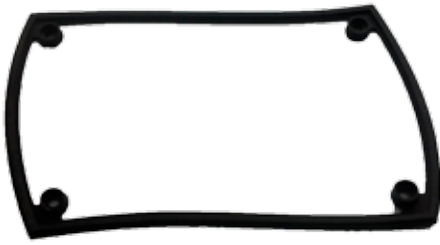
Principal inspiration and method investigation



Apperence



Gaskets and sealing



Moulded rubber gasket

These gaskets are not standard components and special tooling have to be made each connection. It fits in a groove that takes up extra space. They are easy to disassemble and reuse.



Ultrasonic welding and glue

The weldings are the least space consuming solution, but have a great disadvantage in a service situation where the product has to be disassembled.



Cutted gasket

The laser-cut gaskets are only two-dimensional. They are relatively cheap and easy to mass produce. The products are easy to disassemble, but the gaskets are easy to damage, so a replacement is needed.

Examples of sealed and IP-rated products.



O-rings

These come as standard components, and are very like the moulded, and make the product easy to disassemble.



Mechanics

To investigate the mechanics of a moving head, it was chosen to look inside the Genio Mobile, which was at disposal from SGM.

The movements are controlled by gears rotated by two stepper motors. One motor in the base for the pan rotation, and one in the mono yoke for the tilt rotation.

It is made with a direct drive, which is not preferable for the stepper motor lifetime.

The lamp head are made with integrated cooling grills, in molded aluminum. The bearing structure is made from aluminum and steel, with a plastic cover for the body.

It is IP65 rated, where the sealing is laser cut gaskets, glued to the surface





Concept Development

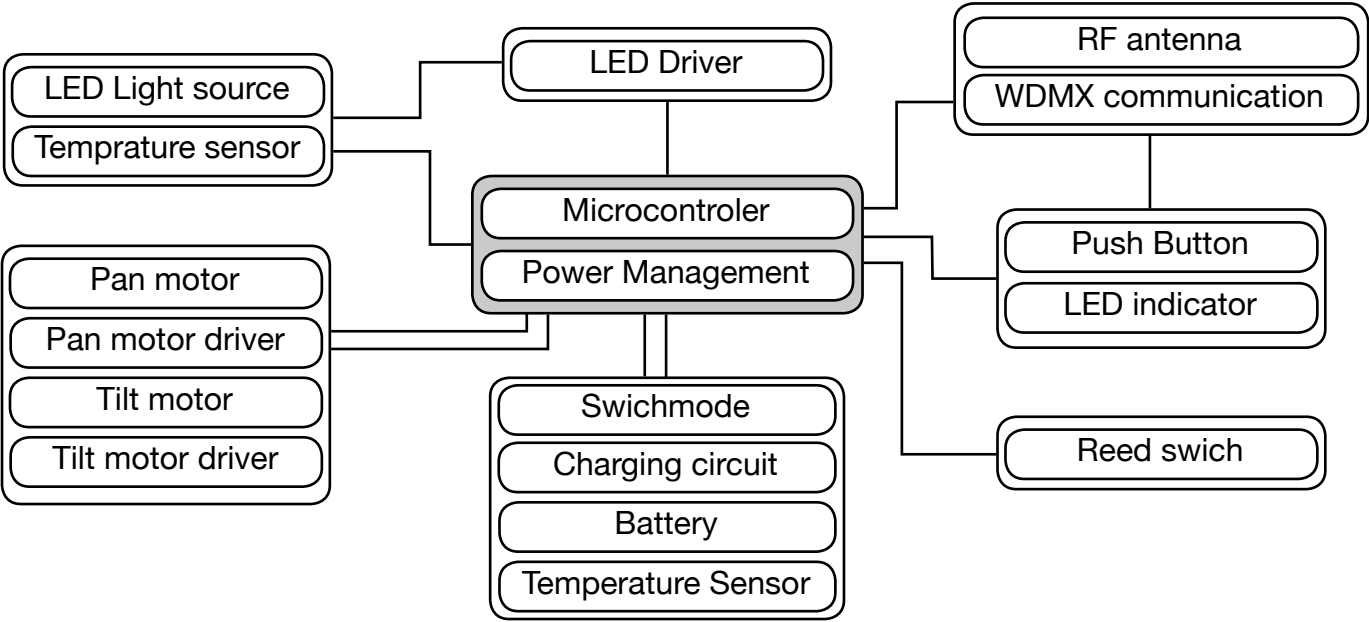


ent

Mudules and Components

To carry out the strategy of designing the product "In-side out" a system diagram was made to get an over-view of what was needed to make the product function. The many different components needs different conditions to work as intended, to avoid electrical noise and heat dissipation. The illustration below shows a block diagram of the electronic system. Some of the components have to get

outboard, and others are combined on one single PCB or module. For the whole product range in the company, SGM tries to design the systems, so that the same components repeats in different products. In this way it is posible to ordre bigger batches of components and save money.



Illustration#: Block diagram of the whole electronic system.



Lamp head



Stepper motors



Battery cels



LED chip



Communication module



Optics



Print circuit boards



RFID module

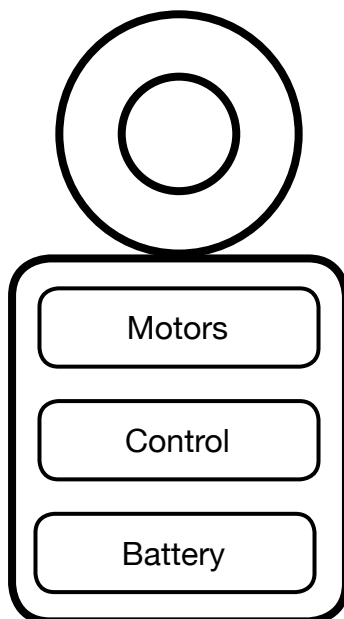
Construction Approach

The highly rated demand for the product is that it has to have a rating of IP65, witch means that it has to be close to watertight. This can be done in many ways, but as another parameter with a high priority, is that it has to be quick and easy to assemble, to make the production cost cheaper (will be assembled in Denmark), and for the service department to disassemble, if that should be needed. This means that liquid seal, weldings and glue, is not a preferred solution. Again, if the product fails during a job, many light technicians will try to repair the product on site.

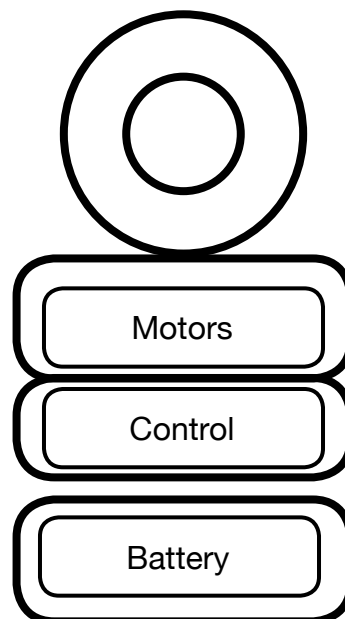
All the electrical components are sensitive parts due to water and moist, and some parts produces heat up, when operating. This factor play a role when you try to completely air tightens a product, due to the physical

laws. If the product is fully airtight, the internal air pressure will rise, when the space inside gets heated up. In worst case this can deform the product, or damage the sealing. In the same time if the product is assembled in a room with high humidity, there is a chance that there will be produced condense moist inside the product that can shortcut the circuits on the PCBs. All these factors can be difficult to predict without a functional prototype, or a solid experience with IP rated designs.

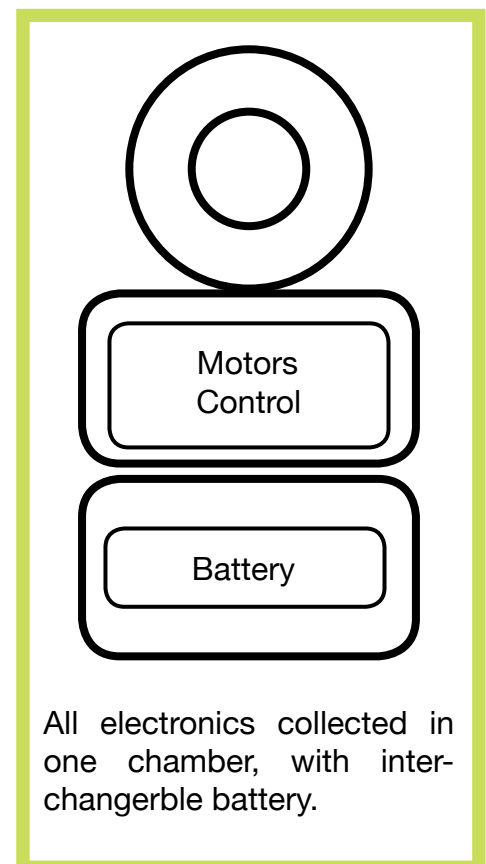
To make the product IP65 rated, the design strategy is to make as few faces to seal as possible. This should lower the risk for the IP rating test, and the product to fail. Gaskets, seals and additional parts, are often a factor to strongly increase the production cost.



One construction where all components are collected in one chamber. No option for battery chance.



Three chambers in connected via shafts and connectors. interchangerble battery. Very similar to a standard conventional moving head.



All electronics collected in one chamber, with interchangerble battery.

Production and Material Considerations

From the analysis of existing products the material choice are mainly steel and aluminium, powder coated in black and grey colours. Only smaller products and a smaller group of parts in the G-Spot are made of plastic. The expected production number, set by Peter Johansen for the prerequisites, is 6000-10.000, In that number of products a year, the production processes and material has to be a considered, in the development of the product.

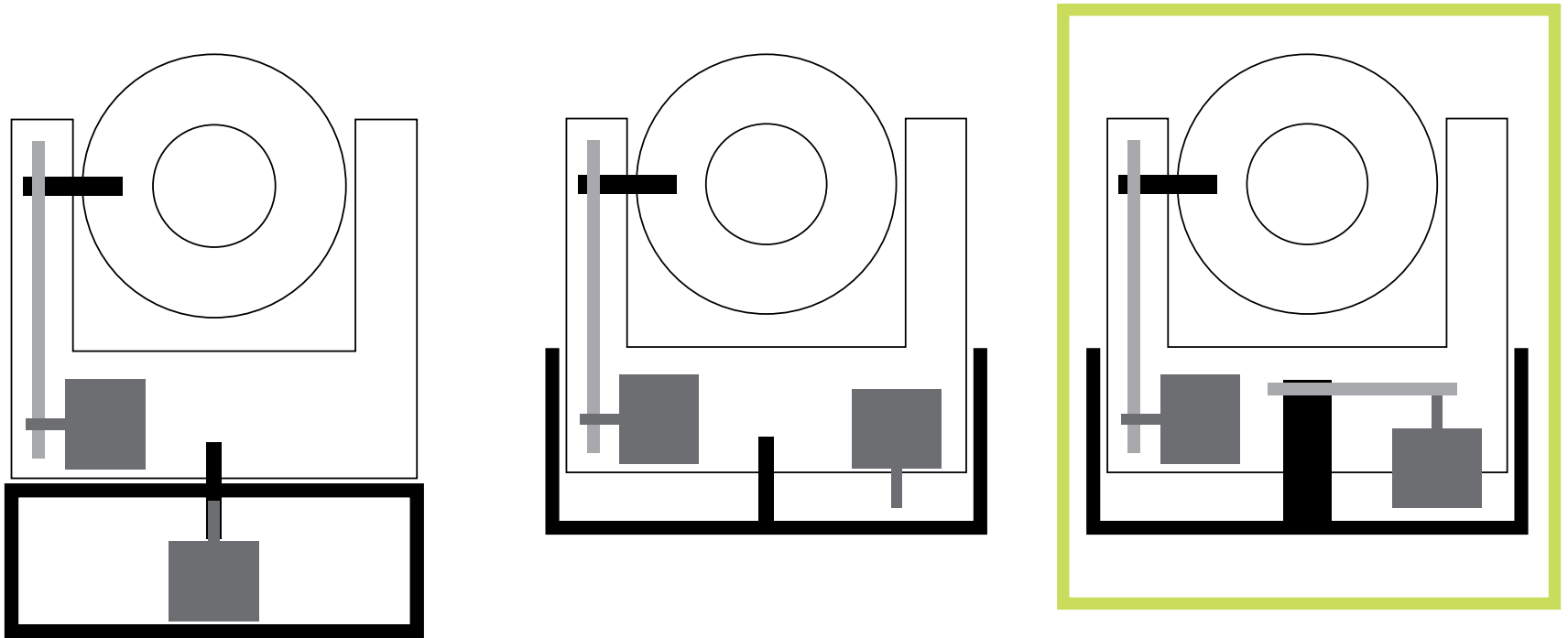
This product belongs to the smaller products in the range, and the expected number of products a year,

is rather high, so it opens up for production methods that are cheaper in a higher number parts, like injection moulding of plastic.

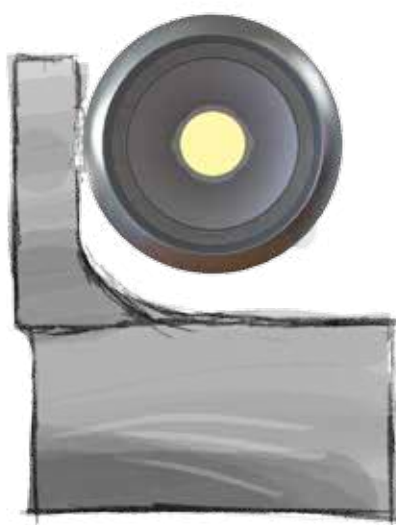
The material has to be UV resistant, because the product will be used outdoors. Also the material has to be impact resistant to smaller bump and crashes if it is dropped.

To make sure that all sealing will work the tolerances for the chosen production method have to be clear defined, or double secured.

Development phase



To make as few seals as possible it was chosen to place all electronics in one chamber.



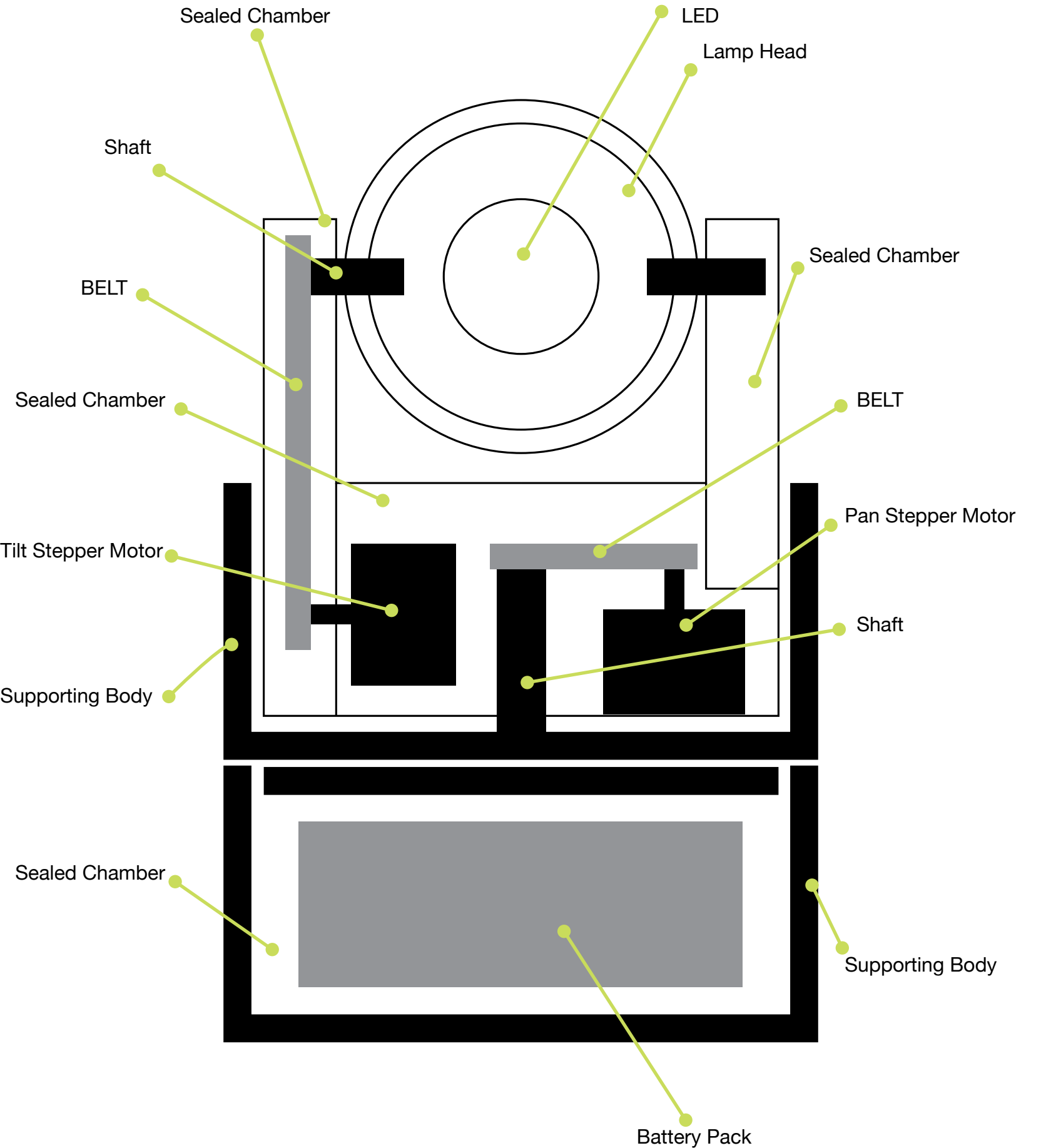
Mono-yoke



Yoke

Despite of the one mounting point on the lamp head, it was chosen to make a yoke, due to space in the monoarm, and to get symmetri in the product apperence.

Final construction concept



Concept det



tailing

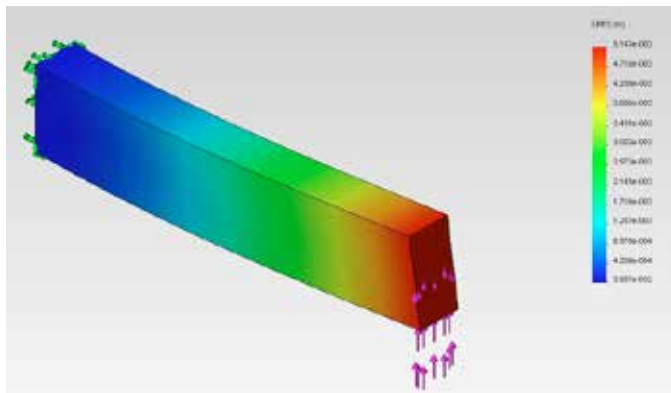
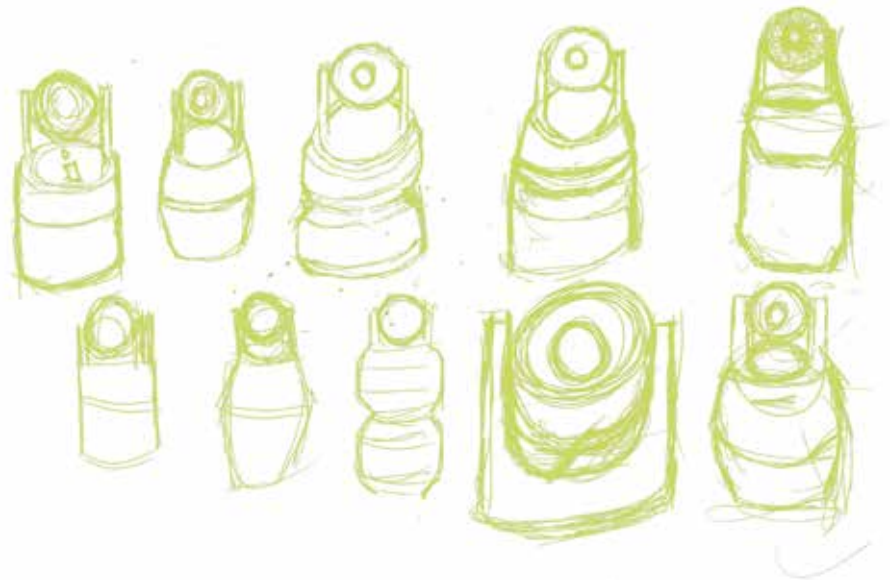


Concept Detailing Process

The integrated design process has been followed to keep track of processes and parameters. For construction analysis Two software programs have been used. Solidworks motion determination and Finite element analysis. To check the plastic parts for their production quality, mouldflow has been used as guideline for sinkmarks, cooling and part quality. Reports from the software analysis' can be found on the server along with the technical drawings of the final products. [SERVER, Technical reports]

Iterating

Sketching



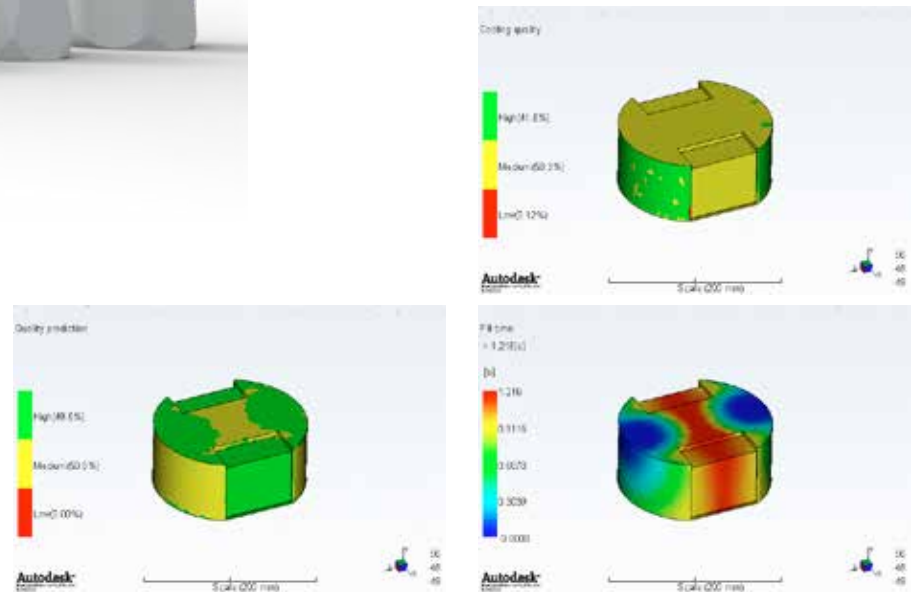
Construction

Detailing





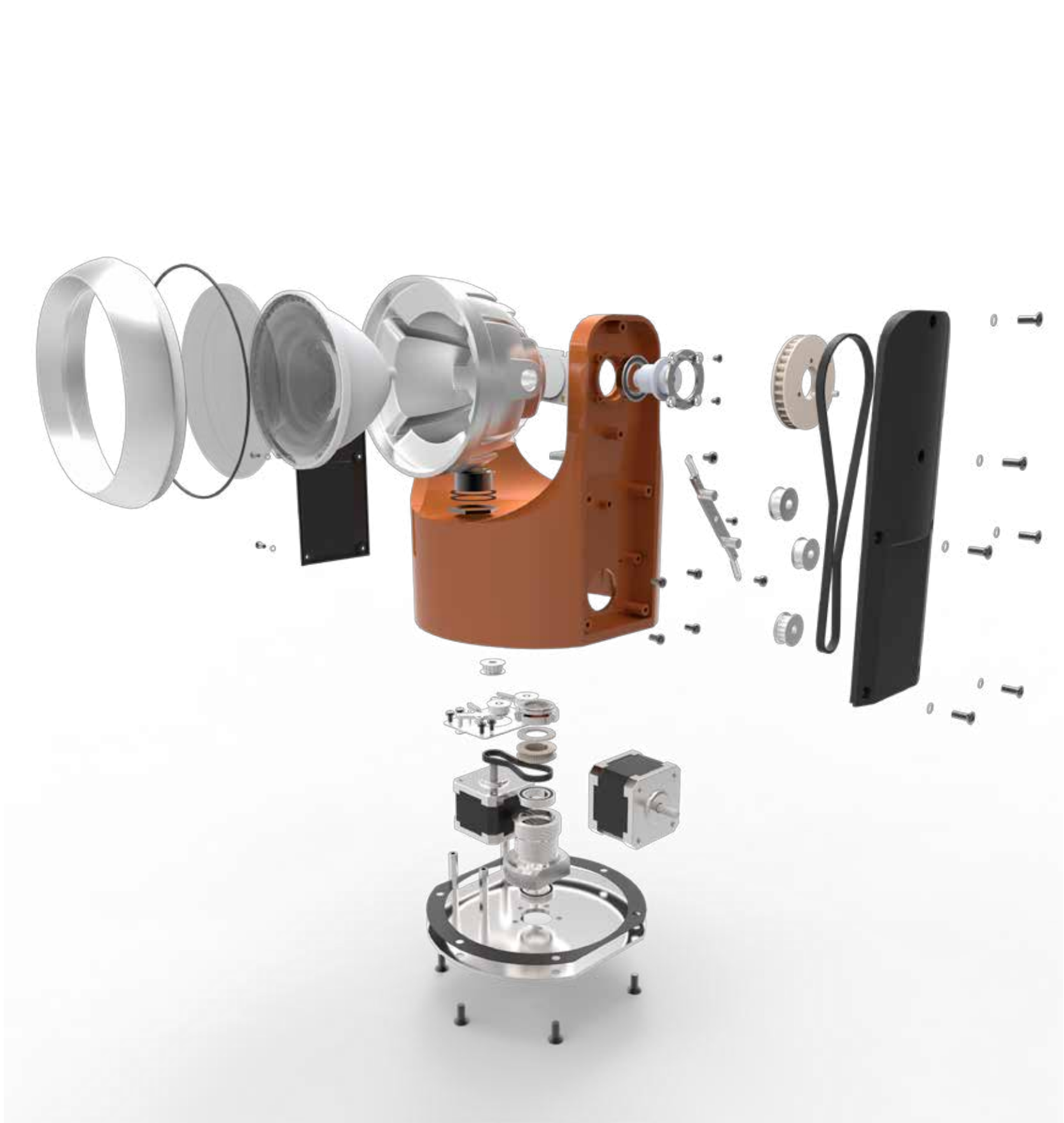
Production quality check



Detailing



The Yoke

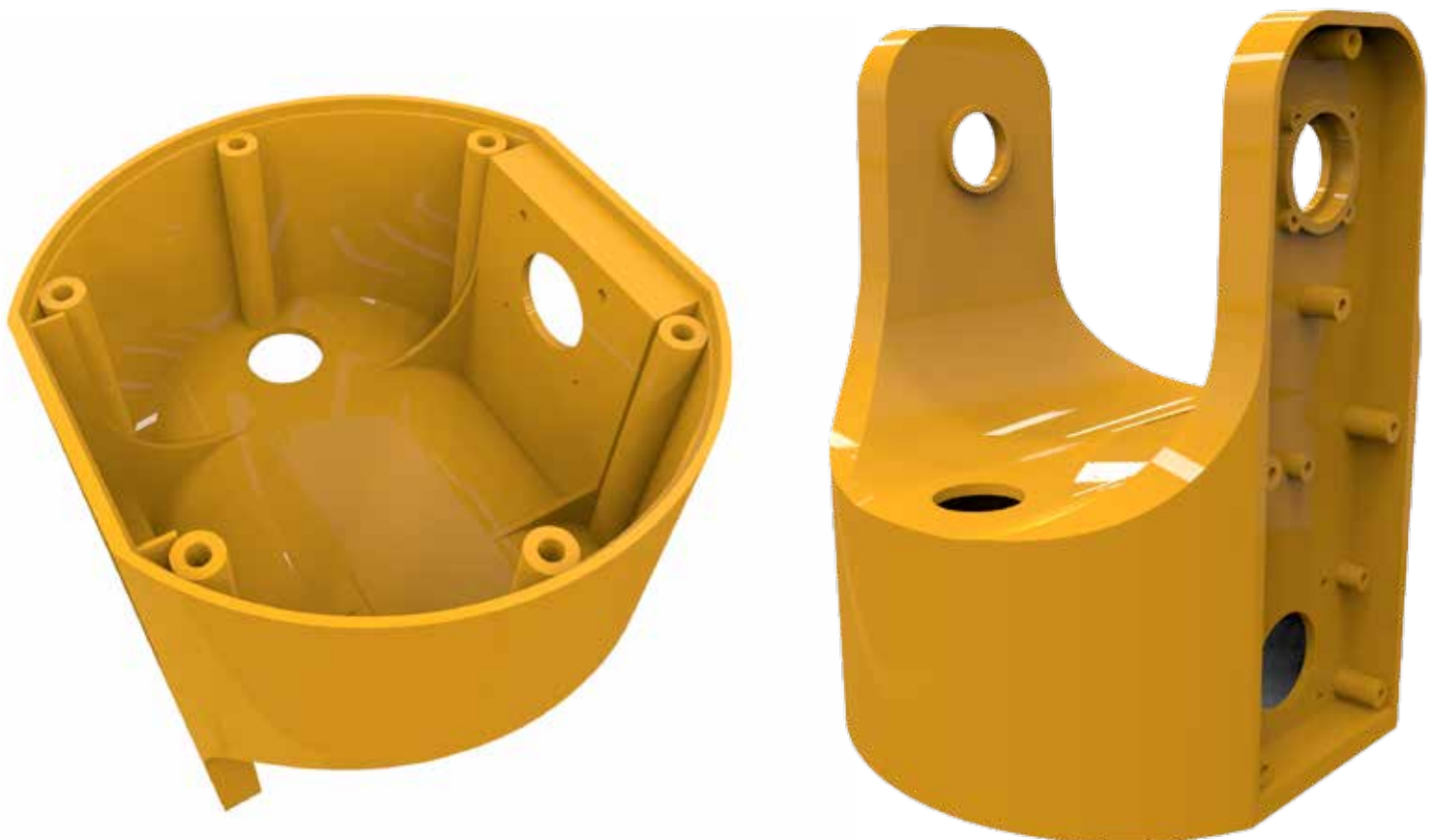


The yoke is made with a three-camber system where all the main electronics are stored in one chamber. The main part is made of injection-moulded plastic, sealed by two additional plastic parts to cover the sides, and a steel sheet metal plate to close the bottom. Inside the pan shaft a power chord is feeding the system with power, from the battery pack or an external power supply. In the bottom of the pan shaft the power cable are moulded, to seal the opening.

The gaskets are made from laser-cut rubber and o-ring-wire. To make the yoke as small as possible, the bearings are exposed to the outside. For that reason special watertight, bearings have been chosen.

The main plastic part is a rather complex plastic part, and needs a five-parted tool to be moulded. Depending on the prices from the subcontractors, it can be necessary to split the part in three pieces.

To make the bearings fit properly the plastic part need a subsequent process, due to the tool drafting from the moulding

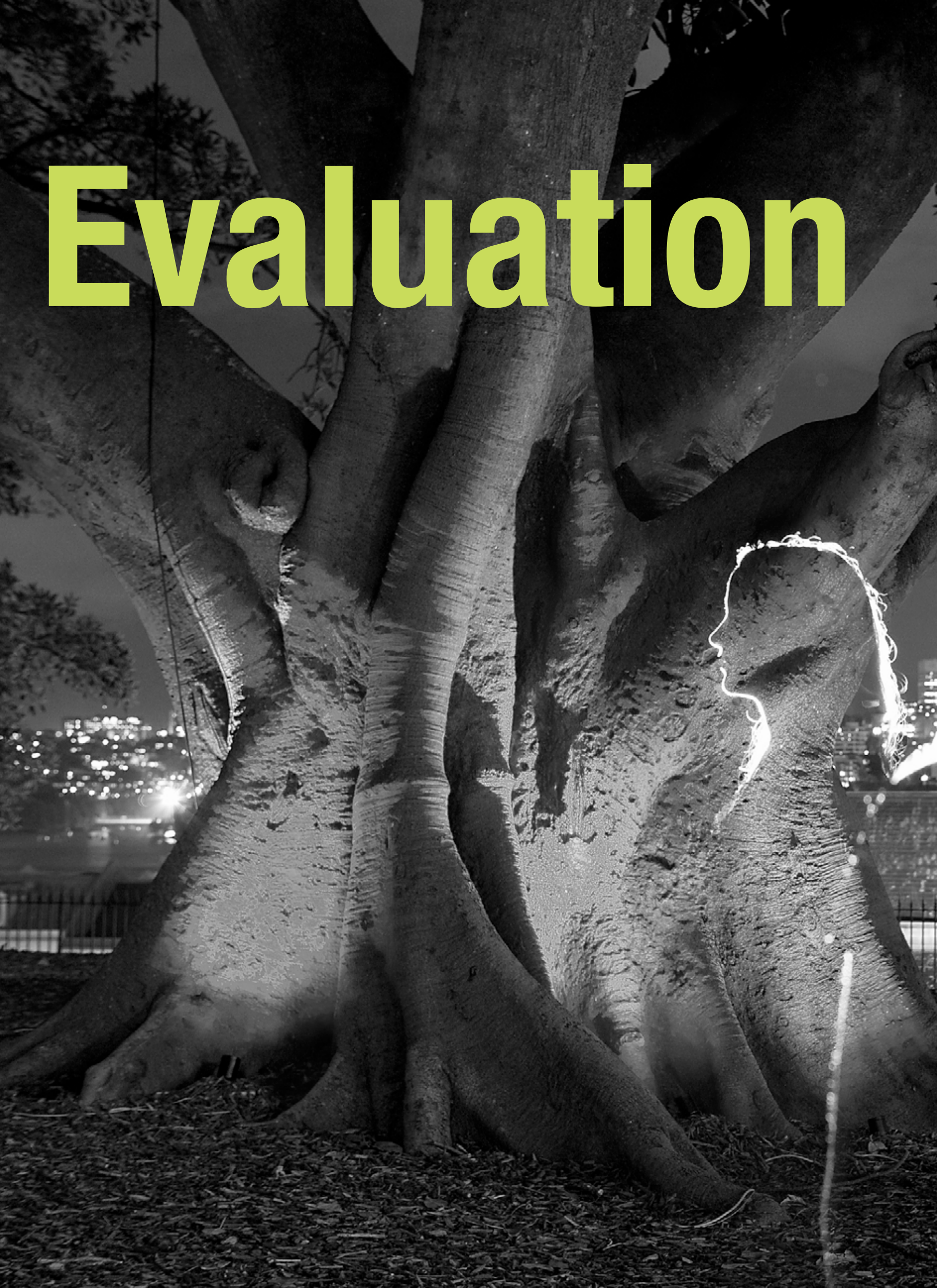


The Body



The body are made from injection moulded plastic, and function as a bearing construction, for the yoke. It is made from four different parts, a shell and a bottom for the fixture, and the same for the battery pack. The battery pack are interchangeable, and it is possible to power the product from an external power supply.





Evaluation



Evaluation

The aim for this project was to make a battery powered moving head for the event and entertainment business, in collaboration with SGM A/S. The product should be an addition to the existing product range and enter on equal basis as the other products. The goal was to end up with a concept and product between the stages of prototyping and production.

To get on track with the topic, different analysis was carried out to understand the user and the company get under the skin of what will create value to the user, and become a successful product for the company.

The battery power supply is a new feature to incorporate for the company, and the solution should fit in between the to existing product categories.

The approach for the process, was extract the key design parameters, understand the business and company, not to be controlled by the company, but to make a solution that made sense to take to the production stage.

The solution is aimed for the user and company, by following the industry standards, so that it will enter the market on the same level as the existing products. Be a plug'n'play solution to the user, so it uncomplicated can work together with the light technician and his favourite equipment.

To make good business is to save money where it is possible. The solution reuses components from existing products, old products and from the same subcontractors that are the main collaborators for the company.

The Battery powered fulfil its purpose and the demands set by the company, and in the writing moment the process has stopped where the different subcontractors has to be defined to take the construction and technology to the next step. By that means that quotes for parts, and new components, like the battery, can still change the construction and parts, depending on price, lead time and main subcontractors competencies.

Reflections

Once again it has been a very exiting to collaborate with SGM A/S. It is a very energetic and dynamic company, with a clear goal and high standards, what I also experienced during my internship.

To collaborate with a company, and to deal with a charismatic CEO like Peter Johansen, can be quite a challenge to combine with writing an academic project. I have had almost free hands, and the company has been very helpful with technical supervision. As mentioned in introduction it is not possible sell a concept to a company, which they do not believe in. To turn this to a fruitful collaboration, I have had a close contact to the decision makers during the process, to get the feeling of what will be best received. This has been done by small status meetings, now and then, where I have presented parts of the concept. In the project period I have had my own desk in the research and development department, and used the work space as much as possible. The pro has been that I always had a technical support when I needed it, but the con is that the process has been coloured by the company without my conscious.

The expectations from the company, was also that I could work in other areas than just as an industrial designer, from which I have learned more than I expected. From the basic design understanding of the electronic system to machine mechanics. During the process I have been working in the field between industrial designer and mechanical engineer.

The product has ended up more complex than I had expected from the beginning. Many different parameters to keep track on, and mechanics I had to study from the bottom, which unfortunately not had been a part of the education at Aalborg University. For that reason I have used the majority of the time on the product development than the process, which was not quite preferred but a necessity. With the goal completing the design and construction, I was drawn to spend the time on this part, as I see it as the direction of the industrial design field where I find my self the best, and I see my future career.

Source list

Homepages

[SGM] - <http://www.sgmlight.com/>
[LEDENGIN] - http://www.ledengin.com/products/emitters#LZC_multicolor
[G-SPOT] - <http://sgmlight.com/shop/g-spot/c-23/p-179>
[MTS] - <http://www.mts.net/~william5/history/hol.htm>
[DOKA] - http://www.dokelight.ru/files/doka_claypaky.pdf
[PAKY] - <http://www.claypaky.it/en/products/glow-up#download>
[LONG] - http://www.longtail.com/the_long_tail/2007/01/give_away_the_m.html
[DR] - <http://www.dr.dk/P1/Kulturnyt/Udsendelser/2011/06/16092245.htm>
[Doblin] - <http://www.doblin.com/tentypes/#framework>
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Alexander Osterwalder & Yves Pigneur
Electronoc book
ISBN: 978-0470-87641-1

[INSTALL] - Installationsnyt 10-2012

Secondary literature

The manufacturing guides_Product and furniture design
Rob Thompson
ISBN:978-0-500-28919-8

The manufacturing guides_Prototyping and low volume production
Rob Thompson
ISBN:978-0-500-28918-1

List of Illustrations

This report documents the process of developing the world's first commercial battery powered moving head for the event and entertainment business. It takes its base in an ideation meeting with the head of SGM A/S who is the collaborator, and company that the solution are aimed to include in their existing product portfolio.

The main focuses are product and mechanical development from marked, company and user point of view.

The outcome of the process will be documented in the enclosed product report.

