duco

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Latin verbum, guide, lead, count, draw, consider,

TITLE PAGE

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ABSTRACT

This master thesis project has its point of departure from the fact that live events are becoming more popular and that its industry is rapidly growing. Live event companies which are responsible for planning and executing the live event therefor experiences a big challenge in keeping track of the increasing amounts of equipment.

This results in missing and lost equipment and time spent on finding and relocated it. The current solutions to keep track of equioment throught the proces, is all measure with low praticallity and the need for better a solution is evident.

A new product service system named Duco is proposed in this project. The system creates a better overview and control throughout the process, through a new device called a E-tourlabel and an app to control it.


THIS SIDE UP
HANDLE WITH CARE
ELECT. EQUIPMENT

INTRODUCTION

In the last few years there has been a huge development in the live music industry. Music is nowadays so easily accessed that people want the full experience of a live music performance.
As the demands from the customers are getting higher the shows are rapidly getting bigger and more spectacular, which requires more and better equipment year by year.
Live event companies, LECs, are the companies who facilitate and plan the events by renting out equipment, setting up the stage, executing the show and taking down the stage when a concert or music festival is conducted. With the increased demands from their customers and the growing number of events the LECs experience challenges in keeping track of their equipment.

PROBLEM

All contacted LECs state that they experience growth, but also problems with missing and lost equipment when executing a show. The LECs are currently relying on a management solution consisting of a software database of their equipment and a low practical tour label placed on all storage boxes on which staff manually note the information about the storage box in terms of the related event.

This solution is insufficient and the big companies experience an annual lost of 40.000DKK on equipment. Furthermore spending more than 50 man hours annually on relocating wrongly packed equipment is a well known scenario for the contacted companies in the industry.

The responsibility of the equipment is internally in the company handed to the event technician when the equipment is shipped for an event. This means that the LEC has to rely on the event technician to take care of the equipment and make sure that nothing is lost or wrongly packed.

The event technician is the person in the company responsible for all tasks related to the light. He helps packing in the warehouse, setting up and dismounting the stage at venue and is the one who executes the light show.

AN EVENT

A typical event setup consist of one truck, 70 boxes with equipment and 140 cables of more than 400m. The total value of the equipment is around 1.000.000DDK

When zooming in on the event technician's work it is divided into two primary tasks with a remarkable difference in motivation and feeling of professionalism.
The event technician is responsible for controlling the lights during the show, a task that he loves and perfectly customizes for on the light console to fits his personal preferences and the beats of the show. He experience a dynamic and satisfying feeling of sync with the show when controlling it from his light console.

Afterwards when the show is over the event technician is in charge of the chaotic repacking process and his control is lost. It is late and he is tired. With no plan or overview he needs to control a group of unskilled workers, called stage hands, and command them to pack the equipment into their respective storage boxes, in this industry known as flight cases.
The stage hands have a low knowledge about how to handle the equipment, which increases the amount of errors. It makes the event technician fear to leave a bad impression on his company and the customer, but he is exhausted and needs control to execute the packing without errors.

All flight cases are black and looks the same at the dark venue. It complicates the event technician's instructions to the stage hands, and makes him feel insecure about communicating the task correctly and understandable. The limited overview of the process results in equipment getting lost and packed in wrong flight cases making it nearly impossible to locate when restocked at the warehouse.

To improve these challenges, it requires an extensive planning procedure and a constant overview of the process. Currently no suitable and streamlined solution that register and keep track of the equipment exist, and no tool helps the event technician creating a better control and overview of the repacking process.

THE SOLUTION

Grei's solution provides the event technician with better control and overview of the packing and repacking process. He gets the ability to visually command tasks to stage hands with a gained confident in the task being understandably handed over. Hence the solution reduces the amount of lost and missing equipment with an automated solution that registers and keep track of all equipment.

THE EXISTING PROCESSES

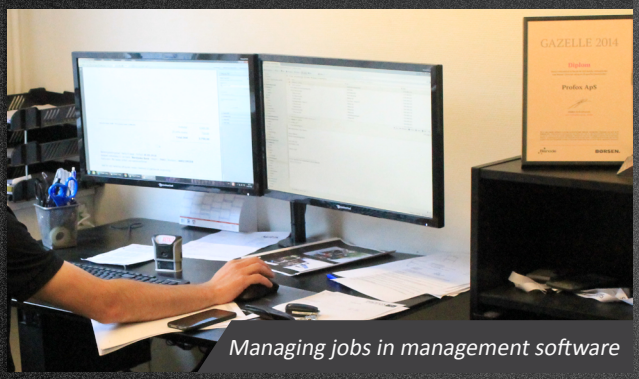
The live event companies use different procedures and tool when planning an event. The procedures features a management software used to manage information about upcoming jobs and about the accessibility of equipment in the warehouse. Furthermore various low practical products, such as picking lists and tour labels, are used as organising tools along the processes to prevent errors. Still the process of executing a show includes several critical risks and problems, and in the end equipment is missing and getting lost.

The following 12 steps representing common procedures executed of the LECs in relation to plan and conduct an event.

1 EASYJOB

In live event companies data about jobs and internal stock is managed in a management software called *Easyjob,* or similar. The data is used when planning a job for booking equipment, exporting invoices to customers and printing picking lists used for packing the equipment in the warehouse.

The software requires constant maintenance of updating and synchronizing the database according to the actual stock in the warehouse. Every time equipments is missing or at service, the database needs to know that it is unavailable for bookings.

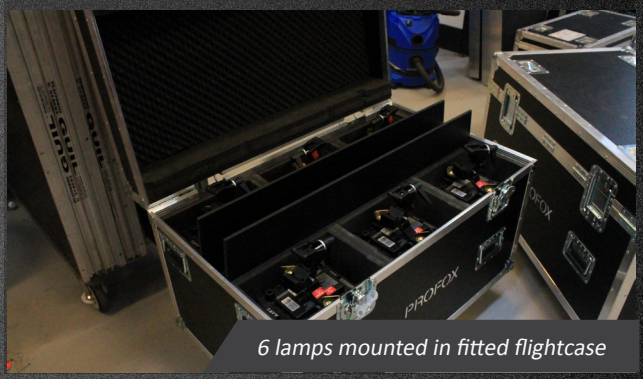


Managing jobs in management software

2 FLIGHT CASES

The big equipment is stored and transported in custom fitted flight cases. Each equipment needs to be stored in its specific flight case at all time. An ID number of the equipment and a matching ID number on its flight case indicates that the two are connected.

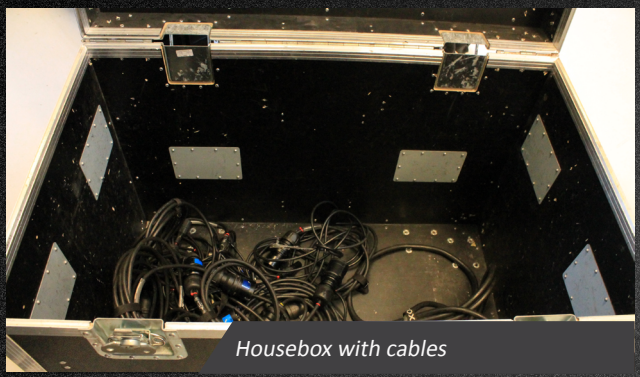
If it is not stored in the right flight case the stock list contains errors, and it gets difficult to keep track of how much a specific equipment ID is used.



6 lamps mounted in fitted flightcase

3 HOUSE BOXES

Smaller equipment do not have its own flight case, but is transported in flexible flight cases called house boxes. The house boxes are often filled with more than 100 different smaller equipment, mostly cables. Keeping track of this is a challenge because the content vary each time, which results in the biggest loss.



Housebox with cables

4 PICKING LIST

The picking list is a document printed from Easyjob when a job is planned, and it represents all equipment brought to an event. The picking list is used when packing in the warehouse. The IDs noted on the picking list needs to match the ID on the selected equipment in order to keep the stock list updated. This is often is skipped due to laziness and limited time when packing.

When equipment is packed it is marked on the picking list with a pen. This is the only evidence that tells what have actually been packed for the event. Therefore it is difficult to

Picking list to be checked of with marker

5 TOURLABELS

On top of each flight case a tour label is mounted to communicate info about the event where it is used. The tour label is manually filled in by the warehouse worker before each event. It contains info about date, production name and content which is written with a marker pen. Bad handwriting sometimes makes it difficult to understand.

The tour label is wiped clean with a cloth and alcohol, before used for a new event. The complete tour label prevent flight cases from being packed to another event by an unknowing colleague.

Tour label with marker writting

6 BARCODE SYSTEM

Easyjob offers the live event companies to integrate barcode printers and scanners into the system. These can register the equipment by scanning the barcodes mounted on each equipment.

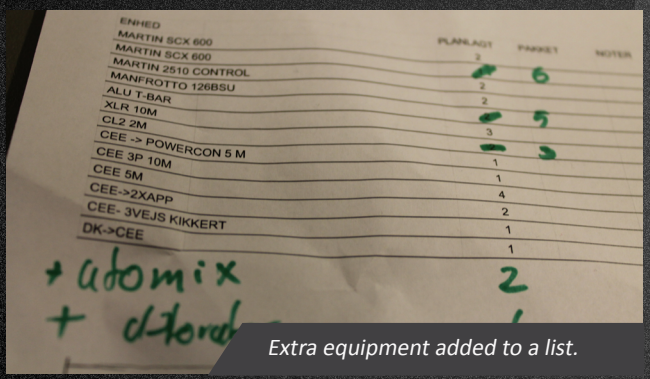
Scanning barcodes on more than 300 equipment for a job is time consuming and contains unwanted manual and repetitive tasks. It is an expensive solution that have not been found implemented in the industry.

Barcode printer and scanner

7 EXTRA EQUIPMENT

The warehouse worker packing the content in the warehouse is adding extra equipment, not found on the picking list, to ensure that enough equipment is brought to the event.

Extra equipment is registered with a small note on the bottom of the picking list or not registered at all. This create errors in the database since extra equipment picked of the shelf still is available in the database for other bookings. Furthermore it entails that the extra equipment are rented out without payment.



Extra equipment added to a list.

8 ERROR TAPE

During an event when equipment is broken or needs cleaning error tape is mounted on the it. A small note is written on the tape to describe the error. The error tape communicates to the warehouse workers that the equipment needs service, and that they need to update the database so that the equipment is not available during the service time.

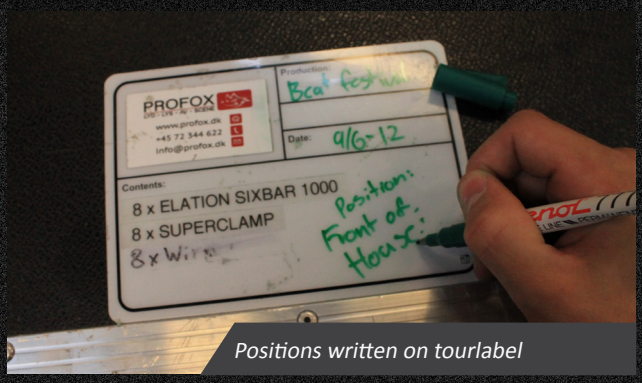
The tape is not always brought to a job and the small notes can be insufficiently filled out and hard to read, which makes it hard to understand what exactly needs to be fixed.

Also, when returning to the warehouse all flight cases must be opened in order to check if they contains equipment with error tape, and this is often skipped.

Error tape on cable, with small note.

11 VENUE POSITIONS

At bigger venues it is necessary to communicate where on the venue the flight cases must be positioned when arriving. This often requires the event technician to pre-plan it by writing the positions on each tour labels. This is a time consuming process, and bad handwriting and internal language makes it hard to understand for the stage hands.



Positions written on tourlabel

12 COLORED TAPE

Coloured tape is mounted on the flight cases to visually group the flight cases that goes to the same position at a venue. This colour grouping creates flow in the process of placing the flight cases at the venue, and helps the event technician to instruct the stage hands.

The task of mounting tape on each flight case is time consuming, when new arrangements is needed for each event. The colour tape mounting is therefore mostly used for big repeating events such as concert tours.

Flighcases grouped with colored tape

SOLUTION OVERVIEW

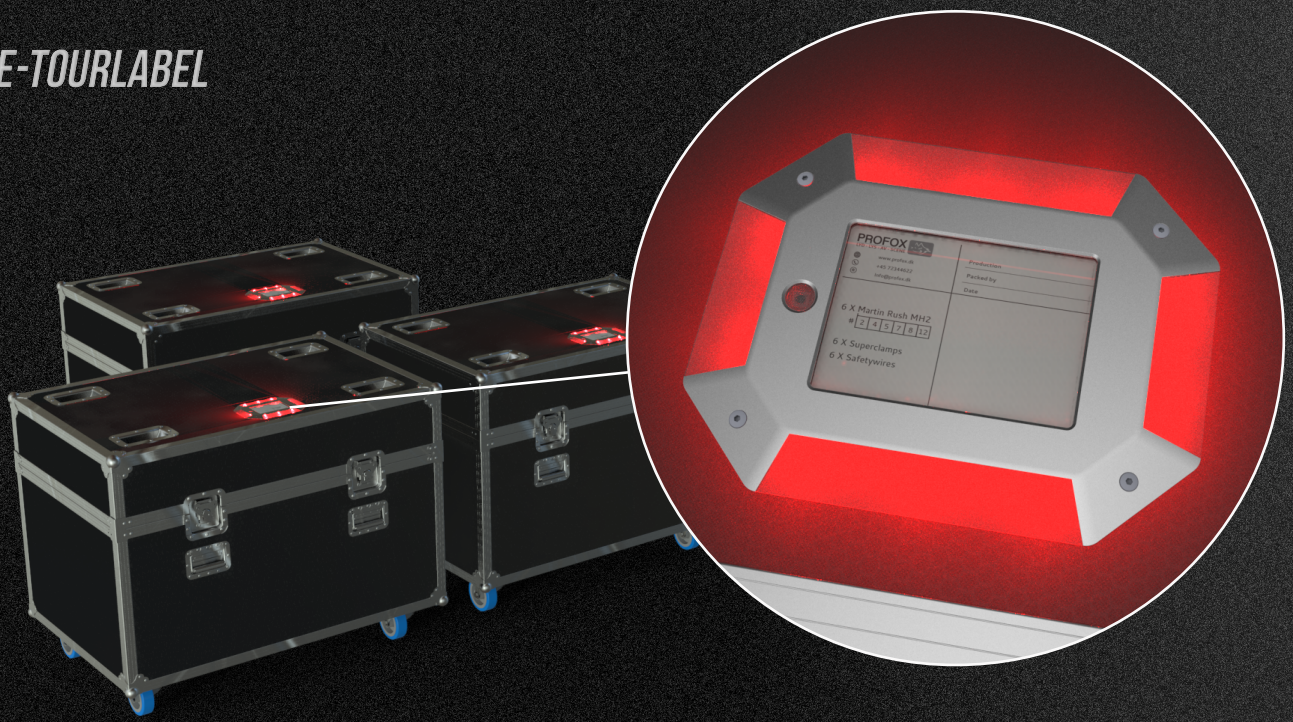
The proposed solution is a product service system called Duco. It consists of Duco E-tourlabels placed on all flight cases and a duco app that controls them and creates overview to the event technician along the process of executing an event.

- The duco E-tourlabel is an electronic communication and registration device mounted on all flight cases.
- The duco app is wirelessly connected to the E-tourlabels and is the centrer of the system's data. The app is used to control and link the information communicated on the E-tourlabel, as well as store and sync all registered data with the management software Easyjob.

The concept features solutions that replaces existing processes in the system and optimizes tasks by providing a registration and communication tool used throughout the whole event execution. Furthermore the concept enables the event technician to manage and plan the set-up and repacking processes at the venue, and it gives him a communication tool to command tasks to stage hands with visual feedback that adds an experience of the tasks being delivered correctly.

The concept's main functions are presented as an overview on this spread. A detailed sequence description of the process will be communicated in the following pages.

E-TOURLABEL



Equipment is packed by pressing the ***Pick button***

Equipment inside the flight cases is automatically registered for the job using a ***integrated*** NFC or RFID ***scanner*** mounted in the flight case

All information as production name, date, venue position and content is clearly communicated and displayed on the ***E-ink display***

To single out a specific flight case or a group of flight cases colours from the ***light guide*** is used

Pack equipment according to a digital picking list on the apps ***Pack mode***

Plot venue positions on a imported venue map in the apps ***Plan mode***

Assign equipment to each defined position from plan mode, in the apps ***Assign mode***

Switch on the light guide on an individual or a groups of E-tourlabel in the Apps ***Unpack mode***

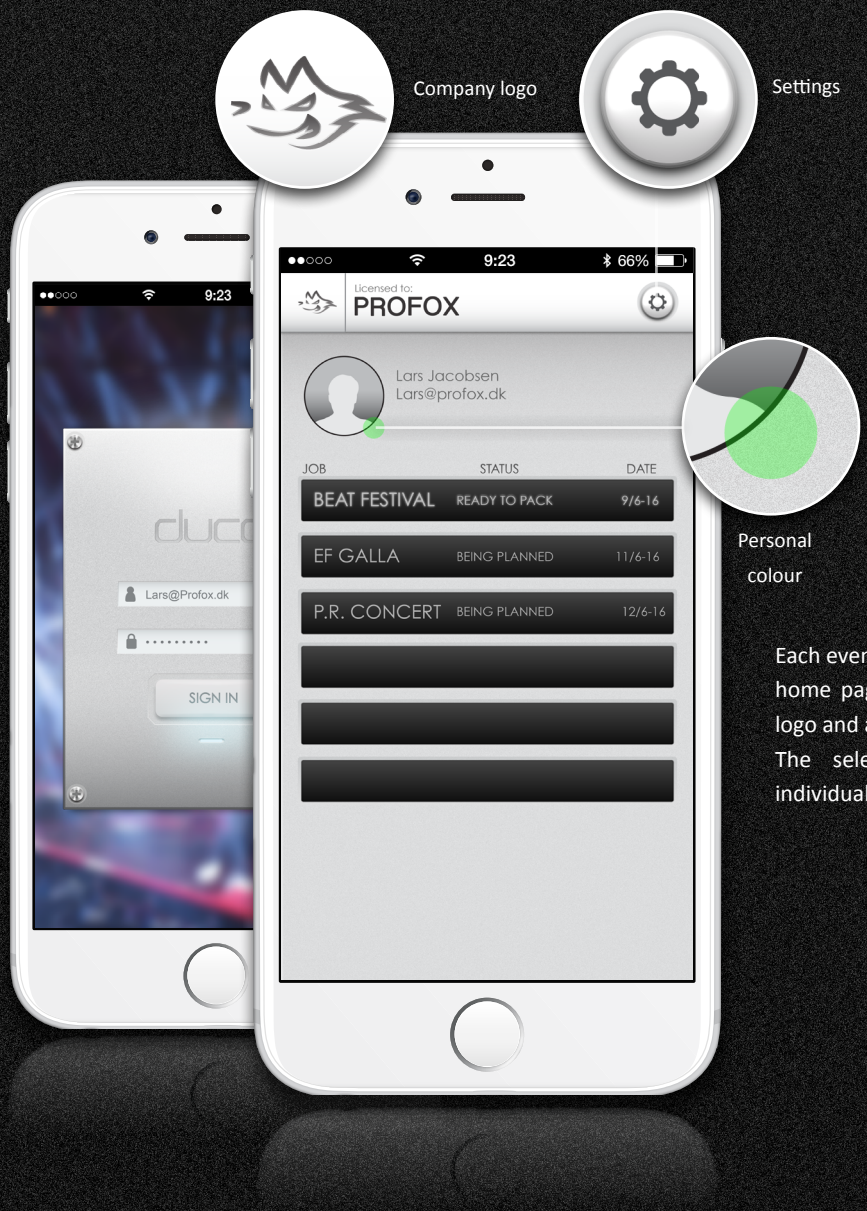
Get an overview of repacked equipment and control the colours of the light guide in ***Repack mode***

Find equipment in the app quickly with a ***Search & NFC scan*** feature

Report malfunctions and dirty equipment with the app ***Report function***

PACKING EQUIPMENT

When a job is ready to be packed the event technician opens the duco app, and logs-in with his personal id. The event technician enters a personal home page, that he can customize to fit his personal demands. The home page's main function is a list of the coming event organized in Easyjob. The event technician selects the wanted event and gets ready to pack the equipment.

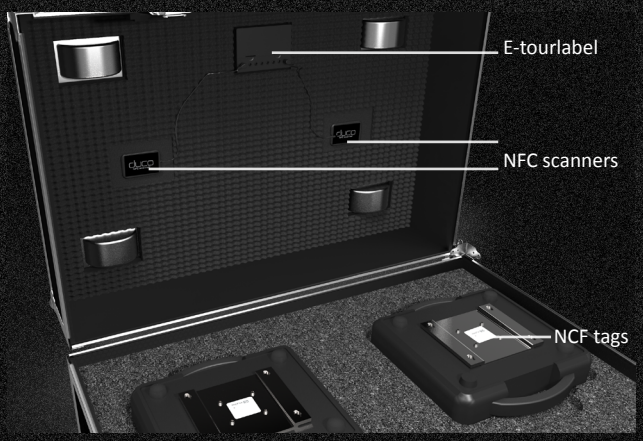


Each event technician has a personal home page with user photo, company logo and a personal colour.
The selected colour visualizes the individual user's actions in the app.

When a job is selected a digital picking list is displayed in the *pack mode* on the app. Flight cases are picked in the warehouse and assigned to the event by pressing the *pick button* on the E-tourlabel. The equipment inside the flight case is thereby automatically registered from a scanner placed inside and time, date, packing responsible and exact equipment IDs is stored in the app, and synced with the data in Easyjob.

The event technician no longer have to matching the IDs from the picking list with exact equipment, hence the packed equipment automatically is registered and synced with the database.

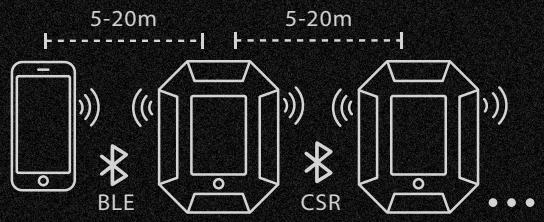
SCANNING EQUIPMENT



Depending on the amount of equipment inside the flight case, 2 UHF (Ultra High Frequency) RFID scanners or 1-8 NFC scanners are mounted and connected to the E-tourlabel, see picture above.

In the house boxes where a large amount of smaller equipment is placed a integrated longrange UHF RFID antenna and reader is used. All equipment is marked with either NFC or RFID tags, and the scanners automatically register the IDs on the equipment stored in the flight case.

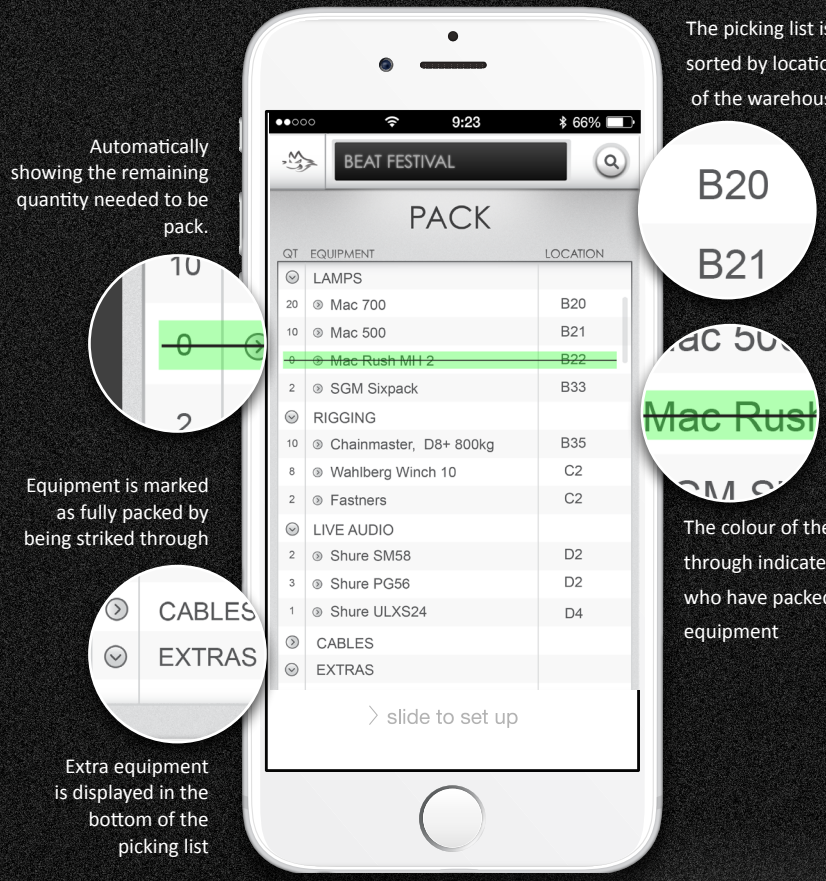
CONNECTION



When a flight case with equipment is packed and the equipment IDs have been scanned by the integrated scanners, the IDs are sent to the duco app via an integrated bluetooth signal placed in all E-tourlabel.

PACK MODE

While packing for the event the event technician uses the *pack mode* on the app. In here the full picking list is provided and displayed with features that makes it easy to manage the packing procedure. The features is explained visualised below.



ADDING EXTRA EQUIPMENT

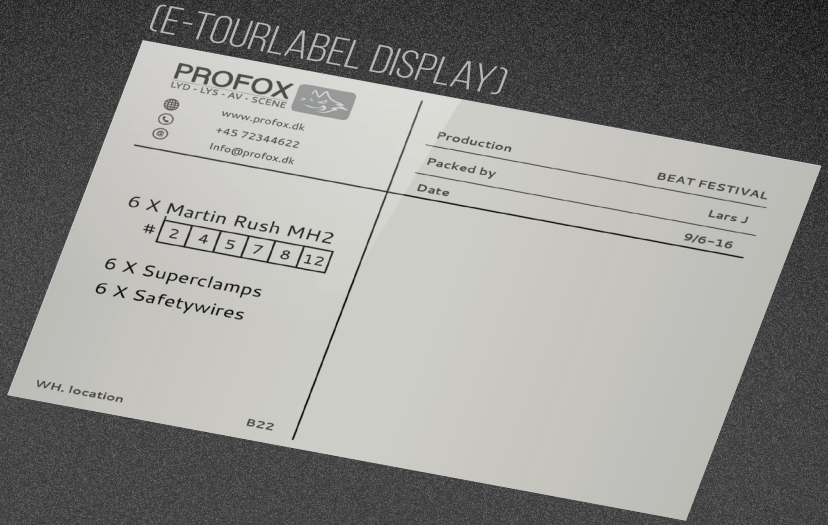
If the event technician wants to add extra equipment to the event, he picks it from the warehouse. The E-tourlabel scans the content an tells if the equipment is available or already booked for another event.

Thereby the app prevents double bookings, and makes sure that the extra equipment automatically is added to the picking list and invoice.

CONTENT UPDATE

When the app receives the IDs of the scanned equipment during the packing process, the apps replies by sending informations about the event to the E-tourlabel. The display of the E-tourlabel is thereby updated with the event info. Time spent on filling in the tour labels is eliminated since the relevant information automatically is updated on the displayed with a easy readable text.

(E-TOURLABEL DISPLAY)



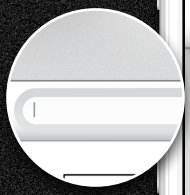
PLAN MODE

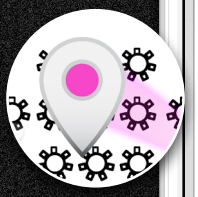
To easy communicatee where the flight cases should be placed when arriving at the venue, different positions of the venue layout is created in the *plan mode* on the app. The positions is named and plotted on the venue map. For each plotted positions a colour is configured.

ASSIGN MODE

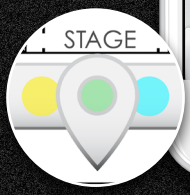
When positions are planned, all equipment can be assigned to them individually. This is quickly done by plots in a matrix.
A category (e.g. light or sound), a type (e.g. a specific type of lamps) or a single equipment can be assigned. When assigning a type of equipment, it can be split and assigned to two different positions, using an index tree structure.

The position is given an name

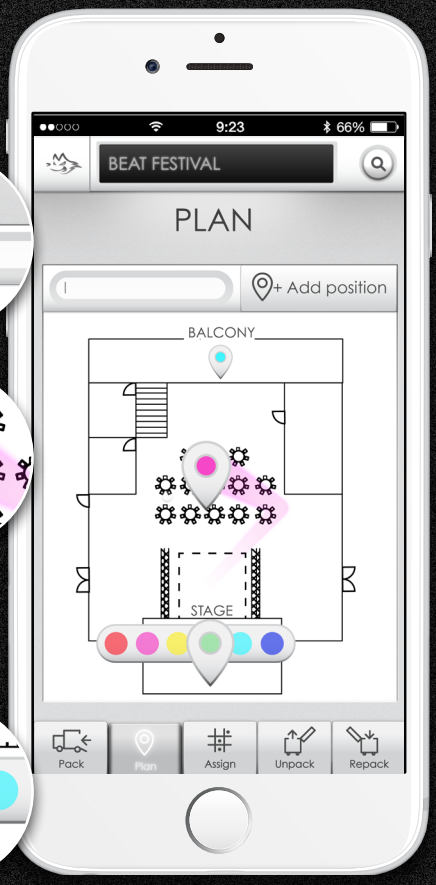


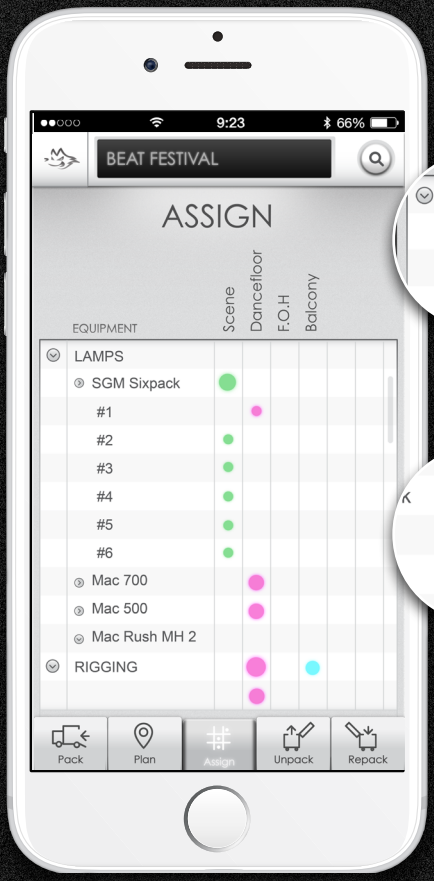


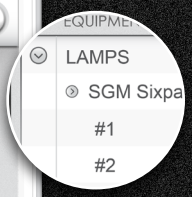
The position are plotted on the map and can be dragged around



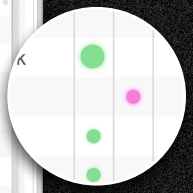
One of the six colours is selected for the position







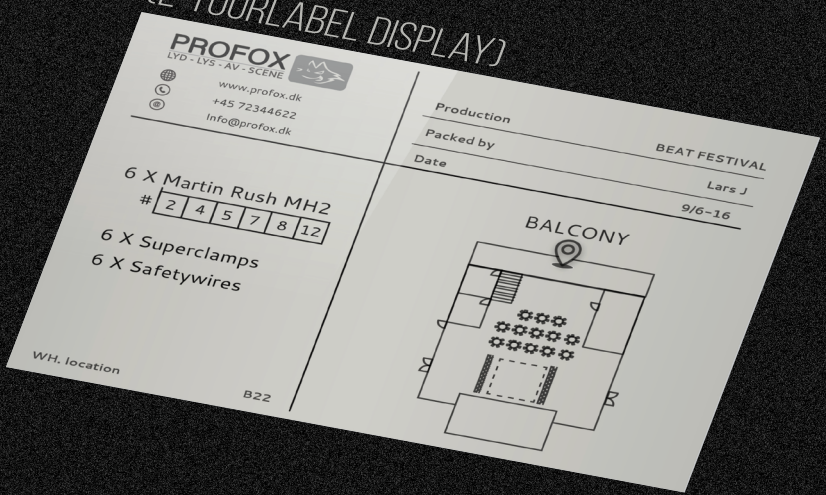
Index tree structure used when dividing a group of equipment



The big dots in the matrix indicates a category, medium dots the types, and small dots the individual equipment.

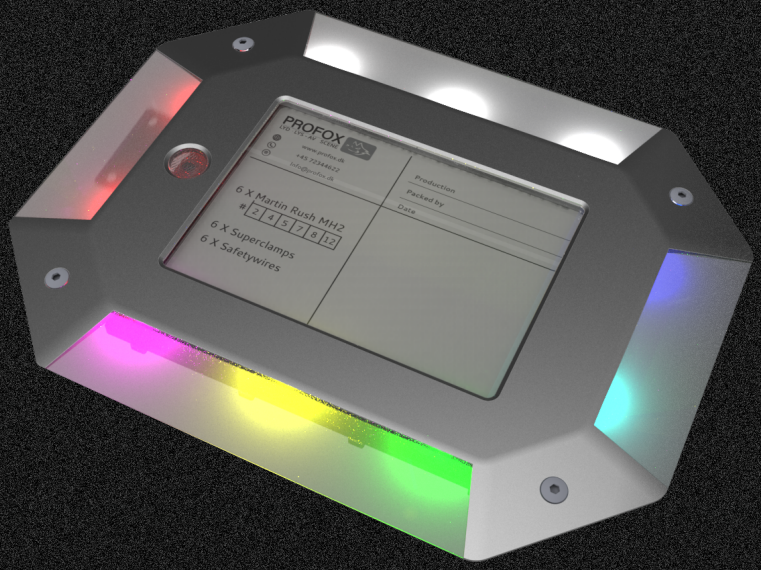
POSITION AND MAP

When all equipment is configured to a positions in the app, the E-tourlabel displays the flight case plotted on the venue map.
The event technician can thereby easily communicate to stage hands where to place the flight cases by making them look at the venue map. Also, it saves him manually writing this on all tour labels.



LIGHT GUIDE

The programmed colours of the venue positions are used in the *Light guide* of the E-tourlabels. The *light guide* makes it possible to give each E-tourlabel a colour and control when the E-tourlabel should light and flash. The different colours is sent from the app to the e-tourlabels and can remotely be switched on in the app's *unpack-* and *repack mode*. Ten integrated RGB LEDs representing the different colours lights through the edges of the E-tourlabel. The light can also lights up the display on the E-tourlabel in dark environment for period of 10 seconds, when the *pick button* is pushed rapidly.



GROUPING FLIGHT CASES

The colours is used to visually group flight cases, and make it instantly transparent
for stage hands that flight case with the same colour have to be placed at the same position at the venue.
The grouping is done without spending hours on preparation with tagging all flight cases with coloured tape.

UNPACK MODE

The *Light guide* is controlled by the app and can be switched on and off in the *Unpack- and repack mode*.
It is used when arriving at the venue and all flight cases needs to be placed. In the app all groups of flight cases is sorted by the different positions and can easily be turned on and off.

The flight cases sorted by positions

On/off switch with colours

SEARCH AND SCAN FUNCTION

If the event technician have problems finding a specific equipment, he can easily use the search function in the app. He just types in the name of the equipment and selects it on the app. When selected on the app he can turn on the light of the flight case in where the equipment is placed. When a single flight case is selected to light on the app its E-tourlabel starts flashing with the defined colour.

If stage hands ask where to put a specific equipment, the event technician can easily check it in the app. He simply tap the equipment with the phone, which then is scanned by an integrated NFC scanner placed in the phone, and a description of the equipment is shown on the app.
He now single out its flight case on the app and makes it flash.

When equipment is found in the app, the light of the equipment's belonging flight case is switched on

SINGLE OUT A FLIGHT CASE

The event technician can thereby single out a specific flight case for equipment when stage hands need instructions. This gives the event technician a visual feedback of the task commanded to the stage hands, which makes him feel confident about the task being understood and delegated correctly.

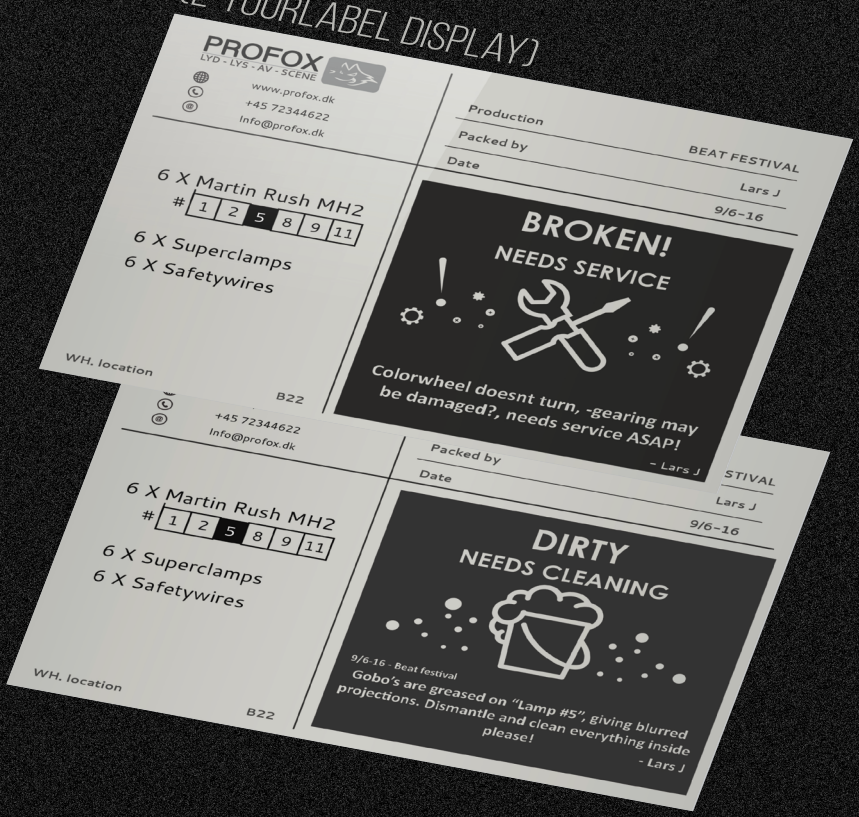
REPORT ERRORS

With the Duco app the event technician can report equipment as malfunctioning or dirty instead of using error tape. He starts the of reporting an error by either scanning the equipment using the NFC scanner in the phone, or looking up the equipment on the app using the *search function*.

When reporting the equipment with an error the event technician simply takes a picture of the error with the phone, and write a complimentary note below, telling what the error is about. He also defines if the error needs service or cleaning by either *broken* or *dirty*.

In the end of the repacking procedure a list of the total error is generated in the app and used by the warehouse workers to create overview.

(E-TOURLABEL DISPLAY)

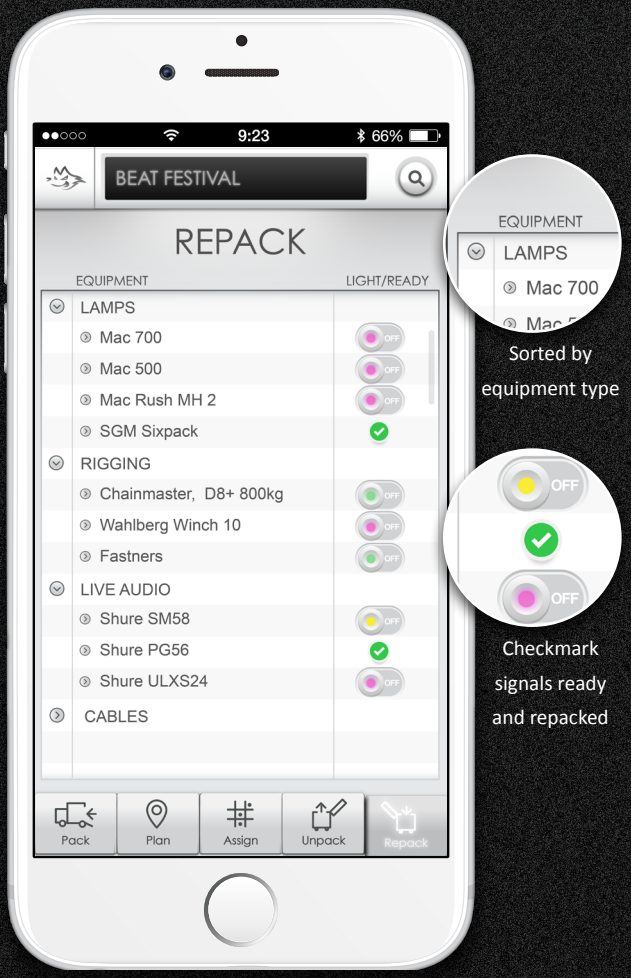


On the E-tourlabel of the flight cases containing an error, the display is updated with a communicative text saying either *broken* or *dirty* depending on the specific error. This makes it easy for the warehouse workers to locate what needs service, even without opening the flight cases

REPACK

When the show is over, it is late in the night and time to repacking the total venue setup. The event technician is tired, but motivated to finish the packing as fast as possible.
The duco app helps the event technician to create on overview of the process when commanding stage hands.
The event technician points at a truss mounted with lamps, and from the duco app he makes their respective flight cases light, and the stage hands knows to connect the two and place the lamps in the flight cases.
The event technician desire the function and feel confident in the task being delegated correctly.

The duco app now adds the overview to the chaotic repacking process by using the *Repack mode*. The list of equipment that needs to be packed is sorted by *types of equipment*, which makes it easy to connect the equipment placed on a truss with their respective flight cases.



AUTO ID

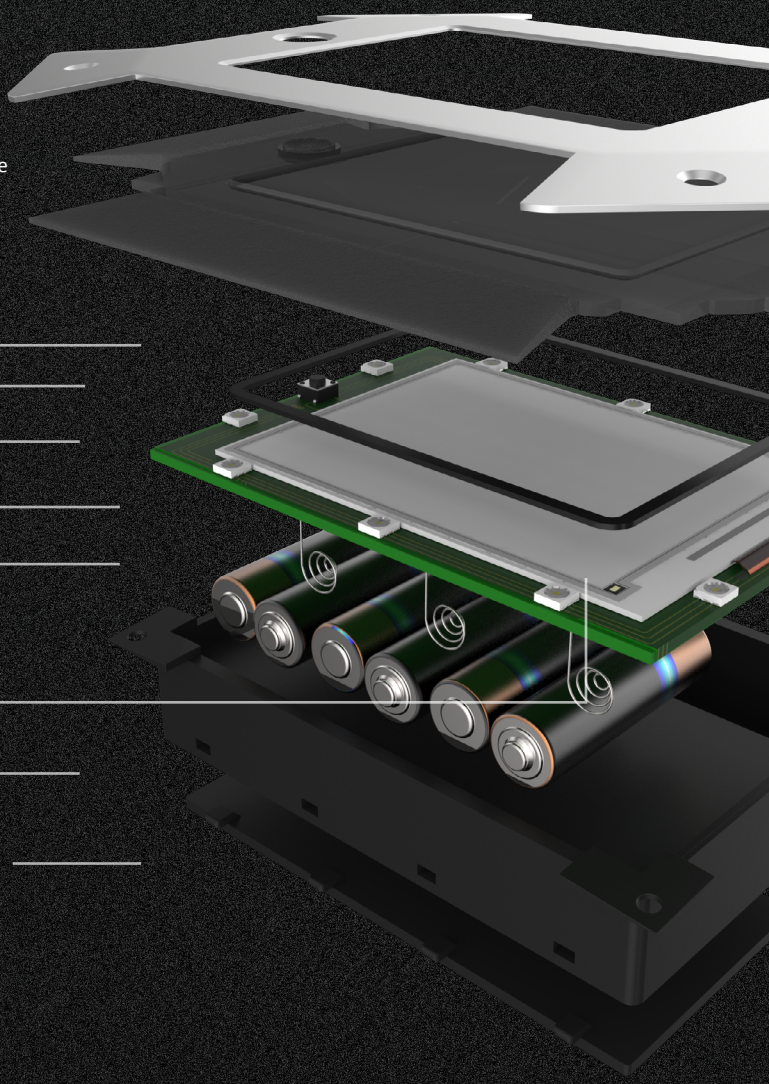
When larger equipment such as lamps are repacked in a flight case the ID number of each lamp is automatically updated and displayed on the E-tourlabel.
When the pick button is pressed, the scanner registers the equipment and update the information on the E-tourlabel.

Larger equipment with corresponding flight cases no longer need to be repacked in the exact same flight case in order to keep track of its use, but only in the same type of flight case that are custom fitted to the type of equipment.

ENGINEERING, E-TOURLABEL

The E-toulabel is intended be produced in large volumes, hence it has been engineered for large volume production, and consist of only 4 costum parts, besides the printable circuit board.

- A protective aluminium frame, press formed from sheet metal
- A durable injection molded transparent polycarbonate, where the screen, pick button and light surfaces are integrated.
- A cheap injection molded PVC shell.
- A belonging battery hatch in same material as the PVC shell.



E-INK DISPLAY

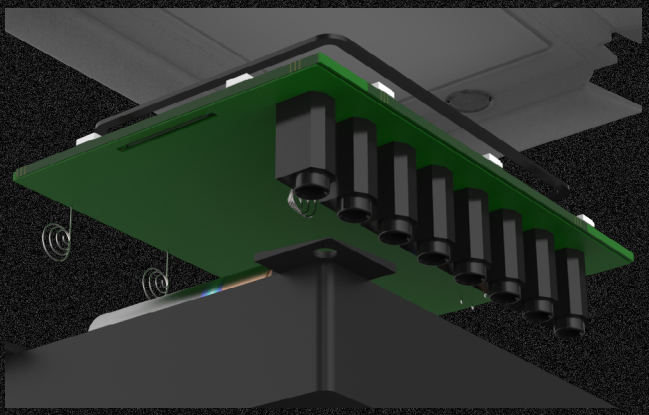
Each E-tourlabel has an 65X80mm E-paper display, that can display and communicate the information clearly with good readability. The E-paper is readable in direct sunlight, and only consume power when it changes its image and information.

BATTERY LIFE

The components and technology used in the product is based on a low power consumption. The E-tourlabel is programmed to ensure power is only consumed when necessary. The E-tourlabel is intended to automatically go to into a hipernation mode when not used, consuming only fractions of the battery life, resulting in a relative battery life of three years.

8 AUX INPUTS

The E-tourlabel has 8 AUX inputs where the scanners can be plugged in and connected. Because the industry is still evolving the 8 AUX can also be used for other devices than scanners. New modules can developed and used in combination with the E-tourlabel. Eg. the possibility to add a light censor that sense and register if a flight case has been opened and if the equipment has been tampered with.



FURTHER DEVELOPMENT

The state of the project is that GREI is ready for investors to fund the development.

Several tasks are needed before the solutions is ready:

- Development of the software in collaboration with inventory management companies, like Protonic Software, and LEC's, like Profox.
- Developing the scanners and acquiring the RFID tags in collaboration with an logistics automation company, like Lyngsoe Systems.
- Producing the first 100 prototypes followed by testing and optimization.

SCANNER DEVELOPMENT

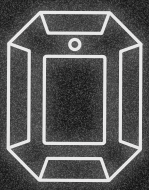
- The RFID scanners are planned to be acquired and developed in collaboration with original equipment manufactures, and further prototyped in collaboration with Lyngsoe systems.

DESIGN RFID TAGS

- The different RFID tags needs to be designed further, integrating them to fit on different equipment types eg. integrating them in velcro straps which is used to tie cables together etc.

MANUFACTURING PROCESS

- The E-tourlabel is already optimized for large production quantity, but it is crucial that the production needs to optimized to such a degree that the production price would be lowered to a level of around 100-200 DKK.



BUSINESS PLAN

EASYJOB AS DEVELOPER & SALES CHANNEL

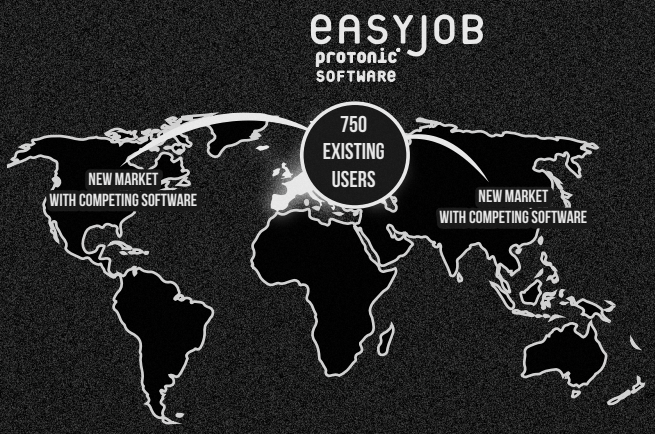
Through evaluation with multiple LECs, they clearly stated their enthuiasm about the concept, and they expect us to bring it to completion.
We intend to co-develop the app and the system integration with Protonic Software, the developers of Easyjob. Hence minimizing our own risk, but still maintaining a revenue stream.

Protonic Software would:

- Develop, program and maintain the software system
- Makes asset sales of E-tourlabels through their sales channels with Easyjob, with a small profit.
- Charge subscription fees for the access to the app, enhancing their value proporsition and expanding their market size.

GREI would:

- Manage and maintain all design and visual content in the app.
- Develop new features to the app and E-tourlabels.
- Produce and sell E-tourlabels, Scanners and RFID tags to Protonic Software



"I truly believe there is a market for this, if you can get it right."
- Mikkel Rodkjær, Owner of Profox APS

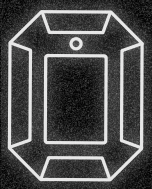
"I would like to use the solution and i'm sure that it would give more clarity and overview"

"If you get Martin or Clay Paky in on this, you can really make money - you can create your own jobs from this"
- Niels Peter Lindholdt, Event Technician at Proshop Europe

REVENUE STREAMS

Based on the information of losses in average sized LECs as well as a their predicted savings, the revenue stream of e-tourlabels and subscription fees are roughly estimated. The price of the e-tourlabel is the estimated sales price to Protonic Software, including the profits for GREI. The price of the subscription is annually paid fees from customers to Protonic Software. All economic considerations and estimates can be seen in the Process Report section 6.1 Market.

GREI sells to Protonic Software:



300 DKK PER E-TOURLABEL

Protonic Software subscription fee from their customers:

26.000 DKK PER YEAR

MARKET PENETRATION

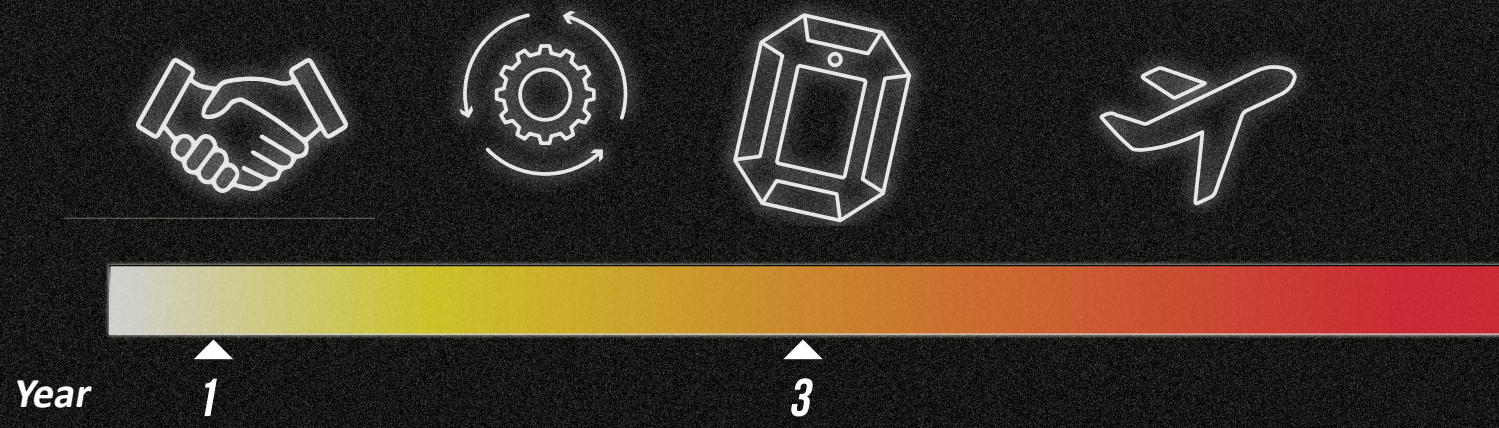
The intention is that the E-tourlabels will be standardized, and will penetrate the market by being integrated in new flight cases from selected equipment and light manufactures. GREI intend to initially offer the companies to mount e-tourlabels on their flight cases for free untill a critical mass has been reached, hence accelerating the penetration and adding more value to the manufactors.

Martin ROBE SGM

INVESTMENT AND POTENTIAL FOR GREI

The Grei team have estimated a 10 year development and investment plan.
Using an initial investment of 5.000.000DKK the company aims to have partners, build prototypes and run a pilot testing at a LEC.
After 5 years development the company will start to gain orders and a market of 750 companies is gained after 10years.
The estimates is based on the market chapter in the process report.

TIME LINE AND PLAN



750 average live event companies purchase around

500 E-TOURLABELS

with 100 DKK revenue per e-tourlabel

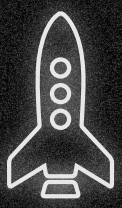
ROUGH REVENUE ESTIMATE

37.000.000DKK

ON E-TOURLABELS

PRODUCTION START

5 6 10



5 6 10

ACQUIRING ORDERS

LAUNCH AND ROLLOUT

INDUSTRY STANDARD IN EUROPE

MSC04.ID - GROUP 9 MAY 2016 MASTER THESIS AALBORG UNIVERSITY

duco

PROCCES REPORT

JANE HOLM HANSEN MATHIAS LUND ANDERS JELLE

TITLE PAGE

Title	Duco
Theme	Live Production
Project period	01.02.2016-25.05.2016
Project group	MSc04 ID - 9
Supervisor	Louise Møller Nielsen
Co-supervisor	Karl Brian Nielsen
Pages	98
Editions	7

Anders Jelle

Jane Holm Hansen

Mathias Lund

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A special thanks to Louise Møller Nielsen and Karl Brian Nielsen for valuable supervisions and feedback during the process.

We also want to thank all involved persons in the gathering of insights and thoughts through interviews and various tests.

ABSTRACT

This master thesis project has its point of departure from the fact that live events are becoming more popular and that its industry is rapidly growing. Live event companies which are responsible for planning and executing the live event therefor experiences a big challenge in keeping track of the increasing amounts of equipment.

This results in missing and lost equipment and time spent on finding and relocated it. The current solutions to keep track of equioment throught the proces, is all measure with low praticallity and the need for better a solution is evident.

A new product service system named Duco is proposed in this project. The system creates a better overview and control throughout the process, through a new device called a E-tourlabel and an app to control it.

0.0 PREFACE

This report documents the process of the 4th Semester Master Thesis Duco in Industrial Design at Aalborg University. The project is documented through a process report, a product report and technical drawings which are printed seperately. The USB stick contains appendix and electronic copies of the reports.
It is advised to read the product before the process report, since it is a better point of departure in relation to understanding the process. Also, the product report is aimed towards potential investors and not possible customers of the solution.

0.1 READING GUIDE

This report is divided into 7 different phases; Introduction-, Research-, Specify-, Conceptualize-, Development-, Market- and lastly the Summary phase. Each phase is started with a brief description of the content and objective of the specific phase.

Each of the phases have smaller subsections which are initiated with descriptions of the content of the specific subsection and the relevant ones are ended with a summary.

The research and tests in the report are shown in relation to the importance of the process and only the main findings are presented. Full versions are to be found in the appendix on the attached usb stick.

The report uses the Harvard referencing system, meaning that sources are written in-text e.g. [author(s), year of publication] and the list of references are placed in the end of the report.

Illustrations will be numbered throughout the report in relation to the specific subsection with a short explanation of the illustration. The list of illustrations will be placed in the end of the report.

0.2 TABLE OF CONTENTS

0.3 APPROACH

Designing a new product requires a holistic way of thinking and an iterative process where, who are we designing for, what are we designing, and how the solution should work, is questioned and defined troughout the project. A process that is mostly value driven with ideas linked to, and evaluated upon, what is desirable for the user, what is technologically feasible and how a idea is viable in a business context.

To communicate this process the project is divided into 5 main chapters; **Research**, **Specify**, **Conceptualize**, **Development**, and **Market**, as well as an Introduction and a Summary.

The **Research** phase unfolds the context and its users, and deals with the important and central insights, and how these are gained. Using these central insights the strategy, desired attributes and requirements are defined and framed through the use of various design methods in the **Specify** phase.

The **Conceptualize** phase explains the concept development process, from initial ideas, that through different tests, expert interviews, and user feedback, form a concept. The development of the concept's further details are explained in the **Development** phase where components, technical dives, manufacturing processes etc. defines the final product. Finally in the **Market** phase, the business and marketing considerations are comminucated, that are combined with estimated cost calculation resulting in a business plan.

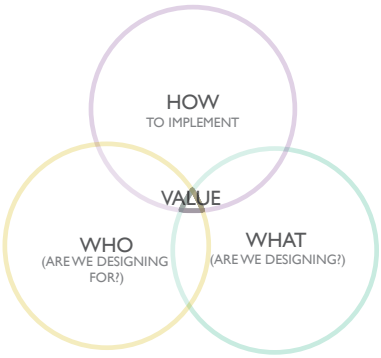


Illustration of IDEO's definition of design thinking (IDEO.com, 2016)

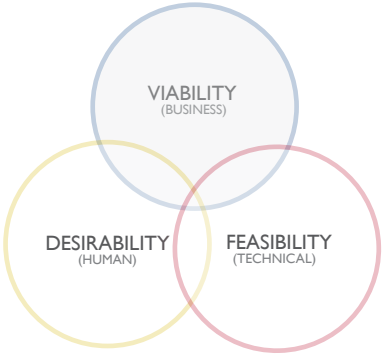
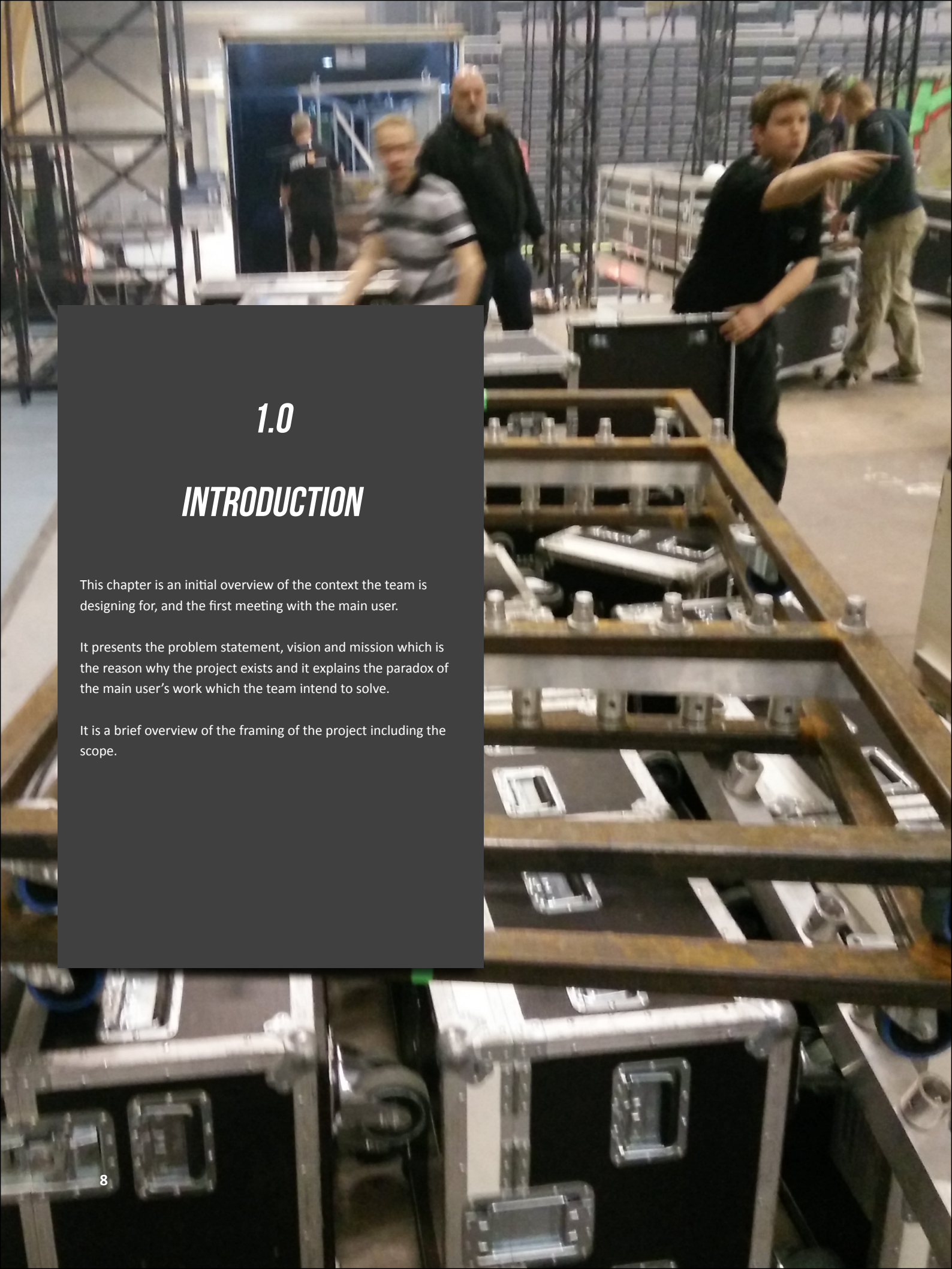


Illustration of Innovative value by design (Schmeidgen, J. 2016)

Illustration of phases/chapters used to communicate the procees in this project.



1.0

INTRODUCTION

This chapter is an initial overview of the context the team is designing for, and the first meeting with the main user.

It presents the problem statement, vision and mission which is the reason why the project exists and it explains the paradox of the main user's work which the team intend to solve.

It is a brief overview of the framing of the project including the scope.

Since the year 2000 there has been a huge development in the music industry and the access to music have changed. From purchasing records in stores, to selling tracks online, to now, where we stream the music for free directly to our smart devices. Artists are now more reliant on live performances in order to profit, and as the music is now so easy accessible, more music listeners want to experience the music live.

Urban night researcher William Straw says:

"Festivals are now the Netflix of music"
(Lamberski, Jamie 2015)

A live show or festival is for many people the go-to-place to experience music in the 21th century and due to this, the shows are rapidly getting bigger and bigger. As the size increases, the audience's and the event planner's demands and expectations of the performance and experience is getting bigger. Besides perfect sound, the audience expects a complete show with spectacular lights, visuals and effects, and the manufacturers want to outdo themselves year after year, which requires more and better equipment.

"As Nibe festival gets bigger, we want to develop ourselves and have the best equipment. Therefore, we not only focus on the price, but also on renting equipment from the top shelf."
Thorkild, event planner at Nibe festival (Worksheet 8)

Live event companies, LECs, are responsible for planning and renting out equipment for events. They store and stock all the stage equipment, transport the equipment from warehouse to venue, set up the stage and connect all equipment with specific cables depending on each function. They program and control lights and sounds before and during the show respectively. When it is all over they dismount and pack the equipment, transport it and then restock it at their warehouse.

With the increased demand from their customers and the growing venues these companies experience challenges in keeping track of their equipment.

Several contacted LECs state that they are experiencing both growth and problems with missing equipment when making a show. Primarily smaller equipments and customized cables are forgotten at the venue, or packed wrong during the repacking at the venue. This entails wrong storage making it inconvenient and demanding to locate wrongly packed equipment at the warehouse - expensive hours in a busy industry.

The big contacted LECs experience an annual loss of up to 40.000DKK in lost cables only. On top of that, the companies use a tremendous amount of time and money on locating missing equipment, which are hard to locate when stored in their corresponding mobile storage boxes; in this industry called flight cases.

The equipment is expensive and complex, and therefore the LECs place an event technician on the venue to make sure that the equipment is handled correctly. The event technician is active during the show controlling the lights and the person in charge of setting up.

INFO

A typical event setup consists of:

- One truck
- 70 flight cases with equipment
- 140 cables of 400m placed in 3 house boxes

The content have a total value of around 1.000.000DKK

1.1 FOCUS

The responsibility of the equipment is internally in the company handed to the event technician when the equipment is shipped for an event. This means that the LEC has to rely on the event technician to take care of the equipment and make sure nothing is lost or wrongly packed. This makes the event technician the main focus of this project.
Event technicians can have various areas of expertise in e.g. sound, light or video. To simplify the user we focus on the light technician, who is in charge of all lights during an event (Ill. 1.1.1).

When zooming in on the event technician's work it is divided into two remarkably different situations. First, the event technician is in control when executing the show with lights, sounds and effects commanded from a single console. Combining every beat of the music with a supplemental effect is the creative and satisfying part of his job, which makes him feel in sync with the show.
Secondly, the event technician experience chaos after the show during the dismounting and repacking process with manual work collecting, rolling up and sorting cables. Everything must be packed in the same order as it arrived, and all equipment needs to be packed in a specific flight case that looks exactly like the 70 others placed at the venue. It is late in the night and tiredness starts occurring. The unskilled stage workers obstruct the process and the efficiency of tedious and uncontrolled repacking tasks results in wrongly packed flight cases.

We focus on the situation and paradox between the event technician's feeling of professionalism and control during the show when he is in control of every little movement of light on the stage, and the feeling afterwards when the audience is leaving and his role converts into a tired worker in charge of packing all equipments perfectly as fast as possible.

We aim to bring elements of the feelings during the show to the following dismounting process.

Our assumption is, that designing a product that adds control and overview to the event technician during the processes of dismounting, will increase the motivation and ability to pack the equipment properly in the right flight cases. Such a product will eliminate loss of equipments hence minimize the hours spend on locating missing equipment. Furthermore it will create a better alignment between the stock list and what is actually accessible in the warehouse and liberate time to practice service on the equipment.

Ill. 1.1.1: Event technician executing a light show

1.2 THE PARADOX

The following paradox is a narrative explanation of the two different situations of the event technician's job. The paradox explains his tasks, desires and dislikes during the two situations, and is used to define the problem statement, vision and mission. The paradox is based on interviews with three event technicians and two fieldwork sessions at two different events. It is described to communicate key findings and create empathy with the main user, the event technician.

1.2.1 EXECUTING THE SHOW

The light starts up - the show is finally on! The event technician is absorbed by the rewarding sight of the masterpiece in front of him, that he and his crew has created during a long, challenging and fast paced day. He has been piecing together the large and complex puzzle, and at this moment he experiences the link between the equipment and him. He controls the entire puzzle down to every little detail.

Before the show starts, the tasks of carefully handling the expensive high technological equipment and devices, and securing them according to precise positions as well as safety, has been going on in a well coordinated process. All equipment has been configured, and the mode and addresses are set according to the light technician's internal map and plan in his mind.

During the execution of the show he experience a dynamic flow where he feels in sync with the show. His mind is extended into the console as all movements and colours have been customized and preprogrammed into a push of a button or a fader. Using his eyes and ears every effect is commanded and perfectly timed. The show is controlled by his finger tips which are placed precisely on the buttons of his light console which is placed in the middle of the crowd. He is the show and in front of him he sees the exact output of his finger's motions.

He is excited, but also anxious because he worries if something goes wrong, because then all eyes will immediately point at him, and therefore he truly cares about his equipment being functional and taken good care of. He only wants the most reliable products from the best brands, because his professionalism depends on the performance of the equipment.

1.2.2. DISMOUNTING THE SHOW

Blacked out and dark - the show is over and he is satisfied, but then the adrenaline leaves his body the exhaustion and tiredness occurs. In front of him he sees a smaller junk yard and at the end of that the massive stage that he needs to take down and fit into boxes before going home to have some well earned, and desired, sleep. Because of limited planning, he does not enjoy the tasks to come, and just want to get it over with.

The stage is a chaos and every equipment is unplugged! The link he felt between him and the equipment during the show is no longer existing. Locating and matching flight cases and equipment is a big challenge since all equipment, cables and flight cases are black and looks the same.

He is now in charge of a bunch of unskilled stage workers, called stage hands, which he needs to instruct precisely in order to avoid errors and misunderstandings. But with only few stage hands sharing the internal language existing at a venue, the technician must trust and depend on them understanding him correctly. This leaves him with concern and a feeling: doing it himself is a more safe decision.

Without a specific plan he must rely on what he remembers from when packing out - a humiliating feeling after having the control and overview just minutes ago. Trying to get an overview, he is interrupted by questions from the stage hands, that he has no immediate answer to.

In the end, if the stage hands provided have not fulfilled his expectations and wrongly packed flight cases are visible, the tired and exhausted event technician might after all just pack everything randomly and leave to go get some sleep, well knowingly that this does not leave a good impression on the crew within his company. Furthermore it makes the warehouse staff use more time on sorting the content in the flight cases than repair broken equipment: an awareness that subsequently induces a guilty conscience, and at the same time limits the event technician's access to equipment at his next show.

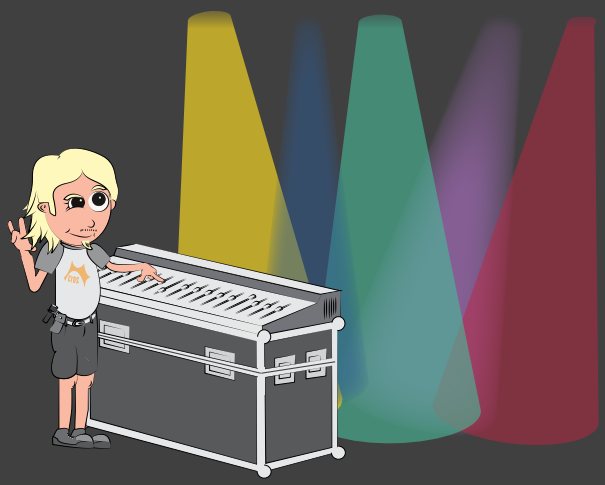
1.3 PROBLEM STATEMENT

"How can we create a product service system that motivates the event technician, at live event companies, to manage the packing processes, and provide the same experience of control, as when executing the show, maintaining his professional role, and thereby reduce the amount of lost equipment?"

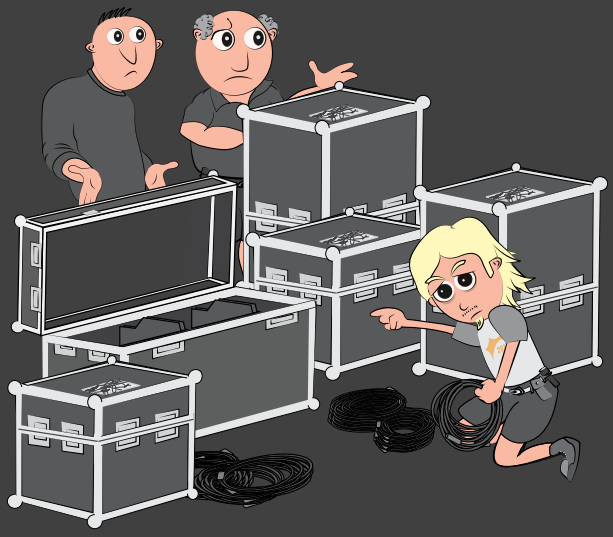
1.4 VISION

Our vision is to...

Add this feeling ...



... to this chaos.



1.5 MISSION

Our mission is to provide the event technician with better control of the packing processes, better command of the stage hands, better registration of equipment and a better overview of the equipment at the venue and in the warehouse.

1.6 PROJECT SCOPING

As a way to limit the extend of the project and to cope with the complexity of designing a product service system, a prioritized list of objectives was made.

1ST PRIORITY

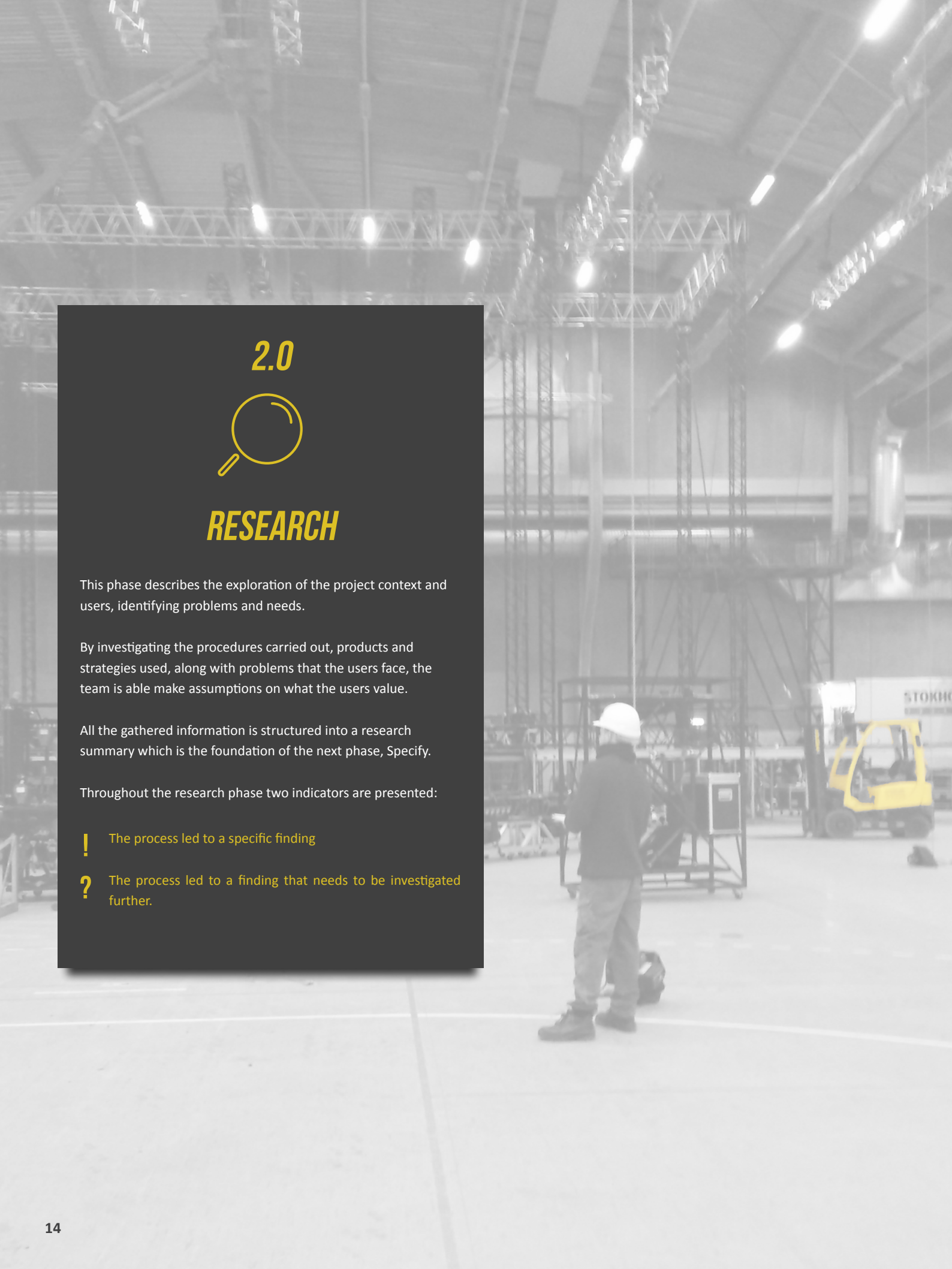
- Desirability: User involvement in terms of validating processes or interactions and the general desirability relating to the user's experience of control.

2ND PRIORITY

- Viability: User involvement in terms of validating the viability of the solution in contrast to existing solutions on the market.

3RD PRIORITY

- Feasibility: Technical detailing and validation of the feasibility of the technology.



2.0

RESEARCH

This phase describes the exploration of the project context and users, identifying problems and needs.

By investigating the procedures carried out, products and strategies used, along with problems that the users face, the team is able make assumptions on what the users value.

All the gathered information is structured into a research summary which is the foundation of the next phase, Specify.

Throughout the research phase two indicators are presented:

! The process led to a specific finding

? The process led to a finding that needs to be investigated further.

2.1 INDUSTRY REVIEW

To gain an understanding of the live event industry and the market we pursue to design for, an initial investigation of their biggest convention Prosound + light and the webshop lightpartner.dk was made along with a general surf around the internet (Worksheet 2)

2.1.1 MARKET

Every year 46.000 visitors visit the Prolight + sound convention around the world, looking for new innovative products and entertainment technologies (ill. 2.1.1). By looking at the industry's larger production companies, recent innovation and some of the rewarded products from this convention, it is evident that the main focus in the industry is delivering products that can create more spectacular shows and experiences than already seen.

At the convention new smoke-machines, moving heads, stage parts, speaker systems and control consoles are represented with price tags from 5.000 to 500.000DKK (ill. 2.1.2-4). Most equipment are advanced mechanicals, intelligent and technical products that result in high prices. Due to the high price on the equipment and fragile mechanical products, it is very common that all equipment is bought with a custom-made and fitted flight case (ill 2.1.5). Flight cases are very rigid, hard and equally expensive boxes with prices from 1000 - 10.000DDK which is required to ensures a safe transport and storage of the exclusive equipment.

Ill. 2.1.1: The Prolight + sound convention

ill. 2.1.2: Smoke machine

ill. 2.1.3: Strobe light fixture

ill. 2.1.4: Light control console

ill. 2.1.5: Moving head with fitted flight case

2.1.2 MARKET GAP

When looking at the online shop, lightpartner.dk, it is noteworthy that they have a product category called *controlling*. The category includes both advanced technical and expensive solutions for controlling lamps on stage, and low-practice solutions used to keep track of the expensive equipment before, during and after a show.

In the category you can also find expensive mixer consoles with price tags ranging from 10.000DKK to 150.000DDK. But you also find tour labels, which is small plastic sheet mounted on each flight case on which you note the content, event number and name, checked by, date etc. (ill 2.1.6). The simple tour label is their only tool to organize and keep track of the equipment when brought to an event. It was notable observing that a tour label was the main organizing tool for the high expensive equipment, when it is possible to track a letter worth only around 100DDK.

Later it was discovered that a bar code scanner system also exists, but due to a time consuming procedure it is rarely used (ill. 2.1.7).

ill. 2.1.6: Tour label

ill. 2.1.7: Bar code scanner

SUM-UP

! Interest for new technology

The live event companies requires new innovative solutions that creates better shows with crispier sound and light, and they desire new ways of controlling it.

? A low practical controlling tool is used to organize intelligent and expensive equipment

There could be potential in developing a new way to control and organize equipment in an industry where all equipment is expensive and intelligent. The team needs to investigate how the tour label is used in the process of planning an executing an event.

2.2 EVENT TECHNICIAN INTERVIEWS

To get an understanding of the event technician and his job the design team conducted semi-structured interviews with three different event technicians. The goal was to gain insights about what they value in their job and what they dislike, in order to locate possible improvable aspects.
All notes and quotes from the interviews is to be found on worksheet 12, 13 and 14.

This section features quotes from the following interviewees from different companies noted under the pictures:

NIELS PETER LINDHOLT
PROSHOP EUROPE

FREDERIK LISBORG
SOUND AND LIGHT

LASSE HENRIKSEN
FREELANCER

2.2.1 A BIG EXPENSIVE AND CHALLENGING PUZZLE

Common for all the interviewees is that they like the process of setting up the stage. The motivation increases afterwards and they are passionate about programming the show and seeing all equipment in connection and working when the show is finally executed! It creates a special feeling of magical forgetfulness, which is why the interviewed event technicians goes to work and why they do not mind working late at night usually in the weekends.

"It is like an enormous puzzle with expensive pieces that needs to be solved - and when it succeeds, it is magical" - Niels Peter

It is fun to create the puzzle, but mostly if it is different every time. The bigger the show the better, and a complex show including a high number of equipment satisfy the event technician and makes the task interesting (ill. 2.2.1).

ill. 2.2.1: The execution of a light show

"It's not as fun if you don't challenge yourself, so you always make it bigger, or try out something new each time" - Frederik

2.2.2 THE CREW AND INTERNAL RESPECT

During the interviews all event technicians indicated that a positive and joking jargon is existing between the crew members. Lasse, as work as a freelancer, also pointed out that he enjoys meeting old colleges when he is hired for different events. It is evident that the fellow-feeling, between the crew when working on a venue, is a valuable part of the job and that an internal respects is existing.

"When you are at a show there is a fellowship with the others that makes you want to perform your very best" - Niels Peter.
"When re-packing, I enjoy the internal joking between the staff" - Lasse

"When everything goes right, I am proud. I care about the impression from the band and the manager - the audience only notice the biggest effects" - Lasse

2.2.3 DEPENDANT ON THE EQUIPMENT

If errors occur during a show all eyes will point at the event technician, even though he is not responsible for e.g. an power outage. This concern makes him care about the equipment and he wants them to be reliable and of the best possible quality to minimize errors during a show.
He therefore also avoids low quality products from China, because they operate with a lower performance than the rest of the equipment, and he is the one responsible of the performance during the execution of the show.

"I care about repacking the equipment correct, - the better we pack the equipment after an event, the less time the service assistant has to do service on the equipment, and most important to me is that the equipment works"- Niels Peter

"China products are a no-go!" - Lasse

The light consoles are the event technician's work station and these have certain features that makes them reliable according to the outcome after pressing a button.

"The faders have to be precise and of a high quality. Then I can have my eyes on the show and just feel the buttons I am controlling" - Frederik

"Because the light console is programmed and controls everything, they have an UPS (backup battery) integrated if power is cut" - Niels Peter

2.2.4 EQUIPMENT IS LIKE TOYS

The event technician do not only care about the equipment being reliable, but do also have a big personal interest in new equipment and upcoming technologies.

"We (event technicians) are just big kids who want the newest and biggest toys" - Niels Peter

"It's always exciting if someone brings new equipment, and we have time to play around with it" - Niels Peter

2.2.4 THE CHAOS OF REPACKING

In the interviews the repacking process is described as a dynamic and chaotic process where the stage hands have to perform and be on the right position, ready to receive and understand the fast and precise orders from the event technician (ill. 2.2.2-3).

"It is about packing as fast as possible after a show, so you can go home and sleep" - Lasse

"To encourage ourselves we often time the unpacking process, and brag about it if the repacking was done quickly" - Frederik

"The more tired you get, the more error happens" - Niels Peter

When it has been a long night and the crew is exhausted, equipment often ends up in the wrong flight cases, because people just want to it get over with, and therefore place the equipment in the nearest flight case instead of the right one.

"When we look for the missing equipment at the warehouse, after a job, 9 out of 10 times it is just located in wrong flight cases" - Niels Peter

ill. 2.2.2: The venue after an executed show

ill. 2.2.3: Chaotic arrangement of the equipment

2.2.5 RELYING ON UNSKILLED STAGE HANDS

During set-up and re-packing the event technician is in charge of and reliant on a group of stage hands: a group of persons provided by the venue. The quality of the stage hands vary from untrained to people being in the industry for years. The stage hands are mainly helping out with physical tasks, which don not require any expertise within the field.

"It's frustrating to see stage hands glance, I have it in the back of my mind that I need to keep them activated" - Frederik

"It's frustrating getting questions, as e.g. where to put this, which I sometimes have no clue about, but still have to answer" - Frederik

Niels Peter further explains that if the stage hand have some knowledge in the field, it is easier to make them follow your order. But if they have to much knowledge they start acting before they get an order, which creates confusion. The relation between the event technician and his stage hand is by Lasse explained as:

"I fell like an general being responsible of my soldiers. I need to tell them what to do and make sure they do it right" - Lasse

SUM-UP

! **Huge complexity, big reward**
What seems to motivate and excite all the interviewed users is the process and the complexity of the show. If the show requires a lot of preparation and planning there is a bigger rewarding feeling when executing it. There is no immediate reward when taking down the show.

! **Reliable equipment**
The users are keen on using high quality equipment mainly because it makes them confident and they can rely on it.

? **Stage hands packing wrong**
Keeping the stage hands activated during the packing process, and the fact that the they need orders to know what to do, can be frustrating for the event technician. The relation between technician and stage hands needs to be further investigated.

? **Equipment is like toys**
The event technician has a personal interest for technology equipment and enjoy to work with the newest and biggest equipment, which he describes as toys.
We need to further investigate what he likes about the equipment and what makes him call it a toy, in order to see if desired values can be obtained.

2.3 THE IN-HOUSE PROCEDURES AT A LIVE EVENT COMPANY

To understand what goes wrong when equipment is lost the design team visited three live event companies. The aim was to get the full picture of the processes within the companies from planning and packing, to dismounting and restocking equipment at the warehouse.

The companies were two medium sized; Profox Aps and Soundandlight and one large company; Nordic Rentals.
The insights are based on worksheet 1, 5 and 6.

The interviewees are all former event technicians which now are event organizers in the companies, which means being responsible for purchasing equipment and planning jobs. The interviewees are asked to show the design team around in the company and tell about their procedures, finishing with a short interview about which problems they face.

The section features quotes from the following:

MIKKEL RODKJÆR
OWNER: PROFOX

FRANK SØNDERGAARD
OWNER: SOUNDANDLIGHT

STEFAN JENSEN
LOGISTICS: NORDIC

2.3.1 DISAPPEARING EQUIPMENT

During the interviews the event organizers confirmed a problem of losing equipment, and explained that it is an industry where keeping track of equipment is difficult. All the companies have huge losses related to disappearing equipment; forgotten at the warehouse when arriving at venue, the other way around or simply being unable to locate items is told to be normal (ill. 2.3.1).

"We lose around 200 cables annually and they cost at least 200DKK each (annually lost of minimum 40.000DDK)" - Stefan

"In the end of a season, where we count up our equipment, we usually experience a loss of around 30-40 cables, and other smaller equipment" - Frank

"It's common that someone do a 'dummy round' where you double check if anything is left behind" - Stefan

"It happens a lot, and it's always very embarrassing when we forgot something that's actually our main job to bring"- Mikkel

ill. 2.4.1: Warehouse at Nordic Rentals

"It's often a stage hand or a freelancer that misplaces something like a microphone in a mixer desk" - Frank

In the festival season, from may to august, when the companies are under pressure, stressed and have freelancers helping out is when most of the errors happens. Reasons are often staff with a limited knowledge about there to store the equipment, and not enough time to double check if all equipment are packed.

2.3.2 EASYJOB, DATABASE AND BRAIN OF THE BUSINESS

Common for the three companies is the use of a management software called Easyjob made by Protonic. The software works as a database of the companies equipment and is a planning tool to plan and schedule events based on availability of equipment, staff and trucks.

All the companies leave a lot of their knowledge in the software and the software does a great job of managing it. The companies depends on EasyJob, but it needs maintenance in order to keep functioning well. It is for instance important to update the database when equipment is missing or at service, to make sure the software do not book unavailable equipment.

"It's kind of like the brain of the company" - "EasyJob does it all, but it requires that you keep it updated with what is going on in the real world" - "It's been a long ride implementing it!" - Mikkel

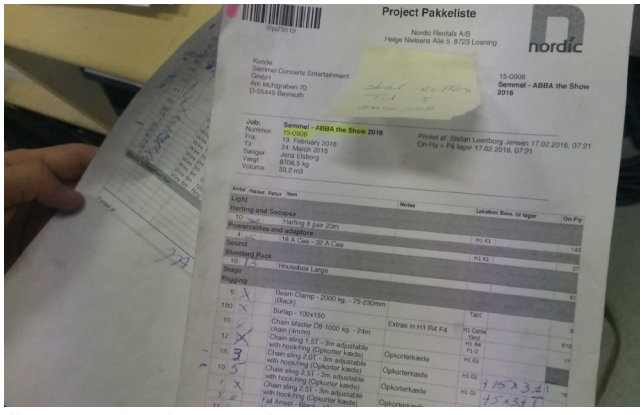
Not registering in the software when equipment is lost or broken creates a huge risk of renting out equipment that cannot be delivered to the costumer. This is something that all visited

companies are experiencing, and a lot of effort is therefore used on reminding each other to *tell the office* when it happens. The low accessibility from the warehouse area to the software EasyJob is the main reason why equipment is not registered. Most of the event technicians can only access the function of reporting malfunctions and extra equipment to the invoice from the main computer in the office, which is time consuming and annoying when packing equipments in the warehouse.

2.3.3 PICKING LIST - THE WAREHOUSE TO OFFICE LINK.

After a job is planned a picking list, a list of the required equipment, is printed directly from the Easyjob software and used to communicate what equipment needs to be packed in the warehouse (ill. 2.3.2). An employee then pack for the job manually, checking and aligning with the picking list. This process seems to work in terms of communicating from the office to warehouse and which of the equipment that needs to be packed. What does not work well with the picking list is the communication back to the office.

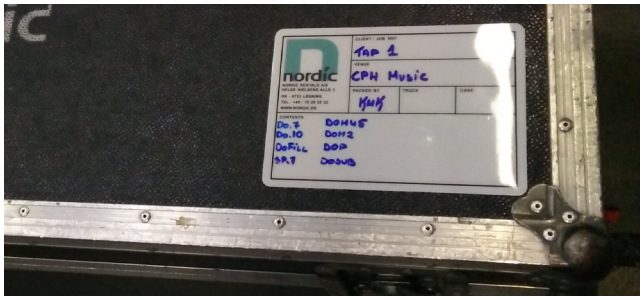
A problem all visited companies experience a lot, is when a technician in the last minutes of packing takes extra equipment with them and do not ask or check with the office and database first. If something is brought along to a job, without being planned in the database, registered or noted in anyway it literally becomes untraceable and can cause trouble when planning new jobs.
When extra items are communicated back to the office, it is often done by writing a note on the picking list, which does not always return to the office. This results in wrong invoices sent to the costumers, where the extra equipment is not paid for.



ill. 2.3.2: Picking list at Nordic

2.3.4 TOUR LABELS

When all equipment is packed it is stored in a *packing area* in the warehouse until it is brought to the trucks. To know at what event the flight cases are used, the tour label (section 2.1.2.) is used as an organizing tool. The tour labels are mounted on all flight cases and includes relevant information about the event, company and content (ill. 2.3.3).



ill. 2.3.3: Tour label at Nordic Rental

This method is described by all of the companies as a necessary procedure to communication between the employees. The writing on the tour labels is done manually with a marker pen and have to be wiped off with alcohol. For all the companies this is a tedious and time consuming task with no better alternative. A minimum of 50 tour labels needs to be filled in before each event, and related to the writing errors often occurs due to bad handwriting.

The tour labels was experienced as being mounted on everything - even the trucks (ill. 2.3.4). At Nordic Rental a truck, that was supposed to be empty, still contained equipment (ill. 2.3.5). The tour label on the truck did not contain any information, which resulted in confusion and frustrated employees. Afterwards Stefan used about 10 minutes with help from three colleagues, to run between the truck and the office, trying to solve the problem and bring the equipment to their right location.


ill. 2.3.4: Tour label mounted on lorry


ill. 2.3.5: Confusion about equipment in “empty truck“

Tasks, like the above mentioned, where the event organizers needs to unravel a mystery of what to do with equipment, is described by all as a common and frustrating phenomenon.

“I use too much time playing Sherlock Holmes, sifting trough picking lists, tour labels and browsing flight cases” - Frank

2.3.5 BAR CODES AND SCANNERS

Both Soundandlight and Nordic Rentals uses bar codes printed from EasyJob that they stick onto all their equipment. Thereby all equipment, except cables, have a unique ID.

“When everything is marked with a bar code ID it is easier for us to track down equipment and discovered if it is broken.” - “We need to pack exactly the right equipment matching the bar code and ID on the picking list though.” - Frank

A tool that is discussed with the event organizers is bar code scanners, which can be purchased as add-ons to EasyJob. It is a more accurate tool to pick and keep track of equipment and costs from 17.000-20.000DKK per scanner (Worksheet 4).

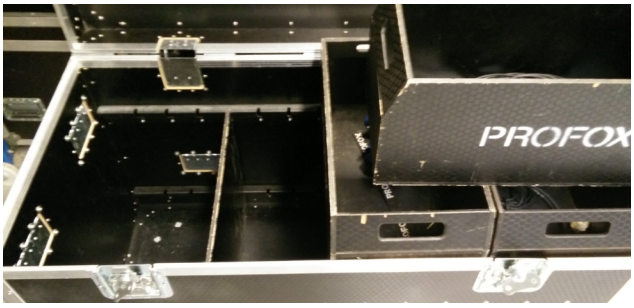
"A scanner is too expensive and the labour cost of scanning everything doesn't match up with the cost of lost equipment for us, yet!" - "I know RFID from other industries, something like that would make us able to track everything automatically" - Mikkel

"We intend to buy 10 bar code scanners before the end of the year," - "Bar code scanners will in short provide me with some transparency and traceability" - Stefan

The organizers all desire something better to track and trace equipment, but barcode scanners are not suitable for all of them, or at least they have a boundary of being to expensive to purchase and operate, and take to must time to use.

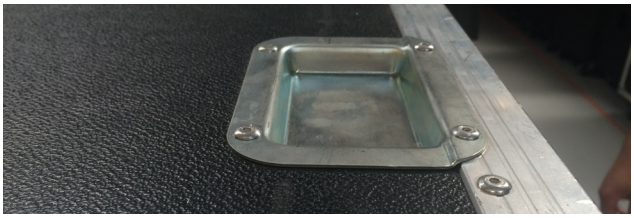
2.3.6 HOUSEBOXES AND FLIGHTCASES

All companies ship and stock equipment the same way. Most of the equipment is stocked, stored and transported in flight cases. Smaller equipment such as cables, connectors etc. are stocked without a case and packed and transported in a box called a house box (ill. 2.3.6). A house box is a modular box as shown below. Writing the full content of house boxes on tour labels is skipped or condensed, because the number of equipment in the house box is high.



ill. 2.3.6: House box with flexible dividers and boxes for cables and smaller equipment

Flight cases often come as desired by the event organizer in standard measures in order to fit the trucks. All cases are made from standard components: 60cmX125cmx60cm (HxWxD), 9mm wooden panel and 3 mm aluminum rails (ill. 2.3.7).



ill. 2.3.7: Wood and aluminium of a flight case

2.3.7 ERROR TAPE

At the company the use of tape with writing was visible in the warehouses as a mean to communicate the status of the equipment. *Error tape* was used to clearly mark equipment that was dirty or broken ensuring that it was not restocked in the warehouse, but send to service. A short note and description of the error was written on the tape (ill. 2.3.8).

ill. 2.3.8: Various error tape used to communicate status of equipment

2.3.8 COLOUR CODING AND SORTING STRATEGIES

To easily pack the various equipment that look similar, different strategies are used to distinguish equipment from each other. All companies have tagged their equipment both with logo and telephone number. Color tagging was used on the cables to indicate the length and type of them.

SUM-UP

! Missing and lost equipment
All visited companies experience lost and missing equipment

! Check and double check
The need for something that automatically double checks the equipment and communicated between the staff if equipment are occupied.

? Interaction with database (EasyJob)
A solution should be able to interact with the database EasyJob or similar. The interface and features of EasyJob should be investigated further

! Communication methods
The company use a lot of time and effort registering and communicating what needs to be packed and what is ready, using picking lists and tour labels as physical tools used manually and repetitively.

! Watching the process
The event organizers all desire a control tool for the packing process, and wants a better registration procedures in order to track and trace equipment.

2.4 A ONE-OFF EVENT

The team visited a smaller one-off event at the concert hall Skråen in Aalborg to follow the event technician Niels Peter Lindholt during his work when being in charge of an event. The aim was to get further understanding about the process of setting up and programming a show, and gain insight about what the user value and dislike in these processes.

This section features quotes from:

NIELS PETER LINDHOLT
PROSHOP EUROPE

A representative from the design team followed and accompanied Niels Peter from arriving at Skråen from noon to finish at 4 AM. The team member observed and participated in the process of setting up, programming and controlling the light effects for the event (ill. 2.4.1). The venue had an already installed and mounted setup and Niels Peter's job was to add extra lamps, program these and the already installed lamps according to the event planner's wishes.

ill. 2.4.1: The show execution at Skråen

2.4.1 LOST EQUIPMENT

Niels Peter surprisingly found a 2.000DKK *power board* belonging to his LEC. A piece of equipment which unknowingly had been forgotten a year ago, since that was the last time they had a job at Skråen. Niels Peter commented that it was not unusual to find forgotten equipments, which adds validity to the problem of companies losing their equipment.

2.4.2 MAKING AND LINKING THE PUZZLE ALONE

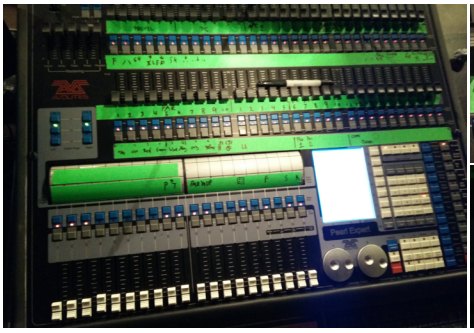
Volunteers for tonights event were 5 persons, but because of the limited amount of equipment that had to be positioned and mounted Niels Peter decided that it was easier to do it himself. He placed all lamps, connected them and linked them with the existing setup. The lamps was connected by manual plugging power and signal cables to input and output of each individual lamp. A long manual procedure that actually should have been delegate to the volunteers, but that he found more convenient to do him selves to avoid miscommunication.
Afterwards the lamps are given a figurative address needed when programming the show. Each lamp gets a individual number, which Niels Peter maps and manage in his head only. He remembers the addresses until the actual programming starts. This seems to be a challenging task for the remaining team, but it is a simple task for Niels Peter.

2.4.3 CUSTOMIZING, AND PROGRAMMING EVERYTHING

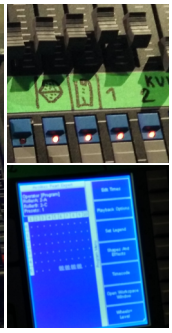
The connected lamps was plugged in a light console placed in front of the stage, from where Niels Peter would program and control the light. Getting to the programming, Niels Peter said:

"Now comes the fun part" - Niels Peter

On the light console, an Avolites Pearl Expert, the movements of lights, color palette, light patterns and intensity of the lights was programmed on a small computer screen (ill.2.4.2-3). Each of these features was after assigned to a button or fader on the light console. Tape was mounted on the light console adding small quotes or icons in order to remember which feature the buttons and faders controlled. Niels Peter configured these features for two hours, customizing every effect he intended to use during the show.



ill. 2.4.2: Avolites Pearl Expert console



ill. 2.4.4: Close ups

The most exiting and interesting task was for Niels Peter to plan every effect, and be prepared to use them during the show when fitting the music the best, in order to amaze the audience.

2.4.4 DEVIANT AND BAD QUALITY EQUIPMENT

When programming the lamps Niels Peter had trouble with some of them. The colors shown on the light controller and the colors on the stage did not correspond very well, which in Niels Peters mind was because the lamps was of very low quality. Niels Peter continued commenting on what he meant was poor quality.

"It almost hurts inside me, when I can hear the servo motors inside" - "If you look at the LED's inside the lamp, you can see that they have all got different intensities - Cheap China ware! It just doesn't match up!"

As indicated in the Event technician interviews in section 2.2, the quality of equipment is related to how well the equipment perform what it is commanded, and there agreed by Niels Peter.

2.4.5 BEING IN SYNC

During the execution of the show the design team had the chance to see Niels Peter controlling the light. The experience of sitting behind the light console controlling the show could be described as being in sync with the show; having the eyes on the lights, the ears on the music, the fingers on the controller and synchronizing these to the various *drops* and *breakdowns* in the music. All actions done on the light console corresponds directly to a visual feedback on the stage, which Niels Peter explained as huge satisfaction.

2.4.6 THE EXCITING PART

The event was executed from 21:00 to 03:00 in the night and due to the long time span Niels Peter seemed to be bored after the first 2-3 hours. This was confirmed by Niels Peter saying:

"It's like when you played with Lego, it's fun to build something new each time, - then you enjoy it for a moment, and then you take everything down, and start over again"

SUM-UP

! **Miscommunication with stage hands**
Niels Peter had a map and plan in his head about which tasks and procedures was needed, but to avoid miscommunication he did not use the volunteers, but decided to do everything himself.

! **Visual feedback from equipment is reliability**
Getting an instant and correct feedback and seeing the result of his commands, being executed on stage is crucial for the event technician, and an aspect of reliability.

! **Customizability**
Being able to customize everything is crucial for the event technician. The possibility to program and define features based on his own preferences is exciting and playtime. The customizability of equipment is fun and what he refers to when describing it as a toy.

2.5 MANAGEMENT DATABASE

The team assessed the rental software Easyjob 6, used by all the contacted rental firms, by downloading a trial and analyzing the various functions, inputs, outputs and potential problems.

2.5.1 FUNCTIONS

The functions described below are based on the trial version with all features explained on worksheet 29.

Easyjob is cloud compatible, meaning the software does not only work on the computers at the warehouse, but the data can be wirelessly accessed. Furthermore it has an open API, which means that additional software functions can be implemented.

General functions in the interface:

1. **Easyjob today** - A daily overview of projects
2. **Address Boo**k - Collection of customer information such as documents, sales, resources etc.
3. **Items (equipment)** - Information about items such as Number ID, stock location, power consumption, dimensions etc.
4. **Workshop activity** - Repair or maintenance of electronic or mechanical defects and wear and tear in relation to attrition, freight damage or user error.
5. **Overbookings** - Information about booking such as project, status, manager etc.
6. **Reports** - Information on previous activities such as jobs/ projects, invoices, sales, manufacturing etc.
7. **Invoicing** - Make invoices by creating or copying old ones, and create reminders or credit notes.
8. **Master data** - Information about everything, from Vehicles, resources, task types, accounts etc.
9. **Business information center** - Optimizing information such as top money makers or top 10 project types etc.
10. **Data exchange** - The importing and exporting of addresses incl. contacts and items incl. devices.

Easyjob can manage input and output in terms of number ID's, inventory and stock data, item status, truck numbers and staff ID to a mobile application through wireless data communication.

2.5.2 PRICE

Easyjob is divided into four different versions relating to the size and demands of the company (see worksheet 4):

- **Easyjob 6 S**: Express = No lump sum but 3.700DKK annually (Silver support)
- **Easyjob 6 M**: Lump sum of 22.000DKK and 2.200DKK or 9.500DKK annually (Silver and Gold support respectively)
- **Easyjob 6 L**: Lump sum of 40.000DKK and 4.500DKK or 12.500DKK (Silver and Gold support respectively)
- **Easyjob 6 XL**: Lump sum of 90.000DKK and 4.500 or 12.500DKK annually (Silver or Gold support respectively.)

Easyjob also offer bar code printers for 5.600DKK, and connecting bar code terminals starting at 17.000DKK per device (ill. 2.5.1)

ill. 2.5.1: The Easyjob bar code printer and scanner

2.5.3 PROBLEMS

- Easyjob do not offer a process-overview of the packing process, so that the organizer can monitor the state of the packing in real time.
- Easyjob provides an alternative to the paper picking lists, a barcode scanners which still require manually repetitive tasks. Frank Søndergaard from Soundandlight, stated that the price of 20.000-25.000DKK is to expensive (see worksheet 5).

SUM-UP

! Different payment methods
Easyjob is expensive, but has a subscription payment method for small firms. Medium sized companies pay around 30.000DKK for buying Easyjob and using it a year.

! Data exchange
Easyjob has a dedicated import and export function that makes is possible to connect ID's from tags to the equipment in the database.

! Cloud compatible
The Easyjob database can be wirelessly accessed

! Open API
Easyjob has an open application programming interface that allows additional software being integrated.

! No need to reinvent the system
A possible product service system could benefit from the features incorporated in the Easyjob software.

2.6 A PROFFESIONAL TOUR

In order to gain information about how to be professional and efficient during a mounting- and dismounting processes on a venue, the team visited and worked along a crew from a professional tour. The team did also investigate the relation between event technicians and the stage hands (Worksheet 11).

2.6.1 GENERAL PROCESS

The venue was Gigantium in Aalborg, and the crew consisted of more than 20 persons with various roles. The show had been pre-build and planned months before during a three weeks planning process. The tour was scheduled to complete 10 concerts, whereas this was the eighth concert.

The fieldwork consisted of two sessions; the first being a observation of emptying the trucks and building the stage including informal interviews from 07.30 to 13.00, and the second being a dedicated work-along from 22.00 to 23.30 where the design team experienced how it was like to be a stage hand for a night helping out repacking.

The day started by seven trucks with equipment was arriving from the warehouse and stored outside the venue overnight (ill. 2.6.1-2). The equipment was unloaded from the trucks and located on different position at the venue, an area of 20X20 meters.

ill. 2.6.1: The back entrance

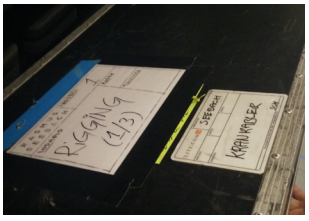
ill. 2.6.2: A truck being unloaded

2.6.2 COMMUNICATION

The process of unpacking and setting up the equipment seemed very well structured and organised. All questions, instructions and confirmations between the crew members was given by personal walkie talkies, ensuring that everyone was aligned and knew the next. The walkie talkies was only given to the crew members and not the stage hands that had fragmented tasks being delegated to them.

2.6.3 COLOUR MARKING

One of the workarounds observed was a method to ensure fast setup through the use of tape in different colours (ill. 2.6.3-4). Every flight case was marked and had a visible tape on top of them in order to quickly communicate and understand where and which part of the setup each flight case belonged to. A simple and very visible way to communicate this to everybody on the set which seemed to work efficiently, even to us, having the role as unskilled stage hands in the complete chaos of repacking.



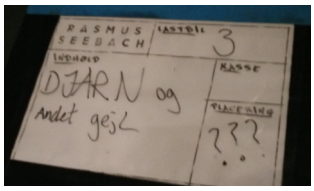
ill. 2.6.3: Flight case marked with blue tape

ill 2.6.4: Orange marked flight case

2.6.4 CUSTOM TOUR LABELS

On top of the flight cases mounted with coloured tape was large homemade tour label (ill. 2.6.5-6). A laminated A4 paper with sections for the tour logo, the position at venue, the truck- and box number was customized to communicate informations about the equipment at the tour setup. Due to bad handwriting and internal language it was hard to understand the information on the labels. For example the abbreviation F.O.H for *front of house* was written on some of the cases, which was understood as the control booth in front of the stage, but it was only understood by the crew members and the trained stage hands.

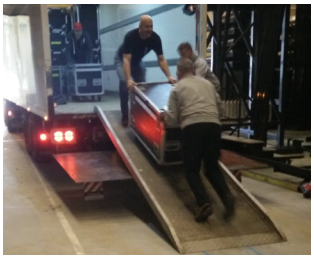
ill. 2.6.5: Tour labels mounted with coloured tape



ill. 2.6.6: Extra custom tour label

2.6.5 ROUGH HANDLING

The flight cases containing equipment are heavy, usually 50kg per flight case, and sometimes they build up quite a momentum during transportation and unloading of the trucks. They are observed rolling down a 3 meter long ramp with a 25 degree inclination, as well as being slided and stacked on top of each other in the trucks (ill. 2.6.7-8). The handling in general is rough which is why flight cases outer shells are tough and build specifically to accommodate this. The materials are aluminium edges and corners, and heavy duty plastic coated plywood sheets.



ill. 2.6.7: Staff unloading flight case from truck

ill. 2.6.8: Stacked flight cases

2.6.6 COMMANDING

When working along and functioning as stage hands the team was assigned to a event technician being under his command. During this time, tasks was commanded by the event technician in a very precise manner, ensuring that we understood exactly what should be done.

"You grab the two lowest horizontal handles, and then we tip the lid 90 degrees, counterclockwise" - event technician

When being commanded the design team experienced various tasks of finding, locating and matching equipment with specific flight cases among many similar, which was impossible for us. This resulted in finding the wrong case or asking the event technician once again. This happened continuously throughout the repacking process and was clearly irritating for the event technician who experienced a tense and stressed situation (ill. 2.6.9).

Production manager Jesper Philbert mentioned that he always asks for trained stage hands for his tours, because it creates a more dynamic repacking process. The venue is responsible for hiring the stage hands, and therefore the crew members never know what they get.

ill. 2.6.9: Event technician instructing stage hands

2.6.7 PLANNING EVERY DETAIL

In general the team experienced a process that was well planned. One of the interviewed crew members told about the three week planning process of setting up the stage, where a lot of packing and repacking are executed in order to organize all equipment in the best possible order.

Even the number of trucks was precisely defined and planned by modelling all flight cases and trucks in Google Sketchup, *3D software,* using the lowest number of trucks possible. The show was planned so well that they could empty seven trucks and set up the whole show in around five hours, and dismount all in around 2,5 hours.

From observing Jesper Philbert the team found that generally there is excitement when talking about how the crew had planned everything. An example:

JESPER PHILBERT
PRODUCTION MANAGER,
RASMUS SEEBACH TOUR

''At Eurovision we even used a big LED screen mounted in the scene floor that showed the planned position of the equipment, in order to change scenery in less than a minute between each act.''

SUM-UP

Synced crew, unsynced hands
The unpacking process where crew members are in sync with each other adds flow to the process.
Communicating and delegating tasks to the stage hands, which have a limited knowledge in the field leads to misunderstood orders, and causes stress and irritation for the event technicians.

Communicating with colours
The principle of marking with coloured tape, worked great to create both overview and redundancy and was a easy way to understand that the same coloured boxes should go to the same location.

Positions and truck numbers
Having position of the venue area and truck numbers defined and communicated on all flight cases created a quick repacking process between the crew members. The stage hands found it difficult to understand the information of internal language communicated by handwriting, and needed precise instruction.

Planning is fun, but time consuming
The planning process is important for the processes handled on stage and the crew finds it exciting though it is time consuming.

2.7 RESEARCH SUMMARY

The main findings from the research are listed in a common summary below. It is divided into three sections: first desribing the main findings, second the event technician's motivations aspects and third a summary of the helping tools used in the processes of the total system.

2.7.1 MAIN FINDINGS OF EXECUTING EVENT PROCESS

- There is a gap between the packing procedure in the office and in the warehouse. It is complicated to add extra equipment to the invoice when the warehouse workers conclude that the office have not booked specific and needed equipment to complete the total setup. This results in wrong stock lists and missing payment for the extra equipment.

- The event technician only have a planned overview of the setup process, and afterwards in the repacking process it is assumed that it is the same just reverse - which is false. The missing overview in the repacking process and tiredness makes it challenging to command stage hands, and creates misunderstandings and errors. This results in wrong packed flight cases and lost equipment.

- When controlling unskilled stage hands precise communication is required. It is predefined which specific flight case suits a specific equipment, and it needs to be packed precise that way. This relationship between flight case and equipment is difficult and demanding to communicate to the stage hands, because all flight cases are black and look the same.

- The flight case's positions on the venue layout depend on their content which is communicated on the tour label. The tour label is filled in with internal handwritten abbreviations in a limited area, which makes is difficult to decode and understand. The space is limited and expands the time used on arranging the flight cases at the venue.

- Missing and lost equipment is known in all visited LEC. Due to expensive man hours and time the companies do not check the content when returning to the warehouse after an event. Also equipment being packed in the wrong flight cases are common, and results in hours spend on locating the right equipment.

- The event technician are dependant on the equipment and rely on their condition, therefore it is important that the equipment gets the needed service at the warehouse. To ensure that, broken and dirty equipment is marked with tape. The limited communication area on the tape challenge the description of the error.

- At big production truck numbers, describing in which truck the flight case needs to be places, is communicated on the tour label outside the flight case. This was a communicative guidance for all staff at stage.

2.7.2 EVENT TECHNICIANS MOTIVATION ASPECTS

Motivation:

- The complexity of the show motivates the event technician
- Preparing and planning a show provides a big reward when executed
- The event technician rely on the equipment and are keen on using high quality products
- The event technician enjoy working with the newest technological equipment
- Visual feedback from equipment is important to the event technician
- Customizability is crucial for the event technician that finds is exiting and satisfying

Demotivation:

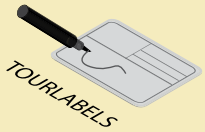
- To dismount the venue without an overview, because errors often happens and the event technician aim at leaving a good expression on the event planner and organizer.
- Frustrating to keep the stage hands activated during dismounting and repacking, because he do not have a total overview
- When stage hands handles the equipments wrong the event technician prefer to do it him selves to avoid errors

2.7.3 HELPING TOOLS

Throughout the research the team gathered understanding of the existing system and processes of executing an event in the LECs. The visited companies all used the management tool Easyjob; but still missing and lost equipment was commonly known. Furthermore additional solutions was used by the LECs.

Besides using Easyjob as a management tool, helping tools was used throughout the processes. The main tools are located as: tour labels, picking lists, error tape and colour tape. The use of these have been investigated throughout the research and errors have been found. Their function and errors are respectively summed up below as a overview of possible improvement aspects.

TOUR LABELS



Functions:

- Communicates the content of the flight case with a permanent equipment ID's
- Communicate what event the equipment are packed for by adding event info with a marker
- Prevent equipment already packed from being picked and packed for an another event

Errors:

- Bad handwriting makes it hard to read and understand
- Internal language can make it hard to understand
- Filling in a high number before each event is time consuming and tedious, and therefore it is sometimes simplified or skipped
- Equipment needs to be packed in the exact same flight case to match the IDs written on the tour label
- The tour label is not always large enough to communicate the needed info

PICKING LIST

Functions:

- Communicates what needs to be packed for a specific event
- Registers if equipment is packed for by marking it with a pen on the list
- Ensures that the right equipment is packed by matching the descriptions on the list with the packed content
- Communicates if extra or fewer equipment is brought to a event by adding notes on the list

Errors:

- The checking is done manually and can easily cause errors
- Bad handwriting can make the notes hard to understand
- The picking list does not tell what extra equipment can be brought to an event or if the equipment is already reserved for another event
- It is hard to track down errors and trace equipment, because the registration is only a check mark on paper

ERROR TAPE

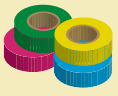
Functions:

- Communicates if equipment needs service, by adding it on the equipment and writing a matching note
- Ensures that malfunctioning equipment gets serviced before it is brought to another event

Errors:

- The procedure is often skipped because the tape is forgotten at the warehouse
- Only a limited area to describe a sometimes complex error
- Bad handwriting can make the notes hard to understand

COLOUR TAPE

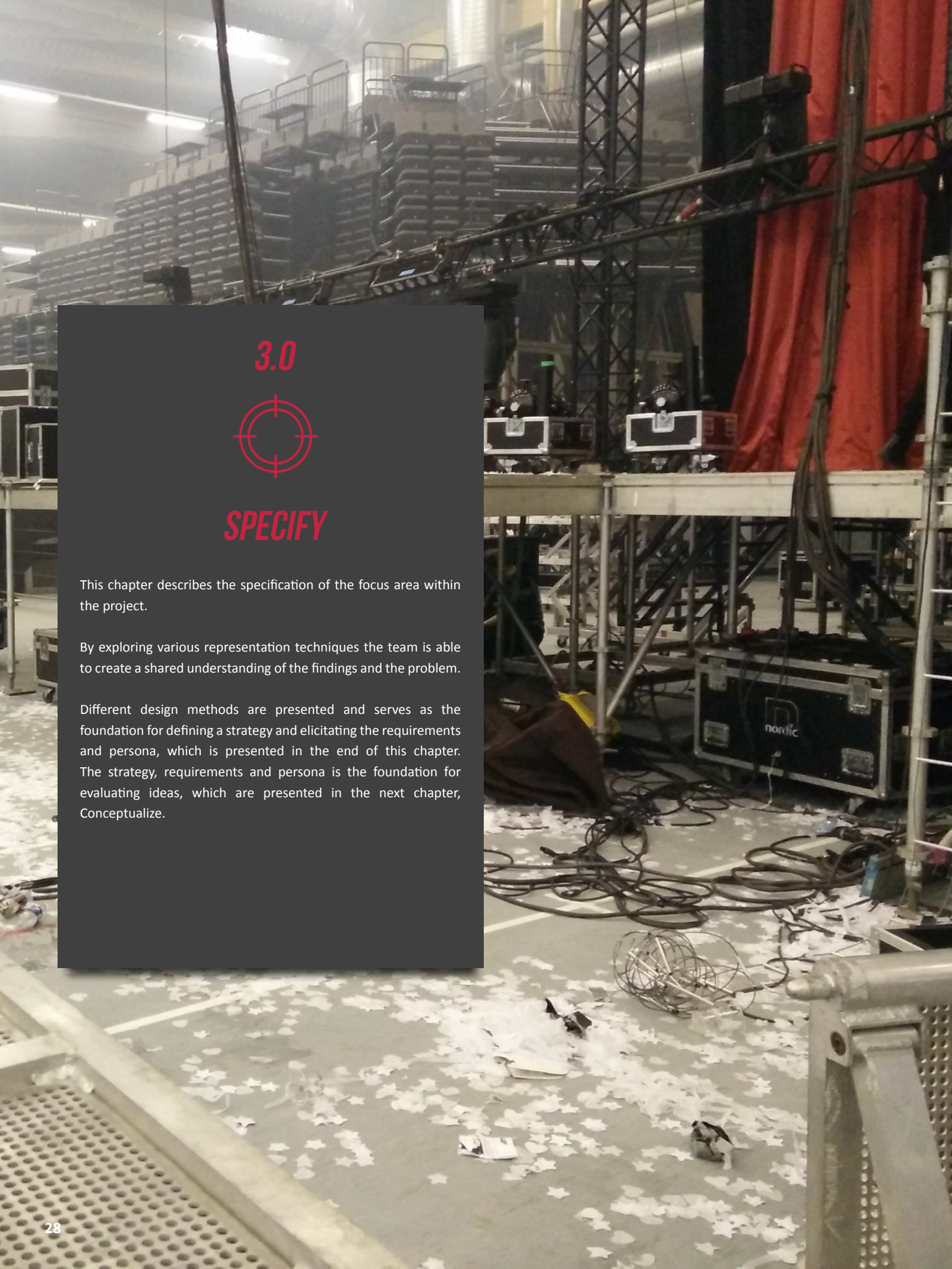


Function:

- Visual communicates that indicates positions and grouping of flight cases and equipment

Errors:

- Time consuming to add new colours before each event
- Different grouping are needed depending on the specific content for the event
- It is cost full to mark all flight cases with tape when only used for one event



3.0

SPECIFY

This chapter describes the specification of the focus area within the project.

By exploring various representation techniques the team is able to create a shared understanding of the findings and the problem.

Different design methods are presented and serves as the foundation for defining a strategy and elicitating the requirements and persona, which is presented in the end of this chapter. The strategy, requirements and persona is the foundation for evaluating ideas, which are presented in the next chapter, Conceptualize.

3.1 EVENT FOCUS AREA

In the research a various range of events has been visited and investigated. On the illustration below the different types of events are scheduled in a model to clarify their relations and differences.
The model is used to communicated and define our focus area for the concept development, which are one-off events.

During the fieldwork it became clear that the size, purpose, time, equipments and people involved varies a lot between the different events. Not only the big different between the size of event was noteworthy, but it was furthermore clarified that LECs also rent out equipment in longer periods without being involved with the execution, and that this scenario face other problems, and therefore it is divided from the focus area.

3.1.1 TYPES OF EVENTS

ONE-OFF EVENTS

Dry-hire
A dry-hire is when the LEC only rent out equipment. They are not involved in the execution, but just supply the equipment.

Installation
An installation is when the LEC rent out equipment and install it at a venue. The LEC do not participate during the execution, and the equipment is often installed for a longer period.

Event
An event is a one-off show planned and executed by the LEC. The size of the event can vary from private parties to big concerts. Everything is supplied by the LEC.

Production
A production is a larger and more commercial one-off event, and can e.g. be a festival.
It requires more planing and staff than an event. Everything is supplied by the LEC.

Tours
A tour is a repetition of the same event, know from band country tours. It is planned to perfection so that all staff know what to do and when. The same crew are working along the hole tour.

3.1.2 FOCUS AREA

Throughout the fieldwork and in our problem statement we include the execution of the show controlled by the event technician. Thereby it is necessary to create a focus on the events where this process exists. Both events and productions have a show executed by an event technician, and common for the two is that they are one-off event with everything supplied from the LEC. They have a big amount of equipment and flight cases to keep track on, and face the problem of lost equipment. These parallels made us focus on the one-off events.
The tours are excluded from the main focus, because we experienced a streamlined and effective process with few errors.

The focus area will be the main target during our development process, but the remaining types of event can maybe still find value in a future concept.

NOTEWORTHY

Our focus area for the development are one-off events. One-off event are characteristic by events executed one time, planned and executed by a LEC.

The size of a one-off event vary from private parties to commercial concerts and tv shows. The contacted LECs all handles different sizes of shows.

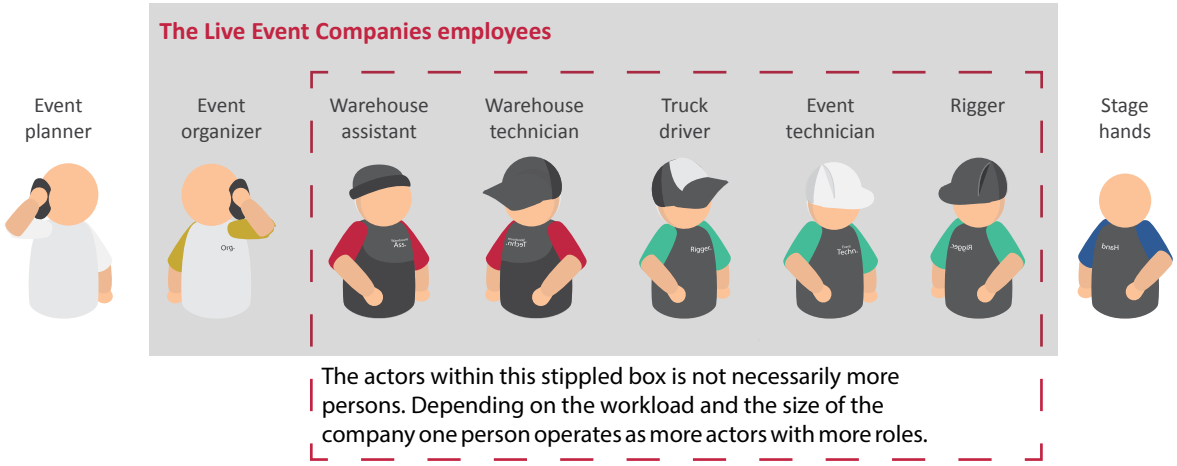
3.2 ACTOR MAP OF A ONE-OFF EVENT

To create overview of the main actors operating during an one-off event a modified actor map is generated in the light of the fieldwork (Tassi, Roberta, 2016). The actor map shows which actors are a part of the LEC and which are external staff.

The illustrated actors are a simplification of the once working at the back end of the show, and the performer, band etc. are excluded. The colour of their shirt are related to the system map on page X and indicates in which context the actors operates.

Below the actor map a description of each actor's main roles is explained. It is important to mention the relationship between the actors in the striped box on the actor map. They are not necessarily individual persons, but often one person is working as more actors depending on the size of the company, the workload and the size of the event.

3.2.1 ACTOR MAP



3.1.2 ACTOR DESCRIPTIONS

Event planner
The customer that buys an event from the live event company.

Event organizer
The costumer contact in the company. He organizes the orders, books the needed equipments in EasyJob and creates picking lists. He also hires extra staff when needed.

Event technician
Unpack the trucks and set the stage at the venue. Design and program the light show and execute it on stage afterwards. After the show he dismount and repack the equipment.

Stage hand
Unskilled workers employed by the event planner mainly to do physical ad hoc tasks at the venue. They are active both during the set up and the repacking procedure.

Warehouse technician
Fixes broken and dirty equipment and creates customized solutions especially with cables.

Warehouse assistant
Finds the equipment in the warehouse described on the picking list, and collect it in the warehouse. When ready he packs it into the trucks.

Rigger
Mounts the stage and climb in the truss to mount equipment at the event.

Truck driver
Drives the truck between the warehouse and the events. He helps loading and emptying the truck.

NOTEWORTHY

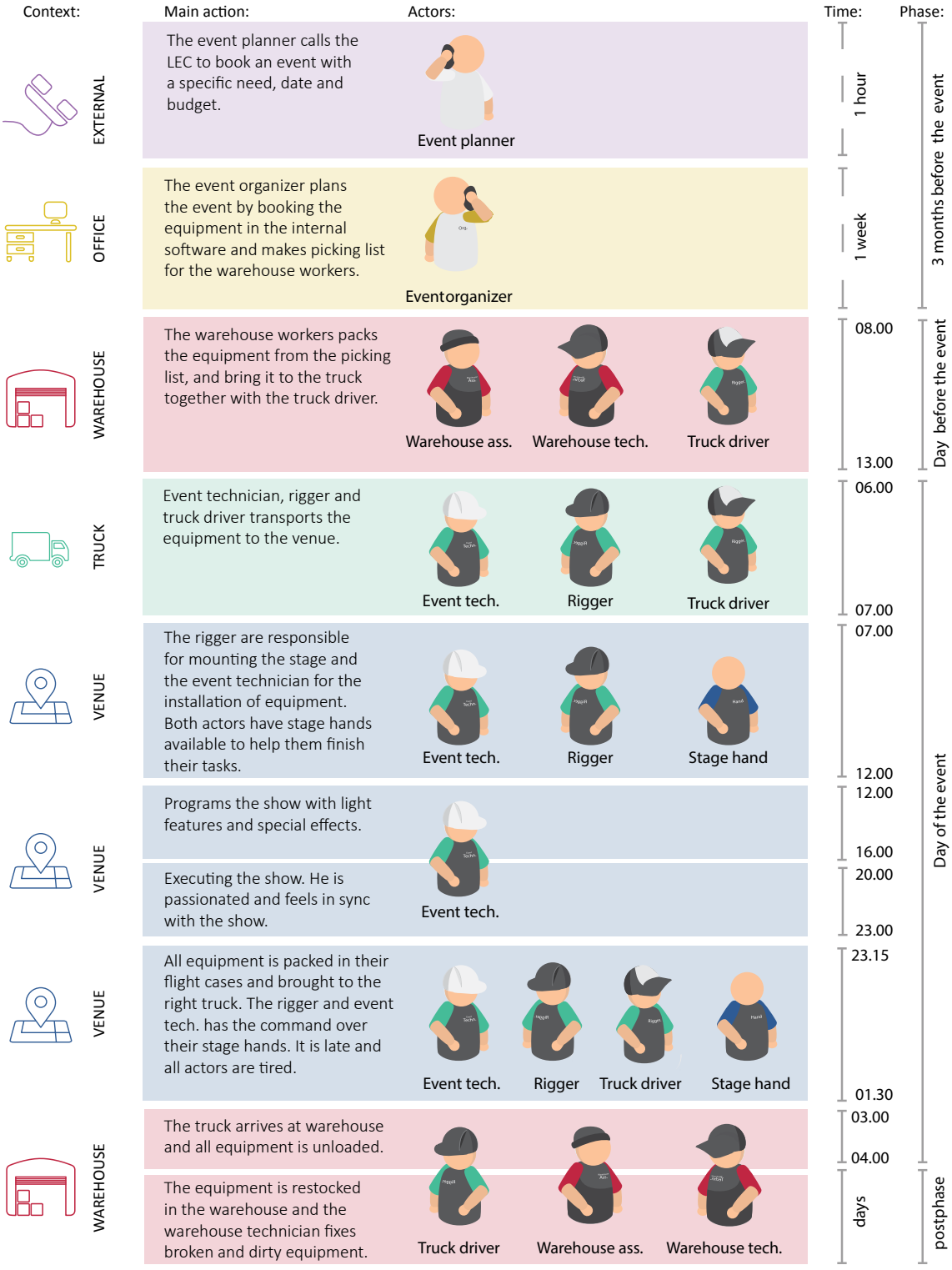
Actors with different tasks and responsibilities are represented within the LEC, but the tasks between the staff are often fluent and overlapping between persons.
A concept should therefore be possible to incorporate in more actor's roles and be streamlined between more tasks with awareness of the total procedure related to a one-off event.

3.3 PROCEDURES AT A ONE-OFF EVENT

To map the time aspect in relation to the actors and their tasks a simplified overview of the procedures related to a one-off event was developed. The map illustrates the main procedures at a typical event execution, but each event is by default different.

Time are added on the right of the figure as a parameter to clarify how tiredness can effect the actors work and mood along the process. It is illustrated that the event technician is working from seven in the morning till 01.30 at night, which most people can relate to as exhausting and with a desire to go home fast as possible.

3.3.1 PROCEDURE MAP



3.4 SYSTEM MAP

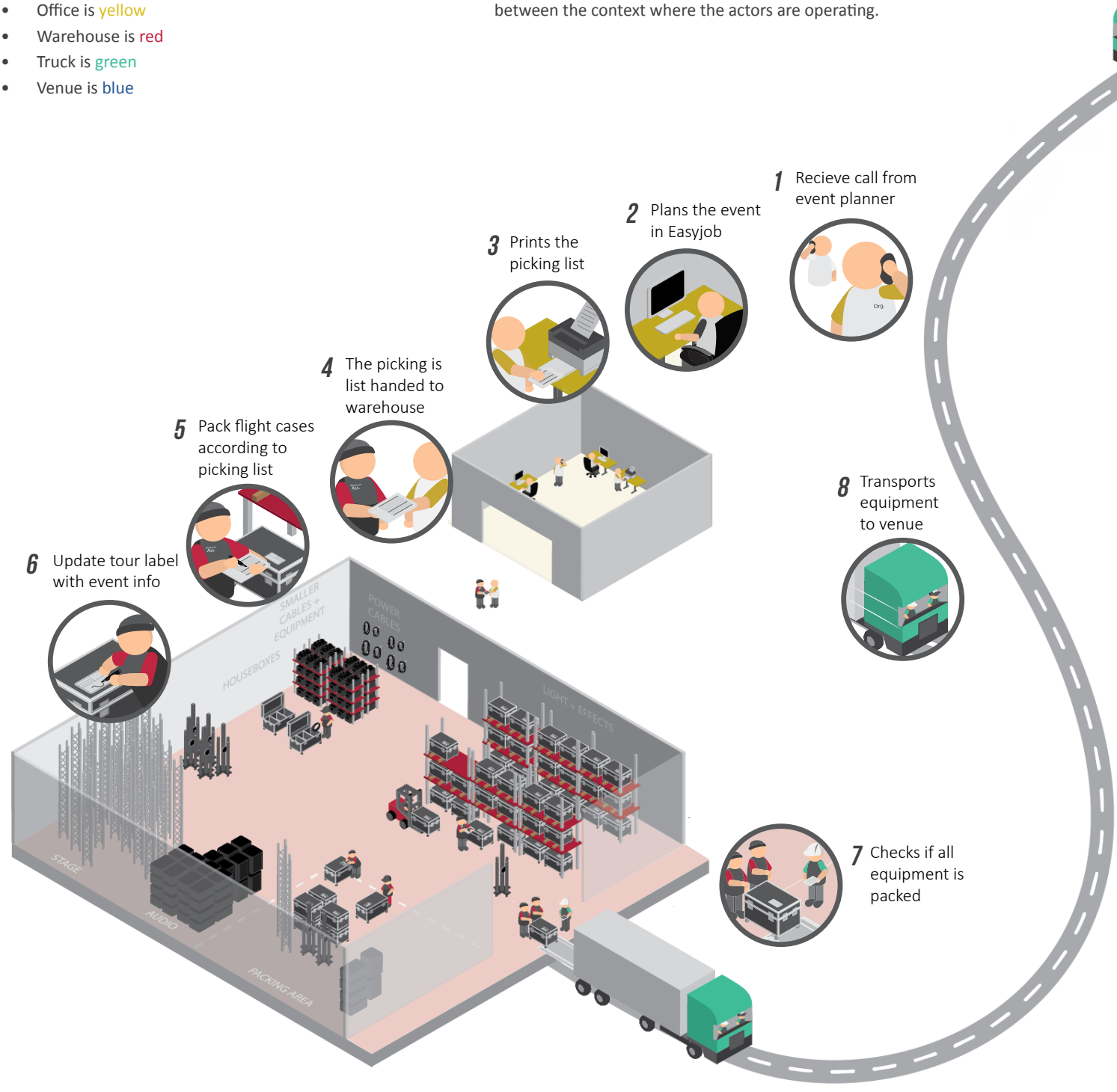
To visualise the physical contexts in relation to each other and to point our where the different tasks are executed a system map was generated (Tassi, Roberta, 2016). The system map was a method, within the team, to get an overview of the entire and worked as a reference during the development to create consensus in different situations.

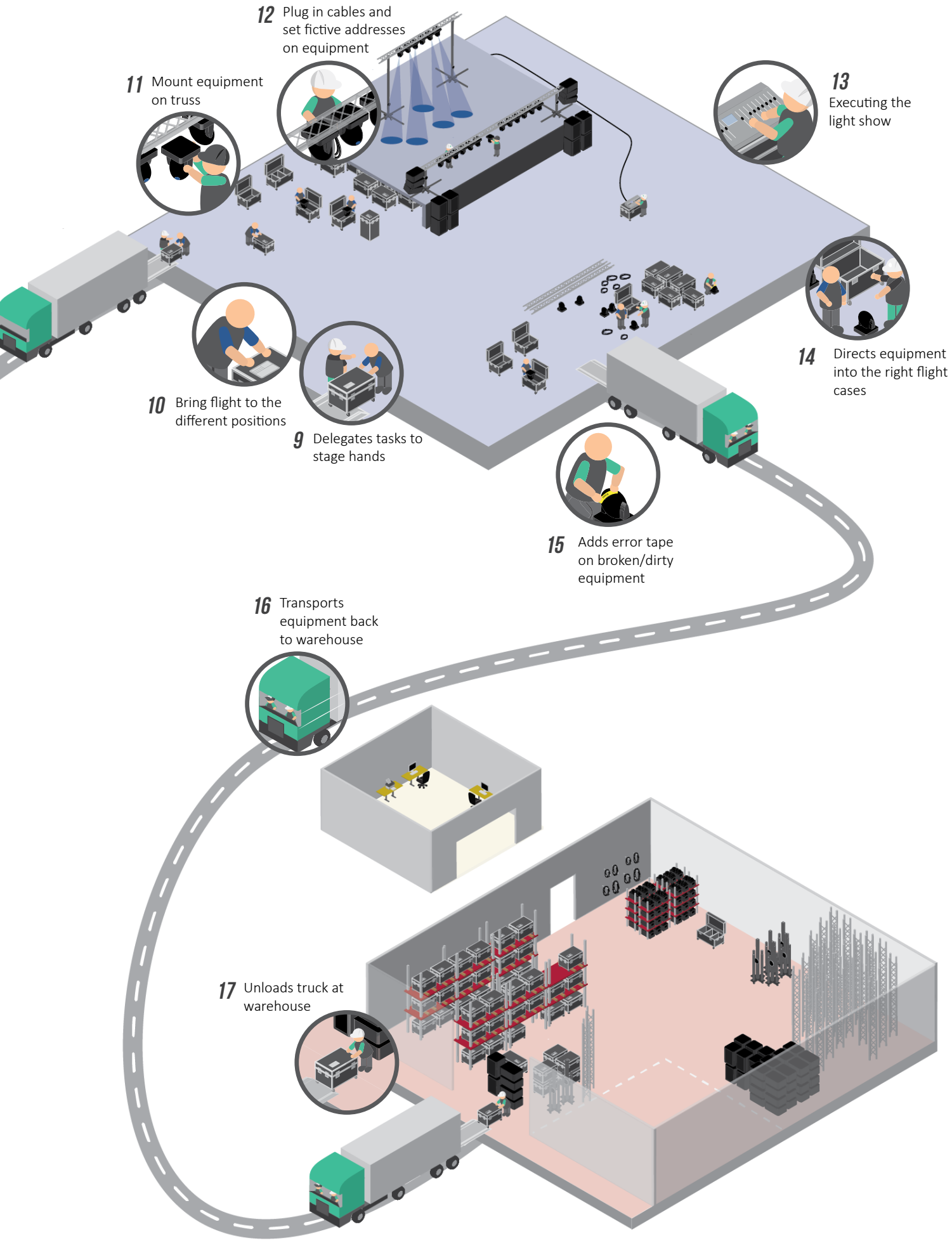
Each context are illustrated by an individual colour to point out where the tasks are done. The context and their colours are as following:

- Office is yellow
- Warehouse is red
- Truck is green
- Venue is blue

The system maps further illustrates the tasks connected to a streamlined event executed without errors by 17 simplified steps. The circles contains different tasks and are placed around the context it is related to. When planning an event it starts by *step 1* and continues to *step 17*, where it starts over again with the plannin the next event.

The simplification of the event execution mapped in its different contexts are created to gain a quick overview of the procedures within the different locations, and to indicate the distances between the context where the actors are operating.



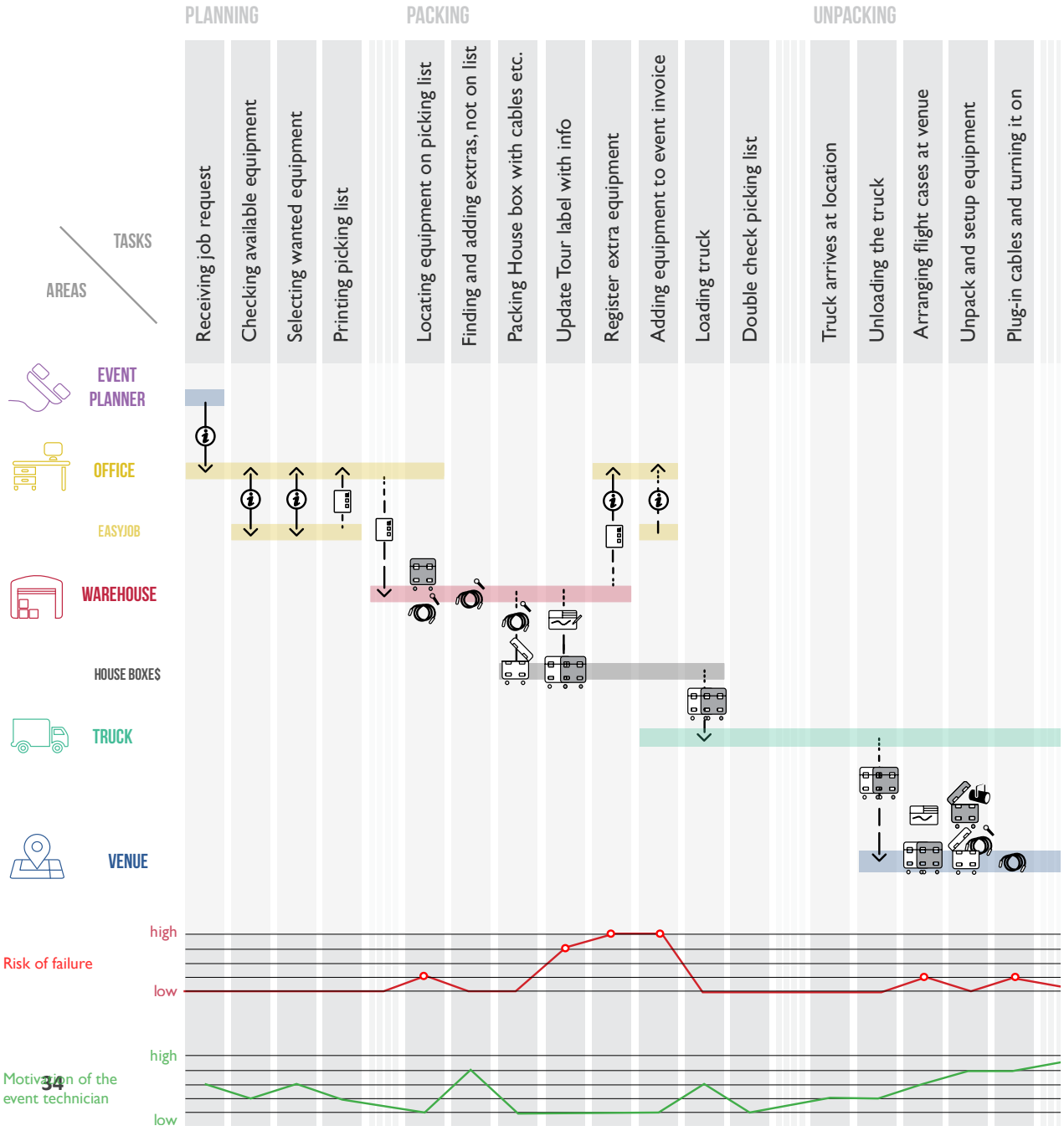

12 Plug in cables and set fictive addresses on equipment
11 Mount equipment on truss
13 Executing the light show
14 Directs equipment into the right flight cases
10 Bring flight to the different positions
9 Delegates tasks to stage hands
15 Adds error tape on broken/dirty equipment
16 Transports equipment back to warehouse
17 Unloads truck at warehouse

3.5 BLUEPRINT

From the knowledge gained in the research the team have through multiple iteration created a blueprint overview, as well as a detailed description of the tasks involved during an event.

The blueprint illustrates the different phases including their tasks, starting in the grey horizontal box on top of the blueprint when receiving a job request, and continuing until the next job is planned. Vertically on the left the different areas are listed with colours linked to the actor map, procedure map and system map on the previous pages. The horizontal coloured bars illustrates which areas are involved during the tasks. The symbols, which are explained in the box in the upper right corner of the spread, shows the artefacts being used between the tasks and the areas.

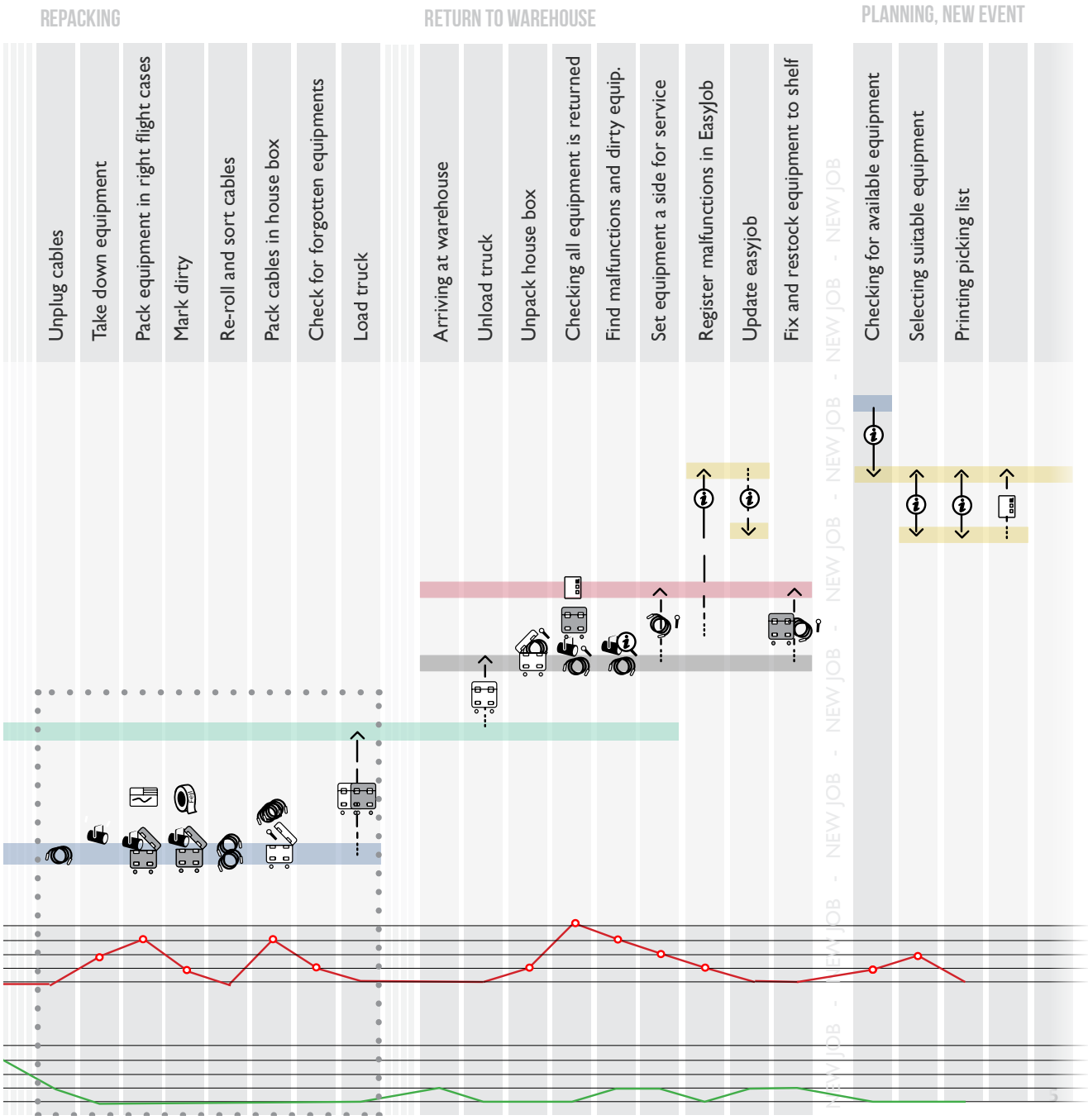
In the bottom of the blueprint we have added *a risk of failure line* and a *motivation line*. The risk of failure line identify where in the process most potential errors and problems occurs. The potential failures during each individual tasks is described on worksheet 35. The motivation line identify the event technician's motivation during the tasks. The motivation line is based on the event technician because he is the focus user and can operate as more actors during most tasks.



The two lines indicate that most failures happen when the motivation are low. This confirms our problem statement of motivating the event technician in the packing process to reduce the loss of equipment.
The area marked with the stippled box is where we intend to motivate the event technician and give him a better overview of the tasks involved, both to reduce the risk of failure line and increase the motivation line.
When planning a new job, see right side of the blueprint, the risk of failure has increased since the first job because all errors will effect the coming jobs. Therefore it is important to fix the errors when they occur.

SYMBOLS

- Information
- Picking list
- Flight cases, equipment
- House boxes
- Cables
- Micro phones
- Tour labels
- Large equipment



3.6 MARKET SIZE

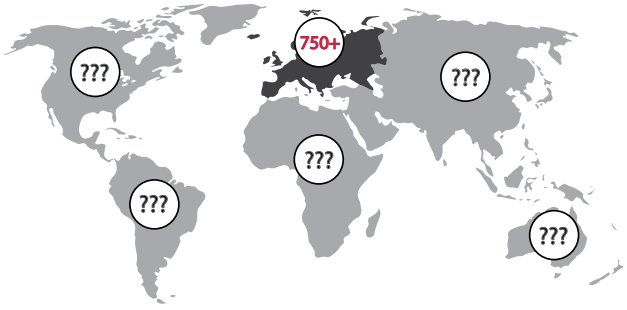
The potential market segment and size is investigated on the basis of the European use of Easyjob.

Easyjob is a management tool already used by several companies helping arranging equipments for jobs, keeping track of equipment and managing the content in the warehouse. Because our mission includes control of the packing process and registration of equipment we believe that the customer segment can be based on Easyjob's.

Easyjob is the most used management software in Europa, and have 749 European companies registered as users on their web page (see ill. 3.6.1). Through research the team know that even more users exist, since all the visited LECs used Easyjob and none of them are represented on the webpage.
In the remaining continents other management software are leading the market. They could probably, as well as Easyjob, be a potential segment on the market.

SEGMENT SIZE

Assuming that all companies using Easyjob experiences problems during the packing process with the helping tool and experiences lose of equipment, the team estimated a market of more than 750 companies in Europe alone.



Ill. 3.6.1 - Easyjob's customers in Europe

3.6.1 A COMPANIES ANNUAL LOSS

To specify how much a live event company should benefit from a new solution taking care of lost equipment, a fictive company is created based on information from the LEC Profox.

The team contacted Profox to create a guestimate on how much their loss and cost is related to missing equipment. The guestimates are based on a company with 10 employees, 200 jobs a year, 10 house boxes and 500 flight cases in their stock.

Owner Mikkel Rodkjær explained that it is hard to estimate what is actually lost and missing, because he cannot track his equipment, and do not have a total overview of what is placed in the flight cases in the warehouse. As a guideline he would guess that a medium size company as Profox annually loss is about 20-30.000DDK. He also explains that as the shows gets bigger, and they have to hire extra external equipment to fulfil a job, it gets even more difficult to keep track of everything.

Mikkel Rodkjær says:
"I know we lose about 23.000DKK on equipment in last year, and there is also things I don't know about"

"When we loose equipment, we are bound to rent equipment from other companies which always gives us an extra transport cost of at least 250DDK"

When Mikkel discovers that something is missing he mainly search for it internal in the company:
"I think 1 hours a week is used on locating missing equipment"

LOSS GUESTIMATE

Annual loss in equipment:
ABOUT 25.000DKK

Extra costs related to renting needed equipment from other companies:
ABOUT 10.000DKK

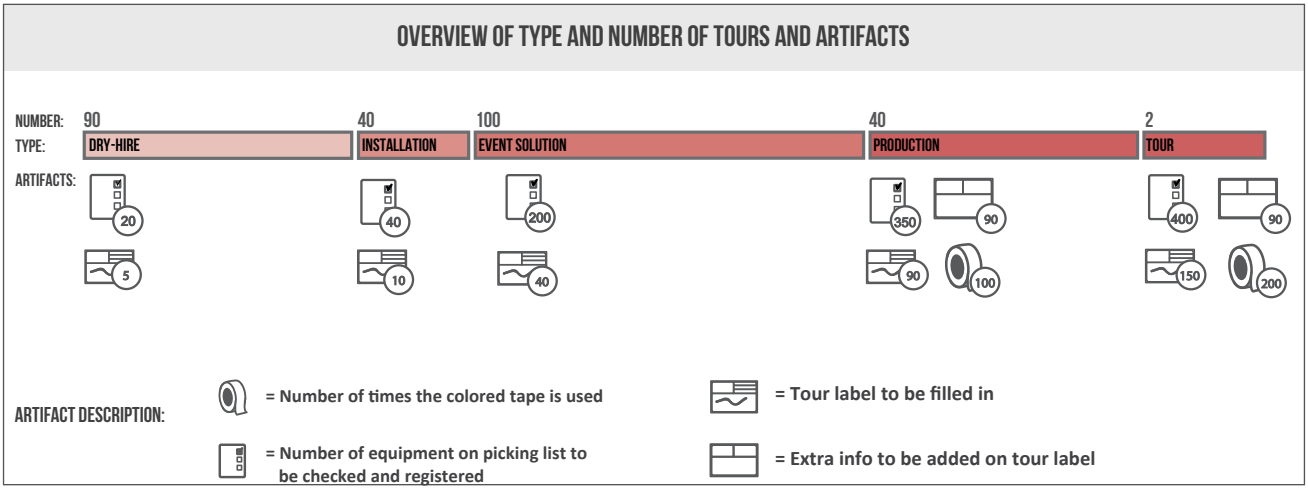
location missing equipment:
ABOUT 50 MAN HOURS = 9.000DDK

In total around:
44.000DDK EVERY YEAR

All numbers are based on guestimates from Mikkel Rodkjær, and a unskilled salary on 180DDK per hour.

3.6.2 INTERACTIONS AND POTENTIAL SAVING

Mikkel Rodkjær also delivered information about the number of different events executed during a year. This was used to estimate how much time is spend in relation to organizing the equipment including the tasks of handling tour labels, picking lists and tape.
The different amount of executed events within the company is visualised in the figure below, along with the number of artifacts involved in the packing process.



Based on the estimated tour numbers the team calculated the numbers of interaction between the involved user and the artifact, these numbers are noted in the circles on the figure. The numbers of interaction with the picking list indicated the number of possible errors related to manual and handwritten check marks.
A rough guestimate of 15 seconds per interaction with the tour label and coloured tape was used to calculate a time perspective.

Both dry-hire, installation and tour are excluded from our focus area, but included in this calculation to give a total overview of the time spend on manual registrations in a medium size LEC, to investigate the total loss and the improvement aspect.

INTERACTION GUESTIMATES

Manual registrations On the picking lists:

AROUND 78.000 A YEAR

Insufficient registrations when trying to increase errors

Time Spent on filling in tour labels and place tape:

AROUND 53 MAN HOURS = 9.500DDK

Procedures which still involve errors

All numbers are based on guestimates from Mikkel Rodkjær, and a unskilled salary on 180DDK per hour.

SUMMARY

When adding up the cost of lost equipment, cost related to hiring extra equipment, man hours spend on locating equipment and time spend on filling in tour labels and placing tape, we get a total loss per year, and a potential cost saving when improving these.

POTENTIAL COST SAVE IN A YEAR FOR A MEDIUM SIZE LEC:

AROUND 53.500DKK

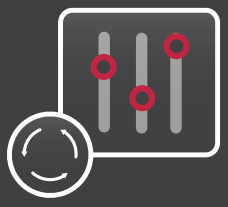
POTENTIAL YEARLY SAVING IN A LEC

3.7 STRATEGY

When creating consensus and synthesize the insights the word *control* was adopted by the team as a value and framing word of what we intent to provide, to make the event technician feel professional both before and after the show (Dorst, Kees 2007).

3.7.1 CONTROL AS THE FRAMING WORD

The feeling of *control* only exists when the event technician is executing the show, and control is the value we intent to add to the packing process. To specify what the word control means in the context of the event technician's job, it is unfolded into three analogies, each explaining an individual meaning of control.



1. Controlling as commanding something on a control panel

2. Controlling, checking and registering something

3. Having something under control by a maintained overview

To clarify the differences an examples of where and why the three types of control is desired, is described:

Control value 1: Commanding stage hands is done without the same level of control as when controlling the show. Instructions to the stage hands is given by pointing, and time and effort is spent on trying to be specific, but sadly it ends with misunderstandings hence wrongly carried out tasks.

Control value 2: When packing for an event, in the warehouse, it needs to be transparent between the involved staff what is packed and what needs to be packed to avoid errors. Double checking the content, adding extra equipment and filling in tour labels are all tedious task, and difficult to keep track of because they are done manually by bad handwriting and adding personal notes.

Control value 3. During setup the event technician has an overview of how to build the stage that are planned in advance. When the show is over chaos exist, and only the memories guides the event technician how to repack the equipment. It is hard to get an overview and the process seems unmanageable.

3.7.2 ELABORATED MISSION AND VISION DESCRIPTION

The team aims to add the same feeling, experienced before and during the execution of a show, into the chaotic and irritating task of managing the packing, unpacking and repacking process. We want to evolve the action of instructing the stage hands into accurate commands and well understood tasks.

The team seeks to create a better control of what needs to be packed, registering who packed it and when, and enabling the possibility of planning the process of the show down to details with minimal efforts. Also it is sought to create an overview that can be used in opposition to make the experienced chaos of repacking into something more manageable.

To easier and more redundantly command tasks to stage hands with comfort in knowing that the commands are correctly understood, and with a feeling of controlling the equipment, a visual feedback will compliment and express the tasks. Furthermore it add a feeling of being plugged in and in control, as the event technician are used to from executing the light show.

3.8 SOLUTION REQUIREMENTS

In order to fulfil the mission, vision and problem statement from the introduction phase the team defined requirements and wishes. These are general for what an overall solution must and should do respectively, and they are later revised into specific product requirements. Based on the fieldwork the requirements are generated to fulfil the problem statement of motivating the event technician in the packing processes, which we, based on the research, means is done by the defined requirements and wishes below.

Each requirement and wish are followed by numbers in a bracket. These refers to the section of the report, where an insight is gathered and generated to a requirement or wish.

3.8.1 REQUIREMENTS

1 The concept should create a packing procedure that aligns the information between planning in the office and packing in the warehouse.

- Must communicate which equipment needs to be packed (2.4.3)
- Must register and communicate which equipment has been packed (2.4.3, 2.4.4)
- Must be able to double check if everything is packed (2.4.1)
- Must register who packed the equipment, at what time and at which context (2.4.5)
- The user must be able to add extra equipment to the picking list during packing in the warehouse (2.4.3)

2 The concept should help event technician create an overview throughout the process from packing to repacking.

- The user must be able to create an overview of the flight cases including its content (3.6.2)
- The user must be able to plan and map where equipment should be placed on the venue layout (2.5.7)
- The user must be able to define a colours of each position at the venue (2.5.3)

3 The concept should clearly communicate the equipment and position on the venue, on each flight case during unpacking and repacking.

- The defined colours of each position must be visible on the flight cases when unpacking and repacking (2.5.3)
- The map of the venue layout with its positions must be visible when unpacking and repacking at a venue (2.5.4)
- The content of the flight case must be visible on top of the flight case (2.4.4)

4 The concept should help the event technician command tasks to stage hands.

- The user must be able to visibly single out a specific flight cases and a group of flight cases (2.5.6)
- The user must be able to identify a specific equipment, locate it and single out its flight case (2.5.6)

5 The concept should ensure and control that all equipment from a venue is brought home to the warehouse.

- Must register if equipment is placed in the right flight cases and communicate if not (2.4.1)
- Must register all equipment before loading it to the truck and communicate if something is missing when leaving the venue (2.4.1)

6 The concept should communicate when equipment is broken and/or dirty and communicate it to the office.

- The user must be able to register a detailed description of broken equipment and what kind of service the equipment needs (2.4.7)
- The condition of equipment, dirty or broken, should be visible on the equipment's flight case (2.4.7)
- Must communicate to the software database when equipment is at service and thereby not available for bookings (2.4.2)

3.8.2 WISHES

1 The concept must have some degree of customizability

- To fulfil the event technicians desire of customizing technical solutions (2.3.3)

2 The concept must help communicating to staff in which truck the flight cases should be placed

- The truck number must be visible when repacking (2.5.4)
- Truck number visible on top of the flight case (2.5.4)

3.9 PERSONA

To specify who the event technician is, a persona was created along with a picture collage (Ill. 3.9.1) of what he values (Cooper, Alan 1999). The intention with the persona is to create common empathy with the event technician, and get a understanding of what person he is and what he values. The persona is based on soft values and is a personalized supplement to the requirement specification.

3.9.1 LARS THE EVENT TECHNICIAN

Lars is an event technician at a professional LEC. He has always been interested in technology and he likes that the job challenges his technical skills, and therefore he finds it a cool and satisfying job.
A normal week for Lars is meeting, planning and evaluating the previous weekend's events with his coworkers on the Monday, followed by days off until Thursday. Thursday he begins packing and setup for the coming weekends shows, and the following night he executes the shows. The weeks varies a lot, which Lars does not mind since he lives on his own, and can do just as he likes.

At an event Lars is responsible for the light equipment and during the execution of the show he is, according to himself, the most important technician and in control of the complete show. When Lars is not executing a show, he spends most of his time planning, pre-programming and imagining how his next shows should be. He is constantly challenging himself to be more creative by programming new unique show features. At the event Lars is also challenging himself and his crew to be fast and efficient when setting up and taking down a show.

Lars likes the small technical detail of his works, but the most rewarding is when a large production comes together and everything works. It is like adding the last brick to a giant puzzle, and when the show is on he enters a moment of forgetfulness being in sync with the show. Everything is then about the correct timing and Lars notices even the smallest mistakes. Even though he knows that the crowd will not detect it, it pains Lars when a piece of equipment is not performing its best or is not with the same light intensity conformity as the others.
Lars is quite picky about the equipment he works with and light equipment should be of the best quality and perform exactly as he orders from his light controller.

He is very thorough when repacking after an event, but constantly commanding stage hands and communicating tasks to do makes the repacking process a confusing mess. This makes Lars feel that he leaves a bad impression on the event planner and event organizers, which is the last thing he wants to. He want to get it over with fast as possible with every thing under control.

Ill. 3.9.1 - Persona collage

4.0

CONCEPTUALIZE

This phase describes the conceptualization of ideas within the focus area.

By using the insights from the Research phase along with an alignment of the strategy, solution requirements and persona, the team is able to create three general concepts.

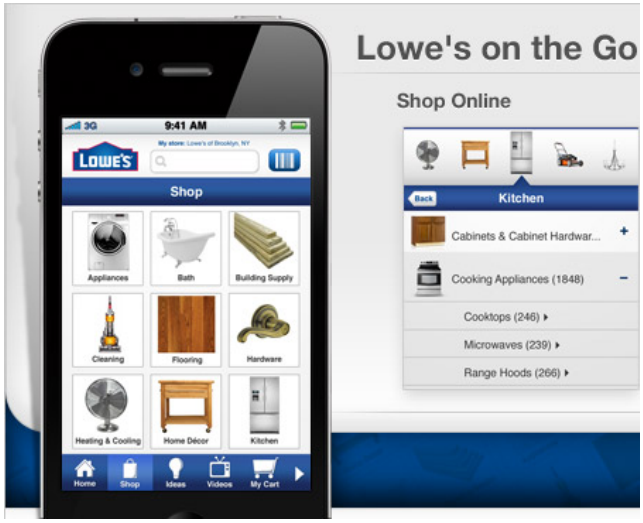
Different ideation and representation techniques are presented and serves as the foundation of representing the concepts and elicitating specific product requirements presented in the end of this phase. The product requirements are linked to the corresponding findings. The specific product requirements are used as the foundation of the development of the solution, which is presented in the next phase, Development.

4.1 TECHNOLOGY INSPIRATION

In order to get an idea of state-of-the-art management solutions the team investigated various industries where inventory management plays a large role, in hope of obtaining inspirational technologies or processes which could potentially be implemented in the solution (Worksheet 3)

4.1.1 SMART DEVICES

Smart devices are becoming ever more present in not only private contexts but also retail contexts, where they can play an essential role in customer service. Due to the developing technology within the field of communication, smart devices, such as iPhones, now come with integrated NFC scanners, and 4G will soon be the standard of wireless data transfer, making the personal smart device a highly intelligent and compatible tool. Lowe, a home improvement company, in Gaithersburg has implemented iPhones as devices working as handheld scanners or computer kiosks. The store manager can now access inventory information on the iPhone to see whether any item at the store is in stock (Worksheet 30).



Ill. 4.1.1: An illustration of Lowe's app

4.1.2 RFID, RADIO FREQUENCY IDENTIFICATION

The U.S. Military has created an ''*enhanced Parachute Tracking System (ePTS) that employs radio frequency identification to provide end-to-end, verifiable chain-of-custody accountability, traceability and airworthiness of a sophisticated new family of personal parachute systems in support of global military operations*''. The RFID technology is a major foundation of IoT (Internet Of Things) and the technology has saved the army from manual methods that are labour-intensive, error prone and subsceptible to malicious tampering (Worksheet 30). The U.S. Military does not only use RFID for the ePTS but also for general track keeping of the vast store of supplies and equipment around the world, replacing IBM punch cards and (EAMs) electric accounting machines.

4.1.3 ESL, ELECTRONIC SHELF LABELS

Electronic shelf labels are gaining momentum within the retail industry, specifically supermarkets, offering instant changes of large quantities of information and at the same time eliminating manual, repetitive and labour-intensive tasks. They differ from other displays, like LCDs, by not depending on emitted light but rather reflected light which increases the readability. They practically do not consume energy except for when the image changes, but they keep the image even after disconnected from an energy source. The technology is called 'E-paper' (Worksheet 30) which resonates well with its ability to produce a natural looking image, as if it was ink on paper. It is connected to a server through either IR (Infrared) or RF (Radio Frequency) where IR has the major disadvantage, compared to the latter, that it needs a line-of-sight connection, which is easily obstruted.

Ill. 4.1.2: An ESL (Electronic Shelf Label)

SUM-UP

Smart devices

Due to smart devices having integrated NFC scanners, it could be used as a cheap RFID scanner, by anyone. Combined with the communicative features in terms of 3G and bluetooth, it could be a powerful tool.

RFID

RFID is evolving rapidly in terms of price, signal reach and security which is why it is being used by a technologically leading industry like the military. It shows that it can be a powerful tool for automation and digitization.

ESL

Electronic shelf labels are powerful tools for rapidly changing static information and its display features, including better readability, seems contradictive to the low price and power consumption, which is probably why they are starting to take over paper and plastic as carriers of information.

4.2 IDEATION

The ideation throughout the project is shown on Ill. 3.2.1 and shows the many iteration processes during the ideation.

Linked to the research of the context and processes gathered from company settings the team created and sketched different ideas and solutions. From the beginning of the process the team had an idea about rethinking the system, and ideas related to this was especially generated. To be more diverge and investigate a wider range of solutions the team hosted several structured ideation sessions where the team used brainstorms and ideation methods to diverge the solution frame in different directions. It was analysed and condense into three initial concepts (worksheet 9).

The solution frame of the three concepts was mainly logistics based solutions that eliminated the errors of the existing system, but without taking care of the involved user needs.

This made the team revisited the research and gained the described insights from the fieldwork and user interviews. These insights, along with a better understanding of the users and their workarounds, created a new framing. Newly evoked requirements inspired the team to come up with a solution that both eliminated the errors in the system, and focused on the user by giving the event technician a tool to created control along the processes.

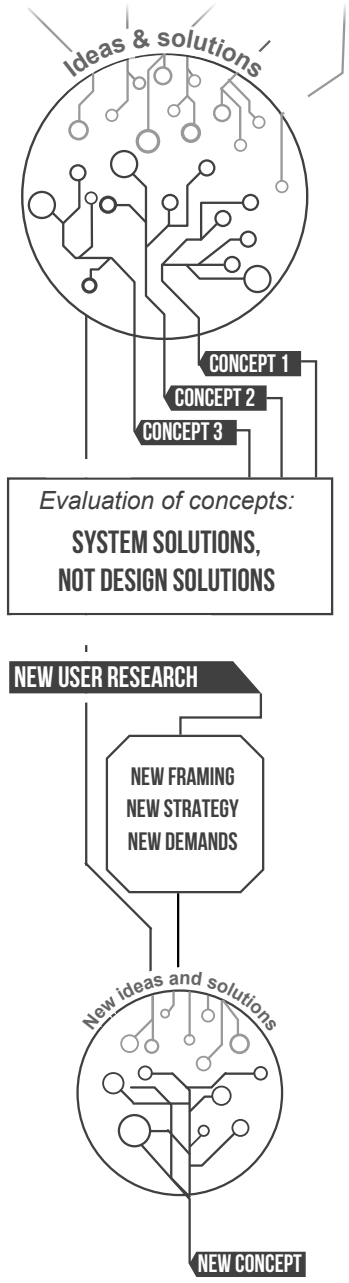
In a new ideation session the team developed a more value driven idea of a concept with features that addressed the dilemma described in the framing and introduction (Worksheet 15) .

A simple overview of the foundation of the final concept is illustrates on Ill. 3.2.2 on in the text below.

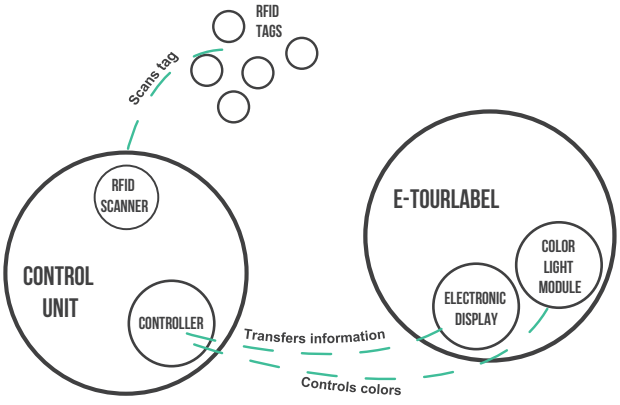
The concept exists of a unit named *the e-tourlabel*. The e-tourlabel is a communication device mounted on top of all flight cases, which replaces the function of the exiting tour label. The e-tourlabel has a display that communicates the content of the flight case, its position at the venue and other wanted information related to a specific event.
An integrated light module with six different colours replaces the function of grouping flight cases with coloured tape.

The concept also exists of a control unit from where the event technician controls the information on the e-tourlabels, programs the colours on the light module and registers all equipment using RFID chips mounted on all equipment.

This concept was unfolded into three different concepts and system architectures, which are explained in the following pages.



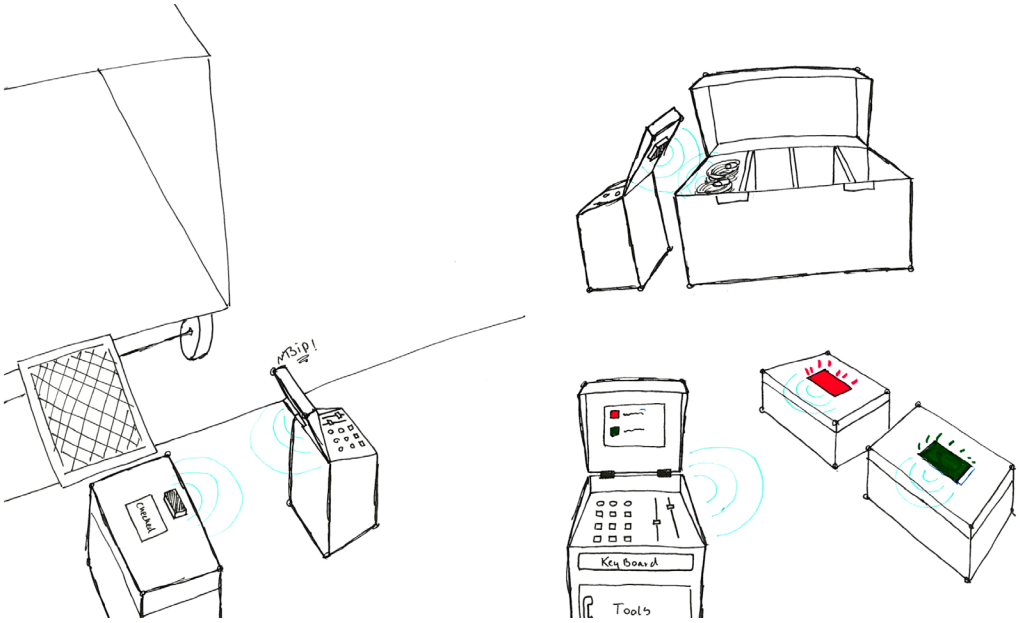
Ill. 4.2.1: An overview of the ideation throughout the project



Ill. 4.2.2: A simple overview of the foundation of the concept

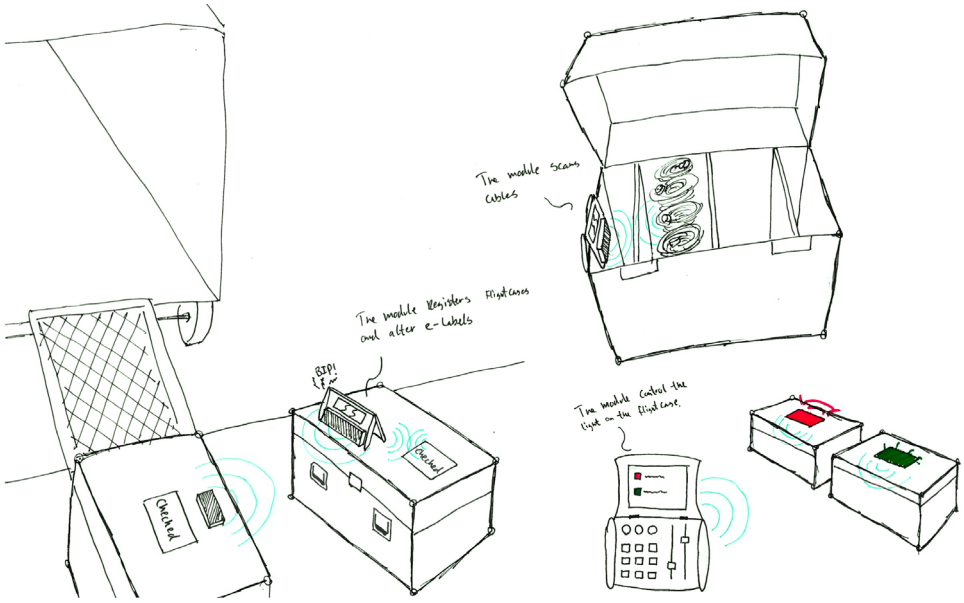
4.3 CONCEPT OVERVIEW

The ideation sprouted three various concepts based on different system architectures explained below.



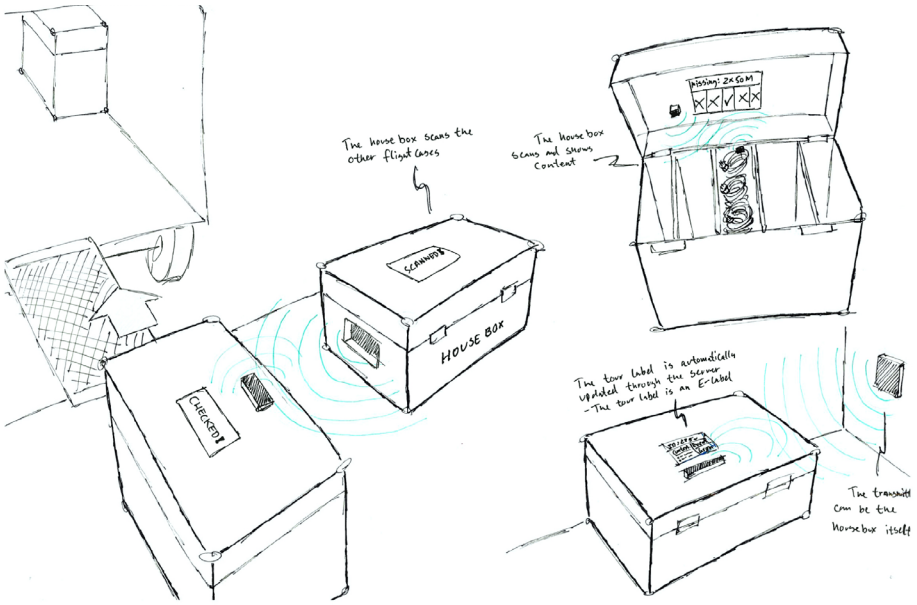
4.3.1 CONCEPT 1 - MOBILE CONTROL STATION

The first concept was a mobile work and control station to be used by the event technician. The product was a tall flight case with an integrated computer and a dedicated interface for controlling and programming the colours on the e-tourlabel, along with an integrated RFID scanner. The command console would work as a flexible work station which would be used both to register cables when packing the house box and to register flight cases when loading in the truck.



4.3.2 CONCEPT 2 - PORTABLE CONTROL MODULE

The second concept was a smaller and more portable version of the *mobile control station* from concept 1. The idea was to get the same functions, with scanning and programming the lights, down to a portable size, which the light technician could then use while e.g. driving towards the venue, in the truck. The product was a small tablet like device, with a customizable interface, that could be flipped around like a book, resting on the edge of a house box, and used to register incoming cables. The idea was also that it could stand on top of a flight case and register flight cases when loading the truck.



4.3.3 CONCEPT 3 - SMART FLIGHT CASE

The third concept was an integration of a scanners in the branch of flight cases called House boxes, transforming it into a mobile scanning check point. The solution would be controlled from a undefined controller, where from the colours could be programmed. The integrated scanner would scan all the cables mounted in the house box as well as scan and register equipment in flight cases that passed by before loading.

4.4 PHYSICAL MODELS

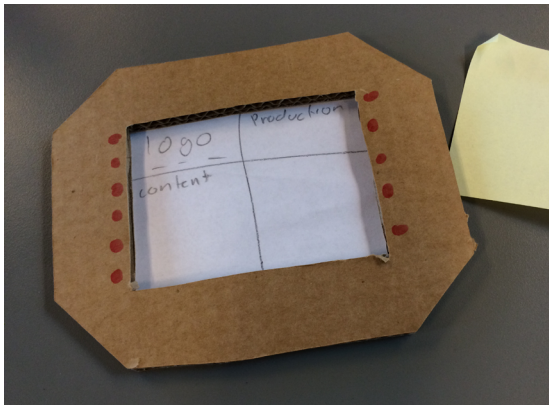
The different elements of the concepts was explored through physical mock ups (Ill. 4.4.1-3). These were made to develop the concepts and create consensus about them from their psychical appearance.

By doing body storming of various improvised scenarios, grasping the physical mock ups and acting around them spatial aspects of the scenarios was analysed. This was continuously done within the design team along the development process, and helped communicate ideas to the other members in the team.

The mock ups was further used when explaining the concepts to the used. The psychical aspect of the mock up was a effective approach to enter the conversation with the user.

Ill. 4.4.1: Mobile control station

Ill. 4.4.2: Portable control module



Ill. 4.4.3: E-tourlabel

4.5 CONCEPT PROBING

In order to develop the concepts in cooperation with the users the team created mock-ups of the concepts. They were used as a communication tool when presenting the concepts through two iteration and feedback sessions, with two of the previous interviewed event technicians. The different user preferences, wished features as well as evaluations is described in this section.

Ill. 4.5.1: Concept probing with Frederik Lisborg

Ill. 4.5.2: Concept probing using models with Niels Peter

4.5.1 SELECTING YOURSELF

The interviewed user Frederik suggested to use some sort of "chip" or phone to tap the tour labels with in order to individually select the flight cases instead of automatically selecting them (Ill. 4.5.1). Both to get a physical action when picking a flight case, but also to ensure that the flight case in the bottom of a stack is not the one automatically picked.

4.5.2 SCANNER PLACEMENT

Both interviewees commented the mobile scanner and suggested that the scanner element should be placed in each truck or at each warehouse gate. Thereby each equipment would be registered according to a defined location, which will make it easier to track if needed.

4.5.3 CHECKING ERRORS AT WAREHOUSE

Niels Peter mentioned that it would be nice to have a notification outside the flight case saying if the equipment contains error (Ill. 4.5.2). Then the warehouse workers do not need to open all flight case, and check for possible error tape when arriving at the warehouse after a job.

4.5.4 AUTO ID

Frederik saw the possibility of saving time if the e-tourlabel automatically registers which specific equipment, hence ID, is placed in it, and automatically update the information on the screen. Hence time is not spend searching for the corresponding flight case of a specific lamp and matching the lamps and the flight cases by the ID on both, but just by matching them with flight cases fitted to the same kind of lamp

4.5.5 EQUIPMENT FORM MORE LECS

A dilemma was raised by the two interviewees: what to do when equipment is rented from external LECs, but are on the same job which is a common scenario. How should these be linked to the command console, and what if they arrived without a e-tourlabel mounted on them? This matter was discussed further with Niels Peter who proposed that the picking lists from other companies should be imported to the system. This was a relevant dilemma that the design team needs to keep in mind.

4.5.6 A SMALL 13' INCH

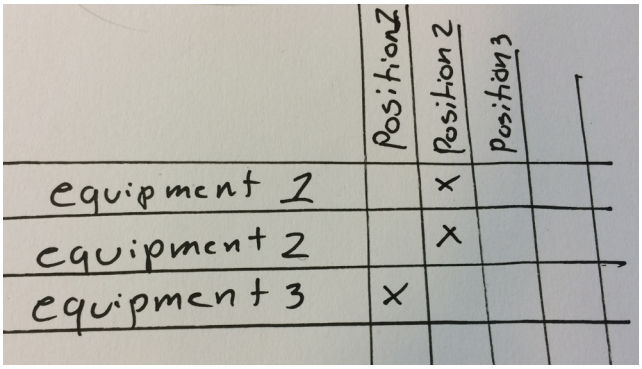
Regarding the size, a small 13'' inch laptop was mentioned by Niels Peter to be a perfect size for something like planning and managing inventory, having a good size for transportation and big enough to get an overview and program the colours.

4.5.7 THE REMOTE

The team proposed the command console with a small physical control panel to turn on the lights of the flight. Niels Peter could not pictures him self using the console in the repacking scenario, as he would always be activated and helping out. He would prefer a small remote that he could carry around with him during the process to create more flexibility.

4.5.8 MATRIX FOR PROGRAMMING

When showing Niels Peter a sketch of the intended interface used to assign colours on the flight case, he suggested to use a matrix instead (Ill 4.5.3). Matrixes is already commonly used when programming lights, and Niels Peter find matrixes easy and fast to use.



Ill. 4.5.2: Niels Peter's sketch of a wanted matrix

4.5.9 LIFESPAN OF THE E-TOURLABELS

In both sessions the users asked about the lifespan of the display on the e-tourlabel, and how often the battery should be replaced. Based on the ESL label and their e-paper display with a battery life time on minimum 2 years, which both users found convincing.

NEW DEMANDS

- There must be a physical interaction point to select a flight case
- The e-tourlabel must update information about contained equipment, instead of having a dedicated flight case for each individual equipment
- Equipment must be registered according to its location
- Picking lists from other companies should be importable to the system.
- The e-tourlabel must give feedback when a group of flight cases are packed correctly and ready for loading.
- Flight cases containing equipment with errors should notify the error on the e-tourlabel and/or in the system.
- A device size of 13 inc and a connected portable remote is desired.

4.6 SCENARIO DEVELOPMENT

To create a coherent concept the team created different scenarios (Caroll J., 1999) and a storyboard (Van der Lelie C., 2006) of how the user would interact with and use the concept (Worksheet 17.)

4.6.1 POST-IT SESSION

Different scenarios of the process, as for exampel: *Event technician packing for an event at warehouse,* was defined. From each scenario a storyboard were developed by creating drawings and notes on post-it representing the steps and actions. These were mounted chronological on a large piece of cardboard and multiple options for each action was proposed and mounted below each task of the total scenario. (Ill. 4.6.2).

Using the storyboard and its drawings the team had the ability and common knowledge to evaluate them. Based on a discussion it was defined which of the possible options should be included, and which should be excluded.

In order to use the storyboard in further feedback and probing sessions, it was digitized into different scenarios of all processes involved when executing an event. The scenarios is shown in the next section.

Ill. 4.6.1: Story board session

Ill. 4.6.2: A cut out of the storyboard. The sequences are represented horizontal an the different options vertically

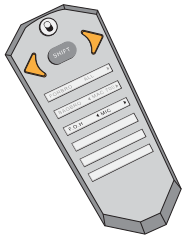
4.6.2 CONCEPT OVERVIEW

A preliminary overview of the concept was created based on the feedback from the users.
The concept consisted of three dedicated products, as well as an assumption about that all the equipments have a RFID chip mounted (Ill. 4.6.3).

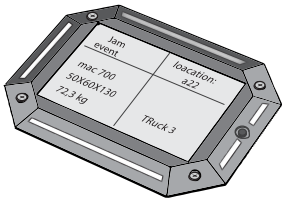
Rfid chips
Mounted on all equipment.

Control console
A 13'' laptop with integrated RFID scanner, which acts like the main control unit.

Remote
A small handy remote the event technician can use to turn on and off the lights of the e-tourlabels, that helps him better instructing the stage hands.



E-tourlabel
Communication devices mounted on top of all flight cases lighting in various colours, and showing various needed information.



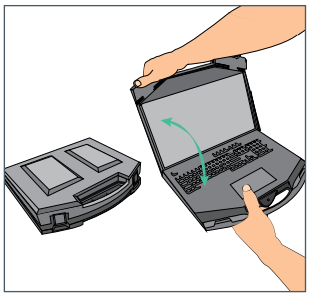
Ill. 4.6.3: The three dedicated products

4.7 SCENARIOS VOL. 1

This sector describes the concept scenarios through the total execution of an event. The different steps along the process is described individually to get an overall of the different situations involved.

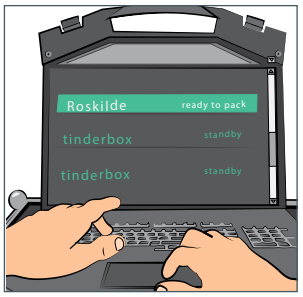
4.7.1 PACKING THE EQUIPMENT AT THE WAREHOUSE

The event Roskilde festival is executed in the weekend and starts with the packing procedure at the warehouse. The event technician Lars is responsible for the packing and assisted by the Grei console, which helps him keeps track of the packed equipment.

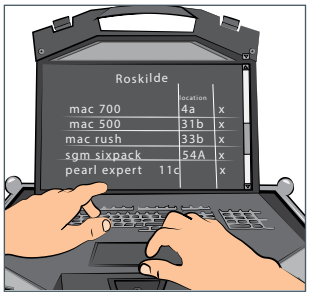


Lars flips up the Grei console

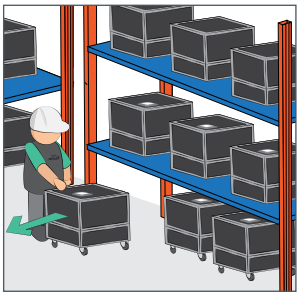
He logs-in with his personal id



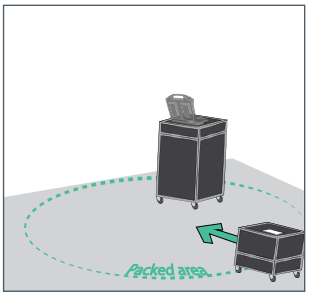
Choose the wanted job from the event list



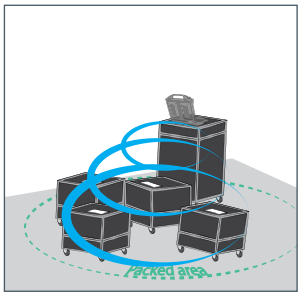
Lars opens the picking list and gets an overview of the equipment



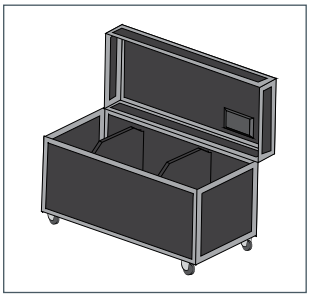
He locate the specific flight cases in the warehouse



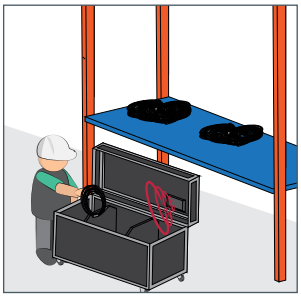
He brings all the needed flight cases to the packing area



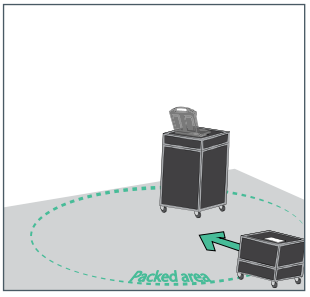
He register that the flight cases are packed with the Grei console



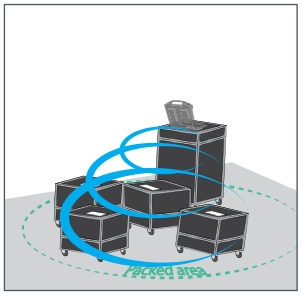
Lars now find a house box



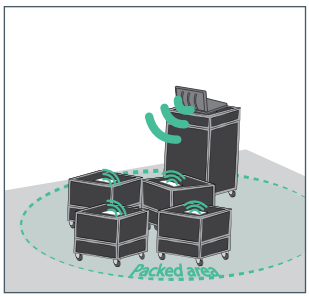
He locates the specific cables from the picking list and put them in the house box



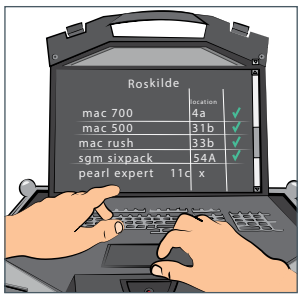
He brings all the needed house boxes to the packing area



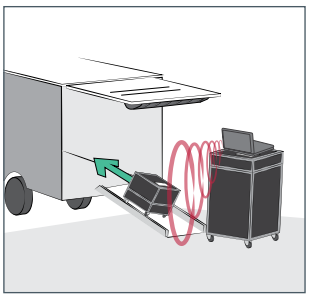
He register that the house boxes are packed with the Grei console



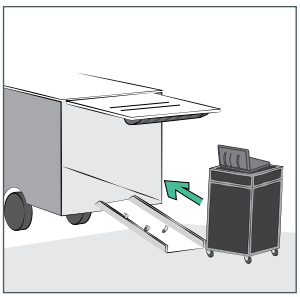
All is packed and the tour labels on the boxes are updated with event name, date, content etc.



Lars controls at the Grei console that all equipment have been packed properly



The Grei console scan all that goes into the truck to double check that the content is right



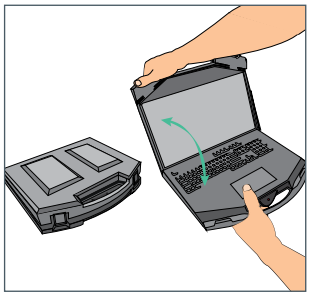
Lars place the scanner base in the truck, and bring the Grei controle to the passenger seat

4.7.2 PROGRAM VENUE POSITIONS

The truck is packed and drives to the venue. If Lars have not programmed the venue positions in advance, *scenario B*, he does it during the transportation to the venue from his Grei console by adding colors to the e-tourlabels, *scenario A*. Each colour defines the position of where the flight case should be placed on the venue, and works as a communication tool between the staff.

SCENARIO A: PROGRAMMING WHILE DRIVING TO VENUE

Driving to venue

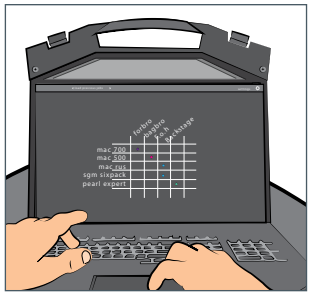


Lars opens the Grei console

He logs-in with his personal id

Lars selects the unpacking mode

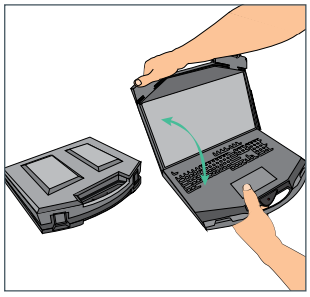
He drags and drops the equipment to the wanted locations on the venue map



He checks the programmed colours on all flight cases in a matrix overview

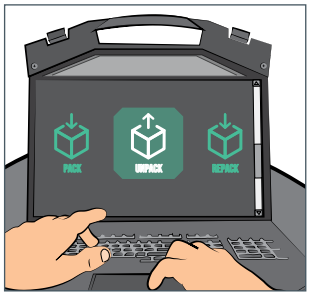
Lars has finished the stage set-up when arriving at the venue

SCENARIO B: PROGRAMMING BEFORE GOING TO VENUE



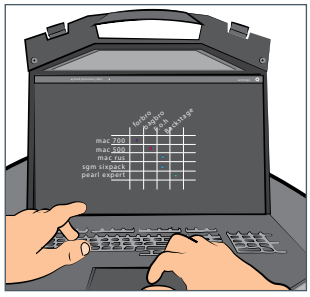
Lars opens the Grei console

He logs-in with his personal id

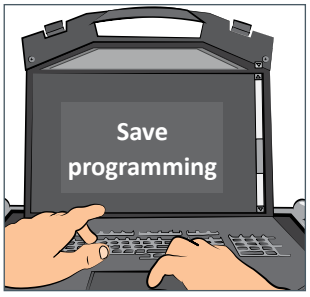


Lars selects the unpacking mode

He drags and drops the equipment to the wanted locations on the venue map



He checks the programmed colours on all flight cases in a matrix overview



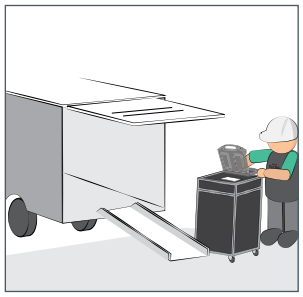
Lars saves the programming and close the Grei console

4.7.3 UNLOAD THE TRUCK AND SET UP STAGE

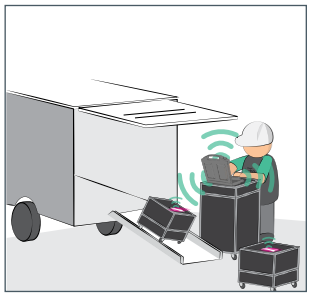
They arrive at the festival venue, and set up stage for the show later in the night. Lars prepares the scanner base and the Grei console and updates all tour labels as the leave the truck. The tour labels light with the defined colours, and stage hands know where to place them.

From the Grei console Lars sends the patch list, which tells in which order the lamps are placed, to the stage hands.

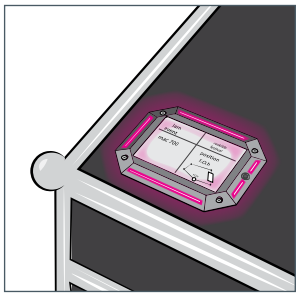
Arriving at venue



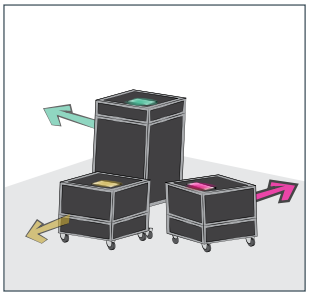
Lars sets up the scanner base with the Grei console



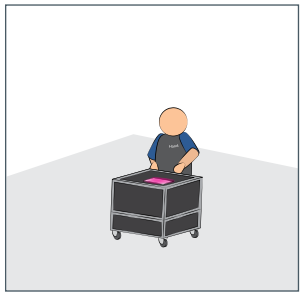
The e-tour labels are updated with the colours programmed in on the Grei console



The e-tour label lights with a colour representing the area where it needs to be placed



The colours on the flight cases shows the stage hands where to place them at the venue



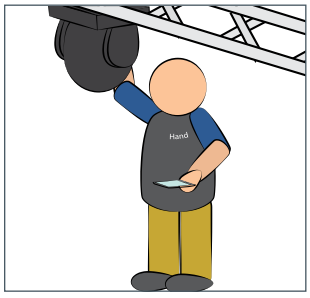
The stage hands bring the flight case to its right position

The event technician creates a patch list on the Grei Console

Event technician sends the patch list by sms to the stage hands

The stage hands receive the patch list, and know where to mount the equipment

The stage hand take the equipments from the flight case

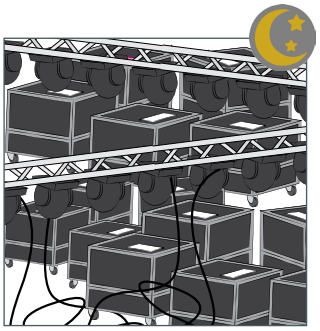


He place it at the truss and set the address from the patch list

Lars approves the task and all tasks are done

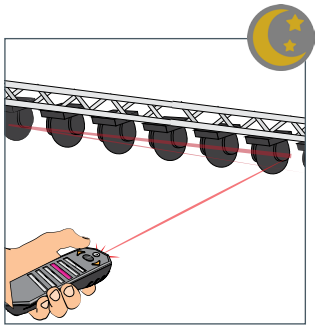
4.7.4 DISMOUNT AND REPACK EQUIPMENT INTO FLIGHT CASES AND TRUCK

After executing the show Lars's is satisfied, but tired. It is late and a group of stage hands are ready to assist him with the dismounting and repacking. Because of the Grei console he have an overview of the process and feels comfortable in commanding them though the different tasks.

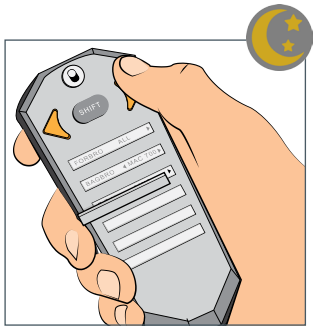


The show is over and all equipment needs to be packed in the same flight cases as it arrived.

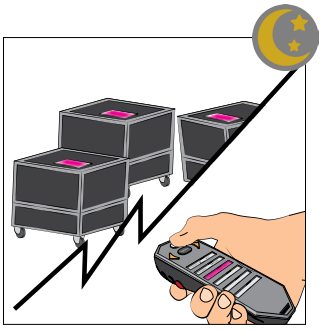
Lars delegates the tasks between his available stage hands.



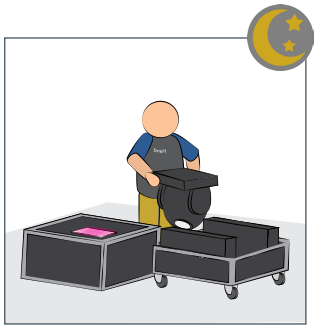
He point out (with a laser in the remote) which equipment to dismount



From the remote Lars locates the group of flight cases needed for the pointed out equipment

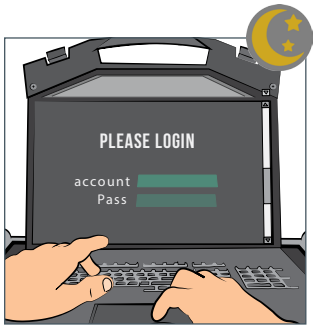


The group of flight cases are selected and their e-tourlabels starts lightning

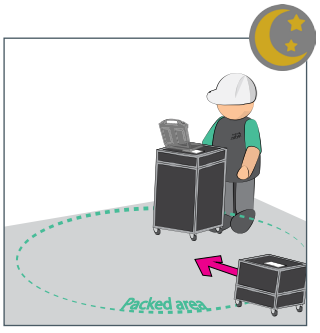


The stage hand packs the flight cases

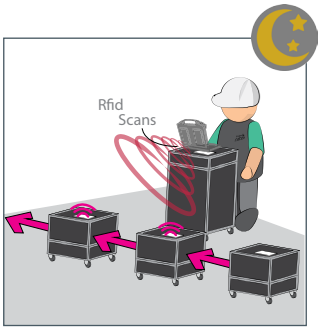
Lars set up the scanning base with the Grei console



He logs-in with his personal id

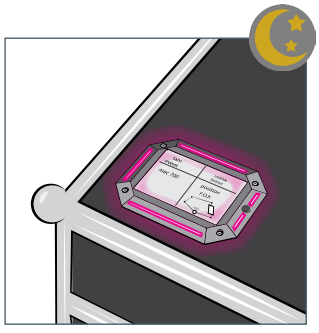


Then a flight is packed it is placed around the scanner base



The scanner in the Grei console checks if the flight case contains the right equipment

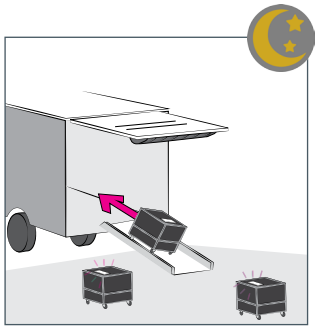
If wrong content in a flight case, it is shown on the Grei console



The e-tourlabel blinks to shows what its content is wrong

The flight case is repacked by stage hand to contain the right content

When every thing is packed correctly the Grei console tells that is it ready to be packed in the truck



The flight cases goes into the trucks all with the same content as when arriving at the venue

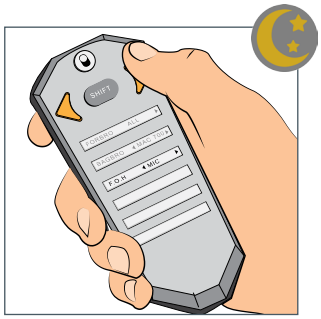
They drive home to the warehouse late in the night. Lars is happy about the streamlined packing process

4.7.5 SUB SCENARIOS FROM THE DISMOUNT AND REPACK PROCEDURE

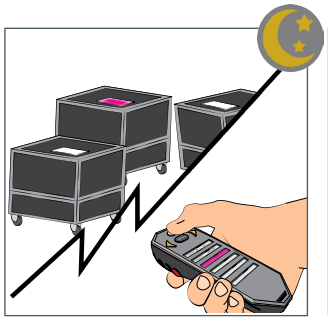
During the dismounting and repacking procedure three sub scenarios are described. They are procedure that the design team have located as needed in the field to give the event technician Lars a better overview of the procedure, and help him feel more professional.

SUB SCENARIO: STAGE HAND CANNOT FIND THE RIGHT FLIGHT CASE FOR AN EQUIPMENT

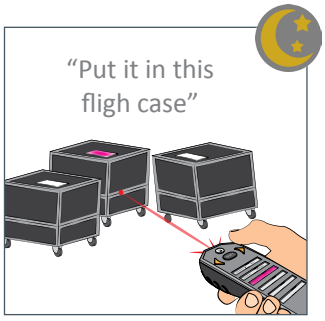
Stage hand ask Lars where to put a specific equipment



Lars locate the equipment at his remote



He select the equipments and its matching flight case starts blinking with light



Alternatively Lars point at the flight case if he already knows which it is

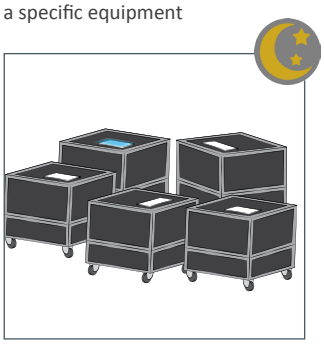
SUB SCENARIO: STAGE HAND CANNOT FIND A SPECIFIC EQUIPMENT

Stage hand ask Lars for help to find a specific equipment

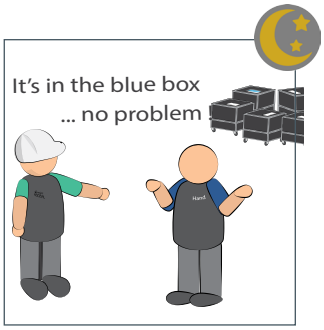
Lars go to the Grei console

He looks up the specific equipment

He gets the location of the flight case in which the equipment is placed

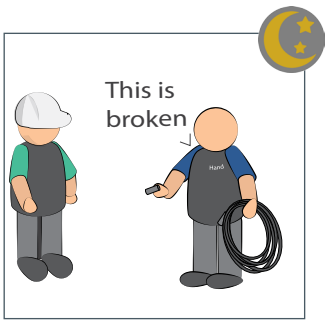


The flight case starts blinking



Lars tell the stage hand to search in the blinking flight case

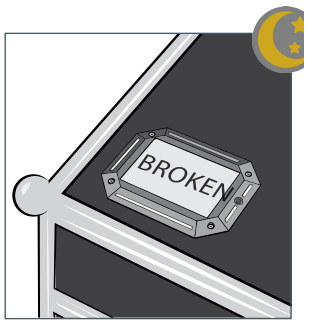
SUB-SENARIO: NOTE OF BROKEN OR DIRTY EQUIPMENTS



Stage hand bring a broken equipment

Lars gos to the Grei console

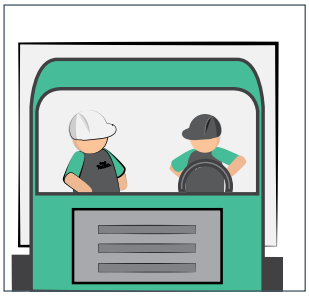
He looks up the equipment, and add the error in the system along with a briefly comment



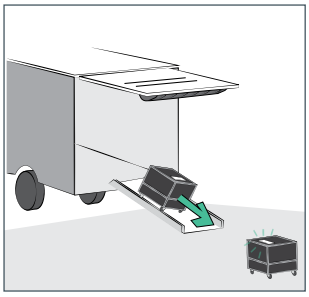
The e-tour label on the flight case is then marked with "broken"

4.7.6 UNPACK TRUCK AT WAREHOUSE AND FIXING EQUIPMENT

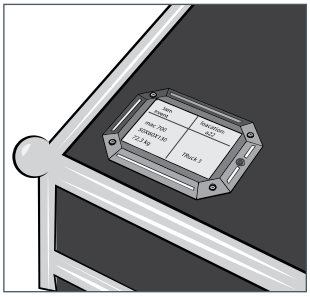
When the event the equipment is brought to the warehouse. Thanks to the Grei system the unpacking procedure happens smooth and with out and need of double checking the content of the flight cases.



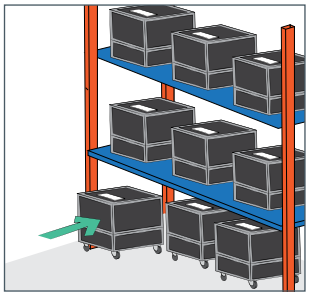
The trucks arrives at the warehouse



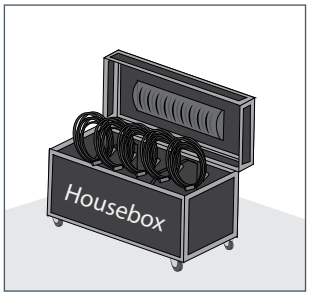
The truck are emptied from flight cases are



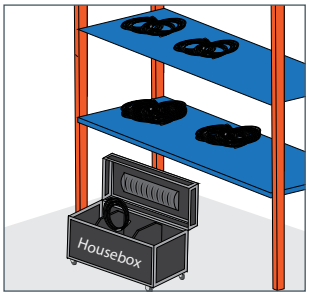
The e-tourlabel shows where in the warehouse the flight case are placed



The flight case are restored in the warehouse



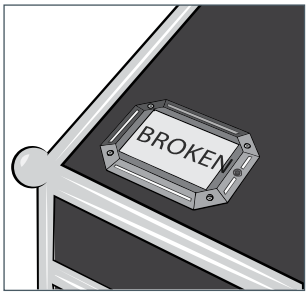
The house box with cables are selected and brought to the cable shelves



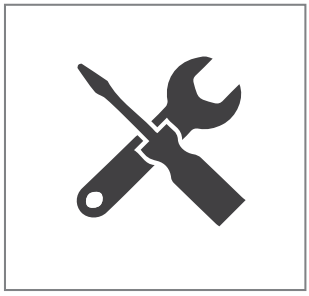
The house box is emptied and the cables are placed on the right shelf

4.7.7 UNPACK BROKEN OR DIRTY EQUIPMENT AT WAREHOUSE

During restoring at the warehouse it is easy to identify which flight cases needs service. Thanks to the Grei system the error is explained on the e-tourlabel and is easy and clear to read. The timed saved on double checking the content of the flight cases are spend on fixing the errors.

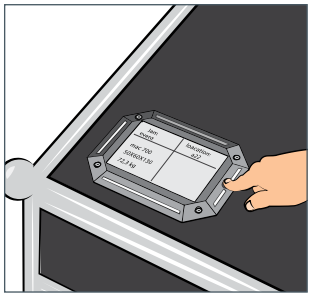


The flight cases saying “broken” or “dirty” are brought to the service area

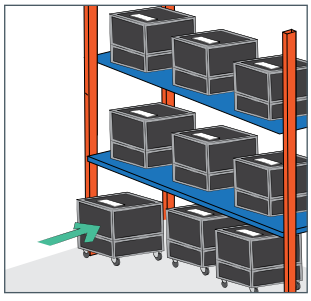


The equipment is fixed in the workshop

The Grei console communicates to EasyJob that the equipment is ready to use



The warehouse technician reload the standard screen on the e-tourlabel by pressing the button in 5 sec.



The fixed flight case are stores in the warehouse and ready for the next event

4.8 TECHNOLOGY EVALUATION

To get a validation of the technological composition and feedback of the concept from a technical perspective Lars Jankowski from Lyngsoe Systems (Worksheet 19), was interviewed and introduced to the concept and the technological challenges.

4.8.1 SCANNER

Lars meant that it was possible to integrate a scanner in both a truck, a flight case and on the back side of a laptop. He advised that instead of pointing outwards to open space it would be more effective and less power consuming if the scanner was internal, and the inner flight case was lined with metal foil in order to reflect the radio signals from the antenna, reading more tags, and to make sure the adjecent flight cases was not registered.

4.8.2 E-TOURLABEL CONNECTION

The e-tourlabel could according to Lars easily be accessed through RFID, IR, Bluetooth or even 3G, through an app, which would work optimally. The 3G just consumes more power than the bluetooth.

4.8.3 PATCH LIST

Lars meant that the patch list from the software could easily be sent to stage hands by SMS, but he advised that it could also be done through an app, which he meant would work better.

4.8.4 WHO IS IN CONTROL?

Lars found it smart the it would be the light technician that controlled the lights, but he advised to use an app which would allow for stage hands to be more included and do more. They could e.g. scan the RFID tags on wires or barcodes in order to see the location or to change a state.

4.8.5 SAFETY AND REDUNDANCY

A system is only as good as its ability to deal with erros, Lars meant that having barcodes present even though tags were used could be a way to cope with the management in case the system goes down. The barcodes can even be scanned with the phone. (Like the e-paper)

4.8.5 EFFICIENT POWER MANAGEMENT

Lars advised that you could make a control system that made the scanner start only when the flight case lid was opened or closed with e.g. a timer, in order to make sure that it does not have a constant drain.

CONCLUSION

- The technological composition of both the scanning command console, the internal scanner in the flight cases and the connection through either a remote or phone was validated through an expert.
- The e-tourlabel can be accessed through RFID, ID, Bluetooth and 3G, even though 3G consumes more power.
- The patch list can be shared by SMS even though it would work better through an app.
- An app opens the possibility of allowing more stage hands be included and do more, using the phone as a handheld scanner.
- Even though the identifier shifts from barcodes to RFID tags, the barcodes should still be visible in case the system goes down, being a kind of backup.
- The system could be designed so that the scanner in the flight case would only start when either opened or closed, and even with a timer, in order to optimize consumption.

4.9 AESTHETIC INSPIRATION

To integrate a design identity in the concept development, the team created two different aesthetic inspirational boards, which helped create consensus in the team during the ideation.

One board is based on products already found in the industry context and is used as an idiom and guideline (Ill. 4.8.1). The other board was based on products which the team found to have a desired expression from the persona's point of view (Ill. 4.8.2)

4.9.1 THE BOARDS AND WORDS

To investigate the existing visual expression of products used in the live event segment we created a context board with products used during an event, and analysed their characteristic. A full sized board with notes from the analysis can be found in (Worksheet 36).

Inspiration boards with products we found interesting based on the user research and personal opinions was developed and analysed to gain knowledge about the aesthetics of the context. The analysis also gained an aesthetic guideline within the group used when developing the concept.

Niels Peter, stated that he desired a solution being robust, reliable and easy to use (Worksheet 16). These words were used when locating existing products for the context board to realise what the words means in a physical manner. For example "easy to use" is in his context not few intuitive buttons, but more a lot of buttons with individual functions and possibilities to customize them him selves. With "reliable" in means that the product should function the best each time, and therefore it needs proper protection, and a protective look as the flight case with its aluminium rails.

All three boards was analysed by pointing out common characteristic on the pictures and followed by a dynamic summary discussed in the group.

The main finding are described in the list on the following page.

Ill. 4.9.1: Inspiration board of the context

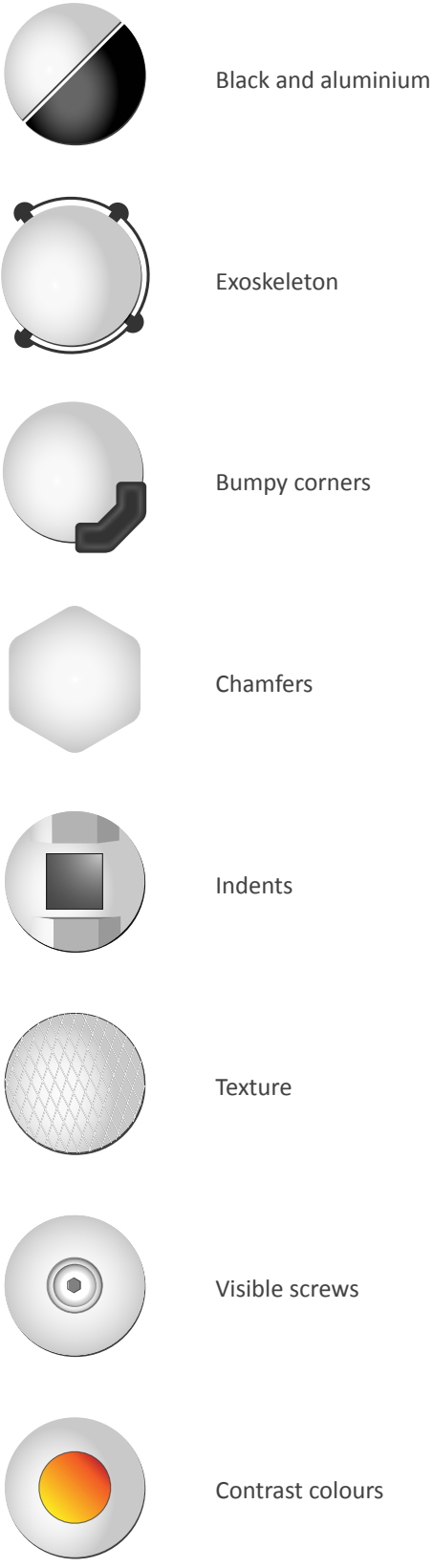
Ill. 4.9.2: Inspiration board of the desired expression

4.9.2 VISUAL IDIOM

The team decided to make a design that would fit into the context's products expression, because it needs to be installed on an existing flight case, and because it is clear that the user desires the expression of the context he is working in.
To obtain a robust and reliable concept, protection is used as the most important factor to make sure the concept can handle the rough environment. The features on illustration 4.8.3 are the once we wishes to include in the visual design expression of the concept.

4.9.3 AESTHETIC PRINCIPLES LOCATED FROM THE INSPIRATION BOARDS:

- Black material with aluminium protection details
  Black is the main colour used because the products should not be visible during a show.
- Indents in the geometry, often to protect interaction points. When they are placed in an intent they are protected by the surrounding geometry and do not brake if the product e.g. is dropped or if several products clashes against each other.
- Exoskeleton, an outer shell or frame
- Textured surfaces commonly on scroll wheels to identify an interaction point
- Bumpy corners as extra protection.
- Visible mounting screws as a part of the visual expression
- Chamfered edges is used in the outer geometry
- Geometrically shaped and rounded edges
- Contrast colours, especially yellow, orange and red often used on details and logos



Ill. 4.9.3: The desired design expression

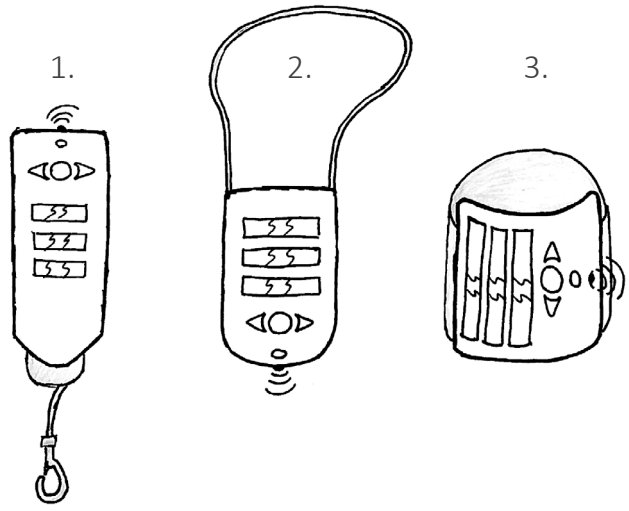
4.10 DESIGNING THE REMOTE

With the aesthetic considerations in place, the interactive device could be designed (Worksheet 20). It was done using quantitative sketching was for investigating the device type and functions, foam models was used to define the size and ergonomics, 3D-rendering was used to define the shape, material and finish, and lastly a 3D-print was used as an exact physical model to be used for validating size and ergonomics.

4.10.1 DEVICE TYPE (WEARABLE, REMOTE OR LANYARD)

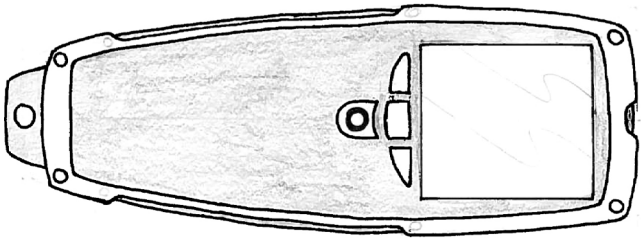
The term 'remote' was broadened into 3 types of devices:

1. A standard Remote
2. A lanyard device
3. A wearable device

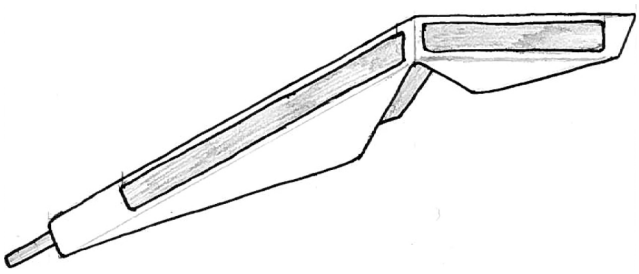


Ill. 4.10.1: The 3 device types

The standard remote was quickly chosen as the interactive device remote, due to the Lanyard being seen as annoying when dangling in packing processes and due to the wearable preventing the user of using both hands to e.g. plan the light show.
Having the device type defined, the sketching came to deal more with the aesthetics and the functions. The sketching ended with a kink remote, which had a gun-like feeling to it, due to the wish of having an integrated laser pointer. Also, the bumpy corners and exo skelton worked as the foundation for the shape, having a aluminum base with a ''coated'' skeleton of a soft and bumpy material. The shape was inspired by origrami and tech-like shapes.



Ill. 4.10.2: Sketch on the remote

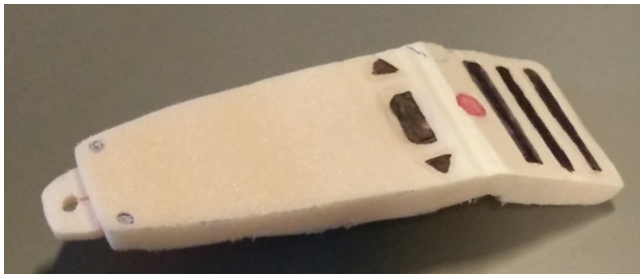


Ill. 4.10.3: Sketch on the remote

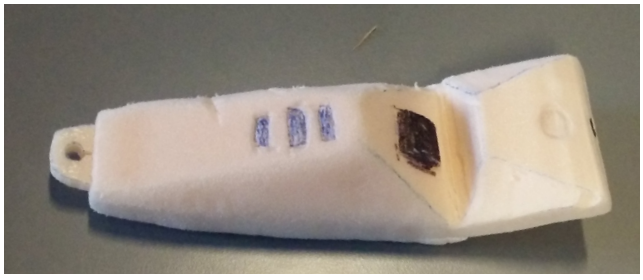
The remote would have 5 buttons: 4 on the front side for navigating through a menu containing *Locations, Flightcases and Equipment,* and 1 one the back side for the integrated laser pointer. The remote would have an extended aluminum frame in the bottom, with a 5 mm hole for clicking on a hook which could be connected to a strap on a pair of pants.

4.10.2 FOAM MODELS - SIZE AND ERGONOMICS

The foam model helped to define a size of the remote of around 15x5 cm. Also the ergonomics were investigated, ending up with a origami-like construction on the back side, where the fingers are placed. The foam model also helped to define the interaction - 3 buttons was needed to navigate a menu, and one button would be needed for chosing in the menu. The last button was placed on the backside as the activating button for the laser. 3 oblong screens would world as 3 different displays, for the Locations, Flight cases and Equipment respectively.



Ill. 4.10.3: Foam model of the remote

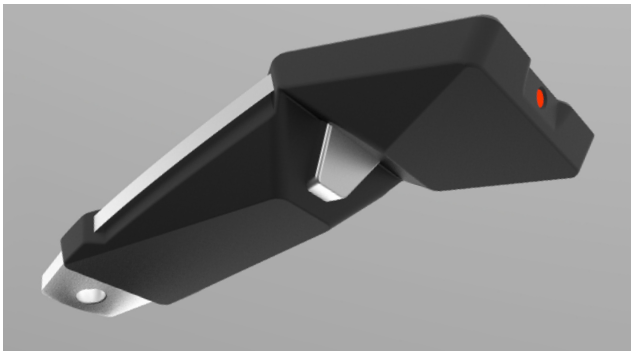


Ill. 4.10.4: Foam model of the remote

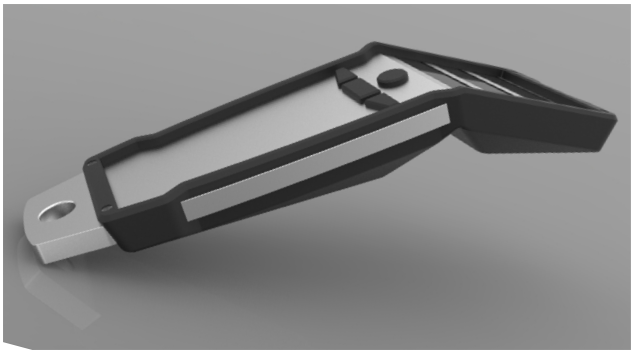
The physical models confirmed that having a gun like shape heightened the ergonomics compared to having a flat design. The edges on the foam model was initially very rounded, but if was decided that in order to get more grip, and to get a more cohesive style, the edges could be more sharp.

4.10.3 3D RENDERING OF MATERIAL AND SHAPE

3D-modelling helped define the color as to being a mix of brushed aluminum and and matte black plastic. The bottom part of the remote was shaped so that it had a chamfered orgiami look with bumby corners. The aluminum worked as an exoskeleton, and the screen was indent compared to the bumpy frame. The moutning screws were visible and the sharp lines on the back worked well with the chamfered edges on the front side.



Ill. 4.10.5: Rendering of the remote



Ill. 4.10.6: Rendering of the remote

Ill. 4.10.7: Rendering of the remote

4.10.4 3D PRINT

The 3D model was the foundation for the 3D print which was made in order to grasp the physical and ergonomic aspects of the remote, and to have a physical artifact for the concept evaluation. The 3D-print fitted surprisingly well in the hand, and the ergonomics relating to the angle of the kink, worked well for using it as a laser pointer.

Ill. 4.10.8: 3D-print of the remote

Ill. 4.10.9: 3D-print of the remote

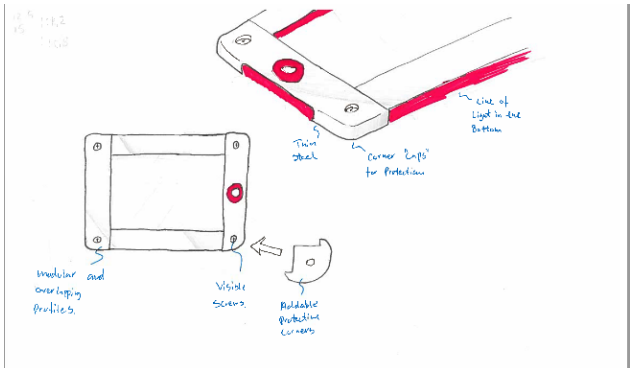
4.11 DESIGNING THE E-TOURLABEL

The aesthetic considerations was also used to design the e-tourlabel. The protective capabilities of the e-tourlabel was in focus when designing the e-tourlabel, and quantitative sketching along with a sum-up resulted in 3 various concepts with various product architectures.

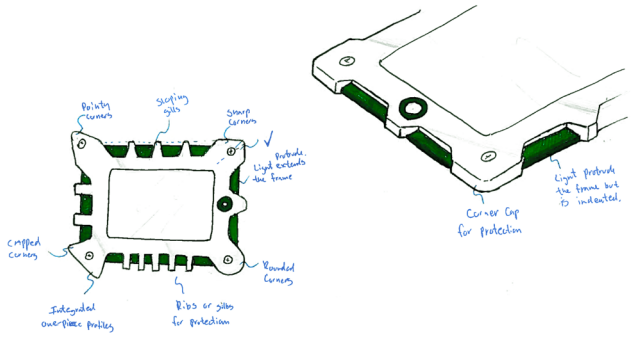
4.11.1 PRODUCT ARCHITECTURE

The ideation ended with 3 different product architectures within a geometric design:

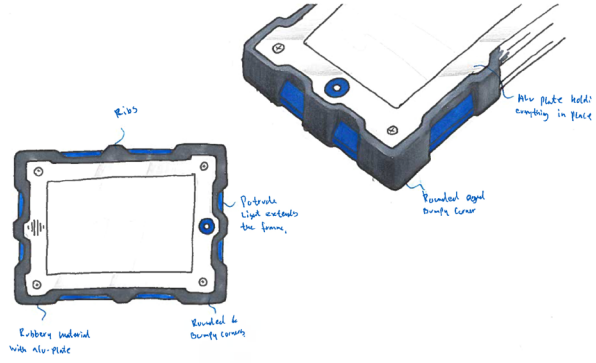
1. Modular profiles, ill. 4.11.1
2. Single and simple frame, ill. 4.11.2
3. Dual material and double protection, ill. 4.11.3



Ill. 4.11.1: Product architecture 1



Ill. 4.11.2: Product architecture 2



Ill. 4.11.3: Product architecture 3

The modular profile product architecture allowed for the frame to be easily replaced, with profiles which could be in store, in order to quickly and easy repair the frame if it would break. Different corner bumpers could be acquired resonating well with the concept of flight cases, where corner bumpers are also modular and additional. A downside to the concept was that the relatively lose profiles would bring negative associations in terms of stability and protectiveness, where a single and integrated frame, like a shield, is more positively associated. Also it seemed like it would result in a lot of manual and repetititve tasks when mounting or repairing.

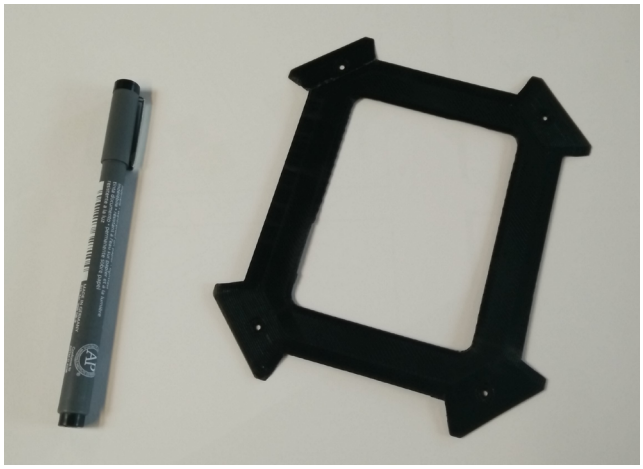
The dual material and double protection product architecture was based on the design of the remote inspired by the aluminum core covered by a soft and bumpy frame where an aluminum plate was indently placed. This product architecture also allowed for the Matte Black vs. aluminum aeshtetic principle to be a part of the design, but naturally this would result in a higher unit price. The flight cases are very roughly handled which is why the soft rubbery material was seen as too unstable in e.g. a sitation where a flight case was slid over the top of another flight case. In this case, the aluminum profile could easily destroy or deform the relatively soft material when coming in contact with this, where if the edge was a aluminum profile like in product architecture 2, it would just slide over.

The single and simple frame product architecture was chosen mainly due to its simplicity and roughness. The product architecture was based on one frame which could be designed with various ridges and corner shapes.

Naturally a low unit price is wanted, and manual and repetitive tasks are avoided, hence the 1. and 3. product architecture was opted out.

4.10.2 3D PRINT

The simple version of the frame was modelled in 3D in order to start considering construction principles. In order to grasp the size and proportions of the frame, a 3D-print was made to as a step to the further development and as a physical artifact for the concept evaluation.



Ill. 4.11.4: 3D-print of the e-tourlabel

4.12 CONCEPT EVALUATION

In order to confirm our demands and desirability of our concept, the scenarios was tested out by a presentation and feedback session with one of the possible user Mikkel Rodkjær from Profox ApS. The session is described in worksheet 23.

4.12.1 POTENTIAL IN E-TOURLABELS

When presenting the concept the e-tourlabel was praised, with features that really could be beneficial for the company. Mikkel mentioned that RFID tags are integrated in many new intelligent lamps for other purposes and if the e-tourlabel could collaborate with these it would have huge eligibility.

Mikkel was especially fascinated by the *light guiding function* of the e-tourlabel, the function of the e-tourlabels being able to automatically update its content and the interactive picking list. He commented that a collaboration with a lamp company like SGM or Martin could accelerate the e-tourlabel to become an industry standard.

"I truly believe there is a market for this, if you can hit it in the right way." - Mikkel

4.12.2 THE REMOTE & COMMAND CONSOLE

The main attitude about the remote is described with the following quotes:

"I get the thought about it being able to communicate, but at venue I think it becomes to much wandering around controlling everything with a remote" - Mikkel

"*The scenario of walking between the Grei console and the warehouse shelves also seems a little unhandy*" - "*I would like to bring the packing list with me*" - Mikkel

Mikkel made the team realise that a rethinking of the remote was necessary to make it desirable and motivating for the event technician.

The same goes for the command console functioning as a control station when repacking at the venue, this would eventually be skipped, and then it would have no purpose being mobile anymore. The remote and console results in more operations.

"With the remote and command console, I think, you will create the same kind of barrier as Easyjobs does selling barcode printers and scanners". - Mikkel

4.12.3 POSSIBILITIES IN AN APP

Opposing buying a dedicated device for controlling, Mikkel argued for the possibilities of rethinking the concept into an App on a smartphone. A smartphone being a device already owned by all his employees, with existing and working technology. Several arguments were given on using the app instead of the dedicated device such as giving the opportunity to open up for the access to parts of the system to freelancers, possibly tracing all actions with locations services, and using the NFC/RFID scanners, and already implemented in new phones.

Ill. 4.12.1: Mikkel with the 3D-print of the e-tourlabel

4.12.4 E-TOURLABEL SIZE AND SHAPE

Mikkel pointed out, while grabbing the 3D print, that something in that size would be well suited in terms of display. The shape was also commented on as being well suited in contrast to the other sketched versions, by being flat and flush without any structures that could scratch other cases while being loaded and packed.

4.12.5 BUSINESS OPPORTUNITIES

When talking about the concept the different ways to profit from the products, and how these ways seemed more plausible with an App, was also discussed. Selling plan views of different venues or skins for special tours which can be seen on the app and the e-tourlabels, as well as licensing different levels of features in the App, could be further ways to profitize. Mikkel mentioned a new procedure in their system where they seal all flight cases with a small ziptie, a brand new procedure decided just 4 weeks before the interview. A feature, serving the same purpose, or other new features, would be easy to implement, develop and license in an app after launch, in contrast to implementing it on a dedicated device.

SUM-UP

The team should consider whether to go with the dedicated device system or rethink it into an app.

The e-tourlabels should be as flat, and flush, and not be able to scratch surfaces stacked on top.

The different mentioned business opportunities mentioned should be remembered when deciding on the final business model.

4.13 APP VS. DEDICATED DEVICE

The team had to make a strategic choice whether to go with device type 1 being a remote, or re-thinking the concept into being app based, hence based on a smartphone.

4.13.1 SWOT ANALYSIS

When concept evaluating with Mikkel in section 3.11 we learned that the smartphone has perhaps been underestimated in terms of functionality, and that it could be a better solution than the dedicated device, wich needs to be considered. A SWOT analysis was to used to assess the benefits and disadvantages of the two device types, in order to make a well considered decision.

CONCLUSION

The app was chosen as the controlling element due to:

- Being more flexible in terms of usage and potential new features.
- Phones being already accessible and culturally adapted.
- The remote seems like an expensive device like Eaysjob's barcode scanners and barcode printers.

APP:

- Smartphones are portable and already at hand, or in the pocket of our user. Most users in the industry has a smartphone and it already has 3G, NFC and bluetooth.
- More users can be using the App at the same time.
- It RF system fails the smartphone can use existing image-technolog to scan barcodes or QR codes.
- The smartphone has a large flexibility in terms of display types and functions.

Dedicated device:

- Can be designed ergonomically to the use.
- Has a dedicated battery
- The psychical objects can be designed aesthetically to the users preferences and provide a wow factor.
- Laser pointer, and other custom components, can be implemented in the concept.

S

APP:

- Negative associations with using a smartphone is being social and texting on the job.
- The battery can be drained by other Apps on the smartphone.
- The screen on a smartphone seems small in relation to the planning scenario, where a bigger screen is needed.
- A smartphone have a low level of tactility and ergonomics.

Dedicated device:

- Is rigid in relation to implementing new buttons or features on the remote (a One-trick-pony)
- We, as company is accountable for all connection, and stability problems.
- Initial investment, development and production cost is high.
- Is dependent on the command console and RF system.

W

APP:

- **New features can easily be implemented in the app.**
- **Location services, speakers, vibro motors etc. in a smartphones can be used in later versions.**
- **A physical cover with features can easily be implemented in later generations.**

Dedicated device:

- **2-3 product types or generations can be developed to better fit various users needs.**

O

APP:

- **New generations of smart devices occur and can be necessary to acquire because they might out date or incapacitate the software or hardware in terms of e.g. power connectors.**

Dedicated device:

- **If broke it can not easily be repaired.**
- **Can be easily forgotten or lost on the venue and can be hard to find.**

T

4.14 SCENARIOS VOL. 2

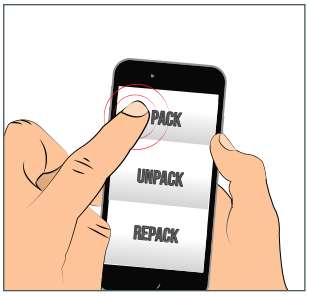
To rethink the concept into a smartphone app, the team revised the previously made scenarios, and transformed the function of the command console and the remote into features in an App. The scanning module was as well now integrated into each flight case and connected the e-tourlabel, which then was connected wirelessly to the app.

4.14.1 PACKING THE EQUIPMENT AT WAREHOUSE

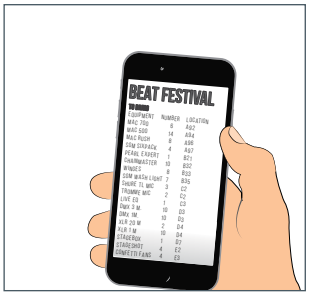
The event BEAT festival is executed in the weekend and starts with the packing procedure at the warehouse. The event technician Lars is responsible for the packing and assisted by the Grei app, which helps him keeps track of the packed equipment.

The event organizer asks Lars to start packing for the event, Beat festival.

Lars opens the Grei app on his phone where he is signed in with his personal id

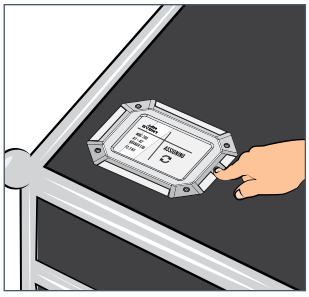


He chooses pack mode, and select the Beat festival and access it with one click

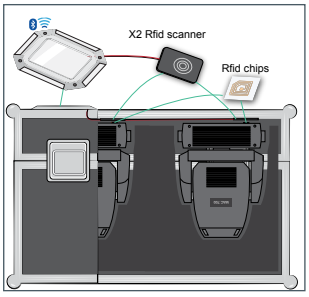


The GREI app now shows the picking list including the warehouse location and quantity

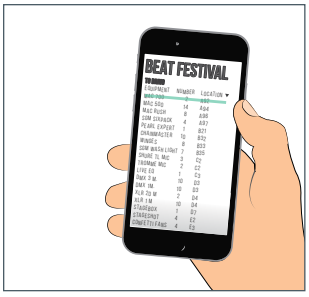
Lars finds the needed equipment



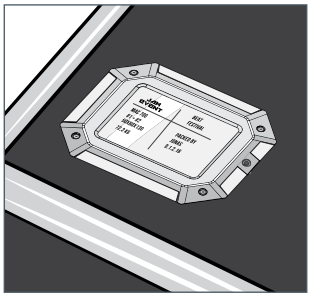
When picking a flight case, Lars pushes the button on the e-tourlabel to turn it on



The NFC scanners placed in the flight case scans the content, and establish a connection to the app

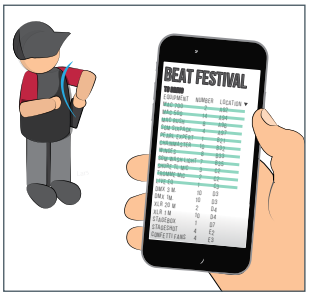


Now the app marks the activated flight case as “packed” on the picking list

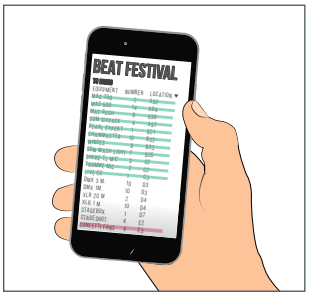


Furthermore the tour information, and person who packed it is transferred from the app to the e-tourlabel

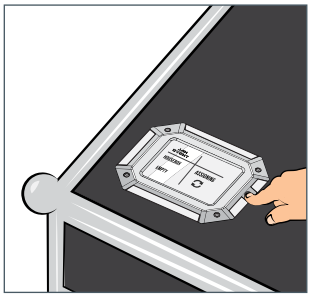
Lars is behind with the packing, and gets help from a warehouse assistance, Henrik.



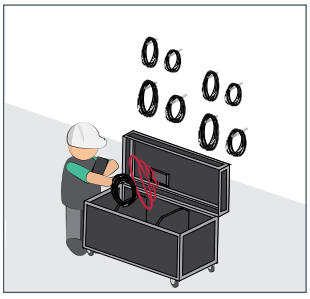
Henrik logs in on his phone and access the same event and picking list



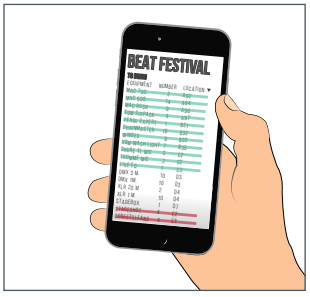
Henrik starts packing and his equipments are marked with another color, e.g. red, than Lars. Both can see each others actions



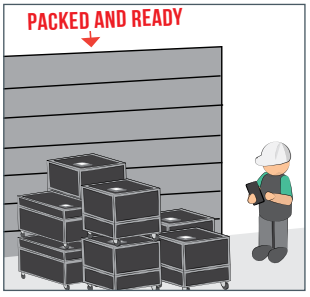
Henrik starts packing a house box and assign it by pressing the button



He packs the needed cables and a RFID scanner in the box register each of them

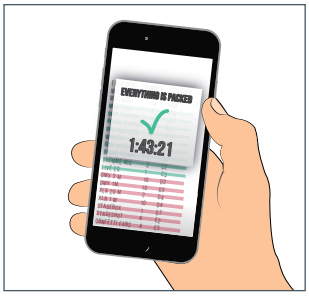


The app is automatically updated along the packing process, so all involved users can see what still needs to be packed

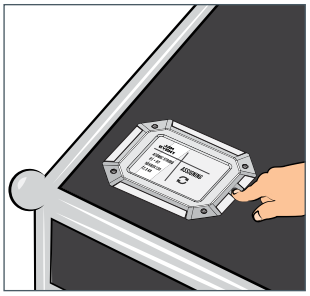


When a flight case is packed it is stored in the packing area near the truck gate

When everything is packed Lars aligns the picking list with the packed content by selecting the *finish-button* in the Grei app



Lars gets a confirmation showing if everything is properly packed, if extras is added or if equipment are not yet packed



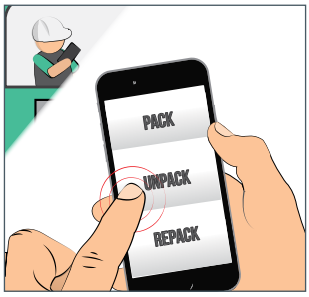
Lars wants to being a extra lamp to the event. He select it in the warehouse and push the button on the e-tourlabel

The equipment is shown on the Grei app that controls if it is available. It is, and Lars adds it to the picking list by a single touch

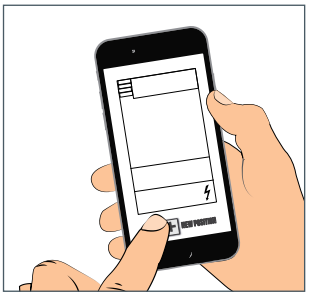
4.14.2 PROGRAM VENUE POSITIONS AND UNPACK AT VENUE

The truck is packed and drives to the venue. During the transport Lars programs the venue setup from the Grei app by adding colors to the e-tourlabels. Each colour defines where the flight case should be placed on the venue and works as a communication tool.

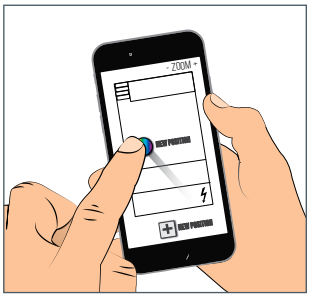
Lars and the truck driver Martin drives to the venue.



Lars opens the Grei app, access the BEAT festival and choose the *unpack function* in the menu

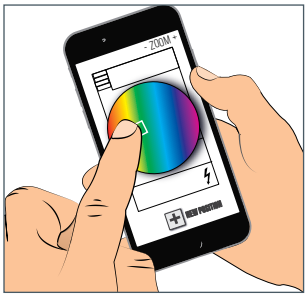


A map of the venue is accessed

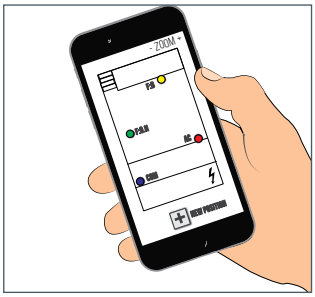


Lars adds a position on the venue map

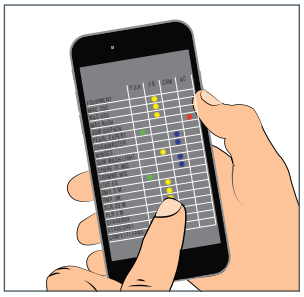
He gives it a name or abbreviation that describes the position



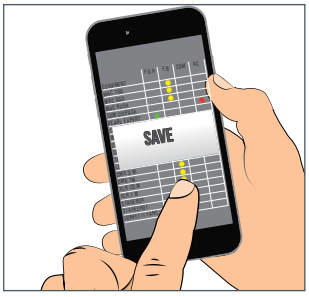
Lars specify a colour using the colour wheel



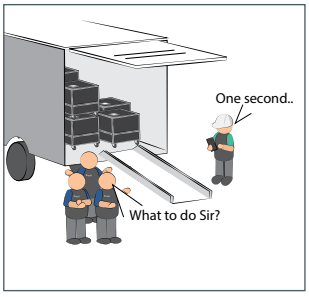
When all positions is configured, Lars add flight cases to each of them



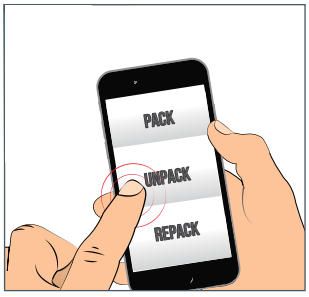
Using a matrix Lars assigns each flight case to a position



Lars save the programming and close the app

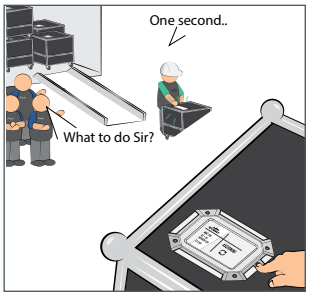


When arriving to the BEAT festival Lars needs to command the stage hands

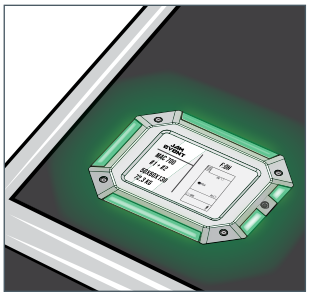


He opens the app and goes to the saved programming in the *unpack function*

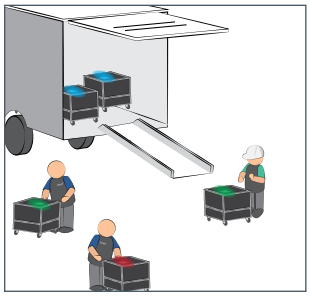
Lars streams the programming to the e-tourlabels



The e-tourlabel have been on hibernation mode. Lars pushes one of a flight case and activates all



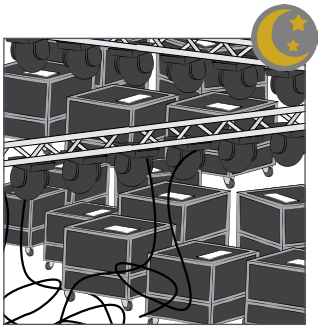
The e-tourlabel starts lighting with the programmed colour



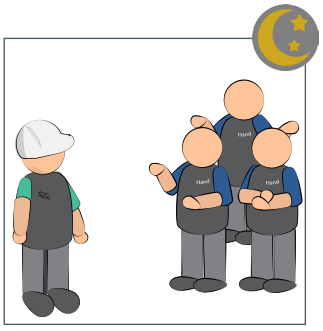
Stage hands bring the flight cases with the same colours to at same area of the venue

4.14.3 DISMOUNT AND REPACK EQUIPMENT INTO FLIGHT CASES AND TRUCK

After executing the show Lars is satisfied but tired. It is late at night and a group of stage hands are ready to assist him with the dismounting and repacking. Because of the Grei app he have an overview of the process and feels comfortable in commanding them though the different tasks.

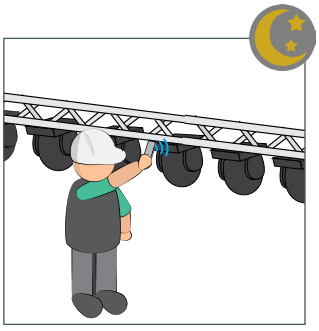


The show is over and everything is a mess. The equipment have to be repacked in the right flight cases as it arrived at the venue.



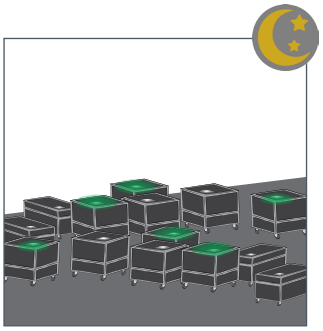
The stage hands eager to help in order to finish quickly and go home.

Lars opens the Grei app an choose the *repack function*.



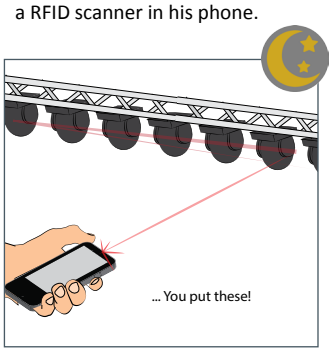
Lars begins by scanning lamps on a truss and identify their specific flight cases. To scanning is done by a RFID scanner in his phone.

When pointing at an equipment the information occurs on the app. Lars selects the colour key



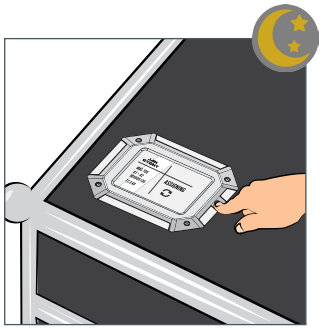
The flight cases used for the lamps start to light.

Lars command the stage hand to dismount the lamps and store them in the green lights cases

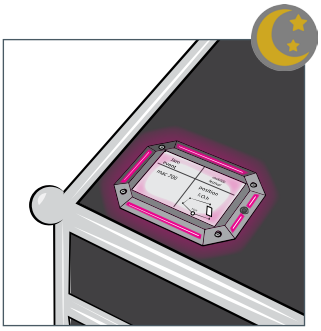


Lars can support the command by guiding it with a laser pointer function, which is added in the audio port.

Lars are comfortable about the stage hands understanding his command

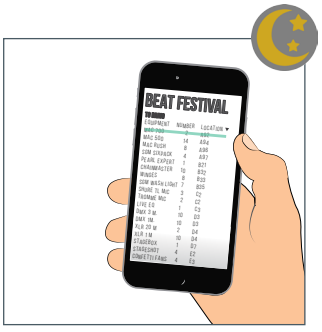


When a flight case is packed the button is pressed. By pressing the button the e-tourlabel check if the content is right.



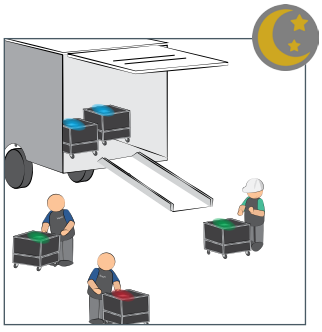
If the content of a flight case is wrong the e-tourlabel blinks, and the error is described on the app.

The flight case is repacked with the right content

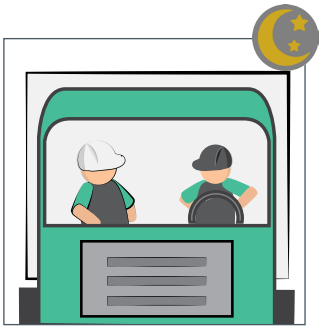


The picking list is automatically updated along the packing process, and communicates what needs to be packed.

When everything is packed Lars receive a confirmation on the app telling that the packing is done. He also receive the time spend on packing.



The truck are loaded with all equipment placed in the came flight cases as when arriving.



Lars and the truck driver Martin drives back to the warehouse, and are done for to night.

4.14.4 SUB SCENARIOS FROM THE DISMOUNT AND REPACK PROCEDURE

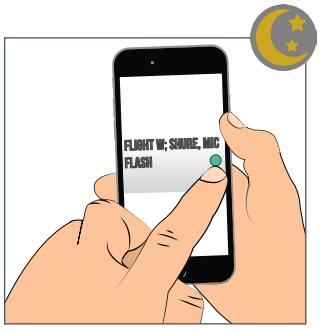
During the dismounting and repacking procedure four sub scenarios are described. They are procedure that the design team have located as needed in the field, to give the event technician Lars a better overview of the procedure and help him feel more professional.

SUB SCENARIO: STAGE HAND CANNOT FIND THE RIGHT FLIGHT CASE FOR AN EQUIPMENT

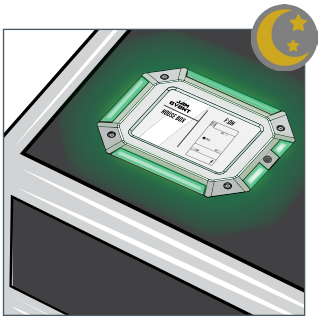
Stage hand ask Lars where to place a microphone.

Lars grabs his phone and opens the Grei app

He scans the microphone with the integrated NFC scanner by pointing the phone at the microphone.

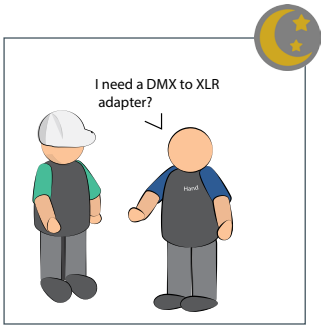


The app, shows the flight case belonging to the microphone and select the colour button.



The e-tourlabel of the needed flight case blinks with the chosen colour

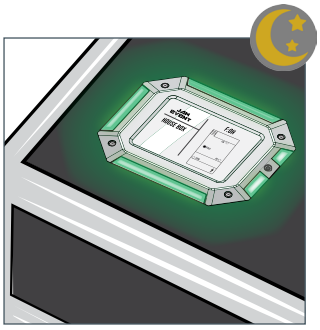
SUB SCENARIO: STAGE HAND CANNOT FIND A SPECIFIC EQUIPMENT



The stage hand are looking for an adapter and asks Lars about where to find it.

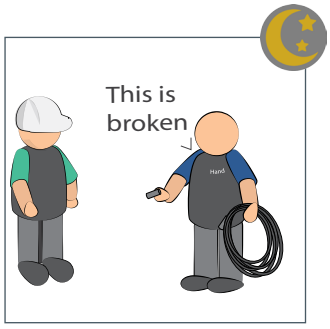
Lars grabs his phone and open the Grei app. He enters the search function and write the name of the adapter in the search field.

The missing adapter and its connected flight case is shown on the app. Lars activates the colour button.



The flight case of the adapter starts blinking and communicates to Lars and the stage hand that this is the flight case to search in.

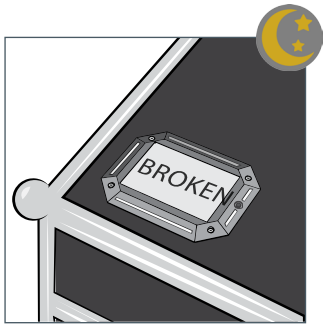
SUB SCENARIO: MARKING BROKEN AND DIRTY EQUIPMENT



A stage hand bring a broken equipment to Lars

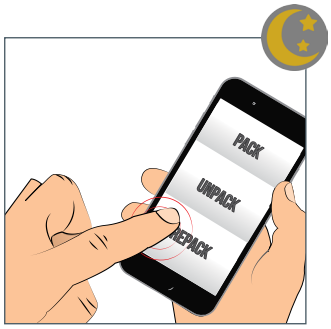
Lars report the error on the app by scanning the equipment with the NFC scanner integrated in his phone.

Lars adds a comment to the error describing what it is about. He save the error on the app.

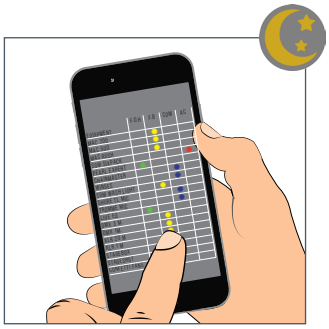


The e-tourlabel is updated with an error text communicating that content in flight case needs service when returning at the warehouse.

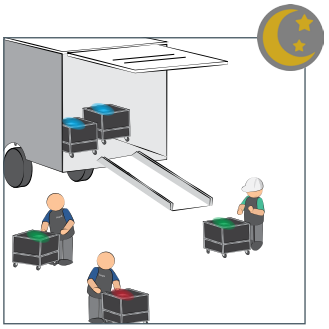
SUB SCENARIO: COMMUNICATING TRUCK NUMBERS



Inside the *repack function* in the app, Lars can configure colours on the e-tourlabel in relation to numbers of trucks.



Lars choose which flight cases will go into which truck, by selecting colours in a matrix.

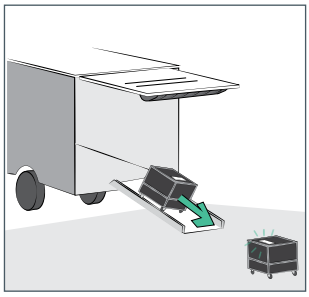


When the packing procedure is done and checked by the app, Lars turns on the truck colours and the flight cases are brought to the trucks.

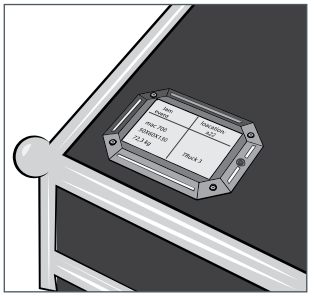
4.14.5 UNPACK TRUCK AT WAREHOUSE AND FIXING EQUIPMENT

When the event is over the equipment is brought to the warehouse. Thanks to the Grei system the unpacking procedure happens smooth and with out and need of double checking the content of the flight cases.

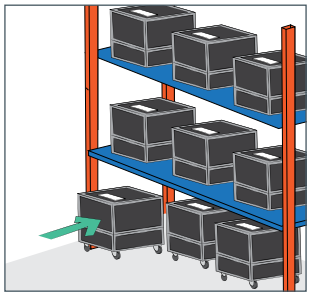
The trucks arrives at the warehouse



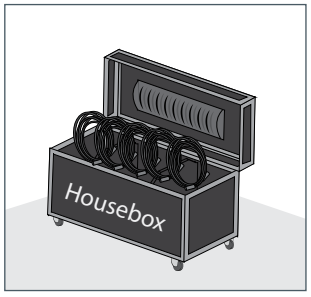
The truck are emptied from flight cases



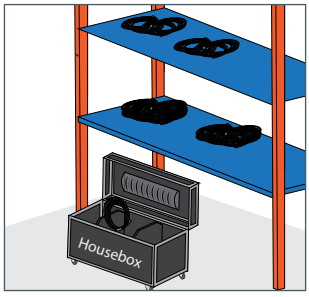
The e-tour label shows where in the warehouse the flight case are placed



The flight case are restored in the warehouse



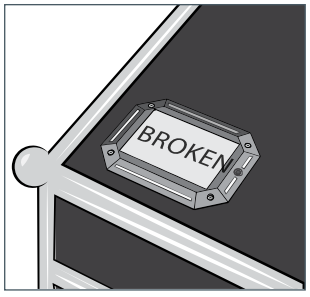
The house box with cables are selected and brought to the cable shelves



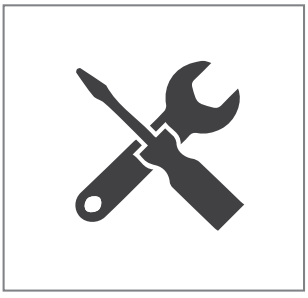
The house box are emptied and the cables are placed on the right shelve

4.14.6 UNPACK BROKEN OR DIRTY EQUIPMENT AT WAREHOUSE

When equipment are restored at the warehouse it is easy to identify which flight cases needs service. Thanks to the Grei system the error explained on the e-tourlabel is easy and clear to read. The timed saved on double checking the content of the flight cases are spend on fixing the errors.

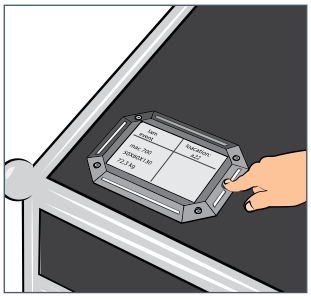


The flight cases saying “broken” or “dirty” are brought to the service area

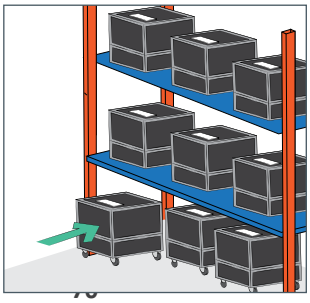


The equipment are fixed in the workshop

The e-tourlabel communicates to EasyJob that the equipment is ready to use



The warehouse technician reload the standard screen by pressing the button in 5 sec.



The fixed flight case are stored and ready for the next event

4.15 CONCEPT EVALUATION 2.0

After rethinking the concept into an app the team presented the scenarios and evaluated them with event technician Niels Peter Lindholt. The feedback is noted in worksheet 26.

4.15.1 GENERAL FEEDBACK

Niels Peter had a positive attitude towards the concept and saw great benefits in rethinking the packing and planning in his job by using the concept. It would save him and his colleagues for a lot of time, and having access to the system via an app was commented as the "obvious way to go".

During the interview the team gaining new insight of which parts of the concept was feasible and which parts needed to be rethought. Niels Peter did not mention particular barriers towards the concept, but discussed smaller challenges as well as possible solutions to overcome and solve these.

4.15.2 APP LAYOUT

When seeing the preliminary sketches of the app interface he appreciated that he can sort the picking list by the location of equipment in the warehouse. He specific asked for the possibility of dividing the picking list in more orders, e.g. dividing the picking list in areas as light, audio and video with a person in charge of each section.

Niels Peter found it natural to have the search function in the top right corner. He also showed an example of a picking list, where his company's logo was largely printed in the top of the list, and he thought that it could be cool if the app could do the same.

4.15.3 DOUBLE BOOKINGS

In order to prevent double booking of equipment, Niels Peter mentions that the app should not only import the picking list, but also the rest of the inventory so it could show an error if equipment got double booked.

4.15.4 SECTIONING ITEMS IN A INDEX TREE

When assigning equipment to positions and turning on the lights, Niels Peter asked for the possibility of only selecting a few numbers of the same type of lamp, and assigning them to another position than the rest of same type of lamps, separating it into to two positions. Structuring the equipment in a index tree was mentioned as a solution. This function must of course be related to how the lamps are stored in the flight case, so that a flight case can not be divided into various positions.

4.15.5 DESKTOP VERSION

When planning positions on the venue layout Niels Peter would like to have a view of the application on a computer display next to his Easyjob management software, so that he can delegate the positions at the same time as he is assigning the equipment for a job.

Ill. 4.14.1: Concept evaluation with Niels Peter

4.15.6 EQUIPMENT STATUS

When each flight case is repacked at the event, and the content of it is correct, the e-tourlabel must notify that it is ready to be loaded into a truck and in which truck is should be placed.

4.15.7 REPAIR LIST

The feature, where errors can be reported it should be possible to register it during the show, and then filling out a more detailed description of the errors after the show.

4.15.8 LASER POINTER

Regarding the integrated laser pointer Niels Peter saw this as function as kind of silly, and not necessary if the rest of the concept worked.

SUM-UP

- Using an app to control the inventory and the light is validated by the user as being very logical.
- The app must be connected to all inventory, in order to check for potential double-bookings and notify.
- It must be possible to single out equipment of a position and assign it elsewhere, but the equipment must be of the same flight case, so that they cannot have two positions.
- It should be possible to update the repair list after the show, instead of having to fill it out when it is discovered.
- The exterior of the e-tourlabel must be able to withstand flight cases being slide over it.

4.16 E-TOURLABEL REQUIREMENTS

The requirements for the e-tourlabel are directly linked to the research phase and decisions made in the next phase, Development.

1. The e-tourlabel should fit on a flight case

a. The e-tourlabel must not extend beyond the top surface of the flight case by more than 3 mm. (2.4.6)
b. Must have an exterior protecting the display and components inside (2.5.5)
c. The geometry must withstand flight cases being slided over the e-tourlabel? (2.5.5)

2. The E-tourlabel should be an interactive way to pick and select equipment to a job.

a. Must have a physical interaction point to assign or unassign flight case to the job opened in the app (4.5.1)
b. Must accommodate that multiple users could be packing at the same time. (4.14.3)

3. The E-tourlabel should have stable connection to the App

a. In packing situation in the warehouse it must have a connection to the phone, when assigning or unassigning a flight case, of distance of maximum 2 meter. (4.11.2)
b. In large venue situations, should be able to turn on/off the light from distances of minimum 20 meters (2.6.1)

4. The E-tourlabel should be able to register the ID of content of the flightcase its mounted on.

a. Must be able to register a minimum of 200 cables and randomly placed small equipment. (2.4.6)

5. The e-label should have a low level of required maintenance

a. Must have replaceable batteries (4.5.9)

6. The E-label should be able to show, change and flash a lighting color as a way to clearly distinguish flight cases going to the same destination, or blink singling out a specific case.

a. The light/colors must be easily distinguished colors (2.6.3)

7. The e-label must be able to communicate the following depending on where in the process it is.

a. Communicate who packed it, which job its going to and the content on the screen, when packing (2.4.4)
b. Communicate where on the venue to be positioned, when unpacking (2.6.4)
c. Clearly state if equipment is or broken/dirty, when returned from job (4.14.7)
d. Communicate which truck to be loaded into, when repacking from the job. (4.14.6)
e. Communicate position at Warehouse after finished repacking. (4.14.6)

8. The e-label should be easily implemented in the system

a. Must not be dependent on additional expensive or labour-intensive devices in order to control the system. (4.11.2)

WISHES E-TOURLABEL

5. The e-label should have a low level of required maintenance

a. Must have a battery life of 3 years. (4.5.9)

6. The E-label should be able to show, change and flash a lighting color as a way to clearly distinguish flight cases going to the same destination, or blink singling out a specific case.

a. The light/color must be visible from at least 20 meters away and from all sides of the box (2.6.3)

8. The e-label should be easily implemented in the system

a. Should have a low unit price (4.11.2)

4.17 FEATURES IN THE APP

The features in the app are a replacement of actual requirements, since it would be incomprehensible to list all app requirements, since it can vary how specific they can be. They are though linked to solution requirement 1e, 2, 4 and 6a. and fulfilled in the later Development phase.

1. It should be possible to upload jobs and plan views of venues from the Easyjob database to the app

- Import packing list and layout from the management software Easyjob
- Import layout and positions directly from the visualisation software Wysiwyg (What-you-see-is-what-you-get)

2. The app should function as a handheld tool that controls the equipment when it is unplugged

- The App should be easy accessible
- It should be easy to navigate between the different modes related to the different procedures
- It should be possible to keep logged in during a whole day

3. Easy access to a job

- Overview of jobs and their individual status.
- Always know which job the user is commanding

4. **Pack mode: Aid in packing and registration of equipment on a job.**

- Function as a easy-to-use picking list
- Have an easy readable overview of the equipment that needs to be packed
- Show location of equipment at warehouse
- Sort list after location
- Mark “picked&packed” equipment on the picking list - Automatically mark, who, where, and when.
- Double check if all equipment is packed and ready in packed area.
- Able to add extra equipment, not on the picking list
- Send a notification if equipment can not be brought, send notification to office if brougt

5. Plan: Aid in planning the unpacking process at the venue

- Overview of venue layout
- Plot positions
- Name positions with abbreviation.
- Configure colors for each position

5. Assign: Aid in planning the unpacking process at the venue

- Easy assign equipment to positions
- Overview of equipment sorted by Types

6. Unpack:

- Overview of equipment sorted by positions.
- Turn on/off lights on equipment.

7. REPACK:

- Overview of equipment sorted by type
- Turn on colorlight on all, or single, tourlables
- Note quipment in the list as ready, when repacked.

8. Search function

- Pack, Assign, Unpack, Repack in order to scan and identify equipment with the phone.

9. Search function

- Find my case function: Turn on flash on a tourlabel,

10. Settings menu:

- Define font sizes
- Configure personal profile.
- Upload a personal photo
- Choose a personal colour, (the color which is used when equipment is crossed of the packing list)
- Choose between a light, and a dark theme.
- Choose how the different modes automatically sorts the equipment list.

5.0

DEVELOPMENT

This phase describes the technical scope and the development of the concept in relation to the specific product requirements.

By using the specific product requirements from the Conceptualize phase, the team is able to represent the development of the product service system.

Different tests are made and various representation and diagrammation techniques are used to describe the development. The reached level of development is used as the foundation for the plan for further prototyping presented in the end of this phase. The level of development along with the plan for further development is used as the foundation of the market considerations, which is presented in the next phase, Market.

5.1 TECHNICAL SCOPING

In order to cope with the complexity of designing a product service system, a priority of the technical scope was defined in order to limit the extend of the technical part.

1ST PRIORITY

- Testing the interface and navigation of the app, hence the desirability with users.
- Showing a proof-of-concept of a critical process, through a software sketch modelling method, describing the communicaiton between user, app, e-tourlabel and server.
- Validation of the technological composition in terms of combining the right technlogies.

2ND PRIORITY

- Detailing the technology composition of e.g. Bluetooth CSR in relation to Bluetooth in the phone.

3RD PRIORITY

- Unit price of various devices due to existing products, like electronic shelf labels, that show that it can be done very cheaply.
- Calculations on power management in relation to battery life, because it depends highly on antenna type.

OUT OF SCOPE:

- The composition of electronic hardware on the printable circuit board.
- Strength calculations on the e-tourlabel.
- Unit price of technical components due to the information on pricing varying greatly or because the technical components need development.
- The frequency and technical specifications of radio frequency devices which needs to be prototyped and tested.
- The implementation in terms of mounting and installation.

5.2 CONNECTION

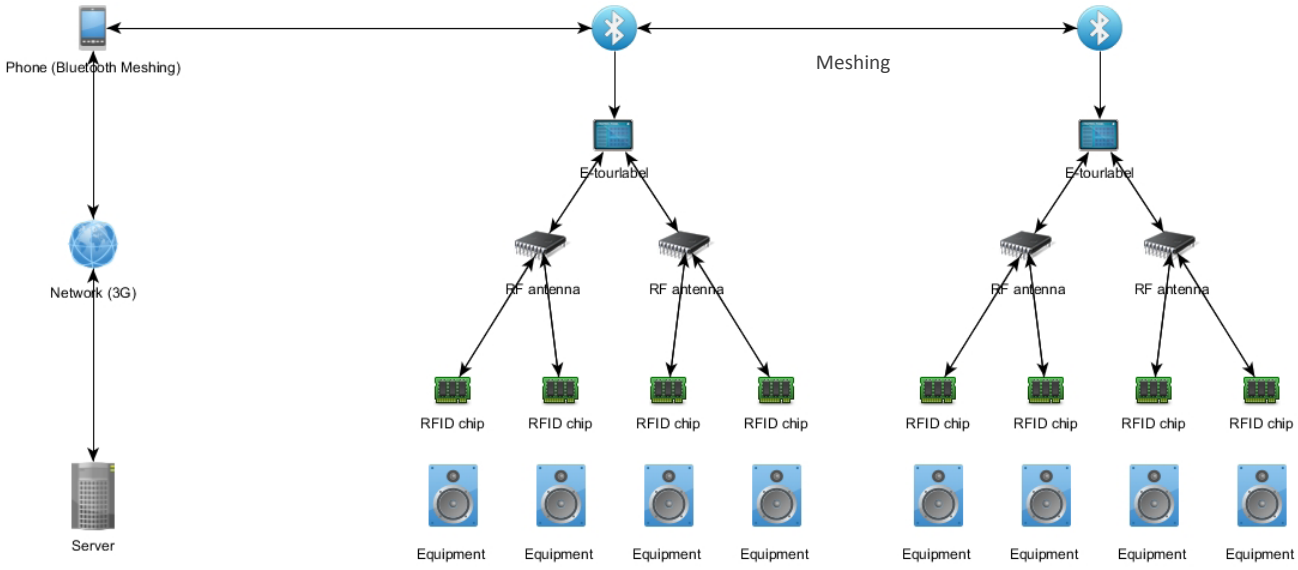
The following section include the development of the product service system including the e-tourlabel and the app. In order to fullfil the requirements the development is either tested with users, validated through experts or compared with existing solutions.

DECISION

- System architecture 3 is chosen based on e-tourlabel requirements 3 and 8.

5.2.1 SYSTEM ARCHITECTURE

Three different system architectures are considered in order to connect the server with the phone and thereby e-tourlabel hence equipment. System architecture 3 is chosen due to it having no need for additional devices in order to maintain the connection, having multiple users at the same time (Worksheet 31). This system architecture uses the bluetooth smart technology CSR (kilde) to make every e-tourlabel a bluetooth hub, instead of only the phone. This makes it possible to connect the phone easily to all e-tour labels and when the phone is connected to the server using 3G it creates a connection from the server and down to every single e-tourlabel (Ill. 5.2.1).

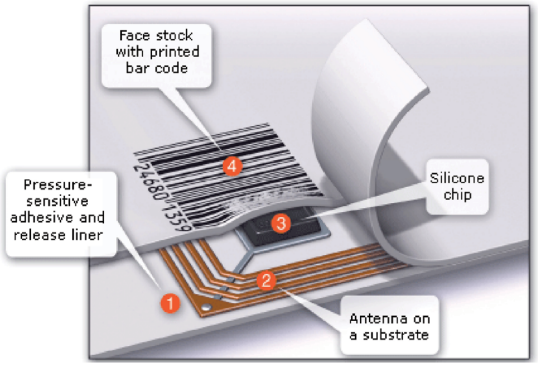


Ill. 5.2.1: System Architecture 3

5.2.2 ANTENNAS AND TAGS

The realizability of the concept relies on the validation of the scanning solution. It is known that the RF technology has not yet been implemented in the event sector due to the obstacles of metallic materials in various equipment. It is though proven through an scientific article called *Smart Flight Case* and by validation of an expert (Worksheet 19) that it can indeed work, though it needs development and testing (Hennig, Andreas 2014). This solution is based on the testing being positive, and that a modular solution like UGrokit (Worksheet 31) works as a plug-in antenna that can be recharged. This solution works on the assumption that you can fit the antenna in one box, even though an alternative solution is to have it implemented in a larger part op the flight case lid, if fitting into one box is not possible.

Passive RFID tags are already being implemented on wires in other industries, like the AV industry, (Worksheet 31) and the easiest, cheapest and safest way to do it is by using labels. Ill. 5.2.2 shows a simple label tag which has the corresponding barcode printed on the outside. With the barcode you get a security because if the RFID system malfunctions you can always use the barcodes or QR-codes through using either a phone or a handheld scanner to scan the tag.



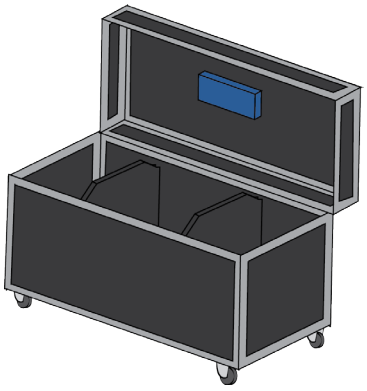
Ill. 5.2.2: The components of a RFID tag

There is a need for two different antennas.

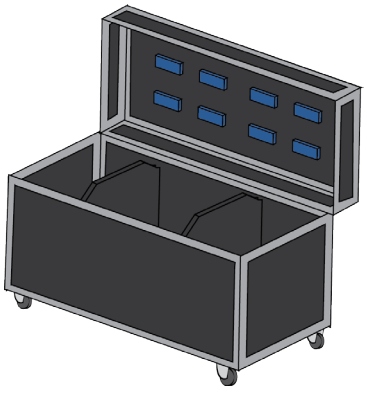
1. A powerful antenna (UHF) in the house boxes, which can read the potential hundreds of tags on cables with a rechargable battery
2. A normal NFC reader in all other flight cases, which can read only the NFC tags on the larger equipment, which is connected to the battery in the e-tourlabel since it does not use as much power.

The powerful antenna in the house boxes is only one or maximum two antennas, which is integrated in a housing with a pasted velcro band, and with a audio port connection. The antenna can be placed beneath the housing for the e-tourlabel but also right next to it (Ill. 5.2.3).
The NFC antennas are to be integrated in the lid of the flight case right above the tag on the equipment (Ill. 5.2.4). A maximum of pieces of equipment in standard flight cases being 8, results in the maximum number of antennas being 8, and also with an audio connection, hence 8 audio inputs must be present on the e-tourlabel. The antennas are pasted onto the foam with the same glue used to paste the foam onto the lid.

The powerful antenna solution might eventually be the solution for all kinds of flight cases, when the technology has developed into being more energy efficient, but for this solution it would be too much maintenance of the system, due to the batteries needing a recharge after 2 hours of continous scanning.



Ill. 5.2.3: View of the UHF antenna position



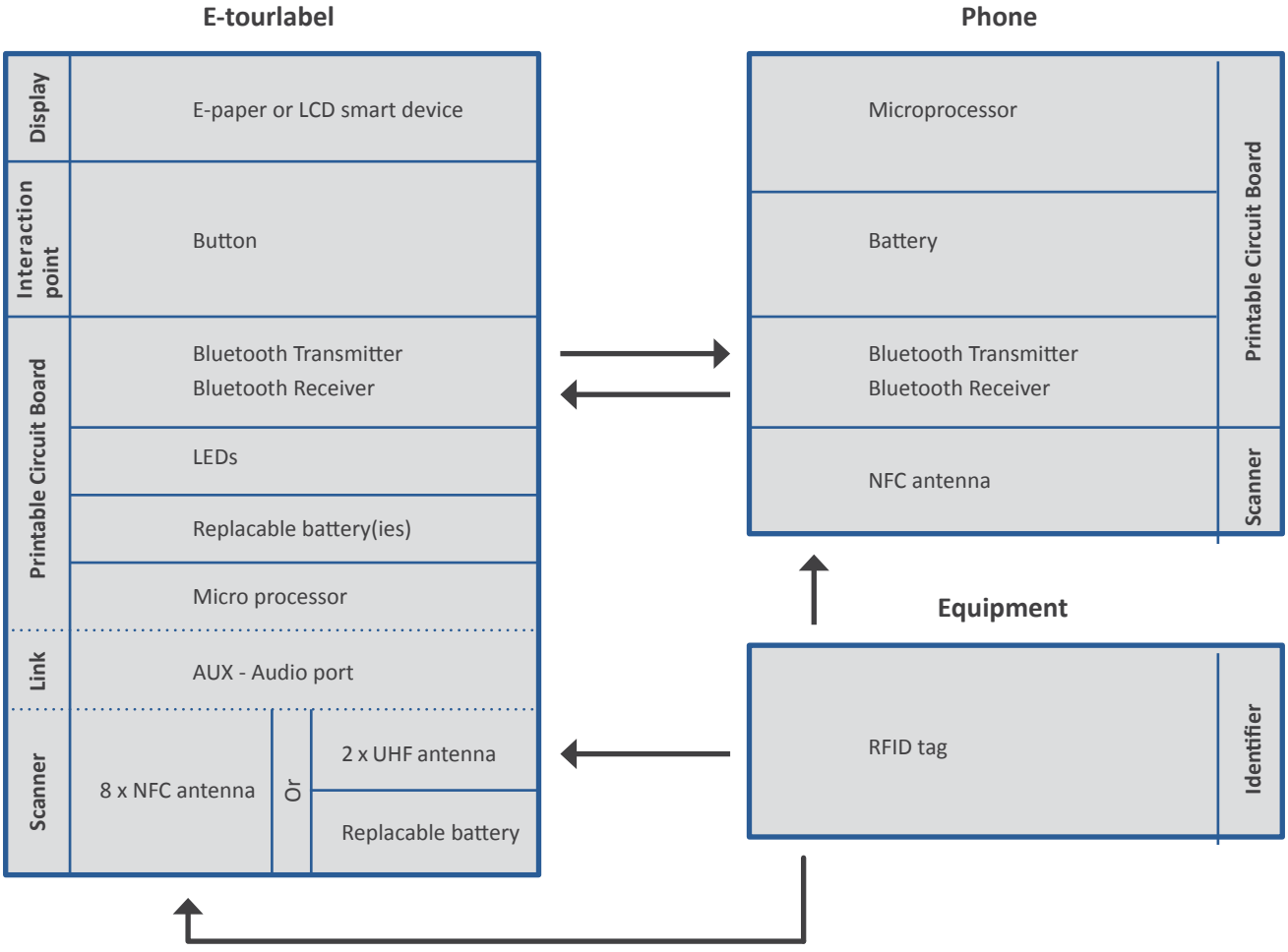
Ill. 5.2.4: View of the 8 NFC antennas position

DECISION

- A UHF antenna for the house boxes and 8 NFC antennas for all other flight cases are chosen based on e-tourlabel requirements 4 and 8.

5.2.3 HARDWARE ARCHITECTURE

There are several pieces of hardware needed in order for the system to run. A Hardware Block Diagram (Ill. 5.2.5) illustrates the hardware architecture and the relationsship between the wirelessly connected parts. It can be seen that the phone allows for the RFID tags to be read by not only the two kinds of antennas in the e-tourlabel but also the phone which has an internal NFC antenna. It also shows the difference between the NFC and UHF antennas, which connect the same way but have two various types of power management.



Ill. 5.2.5: The Hardware Block Diagram

The e-tourlabel must also have one button for assigning or unassigning flight cases and a bluetooth transmitter and receiver in order to communicate with the phone. The e-tourlabel must have a micro processor to cope with the data, and one battery, or more, to provide the power to the whole system including the LEDs. The display can be either E-paper or a LCD smart device which is to be determined in the next section.

DECISION

- A hardware architecture with 3 parts being the equipment, phone and e-tourlabel is chosen based on e-tourlabel requirements 2, 3, 4 and 5.

5.3 E-TOURLABEL DEVELOPMENT

5.3.1 DISPLAY

The expert Lars Jankowski (Worksheet 19) advised that for the e-tourlabel he would use a smart device with an LCD display instead of an un-developed device with an e-paper display. The argumentation was mainly based on that smart devices are developing rapidly, and that they can already accommodate for the wireless connection, through the use of the integrated 3G or WiFi. E-paper is also developing rapidly and in general it is hard to compare the two, therefore the strengths and weaknesses of the two are defined to compare and chose one of the two (Worksheet 18).

Strengths:
E-paper:

- Readability in light conditions
- Low power consumption
- Cheap unit cost
- Small size
- No reflection under bright light
- If power outage it retains the last 'screen'

LCD smart device:

- Flexibility in terms of
  - Display - animations, colors and refresh rate
  - Integrated connection (3G, WiFi, GPS)
- Legibility in dark conditions
- Highly reflective under bright light
- Low initial cost of investment due to the state of development being very high.

Weaknesses:
E-paper

- Readability in light conditions
- Low power consumption
- Cheap unit cost
- Small size
- No reflection under bright light
- If power outage it retains the last 'screen'

LCD smart device

- Flexibility in terms of
  - Display - animations, colors and refresh rate
  - Integrated connection (3G, WiFi, GPS)
- Legibility in dark conditions
- Highly reflective under bright light
- Low initial cost of investment due to the state of development being very high.

The e-paper is chosen as the technology for the display due to numerous advantages specifically relating to price, power consumption and readability. The e-paper is much cheaper than LCD smart devices though it needs a large cost of development. The expert Lars Jankowski guestimated that an LCD smart device would be available for around 800-900 DKK, which is seen as a very high unit price considering it has already been developed (Worksheet 19). The key feature with LCD smart devices is that they have a high flexibility in colors and animation which is not needed in the e-tourlabel. LCD smart devices consumes a large amount of energy compared to e-paper which only uses power when it changes the image, and it actually keeps the image even when turned off. The readability is much higher on the e-paper since it does not rely on emitted light, but rather reflected light, which ensures a natural looking text in any lighting condition. E-paper can be hard to see in dark conditions but in most displays internal LEDs are used to light up the screen.

5.3.2 E-PAPER TEST

The e-paper test was made in order to see if the proposed text and graphics could be easily seen on the e-paper, a Kobo (an E-reader) was bought and tested (Ill. 5.3.1) (Worksheet 33).

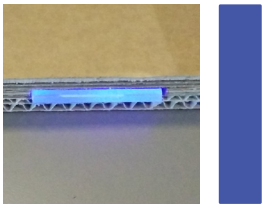
Ill. 5.3.1: E-paper being testet in direct sun light

DECISION

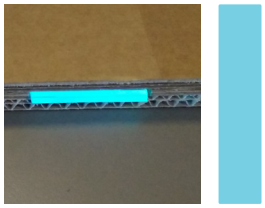
- The e-paper is chosen for the display based on e-tourlabel requirements 7, 8 and e-tourlabel wish 8a.

5.3.3 LIGHT AND COLORS

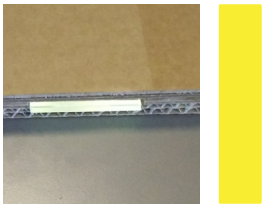
LED was chosen as the light source due to its price, lifespan and power consumption. A test was made in order to see how well people differentiated the various shades of the three primary colors, red, green and blue (Worksheet 22). The test showed that people could see three shades of each color, but two shades of each color is chosen in order to be certain that they can clearly be differentiated, resulting in the colors Dark Blue, Light Blue, Yellow, Green, Purple and Red (Ill. 5.3.2 - 5.3.7)



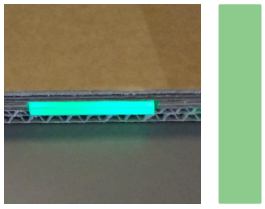
Ill. 5.3.2: Dark blue



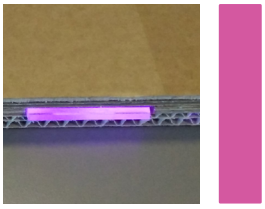
Ill. 5.3.3: Light blue



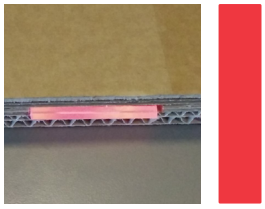
Ill. 5.3.4: Yellow



Ill. 5.3.5: Green



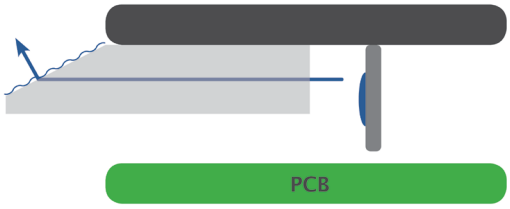
Ill. 5.3.4: Purple



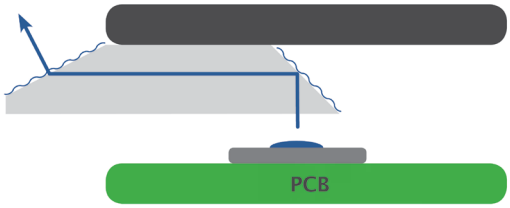
Ill. 5.3.5: Red

Another test was made in order to see how well plexi glas transports light emitted perpendicular to the horizontal surface, on to a frosted slope milled into the surface, and on to the visible frosted surface on the outside (Ill. 5.3.6) (Worksheet 28). The objective was to investigate if the LEDs could be mounted horizontally on a printable circuit bord (PCB) (Princple 1), instead of having to be mounted vertically which would take up more space (Ill. 5.3.7) (Principle 2).

The test showed that the light could indeed be transported, which led to construction principle 2 where the LED could be mounted horizontally emitting vertically onto the glas surface but still shine light horizontally on the outer edge of the glas.



Ill. 5.3.6: Principle 1 - cross section of glass, LED, PCB and frame



Ill. 5.3.7: Principle 2 - cross section of glass, LED, PCB and frame

DECISION

- The colors Dark Blue, Light Blue, Yellow, Green, Purple and Red are chosen as colors, and the construction principle 2 is chosen based on e-tourlabel requirements 1a and 7.

5.3.4 BATTERY

The battery consumption of the e-tourlabel has many various factors which are hard to determine without testing, therefore it is hard to define how much capacity must be required. Hence compared to a iPhone 5, which is a LCD smart device consuming much more power, with a Li-ion 1440 mAh capacity, that can last for around 10 days of 'standby time', it should be possible to fit a battery or more that can last for a minimum of 3 years considering the low amount of power that bluetooth, NFC antennas and e-paper use and the large space available under the lid of a flight case. It is decided to start by implementing a simple solution that is accessible in terms of acquiring new batteries, and which also shows the relative large amount of battery capacity that can potentially be implemented compared to the construction: 6 AA sized NiMH batteries, that can range from 1300-3500 mAh, putting out up to 21.000 mAh are implemented on the bottom of the e-tourlabel in a chamber with a hatch for easy replacement. After testing, it is possible to define a capacity and design an integrated battery, which is optimized and more easily replaced.

DECISION

- 6 AA sized NiMH are used for the e-tourlabel based on e-tourlabel requirements 1b and 6, and wish 6 and 9.

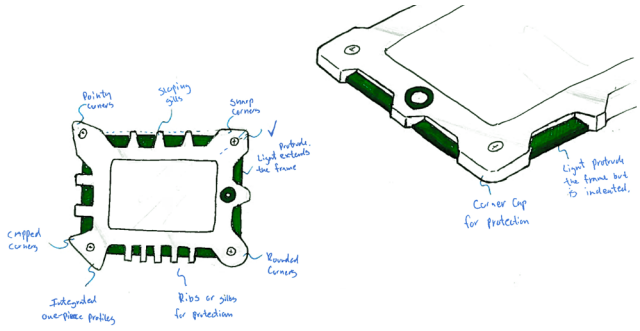
5.3.5 FRAME

The frame is the primary protective element on the e-tourlabel since it covers the corners and the button. From the e-paper test in section 5.3.2 the screen size was defined as being around 4 inches, 85 mm x 60 mm, which was the foundation for the size of the frame.

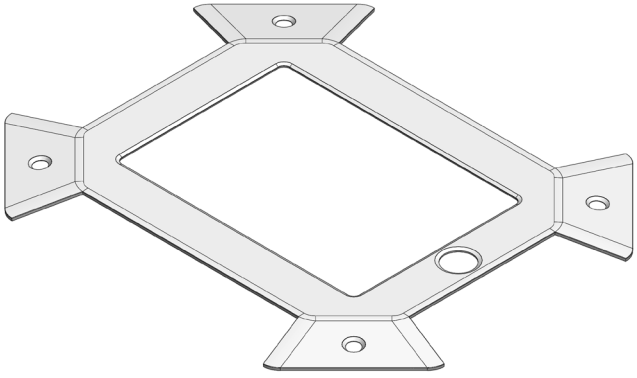
The first ideation on the frame resulted in three various architectures, the one chosen being a simple one piece frame which is mounted on top of the glass. As it can be seen on Ill. 5.3.8 the frame seems flat, with a relatively tall edge and with ribs. Due to the requirement of a maximum of 3 mm in height and the finding from Mikkel, from Profox, that the frame must not scratch other flight cases, the shape of the frame became more sloped, flat and without ribs, and larger fillets were used on the top in order to have as few sharp edges as possible (Ill. 5.3.9). Also the corner type that has a single edge and only two small corners was chosen to meet the potential danger of a flight case that is slid over the top. Rounded unbraco screws are used due to them not having sharp edges.

The material used is aluminum due to its relatively low cost compared to its strength-to-weight-ratio, its corrosion resistance and the ease of processing (Lefteri, Chris. 2013).

The ease of processing also helps chosing the manufactoring method, which is a sheet metal cutting process with press forming and cutting, which is great for a simple geomtry like the frame and where fine tolerances are needed but where the unit price needs to be low (Lefteri, Chris. 2013).



Ill. 5.3.8: Frame type and various corner types



Ill. 5.3.9: The geometry of the final frame

DECISION

- The final frame is sloped, flat and without ribs, and with larger fillets. Aluminum is used for the material and it is produced by press forming and cutting, based on e-tourlabel requirements 1a, 1c and 1d.

5.3.6 PROTECTIVE SCREEN AND LIGHT SURFACE

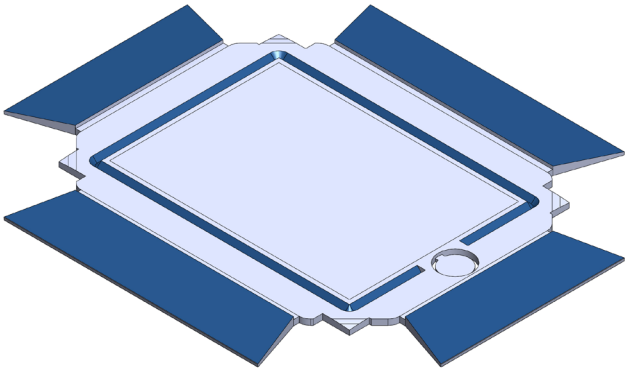
Trying to keep a low unit cost, the protective screen for the display and the frosted, and lit up surfaces, are sought to be one component. In order to do it, the protective screen must extend beyond the screen and out through the frame, and a grove must be milled or shaped into the screen (Ill. 5.3.10). Shows the frosted surface on the internal grove which transports the light from the LED below it, out to the frosted surfaces aligned with the frame corners (frosted surfaces are highlighted with blue).

Ill. 5.3.11 shows a cross section of the screen with a LED beneath the internal frosted grove to illustrate the light principle in section 5.2.3

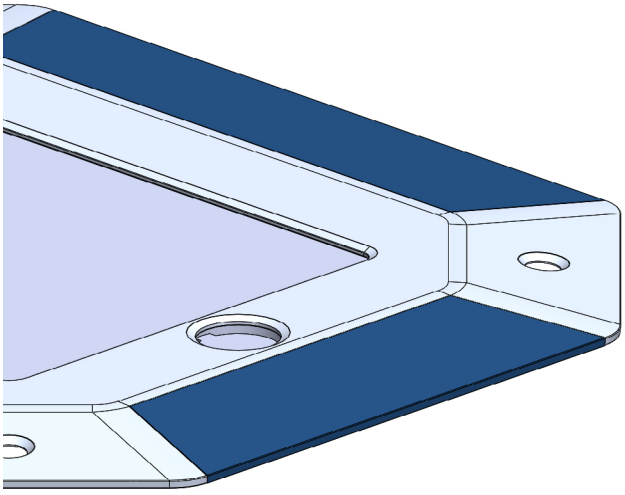
A cut in the glass for the button is made in order to fit the button mechanics into the screen to keep manufactoring costs as cheap as possible, without having a dedicated cabinet for the button, and in order to more easily direct the light emitted from the LEDs into the transparent button.

The glas was first seen as an element which needed protection, but in reality it is not normal glas which is used, but an oil-based engineering polymer, Polycarbonate, that has far better toughness and resistance than normal glas, and at the same time it is easy to process (Lefteri, Chris 2013). This allowed for the construction principle to go from the shape seen in illu. 5.3.8 where the glas is indent and protected by the frame by the corners and ribs, to a construction principle where the glas becomes like a part of the frame, meaning it is aligned and flush with the corners of the frame (Ill. 5.3.12). This way no other flight cases can be scratched when sliding over the top, because there are simply no sharp edges, and the glas works as a protective element.

As stated, the material is polycarbonate which gives numerous possibilities pertaining manufactoring. In general, extrusion and milling is a very cheap start-up process, though it can be difficult with the relatively fine tolerances and the fact that laser cutters are hard to use on transparent materials, though water jet cutting is an alternative. For the initial prototyping, extrusion and milling are the chosen manufactoring processes but in the long run it would be more cost-efficient to use injection moulding. When the construction is fully defined the manufactoring will be more uniform and consistent and have fewer process steps due to e.g. the frosted surface being engraved into the die or cavity, which will reduce time hence ressources.



Ill. 5.3.10: Frosted surfaces highlighted with blue



Ill. 5.3.12: The frame corners flush with the blue light surface

Ill. 5.3.11: Cross section of glass and LED

DECISION

- The protective screen and light surfaces are being made in one part of Polycarbonate and will initially be made through extrusion and milling but later through injection moulding, based on tje e-tourlabel requirements 1c and wish 9a and 7a.

5.3.7 CONSTRUCTION

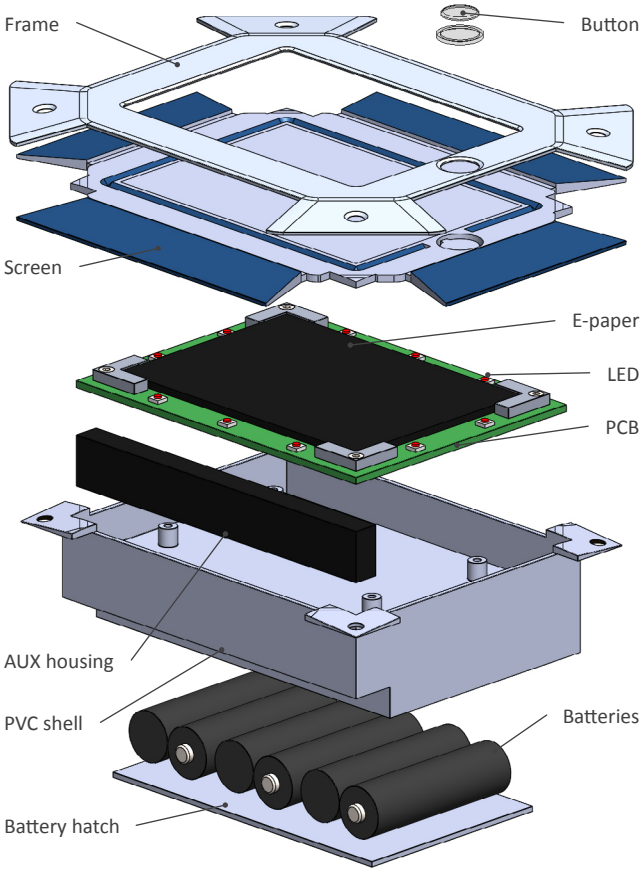
A shell or cabinet is needed to contain batteries, PCB (Printable Circuit Board) and internal components. It has a chamber for the batteries, which the PCB is mounted on top of, and a hatch below for easy replacement of batteries (Ill. 5.3.13). The shell itself will initially be made of PVC due to its versatility, hard wearing and low cost, but after a test period it can show to be necessary to use ABS, which has a god impact resistance, if the PVC is too weak. It is manufactored using injection moulding for the flexibility in design and fast cycles.

The AUX housing for the antenna audio input is mounted on the PCB from underneath and there are 8 holes corresponding to 8 antenna inputs beneath the shell. The 4 corners on the upper part of the shell are mounted, along with the screen and the frame, on to the top surface of the flight case, enclosing the construction (Ill. 5.3.14).

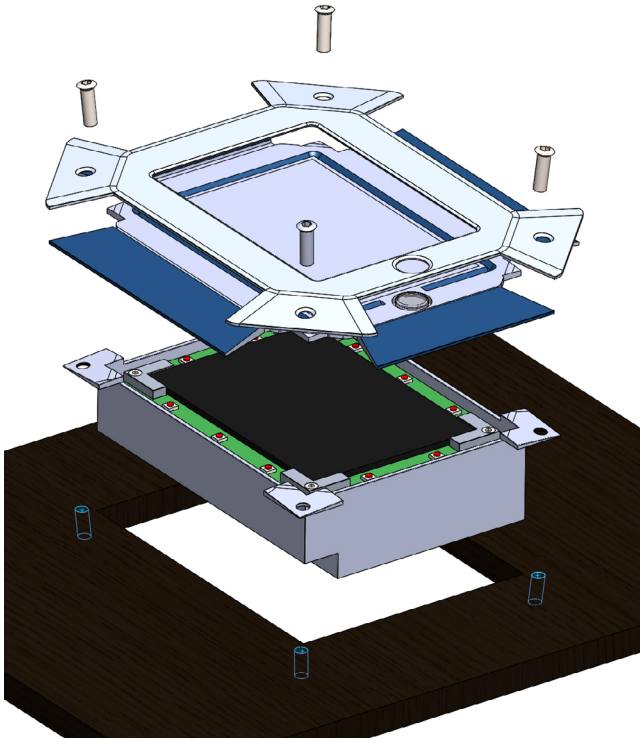
The e-paper display and the 10 LEDs, 3 on the long sides and 2 on the short sides, are mounted on the PCB facing upwards to the screen and the frosted surface.

MOUNTING

The e-tourlabel can be mounted on a closed flight case into a corresponding hole, by placing the shell with components in the hole, then putting the screen on top followed by the shell which keeps the construction in place, and lastly screwing 4 4,0x15mm screws through the lid of the flight case.



Ill. 5.3.13: Exploded view of components



Ill. 5.3.14: Semi exploded view of mounting order

DECISION

- The shell is made of PVC through injection moulding, and 10 LEDs are placed on the printable circuit board, at the same time 4 4,0x15mm screws are used to mount the e-tourlabel on the flightcase, based on the e-tourlabel requirement 1

5.4 SYSTEMS ENGINEERING

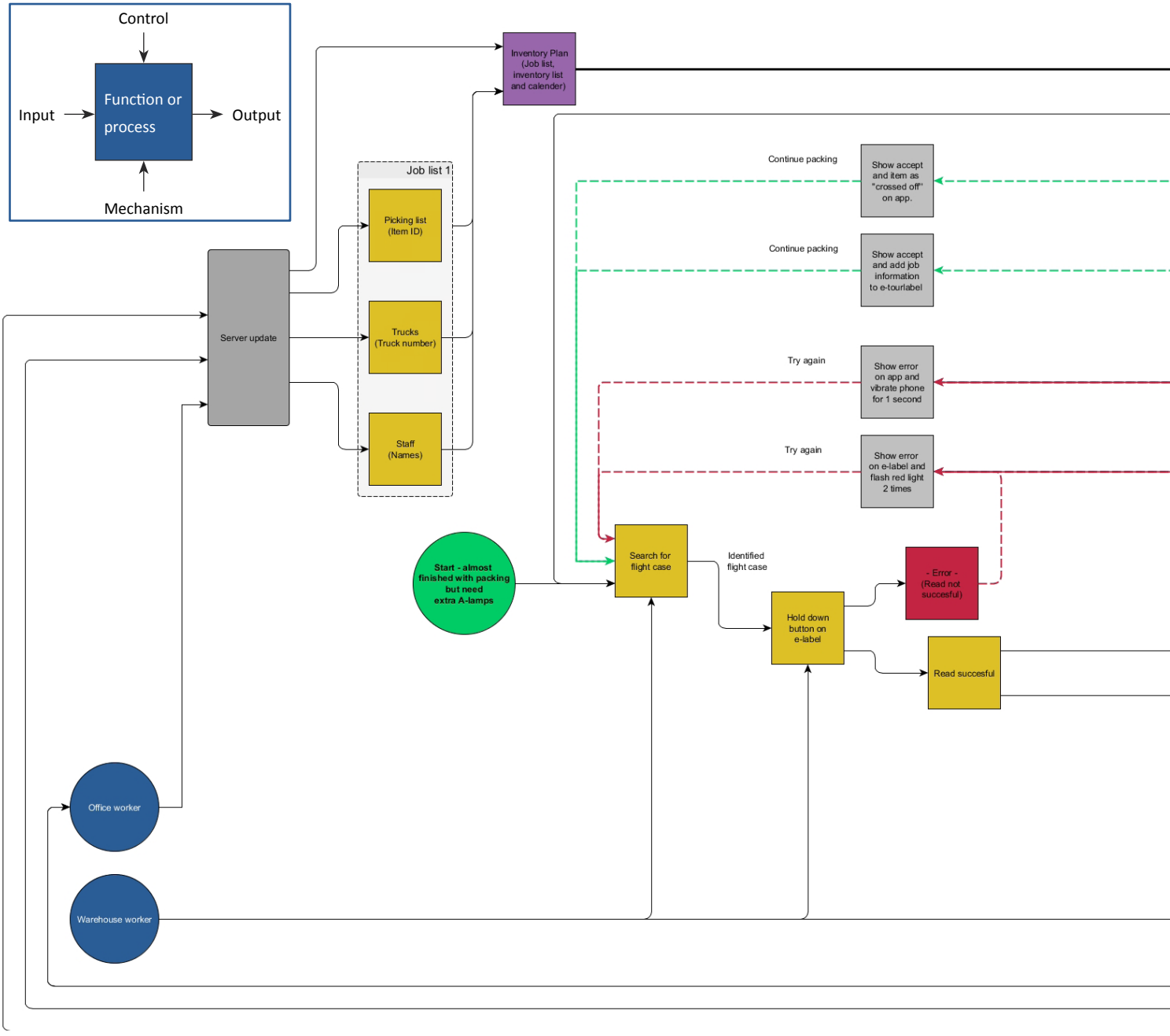
Since the solution is a product service system with electronically interactive IoT (Internet of Things) devices, software analytical measures are taken in order to cope with the complexity of the system behaviour.

In order to get an overview of the system and the processing of information, as a way to probe for critical scenarios and as the technical dive IDEF0 a functional modelling language, is used as diagramming and software sketching tool to map out a critical process where all data relevant artifacts are present - in this case, the packing process at the warehuse (Idef.com, 2016).

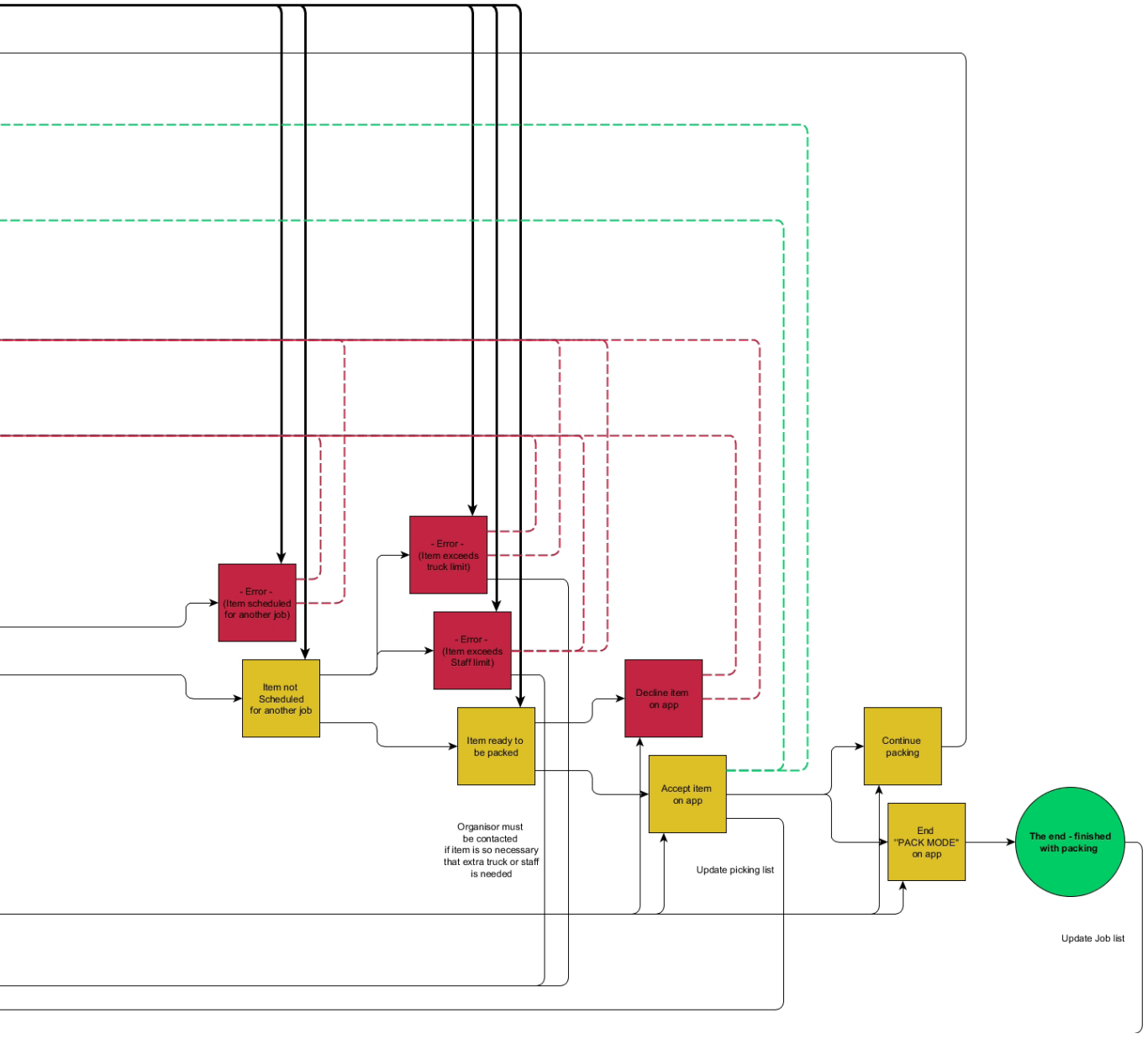
In order to read the diagram the basics of IDEF0 is shown in the top left corner of the diagram.

The process shown is a potential scenario where several possible faults, such as assigning the wrong flight case or packing a flight case which is to be used at another job, are corrected due to the app and the e-tourlabels being syncronized with the main server. The main server holds the data of all the inventory using Easyjob which keep track of overbookings, trucks and staff.

When an order has been made and confirmed the database sets up a 'Job list' which is a summary of equipment to be packed, number of trucks and which staff to use, shown is the **''Job list 1''**. The data from the job list is combined with the data from the inventory list and calender which results in the **''Inventory Plan''** - this is the controlling element, which the phone and e-tourlabels send data to in order to receive data defining if it is OK to pack the specific equipment. The Inventory Plan checks for



overbookings in terms of equipment, trucks and staff.
The process starts with a packing situation that is almost done, meaning that the warehouse worker is already in the 'PACK mode' on the app:
The warehouse worker has assigned all equipment on the picking list, and now want to add an extra item: 8 A-lamps (As shown in the first green circle). The lamps fail to be added to the picking list due to being scheduled for another job. The warehouse worker finds an alternative item to pack, but this exceeds the specific job's truck or staff limit, and another truck or more staff is required, which then needs to be communicated and confirmed with the office workers. It also shows how feedback is given through the e-tourlabel and app, when errors happen or when equipment is accepted and added to the pickinglist. This software sketch relates to only one process, but it needs to be sketched for all other processes as well, in order to make a complete ''sketch'' for a potential programmer.



5.5 APP DESIGN & DEVELOPMENT

The functions of the command console and remote had to be rethought into an App. After getting feedback from the scenarios, this process consisted of several iterations of getting inspiration, creating layouts, visual appearance, icons, and navigation, and prototyping and testing various parts with users (Worksheet 24).

5.5.1 LAYOUT & NAVIGATION

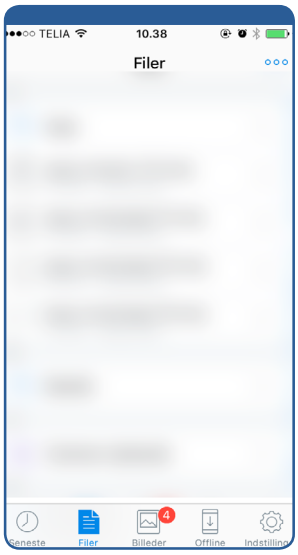
Rule number one when designing an app is: "do not reinvent the pattern", 'with patterns' are meant as a combination of user interface and navigation (designforfounders.com, 2016). Meaning that if possible, new apps should use some of the already known patterns from the existing popular apps.

The team therefore investigated the apps already downloaded to one of the team members Iphone, and looked for apps with the same complexity and number of features.

5.5.2 POSITIONING & NAMING MODES

In most of the investigated apps a quick menu in the bottom with 3-5 icons give an easy navigation between the different modes in the app (Ill. 5.5.1-2).

Ill. 5.5.1: Instagram's 5 button quick menu



Ill. 5.5.2: Dropbox's 5 button quick menu

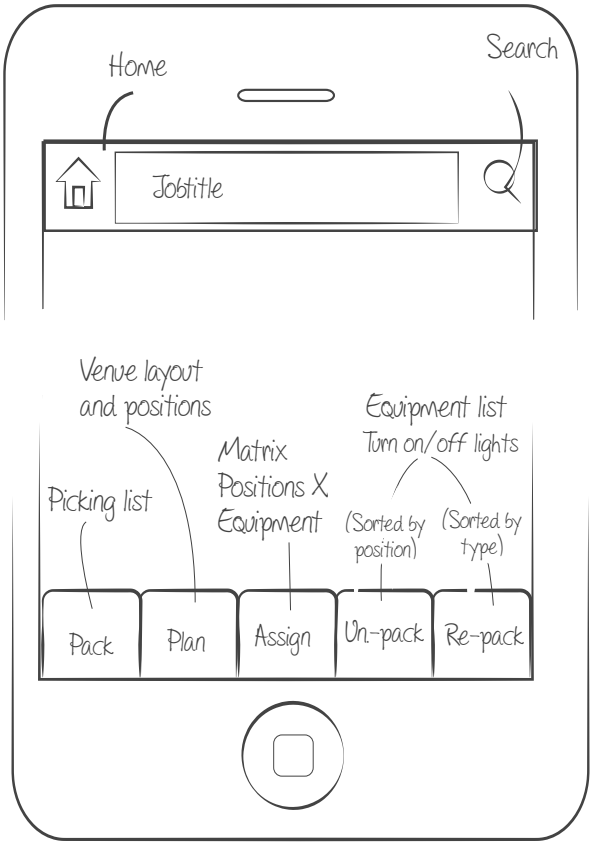
In the *scenarios vol. 2* a menu of three different modes are described in the app, as: *pack*, *unpack* and *repack*.
The easy shift between modes in the investigated apps, gave inspiration to rethink these three modes into five, in order to add a better overview and a faster switching between modes.

The changes are described below, and illustrated on ill. 5.5.3,:
Pack mode:
The pack mode contain the pickling list, and stay the same. By having this as a single button the overview of equipment brought to the event is easy accessible at all times.

Unpack mode:
The unpack mode is unfolded and divided into two new buttons; Plan and Assign. In *plan mode* the positions of the venue layout are created, and in *assign mode* the equipments are added to the positions. The separation of these functions is done to easily switch between them and get a constant overview.

Repack mode:
The repack mode is divided into two individual buttons; unpack and repack. To have a dedicated function in *repack mode* that states when equipment is ready to be packed.

The position of these as well as a *home button*, a *job title bar* and a *search button* was discussed with event technician Niels Peter and placed based on this (Worksheet 26).



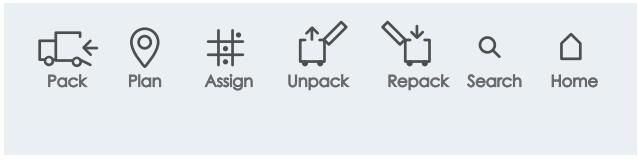
Ill. 5.5.3: The different modes on the developed app

5.5.3 ICONS

Making an user friendly app requires easy readable and understandable icons. The team created and tested different icons through several iterations, going from 3D isometric icons to flat 2D icons. Each step was evaluated with fellow students, which had a low level of knowledge about the project (Worksheet 27). The tests was carried out by asking the test person to decipher the meaning of icons (Ill. 5.5.4).
Based on repeating comments about difficulties reading the isometric unpack and repack icons, and an indication of the isometric design not matching the flat design of the smartphones interface, it was concluded that the icons should be flat 2D icons instead.

Ill. 5.5.4: The tested 3D and 2D icons

The 2D icons was further adjusted into the final icons shown on Ill. 5.5.5.



Ill. 5.5.5: The chosen icons

5.5.4 APPEARANCE & IDENTITY

As well as when designing a physical product, an app also needs a certain identity, mood and appearance to create a user experience. To create the visual expression of the app, the team created a mood board to communicate desired emotional qualities and experiences (Endrissat, Nada 2015).
The mood board was primary based on our vision, and therefore the app should imitate a feeling of control, as the event technician experience it when controlling the show.

The mood board is a mix of light controllers, user interfaces and images that framed the sought experience (Ill. 5.5.6). Different elements of the mood board was inspiration to many of the smaller details in the app, such as psychically looking buttons and grained backgrounds, which e.g. is mimicking the sandblast aluminium top of many controllers.

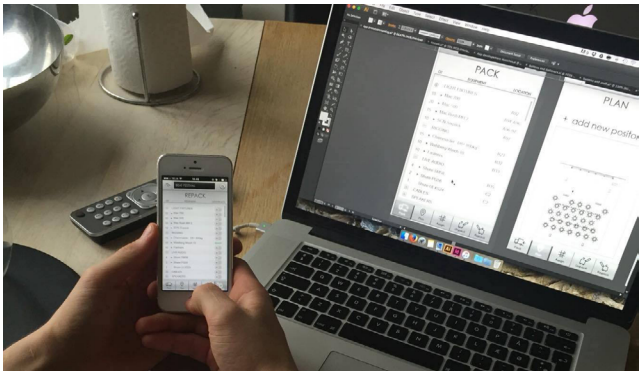
Ill. 5.5.6: The mood board of the app development

5.5.5 APP PROTOTYPING

Using an existing online app called Invision, the team was able to link prototyped screen previews made in Adobe illustrator to each other in an app prototype. Links between the different screen previews where defined, which made it possible to navigate between them on a prototype on the phone (Ill. 5.5.7). Using this, the navigation and interaction principles of the app could be tested on a smart device together with the user.

Two prototype session with previous contacted event technicians was made. One session with Niels Peter Lindholt where the app was send to him and tested online. Feedback was received in text (worksheet 32). In the second session, the prototype on an Iphone was handed to Mikkel Rodkjær. He was asked to use it, while the design team noted his comments along the testing process (Worksheet 34).

The feedback was positive and the users found the navigation and icons intuitive and appealing.



Ill. 5.5.7: Invision prototype on Iphone linked to screen previews in Adobe Illustrator

5.6 FURTHER PROTOTYPING

This sections is a suggestion and assumption about how to execute the further prototyping processes, of the different concept elements, to get closer to a prototype system for proper testing at live event companies.

5.6.1 PROTOTYPING THE SYSTEM

Naturally there are quite the amount of unknown factors and potential errors when designing a product service system, which will be investigated and identified through testing.
There is a need of evaluating the probability of errors since the system is only as good as its ability to cope with errors, which is highly dependent on the extent of the testing. For instance, if the antennas fail to read the tags properly, a coping strategy needs to be considered in order to rectify the error.

It is insufficient to have antennas that misreads 5% of the time which is why considerations to cope with such errors are done before the testing. For example, the mentioned failing antennas can be corrected by raising the signal power, by enclosing the house box with metal foil or by reprogramming the triangulation of 2 antennas etc.
A method to determine a lot of the errors before the testing is by scenario probing using body storming, which would be the design team's next step towards a realistic implementation.

An incomplete version of the software program can be developed based on the software sketch from IDEF0, as a prototype which can simulate few and simple aspects of the final product. This would give valuable feedback obtained from the users early in the project, which leads to a further definition of user needs.
Obvious system errors, which needs to be accommodated for, are power outages and improper tag readings.

All mentioned is a long process containing continuous iterations that all will improve the concept performance.

5.6.2 PROTOTYPING THE E-TOURLABEL

An guestimate from the technical supervisor is that within three years 100 prototypes of e-tourlabels, costing around 1000DKK, are ready to be tested. Within 5-7 years the product service system is ready for sales, with optimized the e-tourlabels to a cost of around 100-200DKK.
The testing requires the simple software prototypes and can be done in collaboration with a technology company like Lyngsoe Systems or Martin Light.
The tests are divided into various aspects, which are prioritized:

1. The error rate of the reader in various environments and scenarios
2. The connectivity and response time of the bluetooth CSR mesh
3. The visibility and readability of the light and e-paper respectively, at night in stressed conditions with tired technicians

5.6.3 PROTOTYPING THE APP

The further app prototyping will continued to use the app simulation program Invision, or a similar, as it is described in section 5.5.5 app prototyping.
The program contain a record function where all actions, touches and swipes executed when using the prototype can be recorded and afterwards analysed. The design team will benefit from this and a second record function that films the users face from the front camera on the phone, and records the sound during the testing.
This is wanted to get an understanding about how the navigation through the app is executed and understood. The sound and video is used to analyse the user when executing double taps or similar errors. Functions that will help the team to develop app interface before engaging the app programming.

6.0

MARKET

This phase describes the market and the strategy and business model to penetrate that market.

By using information about the current solutions and information about the product service system from the Development phase, the team is able to estimate market size and potential revenue.

Different strategies are made and compared in relation to a potential standardization. The chosen strategy is assessed based on the potential revenue for GREI and a plan for implementation is defined and presented in the end of this phase.

6.1 BUSINESS

The previous section covered the development which ended with considerations on the prototyping which is a crucial part of the business, hence the next step is to consider the market, business model and implementation.

6.1.1 COST AND PRICING

The production cost is hard to calculate since it depends highly on the price of the modular scanners for the e-tourlabel, which needs to be customized and developed for the purpose, and the development cost of the programming, hence the price of the product service system is hard to estimate. A guestimate, based on feedback from the technical supervisor, is that after 3 years the first 100 e-tourlabel prototypes can be ready for testing, at a price of around 1000 DKK each, though they are merely used for the prototyping and development. It results in a minimum intitial cost of around 100.000 DKK for e-tourlabels alone. Afterwards, after 5-7 years of development, the production cost can come down to around 100-200 DKK per e-tourlabel which seems like more than a reasonable price. The software cost is not to be overlooked because it is a relatively large post. A guestimate, based on programming student Rasmus Vildner, is that at least 1000 hours is needed for the software development. An estimated hourly wage, bought from a software company, is around 750 DKK, which results in a software development cost of at least 750.000 DKK. So without the development cost, the initial investment cost is estimated to be around 850.000 DKK, after the first three years. A rough estimate is that the total investment cost will be at least 5.000.000 DKK, including the 850.000 DKK, as a way to cope with unexpected expenses. An average sized LEC is estimated to have 500 flightcases, including 10 houseboxes, would need to acquire 500 E-tourlabels, 8.000 RFID tags, 1.000 NFC scanners and 10 UHF scanners. RFID tags, NFC scanners and UHF scanners cannot be estimated in unit cost due to the potental large uncertainty.

6.1.2 MARKET POTENTIAL

From section 3.6 we learned that a rough estimate of an average sized rental firm is that they have a total annual loss of around 53.500 DKK. If a leasing solution could be implemented for those firms, so that the leasing cost is less than their total loss, it could become viable for them to acquire the product service system. When estimating the market potential, the team base the estimate roughly that the 750 companies using Easyjob in Europe are average sized companies, and that they would be willing to pay half of their potential annual loss of 53.500, being 26.750. If they have a total annual loss of 53.500 DKK and they pay only half that amount annually for this system, it would result in a potential annual subscription revenue alone of around 20.000.000 DKK.

750 x (53.500/2) = 20.062.500 DKK

SUBSCRIPTION REVENUE GUESTIMATE

Number of average sized LECs in Europe:

ABOUT 750 POTENTIAL CUSTOMERS

Total annual loss for average sized LEC's:

ABOUT 53.500 DKK

Potential annual revenue per average sized LEC:

ABOUT 26.750 DKK

Potential annual revenue for subscriptions alone in Europe:

20.062.500 DKK ANNUALY IN EUROPE

6.1.2 SYSTEM ARCHITECTURE

The product service system is designed so that it is not dependent on a full implementation right away but a potential customer could start with a test period with only house boxes for cables and small equipment, which are seen as the most labour intensive equipment in terms of both packing and the most lost equipment. The test period will require an installation of the e-tourlabel on a few house hoxes and tagging of cables and small equipment which will show the customer that no cables or small equipment are lost, hence the same goes for the rest of the equipment as an incentive to upgrade. The system shows the automated inventory management feature but a full installation would be needed in order to fully exploit the light guide.
The modular architecture of the scanners, being AUX compatible, is one of the key attributes of the system. When new and better scanners become available in the future, they can be modularized with audio ports and directly implemented without having to uninstall the e-tourlabel. But also, if a major change happens or a new generation of e-tourlabels is developed, the scanners would not need to be replaced if the new e-tourlabel was AUX compatible.

6.1.3 THE THREE STRATEGIES

The system would work best if standardized hence the team is aiming for a standardization throughout the industry. Imagining that the team is its own company, there are several strategies to reach the standadization or mass market entrance, described by the following partnership and sales scenarios:

1. The team find potential investors with existing sales channels, like AmpTown (flight case manufactors), and outsource the programming development to Lyngsoe Systems who would need a relatively high payment, or to indian programmers where the salary is low but the quality

can be the same. The team's company would charge rental firms for the implementation, based on the amount of their equipment, and charge a small monthly subscription fee for the application platform, potential updates and service. The team's company would then offer the investors, such as Amptown, to mount e-tourlabels on all their flight cases for free, but having the customers of those flight cases paying a small subscription fee. In this scenario the team's company is based on only profitting from the subscription fees.

Strength: Very low risk for the investor with the sales channels
Weakness: Relies highly on the investor seeing the potential.

2. The team enters a strategic partnership with Easyjob. Easyjob would then develop the software, get the intellectual rights and profit from the system, but the team's company would produce the products for the system, including e-tourlabels, tags and scanners. This way the sales channels are already established, and a known and trusted provider will take care of sales. In this scenario the team's company is based on only profitting from the sales of products to Easyjob.

Strength: Easyjob sell a full system and not only products
Weakness: Easyjob might be reluctant of disrupting their existing products.

3. The team would need investors to cover for the production cost and partner up with Lyngsoe Systems in order to develop and test the software. The team would then start channeling the system to rental firms by attending the Prolight + Sound trade fair in Frankfurt 2017. The team can then sell the rights through royalties to flight case manufactors or inventory management software firms, when market penetration has reached a critical mass.

Strength: Very low risk for the investor with the sales channels
Weakness: Relies highly on the investor seeing the potential.

The team decided that strategy number 2. would be the most likely to be achieved, since Easyjob's product solutions, barcode scanners etc., have not been implemented succesfully in the market, and this solution could work as an update of their product portfolio. The team also found it a bit unlikely that companies like Amptown, who only sell products, would be willing to start selling product service systems. Their customers are used to paying a fixed price for a specific product, and not whole systems and extra subscription fees. The risk is simply too high for strategy 3, especially when considering that other inventory management companies, like Easyjob, could introducere a likewise solution before the development has even finished, but the idea of going to the Prolight + Sound trade fair is still a valid idea to probe the concept.

6.1.4 BUSINESS MODEL

The business model is based on the 9 aspects of the Business Model Canvas (Osterwalder, A. 2010):
The customer segment is within a segmented and diversified market with mainly the LEC's, but a possible expansion area could be the military industry. The solution sells control and overview, and solves the LEC's problems with managing equipment and gives an extra value in terms of the light guide and the potential of the digital display. The value is a status, a potential cost reduction and convenience through automation and digitization.
The solution will be sold through an inventory management company's existing online channels, and the product is introduced on the Prolight + Sound trade fair. The solution will be sold as both a small asset sale and a subscription fee relating to the amount of equipment needed for installment and the application platform and potential updates. Service, along with potential updates for the app, will also be a part of the customer relationship, which could be expanded into courses on ways to best utilize the system.
The price is going to be both volume dependent and fixed in order to accommodate for Easyjob's existing paying method, but it can be done by bargaining in the initial introduction period, until a critical mass of customers has been established. Lyngsoe is seen as the technological partner providing the scanning and Bluetooth Mesh technology, CSR could also be ideal if Lyngsoe Systems can not develop the Mesh technology. Easyjob is naturally the main partner and the economic relationsship is hard to anticipate due to it depending on the bargaining when engaging the collaboration.
The intellectual ressources such as the application platform will be held by Easyjob, and the physical ressources such as e-tourlabels, scanners and tags will be held by the team's company. The key activities are the maintanence and expansion of the application platform, and the servicing and further development of equipment - the team will provide content for the app. Once the development of the system has reached a sufficient level, the business will be more Value driven, in terms of creating content for the system as e.g. importable plan views of various venues. Economies of scale will help the team in terms of cost advantages when the quantity of production reaches a critical point, from where on the average cost of each unit will decrease.

6.1.5 COMPETITION

It is obvious that Easyjob is very established when it comes to their product portfolio. The Easyjob product portfolio relies on barcode technology which is hard to automate in event environments, but Duco gives a close to full automation and it has an extra element with the light guide. Also Easyjob has got its flaws in terms of flexibility and is not always praised by the

users. When analysing the market it became evident that no one had automation of event processes as a value, but they came close in other industries. CSR showed that they could 'automate' several hundred lighting glow sticks and control it with the use of an iPhone which makes them ideal partners for collaboration, and if not, they could be serious competitors if they began exploiting their RF technology to more advanced systems.

6.1.6 POTENTIAL REVENUE FOR GREI

The estimated sales price when selling the e-tourlabel to Easyjob is roughly estimated using a markup of two, in order to cope with unexpected expenses, making it 200-400 DKK. In this case the highest value of production unit cost and lowerst value of sales price to Easjob are used to make up for uncertainties, making the production unit cost of the E-tourlabel 200 DKK, and the sales price for Easyjob 300 DKK resulting in a revenue of 100 DKK per e-tourlabel.

A potential revenue stream can be roughly calculated for the e-tourlabel, using the assumption that the average LEC of the 750 using Easyjob in Europe, has around 500 flight cases, hence they need 500 e-tourlabels. Even though the average LEC also needs roughly 8.000 RFID tags, 1.000 NFC scanners and 10 UHF scanners, the cost price is hard to calculate due to the many variables.

If all 750 average LECs in Europe bought 500 e-tourlabels, and Easyjob bought the e-tourlabels through GREI at a sales price of 300 DKK, resulting in a potential 100 DKK revenue per e-tourlabel, the potential revenue for e-tourlabels only would be 37.500.000 DKK.

750 x 500 x 100 DKK = 37.000.000 DKK

E-TOURLABEL REVENUE GUESTIMATE

750 LECs in Europe:

AROUND 750 AVERAGE SIZED LEC'S

500 e-tourlabel is needed per average sized LEC:

AROUND 375.000 E-TOURLABELS

Potential revenue per e-tourlabel sold to Easjob:

AROUND 100 DKK

Potential revenue for e-tourlabels sold to Easjob alone in Europe:

37.000.000 DKK REVENUE IN EUROPE

6.2 IMPLEMENTATION

The previous section covered the market which ended with considerations on potential revenue hence the next step is to consider the implementation.

6.2.1 IMPLEMENTATION

Despite not being part of the strategy, and potentially dangerous in relation to potential patenting, the team decided that it would be an ideal vision to bring a prototype and presentation material to the Prolight + Sound trade fair in Frankfurt 2017. Due to Duco resonating well with the themes of event technology, communications technology and AV production, it is very likely that it could be a stepping stone to finding investors, and if not, the interest and validity can be confirmed . In order to do it, the team would need to make an investment plan containing information about how far the team is with the development, what they need in order to enter the market and when. The team aim for entering the market within a maximum of 5 years, with various milestones to be reached.

Year 1

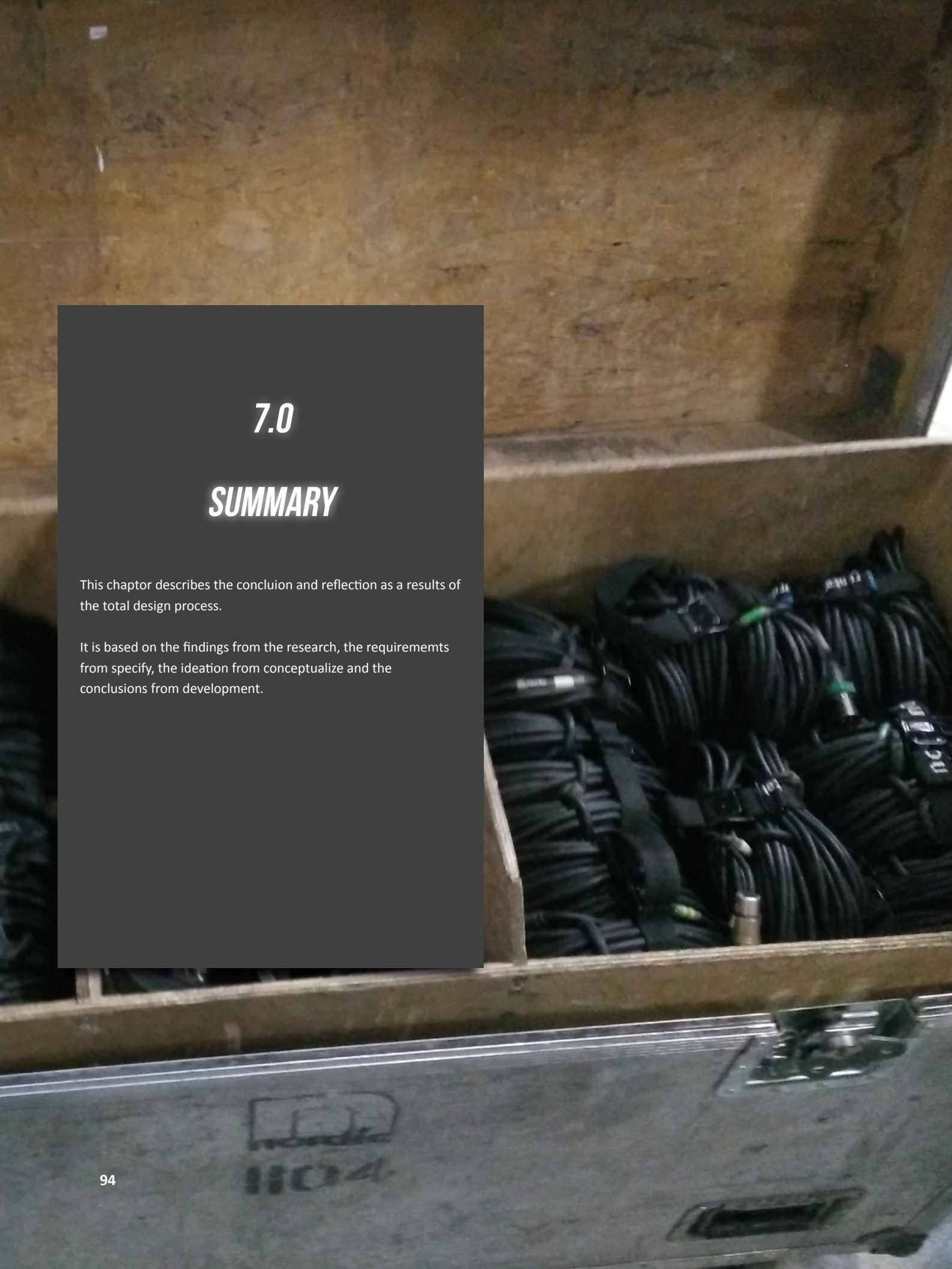
- Visit Prolight + Sound trade fair and search for investors
- Start collaboration with Lyngsoe and Easyjob
- Development of the first 100 prototypes

Year 3

- Implementation period with testing the first 100 prototypes
- Optimization of the production.

Year 5

- Product presentation at Prolight + Sound trade fair
- Market entrance



7.0

SUMMARY

This chaptor describes the concluion and reflection as a results of the total design process.

It is based on the findings from the research, the requirememts from specify, the ideation from conceptualize and the conclusions from development.

7.1 CONCLUSION

The project is based on the rapidly growing live event industry and the event manager's and production manager's thrive for a professional result. Knowing that professional tours were planned to an extreme extent, it was decided to focus on the one off events, which narrowed the system criterias. In the end, the result was a combination finding several problems relating to managing equipment, discovering an obvious gap in the market and utilization of emerging technologies within the realm of IoT.

The outcome of the project is Duco. An automated product service system including a digitized version of a previously analog tool combined with an app, assisting the user with overviewing and registering equipment and at the same time providing a motivational feature that eases the process of instructing tasks, and create a professional experience of the dismounting process.

7.2 REFLECTION

THE SUBJECT

The project was based on a two week set-back from a previous subject - a medico product for knee injuries.
The team revised all possible subjects and the choice was based purely on the fact that one of the members had a large amount of inside knowledge of the event industry, due to having worked with it for several years. Initially, the subject was more product design oriented and the focus was on optimizing the flight case as a product, because it was a product that had not changed or evolved for decades. The project became problem- and user driven, which resulted in the decision of not only designing a product, but a full solution being the whole product service system. Seen in retroperspective the decision of designing a product service system posed several challenges, the biggest being how to represent the processes and corresponding problems within a comprehensible scope.

PROJECT MANAGEMENT

Initially the team used Trello, an online project management software, in order to delegate tasks and keep an overview of the project at the time.
Trello was neglected shortly after the introduction due to it being to incomprehensive in terms of structuring the tasks and uploading documents, also the team worked side by side, so it seemed foolish to delegate tasks digitally that could be done in a fraction of the time verbally.
The SCRUM board was used briefly as a way to visually and tangibly divide the tasks between the team members. It was also neglected due to it being introduced in a very research intensive point of time in the project, where one or two of the team members would be out interviewing or observing sometimes several days a week.

PROJECT TEAM

The team suffered especially in the start from being a composition of three leader types, which, combined with the problem field being very large, resulted in a lot of time being used on creating a shared understanding of the problem. The specify section has consumed a large part of the project's focus and time, but in the end, the Actor Map, Procedure Map, System Map and Blueprint all helped to create consensus within the team, and the methods were imperative in terms of defining the Strategy.

Another important point relating to the team work was that the team faced with two different directions for the project. The one being a product design task with designing the remote, the other being the service design with designing the app. Initially the team had assumed that the tactility and wow-factor of the remote was the core of motivating the event technician, and the team did not want to make 'just another app', but it turned out completely the opposite, with functionality being

the most important. This made the group ‘‘waste’’ some time designing the remote, even resulting in 3D-models, renderings and 3D-prints, but the aesthetic findings from the remote still counted for the e-tourlabel, which made the work worth it. The worst part was that the finding from Mikkel from Profox, that changed the concept from remote to app, came very late in the process, hence the whole concept had to be revised along with the 2D scenarios. In the end the team learned a valuable lesson about disrupting, or killing ones darling, due to the final solution being very well welcomed by all interviewed users, which kind of sprouted a new energy to the team, even though a lot of work was lost.

COLLABORATION

The team decided not to collaborate with a company after some time in the project which turned out to have positive effects. The fact that the team was not bound by either a specific technology or business model helped the team to think more out of the box and come up with an unseen, but to most, logical solution. Had the team e.g. blindly followed the advise from the expert from Lyngsoe, the solution would have included a stationary port scanner and an LCD smart device, which is a solution seen before in other industries, but one that would be insufficient in this particular case. The team was able to think out of the box in terms of combining various technologies and would probably not have ended up discovering the CSR technology if working with Lyngsoe.

REQUIREMENTS

The team had a hard time grasping the requirements of the whole product service system or validating them in relation to the solution. The solution demands were therefore used as a general guideline which was fullfilled by a combination of the e-tourlabel requirements and the features in the app.

FIELDWORK

The team had a hard time researching the context since the events were mostly executed in the weekends and late at night. It was hard to verify the team’s assumtions when having to wait a week or two, and at the same time the weekends did not suit the team as being the time spent on researching.

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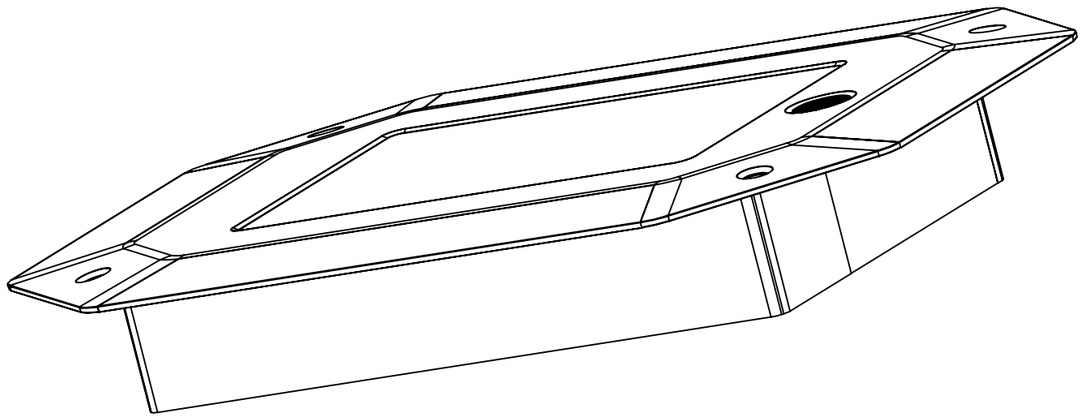
7.3 LIST OF ILLUSTRATIONS

The illustration numbers not listed below are own illustrations:

Ill. 1.1.1: avolties.com
Ill. 2.1.1: prolight-sound.de
Ill. 2.1.2: martin.com
Ill. 2.1.3: martin.com
Ill. 2.1.4: avolties.com
Ill. 2.1.5: martin.com
Ill. 2.1.6: lightpartner.dk
Ill. 2.1.7: protonic-software.com
Ill. 2.5.1: protonic-software.com
Fig. 3.1.1: profox.dk
Ill. 4.1.1: lowes.com



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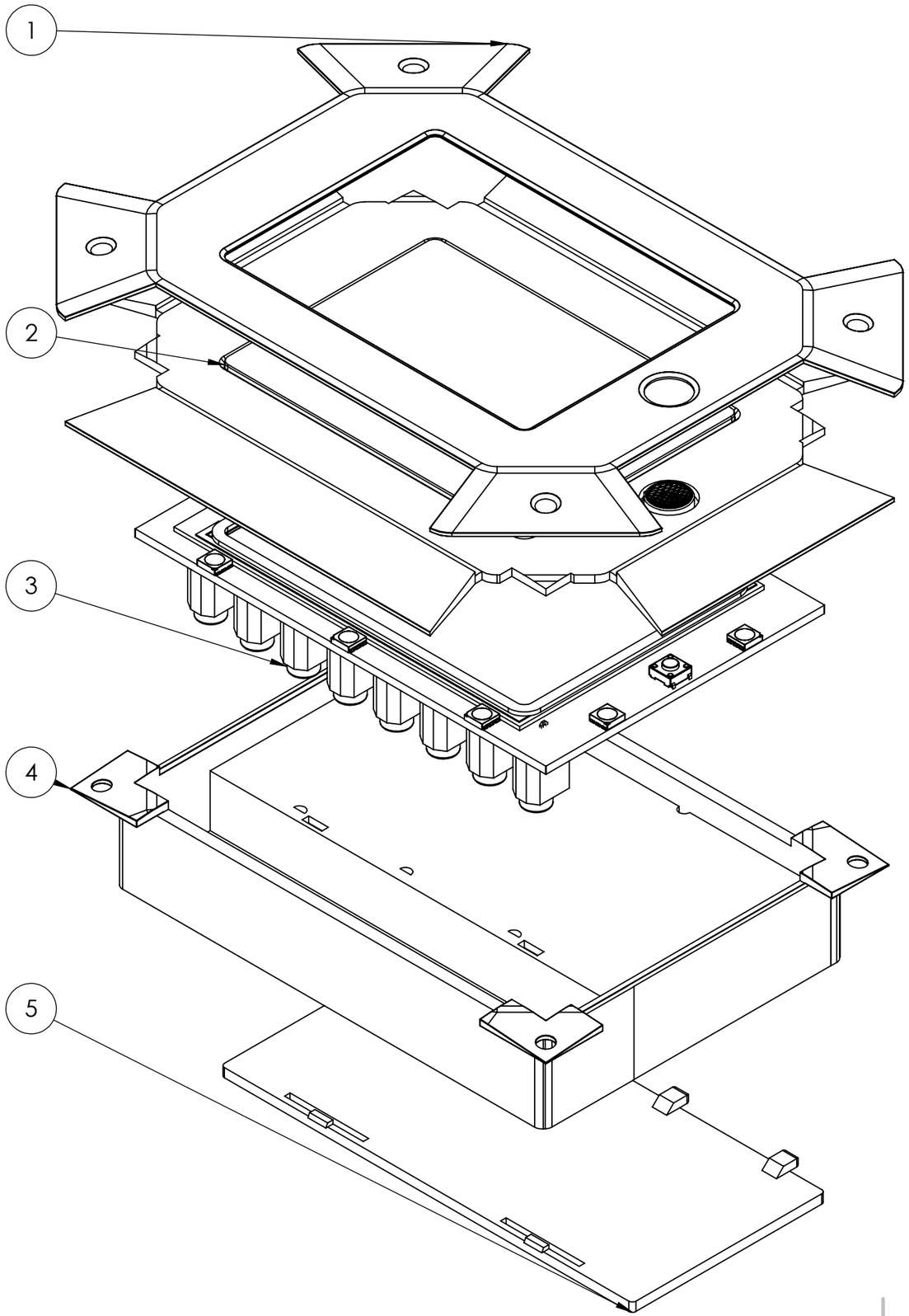
	NAME	SIGNATURE	DATE				TITLE:
DRAWN							
CHK'D							
APPV'D							
MFG							
Q.A				MATERIAL:			DWG NO. e-tourlabel
							A3
				WEIGHT:			SCALE:1:2 SHEET 1 OF 1



ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	frame	Aluminum	1
2	Shield	Polycarbonate	1
3	pcb board	Expoxy	1
4	casing	PVC	1
5	battery door	PVC	1

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:	FINISH:		DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING	REVISION		
	NAME	SIGNATURE	DATE				TITLE:
CHK'D							
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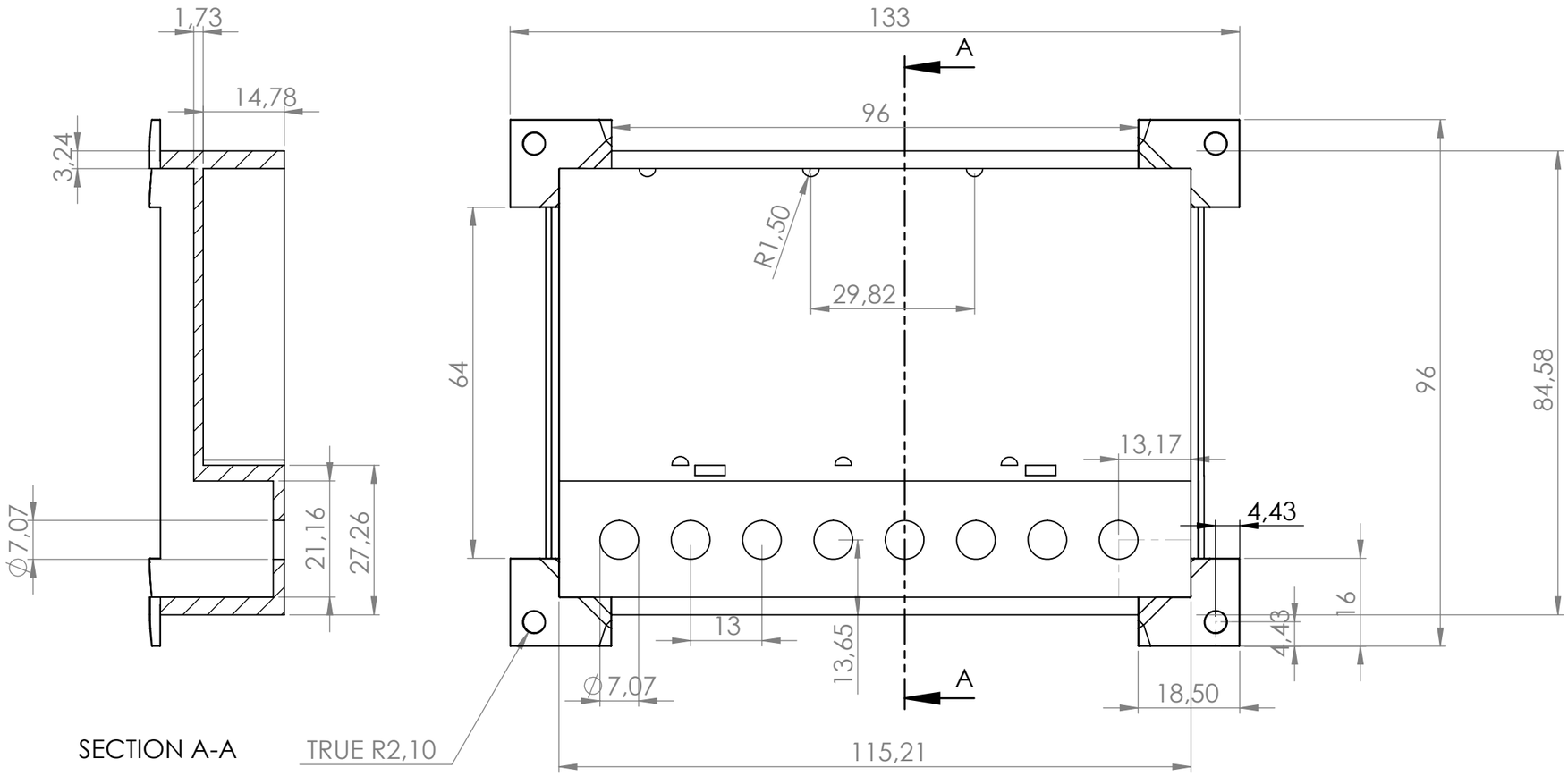

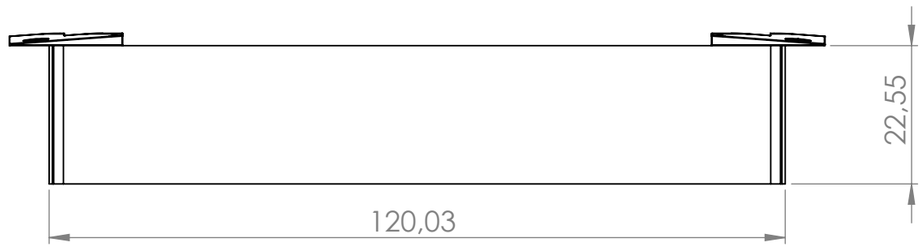

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
4	casing	PVC	1

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:		FINISH:			DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING	REVISION
	NAME	SIGNATURE	DATE			TITLE:	
DRAWN							
CHK'D							
APPV'D							
MFG							
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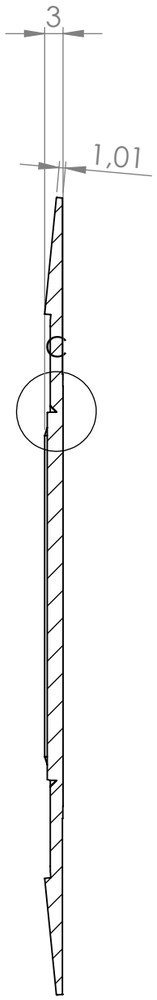
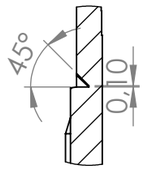
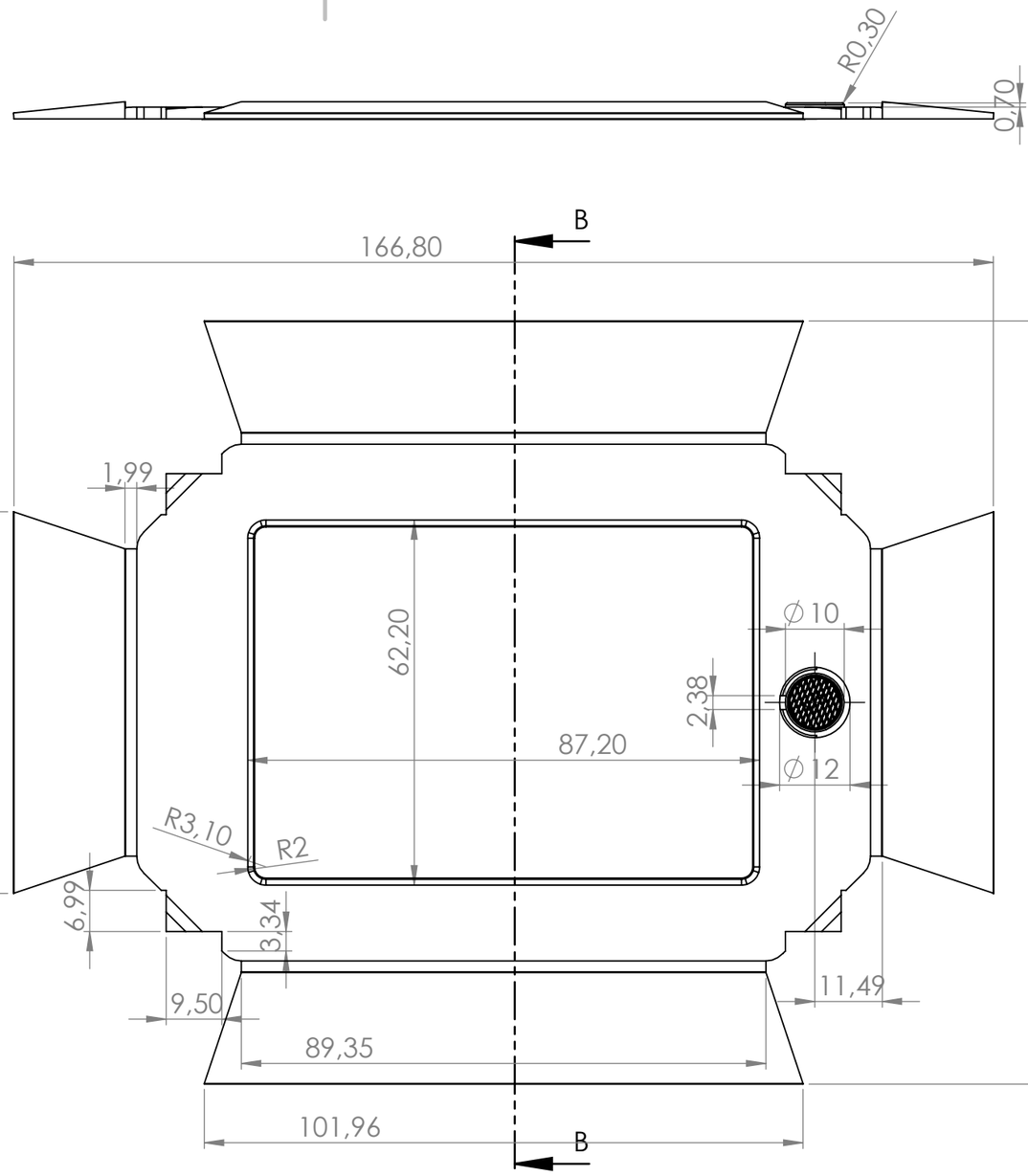


SECTION B-B
SCALE 1 : 1



DETAIL C
SCALE 2 : 1



ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	glas	Polycarbonate	1

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:		FINISH:		DEBURR AND BREAK SHARP EDGES		DO NOT SCALE DRAWING	REVISION
	NAME	SIGNATURE	DATE			TITLE:	
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APPV'D							
MFG							
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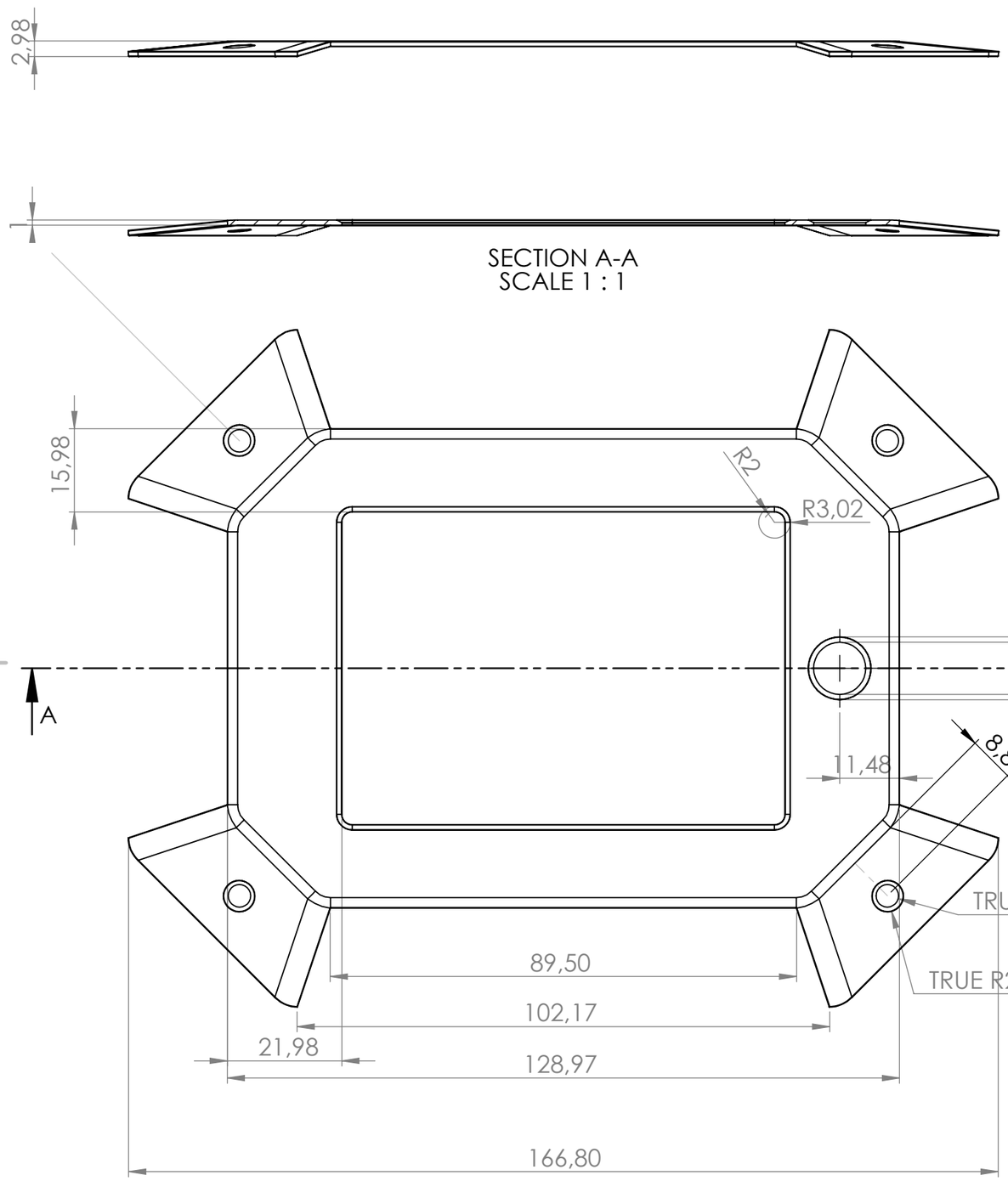

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	alu part	Aluminum	1

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:		FINISH:		DEBURR AND BREAK SHARP EDGES		DO NOT SCALE DRAWING	REVISION
	NAME	SIGNATURE	DATE			TITLE:	
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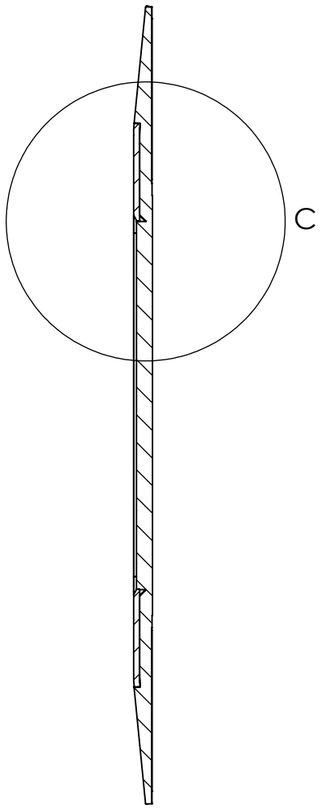
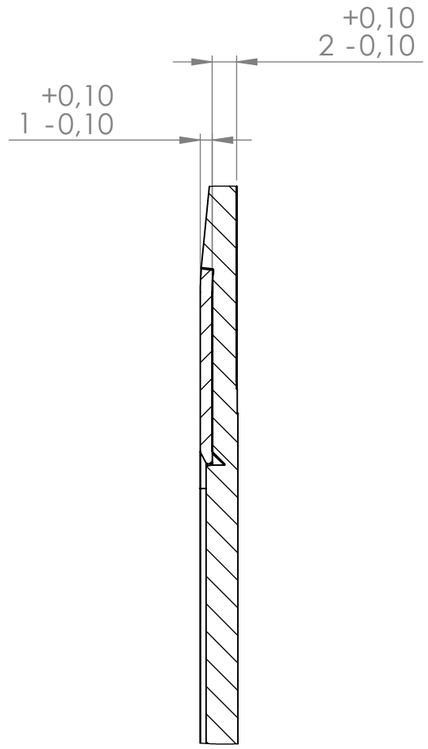
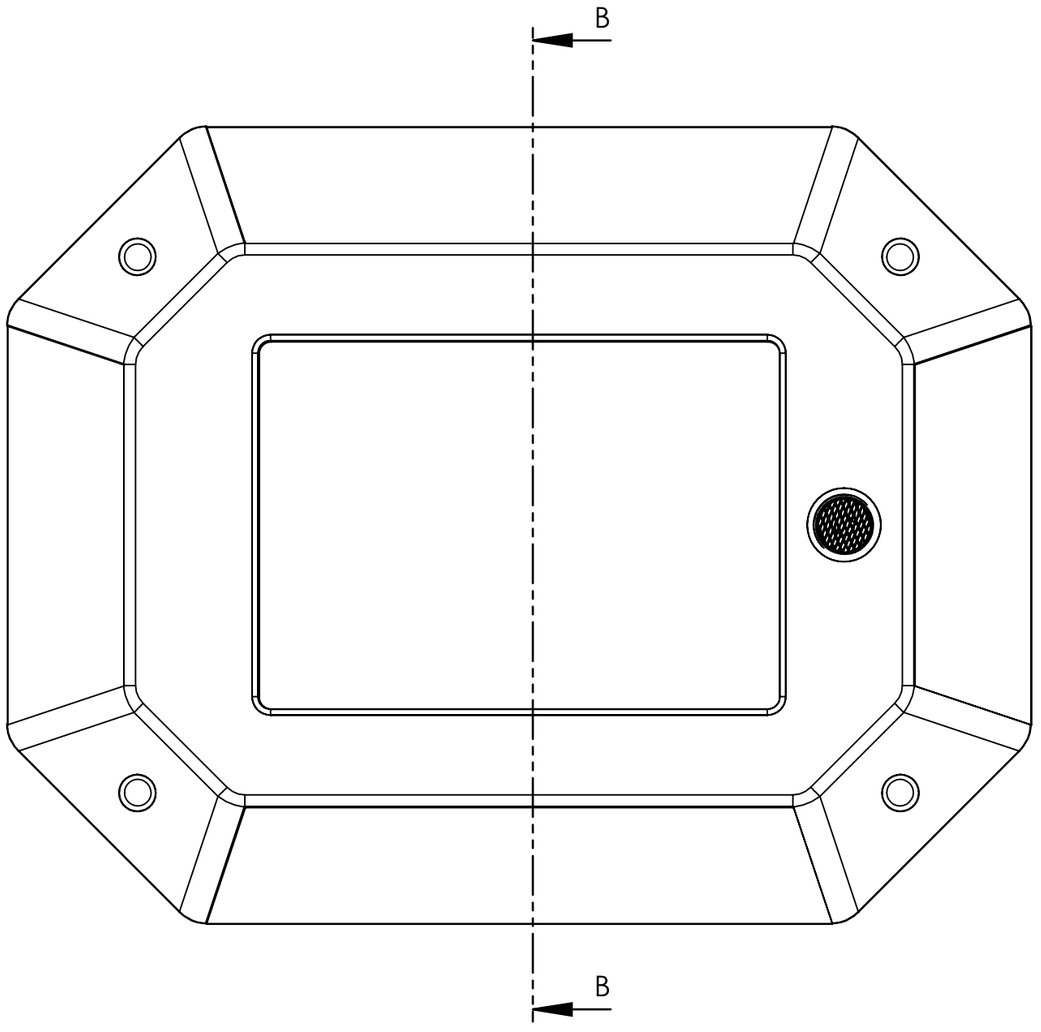


SECTION B-B
SCALE 1 : 1



DETAIL C
SCALE 2 : 1



UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:		FINISH:		DEBURR AND BREAK SHARP EDGES		DO NOT SCALE DRAWING	REVISION
	NAME	SIGNATURE	DATE			TITLE:	
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APPV'D							
MFG							
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