

DYNAUDIO
Ambient 1

Product Report

MSID 04 - Group 1
Aalborg University 2020

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Title Page

Title:
Sound of the Future

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20

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Introduction

This project was a master thesis project made by three Industrial Design students at Aalborg University.

The project was a product of a case partnership with Dynaudio who manufacts speakers. As so the group chose to work within sound reproduction and developed a new type of speaker. The design process of the speaker was documented through the following Process report and Product report.

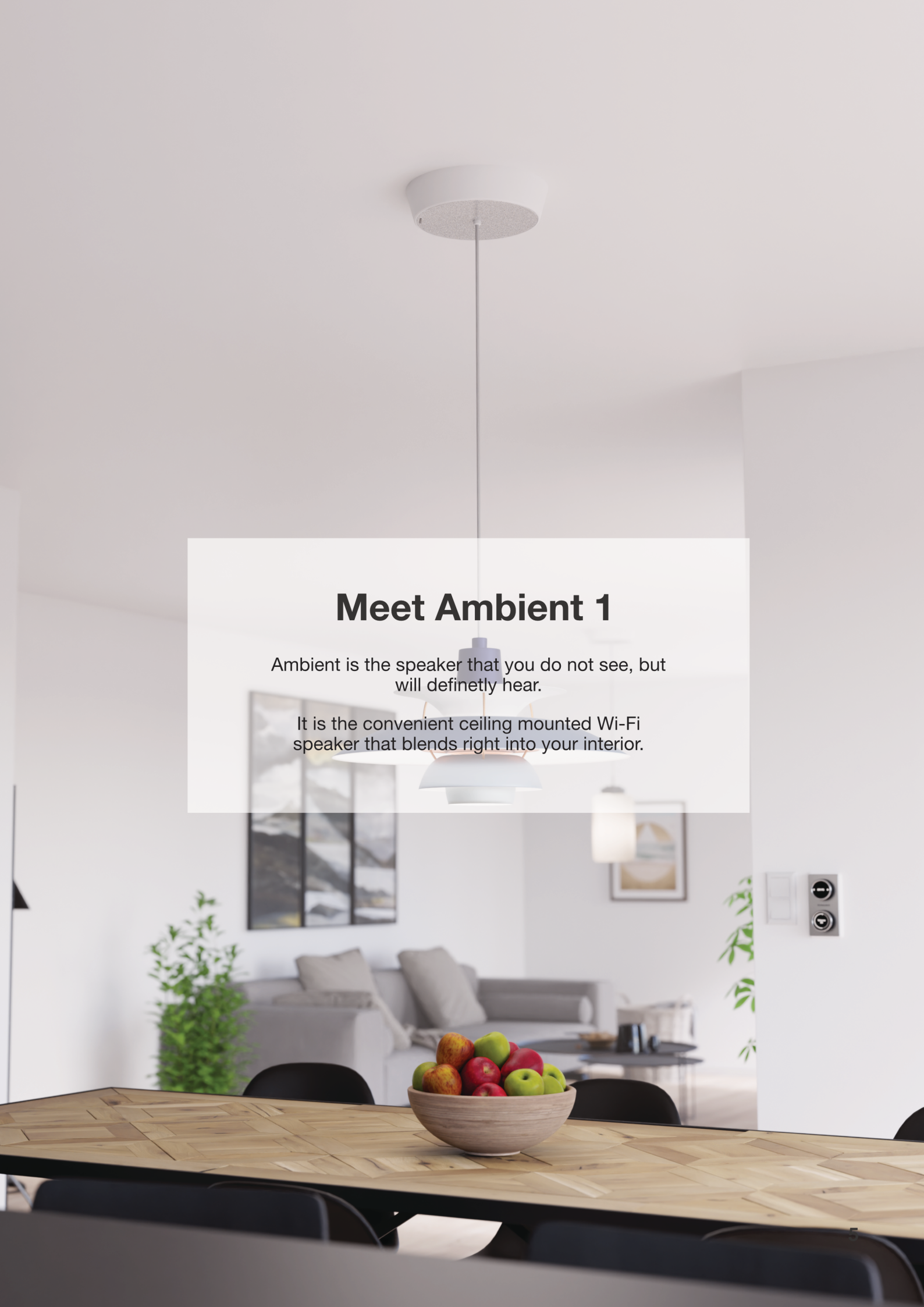


The Oppertunity

As technology evolves so does the devices using them. Conventional passive speaker systems aren’t as popular as they once were.

They are deselected in the favor of soundbars and smaller bluetooth speakers, as these type of speakers requires less effort to use and because they are less visible in the interior.

We think that we can take that one step further.



Meet Ambient 1

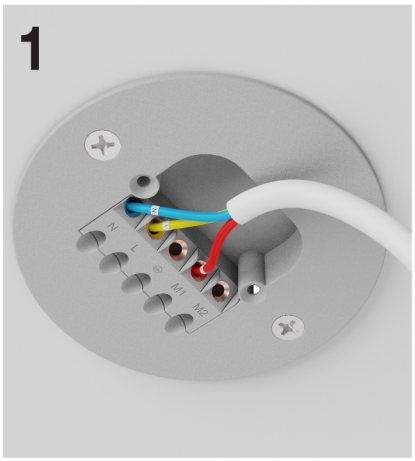
Ambient is the speaker that you do not see, but will definetly hear.

It is the convenient ceiling mounted Wi-Fi speaker that blends right into your interior.

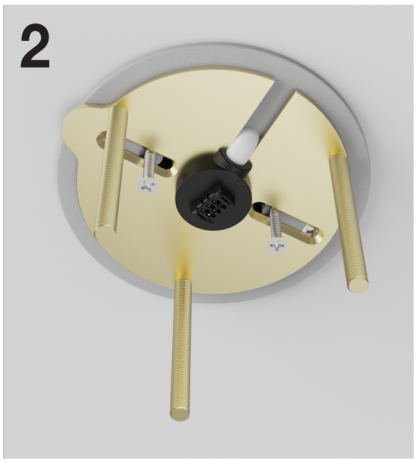
Box contents



Installation process



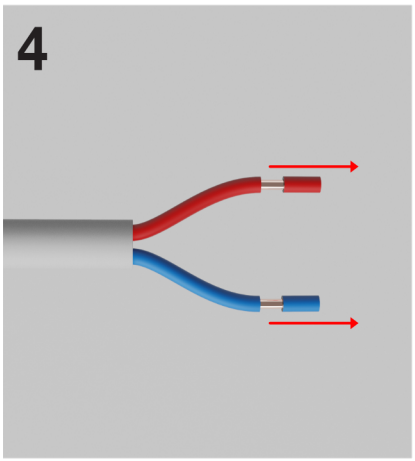
Connect the labeld wires to the corresponding terminals in the ceiling outlet



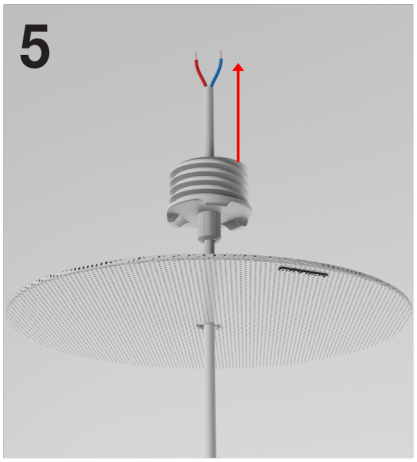
Install the ceiling mount above the ceiling outlet



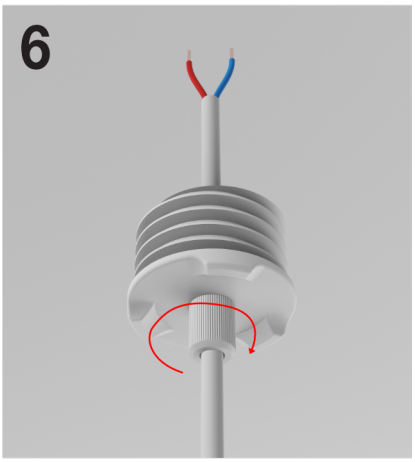
Install and secure the speaker unto the ceiling lamp with the three thumbnuts



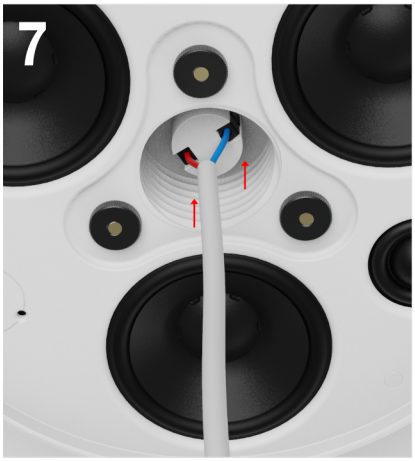
Remove 5mm of isolation on each of the lampcord wires



Pull 5cm of wire through the grill and plug



Lock the pinolt by tightening the thumbscrew



Install the stripped lamp cord into the snaplocking terminals



Screw in the plug to secure the lamp to the speaker.

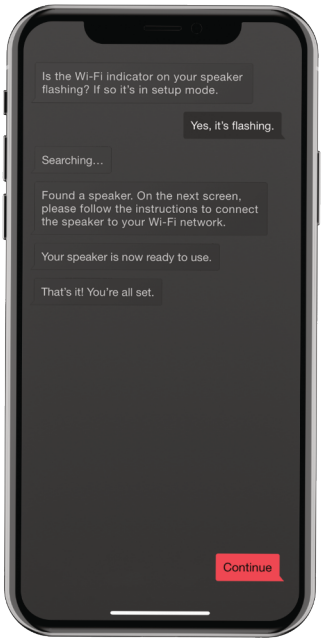


Snap on the magnetic grill, and you are done! If you wish to adjust the height of the lamp, simply losen the pinolt, adjust, and retighten.

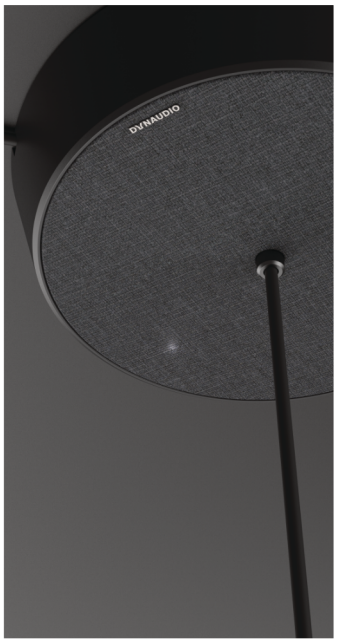
Wi-Fi Setup



Download and open the Music App. Press ‘Add speaker’ to start setup



Follow the setup process, select your network and input the passphrase

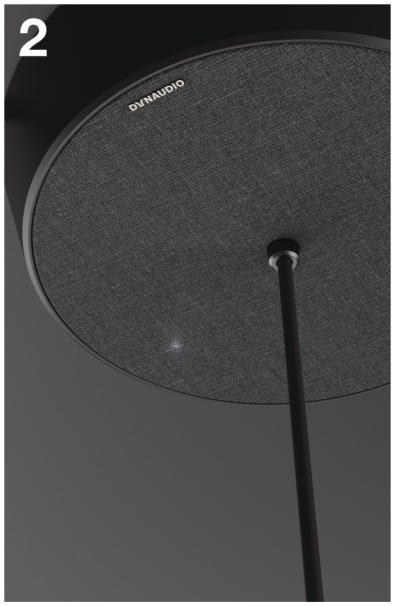


The speaker LED will light up for 10 secs, to indicate setup is finished

Remote setup



Hold the button on the back for 15 sec, while holding the remote up to the speaker you want to pair it with



The speaker LED will pulse five times to confirm the paring.



Your remote is now connected. Use the Music App to add presets.

Streaming

Ambient 1 support the following streaming platforms:

Airplay

Spotify Connect

Google Cast

Remote

The Ambient 1 system remote allows you to change between a series of customizable presets, aswell as adjusting the volume







Packing a punch

By using three 3 inch drivers, the Ambient 1 is able to achive the same great performance as the Dynaudio Music 1

Room-filling sound

The Ambient 1 grill" is developed to use the princple of constructive and destructive interference to spread the soundwaves to the whole room



Wallmount it

Ambient 1 is not locked to being mounted in combination with a lamp.

Install the bracket on the wall, connect it to power, and let the music flow.

Enough for all of them

The speaker weighs in at only 1775g. The strong Polypropylene construction that is the outer shell of the Ambient 1, allows you to choose what ever size of lamp you want. Don’t worry, it can take it.

When the summarized weight of the speaker and your lamp is more than 5 kg, it is recommended to hardmount the ceiling mount to the building structure it self.





A whole Orcestra

Two is better than one, right? You can group multiple Ambient 1's in the Music App and configure them in a Left & Right stereo setup.

Each group can be controlled by a single system remote.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Future proof

Lets face it. Technology will age, and new connectivity will come along. But don't worry.

The upgrade module allows you to replace the connectivity interface of the Ambient 1, and replace it with all of the latest.

Upgrade process



Uninstall the speaker, by removing the grill and the three thumbnuts



Carefully remove the old module, by gripping it at both finger notches



Pack the old module down into the box of the new upgrade module



Install the new module



Seal the box with the included shipping label, and ship the package back for recycling

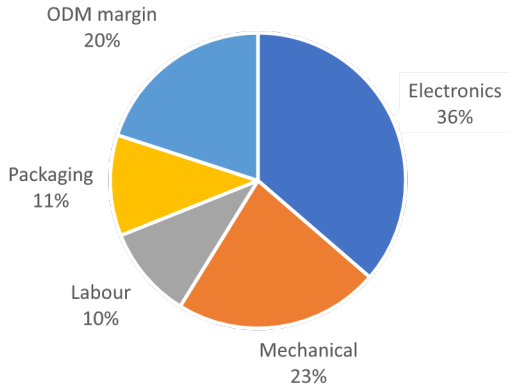


Reinstall the speaker

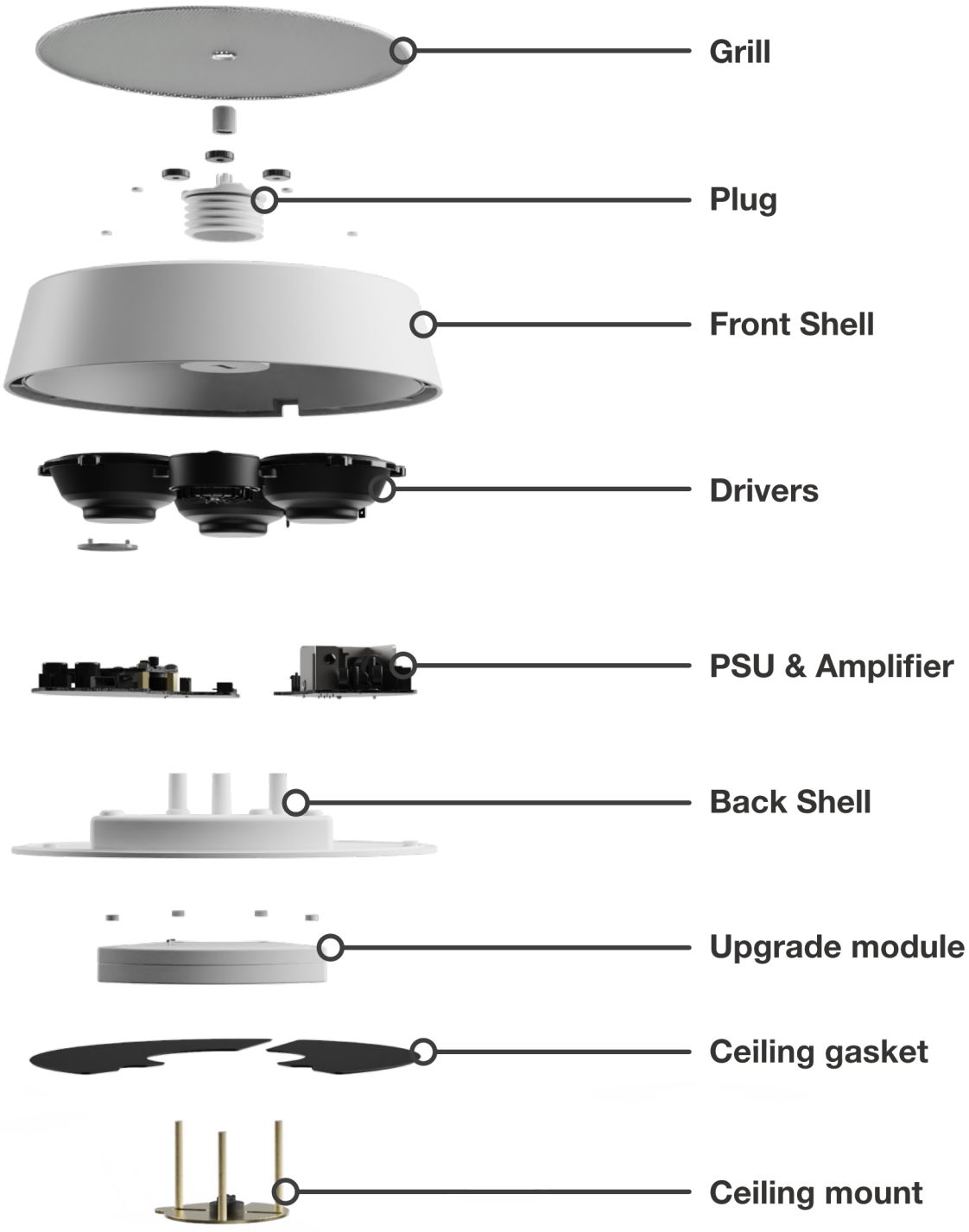
Cost price

The total estimated production cost for the Ambient 1 is 1042 kr. With a Contribution margin of 65%, and a Retail margin of 40%, the retail price ends up at 2999 kr.

Category	Price
Electronics	378.6 kr.
Mechanical	234.2 kr.
Labour	105.6 kr.
Packaging	115.2 kr.
OEM margin	208.4 kr.
Total	1042 kr.



Stage	Price	Cut
Price at OEM	1042.05 kr.	
Contribution Margin (Dynaudio)	677.34 kr.	65%
Sales price @ Factory	1719.39 kr.	
Contribution Margin (Retail)	687.76 kr.	40%
Retail Price (Excl. VAT)	2407.14 kr.	
VAT	601.79 kr.	25%
Retail (Incl. VAT)	**3008.93 kr.**	

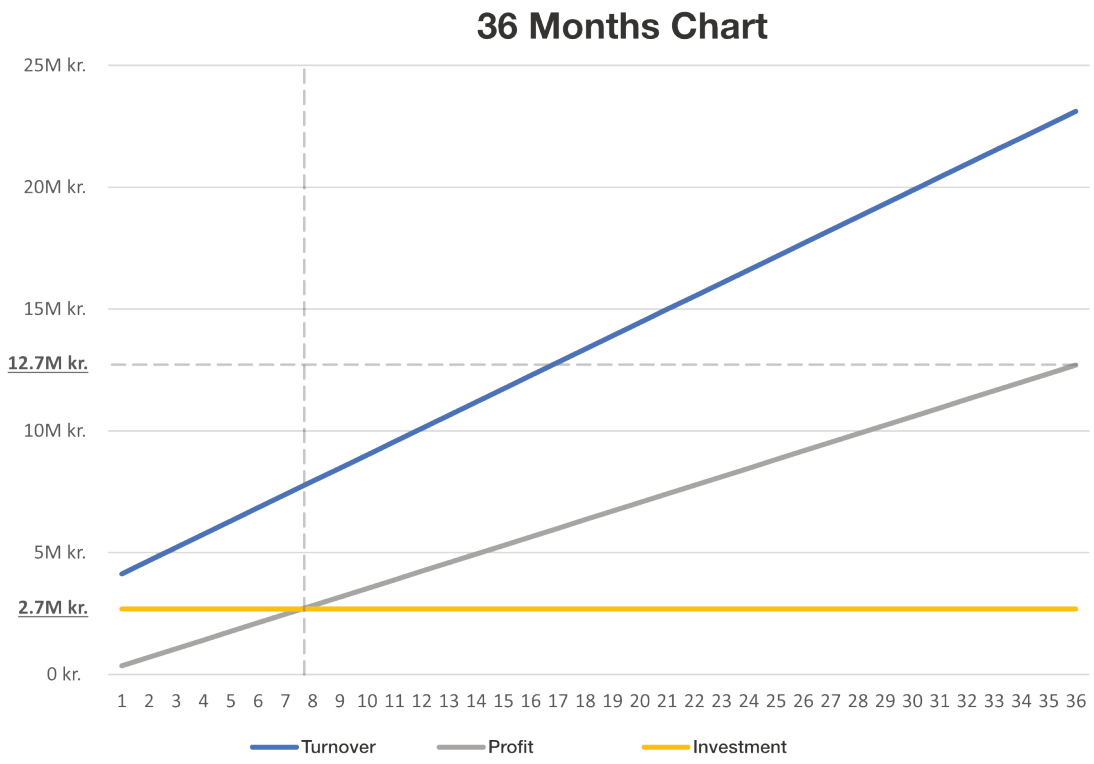

Grill
Plug
Front Shell
Drivers
PSU & Amplifier
Back Shell
Upgrade module
Ceiling gasket
Ceiling mount



Market potential

If the monthly sales estimate of around 500 units globally is met, the project will break-even just before 8 months.

If the sales continue as projected for three years, the project will yield a profit of 12.7M kr.



Operation value chain

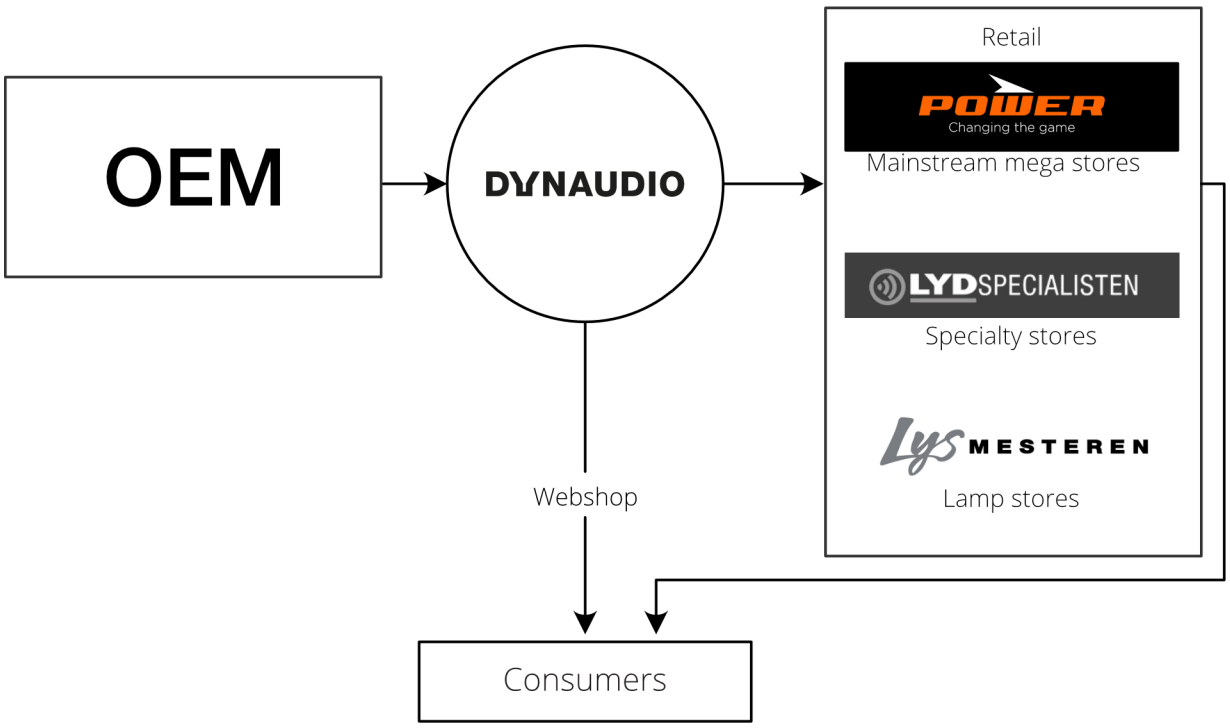
In order to make this project feasible, it is prefered to use an Original Equirement Manufacturer, for the production.

We design the product right here in Denmark, and get an OEM to produce it.

As Ambient 1 is a mainstream targeted product, it is essential to sell it through mainstream sales channels, such as Power.

As it interacts with lamps, lampstores could be another potential sales channel.

Lastly, if the infastructure allows it, a Dynaudio webshop could cut out the retailer margin and increase the profit generated.



Let it rumble!

To allow the user to increase their systems capacity, we suggest to initiate the development of a Wireless subwoofer for the Ambient system.

The idea is to base the subwoofer on the large Music driver, and place the drivers in a Reactance Canceling Configuration (RCC) to eliminate vibrations and rattle.

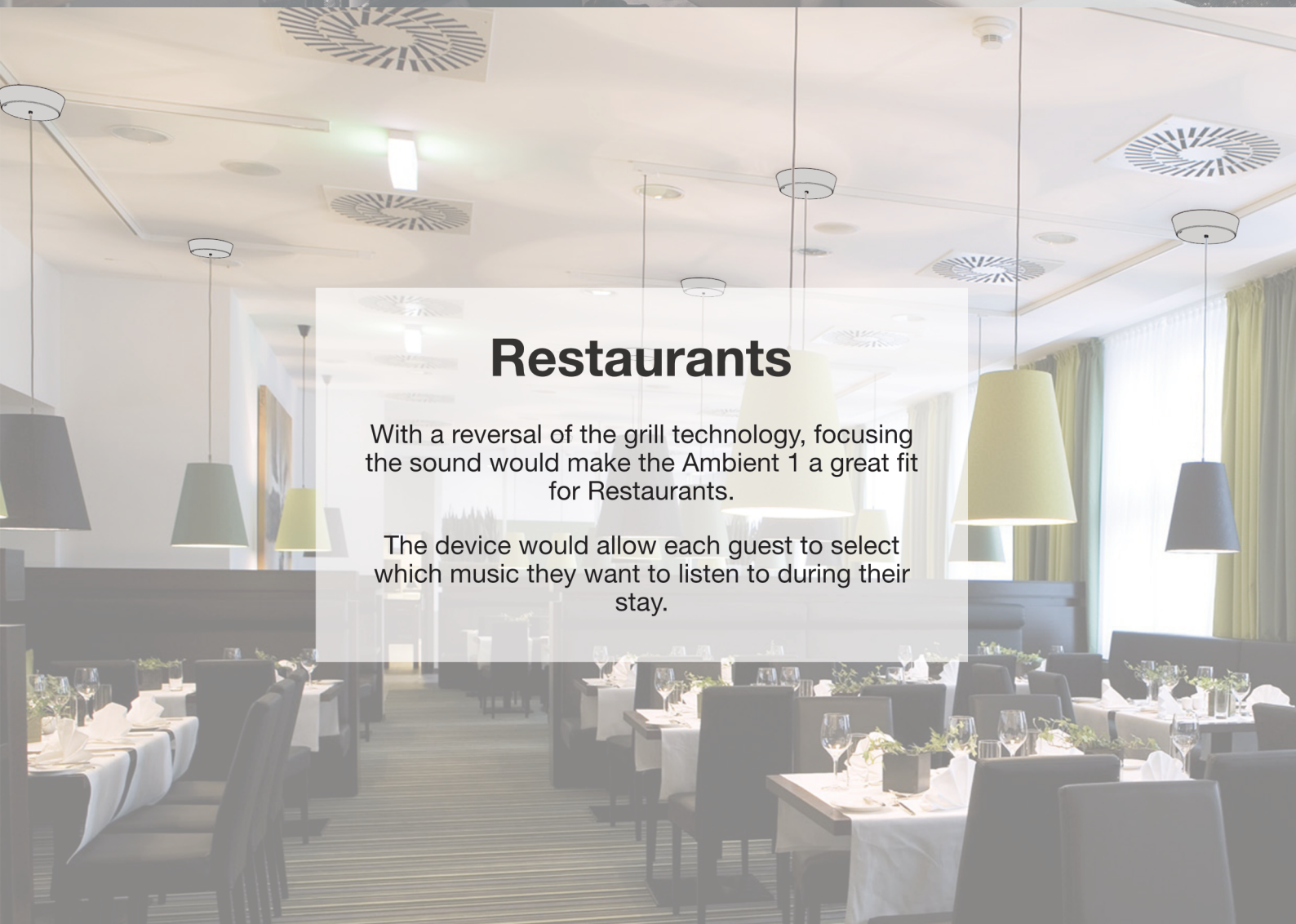




Hotels

With the integration of Bluetooth in the remote, it would be possible for hotel guest to easily connect to the Ambient 1.

The mouting position of the speaker would prohibit the guests from tampering with the device itself.



Restaurants

With a reversal of the grill technology, focusing the sound would make the Ambient 1 a great fit for Restaurants.

The device would allow each guest to select which music they want to listen to during their stay.



AALBORG UNIVERSITET

DYNAUDIO

Ambient 1

Process Report

Msc-ID 04, Group 1
Aalborg University 2020

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0.1 Title Page

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0.2 Prephase

This project was made by three Industrial Design master thesis students at Aalborg University. The project was a product of a case partnership with Dynaudio who manufacts speakers as so the group chose to work within sound reproduction and developed a new type of speaker. The design process of the speaker was documented through the following Process report and Product report.

0.3 Achnowledgements

We would like to thank our main supervisor Christian Tollestrup and technical supervisor Michael Skipper Andersen for their supervision and contribution to our process and project. Additionally we would like to thank the participants in our exercises and interviews along with Dynaudio, without this project would not have been possible.

0.4 Abstract

This project has been about developing a speaker for newly built houses. The vision for this project was to design a suggestion for a speaker for Dynaudio that can reposition and introduce them on the mainstream market in the future.

As technology evolves so does the devices using them. Conventional passive speaker systems aren't as popular as they once were.
They are deselected in the favor of soundbars and smaller bluetooth speakers, as these type of speakers requires less effort to use and because they are less visible in the interior.
By user studies and trend investigation of user demands in regard to sound reproduction, we managed to create a solution space in which our solution was developed.
Dynaudio Ambient 1, is a multifunctional speaker that hides the speakers in its other function as a lamp canopy. The product requires installation but is easier to install than a normal ceiling lamp. As the speaker is a canopy, it can be used as a retrofit solution in existing interiors as well as new houses. It has a neutral aesthetic that, combined with the possibility of exchanging hardware as it get outdated, contribute to securing its relevance on the market in the future as well.

The project was made during the Corona pandemic, which caused a shutdown of interaction with people in public, nationally and globally. As such user testing was restricted.

0.5 Reading Guide

The project consists of the following document.
Project Report: Provides a presentation of the product proposal
Process Report A presentation of the key activities of the design process. For further details, references are placed for the full dataset in the appendix document.
Appendix: Provides the full dataset for the exercises presented in the process report.
Technical drawings Selected technical documentation of the product.
To keep track of the findings throughout the report, information boxes are placed within each section. In the initial development the boxes will show the hypotheses developed based on the investigation. As the project progresses the hypotheses change or get redefined, which is indicated by the last digit (example: Hyp. 6. Version 2 = 6.2). The color of the box changes as hypotheses are validated / falsified throughout the process.

As the project gets more specific the hypotheses will be replaced with demands or user needs. This is indicated similarly, but with the gear icon.

Hypothesis		**Demands / User needs**	
A new hypothesis has been developed based on the exercise.	! 6.0	A new demand has been developed based on the exercise.	⚙ 6.0
A new hypothesis has replaced an existing.	! 6.1	The demand specification has been changed.	⚙ 6.1
A hypothesis has been falsified.	X 6.x	The demand has been removed	X 6.x
A hypothesis has been validated	✓ 6.x	A hypothesis has been validated	✓ 6.x

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1.0 Scope Framing

The first phase was inititated by diving into the product portfolio of our casepartner, to gain an understanding of who they are as a company. We came to realise, that their current offerings are focused upon a niché.

We then looked into the market status of loudspeakers, and realise that it is a market that is shrinking fast, which leads us to our scope. In order for Dyanudio to reinvent themselves, we set out to develop the sound device of the future.

In order for us to gain an understanding for ***the consumer of the future****, a series of user studies were conducted, stating a multitude of hypotheses along the way. These were then summarized into a set of userscenarios.*

To understand the ***context of which the consumer of the future*** *live in, we investiaged floor plans and graphic material describing yet-to-be-build family homes.*

As mean to secure the ***must-have values and features of a futuristic product****, we look into tech and mega-trends.*

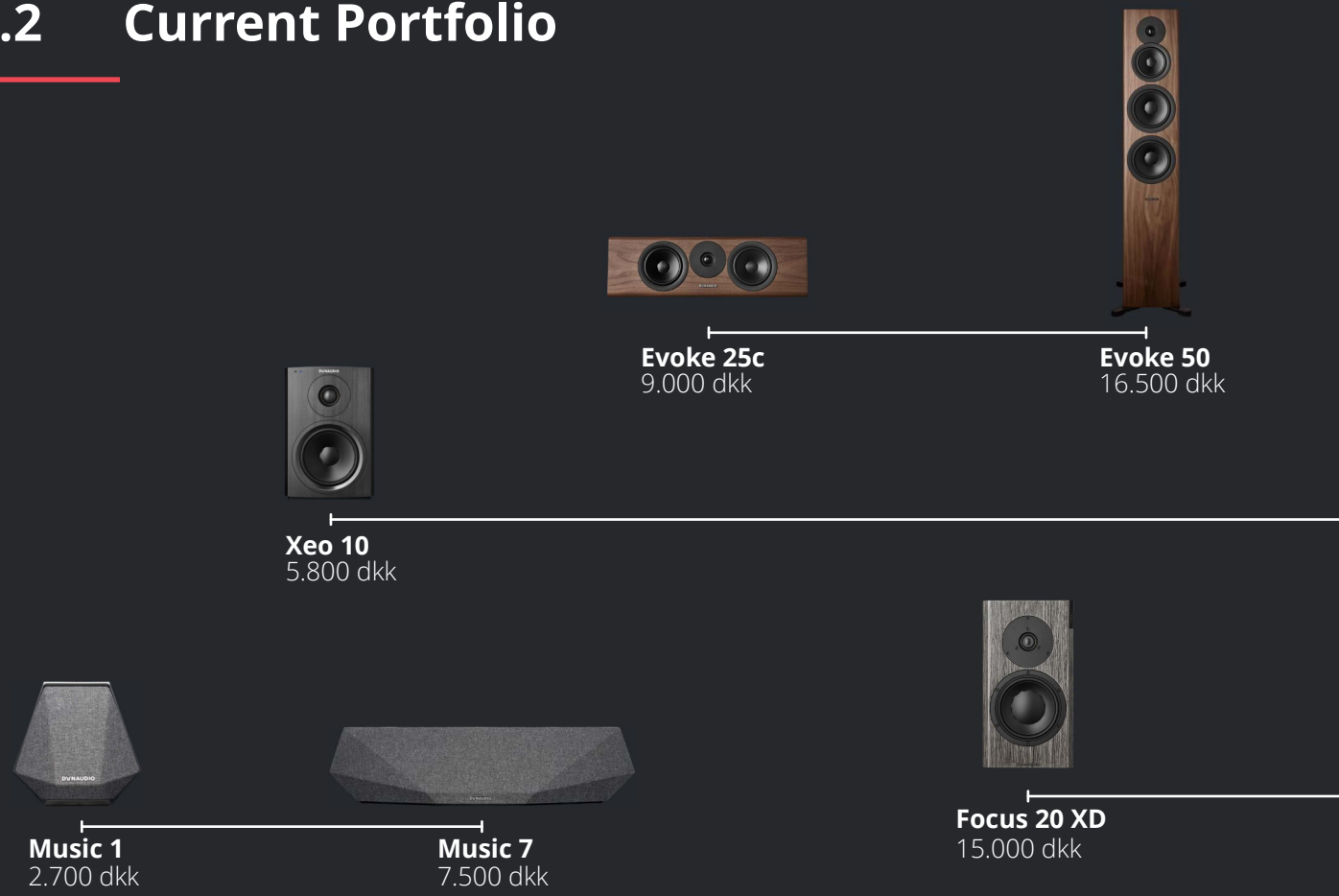
All of this is colledted and framed into three potential solution spaces.

1.1 Dynaudio Intro

Dynaudio is a danish loudspeaker manufacturer, founded in 1977 in Skanderborg. Dynaudio delivers a wide range of speakers for the high-end loudspeaker market, and focuses on achieving the best sound quality possible in these price ranges.

Dynaudio's main customer is the audiophile user. People who value sound- and build quality as the deciding factors when buying a speaker. People who sit down and actively listen to the music, and decide on a music media based on the quality of the sound. This market however is declining, and Dynaudio is experiencing a massive deficit.

1.2 Current Portfolio



Illu. 1. Dynaudio's Product Portfolio





Confidence 20
37.500 dkk

Confidence 60
300.000 dkk





Contour 25c
24.000 dkk

Contour 60
70.000 dkk



Xeo 30
27.000 dkk



Focus 60 XD
60.000 dkk

1.3 SWOT

To get a better understanding of who Dynaudio is as a company, a SWOT analysis was utilized. The information was based on Marcus' knowledge gathered from his time as an intern, and current position as a student worker. The purpose of the SWOT analysis is to get an overview of the company's current position, and possible opportunities/threats, to frame a problem-field.

Strengths - Has 40 years of experience in producing passive loudspeakers. - In-house production, in Denmark and experience with production in China. - High-quality craftsmanship within the high-end market. - Cabinets in MDF and Plastics. - Highly skilled in working with acoustics. - Right to repair, supports repairs of all of their speakers, old as new.	**Weaknesses** - Little experience with external production. - Not a common known brand in Hi-Fi. - Slow adaption to market changes. - Few distribution channels. (Limited to 'Special' uncommon Hi-Fi stores both in DK and other countries)
Opportunities - Already an established and respected brand on the high-end speaker market. - Has developed a decent mobilespeaker and soundbar series. - Distribute products through mainstream retailers such as Elgiganten, Power etc.	**Threats** - Main target group (audiophiles/enthusiasts) is decreasing (Euromonitor, 2019). - Rigid and conservative to change within the company. - Stacked market, lots of competitors and solutions.

1.5 Sound of the future

When looking at Dynaudios current portfolio, their products span over a wide price range, but the main distinction between the speakers are the sound- and build quality. They are all targeting the same user group - even their newest cheaper Music series, as it's only sold through specialists. They do however, from the Music series, have some experience in making cheaper mass-production speakers in China. This could be utilized as an opportunity to make a product for the mass market, and overcome the threat of a declining target group.

The mass market however is quite stacked, and many manufacturers are delivering great solutions. B&O - which is a very similar company structure to Dynaudio - has made the shift to mobile Bluetooth speakers and headsets. Dynaudio however is not as well known by the mainstream market, so different value propositions are needed from the product and company, to attract customers.

Initial problem statement:
The purpose of this thesis is to develop the "sound system of the future" that fits the current and upcoming needs and uses of the regular user in the near coming future. ?

As one of the threats of Dynaudio is their rigid handling of change, and the purpose is to design for the future, the further investigation and development will zoom out, and take basis in the user and not Dynaudio. It's still a wish to design a solution that would be suitable for Dynaudio, but to avoid developing from their existing perspective, Dynaudio will not be a deciding factor initially.

Wishes:
- The system should be developed to be produced and sold by Dynaudio. ?

- It should carry the current Dynaudio DNA / Values, or define a new future DNA / Value.

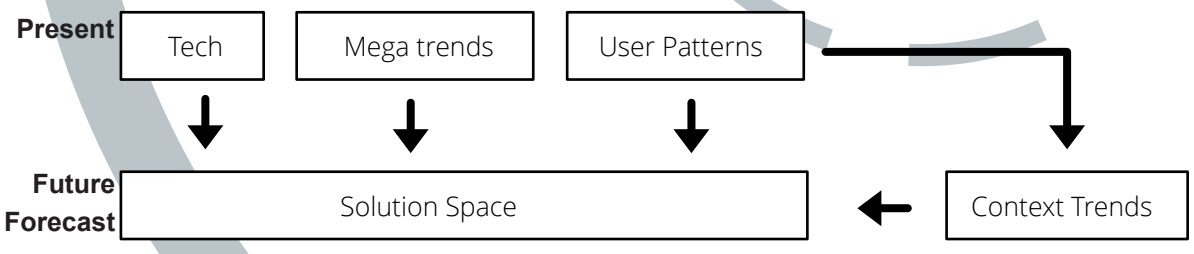
1.4 Strategy

To design the speaker system for the future, a system thinking approach presented by Poul Kyvsgaard (Illu. 2) is used as a starting point. In this you look at the existing (past and present) products (system) in relation to the context/trends (supersytem) they were a part of, and the material- / techtrends (sub-system) at the time. The aim is to understand the future super- and sub-systems, to design a fitting solution.

	Past	Present	Future
Super-System			
System			Our Solution
Sub-system			

Illu. 2. System thinking

In relation to the problem statement, the ambition was to use the before-mentioned approach and look into, tech- and megatrends, and investigate different user patterns in order to make a forecast, that can be combined into a framing and solution space (illu. 3)



Illu. 3. System Approach

1.6 Current state of the loudspeaker market

To make a forecast into the future of the loudspeaker market, we wanted to get an insight into the current state of the loudspeaker market to understand where it is headed and why. The investigation was done by analyzing market reports, while the desired result was to generate hypotheses to the "why" that could be validated further through user studies afterwards.

Data collection

Data for the investigation is gathered from the "Home Audio and Cinema in Denmark" (Euromonitor, 2019) report from Euromonitor. The data focuses solely on the danish market in 2019, as this was chosen as the starting point of the development. The full dataset can be found in **Appendix 1**, while main observations are presented in the table below, together with a hypothesis for further development, to why we see these changes in the market.

Observation	Hypothesis
There is an incline in sales of portable speakers, especially from the younger generations.	The young generation lives a flexible lifestyle, with quick changes of content and context ! 1.0
There is an incline in the sales of soundbars.	People add soundbars to ensure good sound quality to their TV's as TV's get slimmer, their sound quality declines. ! 2.0
There is a huge market decline in home cinema system sales. (Surround sound)	Convenience is important to the users. The setup needs to be easy to install and use. ! 3.0
Sonos has been experiencing a rise in growth and attention after rolling out their partnership with IKEA (style trend speakers)	The users want stylish audio products to go with their current home decoration. ! 4.0

The report shows a shift in the market, towards wireless and mobile solutions. Both the HiFi and the home cinema market showed a decline and are increasingly replaced by soundbars, Sonos or "flexible" Bluetooth speakers. As hypothesis 1 suggests, the shift in the market could be due to changes in the lifestyle of younger generation.
The next step is to look into the content consumption to see if there is any relations between the tendencies on the marked, and shift in content consumed by the users.

1.7 Media Consumption Development

In order to gain knowledge of the type of content the users consume, and if there is any significant change in the younger generation. DR's annual report (DR Medieforskning, 2019) was used, as this was the most thorough report available on the danish market. The report revealed changes in the way the Danes consume content, and the outcome was to identify different use patterns in sound- and media consumption, between generations.

Observation

The DR report compares the media consumption between 15-75 year old's and 15-31. The consumption differs between generations, as the younger generation consumes double the amount of streamt media, but only half the amount of regular TV/radio. The general movement in percentage from 2018 to 2019 is very similar between the different generations. The younger generation change fast, while the older generations slowly adapts.

From the streaming services there will be an increased focus on making content for individuals, than to make a content for larger target groups.

Hypothesis

Media consumption varies between different ages, as younger generations are born with new technological possibilities.

The younger generations are early adapters of new services and devices.

! 1.1

Content gets more personalized and targeted towards the individual user.

! 5.0

According to the DR report, users decide on their content based on three parameters:

Context
Do they have their full attention towards the content, or are doing something else?
How is the mood?

Time
What time of the day is it?
What time do they have available?

Technology / Visibility
Availability of the content
Personal suggestions by the provider
Social suggestions by colleagues

! 6.0

The Danes consume a lot of content, and the type of content, changes depending on the situation, indicating the need for an available speaker. Users tend to consume longer content in the early evening hours, and their content gets shorter and shorter throughout the day *(DR Medieforskning, 2019)*. To develop a new sound solution, we need a deeper insight into how the content, technology, time and context affect each other, and if there is any design opportunities within this. As the report suggests, the younger users are early adapters, the insight needs to be gathered within this user group, as they are the future generation.

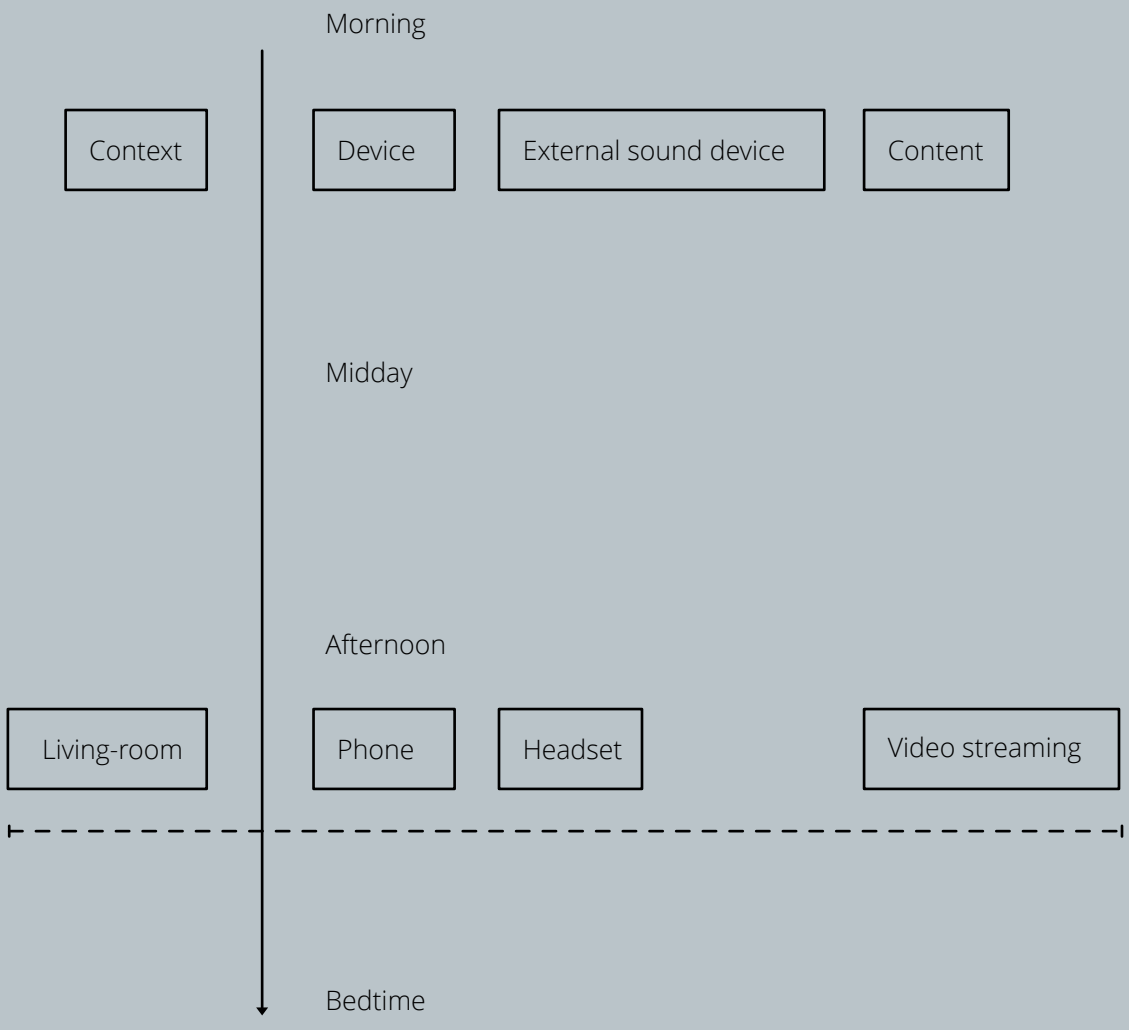
1.8 User studies

A user study was conducted to validate the hypothesis found in the initial **research (1.6 & 1.7)**, to identify patterns in their content, context, and technology/time. The study was based on hypothesis 6, extracted from the DR report.

To do so an interview exercise was conducted, in which we asked a user to take us through a normal day: From getting up in the morning to going to bed in the evening - while we mapped each time, audial content of some kind was consumed.

Throughout the interview the mapping was documented on a timelime **(See ill. 4.)**, Together with the subject. The vertical line represents a timeline for the entire day, on the left side the context of the consumption is noted, and on the right side the device and content. The mapping is done using general categories such as videostreaming (covering all video content online), music streaming or gaming, for easy comparison.

Example:

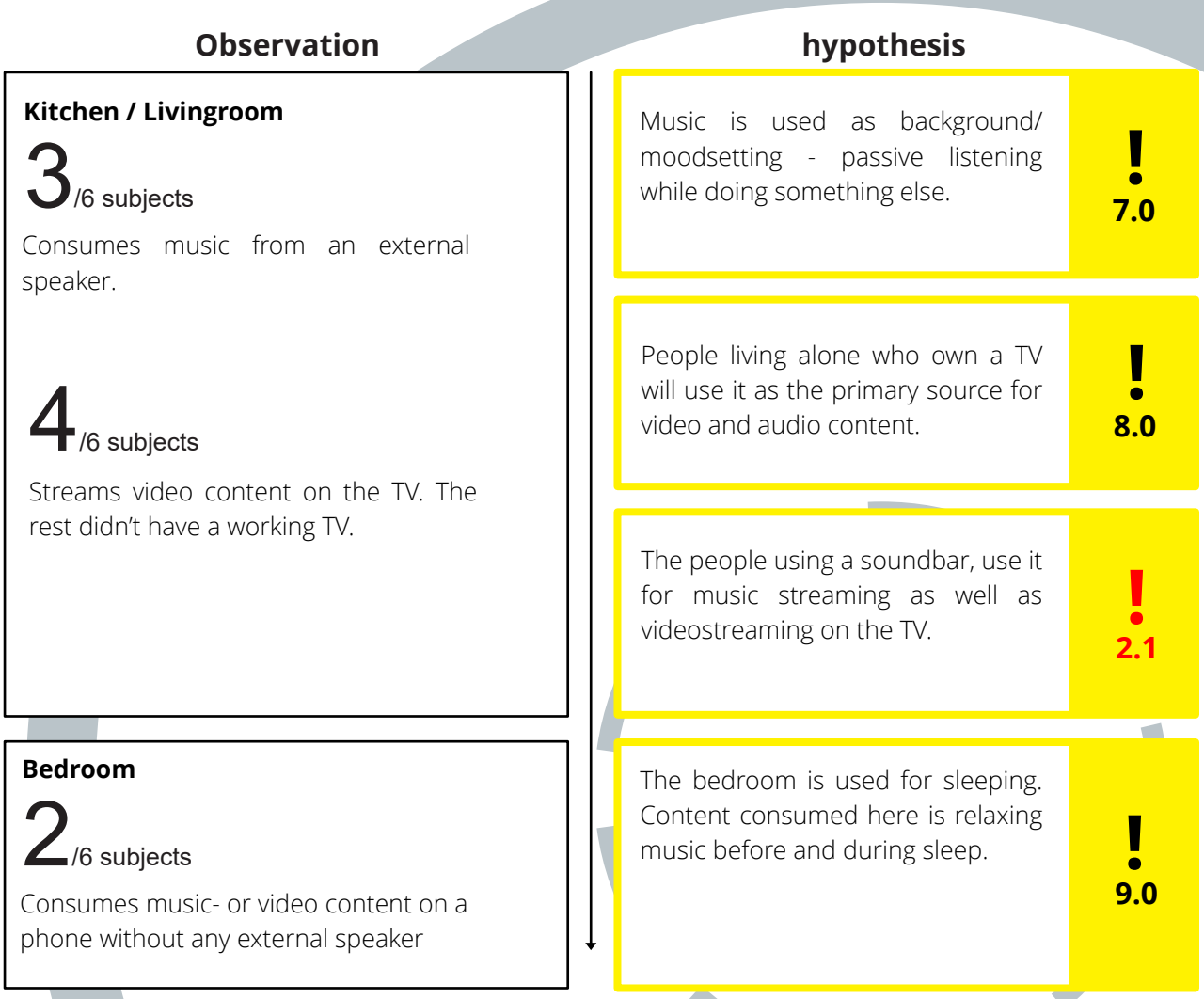


Illu. 4. User Mapping Example

1.9 University students

The initial hypothesis 1.0 & 1.1 suggests that the younger generation lives a flexible lifestyle as they are the early adapters to new types of content. To test this, a user study was conducted on 10th and 3rd semester students on the university (21-24 years old), as they were easily accessed. The user group was all living alone in "temporary" student housings, on the edge of a independent life.

The target was to get a deeper insight into their user patterns, and to see if there was any significant differences between the 10th and 3rd semester students. However as the interviews was conducted it became clear that there weren't any significant difference between the two groups which is why we chose to combine them into a single test group. The entire study can be found in **Appendix 2-8, and comparison chart in appendix 14**.



Evaluation

From the investigation we saw that most media was consumed on the TV , in some cases combined with a speaker. As we did not see any significant change between the two age groups, the next step was to repeat the exercise on high school students in the age of 16-17 years, to see if they would reveal a different use pattern.

1.10 High school

As there were no significant change in the way the 10th and 3rd semester students were consuming content, the same user mapping was done on students from Aalborg HTX (higher technical exam) high school. The interviews were conducted on 5 students (two males and three females) varying from 16-17 years old. The students were all living at home with their family. The full data set of the interview can be found in **appendix 9-13** and a comparison chars can be found in **appendix 14.**

Kitchen / Livingroom

3/5 Subjects

consumes radio or music from a stationary speaker

3/5 Subjects

watches Flow-tv on TV.

Bedroom

5/5 Subjects

consumes video or music content on either Computer or Phone

2/5 Subjects

consumes relaxing/sleeping music from the phone with no external device.

Social context plays an important part in the type of content consumed and the devices used. ! 6.1

The kitchen and livingroom are for shared usage of content chosen by the parents in the family. Often radio or flow TV. ! 7.1

Flow tv is consumed on the TV and is watched actively. The content is the same as the passive TV, but the focus of the user changes ! 10.0

People living with their parents will use their bedroom for consuming a lot of content on different devices. Private content is consumed with no external device or headphones. ! 11.0

Before and during sleep, relaxing music is played on the phone with no external devices. ! 9.1

The interviews revealed that high school students consume content differently from university students as most of their private content is consumed in the bedroom, While the kitchen/living-room is used for common/shared music and video for the entire family. As with the university students the kitchen/living-room area featured background music or video for other activities. In the case of the high school students the music was not an active decision by them, but a "common" ground between all family members.

The type of content however was very similar to university students, but the high school students consumed less "private" content on external speakers than the university students. This may be due to the context, as the high school students share parts of their home, with the rest of the family. To test this the interviews were conducted on University students living with a partner, to see if they share a similar use, as couples has to show consideration for other inhabitants.

1.11 Couples

To see if the social context was defining in terms of what and how the users consume content, different couples on the 10th semester were interviewed, as they share a similar social context with the high school students, and the age of the university students first interviewed. The data for the couples were collected by interview only, as the mapping couldn't take into account what the partner would do meanwhile. The subjects were asked to go through a day, as with the other interviews, but also map how/what their partner would typically do meanwhile. The dataset can be found in appendix 15-21 and comparison in **appendix 22**

Observation	Hypothesis
Kitchen / Livingroom 5/7 Subjects are playing music or radio while cooking together and in 4/5 on an external speaker. 6/7 Subjects Watches video content on the TV together. In two cases external speakers were connected to the TV 4/7 Subjects One of the partners is streaming video to the TV while the other is using their PC or phone to privately stream music/video.	Music is consumed as passive shared listening, while cooking. Typically a music playlist- or chart. Dinner is eaten in front of the TV, as passive content while eating. ! 7.2
	The dinner is followed by either completing the content watched during dinner or continuing on a shared TV series or show - Active watching as the focus is on the TV. ! 10.1
	Private content is consumed in the living-room along side shared content or the partners private content. The content is mainly video content, consumed on tablet or PC. ! 12.0
Bedroom 7/7 Subjects Streams private content on the phone, tablet or PC while the other partner is in the room at bedtime.	Private content is consumed individually in the bedroom before bedtime. The content is consumed on the phone or tablet with sound from the internal speakers, alongside the partners private content or them trying to sleep. ! 11.1

The interviews of the couples showed that they shared a lot of similar usage patterns with the high school students. As with the high school students, the shared context is used for shared content. In all cases the subjects described the shared content as unimportant, as it was a compromise both partners could "endure" to listen to or watch. Compared to the high school students, who consumed most of their private content in a private context (their bedroom), the couples would consume it in the living room while consuming shared content. The private content however was still secondary in the shared context and was consumed either with headphones or sound from the phone/tablet/PC, with a low volume.

1.12 Youth Club

As we didn't see any significant change in the way the Highschool students consume content, compared to the couples we wanted to investigate if this changes if the subjects were even younger. To test this we went to a local Youth Club featuring kids aged 10-12 years old. As with the Highschool students, the kids from the youth club lives with their family, they are however more dependent on their parents. The interviews were done using the same mapping as the first two investigations, and the full data-set can be found in **appendix 23-28** and a comparison chart in **Appendix 29.**

Kitchen / Living-room

5/6 Subjects

Consumes shared tv.
2/5 on a stationary speaker

4/6 Subjects

Consumes radio or music, 3/4 from a stationary speaker, and 1/4 from a mobile speaker

4/6 Subjects

Consumes private content on the phone or tablet - 1/4 with headphones

Bedroom

6/6 Subjects

consumes video-games, video or music content on either computer Phone
1/6 on an external speaker
2/6 with headphones

The kitchen is room for shared content chosen by the parents in the house. This could be a playlist or radio. The content is for passive listening while cooking or eating. ! 7.3

The Living-room is used for shared content such as flow TV, consumed by the whole family. ! 10.2

Private video content is consumed in the living-room along side the other members' private content, either on the TV or phone/tablet with no external devices connected. ! 12.1

The bedroom is used for consuming private video content, social media or gaming on the PC. ! 11.2

Relaxing music or sounds is used to create a relaxing atmosphere before and during sleep. ! 9.2

As with the couples, the kids share a combination of the patterns found in the couples and high school students. The kitchen and living-room remains shared content, but compared to the couples, they all described the shared TV content as interesting, something they actively watch together with the family. Dinner was consumed without background content, as the kids was unable to focus on eating. While watching TV.

The kids consume private content on the phone or tablet in the living-room, or play computer games in the bedroom. The private content is mostly shorter video content from Youtube with sound.

1.13 Sum up of findings

Based on the user interviews we found that the social context was defining, in terms of what and how content was consumed. The University students living alone consumed most of their content on the TV with external speakers, this solution space seemed too narrow. We decided to focus on a shared context found in families, as this presented a more "complex" use of devices and content. Below is a sum up of the hypothesis from the interviews, combined into user situations for further product development.

Kitchen / Living-room - Passive Listening - Shared Content

The kitchen and living-room is used for passive listening of shared content. The content is a common ground within the household, a shared playlist, radio or flow TV.

The content is consumed while cooking, eating or doing other activities within these two rooms, and is often the same type of content each day.

The content moves between the two rooms with the activity, and often one of the rooms feature a stationary speaker, while the other (mostly the kitchen) has a portable bluetooth speaker.

Hypothesis 7.0, 7.1, 7.2 & 7.3

Living-room - Active Listening - Shared Content

A variation of the passive content is active shared content within the living-room. This is video content consumed on the TV, as an extension of the dinner. The content is the same as the common passive content, but the context changes as the focus shifted from the dinner to the TV.

Hypothesis 10.0, 10.1 & 10.2

Living-room - Active Listening - Private Content

The living-room is also a room for private content. This could be user specific content on Youtube, Netflix or gaming. The content is consumed along side shared content on phones or tablets with no external speakers connected. A Variation of this is consuming private content on a phone or tablet, while another user is consuming private content on the PC. Headphones are not preferred as this creates a social barrier.

Hypothesis 12.0 & 12.1

Bedroom - Active Listening - Private Content

The bedroom is used by the kids as a private room with private content, such as computer games and video content with sound.
For people sharing a bedroom, the context is shared, but the content remains private. The content is consumed on a tablet or smartphone with no headphones, while the partner is either consuming private content or trying to sleep.

Hypothesis 11.0, 11.1 & 11.2

Bedroom - Passive Listening - Private Content

Some are consuming calming content before and during sleep. The content is mostly music streaming, consumed on a phone with no external speakers.

Hypothesis 9.0, 9.1 & 9.2

1.14 Context

Based on the user interviews we were able to develop hypotheses for user situations in relation to the context they would be in. In order to develop solutions fitting for these situations, we needed to get deeper understanding of the context itself, how inhabitants move around in the home in relation to the media consumption, while gathering visual cues and interior trends the design needs to cope with.

To decide upon a context for the families, we looked into statistics to figure out how most families in Denmark live. We found that approximately 80% of young people in the age 10-17 years old, live in a house (Danmarks Statistik, 2019), assumingly with their parents and siblings. Based on this an analysis of houses from Huscompagniet, a company designing detached fabricated houses, were made, as these are houses designed to be build in the future, hence giving an indication of where the housing trends are going.

Results

By looking at floor plans gathered from sales material from their website, we found some clear tendencies, in the way new houses are planned. One of the houses can be seen in **ill. 5**, We used it as a reference for an average house,and discovered the following tendencies:

- Kitchen/Dining Room & Livingroom, marked with red, acts as separate rooms, but in a direct connection to each other without any doors.
- Each house had a parents bedroom with access from the livingroom, with a private bathroom accessed from within the bedroom.
- Similarly the childrens' bedrooms were located in its own corridor of the house, with direct access to a separate bathroom, and with direct access to the entrance without having to enter the shared areas.



Illu. 5. Context mapping an average modern house



Illu. 6. Homedecoration trends gathered from lifestyle magazines and sales material

While investigating the floor plans, reference photos of the new houses were gathered (see **illu. 6)**, combined with photos found in lifestyle trend magazines. The photos was used as style references, as we assume they represent the current ideal decoration of homes, and what they go for when buying new furniture. The images gathered from "Huscompagniet" was analyzed for places to put a speaker, and location of power outlets, as our solution is going to need a place to charge a battery or permanently take up an outlet. Below are the pointers found within each room in the house, used for content consumption in the user studies.

Bedroom

Placement

- Desk table
- Shelves
- Nightstand
- Cupboards

Power Outlets

- Floor height

Kitchen

Placement

- Cupboards
- Kitchen table
- Dining table
- Floor

Power Outlets

- Floor height
- Kitchen table (Typically two outlets)
- Between the kitchen and livingroom

Livingroom

Placement

- Single Cupboards
- Coffee table
- TV Table
- Floor
- Windowsill

Power Outlets

- Floor height

Bathroom

Placement

- Sink Table
- Windowsill
- Towel rack

Power Outlets

- 1-2 below the mirror

1.15 Trend research

In order to make an educated guess on what the future consumer expectations and needs, in regard to products released, an investigation on trends and technology was done, in order to figure out what the future audio products needs to accommodate both in regard to social and political expectations, as well as the technological features. The result was a list of possible new trends and technology, that could add/or create value to the product.

Technology Trends.

Technology is rapidly changing especially within consumer electronics, as standards are constantly changing to what consumer electronics need to feature. The idea of looking into technology trends was an attempt to identify the forthcoming standards within electric products. The trends was chosen based on various articles covering both forthcoming and newly used technology trends.

- ***5G network:*** The next generation of cellular connection, that provides much faster internet speed than the current standard 4G, up to multi gigabit speeds. These high speeds enables on-demand-AI services. (qualcomm, 2019)
- ***Bluetooth Low energy (LE):*** Allows for broadcasting to multiple devices at once, new compression LC3, which means it will be less energy demanding. (Hovgaard, 2020)
- ***Wireless charging:*** QI-charging has come out on top as the official standard for near-field induction charging, however, still less effective than cable charging. (Hill, 2019)
- ***Wireless LAN connectivity (W-LAN):*** W-LAN connectivity allows the user to stream the same track to multiple speakers, on the local network in a house. (Consumer Technology Association, 2018)
- ***Cloud movement (Streaming):*** MP3 and CD's have become obsolete as streaming as become the standard for playing both audio and video content. It does compromise the quality, even so it has been ever increasing since it's release. (Consumer Technology Association, 2018)
- ***Applications and Big data:*** Applications that gathers data on customer behavioral patterns, can be analyzed and improve existing solutions. Use of product provides feedback that allows for enhanced personalized experiences. (Briggs, Buchholz and Sharma, 2019)
- ***Smart home integration:*** Assisting in daily quires at home, smart home devices has become increasingly popular since the introduction of Google home and Apple home pod. (Consumer Technology Association, 2018)

Mega Trends.

Mega trends are trends that characterizes the lifestyle and consumption of people, in the span of 3 - 7 years. (Pejgruppen, no. date). Mega trends are because of this used by companies to adapt to fast changing landscapes as consumer behavior and expectations change.
We chose to look into 3 mega trends proposed by Fjord trends- 2018 (Fjord, 2018), 2019 (Fjord, 2019) and 2020 (Fjord, 2020), which we thought was relevant to consider for developing an audio reproduction product: Ethics economy, The last straw and Silence, opt out noise.

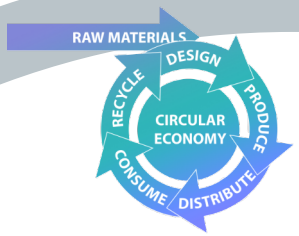
- ***The last straw (2019):*** Is about sustainability. Companies have to take responsibility in global matters such as global warming and pollution, by e.g. reducing plastic waste, introducing circular economy **(see illu. 7)**. It's also about companies enabling consumers to take a personal responsibility, by e.g. allowing for re-usage of products and components.

- ***Silence, opt out noise(2019):*** Is a counter trend to the increasing usage of digital medias, in short, the trend is about decoupling from social and digital medias, that increasingly demand attention in our daily lives. In product development that is expressed by companies developing less attention seeking products such as the light phone **(Illu. 8.)**.

- ***Ethics economy(2018):*** Is a about consumers demanding that companies take a social responsibility and are proactive in political matters. Companies have to represent values that customers can identify themselves with in political matters. E.g. produce in countries that prohibits child labor.



Illu. 8. The Light Phone 2



Illu. 7. Circular economy model example

Sum Up

The trends provided and overview of the expectations for future products, it is however missing details, user behavior, scenarios and contexts. At this stage the research will serve as inspiration for further conceptualization.

Tech- and mega-trend inspiration list:

Ethics economy:
The last straw (Sustainability)

- Turn waste into wealth, extract value from old products that is no longer valued.
- Trace-ability, sourcing of production.
- CO2 Neutral materials
- Implement circular economy into the production setup.

Silence, opt out noise

- Tech companies redesigning user experiences around the principles of control and restriction.
- Less attention-seeking tech is enjoying a resurgence (E.g. The Light Phone)
- Mindful design is fast rising on the agenda for big tech firms. Focus on designing products that meets customer's holistic needs, e.g. prioritize long-term value above usage time.
- Human value as the center of new innovations → more ethical approach, not designing things people don't need.

Technology trends:

- *5G network*
- *Bluetooth Low energy (LE)*
- *Wireless charging*
- *Wireless LAN connectivity (W-LAN)*
- *Cloud movement (Streaming)*
- *Applications and Big data*
- *Smart home integration*

1.16 Framing

Solution spaces

The user situations and context observations, were combined into three different framings based on three different contexts in the home. These framings were made, to facilitate the further development of a conceptual direction. Common for all three is that the context is in a new house, and the user is found in a family with kids.

1. Shared context and content

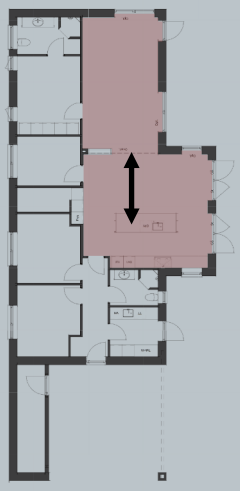
The device needs to facilitate shared content within a shared context. The content is consumed in the kitchen and livingroom and moves with the activities.

Placements

- Cupboards
- Kitchen table
- Dining table
- Floor
- Coffee table
- TV Table

Power Outlets

- Floor height
- Kitchen table (Typically two outlets)
- Between the kitchen and livingroom



Kitchen / Livingroom

Content type

The content is a shared playlist, radio or flow TV. It mainly acts as background noise for other activities throughout the day, but is also actively watched in the evening on the TV.

User

The users of the content are the entire family, as it's it mainly serves as background music. The parents however are mainly responsible for selecting the content / equipment.



Device

The content is played from a phone or the TV.

2. Private content and context

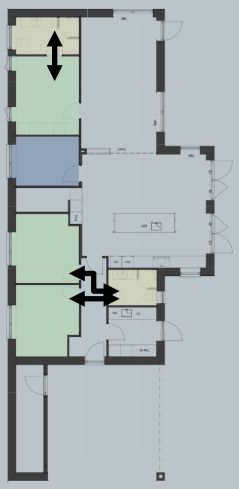
The device needs to facilitate private content in a private context. This is consumed in either the bedroom, bathroom or office. Each of the bedrooms has a direct connection to the toilet, without entering the shared area.

Placement

- Desk table
- Shelves
- Nightstand
- Cupboards
- Sink Table
- Windowsill
- Towel rack

Power Outlets

- Floor height
- 1-2 below the mirror



Bedroom

Bathroom

Office

Content type

The consumed content is mainly computer games and personal video content with sound, but can also be relaxing music.

User

The users of the content are mainly the kids of the family or teenagers, as the adults would consume most content in the shared areas.



Device

The content is consumed from either a PC, a tablet or smartphone.

3. Private Content and shared context

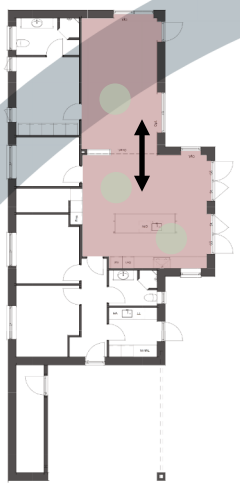
Private content was from the user interviews also consumed in the kitchen / livingroom. Either as private content in one of the rooms and shared content in the other. Or as separate private content with low sound in the same room.

Placement

- Cupboards
- Kitchen table
- Dining table
- Floor
- Coffee table
- TV Table

Power Outlets

- Floor height
- Kitchen table (Typically two outlets)
- Between the kitchen and livingroom



Kitchen / Livingroom

Private Zone

Content type

The content is user specific video content or gaming. It is consumed alongside shared content, or the other members private content.

User

The user is the entire family.



Device

The content is consumed on a smartphone or tablet.

Tech- and mega-trend inspiration list:

Ethics economy:
The last straw (Sustainability)

- Turn waste into wealth, extract value from old products that is no longer valued.
- Trace-ability, sourcing of production.
- CO2 Neutral materials
- Implement circular economy into the production setup.

Silence, opt out noise

- Tech companies redesigning user experiences around the principles of control and restriction.
- Less attention-seeking tech is enjoying a resurgence (E.g. The Light Phone)
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Technology trends:

- *5G network*
- *Bluetooth Low energy (LE)*
- *Wireless charging*
- *Wireless LAN connectivity (W-LAN)*
- *Cloud movement (Streaming)*
- *Applications and Big data*
- *Smart home integration*

2.0 Concept Development

Based upon the three solution spaces defined in Phase 1, we initiate a ideation process, meant to define potential concept directions.

To ensure the validity of the technology behind these, we investigate new cutting edge technology. This ultimately lead to being able to eliminate some of the directions, due to immature technology.

With a reneved set of concept directions, we initiated another ideation, resulting in four concepts. The four concepts were then models and visualised in 3D space.

The availability of the concepts were further investigated, through a competitor anlysis. This lead to discarding two of the proposed concepts.

The remaining concepts were presented to users living in newly build family housing.

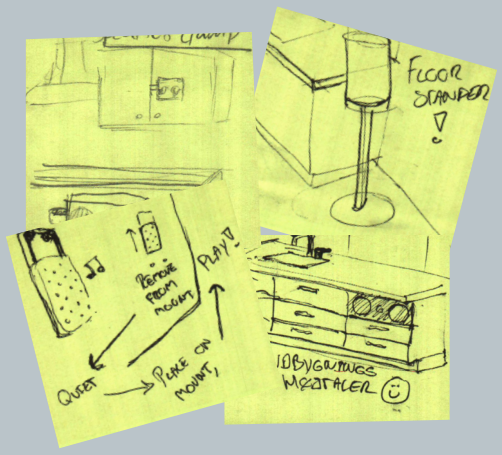
To build upon the user feeedback, a Collaborative partner analysis were conducted, investigating potential sales channels in relation to different project partners.

Based upon this, we were able to choose a concept direction, and end the phase of with a Design Brief.

2.1 Ideation - 1st iteration

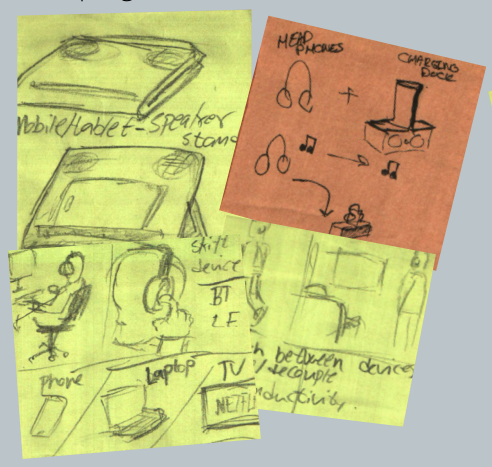
After doing various kind of user- and context research we wanted to try and convert the newly found user scenarios into conceptual product directions and ideas, by using the framings as solution spaces in an ideation- and sketching exercise. This would also provide us with an overview of what our current research translates into and what parts of the research that needs further exploration. We decided to start by ideating and sketching in the three use cases presented in the framing, developing solutions to facilitate the use in each of the contexts.

A sketching method, suggested by Reid Schlegel from FROG design (Schlegel, 2017), was chosen as the methodical frame of the exercise, forcing the group to limit the level of details by using a thick brush size on a small piece of paper, and increase the size of paper while decreasing the size of the brush, and by so, increase the level of detail as the ideation progressed.



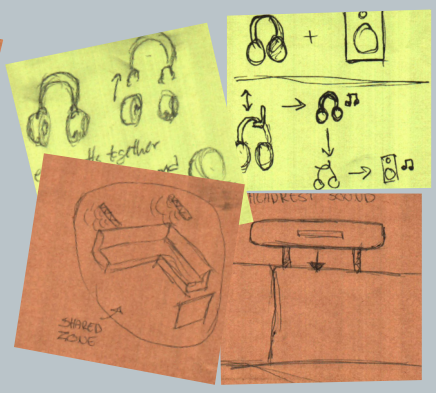
Shared context and content

As the content was consumed in both the kitchen and livingroom, this round tried to accommodate both, by having a speaker in the 'sweet' spot between. At the same time we observed a lot of people use portable speakers in the kitchen, and brainstormed on implementing a speaker into this.



Private content and context

For the private context the ideas went upon accommodating the flexible lives of the kids. The product should facilitate use of different devices and especially the use of the phone as that would target everyone. Ideas of combining headphones and speakers were presented, to quickly switch between gaming, music and video content.



Private Content and shared context

For the private content in a shared context, it was suggested to create private zones in the livingroom, without having the social barrier of headphones. This was based on a hypothesis that technology would enable us to create local sound zones in the home.

Evaluation

The ideation did provide us with initial possibilities for conceptual directions, however some of the concepts in the "private content in a shared context" relied heavily on new technologies to create local sound zones. Because of this we felt a need to validate our presumptions about the technologies, before continuing any development of the initial proposals. To do so, we chose to research the use case possibilities for both sound zones and directional speakers.

Music- and video content can be consumed privately in a shared social context, using either sound zone- or directional sound technology.

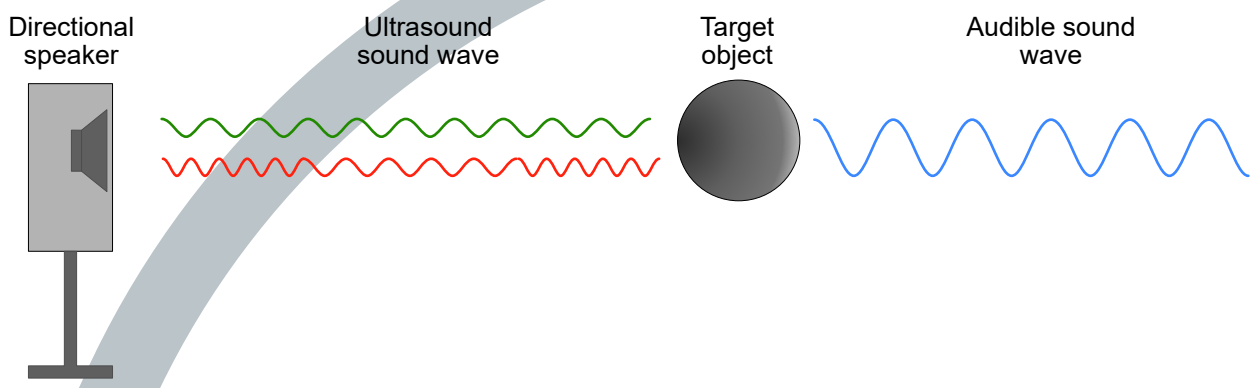
! 13.0

2.2 Directional sound & Sound zones

After the first round of ideation the group felt a need to further research into how to create private listening-zones, while maintaining social availability of the individuals. Through research the group fell upon two technologies, sound zones and directional speakers, that could potentially work. To validate this a research study into the two technologies was conducted to provide a necessary understanding of the potentials the technologies provide, the future prospects and limitations.

Direct sound

Directional speakers differs from conventional speakers as they produce ultrasound waves in frequencies inaudible to human ears. The ultra sound waves produced by a directional speaker, consist of two separate waves that travel parallel to each other in a concentrated beam. Upon hitting objects, the two parallel sound waves interfere and mix and by the interference, transform into a lower frequency sound wave, audible to human ears. **(Illu. 9)** (Woodford, 2020)



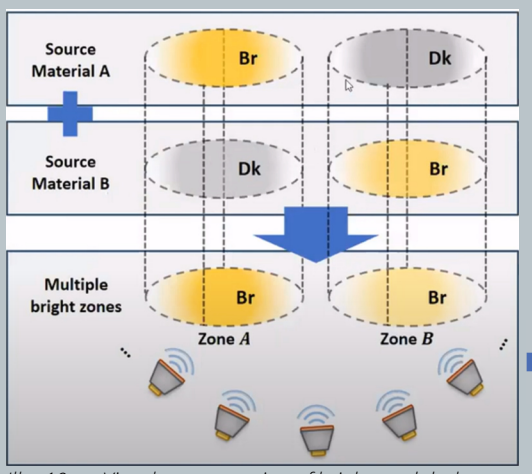
Illu. 9. Directional speaker: Working principle illustration (Woodford, 2020)

The problem with the technology is mainly that it only works on high pitched frequencies that travels up to 20 times as far as sound waves provided by ordinary speakers, however this also limits the technology to work in very specific use scenarios as the frequency spectrum of the sound waves it produces, doesn't span deep enough for e.g. playing music. (FAQ - Ultrasonic Audio Technologies, 2020)

Sound zones

There are multiple variants of sound zone technology, as DTU is running a research project named Monica, for eliminating sound in bigger areas, such as outdoor concerts and festivals. Aalborg university is also running a research project on sound zones, however their study is exploring user tuneable sound zones, which allows for multiple sound tracks at the same time, in the same room. It does so by creating listening-areas for the different tracks called bright zones (Br) and dark zones (Dk) **(Illu. 10)** where the sound pressure level is as low as possible i.e. areas without or with minimal sound. They do this by using an array of speakers that are controlled by specially designed control filters. The filters roughly work by filtering out one source creating a dark zone while enhancing the other source creating a bright zone, doing this for multiple sources provides multiple bright and dark zones. **(Illu. 10)** This could be valuable to e.g. Cinemas where different language audio tracks could be played simultaneously for the same movie(**Illu. 11**) One of the limitations of the technology is however that there are still interference between the sources. In the example in **illu 7**, this would mean that in the English listening zone, the danish audio track would still be audible and interfere.

The technology is suited for situations where you know the exact location of the user, due to the relation between bright zones and the array of speakers. I.e. to move the bright zones around, a modification of the speaker system is required. At this point in time, the listening-zones are around 20cm in diameter, and the content needs to be encoded to work with the system. Also the speaker system has to be adjusted to the exact room it's placed within, making it a rather static system in regards to accommodating multiple, various use scenarios. **(Appendix 30, interview Taewoong Lee)**



Illu. 10. Visual representation of bright- and dark zones (Lee, 2020)



Illu. 11. Visual representation of Sound zones in a cinema with multiple audio tracks. (Lee, 2020)

Evaluation

Sound zones, albeit it's an exciting technology, is still in the early development stages, which means practically that the prospects and applications of the technology remain uncertain. At the current stage, the technology is unsuitable for a home context, because of the size and calibration of the setup in relation to the room and the variance in positioning of the listeners.

Directional sound on the other hand, is a commercially available technology, but only provides high pitched frequencies thus disabling the technology from playing music. This limits the use cases to situations that does not involve music.

Based on the research into the two technologies, we chose to limit us from both of the technologies, as none of them fits our user scenarios nor context and instead focus on specifying other conceptual directions.

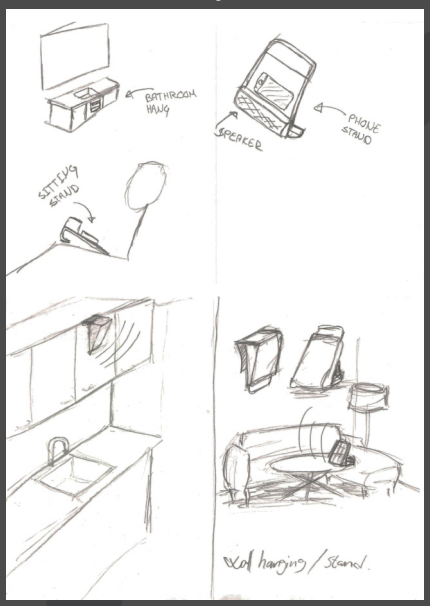
Directional speakers provide focused sound non-applicable for music and video streaming.	X 13.1
Sound zones are non-applicable for video- and music streaming due to calibration and setup.	X 13.2

2.3 Ideation - 2nd iteration

Having researched and deselected the directional sound and sound zone technology, a second round of ideation was initiated. As a continuation of Ideation 1, ideation 2 mainly carried on and further developed previous ideas, however with an increased focus on user interaction and placement of the product within the home. The ideation ended with a selection of the following 4 conceptual directions:

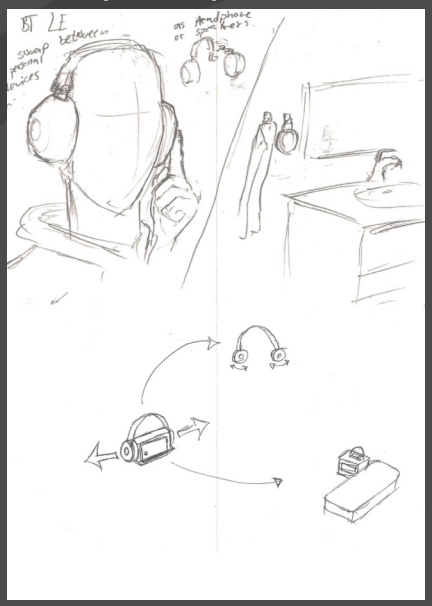
1. A phonestand speaker (to facilitate private video/music consumption on phone or tablet)
2. A headphone speaker (To adjust to the use of the kids of the familys quick changes in content type)
3. A 'sweet spot' speaker (Delivers shared music to the kitchen and livingroom from "the sweet spot")
4. A ceiling lamp with integrated speakers (To deliver sound in the kitchen like soundbars in the livingroom)

1. Phonestand - speaker.



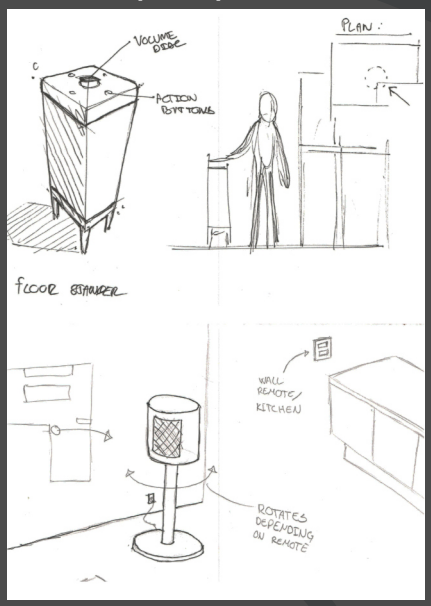
Illu. 12. Sketches of phonestand speaker.

2. Headphone - speaker.



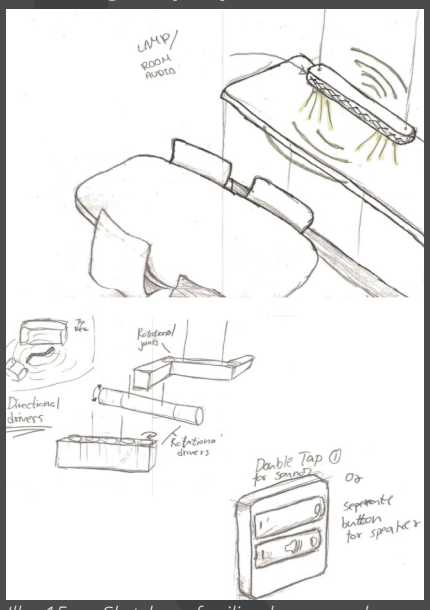
Illu. 13. Sketches of headphone speaker.

3. 'Sweet spot' - speaker.



Illu. 14. Sketches of 'Sweet spot' speaker.

4. Ceiling lamp - speaker.



Illu. 15. Sketches of ceiling lamp speaker.

Evaluation

The concepts were selected on a gut feeling of how the proposals related to the context, the observed consumer behavior and possible technologies. The next step was to further develop the concepts and probe them to representatives of the target users.

To further develop and evaluate the 4 chosen conceptual directions we decided to construct each of the concepts in a 3D program and specify the intended use and context even further, as this allowed us to visualize the concepts in the context they were meant for. The further development also included suggestions for technologies that could solve the functionality aspect each concept. Having each of the concepts specified in visualizations, made it easier for us to communicate with the representatives of the target group about the concepts

2.4 Concept 1 - Phonestand speaker

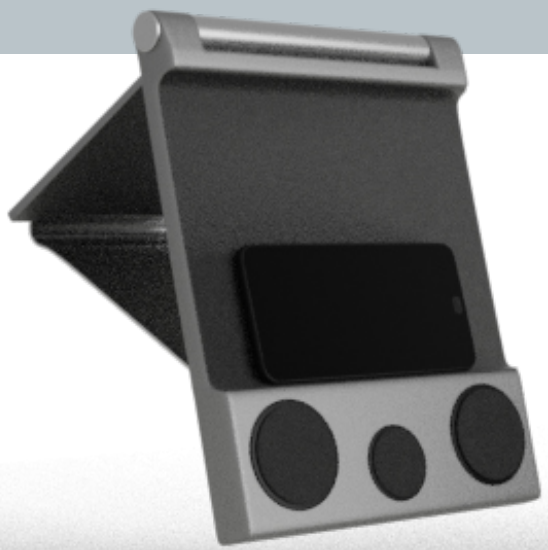
Intended use

Concept 1 is a stand for smartphone or tablet devices with integrated speakers. It enables the user to watch private video content, without holding the phone or tablet. The speakers are front facing, providing a better sound experience.

The stand has two mounting options: standing on a surface or hanging on a vertical surface such as a cupboard.

The concept has built-in Qi-charging capabilities, that allows it to charge the placed phone or tablet.

Placing an external device on the stand, initiates a connection protocol that connects the device to the concept automatically, using Bluetooth LE technology.
The stand is collapsible, making it compact during transportation.









Situation / Context

The mobility of the Phonestand accommodates most listening situations in the home, as it is usable in the entirety of the home and in all 3 of the social contexts as well. The concept adds to the user experience of using the mobile device, as it adds a standing function and angulation of the screen, making it ideal for video streaming.



User scenario

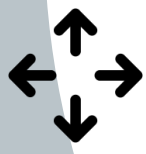
0a. Place stand on table

0b. Hang stand

1. Place device on stand, instant connection via Bluetooth LE

2. Enjoy video or audio footage without setup hassle.

Value proposition



Mobile



Phone charging



Seamless Bluetooth hand-off

Target audience

This product is targeting the entirety of the family; as everyone, despite age, are using tablets and phones for viewing both visual- and audio content in the home.

2.5 Concept 2 - Headphone Speaker

Intended use

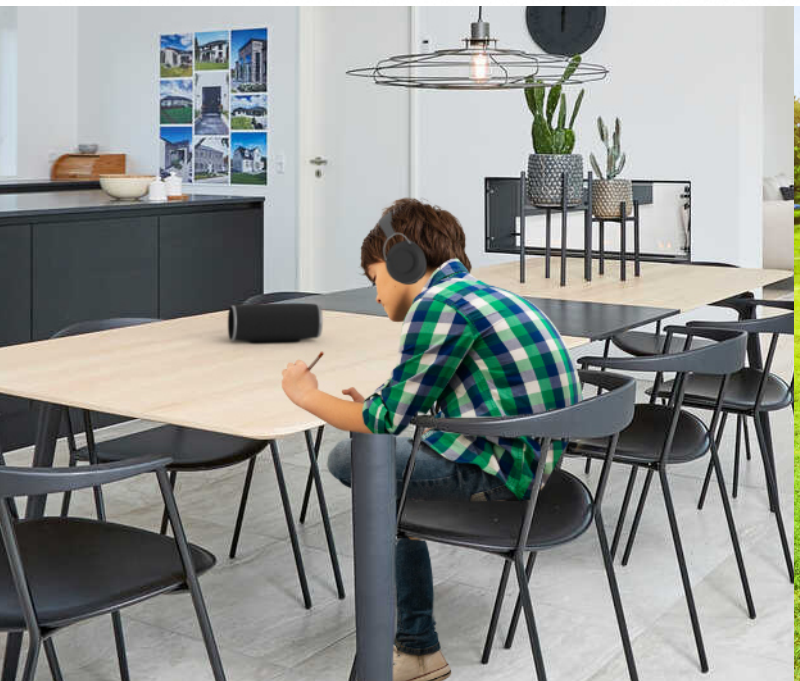
Concept 2, is a combination of a headphone and a speaker, which means that the headset works as a normal headset when using it stand-alone, however placing the headset on the baseunit, amplifies the sound drivers in headset, transforming the headphones to speakers as they are put on the base unit.

During the shift between headphone and speaker, the device hands off the audio source, so the user will not have to reconnect to the speaker, after using the headphones, giving a seamless experience.

As the headphones are mounted on the base unit, the headband functions as a handle as well, making it easier to carry around.

The multi-functionality of the concept targets flexibility in it's various use cases, as the concept is for a home context as well as outdoor.

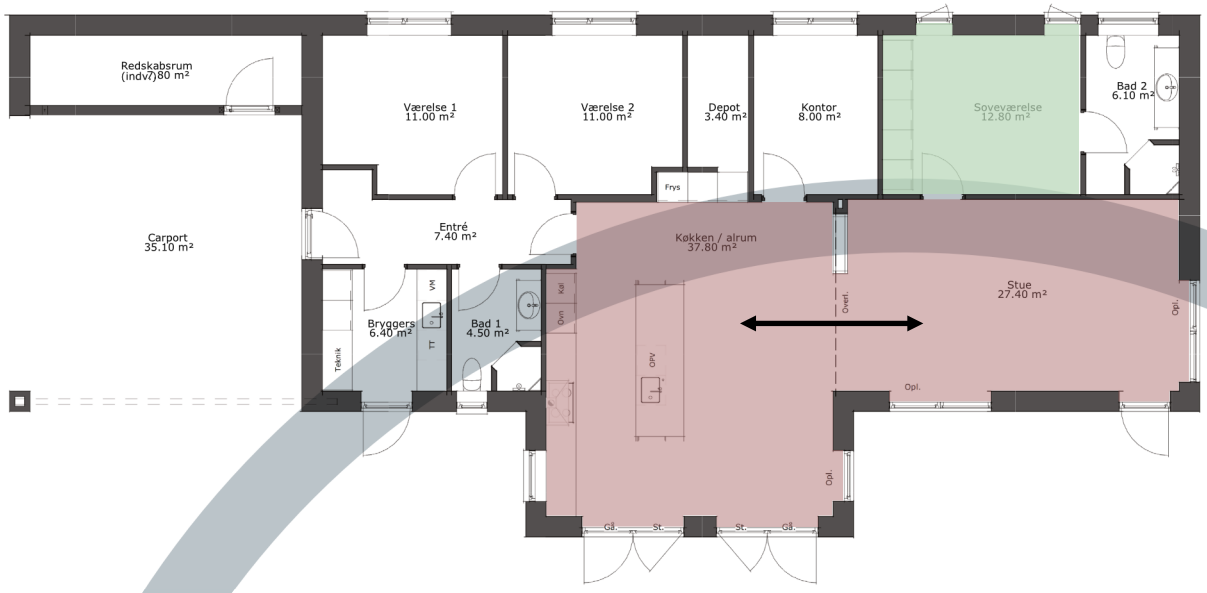






Situation / Context

The concept can be used both for consuming private content In a private/social context, using the headphones of the concept. It also works for shared consumption with it's speaker functionality, which means that the concept is not limited to neither private or shared rooms in a home. It differs from the rest of the concepts in the way that the concept is not limited to a home context, as it is meant to be carried along for situations outside the home as well.



User scenario

0. Listen to music with headphones on → **1a.** Place headphones on amplifier. Seamless source hand-off → **2.** Music from speaker, with no connection hassle

Value proposition



Mobile | Charges headphones | Seamless Bluetooth hand-off | 2 in 1

Target audience

This product is targeting teenagers and young people, as the mobility and dual functionality is meant to appeal to the flexible lives of young people. The concept arguably differs from the other proposed concepts in target audience as well, as it's not directly targeting future home owners.

2.6 Concept 3. - Room divider

Intended use

Concept 3 was initially a speaker meant for the 'sweet spot' placement between kitchen and living room, but ended up as a mobile, acoustic room divider with built-in speaker functionality, as the idea of creating temporary private spaces in a shared context, was deemed a good fit for a family.

The speaker unit is compatible with regular WiFi speaker connectivity (Airplay 2, Google Cast etc.), but can also be activated through the built in preset buttons, where it is possible to bind presets such as playlists and radio stations. Additionally, it is possible to control the volume level, with the capacitive touch interface place underneath the preset buttons.

The panels are modular, so you can connect multiple panels. The unit has a battery pack, that allows it to function without being connected to a power outlet.

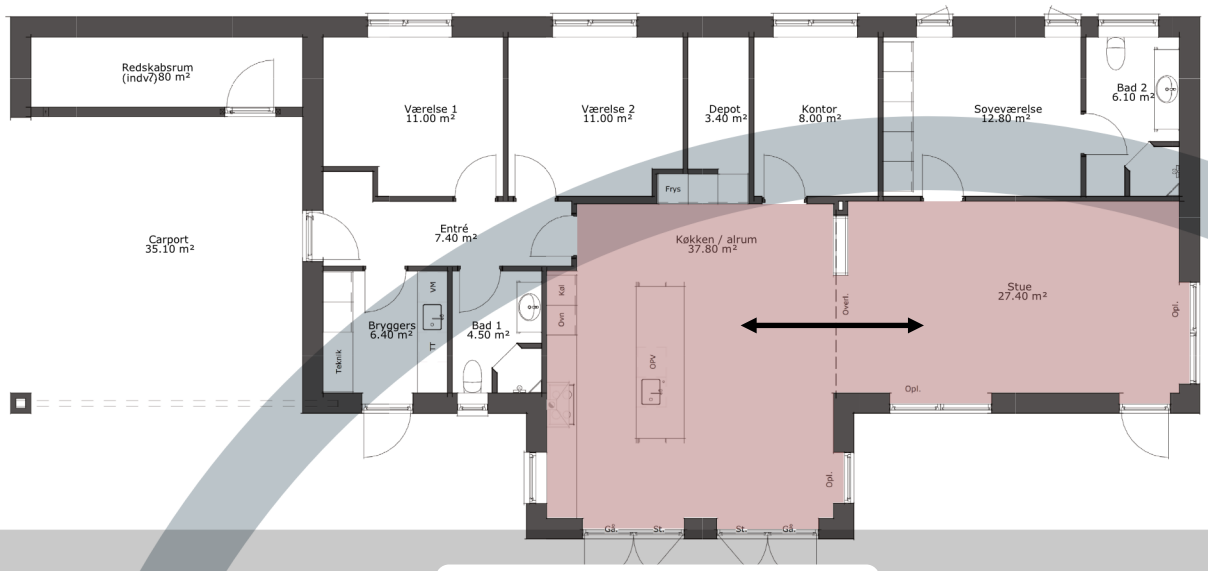






Situation / Context

The concept is meant to be placed in the shared contexts: Kitchen-dining area and living-room, to provide sound for shared consumption. However as it divides the shared context into smaller more private spaces, it arguably supports private consumption as well, extending the use case. As the panels are mobile, the sound can be moved to the center of action as the activity moves around.



User scenario

0. Move panel to desired location, to separate a larger space.

1a. Select a preset, and adjust volume accordingly

1b. Airplay or Google cast to device, adjust volume from external device

2. Turn down volume to 0 to pause playback.

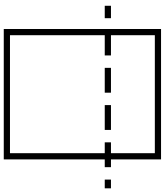
Value proposition



Blends in



No phone needed



Divide large open spaces



Improves acoustics

Target audience

This product targets the house owners/parents as potential buyers for a family. It is assumed that they are the ones in charge of decorating the shared context, which is where this is concept is meant to be placed.

People want to hide their speakers in furniture. ! 4.1

2.7 Concept 4. - Ceiling Lamp speaker

Intended use

Concept 4 is a Ceiling Lamp with built-in speaker functionality. The speakers are producing sound on both sides of the lamp.

The speaker unit is compatible with regular WiFi speaker connectivity (Airplay 2, Google Cast etc.) and can be operated from mobile devices. In addition to that it can also be activated through the wall-mounted remote, that features preset buttons where it is possible to bind presets such as playlists and radio stations. It is also possible to control the volume level, with the rotary switch placed beneath the presets.

The concept does not take up any surface space, as it is ceiling mounted, and by so avoid taking up existing power sockets, as the power is delivered from ceiling junction box in the ceiling.





Situation / Context

The concept is the only one that is installed in a fixed position, making it immobile. It's meant for shared consumption in the shared contexts; kitchen-dining area and living-room, functioning as a floating sound bar, hidden in a lamp.



User scenario

0. Turn on the light when entering the room.

1a. Select a preset, and adjust volume accordingly

1b. Airplay or Google cast to device, adjust volume from external device

2. Turn down volume to 0 to pause playback.

Value proposition



Blends in



No phone needed



Lamp



Doesn't take up a poweroutlet or countertop space.

Target audience

This product targets the parents as potential buyers for a family. It is assumed that they are the ones in charge of decorating the common spaces, which is where this is concept is meant to be integrated..

People want to hide their speakers in furniture. ! 4.2

2.8 Competing products

As the value propositions and context were specified, the four concepts was compared to competing products. This was done to test the originality of the value propositions. The intention with the comparison was gain an insight into the competitive landscape of the market, each of the concepts were targeting. This insight allowed us to opt out the concepts with unoriginal value propositions and further narrow the solution space towards a final conceptual direction.

To gather knowledge about competing products, an online search for products with similar functionality and target audience, was conducted for each of the concepts. The resulting competing products were then analyzed individually and compared to the responding concept. The data can be found in ***Appendix 31****.*

Concept 1 - Competing products

There are multiple competing products with almost identical value propositions as the phone stand speaker. However the idea of combining a stand for a mobile device with a speaker and wireless charging is popular. The product displayed below is one of more examples of this.



Illu. 16. Azpen - D100

AZPEN - D100

The Azpen D100, is a speaker, charger and stand for a mobile device. The value propositions are identical to the phone stand, with the exception of the connect/disconnect device interaction. Given the amount of competing solutions, **(See worksheet 17**) the market seems to be stacked with a lot of solutions in this category.

Concept 2 - Competing products

The Motorola sphere, was the only competing product we were able to find that combined headphones and a speaker into a single product. Even though the concept is rather original, it arguably competes with other normal Bluetooth speakers and headphones as well, and both of those markets are heavily stacked with products in various shapes, sizes and price-ranges.



Illu. 17. Motorola Sphere

Motorola - Sphere

The Motorola sphere, shares value propositions and functionalities with concept 2. It switches from speaker to headphone, as the headphones are removed and back to speaker as they are placed on the speaker again. The concept has received mixed reviews, as reviewers like the idea but not the build- or sound quality. (Wiggins, 2018) The product has yet to establish Itself on the market and that does add to the uncertainty of the consumers acceptance of the concept.

Concept 3 - Competing products

There are many products that integrates speakers into home furniture with acoustic dampening elements, thus camouflaging the speaker. However none of them has the ability to divide large shared contexts into smaller ones. Below is listed one of more examples. (**See worksheet 17**)



Illu. 18. Beosound Shape

B&O - Beosound Shape series

Beosound shape is a system of decorative, hexagonal, acoustic panels and speakers that are mounted on a wall. They share some functionality and value propositions with concept 3, but there are differences as the B&O shape is static while concept 3 is mobile and has room dividing functionality as well.
The Beosound shape system, has been quite successful and has been adding revenue growth (B&O, 2018) which indicates that there might be a market for a product with similar value propositions.

Concept 4 - Competing products

There are many examples of products combining audio and light, however there are no products that overlap completely. Among the similar products were light bulbs and table lights with integrated speakers. The one with closest relation among the speaker lamps, were IKEA Symfonisk.



Illu. 19. IKEA Symfonisk

IKEA - Symfonisk

IKEA Symfonisk is a table lamp with an integrated Sonos speaker. It targets the same context share the same functionalities, and has a well renowned speaker company creating the audio system. While the case do have many similarities it is however a different type of lamp and still takes up table space and a power outlet. The Symfonisk products are quite popular and receive decent reviews. (Brown, 2019) Which indicate that there's a market for a product combining sound and light.

Evaluation

Based upon the research of competing products, concept 1 and 2 was opted out of further development, as the prospect of adding original value for those markets seemed low in comparison to concept 3 and 4. The competing products to concept 3 and 4 indicated that there's a trend for integrating speakers in furniture and hiding them in plain sight.
The remaining concept 3 and 4 was prepared for a virtual user probe, to validate the concepts and potentially choose a final conceptual direction.

Camouflaging speakers in furniture is trending ! 4.3

2.9 User probe

Having narrowed the amount of conceptual directions down, we wanted to get some feedback from the supposed target group. Instead of probing the concepts to young peoples as 'future householders' we wanted to probe the concepts for actual house owners who could relate to the problems and value propositions of the concepts.

To probe the conceptual directions, we reached out to a group of house owners in a newly built residential neighborhood in Solbjerg, a smal city outside of Aarhus. Two of the residents agreed to let us pitch the concepts in a virtual Skype presentation (interviews can be found in ***appendix 33 & 34)*** *and gave us their thoughts on the concepts* ***(APPENDIX 32)****.*

The following pointers are extracts of the feedback given by the interviewees. As they agreed on most of their answers, the pointers are common opinions on the concepts.

Common background of the interviewees:

- Both are male house owners in their 40's.
- They both live in the same newly built neighborhood with a wife and two kids each.
- Sonos Bluetooth speakers placed around their houses for music streaming.
- They like the interaction and system that Sonos provide.
- They don't like the aesthetics and space that the Sonos speakers takes up.
- Both of them have Sonos as a compromise due to price and convenience of competing products.

Concept 3. Feedback:

- They both find the aesthetics exclusive and would consider buying such a product.
- They agree that the room dividing feature, was an attractive feature that they could use themselves.
- Both agree that having a possibility for a physical remote is a good idea.
- They both express a need for acoustic elements in homes like theirs, as there are many large smooth surfaces.

Concept 4. Feedback:

- They both like the idea of camouflaging the speaker in furniture.
- They both like the aesthetics and would strongly consider changing their Sonos for such a device.
- They both agree that it would be nice for the speaker not to take up table or floorspace nor a power outlet.
- Both says their wifes likes to have speakers, but wants to hide them.

Evaluation:

The interviewees in general agreed with a lot of the problems the concepts deal with and found both of them interesting. They did incline a bit toward concept 4 as concept 3 is rather large and the room division would only be needed occasionally. It should be noted that only probing the concepts for two users, both of them male and with a lot in common, are insufficient in regard to getting feedback that represents the entire target group. To get a more sufficient foundation for choosing the final conceptual direction we decided to look into how the sales channels would look for each of the concepts and how they would fit with Dynaudio.

The users want audio products that fits with their current home decoration. ✓ 4.x

2.10 Collaborative partner analysis

As the user probe did not provide any clear direction, Dynaudio is pulled in to be the deciding factor for the concept direction. We assumed that for any of the two concepts to be realized Dynaudio would need to collaborate with an external company for developing the parts of the product, unrelated to sound reproduction. The purpose of this analysis was to investigate each of the concept directions in regard to how a collaborative partner-company, would fit the values and profile of Dynaudio. This analysis was done to get an insight into which of the conceptual directions that are seemingly most logical for Dynaudio to pursue and not an extensive research of actual partnership proposals.

DYNAUDIO

Brand & values:
Dynaudio is a danish Skanderborg based audio-tech company, delivering high-end speakers. Their main focus lies on the sound reproduction experience in their products while they aim for a clean and simple Nordic design-aesthetic. They value precision and craftsmanship in their products.

Production knowledge:
Dynaudio has extensive experience in developing high performing speaker drivers. They are producing hand-crafted speakers with cabinets in MDF and plastics.

Sales channels:
Online sales, specialty Hi-Fi shops

(Troldtekt, no date)



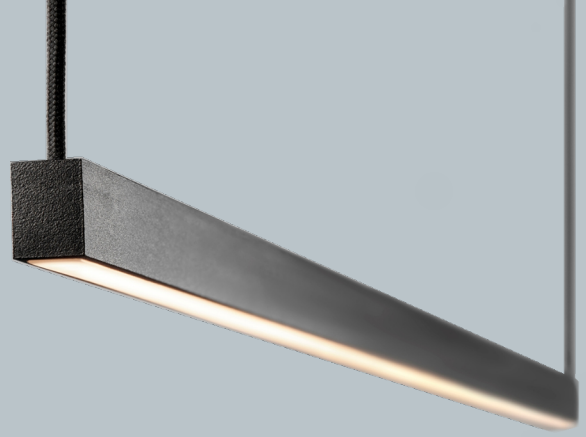
Brand & values:
Troldtekt is a manufacturing company, known for developing and providing acoustic panel solutions for both private homes, office- and industrial spaces.

They design and produce their products in Denmark. Their products are characterized by the functionality in regards to acoustics and indoor climate, as well as the aesthetics they provide to rooms. They aim at being a sustainable, innovative and social responsible company.

Production knowledge:
Extensive experience in producing in concrete and wood, and with both acoustics and indoor climate within different types of rooms.

Sales channels:
They are mainly distributed through hardware stores such as STARK, Silvan, Bauhaus, bygma etc. They sell to both contractors, entrepreneurs and private consumers.

LIGHT·POINT
COPENHAGEN



Brand/Values:

LIGHT-POINT is a medium-small sized company that has 25 years of experience in the design of lamps and lightning-systems and has won multiple red dot awards for their designs. They aim for delivering emotional as well as functional lightning experiences. They value quality, innovative technology and Nordic minimalist design.

Production knowledge:

They don't produce lamps themselves, but design both their own series as well as specially developed lightning solutions.

Sales channels

They distribute both online and through private interior design stores in more than 50 countries both in specialty stores and more mainstream stores such as Illum.

(LightPoint, no date)

	Dynaudio	Troldtekt	LIGHT-POINT
Aesthetics	Nordic minimalism	Nordic minimalism	Nordic minimalism
Sales Channels	Specialty stores, online	Hardware stores	Interior design stores
Brand	High-end, quality craftsmanship	Solid quality products, sustainability	High-end, quality craftsmanship
Target group	Audiophiles, enthusiasts	Entrepreneurs, Home owners	Design enthusiasts
Production	Drivers & cabinets	Panels in wood and concrete	External production

Evaluation

Both of the analyzed companies match Dynaudio in their ambitions to be recognized for delivering high-quality products in a minimalist Nordic inspired aesthetic. However Troldtekt is unlike both Dynaudio and LIGHT-POINT, not targeting a specific high-end market. Add to that, that distributing Dynaudio products through their sales channels would be an ill fit, LIGHT-POINT shares a lot of the same ambitions and target group (A higher social class). In regards to matching a partner with fitting sales channels and design values, the lamp speaker is seemingly a more fitting direction, given that the proposed partner has more in common with the profile of Dynaudio. The results of this investigation was presented to Dynaudio, to verify that they would be willing to enter into a partnership with a lamp design company. During this it was proposed from Dynaudio to develop a "base"-unit that would act as a platform multiple designcompanies could develop designs upon. By doing so the lamp designers would be responsible for meeting the current style trends, and Dynaudio would remain independent from changes this area. Based on all of the above, the lamp speaker concept is choosen for further development.

The ceiling lamp speaker should be developed as a platform for a lamp design.

14.0

2.11 Phase 2 sum up.

Phase 3 has been about finding and choosing a final conceptual direction for our project.
To find the different opportunities for a conceptual direction, we diverged our process into many different directions and ideas, by ideating with basis in our research prior to this. To converge and navigate this field of different possibilities, we selected a handful of concepts and developed them to a degree in which a comparison made sense. The chosen concepts underwent a competitor analysis, user probe and collaborative partner analysis, which resulted in a converging of the conceptual direction to a ceiling lamp speaker. Phase 3 provided us with new insights and demands to be carried on, in the further specification of the concept.

Design brief:

New problem statement:

Design a Dynaudio speaker that can be hidden in / facilitate lamp designs created by external lamp design companies

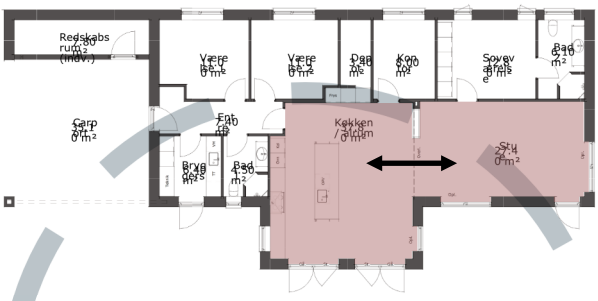
?

User

This product targets families, and the parents in specific as potential buyers.

Context

The owerall context is newly build house. The lamp should the kitchen and livingroom. More often it will proberly be the kitchen as people own soundbars for the livingroom



Unique selling points

- Does not take up a power outlet
- Does not take up counter top space
- No phone is needed for usage
- Is a lamp
- Blends in with the interior

Demands

Req no.	Requirement	Source
1.	The ceiling lamp speaker should be developed as a platform for a lamp design.	2.10 - Collaborative partner analysis
2.	The speaker should be compatible with the existing power outlets in the ceiling	2.9 - User probe
3.	The speaker should be compatible with Apple Airplay and Google Cast	2.9 - User Probe
4.	The user should be able to play content without the phone.	2.9 - User Probe

3.0 Detailing

Phase 3 is initiated with segmenting the concept proposal into subsystems, along with a strategy for the phase.

We looked into the inner workings of the case partners products, in order to gain an understanding of what goes into such a system.

The case partner provided one of their entry-level products, and we deconstructed it to understand the construction principles that goes into creating a speaker for the mass market.

We then conducted a series of tests regarding the subsystems of the concept proposal, that lead to a initial specification.

Based on that we challenged the component placement in the concept proposal, that resulted in three new concept directions

We presented them for Dynaudio, and were able to choose a final conceptual direction.

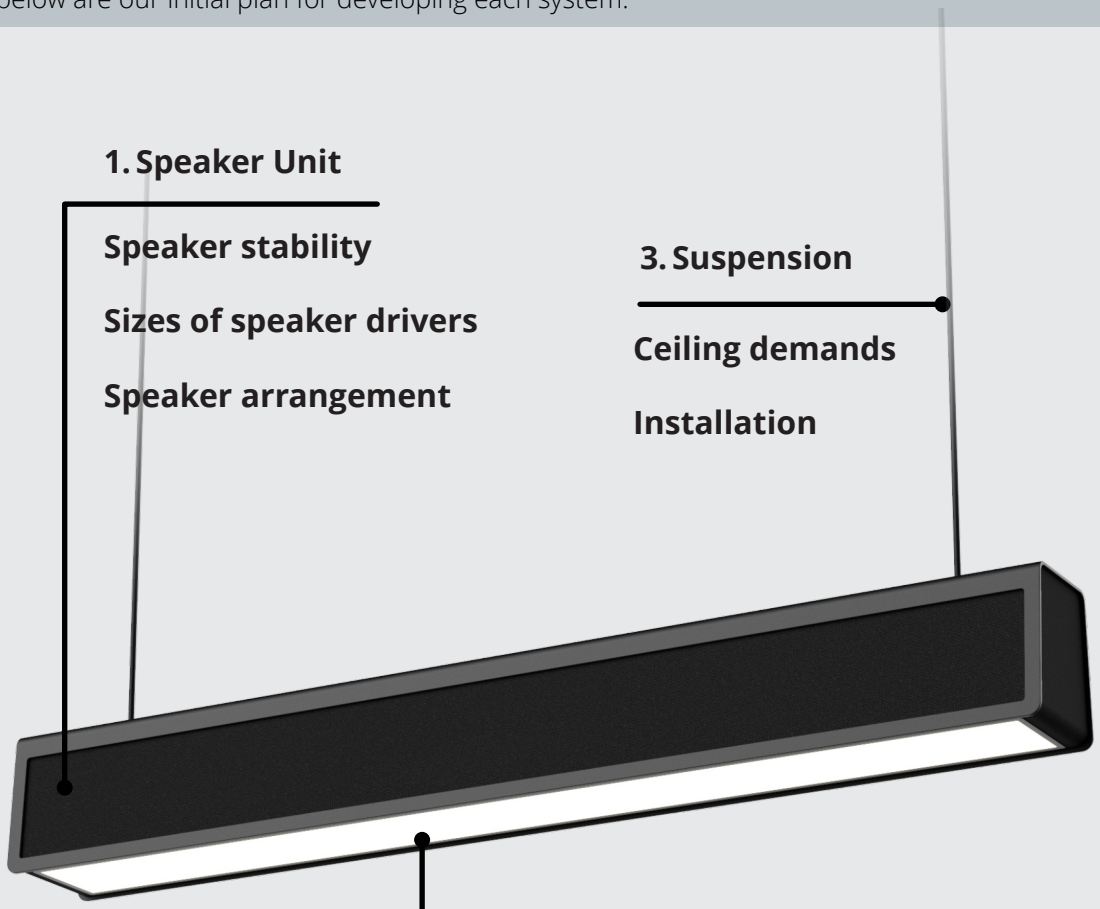
To ensure that the concept proposal were aligned with the trending product values, we dug up the mega trends analysis from earlier, and applied it to the proposal.

Lastly we were able to create a final specification

3.0 Detailing

3.1 Introduction

To further develop the Ceiling lamp speaker, we segmented the development of the concept into the three constructional systems required for the concept to function: The suspension system, the lighting system, and the speaker system. Segmenting the development in the three systems, allowed us to develop each system individually before assembling them in the final concept. Developing each system involved analyzing relevant information and translate that into specifications we could use for constructing the final concept. Listed below are our initial plan for developing each system:

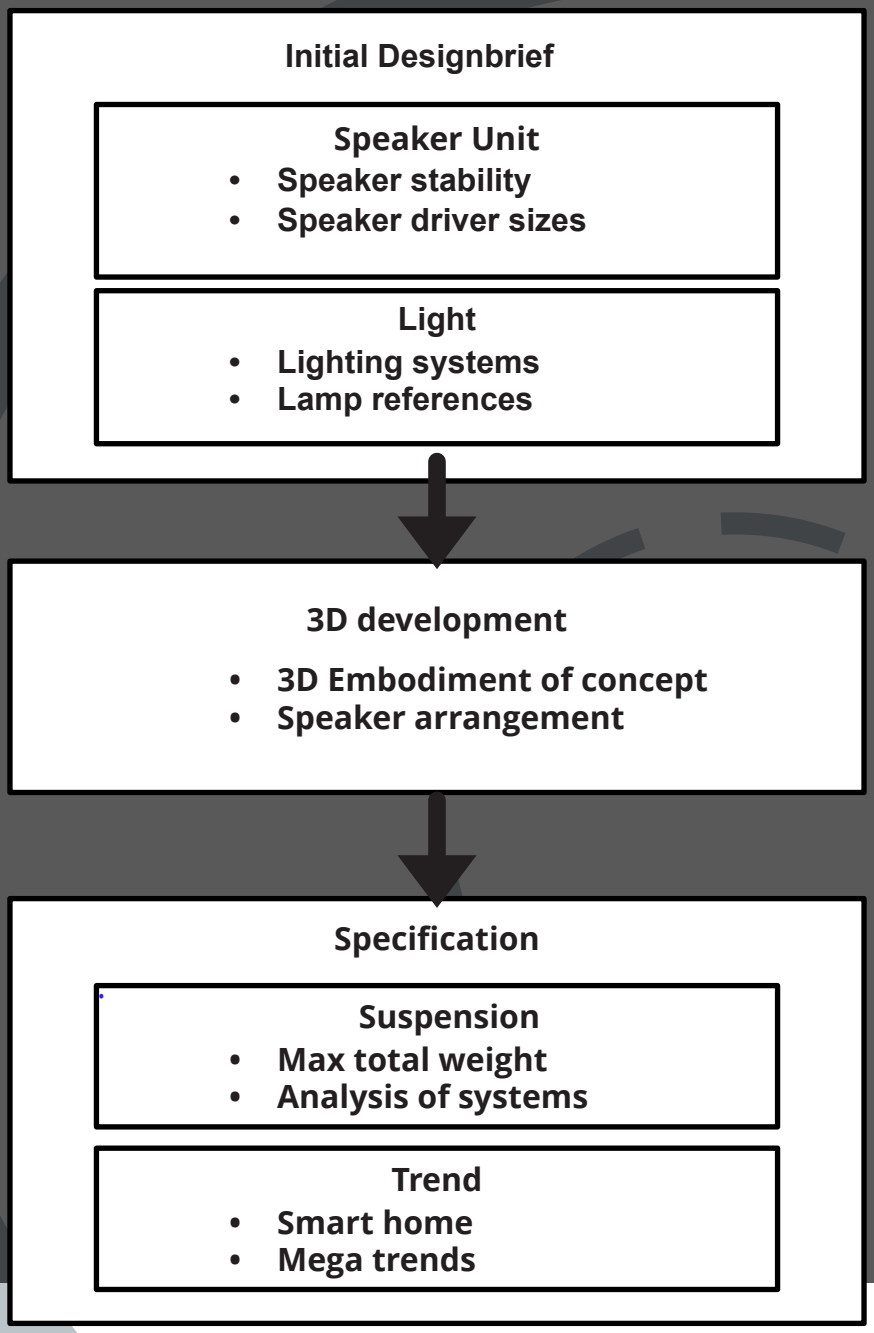


3.2 Strategy

Phase 3 - Concept development.

This phase will explore the ceiling lamp concept in depth by looking into the different systems of the ceiling lamp speaker, at the current state. By exploring the three different systems, the hope is that we can extract demands we can use in a design brief to frame a final 3D construction of the concept. By the end of this phase the concept should be defined to a degree in which a final specification can be made for the following Phase 4, which will deal with finishing the construction of the concept.

Listed below is our initial plan for developing the concept, as we diverge the process we may deviate from this plan, however the goal for this phase remain developing the final specification.



3.3 Conventional loudspeakers explained

Objective

In order to understand the speaker drivers in Dynaudios products, we documented and explained the principles and elements of a conventional speaker driver in the section below.

Whats is sound?

In short, sound is vibrating waves, that are emitted through a transmission medium, in most cases air. These vibrations could i.e. be caused by a vibrating engine, your neighbor drilling or a loudspeaker. (Sharp, 2019)

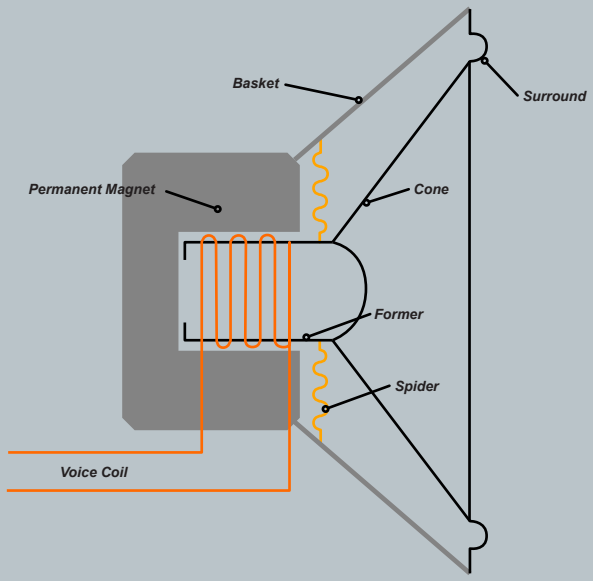
The vibration waves can be recorded, using a Microphone. These devices typically work by the principle of electromagnetic induction, where the movement of a magnet in a magnetic field can make a current flow through a coil. The signal flowing in the coil can be recorded. (Bitesize BBC, 2020)

How does a loudspeaker work?

Loudspeaker drivers work by the same principle as a microphone, but in reverse. Instead of receiving a signal, one is emitted.

A signal is sent as electrical current, to the *Voice Coil*, that is attached to the *Former* (Illu. 20). The former is attached to the *Cone*, and all of this is suspended from the *Spider* and the *Surround*.

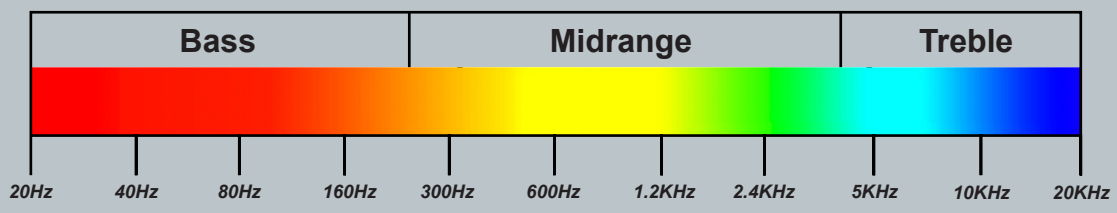
By sending current through the voice coil, a magnetic field Is created, that interacts with the *Permanent magnet*, and moves the cone forward. The currents direction is then reversed, and causes the magnetic field to interact with the permanent magnet in reverse, and pull the cone back. (Bitesize BBC, 2020)



Illu. 20. Loudspeaker principle

The Audio spectrum

The audio spectrum is the span of sound that humans can hear. It ranges from 20Hz-20.000Hz (20kHz), and can be further divided into sub categories **(Illu. 21):**
Bass: 20-250Hz Midrange 250Hz-4.000Hz Treble: 4.000-20.000Hz

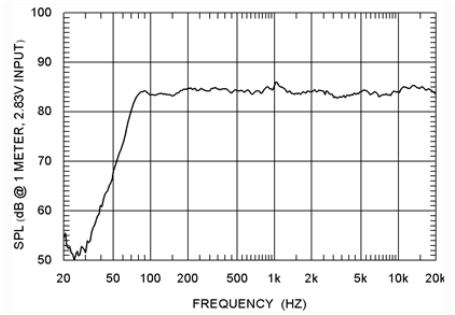


Illu. 21. Audio Spectrum

Manufacturers use multiple drivers to cover different aspects the spectrum: A smaller lighter and more agile unit, called the Tweeter for reproducing Treble, a midrange driver for the midrange frequencies, and a larger woofer for the bass. (Teachmeaudio.com, 2020)

Frequency Response

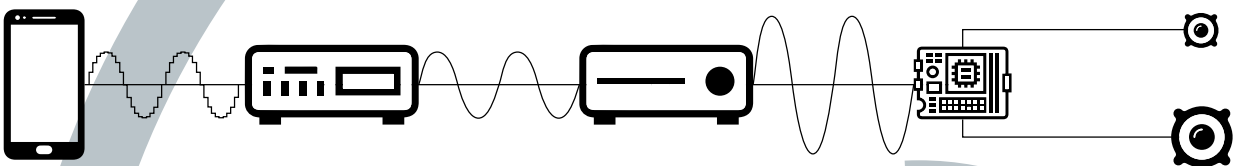
A frequency response curve, is a graph that represents the speakers ability to playback a given frequency. It plots the Audio spectrum at the X-axis, and the sound pressure level (SPL) at the Y-axis. **(Illu. 22)**
Any spikes in the graph would represent a point in the spectrum, where the speaker produces an uneven SPL, and plays a little too loud or too low, thus deviating from the original recording.



Illu. 22. Frequency response curve

The signal chain

Recreating sound can be explained in the following four steps;



1

Medium: A digital signal is emitted from a device.

2

DAC: The digital signal is converted to a analog signal.

3

Amplification: The analog signal is amplified enough to drive the drivers.

4

Crossover: The Analog signal is split between the drivers.

Active and Passive systems

Passive speakers typically only include step 4. A system based on passive speakers are modular, and gives the user the option to exchange and upgrade components along the way. This also means that it takes up more space. The passive system allows the user to mix and match components of different quality and brand, so the experience will vary depending on all of these factors.

Active speakers includes step 2,3 & 4 in one package, so all you need to do, is add power and a digital signal. Active systems typically offer higher convenience in exchange of amplifier choice and upgradeability. It also allows the manufacturer to have greater control over what the user hears, as the only user controlled aspect is the input.

3.4 Stabillity testing

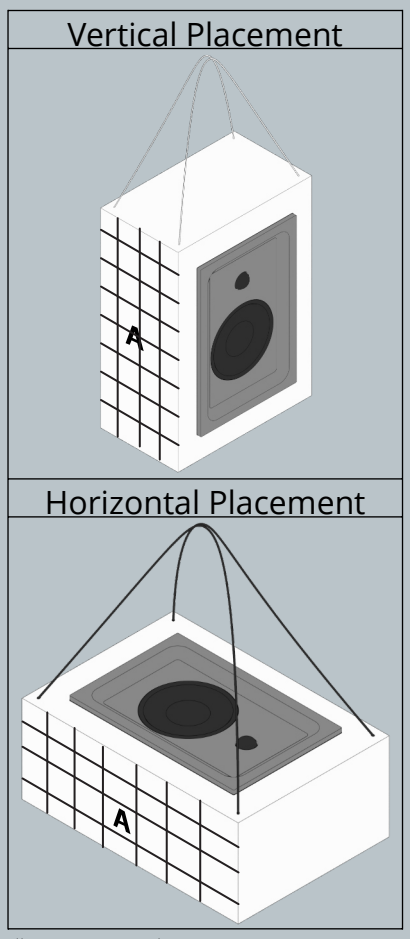
One of the concerns found in the user probe, was if the lamp would move when playing music. To ensure this wouldn't become a problem, a test was made. The purpose was to test different driver setups and measure the movement when hanging from a celing.

Setup

The woofer placement is seen to be the most critical to test, as this is the one with the largest amount of moving mass, and thereby ability create movement.

A sealed cabinet will be constructed in OSB plate, and hung from the ceiling in a vertical and horizontal placement (Illu. 23). The following driver setups was tested:

1. Vertical Placement, One driver
2. Vertical Placement, Two drivers
3. Horizontal Placement, One driver
4. Horizontal Placement, Two drivers



Illu. 23. Test Placements

Method

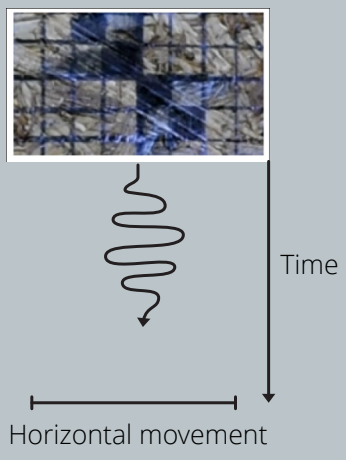
A video will be recorded on a camera mounted on a tripod for stability. The subject will have a 1x1cm mesh drawn on side a (Illu 23).

The loudspeaker will then play a fixed test track (Hardest Button to button - White stripes) at high volume. The recording will begin without music, then play and end with a pause without music again, to see the movement before, under and after playback. (Illu. 24.)

The video will be animated in Adobe Premiere, with two modifiers;

1. A 800% zoom, to magnify the potential movements.
2. A scroll in the Y direction.

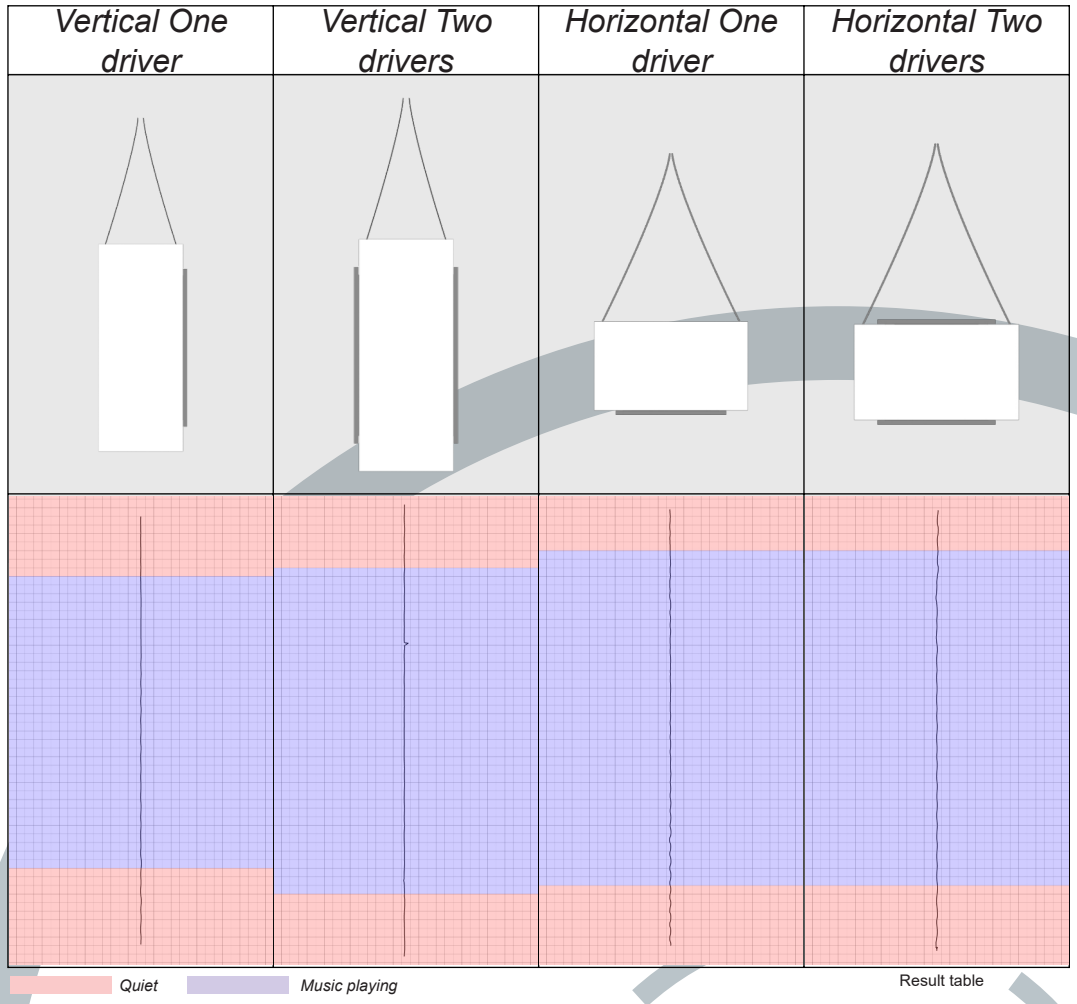
Afterwards, the footage will then be motion tracked in Adobe After effects, to track the movement in the horisontal direction with each frame. The output will be a Vertical line, where deviation in the X axis indicates movement.



Illu. 24. Adobe premiere animation

Test

During the test, it was not possible to eliminate all the movement in the hanging device before recording, so what we are looking for is a change in the amplitude of the frequency.



Test evaluation

The tendency we see, is that with using only one driver, it introduces a growth in the amplitude of the frequency band. This is the result in both the Vertical and Horizontal case. The dual driver cases see a much more stable amplitude, and is there fore more ideal. As the size of the choosen drivers will probablybe smaller compared to the test drivers, we can assume that the results will be less prominent.
It should be noted that uneven weight distribution in the two cases with a single driver, may have caused or at least increased the instability, which could be tested by evening the weight in the cabinet and run the test again.

The array of speaker drivers should be arranged in an axial dual driver setup for optimal stability, if suspended in cables.

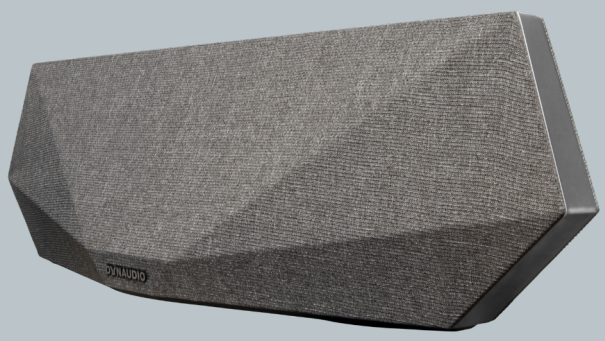
5.0

Acoustic Lens

As an alternate to having multiple drivers for spreading the sound, an acoustic lens can be added. An acoustic lens functions by either focusing or dispersing the sound uniformly to an area, thus a single sound driver can cover multiple directions. (Sweetwater, 2004) It is however unknown how this will affect the stability. Recently B&O reintroduced the acoustic lens in their Beolab speaker series.

3.5 Deconstructing a Dynaudio Music 5

Dynaudio provided a Music 5 speaker (See illu. 25) for our project. The Music series speakers are mobile W-LAN speakers which in functionality are similar to our concept in the interaction, which is done by either the physical interface or by using the Dynaudio app for streaming. As it contains the needed features (Apple airplay and google Cast) and similar value propositions the hope was that analyzing the construction of the speaker, would provide specifications for further constructing our own concept in regard to components and structure needed for this functionality to be present. The entire deconstruction can be found in ***appendix 35****.*

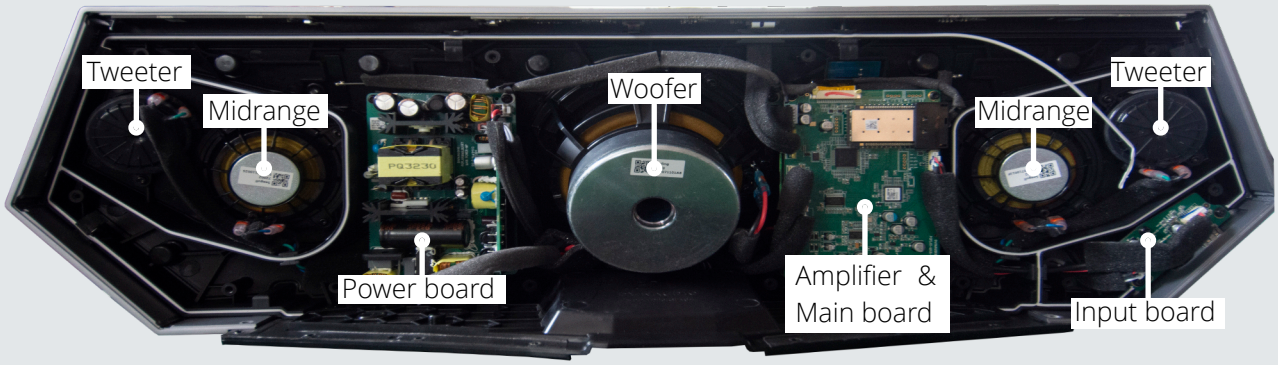


Illu. 25. Dynaudio Music 5 Speaker

Components Hardware

Deconstructing the speaker reveals that it's functional system consists of the following internal components (See Illu 26.)
2x Tweeters (Height 28mm x Diameter 50mm)
2x Mid range drivers (Height 35mm x Diameter 85mm)
1x Woofer (Height 77mm x Diameter 145mm)
1x Power board (Height 133mm x Width 82,5mm)
1x Main board + Amplifier combo board (Height 137,5mm x Width 104mm)
1x Input board for USB and AUX. (Height 70mm x Width 30mm)

In addition to the internal components it consists of a cabinet which is further divided into different components. (See Components Cabinet)



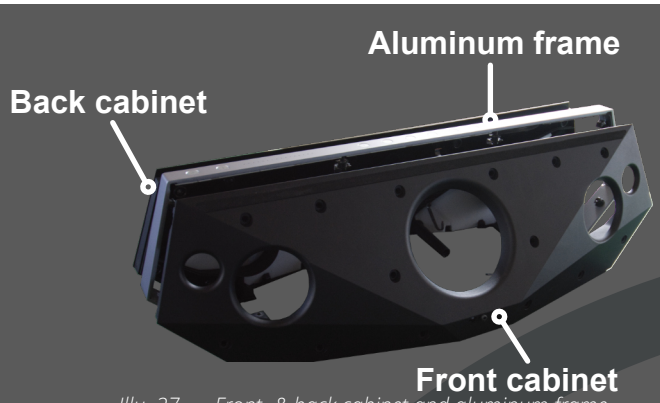
Illu. 26. Dynaudio Music 5 - Components

Because of the quality of the sound output and the insight we gained deconstructing the speaker, we decided to use the same drivers for the further specification of our own concept.

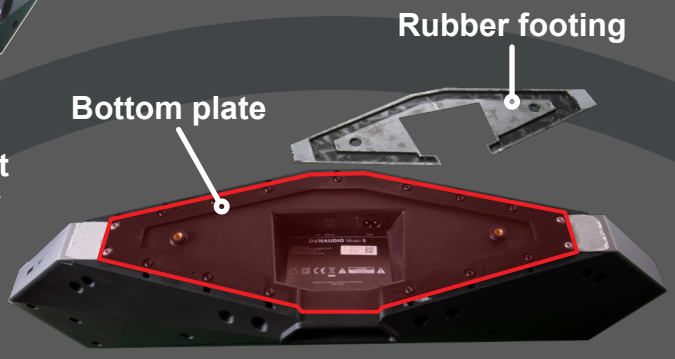
The concept should use the same drivers and electronics as the Dynaudio Music 5 speaker. 3.1

Components Cabinet

The cabinet is assembled by a front- and back cabinet that are connected and sealed by an aluminum frame (See illu. 27). Both the front- and back cabinets, are mounted with a grill, covered in fabric (See illu. 25) It has a bottom plate, finished off by a rubber footing (See illu. 28) The hardware components are sandwiched by the cabinet components.



Illu. 27. Front- & back cabinet and aluminum frame.



Illu. 28. Front- & back cabinet and aluminum frame.

Driver volumes

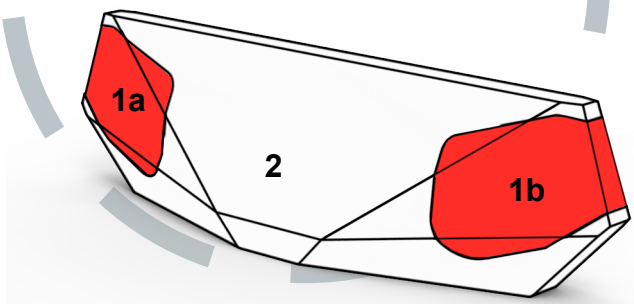
The front- and back cabinet forms 3 spaces for the 2x midrange and woofer drivers. These spaces are necessary as the sound drivers depend on having a volume of air around, for optimal sound performance.

Volume 1a and 1b are for the midrange and tweeter drivers. The tweeter has its own closed off back chamber, so the volume of this cabinet doesn't affect its performance. The volume of the tweeter should be deducted when calculating the volume of this cabinet. (See illu 29. & 30)
Volume 2 Contains the volume for all the electronics and the woofer. (See illu 29. & 30)

The Volume required for the different drivers were provided by Dynaudio, and measures as follow:
Woofer: 4,5 L as a ported cabinet and 3,7 Liter as a sealed cabinet.
Mid range: 0.5 L sealed cabinet.
Tweeter: No limit - needs a closed chamber.



Illu. 29. Dynaudio Music 5 - Cabinet volumes



Illu. 30. Dynaudio Music 5 - Cabinet volumes colorcoded

The concept should have a cabinet with a volume of minimum: Woofer (4,5L) and Midrange (0,5L)	6.0

3.6 Light Specification

Lighting demands

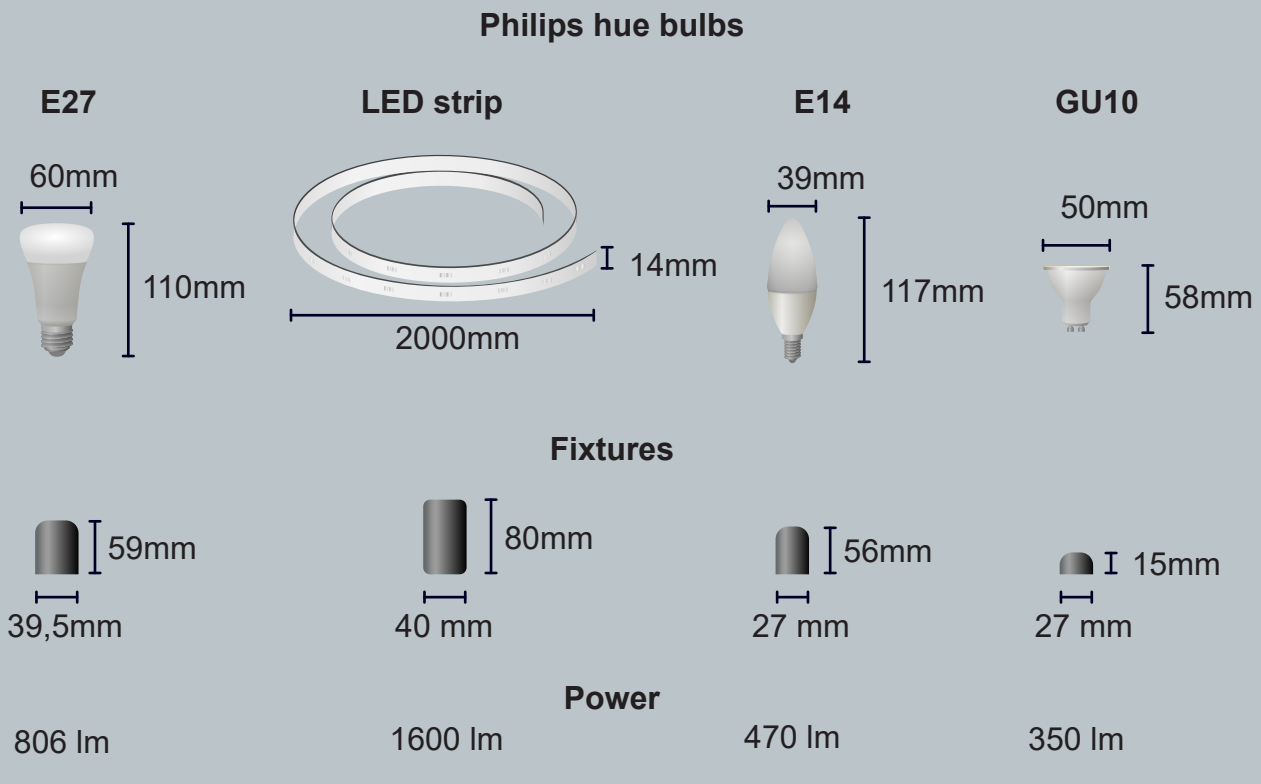
The speaker should function as a lamp in the house as well as a speaker. It's a must that the speaker is not only a decent speaker, but also a good lamp as it is going to compete and replace other lamps. As each room in the house is used differently the requirement to the effect of the lamp is differs as well. Below is listed suggestions to the lumen effect of the lightbulb in respect to the room they are used in.

Kitchen	Livingroom	Bedroom
800 - 1000 lm	470 lm	250 lm

As seen the kitchen has the highest demand (EnergiFyn, no date), as it functions as a working-area of the house. The lamp-speaker will need to fit a bulb that is able to fulfill the lumen-demands of the kitchen as this is the extreme case.

Smart home

As the speaker is designed to be a part of the future home, it needs to fit with the current smart home lighting systems. Philips hue is a common system for this, so the lamp speaker will need to fit the demands of this. Below is an overview of the Philips Hue series of light bulbs, together with their specifications and fixture sizes.



Direct VS diffused lighting

As before mentioned the rooms of the house has different demands for the lighting. To handle this lamps are designed to direct the light from the light bulb in different directions to get the right light for the given situation. Lamps can be categorized into two overall categories - diffused light and direct light. The direct light is dispersed by lamps that directs the light in a focused direction. These are typically used in functional situations such as the kitchen. The diffused lamps diffuses the light using a lamp shade or similar, and are often used as an ambient light source such as the center of the livingroom. Here directional lights could be placed by the couch to create a reading area (functional area), and it is suggested that the most successful lighting is created by a mixture of diffused and direct lighting. (FritzHansen, no date)

As the lamp is designed to be used in different situations, it needs to be adaptable to feature both direct and diffused lighting. Below are graphic examples of the different lighting types.



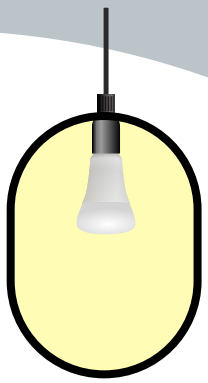
Direct Light

The shade covers the sides of the bulb. The light is reflected on the sides of the shade, and is directed downwards.



2. Direct Light (Diffused)

The shade covers the sides of the bulb. Under the bulb, a reflective plate is placed. This directs the light upwards and onto the sides resulting in a softer light than the direct, in one direction.



3. Diffused Light

The shade of the lamp consists of a semi-transparent material. It covers the bulb, and the light is reflected inside the shade, to create a diffused light in all directions.

Evaluation

As we want to create a platform for a lampdesign *(Requirement 14)* the concept should preferably fit multiple types of lamps, in different sizes and with different types of shades. As the E27 is the only Phillips Hue bulb along with the LED strip, that can produce a strong enough effect for the kitchen, the ceiling lamp speaker should fit this as well. To accommodate these requirements in the concept development, 5 reference lamps representing a varied selection of lamps, was selected and modeled along with a E27 Phillips Hue bulb.

The ceiling lamp speaker should be a platform for all 3 types of lamp shades.	1.1
The lamps should all be able to fit the E27 phillips hue light bulb and socket.	4.0

3.7 Initial specification

List of specifications

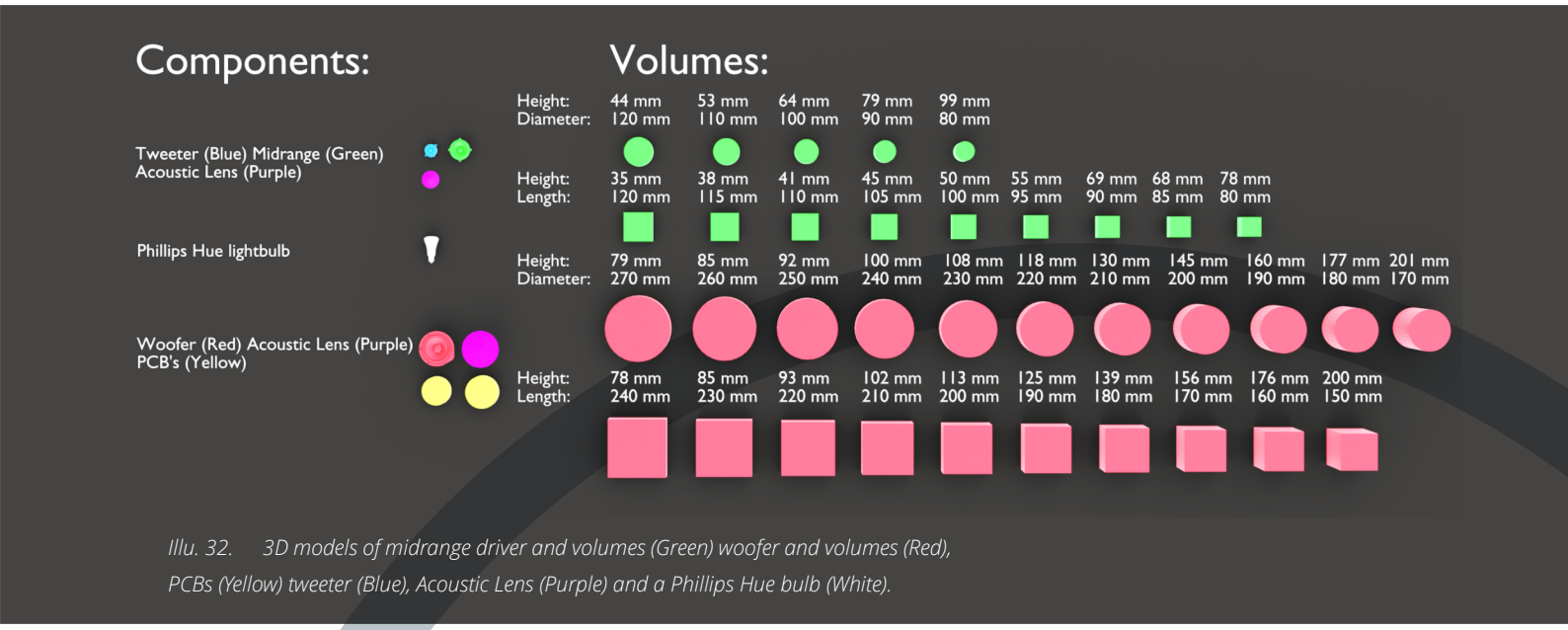
The specifications listed below, is a work in progress. At this stage of the development the purpose of the requirements is to specify elements for the following concept development.

Req no.	Requirement	Specification	Source
1.1	The ceiling lamp speaker should be developed as a platform for a lamp design.	Direct Lighting Direct lighting (Diffused) Diffused lighting	**3.6** - Light Specification
3.1	The concept should use the same drivers and electronics as the Dynaudio Music 5 speaker.	Tweater (H28mm x D50mm) Midrange (H35mm x D85mm) Woofer (H77mm x D145mm) Power board (H133mm x W82,5mm) Main board (H137,5mm x W104mm) Input board (H70mm x W30mm)	**3.5** - Deconstructing a Dynaudio Music 5
5.0	The array of speaker drivers should be arranged in an axial dual driver setup for optimal stability, if suspended in cables.		**3.4** - Stabillity testing
6.0	Minimal cabinet volume	Woofer Volume > 4,5 L Midrange Volume > 0,5 L	**3.5** - Deconstructing a Dynaudio Music 5
7.0	The lamps should all be able to fit the E27 phillips hue light bulb and socket.	Bulb (H110mm W60mm Socket (H59mm W 39,5mm	**3.6** - Light Specification

3.8 Concept development

To further develop the concept towards a final constructional and aesthetic solution, 3D models of electronics, a E27 Phillips Hue lightbulb, sound drivers and their required volumes, was made. (See illu. 32) Dynaudio provided the necessary 3D files for the sound drivers. The exercise was about combining these 3D components into a platform that fits each of 6 chosen reference lamps (See illu xx) s, to test different placements and setup of drivers. The hope was that this would provide us with a rough estimate of the scale of the platform in relation to the lamps and placement hereof.

As we planned the exercise, it became apparent to us, that the platform could be segmented into 3 different categories depending on the placement in relation to the reference lamps.
An Integrated platform - integrating the speakers into the lamps.
A partially integrated solution - Integrating some of the speakers into the lamps while separating the rest.
A disintegrated solution - Separate the speakers from the lamp entirely.



Illu. 32. 3D models of midrange driver and volumes (Green) woofer and volumes (Red), PCBs (Yellow) tweeter (Blue), Acoustic Lens (Purple) and a Phillips Hue bulb (White).

Reference lamps

The 6 lamps shown below **(See illu. 31)**, represents the 3 different types of ceiling hanging lamps and different sizes. By using lamps in a wide span of sizes will provide us with an idea of the limits of the size of lamps the concept will work with.



Lightpoint
BLOW S370
Diameter: 370 mm
Weight: Unknown

Poul Henningsen
PH5
Height: 267 mm
Diameter: 500 mm
Weight: 1,8 kg

MUUTO
Under the bell
Height: 640 mm
Diameter: 820 mm
Weight: 6 kg

Secto Design
Octo 4240
Height: 680 mm
Diameter: 540 mm
Weight: 1,8 kg

LE KLINT
Pendel medium
Height: 370 mm
Diameter: 200 mm
Weight: Unknown

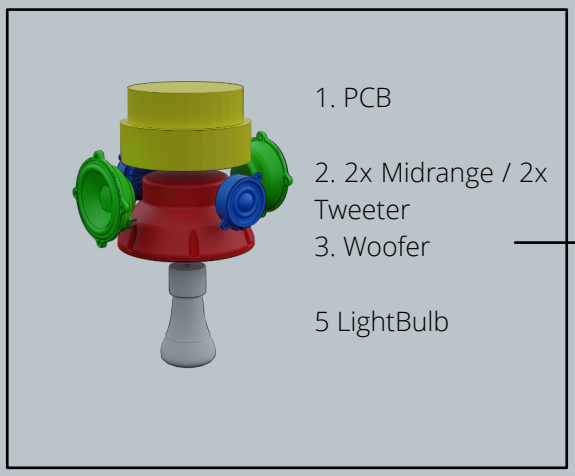
Verner Panton
Flowerpot VP1
Height: 160 mm
Diameter: 230 mm
Weight: 1 kg

Illu. 31. 3D models - Reference lamps

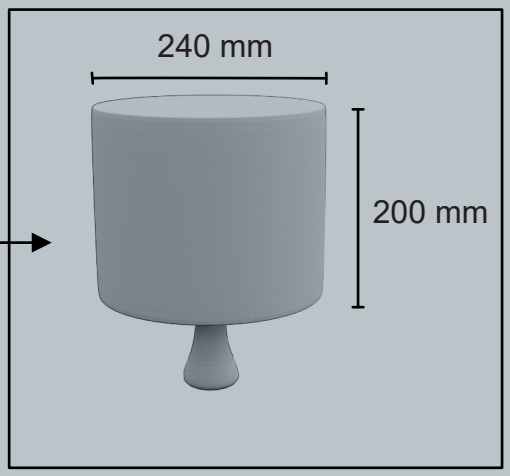
3.9 Fully Integrated

The fully integrated concept: all of the drivers are combined in a single cabinet on which the lightsocket is placed. The thought of this direction was to construct a platform which was fully integrable with a ceiling lamp.

In this version of the concept (see illu. 33 and 35) the midrange drivers (Green) and tweeters (Blue) encircles the woofer (Red) the concept follows the demand with axial dual drivers while the encirclement by midrange and tweeter, also disperses the sound in a 360 degree angle. The PCBs (Yellow) are placed on top of the drivers. Placing the sound drivers on the same vertical level make the concept wider, but shorter.



Illu. 33. Components and placements



Illu. 35. Speakers enclosed in cabinet

Reference speakers



Illu. 37. Visualization of reference lamps with concept.

As it can be seen in the visualization above, the concept only fits the Muuto in scale, as the only reference lamp wide enough to encompass the width of this version. The concept adds a lot of volume and and significantly changes the appearance of the lamps.

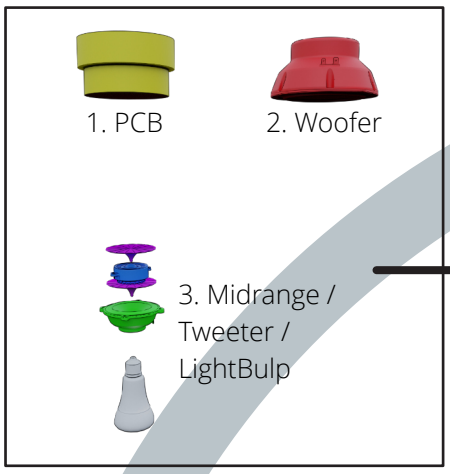
Conclusion

The fully integrated concept was too large in comparison to the chosen reference lamps. Few of the lamps has a size large enough to encompass this size of speaker platform. This means that for this direction to work, it either has to be targeted at larger lamps or some of the drivers, such as the woofer needs to be removed entirely from the concept to scale it down.

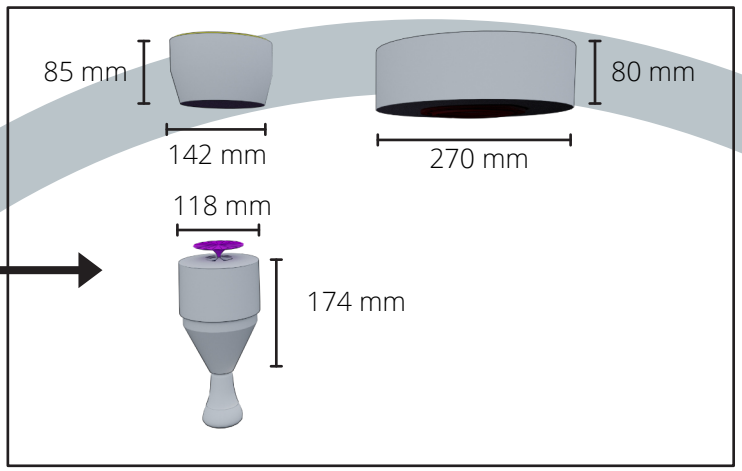
3.10 Partially integrated

The partially integrated concept: the woofer and PCB's, which make up the biggest components, are placed away from the lamp, while the midrange and tweeter are integrated in a light socket for a lamp to be built around. The idea behind this was to develop the smallest possible 'socket', to facilitate a wider range of lamp designs.

In this version of the concept (see illu. 34 and 36) the axial dual driver setup is circumvented by placing an acoustic lens (Purple) above the midrange and tweeter, dispersing the sound.

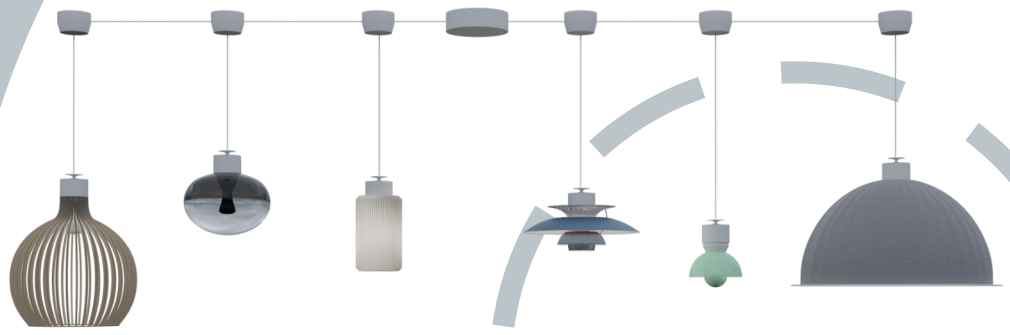


Illu. 34. Components and placements



Illu. 36. Speakers enclosed in cabinet

Reference Speakers



Illu. 38. Visualization of reference lamps with concept.

By disintegrating the largest components in cabinets separate from the lamps the concept can be comprised to a size that fits a wide range of lamp sizes. It fits all of the reference lamps but the flowerpot, in regard to size.

Conclusion

The partially integrated concept is a large setup as it consists of three separate units. It fits most of the reference lamps in scale, and in such is a viable solution. The lampshades would have to be redesigned to or designed specifically for this platform. The scale of the setup could be adjusted by leaving out the woofer like suggested in the Integrated concept before.

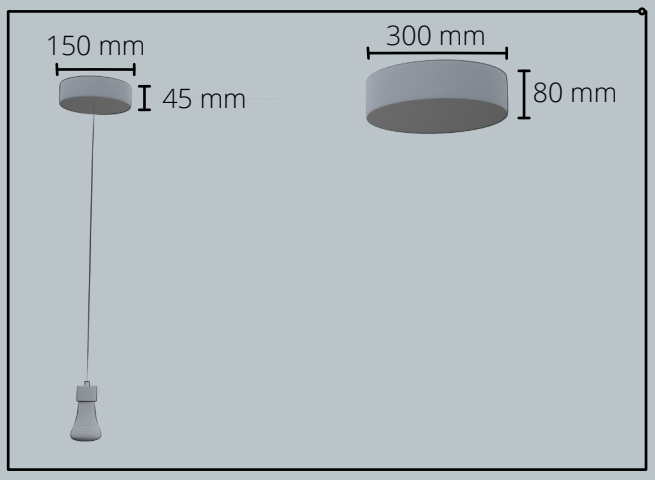
3.11 Disintegrated

The disintegrated solution; all of the drivers are placed away from the lamp and separated into a canopy containing the midrange and tweeter driver and a base unit containing the PCBs and woofer. This way the lamp is independent of the set of drivers and PCBs as the platform replaces the suspension system and not the structural construction of the lamps. (See illu. 39 and 40)

Version 1.



Illu. 39. Visualization of reference lamps with concept.



Illu. 40. Visualization of reference lamps with concept.

Reference speakers



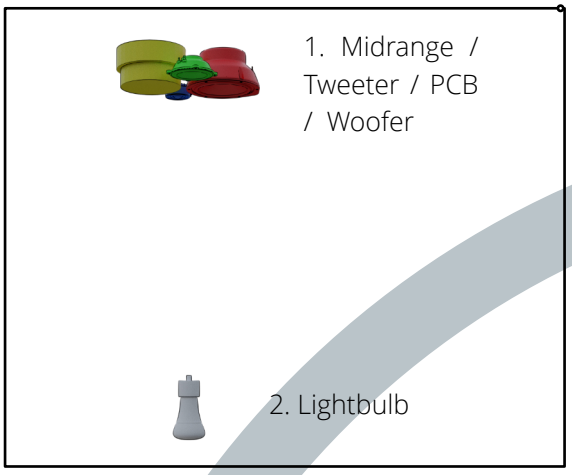
Illu. 41. Visualization of reference lamps with concept.

The direction fits all of the lamps independent of their size and aesthetics as it neither adds or subtracts from the lamp it self. The disadvantage however is that the user would have to install a minimum of two 'speaker canopies' in the ceiling which makes the installation of this concept a weak link, with regard to the convenience.

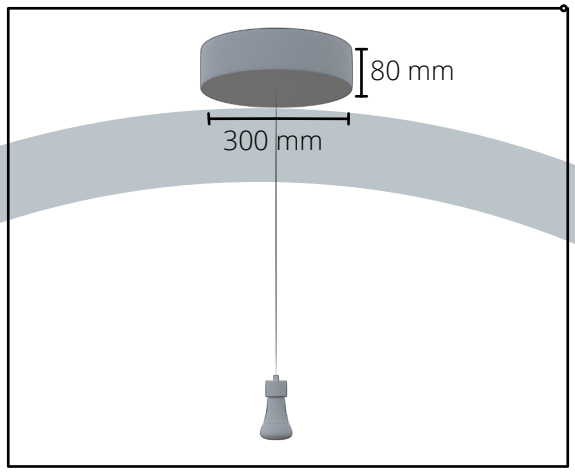
3.12 Disintegrated

As the concept showed a promising result in regard to creating a platform suitable for all lamps, a second iteration was done, in which we tried to combine the electronics and sound drivers into a single unit, and by that ease the installation. (See illu. 42 and 44)

Version 2.



Illu. 42. Visualization of reference lamps with concept.



Illu. 44. Visualization of reference lamps with concept.

Reference speakers



Illu. 43. Visualization of reference lamps with concept.

The concept seems large in comparison to the smaller lamps - the Flowerpot, PH5 and Le Klint. (See illu. 43) If it should facilitate smaller lamps such as the small flowerpot vp1, it would need a decrease in size. The concept at this stage, seems too large for the concept to be camouflaged.

Conclusion

The idea however of a retrofit solution fits very well with our demands and direction. Combining all of the electronics and drivers does make it too large, as the idea of hiding the speaker is compromised by the scale of the concept. Perhaps keeping the drivers in separate units with a woofer unit and a midrange unit as in version 1, would be a more fitting solution. This would also allow the user to determine whether a woofer is necessary or not. For concept validation we sat up a presentation for Dynaudio to get an insight into the technical feasibility of the different concepts and to get their opinion.

3.13 Concept presentation for Dynaudio

A presentation of the three concepts, described in the Concept development section, was sat up for Malte Köhn (Design Director at Dynaudio, MK from this point). Before choosing any of the 3 concepts, we wanted to get the opinion of Dynaudio, in regard to the technical feasibility - We didn't see any problems with any of the proposals in regard to the technical functionality, however before choosing either and creating a final specification, we wanted to verify that assumption.

The fully integrated concept

MK quickly ruled out an integrated solutions with those drivers, as the size of such a platform was too big.

The partially integrated concept

For a concept like the partially integrated speaker to work, it would have to targeted future lamp designs because they would need to be designed around the platform, ruling out the platform as a retrofit solution. It could be a platform targeting IKEA lampshades.

The disintegrated concept

Regarding the disintegrated concept, he agreed that the installation was a weak link and he questioned the actual invisibility of the concept. However dividing the units into two, might be a solution to that. He also mentioned the idea of leaving out the woofer unit entirely, as the Music 1 speaker in the Music series, doesn't have a woofer integrated, but still performs decently.

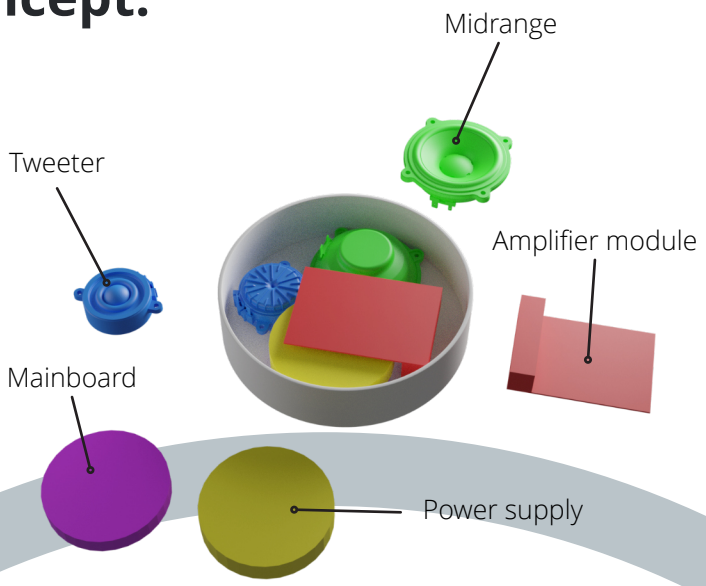
Conclusion

We all agreed that the disintegrated concept was the most interesting direction, because it wasn't limited by the type or size of lamp, and would work as a retrofit for new as well as older lamp designs. By leaving out the woofer it was deemed possible to make the solution small enough to still camouflage itself in the interior. Another quality of the concept was that it could utilize the ceiling junction box for powering the unit, which would free up a slot in the power outlets.

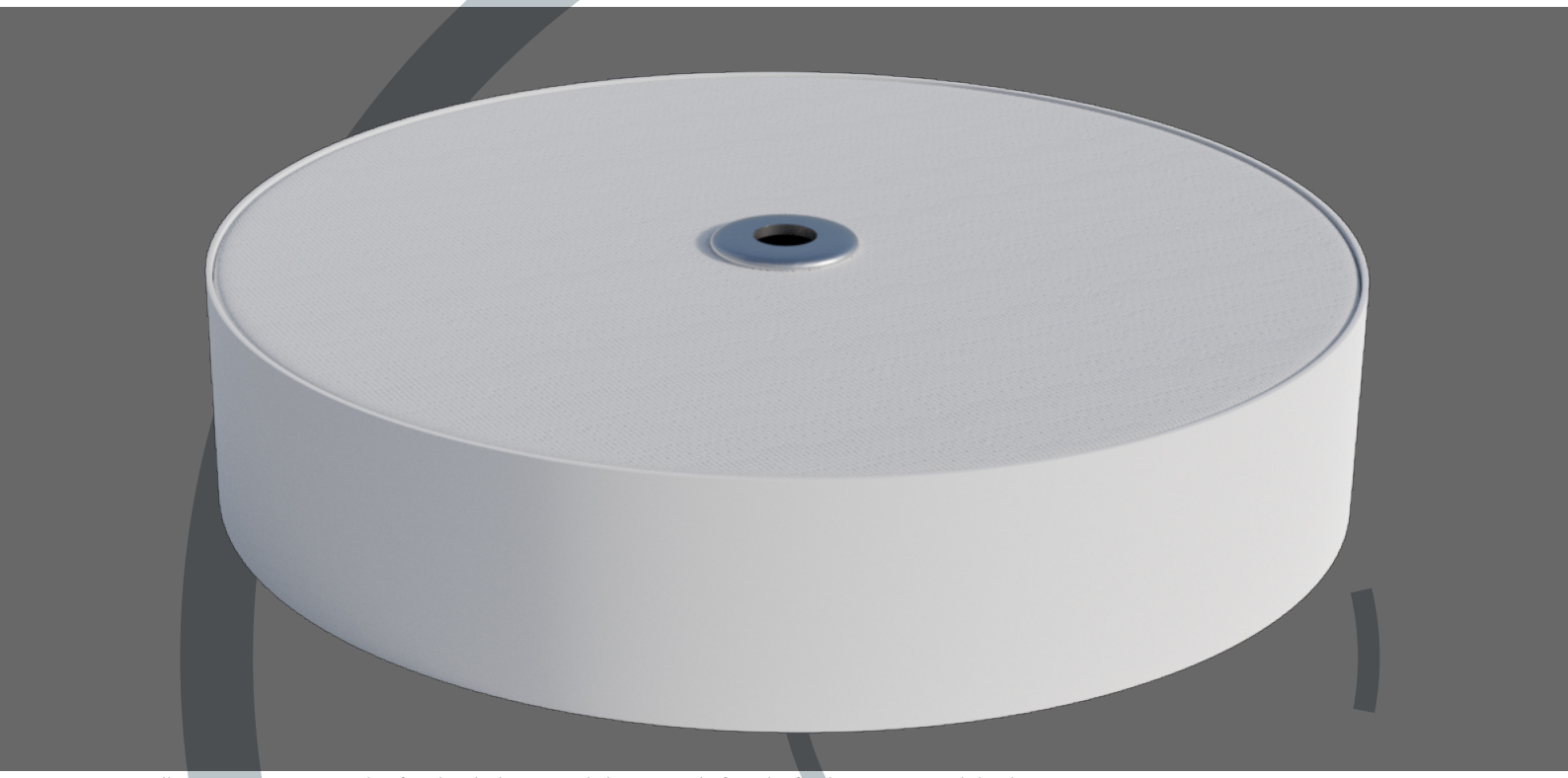
Camouflage / blend in with ceiling/surroundings.	1.2
The concept should use the same drivers and electronics as the Dynaudio Music 1 speaker (Updated PCB size and only midrange and tweeter).	3.2
The array of speaker drivers should be arranged in an axial dual driver setup for optimal stability, if suspended in cables.	5.0
The lamps should all be able to fit the E27 phillips hue light bulb and socket.	7.0

3.14 Adjusting the concept.

As we changed the demand for the drivers to be incorporated into the canopy, an adjustment of the 3D model was made.
A Dynaudio Music 1 speaker, has a single midrange driver and tweeter, while the electronics count a mainboard, powersupply and amplifier module. (FCC, 2017) The geometry was roughly created in 3D and placed in a cabinet. Adjusting the position of the new components allowed for a cylindrical cabinet with a diameter of 180 mm, which seemed small enough for the concept to blend in with the ceiling, finalizing our choice of concept.



Illu. 45. Concept adjustment - Drivers and electronics fitting in new cabinet.



Illu. 46. Canopy speaker fitted with drivers and electronics, before the final constructional development.

Conclusion

Choosing the canopy speaker concept, meant that we had to work on the weakness identified in the concept, before completing the final construction of the concept. The remaining critical weaknesses of the concept was the suspension system and installment of the canopy speaker on a ceiling to which started research and analyze existing celing lamp suspension systems.

3.15 Suspension system

Intro

As we chose to develop a Canopy speaker concept, we needed to identify requirements in regards to the suspension system and the installation hereof. As we chose to develop a ceiling device we needed to identify the weight limits and positioning on a ceiling in a common home. Further to get an understanding of the most common canopy and lamp installment procedures, we chose to analyze the installment by following the recommended instructions provided by Sikkerhedsstyrelsen. (Sikkerhedsstyrelsen, no date) Following the instructions we tested the installation of a lamp with a canopy on our own ceiling and analyzed the procedures for problems in the setup.

Placement of suspension hangers.

Plaster and troldtekt modules are popular choices for ceilings in new houses, however these type of ceilings provide limited support for mounted objects.
For normal ceilings there's a rule of thumb stating that the ceiling holds 5 kg. If the object suspended weighs more than 5 kg. It has to be installed into the rafters of the house. (Bolius, 2019) In case of multiple suspensions the spacing has to be divided between rafters meaning that they would need a spacing between 60-100 cm. (Art-tek, no date) Because of the weight limit of 5 kg, we chose to limit the weight of our canopy to 2 kg, as most of the reference lamps weighed in below 3 kg, making it possible to install everywhere on the ceiling.

The canopy speaker must not exceed a weight of 2 kg and should be able to hold a lamp up to 3 kg	8.0

Installation of suspension system

Preferably, our solution had to be easier to install than current standard lamp canopies. We chose follow the installation guide in the hope that we could identify problems in the current installation and optimize then solution.
The installation was documented in the following pictures.



Step 1

Switch of the power on the main switch.



Step 2

Remove the fuses to prevent others from turning the power back on, while you are installing.



Step 3

Test it with a voltage tester before starting any operations, to ensure that the outlet is complete off.



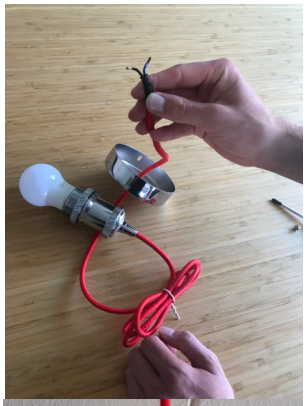
Step 4

Mark the desired location for the lamp.



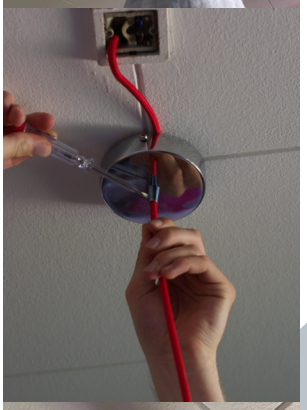
Step 5

Install the bracket with 2x screws, make sure to use the right type of screw, e.g. drywall screws for plaster.



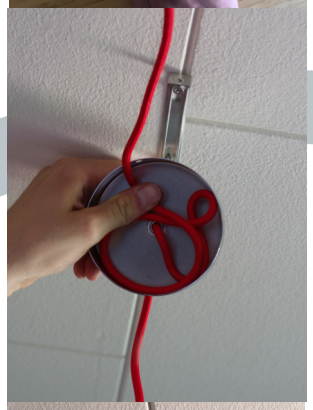
Step 6

Strip the insulation from the two cords and twist the copper wires to ensure they stay in a tight thread.



Step 7

Adjust the height of the lamp by loosening the socket screw, and pushing / pulling the cord.



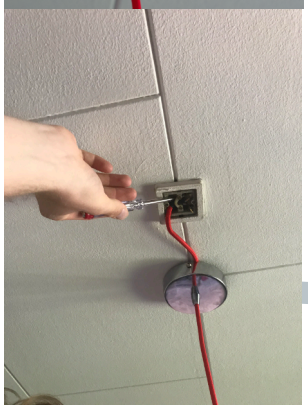
Step 8

The excess cord is rolled up in the canopy.



Step 9

Mount the canopy on the bracket align the screw holes. Fasten the canopy by tightening two screws.



Step 10

Connect the cords to the outlet and tighten the hanger on the cord. Before covering the outlet with a lid.

Evaluation

Following and analyzing the procedural instructions step-by-step, we were able to identify some problems with the installation procedure of the canopy. The identified problems are listed below:

Step 4. Placing a lamp with one hand, while marking it and trying to ensure that the placement is correct, is difficult. Step 7. 1) No cutout in the canopy for the cord between the canopy and outlet. 2) Aligning the screw holes was difficult. 3) Screw holes on the side of the canopy was difficult to see which made the positioning of the screwdriver difficult.

The canopy should have a cutout for the cord between the ceiling junction box and the canopy. (Step 8)	9.0
The canopy need storrageroom for excess cord, to enable heightadjustment of the lamp. (Step. 8)	10.0
The intallation should avoid using horisontal oriented screws. (Step 9)	11.0
The intallation should avoid handling more than two components at once. (Step 9)	12.0
The canopy and bracket should fit together without any visual alignment of screw holes. (Step 9)	13.0

3.16 Utilizing mega trends

Before finalizing a specification for construction of the canopy, we needed to revisit some of our initial research on mega trends (See section 1.15 pp. 17) as the canopy should accommodate relevant mega trends to en ensure it's relevance on a future market.

Utilizing Mega trends

Among the mega trends found in the early stages of the process was "The last straw" which concerns itself with problems in sustainability and designing products for circular economy.

Sustainability can be achieved by using the follwoing main strategies:
1. Slowing resource loops - meaning designing the product to last for a long period of time.

2. Closing resource loops - Reusing the materials from the product into new products.
(Bocken *et al.*, 2016)

In general - within circular economy - the smaller the loop the better, meaning its better to design products that lasts for a long period of time, than to design for recycling.

One of the other strategies was to design for standardization and compatibility. The idea was use Apple Airplay & Google Audio, to facilitate the use of most smartphones, and not limit the user to one platform. These systems however gets updated with new features every year and are quickly outdated with new standards. This could - as with the interior trends - mean that the speaker could be replaced simply due to new compatibility standards. Designing the product for easily upgrading the "connection" part would mean the user could upgrade the product with new features from Dynaudio, while keeping the original speakers and amplifier modules.

Design strategies for slow loops:

Designing long-life products

- Design for attachment and trust
- Design for reliability and durability

Design for product-life extension

- Design for ease of maintenance and repair
- Design for upgradability and adaptability
- Design for standardization and compatibility
- Design for dis- and reassembly

(Bocken *et al.*, 2016)

As the canopy already is disintegrated from lamp designs the concept is independent of current lifestyle trends in lamps while it is trying to camouflage itself on the ceiling by having a non-design aesthetic and by so is arguably designed for long-life on the market.

Camouflage / blend in with ceiling/surroundings and be a platform to faciilitate different home style trends

1.3

The electronics concerning compatibility of software should be designed for upgradeability.

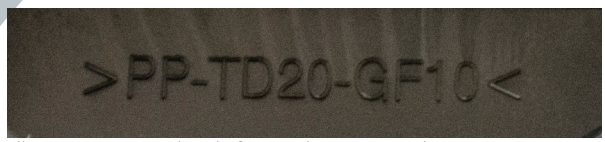
14.0

3.17 Materials & production

We needed to consider the materials for the canopy and grill which visually hides the drivers, along with how they should be produced. To do so we looked into how the speakers from the Dynaudio Music series are produced and their materials used. The reason for seeking inspiration in the existing Music speakers was that by using the same materials we would assure materials with acoustic properties good enough for this level of speaker.

Materials and production methods

Dissecting the Dynaudio Music 5 Speaker, revealed that both the front- and rear cabinet are to be injection-molded in PP TD20 GF10 (See illu. 47) , a polymer commonly used to produce housings in the automotive industry as well as consumer electronics. This type of polymer has a high stiffness which does increase resonance, however a higher stiffness drives the resonance into higher frequencies which are easier controlled by dampening materials (Klasco, 2019). The cabinets are produced with a wall thickness of 4 mm which is rather thick, but this also adds to the stiffness which should be considered in our construction. The polymer also has a high impact strength which makes it resistant to being dropped. Injection molding the cabinets in plastics offers a lot freedom to the aesthetics of the cabinets as it can be produced in many different shapes, without adding to the production cost.



Illu. 47. Material code front cabinet Dynaudio Music 5

Besides the cabinet parts the grill is injection-molded in ABS GF-10. Injection-molding the grill allows for angled and differently shapes grids increasing the freedom of design. The grill has 14 molded tabs, that fit into rubber grommets found in the corresponding cabinet, for mounting the grill on the cabinet. (See Illu. 49 and 48) The tabs mounts the grill on the cabinet which is an easy interaction.



Illu. 49. Dynaudio Music 5 - Rear, no grill



Illu. 48. Dynaudio Music 5 - Front, grill

The canopy cabinet should be constructed for injection-molding in PP TD20 GF10.	15.0
The grill should be constructed with tabs for mounting on the cabinet.	16.0

As Dynaudio already has production knowledge within this type of production and materials, selecting these materials and production methods, could provide an edge in the manufacturing of these parts.
Choosing these materials and production methods for the construction of the cabinet allows us to finalize the specification for the construction of the Canopy speaker.

3.18 Specification for construction development

Intro

Phase 3 has been about defining a the concept to a degree where It can be constructed in CAD in a higher degree of detail, adding to the validity of the canopy speaker. Below is a table with listed user needs and how they translate into requirements and specifications. The specifications are a summation of all the user needs and requirements we had identified at this point.

Req no.	Requirement	Specification	Source
1.13	Camouflage / blend in with ceiling/surroundings and be a platform to faciilitate different home style trends	-	**3.16** - Utilizing mega trends
2.0	The speaker should be compatible with the existing power outlets in the ceiling	-	**2.9** - User probe
***3.2**	The concept should use the same drivers and electronics as the Dynaudio Music 1 speaker.	Tweater (H28mm x D50mm) Midrange (H35mm x D85mm) Power board (?) Main board (?) Input board (?)	**3.13** - Concept presentation for Dynaudio
4.0	The user should be able to play content without the phone.	Remote	**2.9** - User Probe
6.0	Minimal cabinet volume	Midrange Volume > 0,5 L	**3.5** - Deconstructing a Dynaudio Music 5
8.0	Max weight of product and load	Product < 2kg Load < 3 kg	**3.15** - Suspension system

***** Needs further specification by consulting Dynaudio .

Req no.	Requirement	Specification	Source
9.0	The canopy should have a cutout for the cord between the ceiling junction box and the canopy.	-	**3.15** - Suspension system
1 0	The canopy need a place to storrage excess cord, to enable adjusting the height of the lamp.	-	**3.15** - Suspension system
11.0	The intallation should avoid using horisontal oriented screws.	-	**3.15** - Suspension system
12.0	The intallation should avoid handling more than two components at once.	-	**3.15** - Suspension system
13.0	The canopy and bracket should fit together without any visual alignment of screw holes.	-	**3.15** - Suspension system
14.0	The electronics concerning compatibility of software should be designed for upgradeability.	-	**3.16** - Utilizing mega trends
15.0	The canopy cabinet should be constructed for injection-molding in PP TD20 GF10.	-	**3.17 -** Materials and production
16.0	The grill should be constructed with tabs for mounting on the cabinet.	-	**3.17 -** Materials and production

4.0 Construction

Based upon the final specification from phase 3, we updated the construction.

We then created aesthetic variations of the concept, and presented them to Dynaudio, and by utilizing the feedback, it lead us to a choice of styling.

To ensure the feasibility of the concept, we discussed the acoustical performance aspects with a Acoustic engineer at Dynaudio.

Based upon the feedback from both presentations, we updated the construction yet again.

We created an overview over the interaction experience, by specifying the intended user interaction experience of the product.

Through testing and iteration we finalized the suspension system.

In order to verify the strength of the construction and optimize it, a series of Finite Element analyses were conducted.

Finally, the construction for the system remote is developed.

4.1 Initial Construction

Based on the specification, a proposal for the construction was developed. The purpose of the initial contruction was to develop a starting point which incoorporated all of the specifications, while maintaning the smallest size possible of the cabinet. This will be used to present the construction for an acoustic engineer, to validate the proposed size and placement of the drivers and get feedback for further development.

Construction

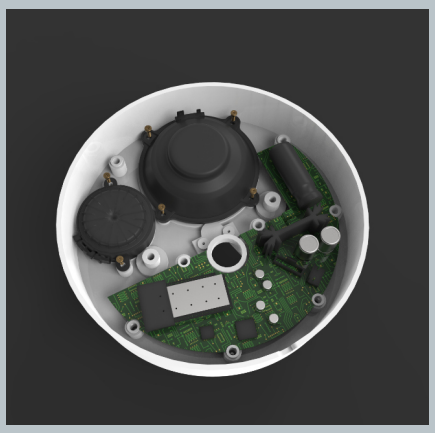
The cabinet consists of two main shells **(illu. 50)**. Both shells are constructed for a 'two part injection moulding', with a 1 degree draftangle. Pins are incoorporated into the mold for the drivers and PCB to be installed upon.

The canopy cabinet should be constructed for injection-molding in PP TD20 GF10.	✓ 15.0
Minimal cabinet volume of 0.5L	✓ 6.0



Illu. 50. Front casing

The drivers are screwed in place in the front casing and the PCB is placed between, floating on the pins **(illu. 51)**. The PCB is clamped between the two shells, which are screwed together **(illu. 52)**. This was done to save screws, assembly time and make it easy to replace the board. The board however is only replaceable by opening the cabinet.



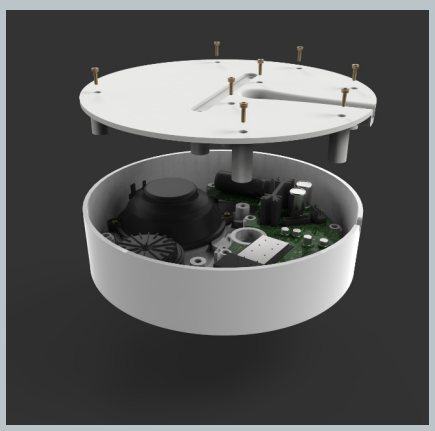
Illu. 51. Internal components

At this point the final specification of the internals of a Music 1 was not complete, so the design was made using the midrange and tweeter from the music 5 **(illu. 51)**. The PCB was reduced compared to the Music 5 as we assumed the PCB could be made smaller because of the fewer sound drivers. This will be verified by Dynaudio, for the further development.

The concept should use the same drivers and electronics as the Dynaudio Music 1 speaker.	⚙ 3.2
The electronics concerning compatibility of software should be designed for upgradeability.	⚙ 14.0

The weight of plastic molded plastic parts and bracket is 270g and combined with the tweeter (120g) and midrange (90) ends way below 2kg.

The canopy speaker must not exceed a weight of 2 kg	✓ 8.0



Illu. 52. Assembly

To mount the canopy, the user starts by installing a bracket on the ceiling. The bracket was designed with adjustable screwholes **(illu. 53)**, to accommodate installation on top of the power outlet and the ceiling. Further development needs to be done, into how to align the bracket correct to the power outlet.

The bracket needs to indicate how to align the cord to the power outlet	⚙ 17.0
The canopy should have a cutout for the cord between the ceiling junction box and the canopy.	✓ 9.0



Illu. 53. Mounting breacket

To ensure easy alignment, the canopy is slid on top of the two threaded rods on the mounting bracket. To fasten the canopy two thumbscrews are tightened on the rods, facing down towards the user.**(Illu. 54)**

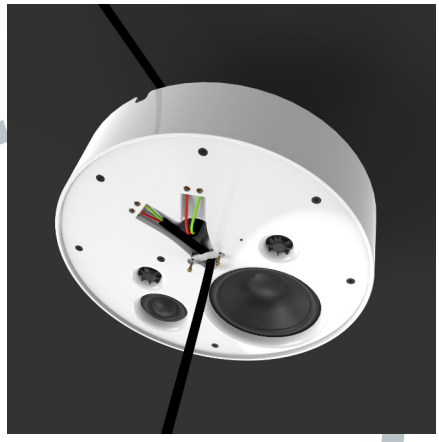
The canopy and bracket should fit together without any visual alignment of screw holes.	✓ 13.0
The intallation should avoid using horisontal oriented screws.	✓ 11.0



Illu. 54. Thumb screws

The cord, installed in the ceiling junction box, is pulled through the device and fastened on the front using two screw terminals **(illu. 55)**. The cord to the lamp is secured using a bracket and two screws **(illu. 55)**, and is similarly connected to the device. By using screw terminals, the design will fit most lamps as this is how the connect to the poweroutlet. This part needs to be redesigned, as the user would need to hold the lamp, a screwdriver and two screws simultaneously. The design is also missing a place for excess cord, for adjusting the height of the lamp.

The intallation should avoid handling more than two components at once.	⚙ 12.0
The canopy need a place to storrage excess cord, to enable adjusting the height of the lamp.	⚙ 10.0



Illu. 55. Cord installation

The grill is, as the body, designed to be injectionmoulded. Afterwards the grill will be covered with fabric. The grill is mounted with pins onto the canopy **(illu. 56)**. The holes for the pins feature rubber gaskets for a tight fit.

The grill should be constructed with tabs for mounting on the cabinet.	✓ 16.0



Illu. 56. Gril installation

4.2 Aesthetical Variation Probe

With the construction in a defined state, it was decided to challenge the aesthetics of the product and of the remote. To do so, variations of shapes with different materials and details were made, and visualized in context to see how it related to the intended surroundings. **(see illu. 57)** To choose the variation Dynaudio would choose, we sat up a meeting with MK and presented the proposals for him **(See appendix 36)**. We wanted him to choose the ones he felt was most fitting for a Dynaudio product. The meeting started as a presentation in which we presented our aesthetic variations of the Canopy speaker and remote, while the feedback was conducted as an open conversation on our solution.

Feedback

In general MK thought that a non-design solution like variation 6 **(See appendix 36)** was the best fit for both the concept and Dynaudio, as it's simplicity fits the nordic design language Dynaudio tries to accommodate in their existing portfolio. MK suggested that we allowed for an exclusive edition, perhaps a variation in a veneer material. Also he suggested that we left some customization options for the customers in the form of different fabrics on the grill and an addition of a grill variation without a lamp plug, for using the canopy speaker without a lamp.

On another note he suggested to integrate the symbols and icons needed on the product into the molds as this would reduce the cost in comparison to silkscreen printing or stickers.

As for the remotes he liked variation 4 and 5 the most as these related the most to the existing power outlets. He thought we should continue with variation 4 of the remotes as this was the one he found most aesthetically pleasing. Arguably the remote had not gone through the same development as the Canopy speaker and would need further validation..

Evaluation

Based upon MKs remarks and opinions we decided to proceed with the construction of the non-design variation 6 and to leave the suggested additions for later development. In addition we chose to proceed with variation 4 of the remotes, for a suggestion as to what it would demand to construct and the influence it would have on the business case.



Illu. 57. Context render white concept.

The product needs to facilitate a grill option with no hole, for use without a lamp	18.0
Camouflage / blend in with ceiling/surroundings and be a platform to faciilitate different home style trends	1.13

4.3 Acoustic Performance Evaluation

In order to verify the acoustic properties and expected performance of the system, we got a meeting with Dynaudios Senior Acoustics designer, Stephen J. Entwistle (SJE from this point). The concept was presented at the stage described in the previous section 4.1 - Initial construction, for open discussion (Presentation can be found in **appendix 37**).

Feedback

After the presentation we discussed the technical aspects of the product. Below are the most important notes from the session.

Not the right driver; The 3" midrange from the Music 5 is not the same driver as in the Music 1, it is a 4" driver that is much deeper. For bass we needed either a large driver with low movement, or a small one with large movement. The Magnet system can be placed up against the back part of the cabinet, no problem.

Alternative grill material; Instead of the fabric grill illustrated, we could consider using a perforated metal grill, as it has superior acoustic performance. We could then add a thin cloth mesh behind it to decrease visibility of the tech behind the grill from the user. The grill could also be designed to spread the sound, avoiding the need for a lens.

Decoupling; Rubber foot or other gasket material against ceiling to reduce vibrations when playing.

Existing elements from Music; If we wanted to use the room correction integrated within music, we needed a microphone, preferably placed outside the grill. For grouping multiple speakers, we could use the existing Music app functionality.

Subwoofer Extension; For an external subwoofer, one could use the woofers in Music 7, but it would require slight modifications to the app.

Cabinet Volume; We should leave the chamber around the midranges open. Digital signal processing can compensate for the missing volume, if any, as it's not as essential as on passive speakers.

Evaluation

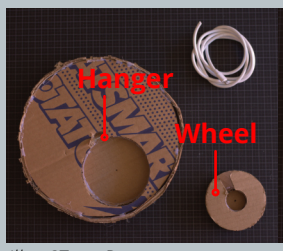
The talk with SJE validated some of our concerns and his comments on missing elements gave us the last details needed to finish our Canopy speaker. He did raise a concern in regard to the misunderstanding of the Music 1 woofer, as this may increase the size of our Canopy speaker, which would be unwanted. Before looking into the replacing the current midrange driver, we needed to look into and develop the connection between the lamp and the canopy.

It needs to have a front faceing a microphone to enable roomadjustment	19.0
Feature the music one midrange (Diameter 4" height 69mm) and tweeter (Height 28mm diameter 50mm)	3.3
Perforated metal grill as alternative to fabric grill - Designed to spread the sound	3.3
No need to hit exact volume of the cabinet. It can be adjusted with Digital Signal Processing.	X 6.0

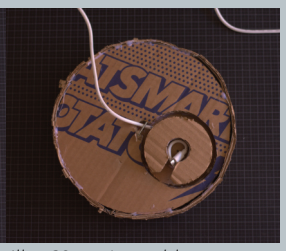
4.4 Suspension development

For developing the mechanism connecting the lamp to the speaker, a prototype development was effectuated. Different mechanisms for both hiding and a reeling in the cord of the lamp was constructed in cardboard, before a decision on the mechanism of choice was made. The development process was done simultaneously with the interview with SJE meaning that some of the insights from that interview, impacted some of the proposed mechanisms afterwards. The process and the ideas tested can be viewed in the section below.

1. Side Roll up



Illu. 67. Parts



Illu. 68. Assembly

The mechanism consisted of a wheel and an added room and hanger into the body **(Illu. 67)**. The user puts the cord through the loop, and fastens the cord onto the wheel **(illu. 68)**. The height of the lamp is then adjusted by reeling the wheel as the wheel slowly reels up the cord around its center. **(illu. 69 & 70)**



Illu. 69. Cord mounting

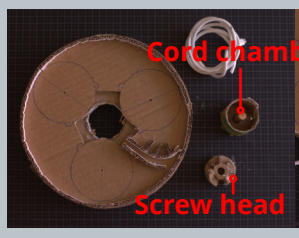


Illu. 70. Adjust lamp height

Evaluation

The mechanism itself was functional and added a decent amount of convenience, however as we will discuss in the following chapter, due to an increase in the amount of midrange drivers, the mechanism took up too much space in this placement.

2. Center Roll up

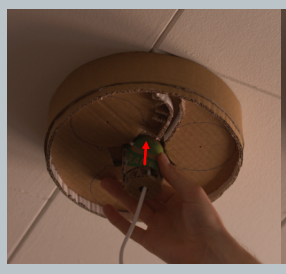


Illu. 58. Parts



Illu. 59. Assembly

The mechanism consisted of a cord chamber and a screw head **(illu. 58)**. The user pulls the cord through the screw head and fastens it onto a screwing terminal on the cord chamber **(Illu. 59)**. The two pieces are then put together, and plugged into the canopy. To reel up the cord, the screwhead guide the cord around the core in the cord chamber. By turning the screw head, the height of the lamp is adjusted **(illu. 61)**.



Illu. 60. System mount

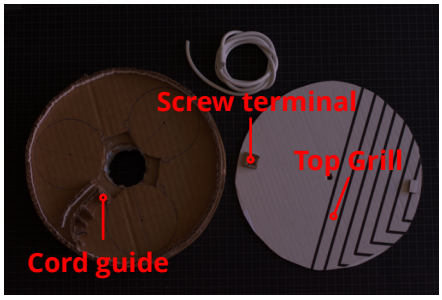


Illu. 61. Lamp Adjustment

Evaluation

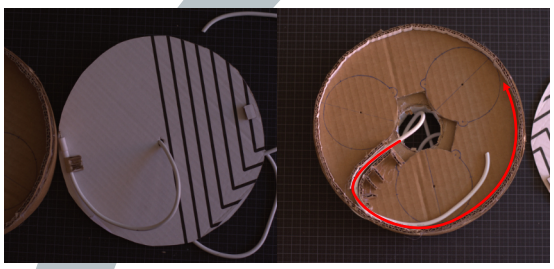
The mechanism reeled in the cord accordingly, but held a limited amount of cord, which decreased the span of height-adjustment of the lamp. It also required many turns head to adjust the height.

3. Grid Rollup

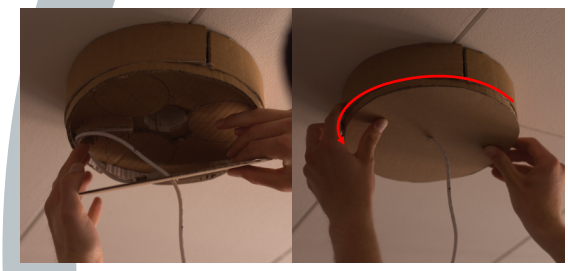


Illu. 66. Parts

The mechanism consisted of a top grill with a screwing terminal attached **(Illu. 66)**. On the canopy, a cord guide was added to guide the cord around the edge, dodging the drivers **(illu. 63)**. The user attaches the cord to the top grill by fastening the cord-head to the screwing terminals **(Illu. 62)** and pulls it through the center of the grill. The cord is then placed in the guide the grid is clamped on using magnets. The user adjusts the height of the lamp by turning the grill. **(illu. 16)**



Illu. 62. Cord Mounting Illu. 63. Cord placement

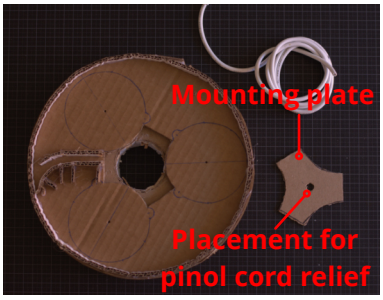


Illu. 64. Grid mounting Illu. 65. Lamp Adjustment

Evaluation

As SJE made it clear that we could not use a turnable grid, as this would affect the spreading of the sound. This meant it had to remain in a fixed position to controlling the output.

4. Center Piece





Illu. 71. Parts Illu. 72. Pinol cord relief

The solution consisted of a mounting plate with a pinol cord relief attached **(illu. 71 & 72)**. The user pulls the lamp cord through the mounting plate and pinol cord relief and then installs the lamp to the canopy. **(Illu. 73)**. The mounting plate is then mounted on the canopy. The height of the lamp is adjusted by pushing the cord through the pinol cord relief **(illu. 74)**. The cord is fastened by tightening the pinol cord relief.



Illu. 73. Cord Installation Illu. 74. Lamp Adjustment

Evaluation

The mechanism has a simple construction with the only moving part being the cord and the screw head on the pinol cord relief. This leave less room for mechanical errors.
The adjustment was easy as it did not require multiple turns of a reel, however it doesn't have the fine-tuning height-adjustment capabilities of the reels.
Leaving out the reels also freed up more room for cord, which increased the span for height adjustment of the lamp.

Evaluation

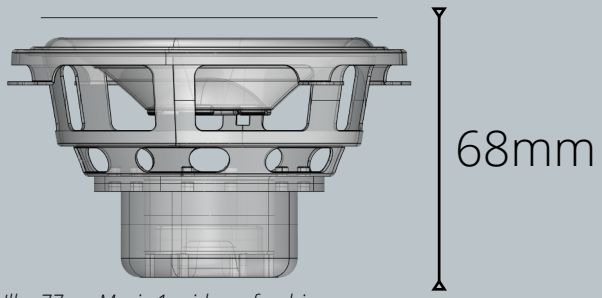
We chose to implement concept 4 - center piece, because of the simple construction and because it easy to adjust lamp height even though it can't fine-tune the height of the lamp, however we don't see that as an issue. Also the solution accommodated the new drivers. We will elaborate on that process in the following section.

4.5 Construction update

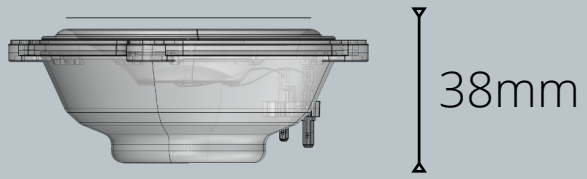
Based upon the meeting with SJE, clarifying that the Music 1 mid-woofer was in fact not the same as the midrange in the Music 5, the construction needed to be updated accordingly.

Driver troubles

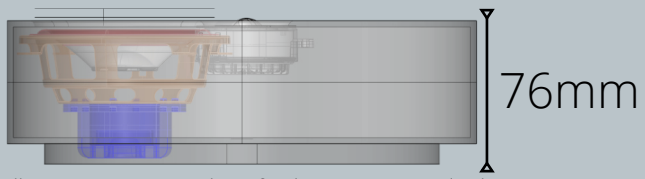
Due to the increase height of the Music 1 mid-woofer. **(Illu. 78)** The cabinet would need to be increased in height, resulting in a less desirable size as the canopy looses some of it's camouflage with the increased height, meaning we would have to find an alternative to the Music 1 mid woofer.



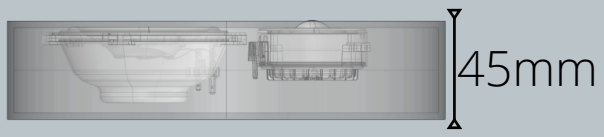
Illu. 77. Music 1 mid woofer driver



Illu. 80. Music 5 midrange driver



Illu. 78. Music 1 mid woofer driver in estimated cabinet



Illu. 79. Music 5 midrange driver in estimated cabinet

Searching for a solution that could reduce the height lead to the discovery of the Monitor Audio CSS230 (MonitorAudio, no date) that uses the principle of multiple small drivers, to emulate the effect of a larger one. This proposal was introduced to SJE, and he commented that it would be possible, but would require the following:

3x midrange drivers from Dynaudio Music 3.
A larger amplifier module with more outputs. (Increasing the Music 3 amplifier with 10% in size would be a close estimate.)
Using the internal power supply from the Music 3 instead of the external one found in the music 1.



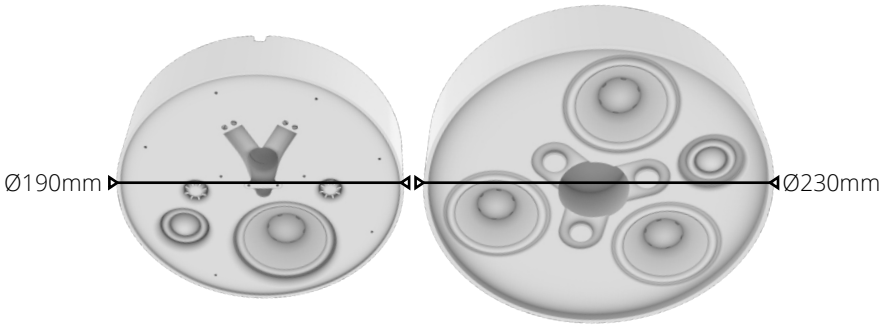
Illu. 76. Monitor Audio CSS230 Cusom install speaker.

Feature:
3 x music 5 midrange (D 85mm x H 35mm)
1x Tweeter (H 28mm x D 50mm)
1x Mainboard (H 90mm x W 63mm x D 12,5mm)
1x Powersuply (H 180mm x W 80mm x D 17,5mm)
1x Amplifier (H 75mm x W80mm x D 30mm

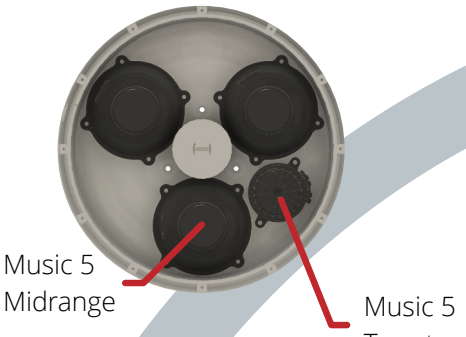
3.4

Cabinet updates

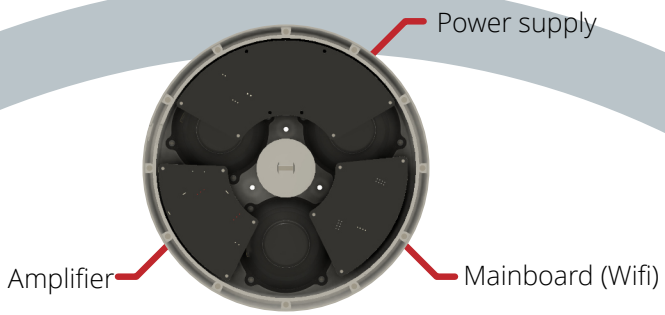
With the changes to the driver setup, the cabinet needed a small increase in size as well, to make room for the two additional midrange drivers **(Illu. 82)** and PCB's **(Illu. 83)**, the diameter of the cabinet was increased from 190mm to 230mm **(illu. 81)**. An increase in size also means an increase in visibility, which we afterwards tried to compensate for by changing the shape of the cabinet.



Illu. 81. Old size on the left and new size on the right



Illu. 82. Driver arrangement

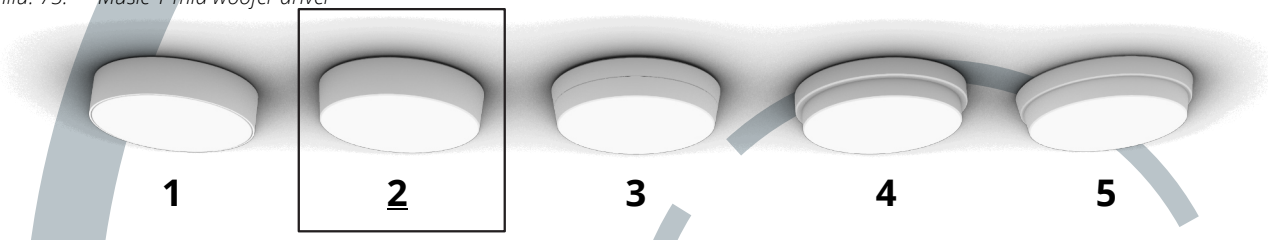


Illu. 83. PCB arrangement

Shape iteration

To make the product less visible, the surface area for the grill was reduced in size in different variations, as this would make the grill smaller. **(Illu. 2.)**

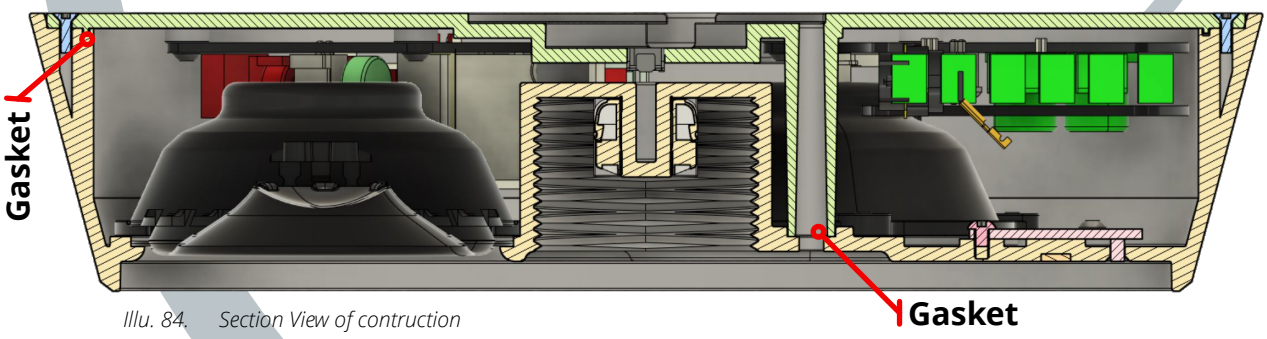
Illu. 75. Music 1 mid woofer driver



Subject five was chosen for the final shape, as it reduced the visual footprint while preserving the minimalistic expression of the product.

Cabinet construction

The construction principles from the Music 5 were implemented. The cabinet was constructed in two pieces, with a gasket placed between **(see illu. 84)**, to ensure an airtight seal, which was necessary for the cabinet to act as a sealed enclosure. Additionally the construction was prepared for injection-molding, by having even wall thickness throughout the shell as well as draft angles of 1deg.



Illu. 84. Section View of contruction

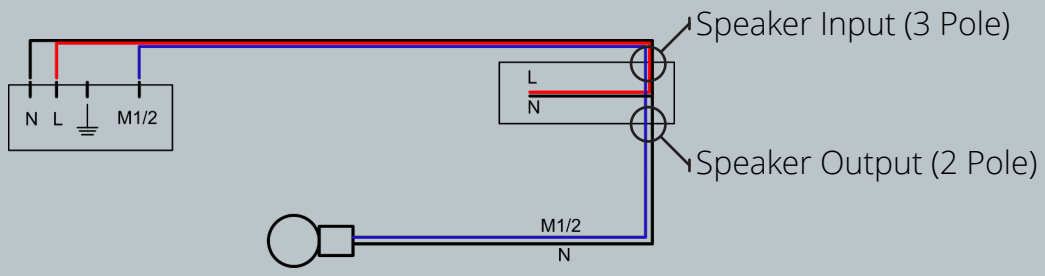
It was chosen to go with a 3mm wall thickness which is a millimeter thinner than the Music 5 cabinet, but it was deemed thick enough to ensure enough stiffness in the cabinet, as discussed in the material and production section **(3.17 - Materials and production)**

4.6 The electrical components.

Since one of the main features of the Canopy speaker is the possibility of connecting it to a ceiling junction box along with the installation of the lamp in the canopy, we had to consider the electrical cords and connectors. To get an understanding of our possibilities for connecting the lamp to the canopy, which acts as an extension of the ceiling junction box for the lamp.
Andreas, an electrician, informed that all new houses have a permanent live wire In the ceiling junction box along with a light switch live wire. Older houses have them in most cases as well. This means that the speaker can stay on, even when the light is off, if it is connected to the permanent live.

Understanding the system

Based upon the talk with Andreas, it became clear that we needed to draw three wires from the ceiling junction box. In the Music products uses a main and a null (N), which can be drawn from the permanent main (L). The power for the light (M1/2) needs to be passed through the Speaker, along with a null aswell. **(Illu. 91.)** The music products does not use a ground, but this could be included if needed, but was excluded at this time.



Illu. 91. Electrial diagram of power connection

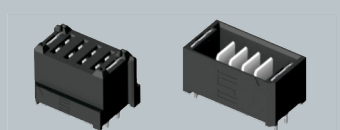
The speaker should be compatible with the existing power outlets in the ceiling	✓ 2.0

Exploring connection interfaces.

To improve the ease of setup, it was chosen to split the cable-runs. This was done at two points:
The speakers input, where 3 poles are needed (N,L & M1/2)
The speaker output, running 2 poles to the lamp (N & M1/2)

To make these splits, cable connections was needed, and was explored for both of the cases.

Speaker Input;
Multiple solutions were investigated (Further information in WS XX), among these a C7 plug, a magnetic connector and finally the customizeable Samtec M.power connector, which is both compact and can handle the high voltage and amperage rating. The Samtec solution was implemented as the input into the Speakers.



Illu. 85. Music 1 mid woofer driver



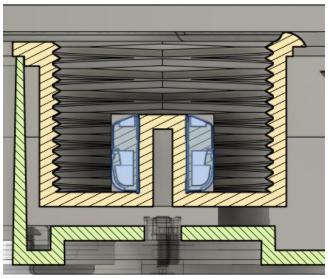
Illu. 86. Music 1 mid woofer driver



Illu. 87. Music 1 mid woofer driver

Speaker Output:

For connecting the Speaker to the lamp, a two pole connection solution was needed. Banana plug **(Illu. 88)** solutions aswell as multiple terminal block solutions and connectors were tested **(Further information in appendix 38)**, but the final choice fell on the WAGO PCB terminal block **(Illu. 89)**, which could handle the required power, was compact and featured a lever style fastening system for easier installation of the cords.



Illu. 90. Suspension terminal



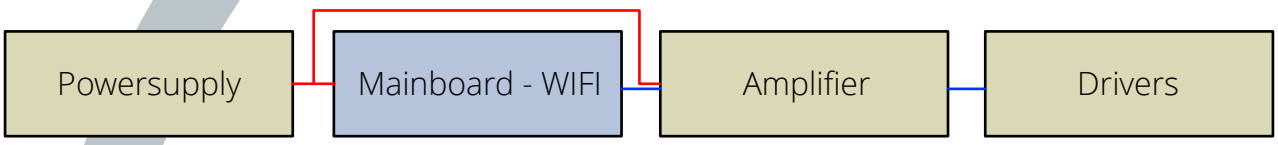
Illu. 89. Wago PCB terminal block



Illu. 88. Banana plug

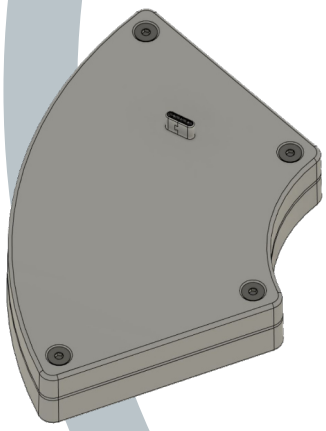
Accommodating to the mega trends

The consumer electronics market segment suffers from a very fast technology development, and thereby a short lifecycle on the products. In our electrical system, the mainboard include the wi-fi module and is thereby the connection to the fastpaced consumer electronics market. The yellow boxes are the parts of the system that is not connected to this fast development cycle.**(Illu. 92)** By keeping this board an individual component, it is possible to make the system upgradeable, and thereby give it a longer lifecycle.

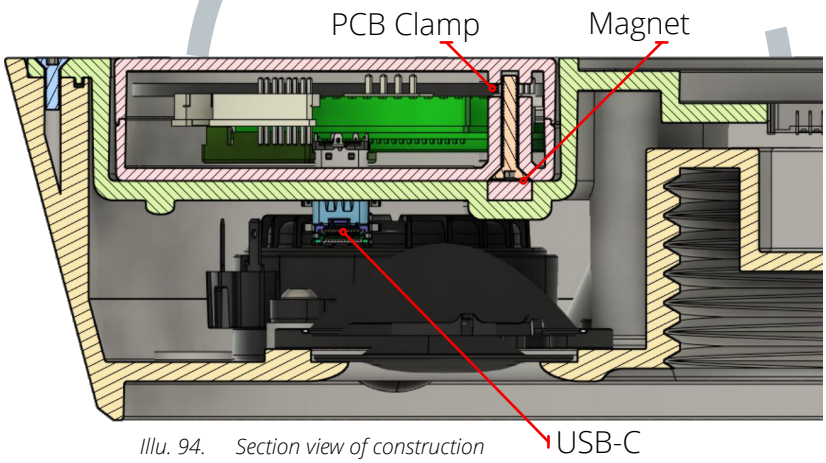


Illu. 92. Block diagram of speaker unit

The upgradeability was achieved by putting the mainboard in an external enclosure, outside of the cabinet, so the user has access to replacing it. A USB-C connector was chosen as interface, as it carries both power and data. The enclosure consists of two shells held together by 4 screws with the PCB clamped between **(see illu. 93)**, and the whole box is fastened to the cabinet with four magnets. **(see illu. 94)**



Illu. 93. Music 1 mid woofer driver



Illu. 94. Section view of construction

The electronics concerning compatibility of software should be designed for upgradeability.

14.0

4.7 User Experience Specification

Objective

In order to gain an overview of the system in its entirety, a specification in the form of a flowchart was created for what the user is going to experience during the interaction with the product and its ecosystem. The interaction scenarios related to the app and remote is described below.

Setup process

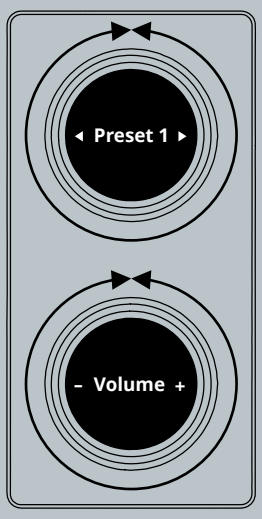
Upon opening the box with the product, the first thing presented is a qucikstart guide. On the frontpage of the guide, there is a QR code that takes you to the download page for the Music App. Upon opening the app you are asked to register an account and are then promted to add a speaker. **Ill. 97** is a flowchart of the process. If the user already own products that use the Music app, they simply enter the settings to press 'Add speaker, where the same flowchart is initiated.

Interacting with the product

On a daily basis, the user is going to interact with the product in two ways:

The remote: The user can navigate the App-defined presets by rotating the upper dial clockwise to go right and counter-clockwise to go left.
The volume can be adjusted in the same manner. To increase, turn the dial clockwise and to lower it turn it counter-clockwise. If the volume is lowered all the way, it pauses what is currently playing. Turning it up again will resume playback.

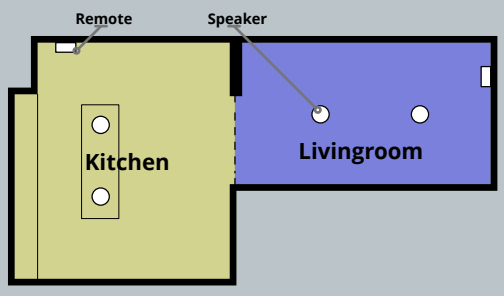
Streaming: The user can stream content to the speaker, using either Airplay or Google Cast.



Illu. 95. Remote inteface

Multiple remote controls

The speaker systems can be paired into rooms **(Ill. 96)**. Each room can have multiple speakers. To make two rooms play the same preset, simply set them to play the same preset on the remote, and they will sync up.
Regarding streaming, the rooms need to be merged in the Music App. The initial Room grouping is handled through the App.



Illu. 96. Kitchen-livingroom plan drawing

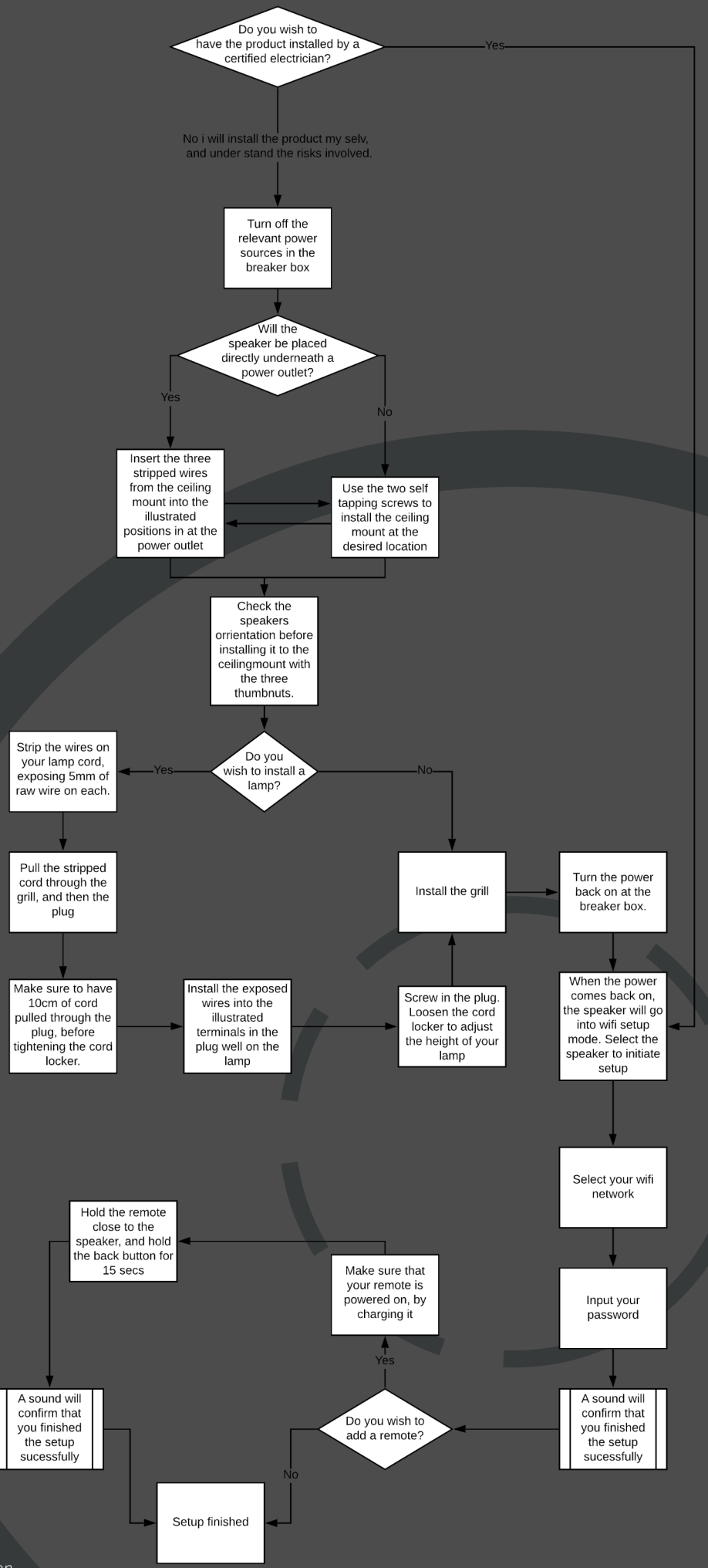
Hard reset

If the speaker is left in a state where the user is unable to communicate with it, there are two options.

A Hard reset, that can be done by holding down a button on the speaker front, for 15 sec, rebooting the speaker.

A Factory reset, that can be done in two ways; In app or holding the front button for 30 sec. Factory reset, reboots speaker and returns it to wifi setup mode with pulsating white LED.

The product needs to have a button and led for error handeling. **20.0**



Illu. 97. Flow chart of installation

4.8 Streaming support

The current Music series support input from last generation Airplay and Bluetooth. Additionally you can use the Music app on both iOS and android. If the current hardware allow it, we suggest to implement Airplay 2 & Google Cast support, along with Spotify connect for streaming.

In **Ill. 99** we constructed a flowchart describing the systematic reaction to different situations.

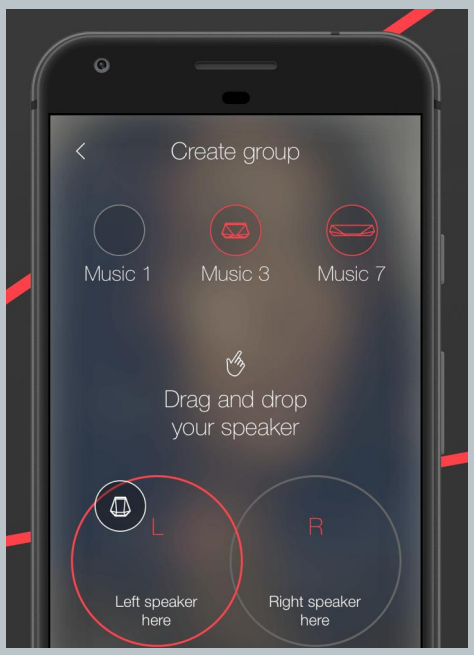
Current Music-app features

As the product proposal is intenteded to function with the existing music ecosystem, and use the same hardware, we could use some of the features implemented in this product series as well.

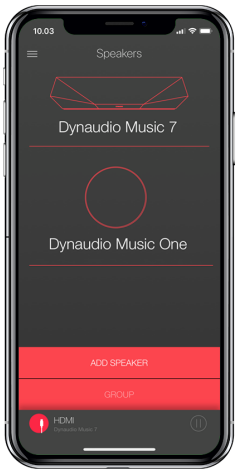
RoomAdapt uses Digital Signal Processing (DSP) and microphone feedback to adjust and optimize the speakers output to the specific room.
NoiseAdapt adjusts the sound with DSP based upon the noise level in the room, ensuring that the volume level is always right. (Dynaudio, no date)

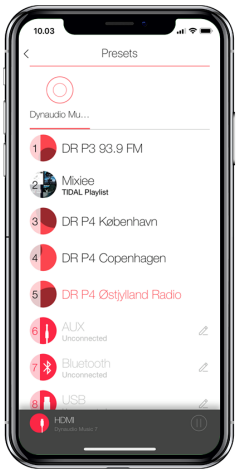
These features are not build into the app, but is merely a on/off toggle for within the speaker itself.

The current Music-App allows the user to bind presets to physical buttons on the products (**Ill. 98)**. T
Lastly the system allows for grouping within the App, where it is possible to group multiple speakers and define left and right channel stereo setups. This feature was implemented in Airplay 2, but is still very device dependent with Google Cast.

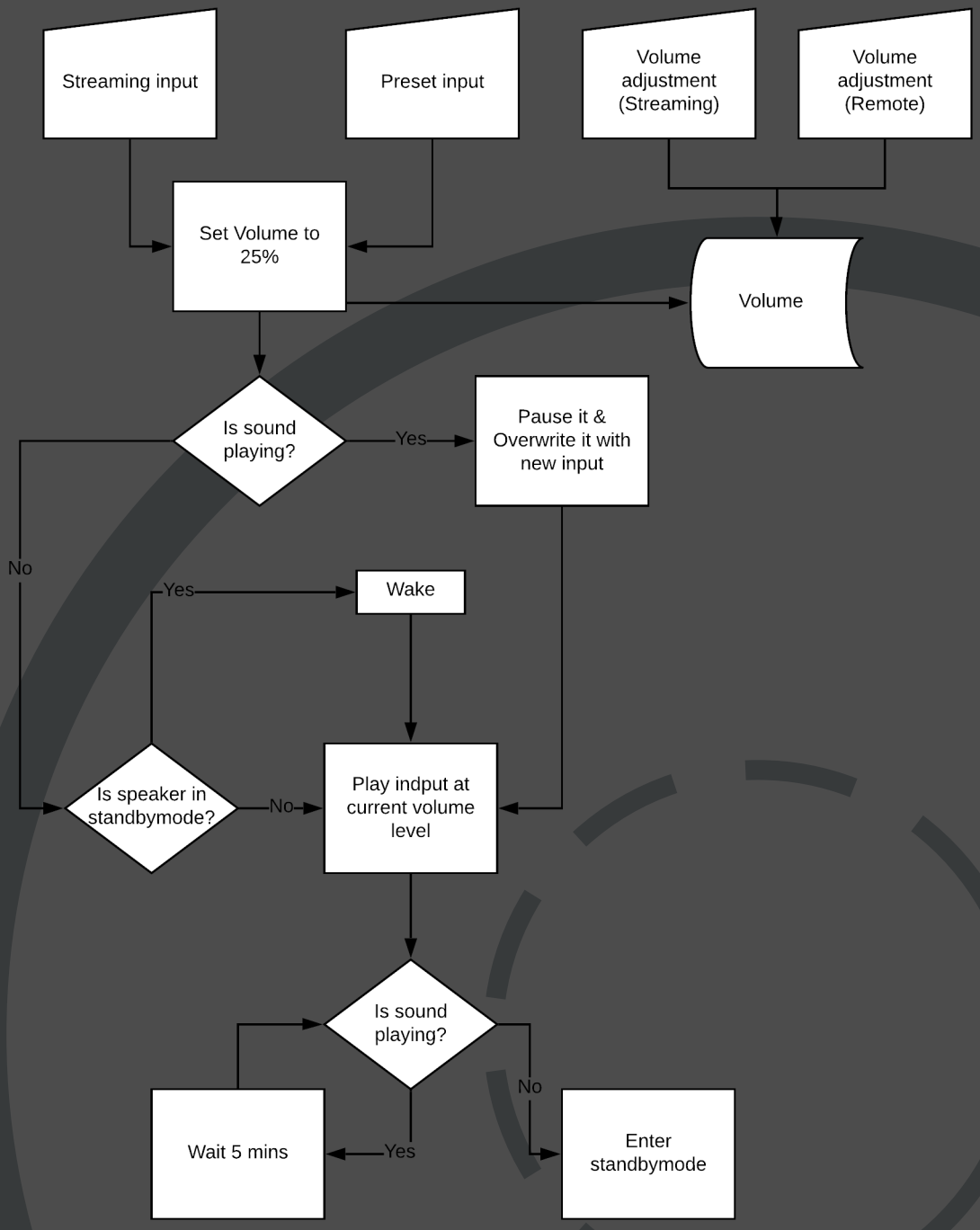


Illu. 98. Kitchen-livingroom plan drawing





Illu. 100. Kitchen-livingroom plan drawing



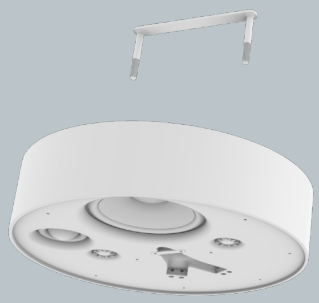
Illu. 99. System flowchart

4.9 Adjusting the mount bracket

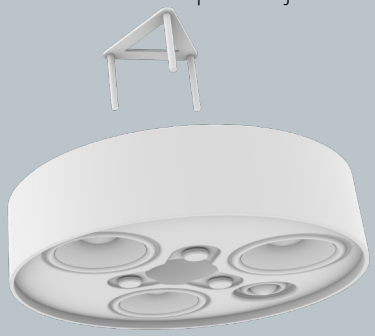
Ceiling mount

Due to the reduced surface area on the front of the cabinet, the ceiling mount was updated to fit the new driver placement and went from its two fastening points to three **(Illu. 106)** to even out the weight distribution. Additionally the mount was prepared further for production. The threaded rods are meant to be welded onto a CNC-routed brassplate and the small plastic housing with the Samtec connector is attached with three screws. The thumbnuts used on the front of the cabinet remains the same.

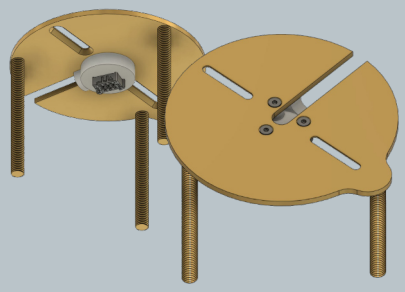
For further development this part could be optimized for easier production, i.e injection moulded PEEK or PP, with the threaded rods moulded in. This would require adjustments to the rest of the design.



Illu. 101. Previous construction



Illu. 102. New construction



Illu. 106. Mounting bracket

Mounting the lamp

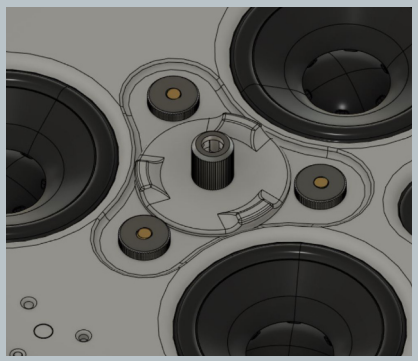
For fastening the lampcord to the speaker, it was choosen to use a pinol cord relief mechanism, as it allows for incremental height adjustment. The suspension mechanism needs to be installed after the lamp has been connected to speaker with the WAGO PCB terminal blocks. Three concepts were established for solving this problem:



Illu. 103. Concept 1: cap & 3x thumbnut



Illu. 104. Concept 2: 6x thumbnut & cap



Illu. 105. Concept 3: Circular screw cap

Concept 1. (Illu. 103): Concept 1 is a plate, placed between the cabinet and the three thumbnuts. This concept needs to be inserted, during the mounting to the ceiling mount bracket (illu. 49).
Concept 2. (Illu. 104): Concept 2 is a plate, mounted to the face of the cabinet with smaller thumbscrews. It has a lot of screwing operation, and the thumbnut are too tall to clear the grill.
Concept 3. (Illu. 105): Concept 3 is a screw cap with a large thread. It allows the user to install the lamp first, and then install the plug in a single operation.

It was chosen to proceed with concept 3, due to its low amount of installation operations, as well as clearing the grill.

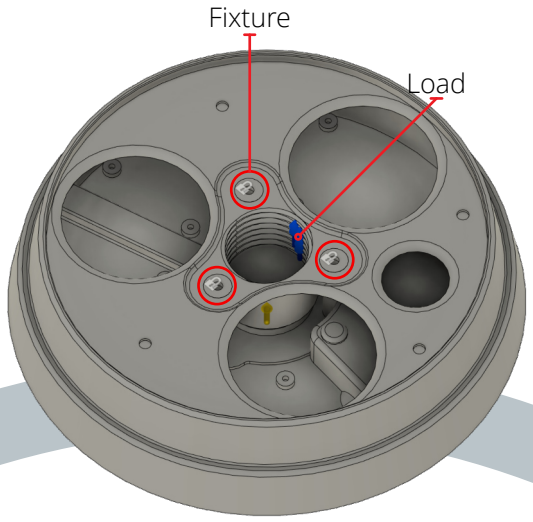
The bracket needs to indicate how to align the cord to the power outlet	✓ 17.0
The intallation should avoid handling more than two components at once.	✓ 12.0

4.10 Validating the cabinet tensile strength

FEA

To ensure that the cabinet would hold up under load, a series of Finite Element Analysis (FEA) were conducted. The load case was a mesh of the cabinet **(Illu.107)**.

The fixture points was placed below were the thumbnuts would secure the cabinet to the sealing mount, and are locked for movement in the X, Y and Z direction. A 100N load is applied to the thread of the cabinet, where the Lamp is installed, equal to a load of roughly 10 kg. The material defined for both Cabinet pieces is Polypropylen.



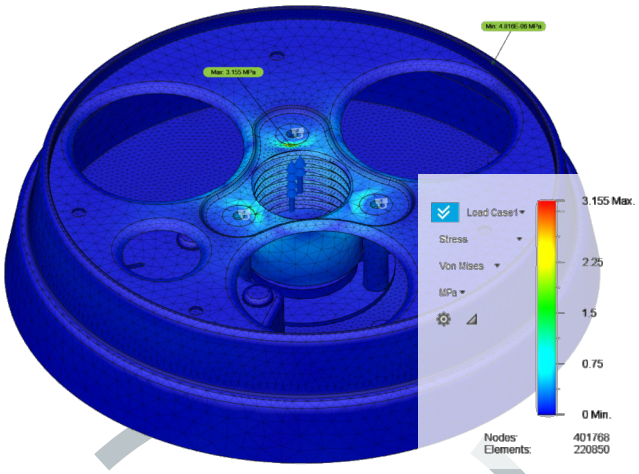
Illu. 107. Cabinet mesh

Stress analysis

The stress simulation yielded result of maximum of 3.16 Mpa, **(Illu. 108.)** way below the Yield strength of Polypropylen, which is approx 30 Mpa. It results in a safetyfactor of 9.5.

$$\textbf{Safety Factor} = \frac{\textbf{Yield strength}}{\textbf{Max stress}} = \frac{\textbf{30 MPa}}{\textbf{3.16 MPa}} = \textbf{9.5}$$

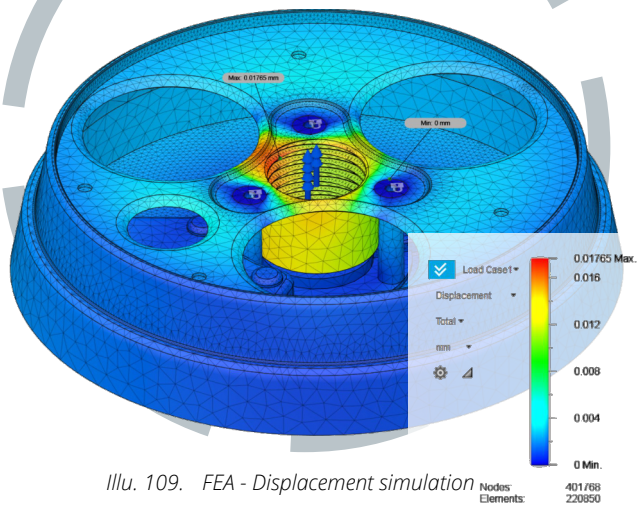
This means that the wallthickness could probably be reduced from 3mm to 2mm to save material cost. However this would have to tested against the difference in resonance it would cause, due to a decrease in stiffness.



Illu. 108. FEA - Stress simulation

Displacement

In the 100N load scenario, the maximum displacement found was 0.01765mm **(Illu. 109.)**, which was found to be insignificant.

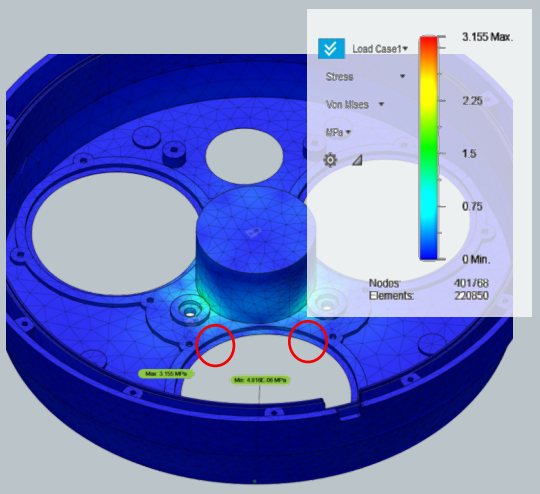


Illu. 109. FEA - Displacement simulation

The solution will can hold 10Kg load	✓ 8.0

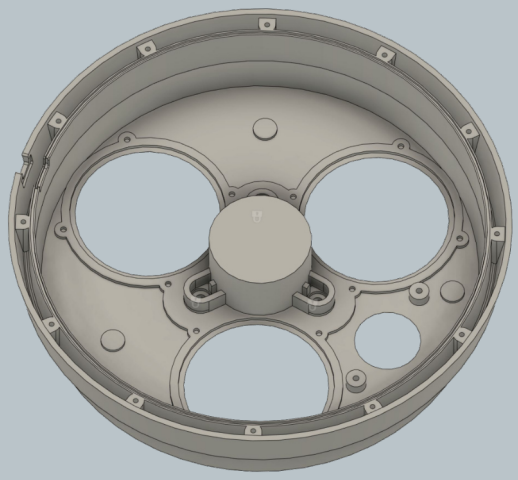
Optimization

Even though the safetyfactor was high, and the deformation is insignificant, the design could be improved. The maximum stress can be reduced by adding support pieces at the critical areas **(Illu. 110)**.



Illu. 110. FEA - Stress concentrations.

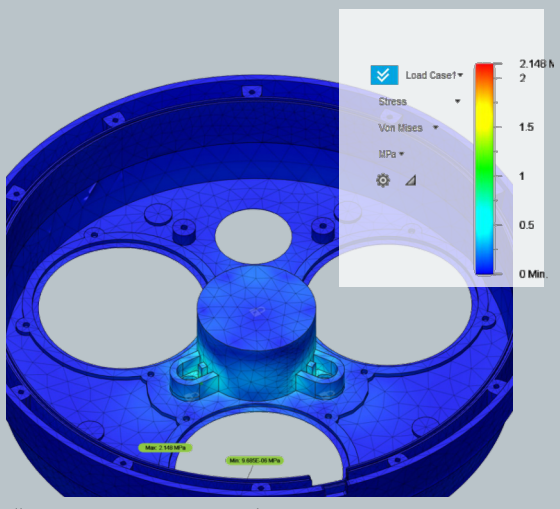
Support pieces were added **(Illu. 113.)**, following the wallthickness of the cabinet.



Illu. 113. Optimized mesh with support pieces.

Running the same load case again, yielded a new maximum stress at 2.15 Mpa **(Illu. 114.)**, resulting in a safety factor of 13.95, which is a 46,8% increase with little material added.

$$\textbf{Safety Factor} = \frac{\textbf{Yield strength}}{\textbf{Max stress}} = \frac{\textbf{30 MPa}}{\textbf{2.15 MPa}} = \textbf{13.95}$$



Illu. 114. FEA - Stress simulation 2.

The FEA analysis of the cabinet validated the strength of the cabinet, given that a ceiling holds 5kg for mounted objects, it proves that the canopy will work with heavier lamps as well, hanging in rafters. This concludes the construction of the canopy speaker, for this project at least, the next section will cover the brief construction process of the remote.

4.11 Remote construction

Objective

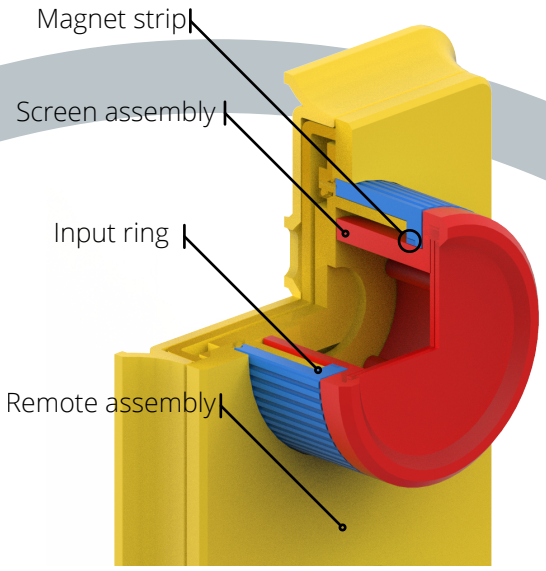
*After the conversation with MK, it was decided to pursue the minimalistic remote **(Illu. 111)**. It was decided to keep the simple 'non-design' approach for the speaker It self and create a solid remote with the high-end feel, that Dynaudio is known for. The remote has not undergone an in depth development like the Canopy speaker, however the construction was done to a point in which we could include it in our business plan. The mechanism needed were constructed so a plausible BoM could be made for the construction cost of the remote.*

The remote chosen has two inputs, that function by rotation. The interface consist of two screens, one displaying the active preset, and the other the current volume level.

Rotary mechanism

Due to the screen that needs to stay in place, during the rotation of the ring, the mechanical solution required some thought. It had similarities to the Nest Thermostat, which functions in the same manner. The nest uses a plastic ring with a magnetic strip attached on the inside. It uses a KMT39 Magnetic angle sensor, that detects changes in the magnetic field created by the magnet strip (Alvey, 2017).

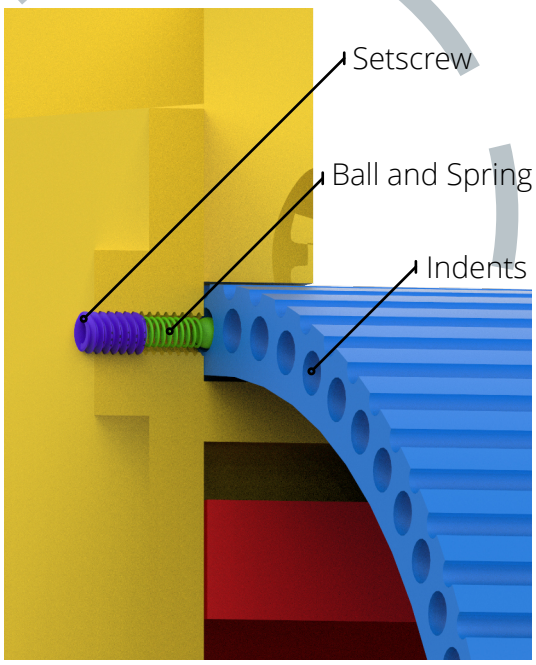
Our Remote use the same detection principle, and a similar mechanical one. In **Illu. 111** we see a section view of the remote, where the rotary piece *(BLUE)* is fitted onto the screen assembly *(RED)*. The screen assembly keeps the rotary piece secured between itself and the rest of the remote assembly. The KMT39 would be placed with the screen assembly.



Illu. 111. Remote - section view

Tactile feedback

As the magnetic angle sensor gives no tactile feedback, it could end up feeling like a cheap plastic dial. To prevent this, a system was developed to introduce tactile feedback in the interaction. It consist of a set screw, a spring and a metal ball **(Illu. 112.)**. The metal ball is pressed against small indents in the Input ring with the spring and is forced back upon rotation. As the input ring gets to a new indent, the ball is pushed back into it, and effecting in small click. The system can be loaded in from the back after the dials have been assembled. The rotational force required can be adjusted with the setscrew, as setting it further into the thread will lead to increased spring pressure due to further compression of the spring.



Illu. 112. Rotational feedback mechanism

PCB estimates

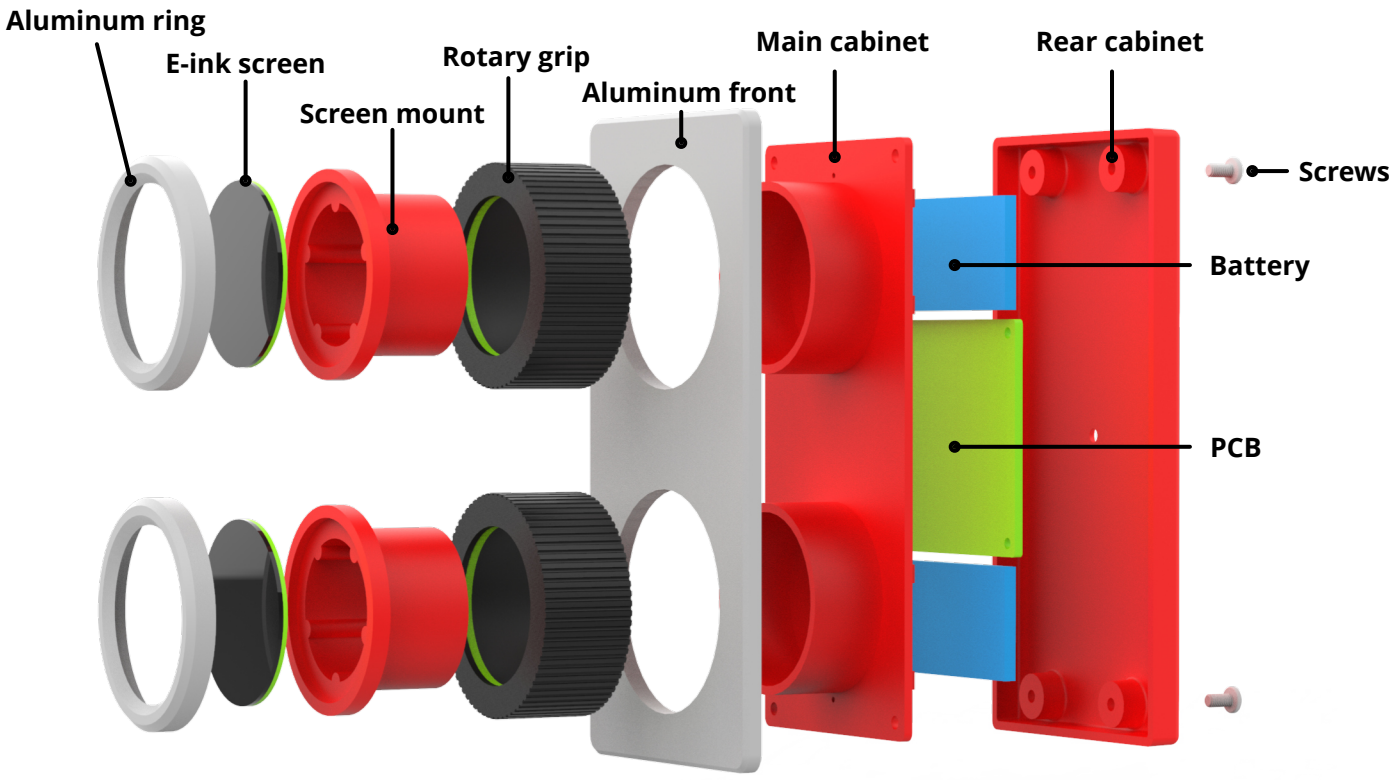
The IKEA traadfri remote, used for adjusting brightness and color of IKEAs wireless LED lightbulbs, has the same amount of inputs as the concept. The Traadfri remote connects to the bulb with Zigbee meshing technology. The PCB dimensions in the IKEA remote was used as a surface area reference for the PCB in the product proposal remote. The dimensions were found by doing a tear-down of the remote REF.**(Appendix 39).** The battery used in the IKEA remote (A CR2032) was considered too small, as the product proposal remote has two displays to update. It was replaced by a battery of the same capacity that is found in the Nest Thermostat, which is of 3950mAh (A MH29195). Placement in the construction can be seen in **Ill. 115**.

Wall-mounting bracket

As the remote is running on battery power, it is possible to move it around to adapt to the situation. To support this, a wall-bracket with magnets have been constructed. The bracket can be mounted on a wall, to allow the remote to have a 'home-location', a place where it usually is. The bracket has two countersunk screw seats, that are oval to allow for adjustment once of the screws are inserted. The wall-mount can be see in **Ill. 115.**

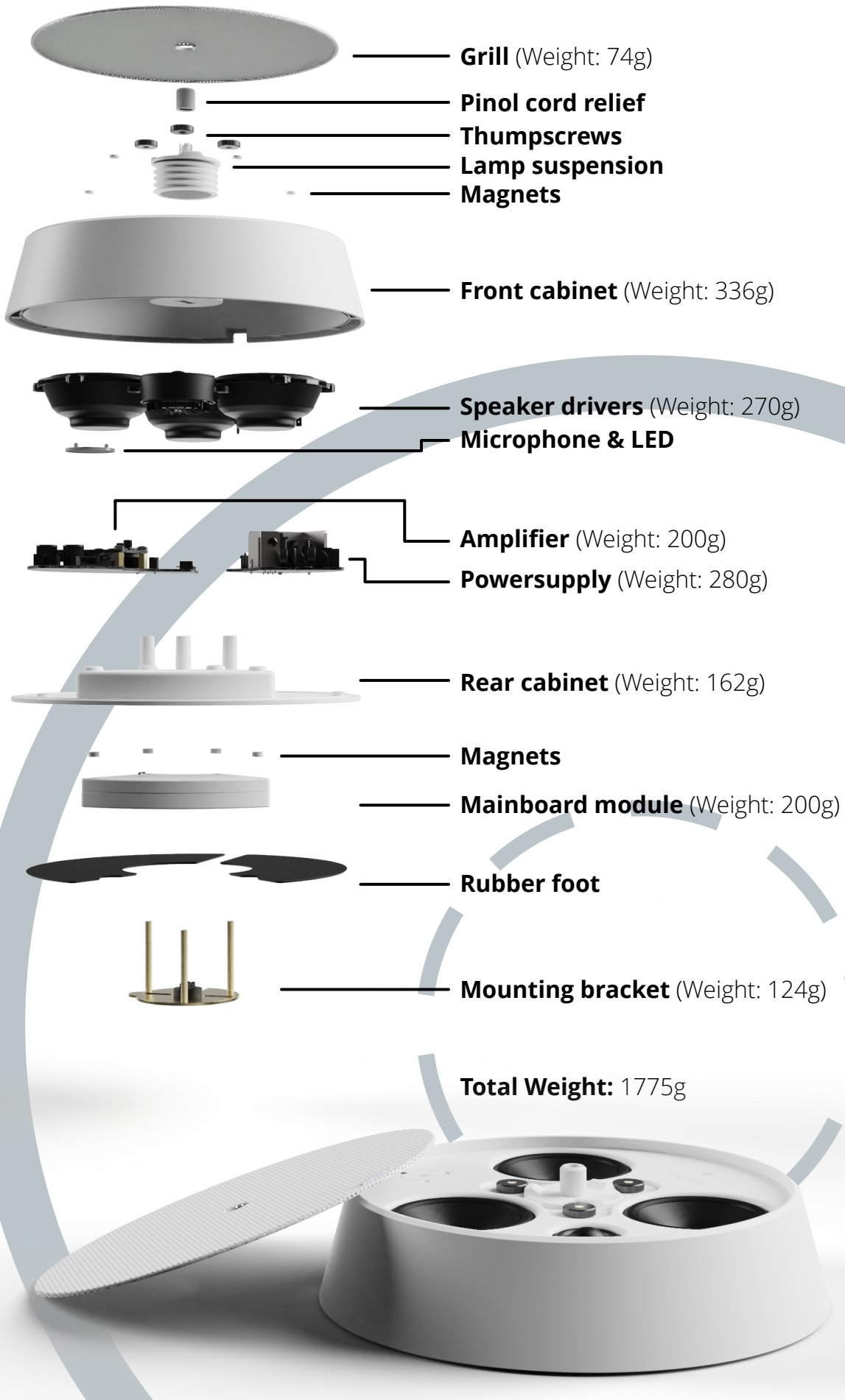
Materials

The remote components consist mainly of Injection molded parts, with the exception of the parts the user interact with. The Input ring will be molded in a hard rubber (Shore A95). The Front plate and the dial rings will be CNC-milled in aluminum and bead-blasted, to achieve a high-end feeling finish.



Illu. 115. Remote exploded view.

This concludes the construction of the remote as a BoM can be made and put to use in the final phase of the project, the business phase.


Grill (Weight: 74g)
Pinol cord relief
Thumpscrews
Lamp suspension
Magnets
Front cabinet (Weight: 336g)
Speaker drivers (Weight: 270g)
Microphone & LED
Amplifier (Weight: 200g)
Powersupply (Weight: 280g)
Rear cabinet (Weight: 162g)
Magnets
Mainboard module (Weight: 200g)
Rubber foot
Mounting bracket (Weight: 124g)
Total Weight: 1775g

5.0 Business

Based upon the product proposal, we establish a business case, that dives into production and sales channels.

We looked into product and project cost, in order for us to validate the feasibility of the proposal.

Lastly we took a look at potential market expansion options.

5.1 Business Case

'Few sales channels, limited to specialty stores' was one of the weakness identified in the SWOT analysis of Dynaudio in the initial phase. To accommodate this and to add value to both the brand Dynaudio and the product, we made a suggestion for how the distribution channels could look. Both from a production perspective and from a retail- and brand perspective.

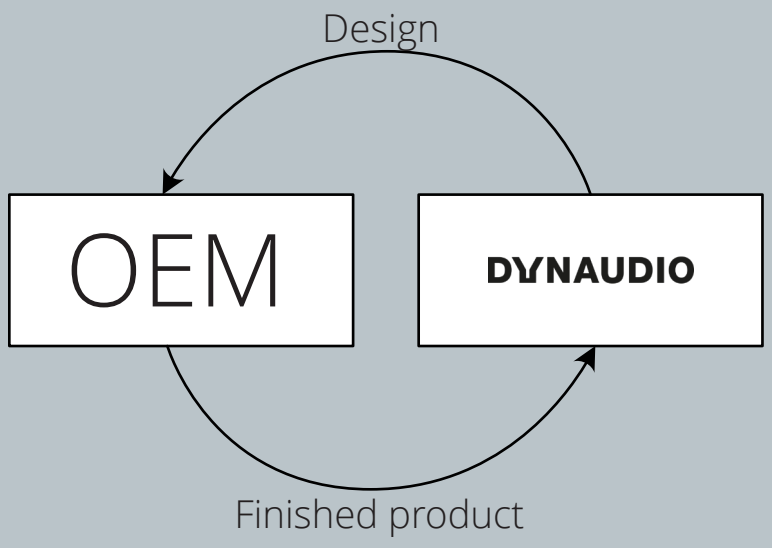
Production

Even though the product proposal is designed in Denmark along with further development as well, it's intended to be produced through an original equipment manufacturer (OEM). An OEM can benefit a production by:
1. A Lower production price, even with a added OEM margin.
2. Storage as there's no need to keep a lot of disassembled components in stock as we buy a finished and packaged product that is ready to ship to retailers.

It also has its downsides;
1. It will not have a 'Made in Denmark' label on it, which some consider a quality stamp.
2. As the full production is outsourced, the business become dependent on the supplier. In case they are unable to deliver, the business pauses, and would require bigger changes in the supplychain to continue delivering.
3. It results in limited control over the processes in production and could lead to a lower quality.

An alternative to an OEM, could be to outsource the components that cannot be produced in-house, such as the injection molded components and the fabric materials. This would be expensive due to higher labor cost which would result in higher component prices, and therefore to either a more expensive product, or a lower contribution margin.

The Music speaker-series are produced in the China, because of that we have chosen to proceed with the suggestion to use an OEM manufacturer for the production **(Illu. 116)**. It should be noted that this may upset some customers as it may contradict some of the mega trends mentioned earlier.



Illu. 116. Production chain

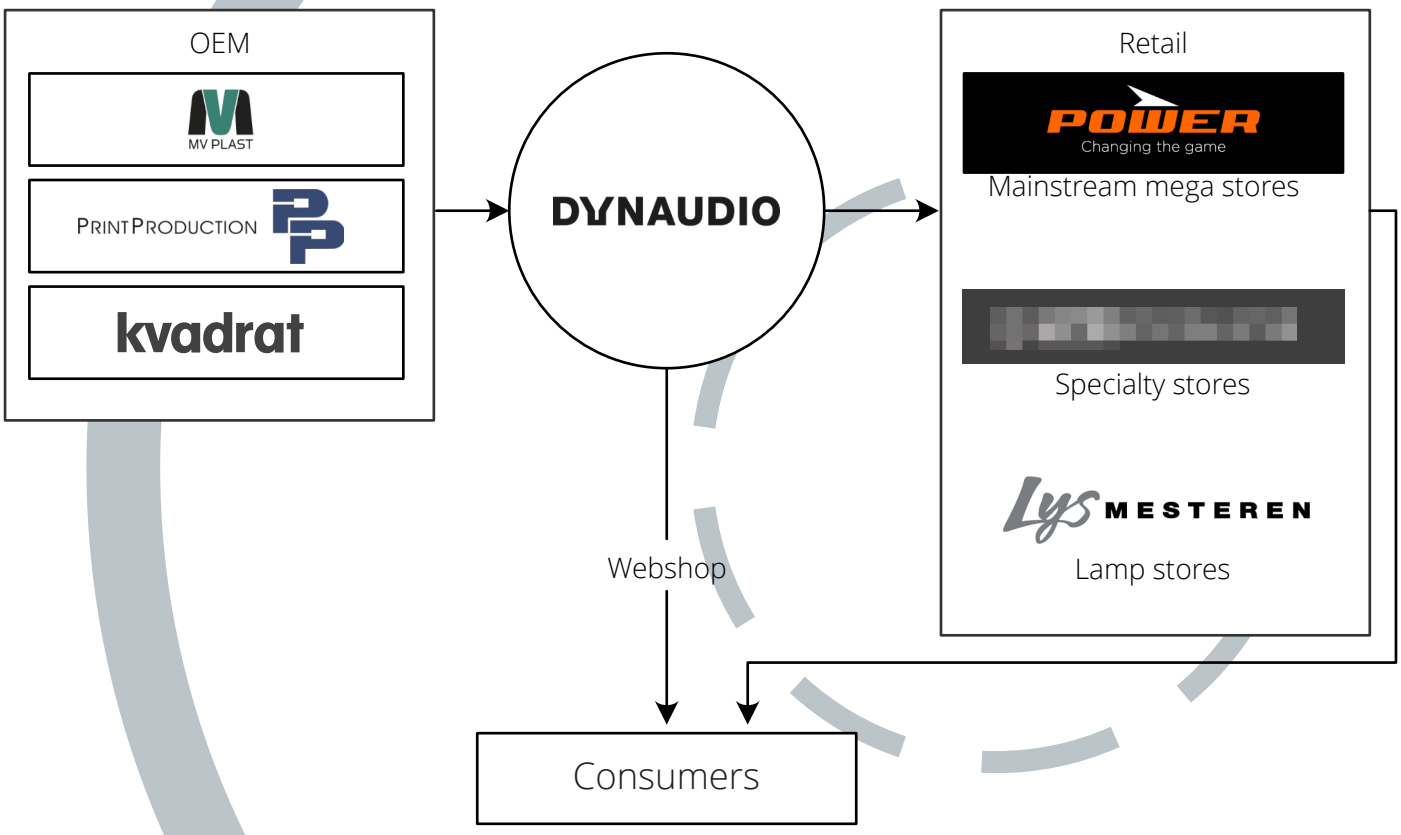
Sales channels

As the product proposal is targeted at the mainstream audience, the specialty stores will not be optimal sales channel for this product.

Other high-end hifi brands (Bang & Olufsen, KEF, Klipsh, Bose, Polk, Harmann Kardon) sell their entry-level products through electronic franchises in Denmark like (Power) **(Illu. 117).** This type of store targets the mainstream market. This sales channel could potentially increase brand awareness and get the mainstream focused products to the right customer segment.

Additionally, we see some of the competitors (KEF, Bose, Harmann Kardon) who sell their products directly on their website. This allows them to cut out the retailer and thereby cut their margin out while adding it to their own contribution margin. KEF is offering their Entry-level products online. The mid to high-end products are only available through retailers. We suggest to proceed in the same manner.

Lastly, the product is intended to be used with a lamp underneath it, and it would therefore make sense to sell it through lamp retailers, such as Lampemesteren or other retailers that carry Designer lamps.



Illu. 117. Distribution chain

5.2 Project and Product costs

In order to verify to feasibility of the project, it is essential to consider the project cost in relation to the potential earnings made on the product. All of these calculation will be based upon the speaker itself, and does not include the Remote.

Production Cost

The production cost include all of the components found in the BOM, as well as Labour, Packaging and a OEM Margin **(Illu. 118)**. This leaves the product at a price of 1042 DKK at the OEM. With a Contribution margin of 65%, the final retail prices lands at 3000 DKK (**Illu. 120)**, just above the Music 1, which it is estimated to perform on par with. With the additional Unique selling points, it seems a viable price point.

Project Investment

The project cost calculation (**Ill. 6**) includes Further development hours of the design, both in regard to the construction, but also the acoustics, where further work needs to be done on the grill and adjustments in the DSP. The tooling costs are based upon a quote from 3dhub.com **(appendix 40 & 41)**. The price for certification has been added as well, that is derived from previous Dynaudio projects, that have the same electronical and mechanical base. These products has been launched globally as well. Additionally, there has been added a post for both traveling (to the factory in china) and prototyping. The total investment of the project ends up at roughly 2.7M DKK **(Illu. 121 & appendix 42)**.

Market potential

Retrofit Custom install speakers will be a large competetive market in the US due to the ease of installation related to their house construction. We therefore consider the market to be larger in countries with housing constructions that makes it harder to retrofit CI products. We therefore estimate the sales volume to be 75% of the Music 5 global sales numbers (3750 units). With a 10% sales decrease each year over 3 years, the product is estimated to achive a profit of 5 million DKK **(Illu. 119)**.

The remote control will be sold as a separate item, to keep the cost of the speaker it self down. With the remote controls current design, it will require a investment of around 500.000 DKK to initate the project **(see appendix 44 for further data)**. The goal is for the remote to cost around 1000DKK. With the remote costing 500 DKK at the OEM factory **(See appendix 44 for further data)**, it will allow for a contribution margin of 40%, to achive that goal, with the retailer receiving 40% as well. It is estimated that 50% of the sold speaker units will be sold with a remote, leading to a profit of 259.000 DKK after 3 years **(Illu. 122)**. As the CNC milled components take up 30% of the BOM list, there is room to work with to decrease the cost price at the OEM factory.

Additionally, the upgradeable Mainboard module is a source of revenue as well. We estimate that 25% of the sold units will be upgraded. The investment of the upgrade module consist of creating a new PCB, and is therefore considered development hours, estimated to be 200.000 DKK. If we see the same 10% drop in sales pr. Year, the upgrade modules will yield a profit of 1.2M DKK at the end of year 3 (**Illu. 123)**. The calculations can be found in **appendix 43**.
In total, the three projects are estimated to require a total investment of 3.4M DKK. If the cost estimates and the sales prognoisis are correct, the three projects. will generete 8.8M DKK in turnover, ending up with a profit of 5.45M DKK.

Production cost

	Cost
Electronics	378.64 kr.
Hardware	234.20 kr.
Labor	105.60 kr.
Packaging	115.20 kr.
ODM Margin	208.41 kr.
Total:	**1042.05 kr.**

Illu. 118. Production cost - Canopu speaker

Unit Price

ODM price	1042.05 Dkk	
Contribution margin (Dynaudio)	677.34 Dkk	65.00%
Sales price (At Dynaudio plant)	1719.39 Dkk	
Contribution Retail	685.45 Dkk	40.00%
Sales price (excl. VAT)	2,399.06 Dkk	
VAT Retail	599.77 Dkk	25.00%
Retail price (incl. VAT):	**2,998.84 Dkk**	

Illu. 120. Unit price - Canopy speaker

Investment

Project cost	Price DKK	PCS	Total
Tooling	539,847.65 Dkk	1	539,847.65 Dkk
Accoustic Eng. Hourly	302 Dkk	300	90,600.00 Dkk
Hardware Dev Hourly	302 Dkk	500	151,000.00 Dkk
Traveling	94,375.00 Dkk	1	94,375.00 Dkk
Certification	1,510,000.00 Dkk	1	1,510,000.00 Dkk
Prototyping	302,000,00 Dkk	1	302,000.00 Dkk
		Total:	**2,687,822.65 Dkk**

Illu. 121. Initial investment - Canopu speaker

Business case

Decrease:	*100.00%* **Year 1**	*90.00%* **Year 2**	*80.00%* **Year 3**
Units sold	6,250	5,625	4500
Sales price (Factory)	1,719.39 kr.	1,719.39 kr.	1,719.39 kr.
Production cost	-1,042.05 kr.	-1,042.05 kr.	-1,042.05 kr.
Turn over	10,746,181.88 kr.	9,671,563.69 kr.	7,737,250.95 kr.
Variable cost	-6,512,837.50 kr.	-5,861,553.75 kr.	-4,689,243.00 kr.
Contribution margin	4,233,344.38 kr.	3,810,009.94 kr.	3,048,007.95 kr.
Investment	-2,687,822.65 kr	1,545,521.73 kr	5,355,531.66 kr.
Remaining	**1,545,521.73 kr**	**5,355,531.66 kr.**	**8,403,539.61 kr.**

Illu. 119. Business case - Canopy speaker

5.3 Business case - Remote

Decreas:	*100.00%* **Year 1**	*90.00%* **Year 2**	*80.00%* **Year 3**
Units sold	3,125	2,813	2250
Sales price (Factory)	573.99 kr.	573.99 kr.	573.99 kr.
Production cost	-409.99 kr.	-409.99 kr.	-409.99 kr.
Turn over	1,793,720.74 kr.	1,614,348.67 kr.	1,291,478.93 kr.
Variable cost	-1,281,229.10 kr.	-1,153,106.19 kr.	-922,484.95 kr.
Contribution margin	512,491.64 kr.	461,242.48 kr.	368,993.98 kr.
Investment	-546,136.80 kr.	-33,345.16 kr.	427,597.32 kr.
Remaining	**-33,345.16 kr.**	**427,597.32 kr.**	**796,591.30 kr.**

Illu. 122. Business case - Remote

5.4 Business case - Upgrade modules

Decrease:	*100.00%* **Year 1**	*90.00%* **Year 2**	*80.00%* **Year 3**
Units sold	1533	1406	1125
Sales price (Factory)	462.54 Dkk	462.54 Dkk	462.54 Dkk
Production cost	115.63 Dkk	115.63 Dkk	115.63 Dkk
Turn over	722,712.50 Dkk	650,441.25 Dkk	520,353.00 Dkk
Variable cost	180,678.13 Dkk	162,610.31 Dkk	130,088.25 Dkk
Contribution margin	903,390.63 Dkk	813,051.56 Dkk	650,441.25 Dkk
Investment	-200,000.00 Dkk	703,390.63 Dkk	1,516,442.00 Dkk
Remaining	**703,390.63 kr.**	**1,516,442.19 kr.**	**2,166,883.44 kr.**

Illu. 123. Business case - Upgrade modules

Market expansion options

We may have chosen to develop the Canopy speaker specifically for a house, however that does not mean that it is limited to this context e.g. There's nothing to hinder it being valuable for families living in apartments as well. During our meeting with Malte , we discussed the potential of the solution regarding both hotels and restaurants as potential markets for the solution. Should they work for these business some minor changes might be beneficial as the situations differs a bit.

Hotels

The solution would have to allow a user to connect to it without it being connected to the hotels WiFi network. This could be achieved by allowing the product to create its own WiFi hotspot.

Restaurants

Restaurants: The hole pattern in the grill would need to be developed into focusing the sound underneath the mounting area, to create a small soundspace, for the guests. This would allow each party to select their soundtrack individually.



6.0 Conclusion

We chose to work with the subject sound reproduction, because Dynaudio agreed to case partner with our project. An initial market analysis revealed a rapid decline in the sale of surround sound speakers, prospected to decline further over the coming years. Research into the portfolio of Dynaudio's conventional speakers for the private market, revealed that they mostly design for the very declining market. This prompted our initial thesis statement to design 'the sound reproduction device of the future" as we thought Dynaudio needed to reposition themselves with a new type of speaker that could accommodate the present and future user demands.

As we wanted to disclose new user demands in user studies, we found that the social context, an individual acts in, influences their consumption of media and sound. From this we were able to define a social context as a solution space to design for. In this space we found out that integrating speakers into furniture is popular, as it camouflages the speakers in plain sight. This resulted in the development of a canopy with integrated speakers, which also suspends a lamp, camouflaged on the ceiling of a home. The canopy is a retrofit solution which allows it to be installed independent of the lamp. It features a suspension system that allows for an easy installation of both the canopy and the lamp, as the canopy is plugged into a ceiling junction box and the lamp into the canopy.

As we wanted to develop a product for a future market, we chose to incorporate elements, inspired by current Mega trends, to increase the relevance of our product proposal in the future. This resulted in an exchangeable module which contains the compatibility components needed to connect to the speaker from a device, as standards for compatibility changes often.

As this project was written during a pandemic, we were prevented from testing principles and prototypes on actual users, apart from virtual meetings on skype. This leaves the installation of the canopy and lamp untested along with the interaction and setup of remote. These elements of the Canopy need further validation before a final validation of the proposals can be confirmed.

6.1 Reflection

As we started this project none of us saw any obvious paths into this case, as the speaker market is stacked with competitors and solutions. As we chose to develop a sound reproduction device for a future customer we took on a broad scope of possible directions as we refused to limit the project to speakers, in fear of missing innovative solutions. This made it harder to navigate the research of our project, as what we were looking for specifically were unclear. We could have chosen to work with conventional speakers earlier as Dynaudio already work in this field, which might have eased the framing of the project.

In phase 2, we could have done a competitor analysis before defining and modelling the concepts to that degree, by so we could have deselected two concepts earlier or adjusted the concepts according to the findings, however the comparison was made easier because of the defined state of the concepts.

The future customer was a difficult user to work with, as we tried to identify behavior in media consumption to predict demands to future sound devices. Specifying a user earlier and in a defined state, might have made comparisons between concept proposals easier, as they would could be tested against each other by the user, for selection. Not specifying the user resulted in very different conceptual directions initially which was hard to choose direction upon.

In our user studies we chose to interview and analyze university- and highschool students which share a similar background. The behavior patterns might be different for people with different cultures or background.

In the period of the project, the society was shut down due to the Corona Pandemic, as such we became restricted in our design process, which the biggest issue being restricted from user testing. E.g. Having actual users to physically test our proposed suspension system and installation could clarify eventual problems with our solution. Instead our work has been done mostly digitally. Overall we are satisfied with our digital process but it did mean that some preparations took extra time, as our communication was limited.

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DYNAUDIO

Ambient 1

Appendix

Msc-ID 04, Group 1
Aalborg University 2020

Jonas Bennedbæk Knudsen
Marcus Heinrich Abrahamsen
Casper Mohr

0.1 Title Page

Title:
Sound of the Future

Project:
Msc-ID04, Aalborg University

Project Start:
03.02.2020

Submission:
03.06.2020

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Pages:
104

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1. Market analysis

Worksheet no.: 2
Date: 6/2-2020
Responsible:
Deadline:

Activity: Loudspeaker market state

Objective:
The objective of this activity is to investigate and get insight into the current state of the loudspeaker market. The investigation will be done through analysis of market reports, and the desired result is to see if the market is sustainable to keep working in.

Wireless streaming rises:
As a result of streaming services such as spotify gaining traction among the Danes, wireless adaptation is growing in importance within the home audio segment. As a result of this, we see a shift towards wireless home audio products. This shows a negative impact on the Hi Fi system sales. The retail volume for HiFi systems in Denmark has declined by 33%, to a total of 20.000 units in 2019

The sales forecast estimates that there will be sold 11.600 HiFi systems in Denmark in 2024, which is a further 50% decline from 2019. Home cinema and speaker systems are estimated to decline to 79.800 in 2024, which is a 66.6% decline from 2019. The rising demand for soundbars helps to limit the decline in sales within home cinema and speaker systems.

The rise seen in demand for Soundbars follows the trend of slimmer and more compact TV's which puts indicates an underlying need for a supplementary audio purchase.

Soundbars are eating market share from component based homecinema setups:
The rising popularity of soundbars are hurting the lower end home cinema speaker setups. They are easy to setup up, and does not take up much space, at it is typically based underneath the TV, sometimes with the addition of a wireless subwoofer. The performance of soundbars has increased, and more and more people are replacing their stereo setup for enjoying music, with a soundbar. To further support this, many of the soundbars come with built in wifi streaming, to integrate with other multiroom streaming products. (Consumer Technology Association, 2018)

Shopping moves online:
Hi Fi Klubben is converting their shops to showrooms, where the costumers can seek guidence before buying it online.

Embracing interior design trend:
Sonos' recent partnership with IKEA, yielded the 'SYMFONISK' series, that taps into the growing pride in home appearance that is the current interior design trend. There is a rising demand for stylish, premium audio and cinema systems, that can be displayed in our homes. [Home Audio and Cinema in Denmark, Euromonitor 2019]

Portable devices replace traditional products in home electronics
Consumer, with larger weight on the younger generation, want to be flexible in their lifestyle, and therefore in-home electronic products lose sales to portable consumer electronics, that serve the same purpose. [In-home consumer electronics in western europe, Euromonitor 2019]

B&O loses market share to SONOS
Bang&Olufsen is one of the few local brands that are present in the home audio and cinema market in Denmark. During the review period of the Euromonitor report, B&O saw a decline in market share, mainly due to the strong growth of SONOS [Home Audio and Cinema in Denmark, Euromonitor 2019].

Evaluation:
As wireless features become more important due to adaptation of streaming, we see a large decline in traditional Hi-Fi systems, and as the sales are moving towards wireless speakers.

Home Cinema and Speaker systems see a slower decline, as this category is supported by the increasing demand for Soundbars.

A rise in demand for stylish premium audio products, is verified by the growth and attention that SONOS has seen after rolling out their partnership with IKEA.

The Young generation want portable electronic products to fit their flexible lifestyle, and this makes them replace traditional in-home electronic products with portable alternatives.

B&O Olufsen loses market share due to rapid growth of SONOS.

Reflection:
What did you learn? Do you need to change method? approach or revise the objectives, specifications or criteria? What's the next move?

Does this huge market decline in Home cinema system sales have anything to do with the way we consume content today? The next step could be looking into how we consume content as individuals, both audial and visual content. Perhaps through a customer journey for different age groups.

Why do people see the need to add a soundbar to their TV, when it already delivers sound? Contact users of this product

Look into the current interior trends, to meet the rising demand for stylish products, that fit into the modern home.

Why do the users prefer the SONOS products over Beoplay? What does SONOS do better than B&O? Wifi vs bluetooth?

2. 10th Semester University student (1)

Worksheet no.: 005
Date: 10/02/2020

Nr. 004
Alder: 24 år
Køn: Mand
Beskæftigelse: Studerende
Bosted: Aalborg C
Samboende: Nej

Noter:
Hvis han skal høre musik imens han skal fokusere på en arbejdsopgave skal det gerne være uden sang.

Når han laver mad, er det nogle "ligegyldig" streams eller serier han har set før

Har det svært med stilhed når han er hjemme. Føler sig tilpas i baggrundsstøj.

Benytter sig af spotifys anbefalede numre; han har valgt 10 sange i en playlist som spotify fortsætter med lign. musik efter de er spillet igennem.

Sæsonpræget ift. valg af musiktype/radio

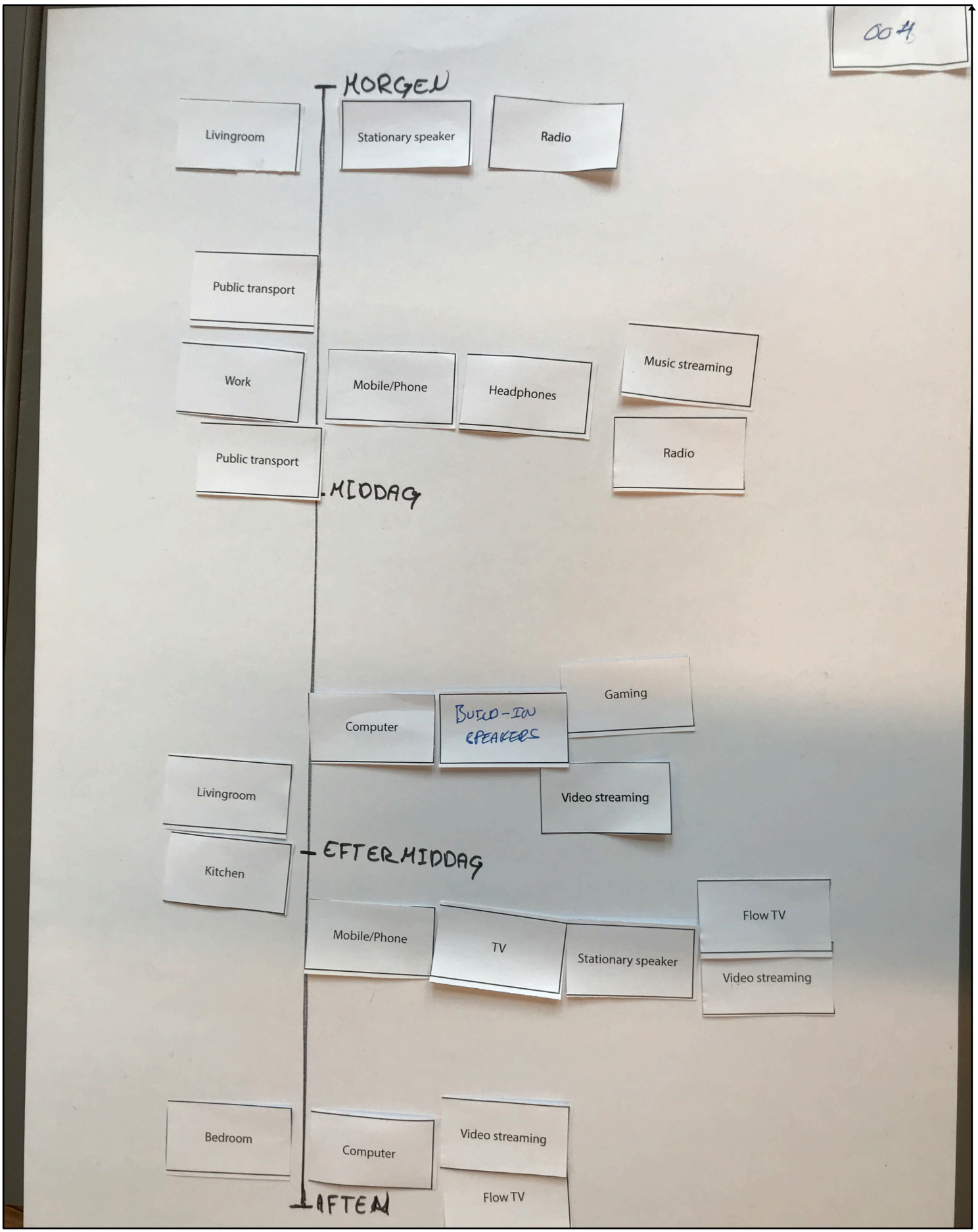
Ikke fan af stemmestyring, føler sig lidt akavet ved at skulle "tale med sig selv" særligt hvis enheden ikke forstår ønsket første gang.

Hvorfor hører du lyd i de situationer?
Baggrundsstøj, nyheder om morgenen.

Når han spiller er det uden høretelefoner og for at koble af. Kan godt lide at se streams af det spil han spiller.

Er der nogle situationer, hvor du bliver forhindret i at høre lyd?
I gruppearbejde hvor det kan være rart at fokusere, men samtidig også skal være tilgængelig for gruppen.

På arbejdet hvis han har skulle passe telefonerne, bliver han nødt til at tage musikken ud.


004
MORGEN
Livingroom
Stationary speaker
Radio
Public transport
Work
Mobile/Phone
Headphones
Music streaming
Public transport
Radio
MIDDAG
Computer
BUILD-IN SPEAKERS
Gaming
Livingroom
Video streaming
Kitchen
EFTERMIDDAG
Mobile/Phone
TV
Stationary speaker
Flow TV
Video streaming
Bedroom
Computer
Video streaming
Flow TV
AFTEN

3. 10th Semester University student (2)

Worksheet no.: 005
Date: 10/02/2020

Nr. 005
Alder: 24 år
Køn: Kvinde
Beskæftigelse: Studerende (uni)
Bosted: Aalborg C
Samboende: Nej

Noter:
Hører lyd om natten, for at falde i søvn (ikke altid at det hjælper). Meditative historier. Bare telefon-lyd når hun skal sove.

Bruger voice control (google home)

Bruger kun tv hvis der er noget specifikt hun skal se.

Nostalgisk med radio om morgenen ligesom da man var barn og boede hjemme.

Bruger mest bare blandede likede sange, har prøvet at organisere det i playlists men det holder sjældent længe.

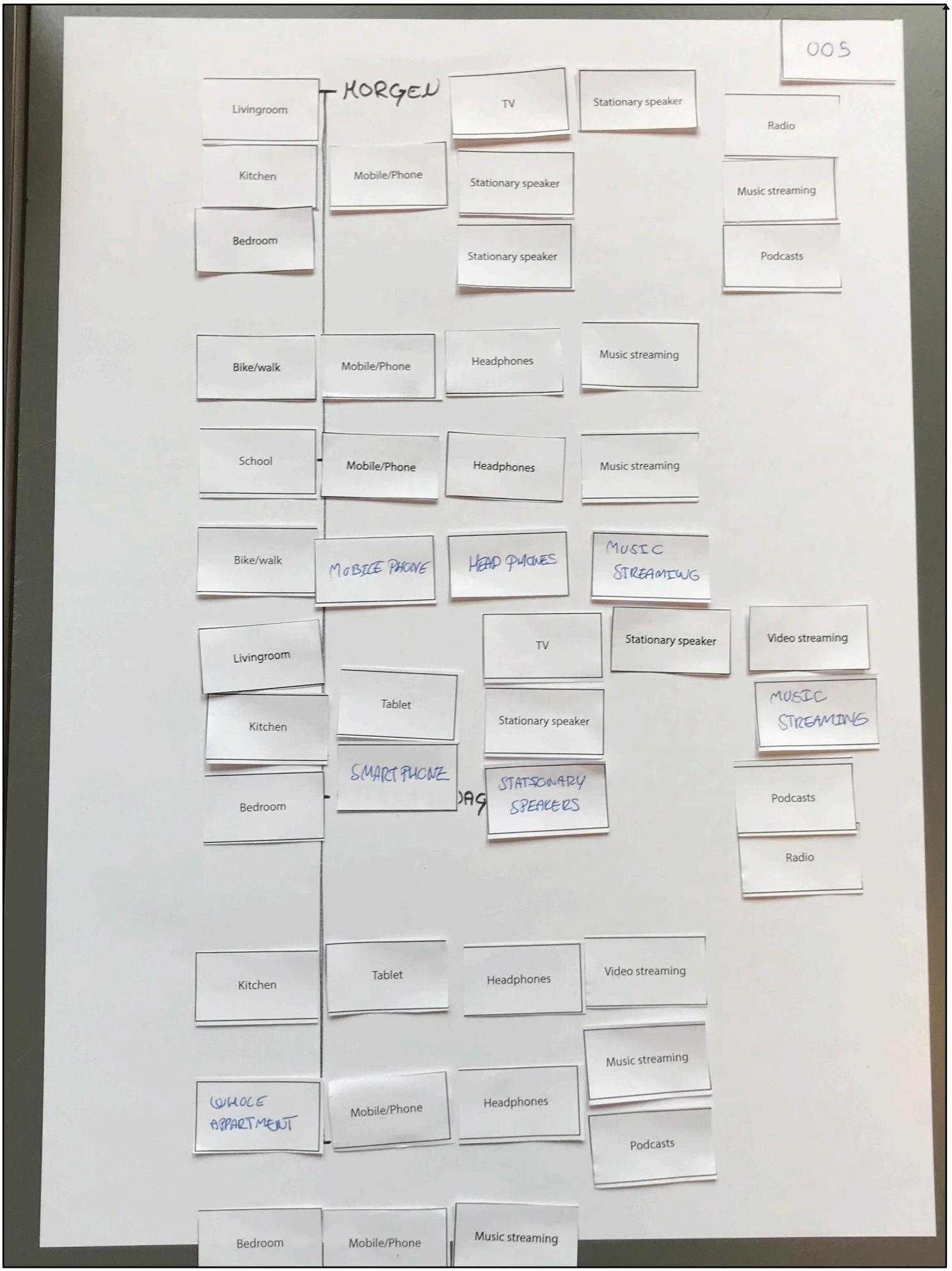
Hvorfor hører du lyd i de situationer?

Har behov for at der skal være noget baggrundslyd når hun er alene hjemme. “Der skal ske noget” eller have følelsen deraf.

Hører podcasts for at tænke på noget andet.

Er der nogle situationer, hvor du bliver forhindret i at høre lyd?

Bruger ikke højtalere når hun laver mad, da hun føler hun bliver nødt til at tage hensyn til sine omgivelser og naboer i opgangen. (ville ikke selv have noget imod at hendes naboer spiller lyd på højtalere)


OOS
MORGEN
Livingroom
TV
Stationary speaker
Radio
Kitchen
Mobile/Phone
Stationary speaker
Music streaming
Bedroom
Stationary speaker
Podcasts
Bike/walk
Mobile/Phone
Headphones
Music streaming
School
Mobile/Phone
Headphones
Music streaming
Bike/walk
MOBILE PHONE
HEAD PHONES
MUSIC STREAMING
Livingroom
TV
Stationary speaker
Video streaming
Kitchen
Tablet
Stationary speaker
MUSIC STREAMING
Bedroom
SMARTPHONE
STATSONARY SPEAKERS
Podcasts
Radio
Kitchen
Tablet
Headphones
Video streaming
Music streaming
WHOLE APPARTMENT
Mobile/Phone
Headphones
Podcasts
Bedroom
Mobile/Phone
Music streaming

4. 3th Semester University student (3)

Worksheet no.: 005
Date: 10/02/2020

Nr. 006
Alder: 21
Køn: Kvinde
Beskæftigelse: Studerende (Uni)
Bosted: Aalborg C
Samboende: Nej

Noter:
Hører ikke noget om morgenen.

Vælger en playlists, ikke specifikke numre.

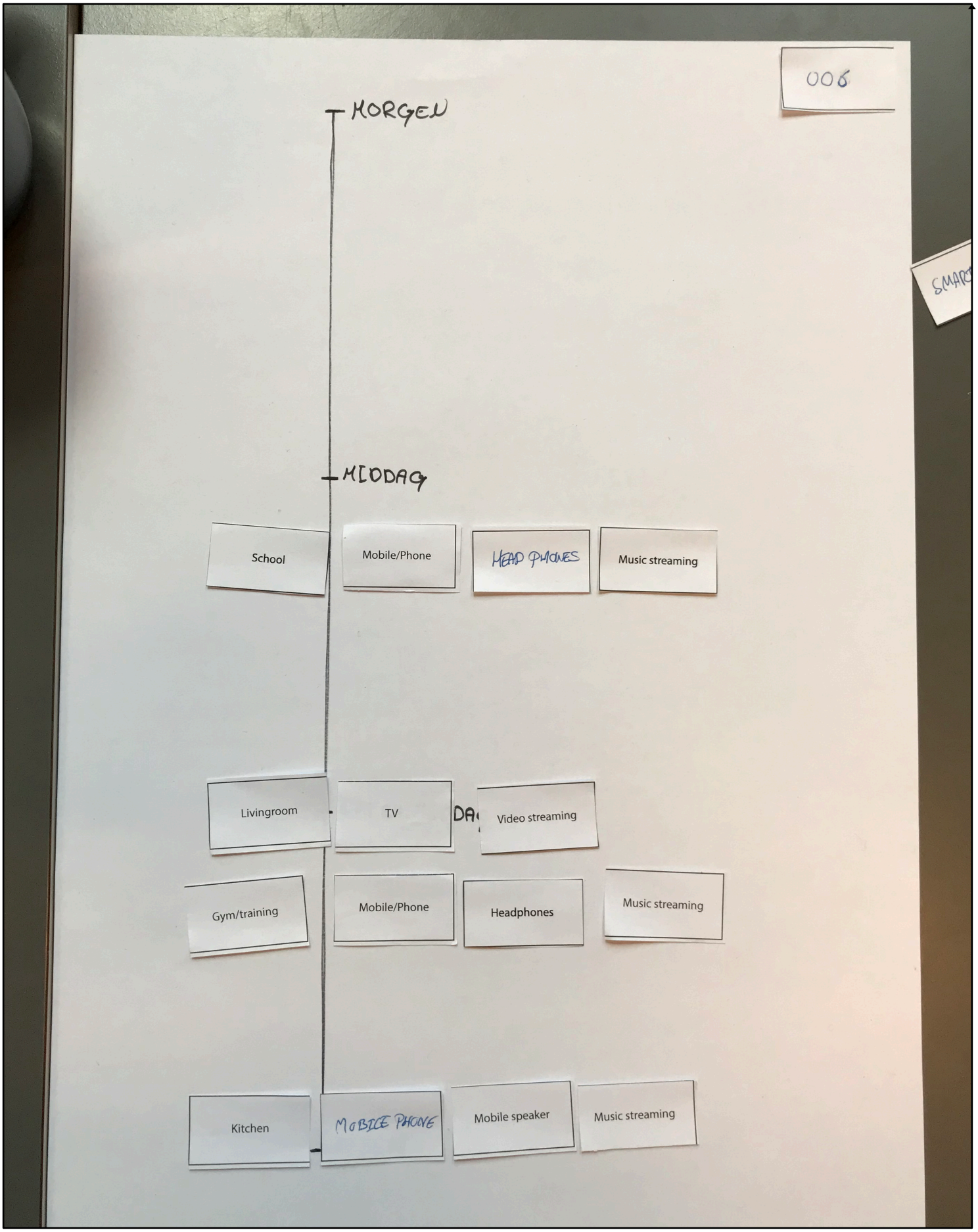
Ser af og til noget content på facebook, i så fald er det bare på mobilens højtaler.

Hvorfor hører du lyd i de situationer?

Når hun skal fokusere, lukke larm ude.
Hører ikke musik under transport, for at kunne begå sig i trafikken

Vælger aktivt hvad hun vil se når hun ser fjernsyn (ikke bare baggrundsstøj)

Er der nogle situationer, hvor du bliver forhindret i at høre lyd?


006
MORGEN
MIDDAG
School
Mobile/Phone
HEAD PHONES
Music streaming
Livingroom
TV
Video streaming
Gym/training
Mobile/Phone
Headphones
Music streaming
Kitchen
MOBILE PHONE
Mobile speaker
Music streaming

5. 3th Semester University student (4)

Date: 10/02/2020
Nr. 007
Alder: 21
Køn: Mand
Beskæftigelse: Studerende (uni)
Bosted: Mand
Samboende: Ja - kæreste

Noter:
Første lyd er alarmen fra telefonen.
hvis der er god tid om morgenen så hører han han noget musik.
Headset: løbeheadset.

Vælger selv playlister alt efter humør, men playlister han selv har lavet.

Bruger sjældent lyd på studiet

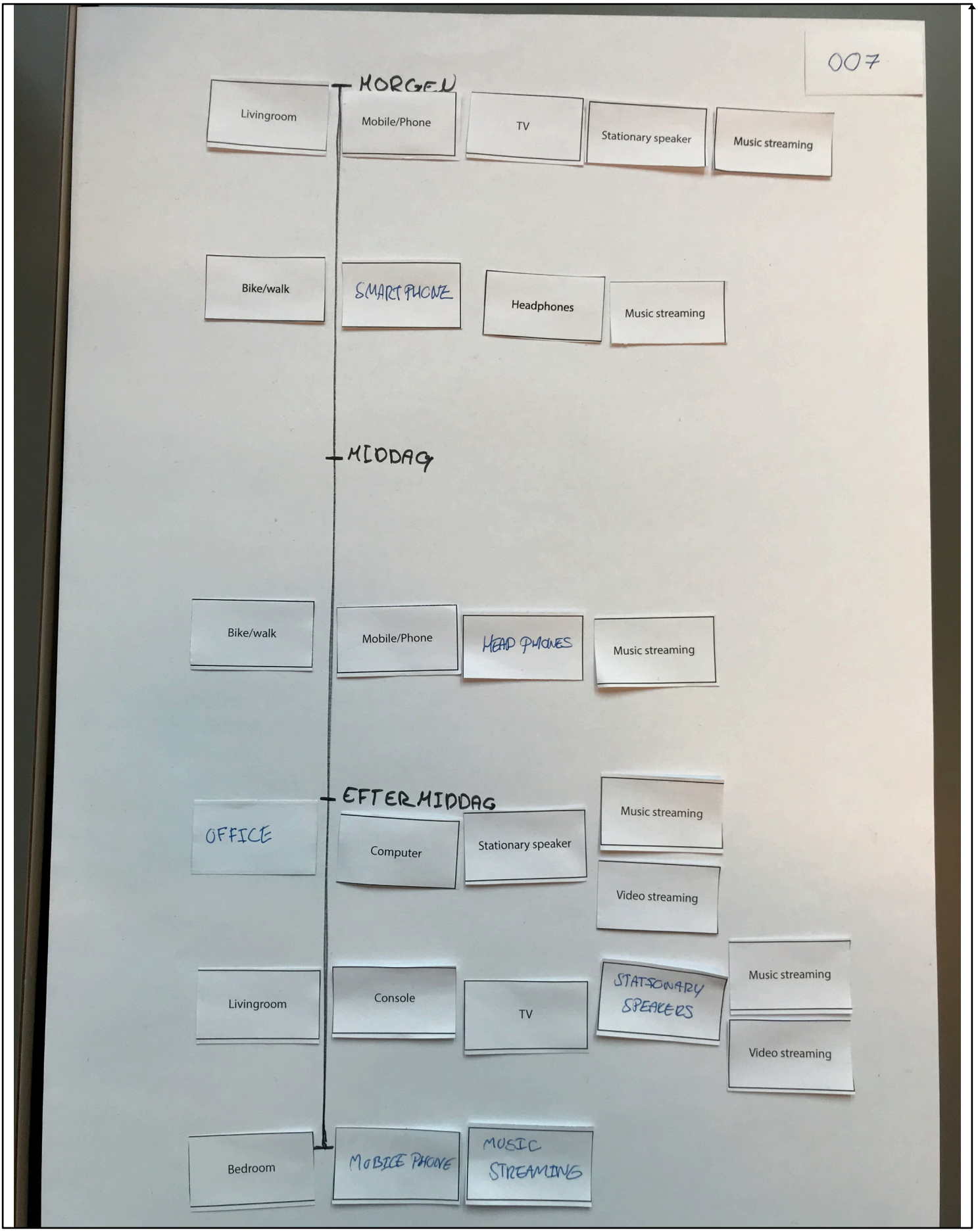
Har store gulvhøjttalere inde ved fjernsynet.

Hvorfor hører du lyd i de situationer?

kan godt lide musik, sætter sig og lytter aktivt til det - vigtigt med god lyd.
Hvis stresset kan han godt finde på at høre musik for at få noget ro på

Er der nogle situationer, hvor du bliver forhindret i at høre lyd?

Kunne være rart at bruge noget lyd på studiet en gang imellem når der skal fokuseres, men gruppearbejde forhindrer det lidt - problemet er at man også kan miste fokus af at bruge lyd.


007
MORGEN
Livingroom
Mobile/Phone
TV
Stationary speaker
Music streaming
Bike/walk
SMARTPHONE
Headphones
Music streaming
MIDDAG
Bike/walk
Mobile/Phone
HEAD PHONES
Music streaming
EFTERMIDDAG
OFFICE
Computer
Stationary speaker
Music streaming
Video streaming
Livingroom
Console
TV
STATIONARY SPEAKERS
Music streaming
Video streaming
Bedroom
MOBILE PHONE
MUSIC STREAMING

6. 3th Semester University student (5)

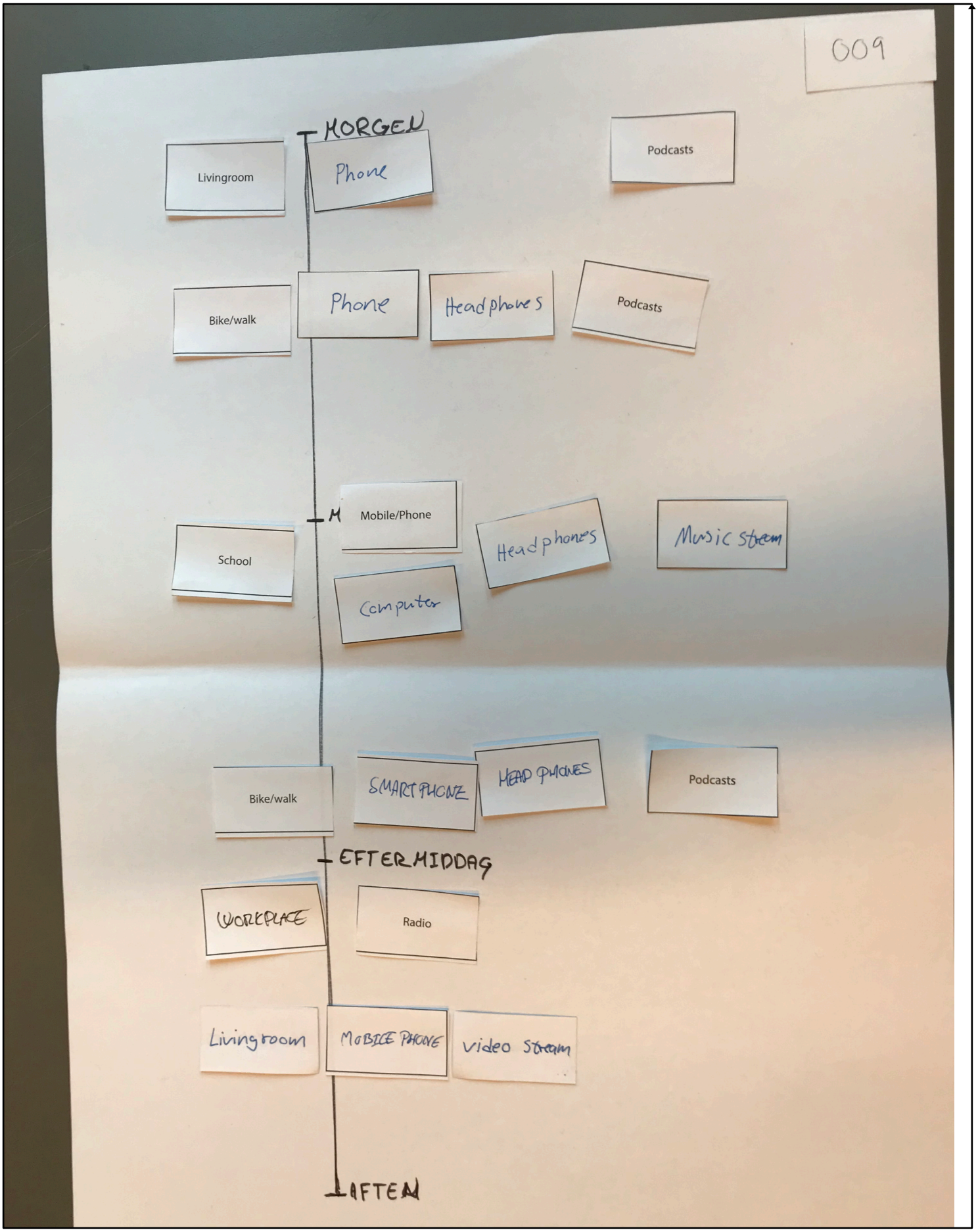
Worksheet no.: 005
Date: 10/02/2020

Nr. 009
Alder: 23
Køn: Kvinde
Beskæftigelse: Studerende (uni)
Bosted: Aalborg
Samboende: Nej

Noter:
Ipad
Hvorfor hører du lyd i de situationer?
Afstresser med podcasts, forskelligt om det er noget hun aktivt lytter til.
Bruger også lyd til at udelukke baggrundsstøj når der skal arbejdes fokuseres, på universitetet.

Arbejder oftest om eftermiddagen, hvor der kører radio

Er der nogle situationer, hvor du bliver forhindret i at høre lyd?

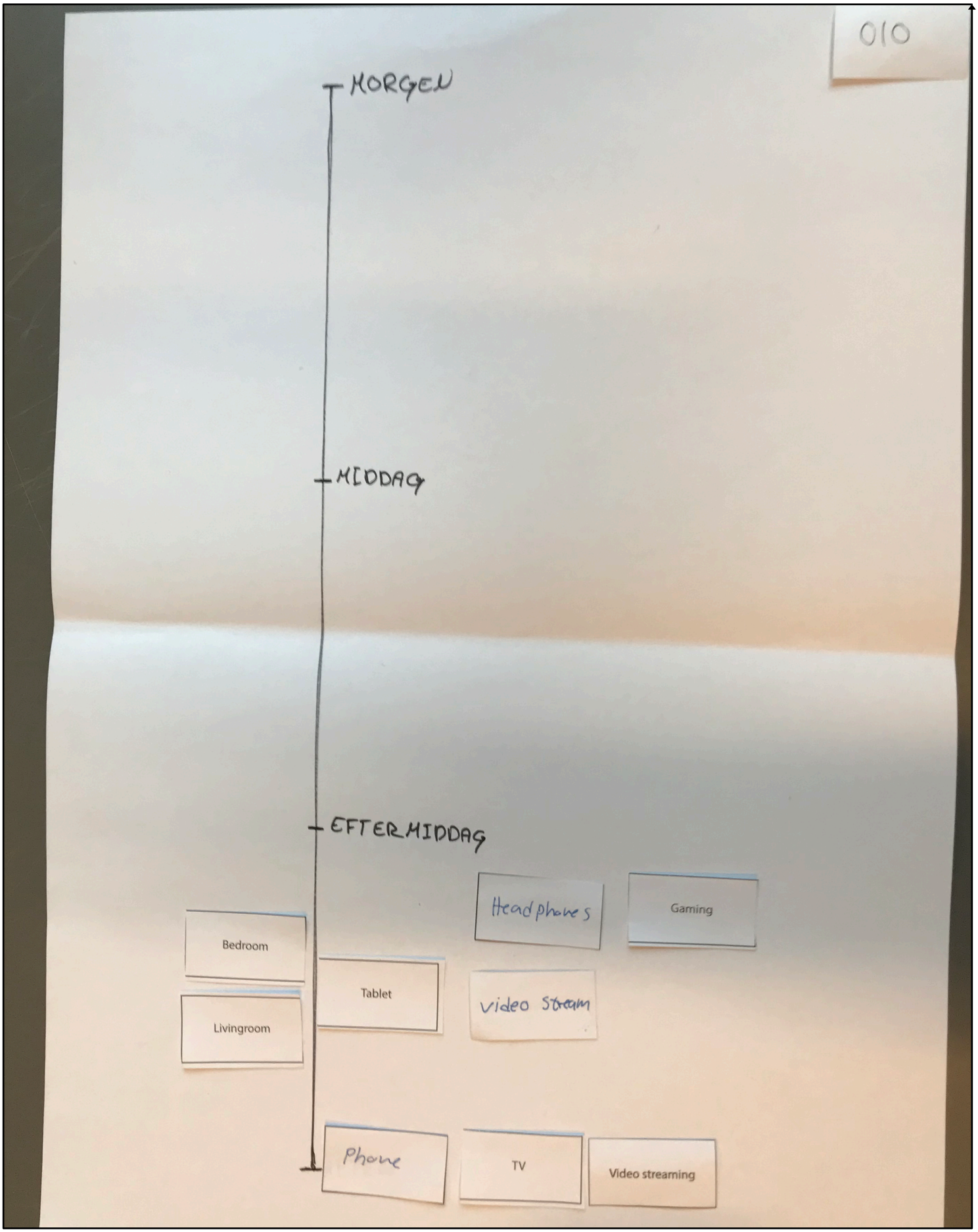

009
MORGEN
Livingroom
Phone
Podcasts
Bike/walk
Phone
Headphones
Podcasts
M
Mobile/Phone
School
Headphones
Music Stream
Computer
Bike/walk
SMART PHONE
HEAD PHONES
Podcasts
EFTERMIDDAG
WORKPLACE
Radio
Livingroom
MOBILE PHONE
video Stream
AFTEN

7. 3th Semester University student (6)

Worksheet no.: 005
Date: 10/02/2020

Nr. 010
Alder: 23
Køn: Kvinde
Beskæftigelse: Studerende (uni)
Bosted: Aalborg
Samboende: Nej

Noter:
Bruger høretelefoner til online undervisning fra uni.
Ipad
Hvorfor hører du lyd i de situationer?
Bruger musik i eksamenssituationer til at komme i et bestemt humør, bliver følelsesmæssigt påvirket af musikken.


010
MORGEN
MIDDAG
EFTERMIDDAG
Headphones
Gaming
Bedroom
Tablet
video stream
Livingroom
Phone
TV
Video streaming

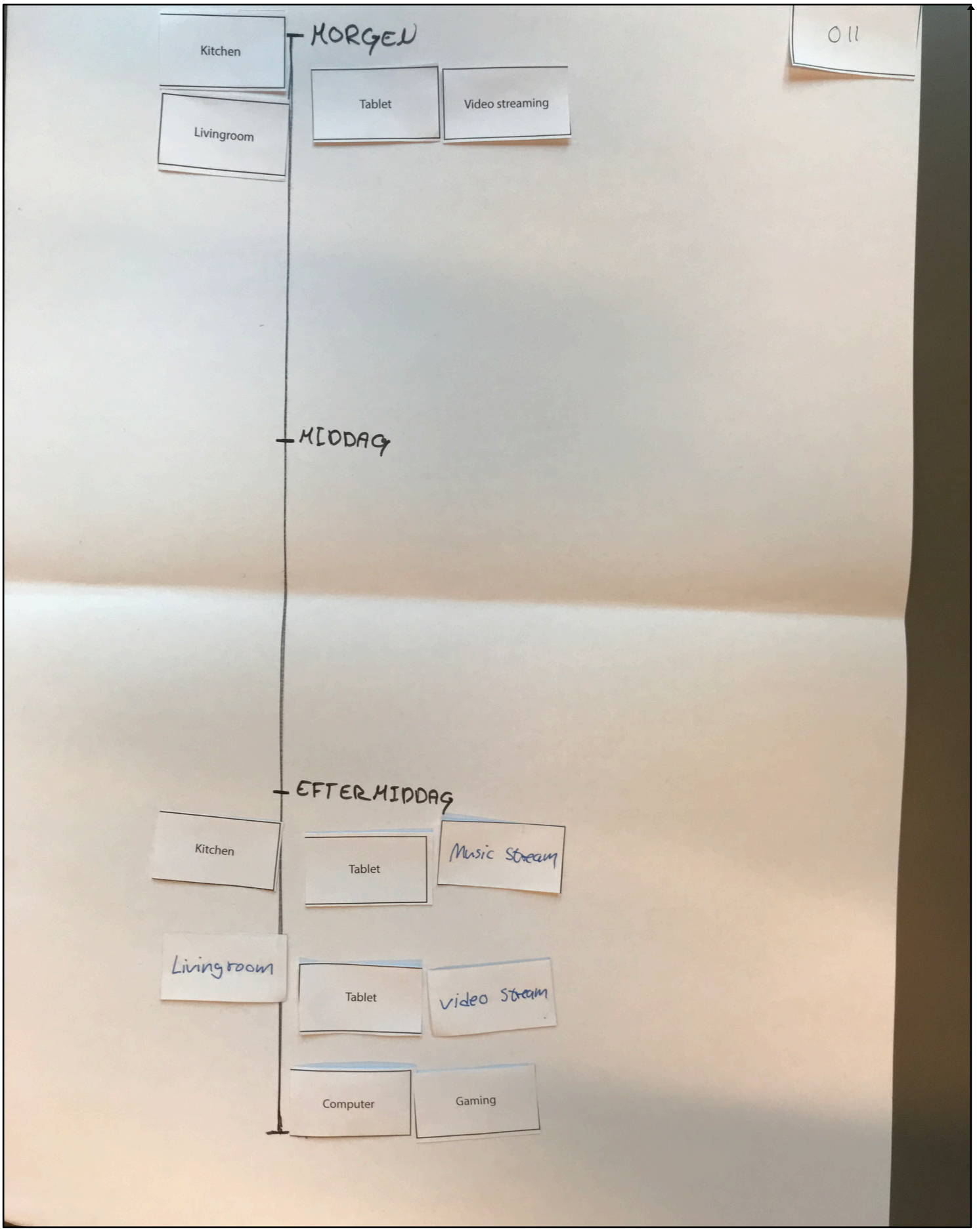
8. 3th Semester University student (7)

Worksheet no.: 005
Date: 10/02/2020

Nr. 011
Alder: 23
Køn: Mand
Beskæftigelse: Studerende
Bosted: Aalborg
Samboende: Nej

Noter:
IPad air

Hvorfor hører du lyd i de situationer?
Underholdning, information.


Kitchen
MORGEN
Tablet
Video streaming
Livingroom
011
MIDDAG
EFTERMIDDAG
Kitchen
Tablet
Music Stream
Livingroom
Tablet
video Stream
Computer
Gaming

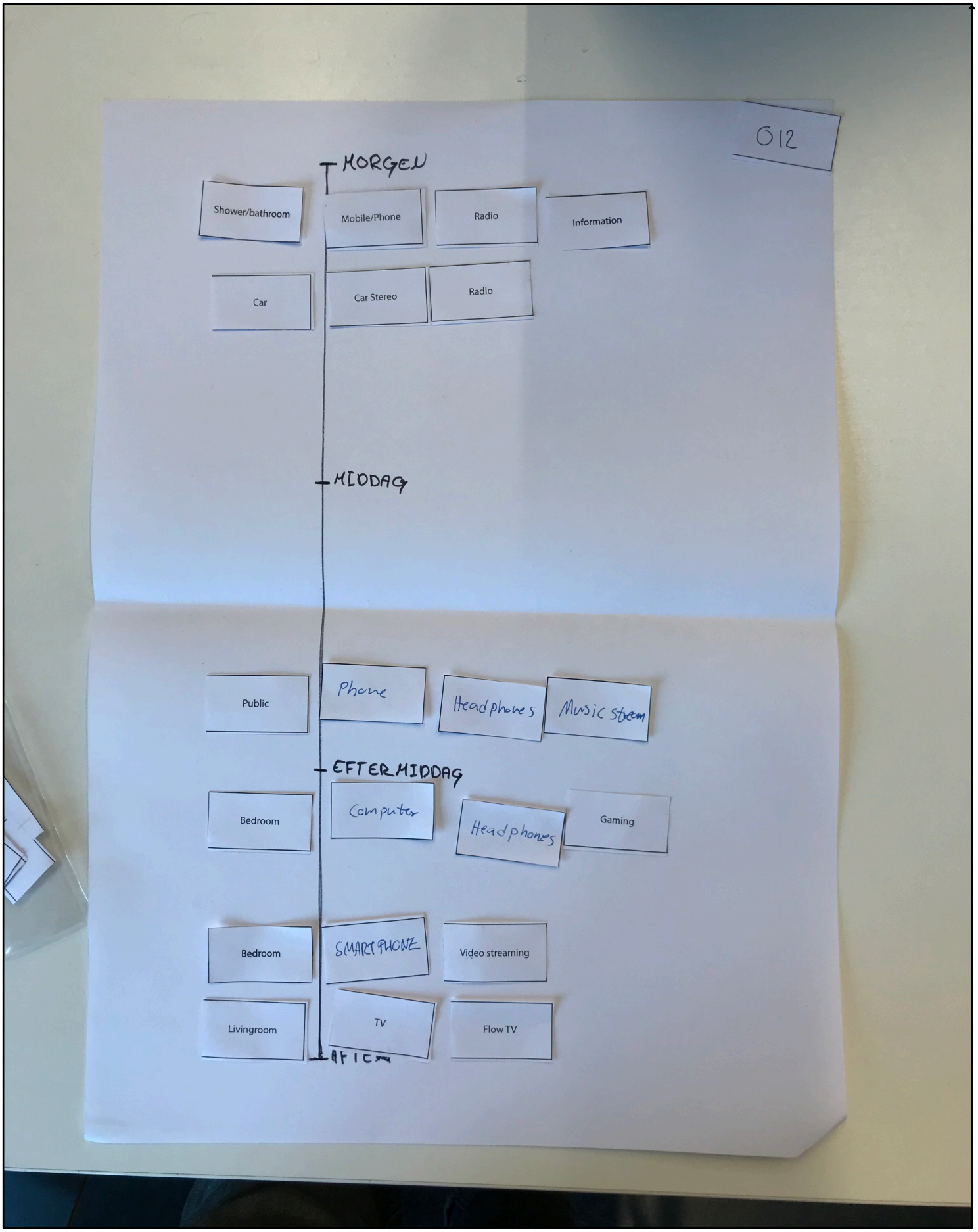
9. HTX Student (1)

Worksheet no.: 005
Date: 13/02/2020
Nr. 012
Alder: 17
Køn: Mand
Beskæftigelse: Studerende (HTX)
Bosted: Vodskov
Samboende: Forældre, i hus

Noter:
Alarm på telefonen.
Ser ikke rigtig videoer på facebook

Hvorfor hører du lyd i de situationer?
Primært for underholdning.

Er der nogle situationer, hvor du bliver forhindret i at høre lyd?
Nej.


012
MORGEN
Shower/bathroom
Mobile/Phone
Radio
Information
Car
Car Stereo
Radio
MIDDAG
Public
Phone
Headphones
Music stream
EFTERMIDDAG
Bedroom
Computer
Headphones
Gaming
Bedroom
SMARTPHONE
Video streaming
Livingroom
TV
Flow TV

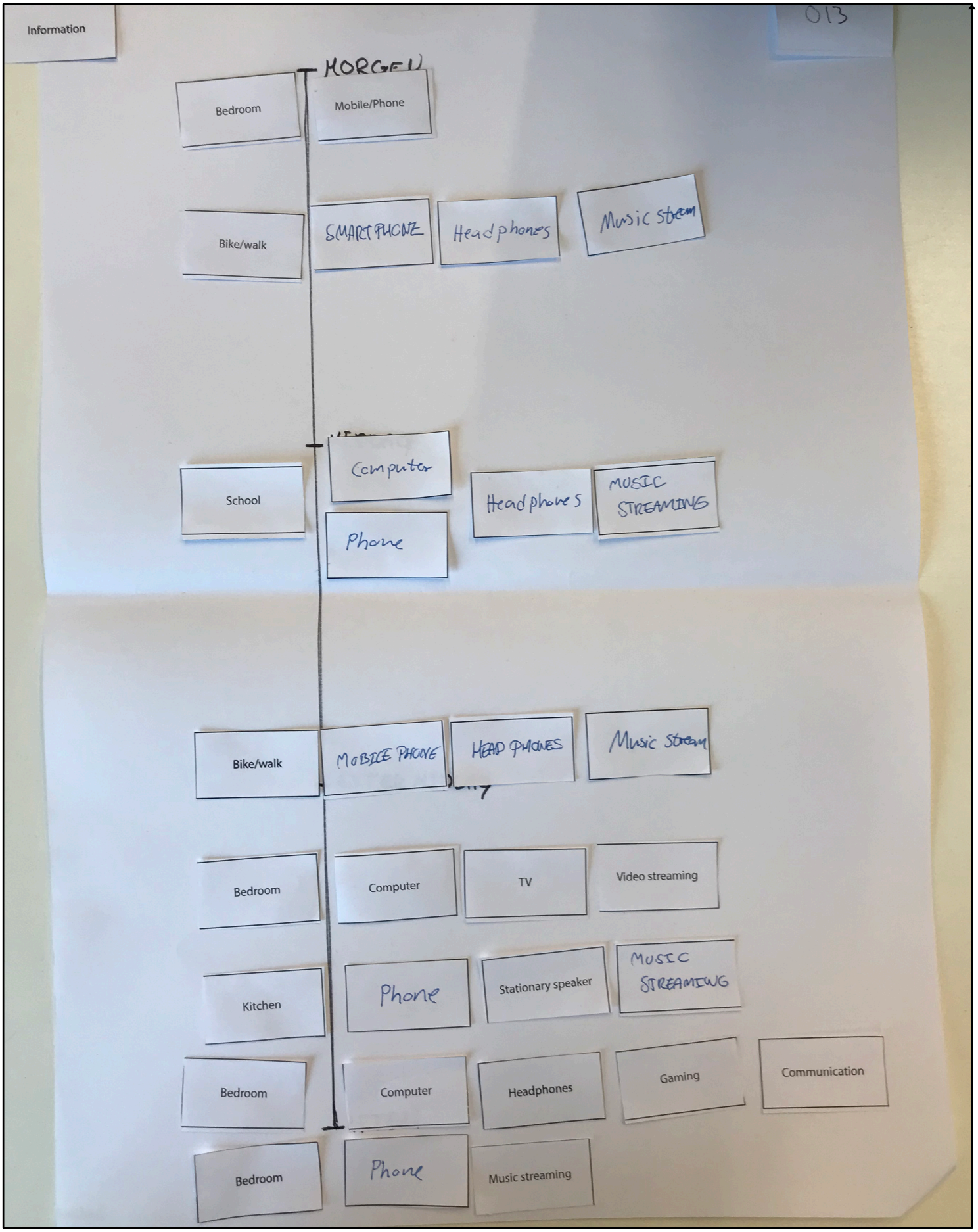
10. **HTX Student (2)**

Worksheet no.: 005
Date: 13/02/2020
Nr. 013
Alder: 17
Køn: Mand
Beskæftigelse: Studerende HTX
Bosted: lidt udenfor Aalborg
Samboende: Forældre

Noter:
Alarm på telefonen.
Har lavet egne playlister, som benyttes efter humør.
Stationær højtaler m. AUX-streaming af Spotify.
Headset – gaming headset m. Mikrofon.

Hvorfor hører du lyd i de situationer?
Bruger nogle gange musik til at lukke baggrundsstøj ude og for at komme i et bestemt humør, når der skal fokuseres.
Bruger også fjernsynet derhjemme som baggrundsstøj.
Bruger musik til at falde ro/i søvn.

Er der nogle situationer, hvor du bliver forhindret i at høre lyd?
Nej.


Information
013
MORGEN
Bedroom
Mobile/Phone
Bike/walk
SMARTPHONE
Headphones
Music Stream
School
Computer
Phone
Headphones
MUSIC STREAMING
Bike/walk
MOBILE PHONE
HEAD PHONES
Music Stream
Bedroom
Computer
TV
Video streaming
Kitchen
Phone
Stationary speaker
MUSIC STREAMING
Bedroom
Computer
Headphones
Gaming
Communication
Bedroom
Phone
Music streaming

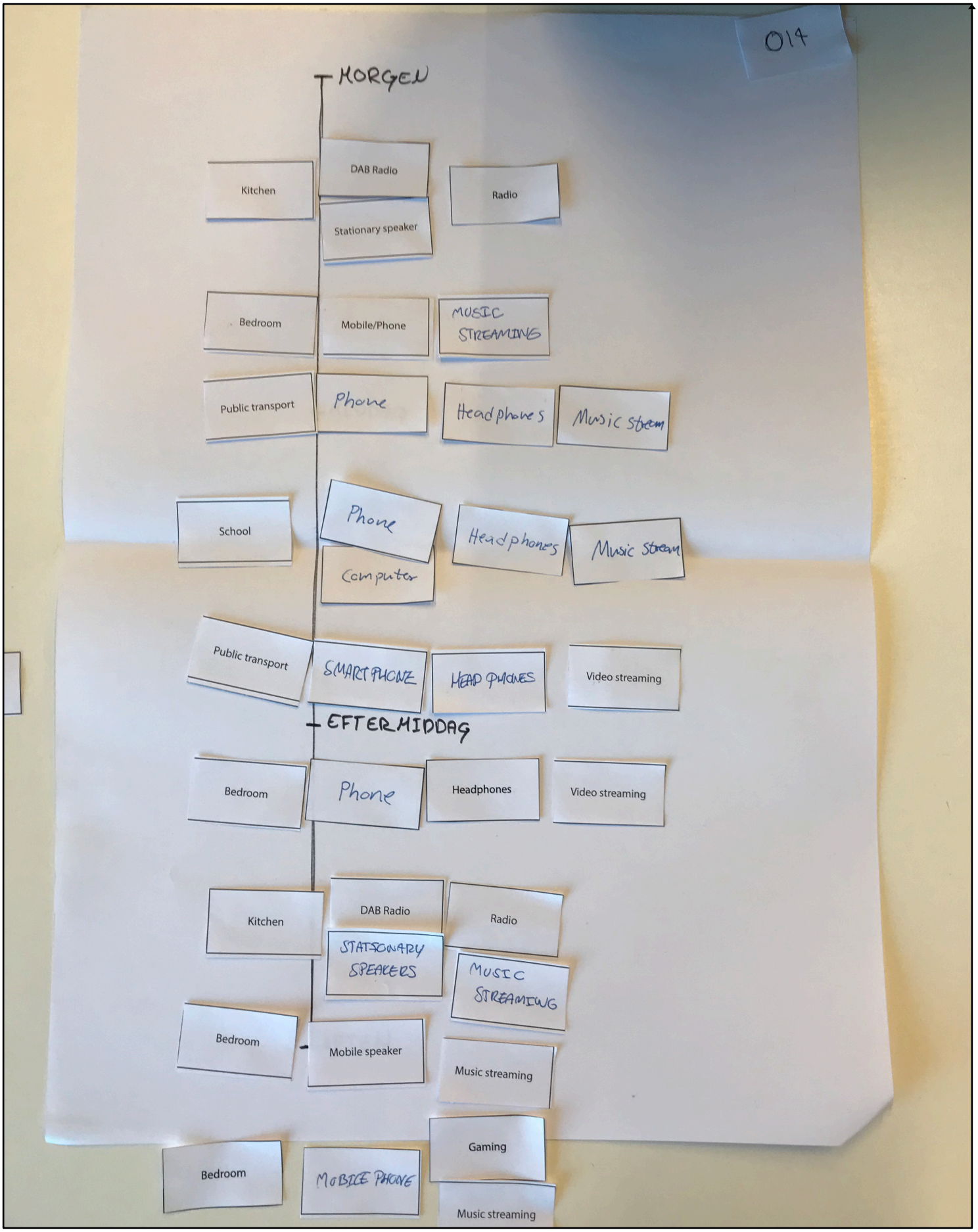
11. **HTX Student (3)**

Worksheet no.: 005
Date: 13/02/2020
Nr. 014
Alder: 17
Køn: Kvinde
Beskæftigelse: Studerende HTX
Bosted: Aabybro
Samboende: Forældre

Noter:
Alarm på telefon.
Volumen betyder ikke så meget.
'Monday motivation' playlist på spotify
Samsungs ear-plugs til telefon.
Fortrækker telefon fremfor computer til at streame video, den er nemmere at placere.
Der kører som oftest radio derhjemme, men det er far og bror der sætter det til, hører ikke radio hvis alene hjemme.
JBL flip4 højtaler.
Lydløst når hun spiller – mest sudoku og lign.

Hvorfor hører du lyd i de situationer?
Bruger musik til at vågne op.

Er der nogle situationer, hvor du bliver forhindret i at høre lyd?
Hvis der er en situation hvor hun forhindret betyder det ikke så meget, da lyd ikke er så vigtigt for hende.

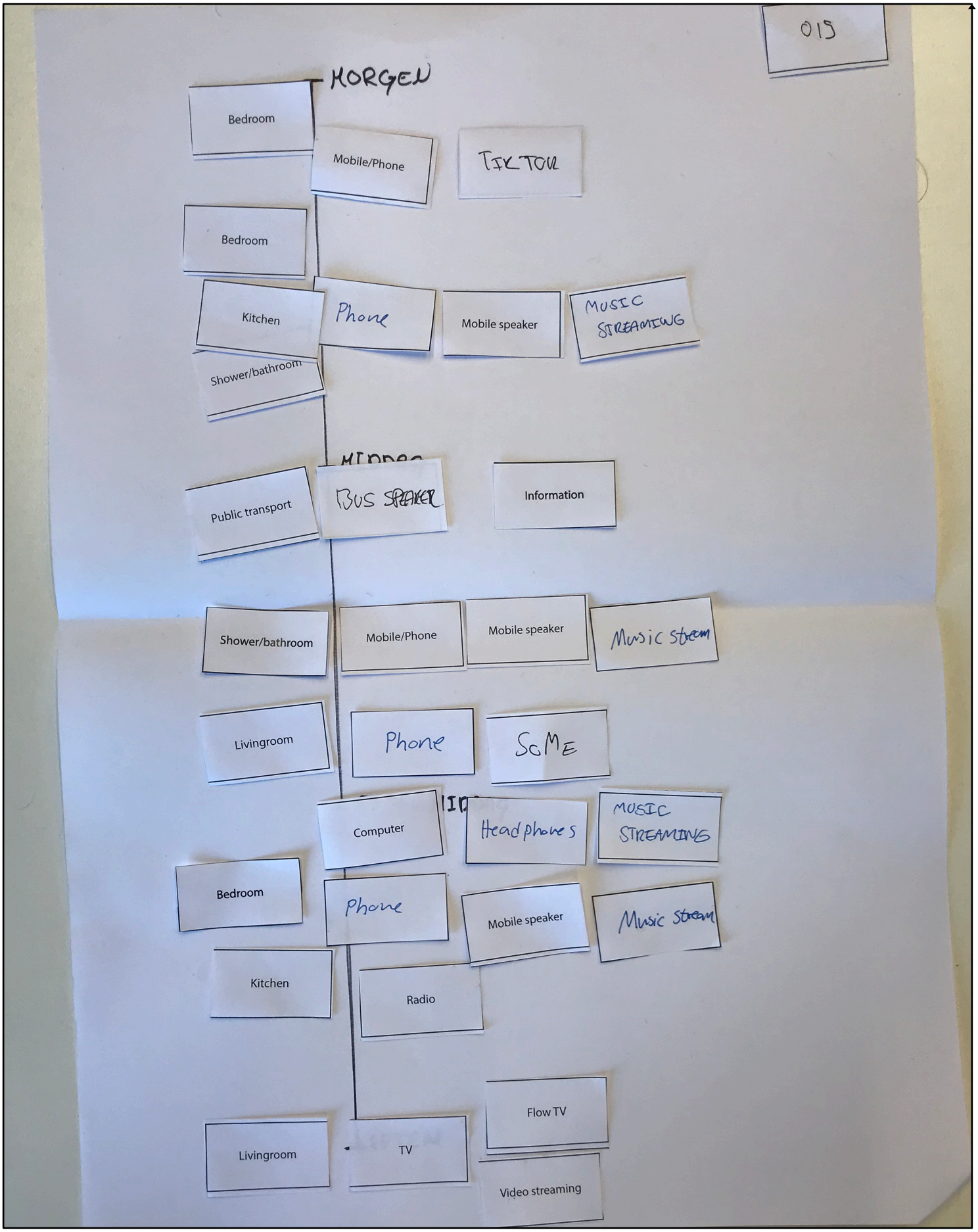

014
MORGEN
Kitchen
DAB Radio
Radio
Stationary speaker
Bedroom
Mobile/Phone
MUSIC STREAMING
Public transport
Phone
Headphones
Music Stream
School
Phone
Computer
Headphones
Music Stream
Public transport
SMARTPHONE
HEAD PHONES
Video streaming
EFTERMIDDAG
Bedroom
Phone
Headphones
Video streaming
Kitchen
DAB Radio
Radio
STATIONARY SPEAKERS
MUSIC STREAMING
Bedroom
Mobile speaker
Music streaming
Gaming
Bedroom
MOBILE PHONE
Music streaming

12. **HTX Student (4)**

Worksheet no.: 005
Date: 13/02/2020
Nr. 015
Alder: 16
Køn: Kvinde
Beskæftigelse: Studerende HTX
Bosted: Aalborg
Samboende: Forældre (hus)
Noter:
Alarm på telefon.
Tiktok app på telefon.
Soundcloud - går op i selv at finde noget anderledes musik.
Information i bussen, fra bussens højtalere.
Højtalere i klasseværelset til forskellige præsentationer.
Bruger ikke høretelefoner da hun glemmer dem.

Hvorfor hører du lyd i de situationer?
Bruger musik til at vågne op/komme i gang.
Bruger musik uden tekst til at fokusere/berolige. Mest derhjemme, men brugte også musik til de skriftlige eksamener i 9. Klasse.
Bruger også musik til at falde ned om aften (Tiktok)
Sætter meditations musik på til at falde i søvn, stopper selv om natten.

Er der nogle situationer, hvor du bliver forhindret i at høre lyd?


015
MORGEN
Bedroom
Mobile/Phone
TIKTOK
Bedroom
Kitchen
Phone
Mobile speaker
MUSIC STREAMING
Shower/bathroom
Public transport
BUS SPEAKER
Information
Shower/bathroom
Mobile/Phone
Mobile speaker
Music stream
Livingroom
Phone
SOME
Computer
Headphones
MUSIC STREAMING
Bedroom
Phone
Mobile speaker
Music stream
Kitchen
Radio
Flow TV
Livingroom
TV
Video streaming

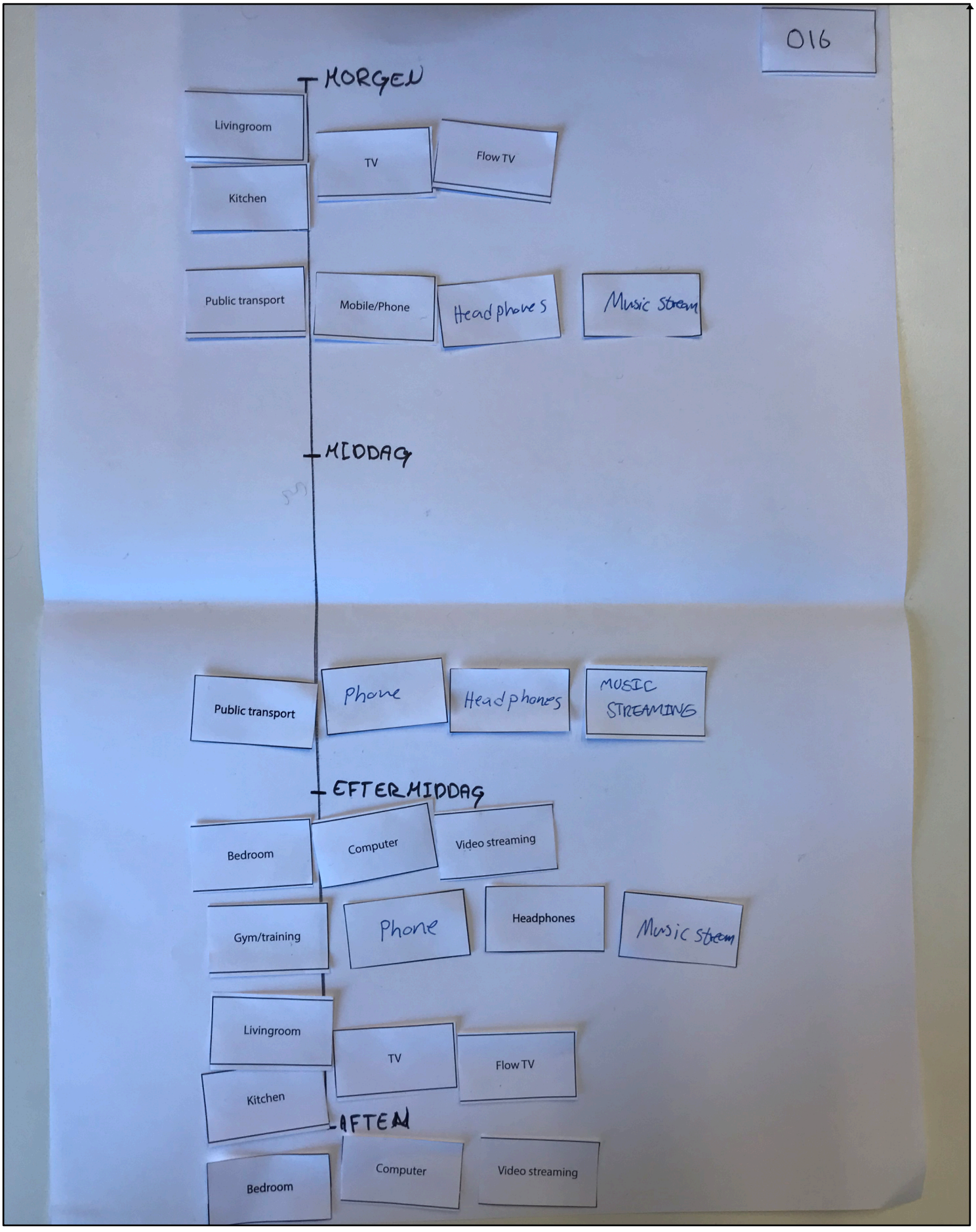
13. **HTX Student (5)**

Worksheet no.: 005
Date: 13/02/2020
Nr. 016
Alder: 17
Køn: Kvinde
Beskæftigelse: Studerende HTX
Bosted: Vester hassing
Samboende: Forældre (hus)

Noter:
Alarm på telefonen.
At snakke i telefon er ikke en hverdags ting.

Hvorfor hører du lyd i de situationer?
Flow tv om morgenen, for at have noget baggrunds lyd.
Om morgenen bruger hun musik til at lukke støj ude.
Om eftermiddagen 'for hyggens skyld'
Bliver distraheret af lyd hvis hun skal fokusere.
Bruger fjernsyn som baggrundslyd, også hvis hun er alene hjemme.

Er der nogle situationer, hvor du bliver forhindret i at høre lyd?
Nogle gange i bilen med familien.


016
MORGEN
Livingroom
TV
Flow TV
Kitchen
Public transport
Mobile/Phone
Headphones
Music Stream
MIDDAG
Public transport
Phone
Headphones
MUSIC STREAMING
EFTERMIDDAG
Bedroom
Computer
Video streaming
Gym/training
Phone
Headphones
Music Stream
Livingroom
TV
Flow TV
Kitchen
AFTEN
Bedroom
Computer
Video streaming

14. University / HTX - Comparison

Room							Qty.
Bedroom	Phone						4
	Phone	+	Mobile speaker				2
	Phone	+	Headphones				1
	Phone	+	Stationary speaker				
	Computer	+	Stationary speaker				
	Computer	+	Headphones				3
	Computer	+	Tv				1
	Computer						1
	Tablet	+	Headphones				
	Tablet	+	Stationary speaker				
	Tv						
	Tv	+	Stationary speaker				
Kitchen	Phone	+	Mobile speaker				1
	Phone	+	Stationary speaker				2
	Phone	+	Headphones				
	Tablet	+	Stationary speaker				
	Tablet	+	Headphones				
	Tablet						
	Tv						1
	Radio speaker						2
Bathroom	Phone						1
	Phone	+	Mobile speaker				1
Livingroom	Phone						1
	Phone	+	Tv	+	Stationary speaker		
	Phone	+	Tv				
	Phone	+	Stationary speaker				
	Phone	+	Headphones				
	Computer						
	Tablet						
	Tablet	+	Stationary speaker				
	Tv	+	Stationary speaker				
	Tv						2
	Console	+	Tv	+	Stationary speaker		
	Stationary speaker						

16 - 17 årige		21 - 23		24			
Worksheet nr.	Qty.	Worksheet nr.	Qty.	Worksheet nr.		Sum	Sum total (Device)
12 + 13 + 14 + 15		1	7	1	5	6	13
14 + 15						2	
14				2	1 + 5	3	
				2	3 + 5	2	
				1	3	1	9
12 + 13 + 15				2	1 + 3	5	
13						1	
16				1	4	2	
		1	10			1	2
				1	5	1	
				1	2	1	2
				1	3	1	
15		1	6	1	2	3	8
13 + 14				1	5	3	
				2	1 + 5	2	
				1	5	1	3
				1	5	1	
		1	11			1	
16						1	1
14 + 15						2	2
12						1	1
15						1	1
15		2	9 + 10			3	8
		1	7	1	4	2	
		1	10			1	
				1	5	1	
				1	5	1	
		1	11	1	4	2	2
		2	10 + 11			2	3
				1	5	1	
				2	2 + 5	2	5
12 + 15 + 16		1	6			3	
		1	7	1	2		2
				1	4	1	1

15. **Couples (1)**

Subject: 017
Søren
24 år
bor med kæreste og kat

Evaluation:
Fælles Content

Baggrundsmusik hvis vi laver noget fælles:

Kører automatiske spillelister fra Spotify - chill spilleliste

Hvis den den ene er startet på noget forbliver musikken hvis den anden støder til

Fælles musik er hvis køkken på bluetooth højtaler via telefon og ellers anlægget i stuen

Spiser ved sofabordet, og ser noget fælles tv - fælles tv show (noget simpelt ala masterchef), fravælger content man er nødt til at følge med i

Når begge er hjemme, laves det meste sammen

Individuelt Content

Hvis den ene er nødt til at lave noget selv er det personen som kapsler sig inde med høretelefoner.

Hvis der bliver lavet negle, foregår det men content fra tv'et og partneren har mulighed for selv at isolere sig fra det.

16. Couples (2)

Subject: 018
Lars
26 år
bor med kæreste

Evaluation:

Fælles Content

For hyggens og stemningens skyld. Laver mad sammen og høre musik -> top 50 eller kæresten vælger

Ser fjernsyn mens de spiser -> fælles serie.

Individuelt Content

Ser youtube tutorials på computeren -> i stuen med computer lyd mens kæresten sover

Ser youtube tutorials på computeren -> Kontoret med høretelefoner for ikke at genere eller blive generet af kæresten

Kæresten sidder i stuen med computer som afspiller musik

Anlæg er ikke koblet til for at bassen ikke generer andre

Finder personligt content hvis han laver mad selv.

Den ene sover og den anden læser på mobil, eller ser serier med lyd fra tablet. -> Baggrundsstøj hjælper modparten til at falde i søvn.

17. **Couples (3)**

Subject: 019
Frederik
24 år
bor med kæreste

Evaluation:
Fælles Content

Ser nyheder på tv, med lyd fra højttaler

Hvis begge sidder og læser, bliver der kørt musik i baggrunden fra en telefon eller computer -> gider ikke bruge tiden på at sætte det op.

Spiser sammen med aften nyhederne fra fjernsynet -> baggrundsstøj

Sidder sammen og ser en film eller en fælles serie.

Individuelt content

Sidder og læser med musik fra en telefon og computer - random musik eller radio

Ser youtube i sengen hver for sig i sengen og ser interesse videoer, fra telefon med lyd, men lavt for ikke at forstyrre den anden.

Spiller konsol på tv skruer ned for konsollen og spiller fælles musik for at begge kan være det og kæresten kan læse.

18. **Couples (4)**

Subject: 020
Alexander
24 år
bor med kæreste

Evaluation:
Fælles Content

Ser reality sammen mens de spiser -> sjovt for at sætte humøret (smartphone + tv + stationary speaker)

Fortsætter med lidt reality bagefter

Streamer fra telefonen på trods af et smart tv

Individuelt content

Sociale medier mens han spiser mad

Streamer musik med hovedtelefoner i fitness -> premade eller egen

HBO, netflix, viaplay & tv2 play

Om aftenen bliver der splittet op en på computer og en på ipad
Kæresten ser på tv'et med højtalere slået til.

Twitch stream computer høretelefoner i computeren

Slår det til højtaleren når han er alene hjemme

Hører musik på en bluetooth højttaler på toilettet.

Kæresten streamer tv på ipad'en i sengen, Han streamer twitch på ipad lyd fra ipad'en

Hvis kæresten laver mad eller laver andet kan der godt køre serie -> Baggrundsstøj

19. **Couples (3)**

Subject: 021
Anders
26 år
bor med kæreste

Evaluation:
Fælles Content

Høres jazz sammen med morgenmaden i weekenden

Ser film / serier sammen

Højtaleren i stuen bliver brugt til spisning eller rengøring - baggrundsstøj. (smartphone + stationary bluetooth speaker)

Individuelt content

ser serie eller film på fjernsyn om morgenen mens han er alene hjemme på fjernsynet -> baggrundsstøj

Høre podcasts til skole / arbejde - på skole er det spotify

Kæresten ser youtube på telefonen, samtidigt med at de ser fælles film og serier på tv

Ser serie selv mens der bliver lavet mad -> kæresten hører musik hvis der laves mad selv.

Kæresten ser youtube i sengen af og til, han læser eller går i seng.

Hvis der skal fokuseres bliver der sat hovedtelefoner på

Hvis den ene ser film og den anden laver mad bliver døren lukket i mellem

Musik i køkkenet er på lille bluetooth højtaler

Musik i stuen er på en større bluetooth

20. **Couples (4)**

Subject: 022
Janne
26 år
bor med kæreste

Evaluation:
Fælles Content

Sætter radio på bluetooth højtaler fra telefonen og tager den med rundt

Første mand i køkkenet sætter fælles musik på til madlavningen

Ser fjernsyn mens de spiser -> ligegyldigt tv

Ser fælles serie, film eller serie eller spiller konsol sammen halv halv om de sker sammen eller om de går hver til sit.

Ser fælles serie på ipad i soveværelset

Individuelt Content

Kæresten ser youtube i sengen sengen om morgenen

Sætter flow tv på om eftermiddagen, som baggrundsstøj -> fjernsyns højttaler

Kæresten spiller computer i soveværelset med headset

Kæresten ser youtube før sengetid - hun sover - han finder headset frem hvis hun brokker.

21. **Couples (5)**

Subject: 023
Jonas Svendsen
26 år
bor med kæreste

Evaluation:
Fælles Content

Fælles 50/50 musik i mens der laves mad.

Stilhed mens der spises

Ser serier efter maden på værelset nogen gange hver for sig.

Individuelt Content

Ser fjernsyn på computeren med lyd fra computeren - enten i stuen (hvis alene) eller på værelset

Mediterer med noise reduction headset fra telefonen.

Spiller trommer (stuen) med to headset på -> et til musik fra telefonen og et til trommerne.

Sætter musik på når der bliver lavet mad, enten på anlæg i køkkenet (fast højttaler) eller headset (hvis der er flere i stuen)

Headset med streaming når der gøres rent

Podcast i høretelefoner fra telefonen -> aktiv lytning evt i køkken

Kan godt se hver sin ting på hver sin computer

22. **Couples Comparison chart**

	Shared content	Device		Reciever		Speaker	No.	Case
Kitchen	Music streaming	Smartphone	+			Mobile Speaker	2	17 + 21
	Music streaming	Smartphone					1	18
	Radio	Smartphone				Mobile speaker	1	22
	Music streaming	Smartphone	+			Stationary speaker	1	23
Livingroom	music streaming	Smartphone	+			Stationary Speaker	1	17 + 21
	music streaming	Smartphone / PC					1	19
	Radio	Smartphone				Mobile speaker	1	22
	Video streaming	Smartphone	+	TV	+	Stationary speaker	2	17 + 20
	Video streaming	Smartphone	+	TV			4	18 + 19 + 21 + 22
	Gaming	Console	+	TV			1	22
Bedroom	Video streaming	Tablet					1	22
	Video streaming	Smartphone	+	TV			1	23

Couples Comparison Device

	Private Content					Private
Livingroom	Music streaming	Smartphone	+	Headphones	Livingroom	Video st
	Music streaming	Smartphone		Stationary speaker		Alone
	Video streaming	PC			Bedroom	Sleeping
	Music streaming	Smartphone				
	Music streaming	PC				
	Music streaming	PC				Gaming
	Video streaming	PC	+	Headphones		Video st
	Video streaming	PC	+	Headphones		Video st
	Video streaming	Smartphone	+	TV		
	Video streaming	Smartphone				Video st
	Video streaming	Smartphone	+	TV	Bedroom	Gaming
Kitchen	Music streaming	Smartphone				
	Music streaming	Smartphone	+	Mobile speaker		
	Music streaming	Smartphone	+	Stationary speaker		
	Music streaming	Smartphone	+	Headphones		Video st
	Video streaming	PC				
Bedroom	Video streaming	Tablet				Sleeping
	Video streaming	Smartphone				Sleeping
	Video streaming	Smartphone	+	Headset		Sleeping
	Video streaming	Smartphone				Video st
	Video streaming	Tablet				Video st
	Video streaming	PC				Video st
Bathroom	Music streaming	Smartphone	+	Bluetooth speaker		Alone
Fitness	Music streaming	Smartphone	+	Headphones		

content					
treaming	Smartphone	+	TV	+	Stationary speaker
g					
	Console	+	TV		
treaming	Tablet				
treaming	TV	+	Stationary speaker		
treaming	TV				
	PC	+	Headset		
treaming	TV				
g					
g					
g					
treaming	Smartphone				
treaming	Tablet				
treaming	PC				

23. **Youth Club (1)**

Worksheet no.: 017
Date: 02/03/2020
Nr. 017
Alder: 11
Køn: Dreng
Beskæftigelse: Folkeskole
Bosted: Forældres hus
Samboende: Forældre
Noter: (Spørg til enhed/indhold)
Bruger den mest om aften, spiller fodbold om dagen med venner, der er typisk en der tager højtaler med, spotify (primært, der har de playlister, en sang hver) og youtube.

inden og tjekke/følge op sin streak (Snapchat) om morgenen (Gamification)
Youtube musik nogle gange med høretelefoner

IPad, spiller fortnite

Wii ligger på loftet

Playstation og computer

Er udenfor når det er godt vejr.

Slukker fjernsynet når de spiser aftensmad derhjemme. Nogle gange tænder mor radioen, hvis det har været en god dag.

Ser ikke fjernsyn længere fordi at koncentrationen på TV gjorde at han ikke spiste så meget.

Ser youtube på telefonen/IPad i stander med høretelefoner, nogle gange paradise .

Sidder mest inde i stuen med mor og ser paradise nogle.

Fjernsyn med integreret lyd.

Ser ikke på telefonen om aftenen, lyser forstyrrer

hører noget stille musik til at slappe af inden han skal sove.

Bliver vækket af mor. (ingen alarm.)

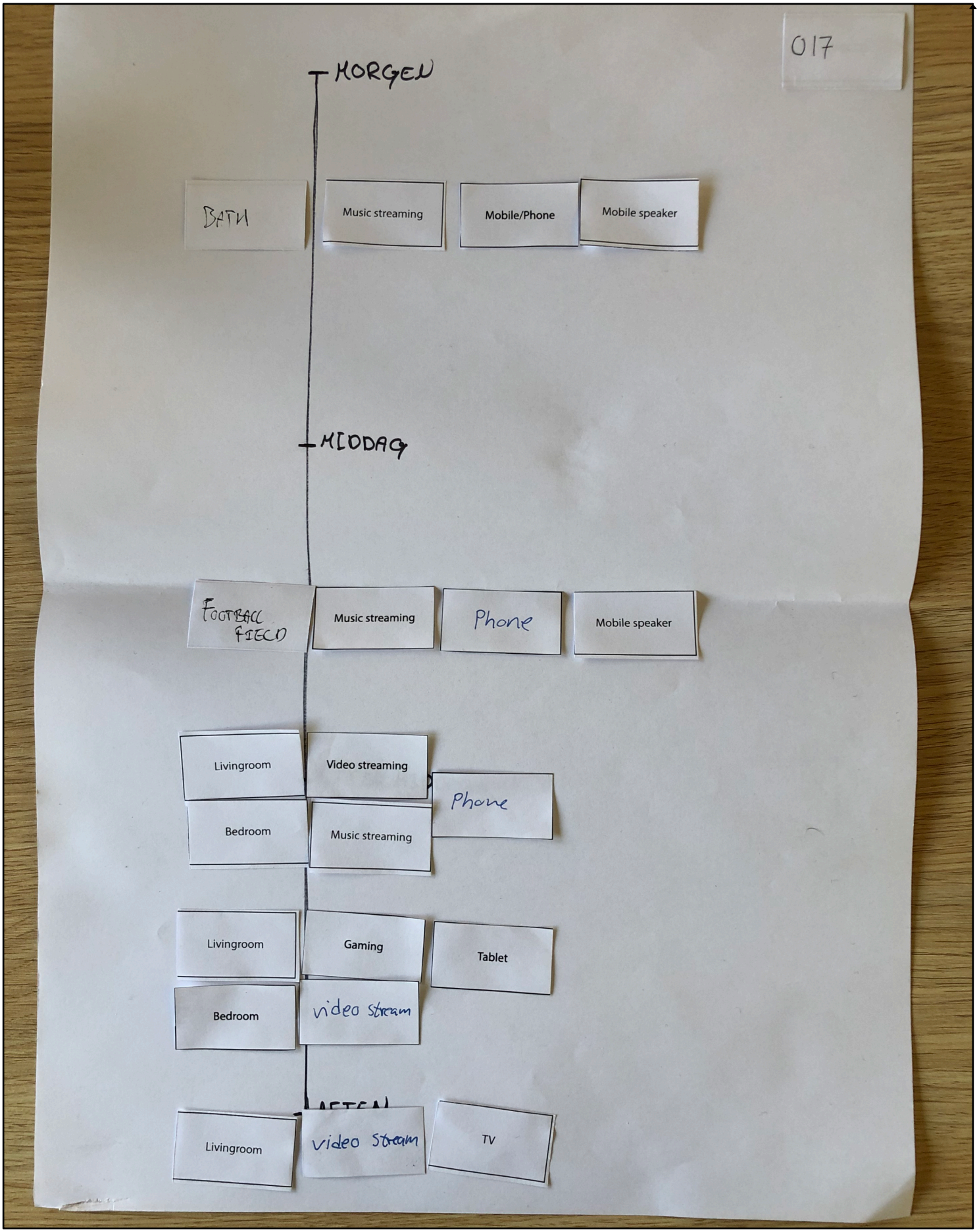
Har to bluetooth højttalere (Harman kardon) og en mindre firkantet, bruger dem når han er ude med sine venner, har den med i sin AAB pose.

Høre musik mens han tager bad om morgenen på mobilen (Iphone 11) nogle gange højtalere, men ikke så højt.

Slukker højtaler imellem brug, for at spare på strømmen.

Hvorfor hører du lyd i de situationer?

Er der nogle situationer, hvor du bliver forhindret i at høre lyd?


017
MORGEN
BATH
Music streaming
Mobile/Phone
Mobile speaker
MIDDAG
FOOTBALL FIELD
Music streaming
Phone
Mobile speaker
Livingroom
Video streaming
Phone
Bedroom
Music streaming
Livingroom
Gaming
Tablet
Bedroom
video stream
Livingroom
video stream
TV

24. **Youth Club (2)**

Worksheet no.: 018
Date: 02/03/2020
Nr. 018
Alder: 11
Køn: Pige
Beskæftigelse: Folkeskole
Bosted: Forældres hus
Samboende: Forældre
Noter: (Spørg til enhed/indhold)
Iphone 6S.

Om morgenen kigger på mobil inden mor kommer og vækker hende

Ser TikTok videoer på mobilen til at vågne.

Når hun er hjemme ved sin mor ser hun mere TikTok, ikke så meget ved far pga. lillesøster hun er sammen med på 2 år.

Ser CS:GO på youtube via chromecast på fjernsynet.

Laver videoer til TikTok, deler sange op og danser dertil bruger bare mobilens højtaler. Har ikke nogle eksterne højtalere.

Spiller CS:GO i klubben, har ikke en computer derhjemme der kan spille det.

Ser to engelske youtubere (Sofie og sarah)

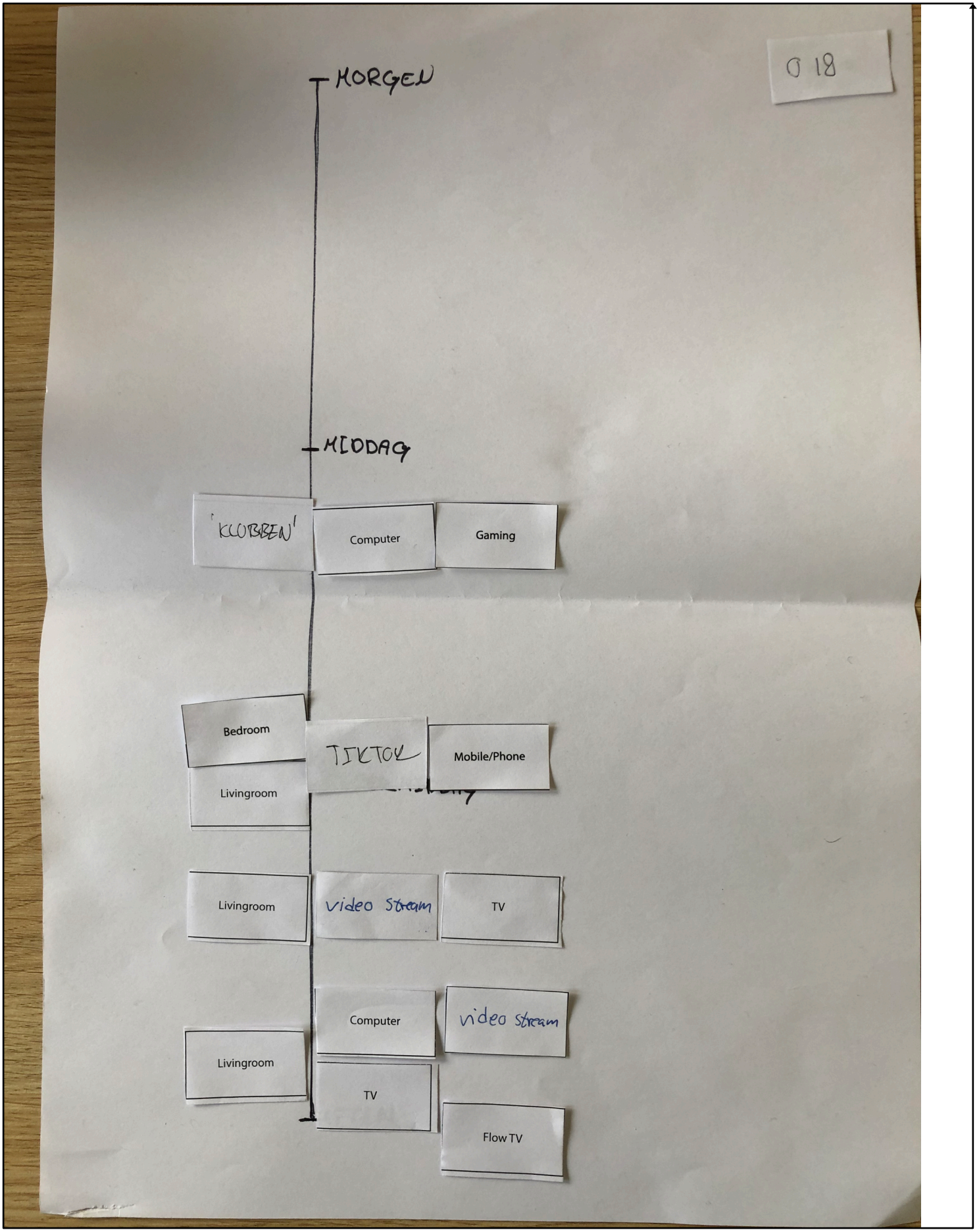
TikTok mashup sange på youtube på fjernsynet (Nogle gange computer), som hun danser til.

Ser fjernsyn mens hun spiser, lillesøster vil ikke spise uden underholdning.

Ser politijagt hjemme ved far, på fjernsynet.

Elsker at danse

Sidder og kigger på mobil sammen med veninderne i fritidsklubben inde i diskorummet


MORGEN
MIDDAG
'KLOPBREN'
Computer
Gaming
Bedroom
TIKTOK
Mobile/Phone
Livingroom
Livingroom
video stream
TV
Computer
video stream
Livingroom
TV
Flow TV

25. **Youth Club (3)**

Worksheet no.: 019
Date: 02/03/2020
Nr. 019
Alder: 10
Køn: Pige
Beskæftigelse: Folkeskole
Bosted: Forældres hus
Samboende: Forældre
Noter: (Spørg til enhed/indhold)
Har en gameboy fra far hun bruger engang imellem.
Iphone 6S

Bruger ikke mobil om morgenen

Hører radio med familien når de sidder og spiser.

Sidder og spiser i ro og fred om morgenen.

Sidder på snapchat når hun kommer hjem fra skole.

Bruger mobllen sammen med en App for at se hvor meget de læser.

Spiller tit på skolecomputer, roblox (spil) synes lyden fra spillet er lidt irriterende. Både på stue og på værelset.

Spiller på fars playstation på fjernsynet inde i stuen.

Fjernsyn har surround, som de bruger når de ser film (3 gange om ugen) når de ser aftensmad.

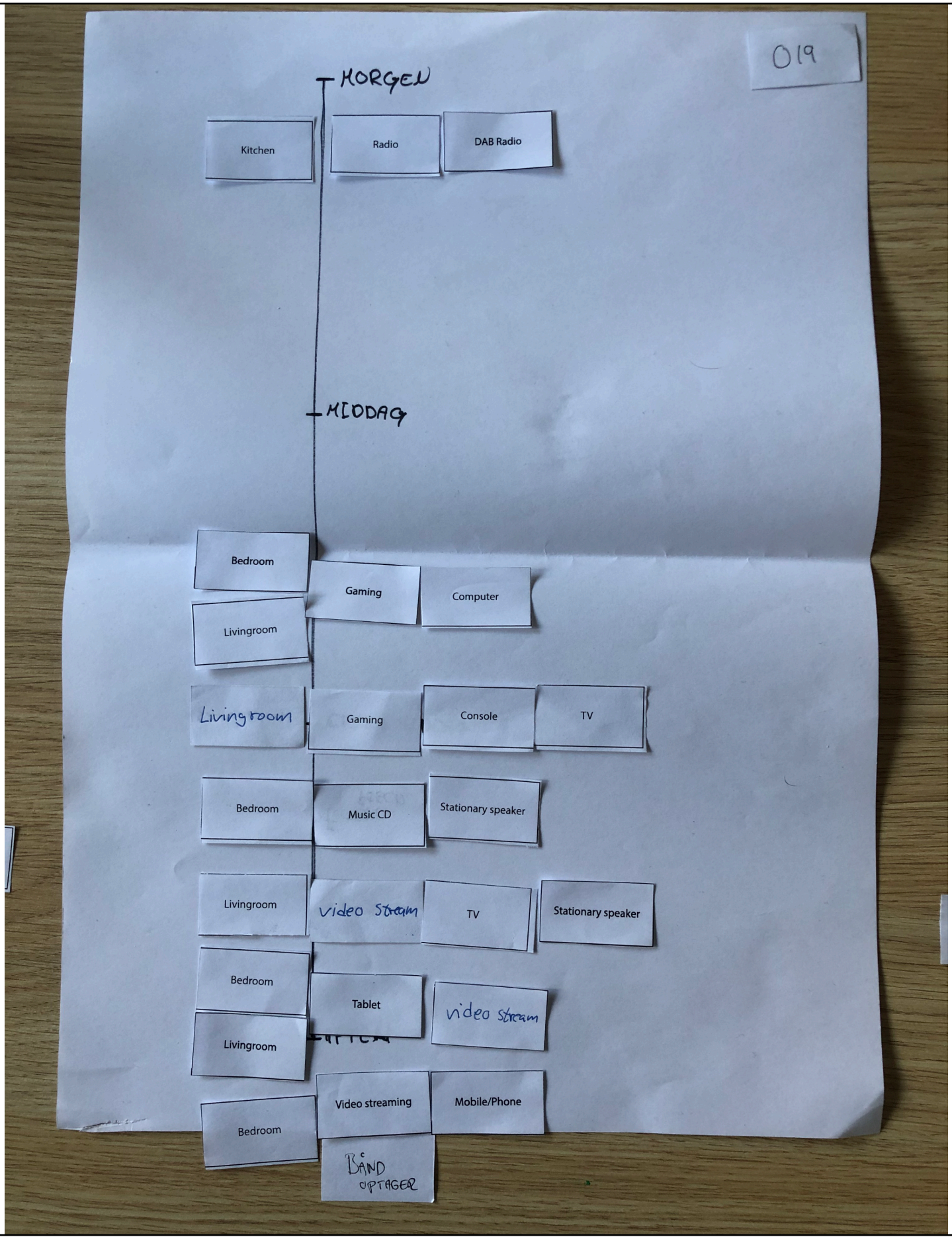
Har en IPad, som hun ikke ved hvor er (Bruger den ikke så meget) brugte den til youtube. Ser youtubere (Både engelske og danske) youtubere derude og opleve ting, som de fortæller om. (Både i stuen og på værelset)

Har også TikTok, men bruger det ikke så meget, laver sine egne TikToks, ikke så mange som veninder.

Hører musik på CD-afspiller med højtalere i, Rasmus Seebach.

ASMR, afslappende lyde - når hun ikke kan falde i søvn, afspiller far mobil på youtube.

Mormors sang på lydbånd når hun skal sove.


019
MORGEN
Kitchen
Radio
DAB Radio
MIDDAG
Bedroom
Gaming
Computer
Livingroom
Livingroom
Gaming
Console
TV
Bedroom
Music CD
Stationary speaker
Livingroom
video stream
TV
Stationary speaker
Bedroom
Tablet
video stream
Livingroom
Video streaming
Mobile/Phone
Bedroom
BAND OPTAGER

26. **Youth Club (4)**

Worksheet no.: 020
Date: 02/03/2020
Nr. 020
Alder: 11
Køn: Pige
Beskæftigelse: Folkeskole
Bosted: Forældres hus
Samboende: Forældre
Noter: (Spørg til enhed/indhold)
Iphone 5, fik den af en fra sin klasse.

Har ikke sociale medier, må ikke have dem for sin forældre.

TikTok man skal være 13, det går hendes mor meget op i.

Ser videoer på youtube, når hun kommer hjem fra skole, på telefon eller computer.

Sætter musik på radio

Ser noget DR på fjernsynet (Sammen) med fjernsynets integreret højtalere.

Bruger høretelefoner hvis hun sidder sammen med andre, men ikke hvis hun ser på værelset.

Ser film sammen med sine søskende, hvis de ser noget sammen.

Lillesøster (6 år, må først få telefon når hun bliver 9) har ikke telefon eller computer, så hun bruger fjernsynet.

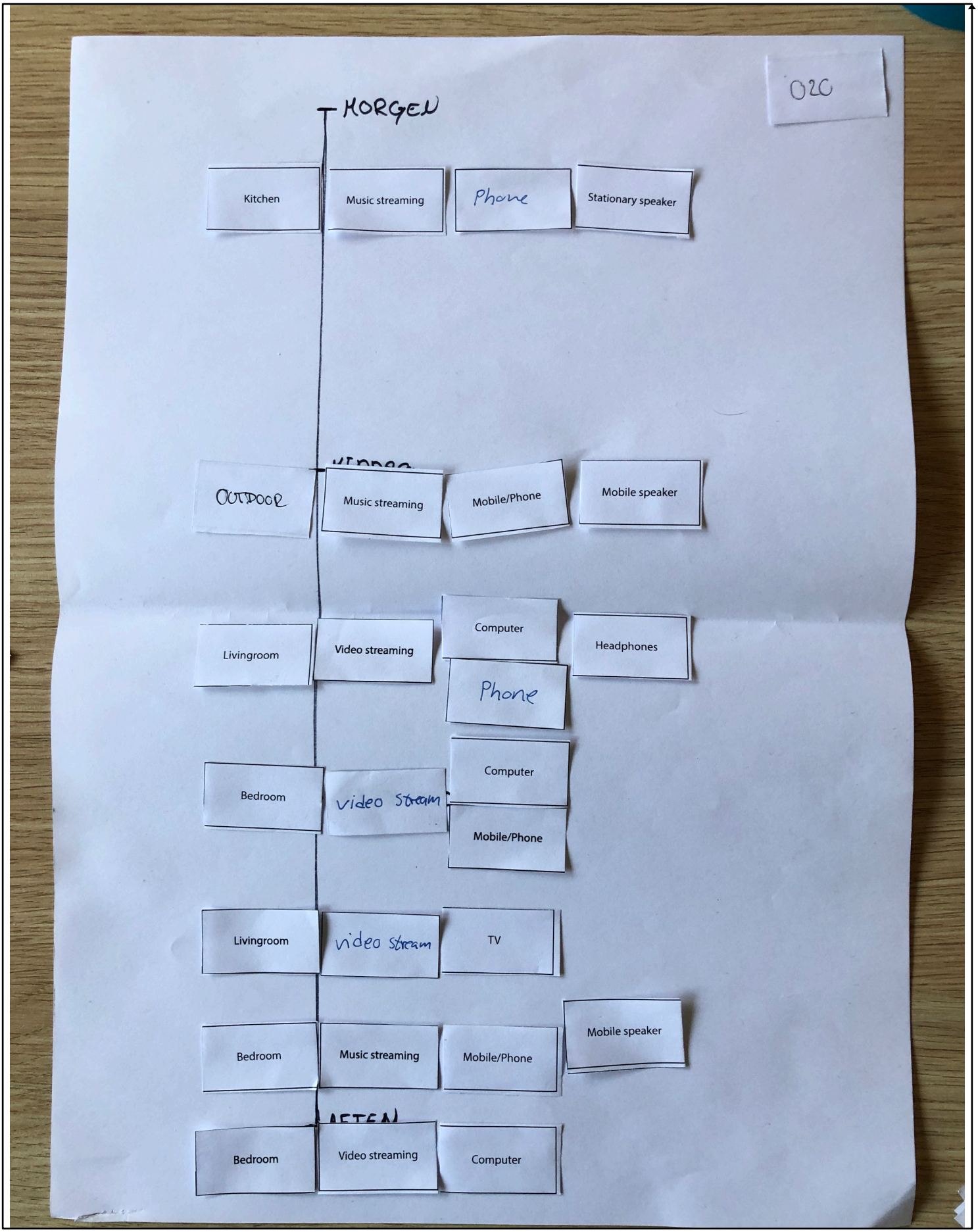
Far hører musik på højtalere ude i køkkenet, som han hører musik på mens han laver mad.

Hører selv musik når hun laver lektier, rydder op og gør rent. Mest på telefonen, mest på værelset.

Koblet på bluetooth højtaler nogle gange, ikke altid, så skal hun først ud og hente den.

Ser film sammen med veninderne på skole computer, mest fra netflix eller laver film på telefonen til Imovie.

Nogle gange ude og hoppe på trampolin med veninder, der kunne de godt finde på at tage en højtaler med, ikke så tit.


020
MORGEN
Kitchen
Music streaming
Phone
Stationary speaker
OUTDOOR
Music streaming
Mobile/Phone
Mobile speaker
Livingroom
Video streaming
Computer
Headphones
Phone
Bedroom
video stream
Computer
Mobile/Phone
Livingroom
video stream
TV
Bedroom
Music streaming
Mobile/Phone
Mobile speaker
Bedroom
Video streaming
Computer

27. **Youth Club (5)**

Worksheet no.: 021
Date: 02/03/2020
Nr. 021
Alder: 11 år
Køn: Pige
Beskæftigelse: Folkeskole
Bosted: Forældres hus
Samboende: Forældre
Noter: (Spørg til enhed/indhold)
Iphone 6, har fået den fra sin farfar, bruger kun telefonen til at ringe til nogen.

Sidder bare og snakker om morgenen.

Har ikke sociale medier

Ser fjernsyn (Netflix) med lillebror på smart tv med tilkoblet soundbar.

Bruger skolecomputer til at spille roblox eller blokster. Både på væreset eller ude i stuen.

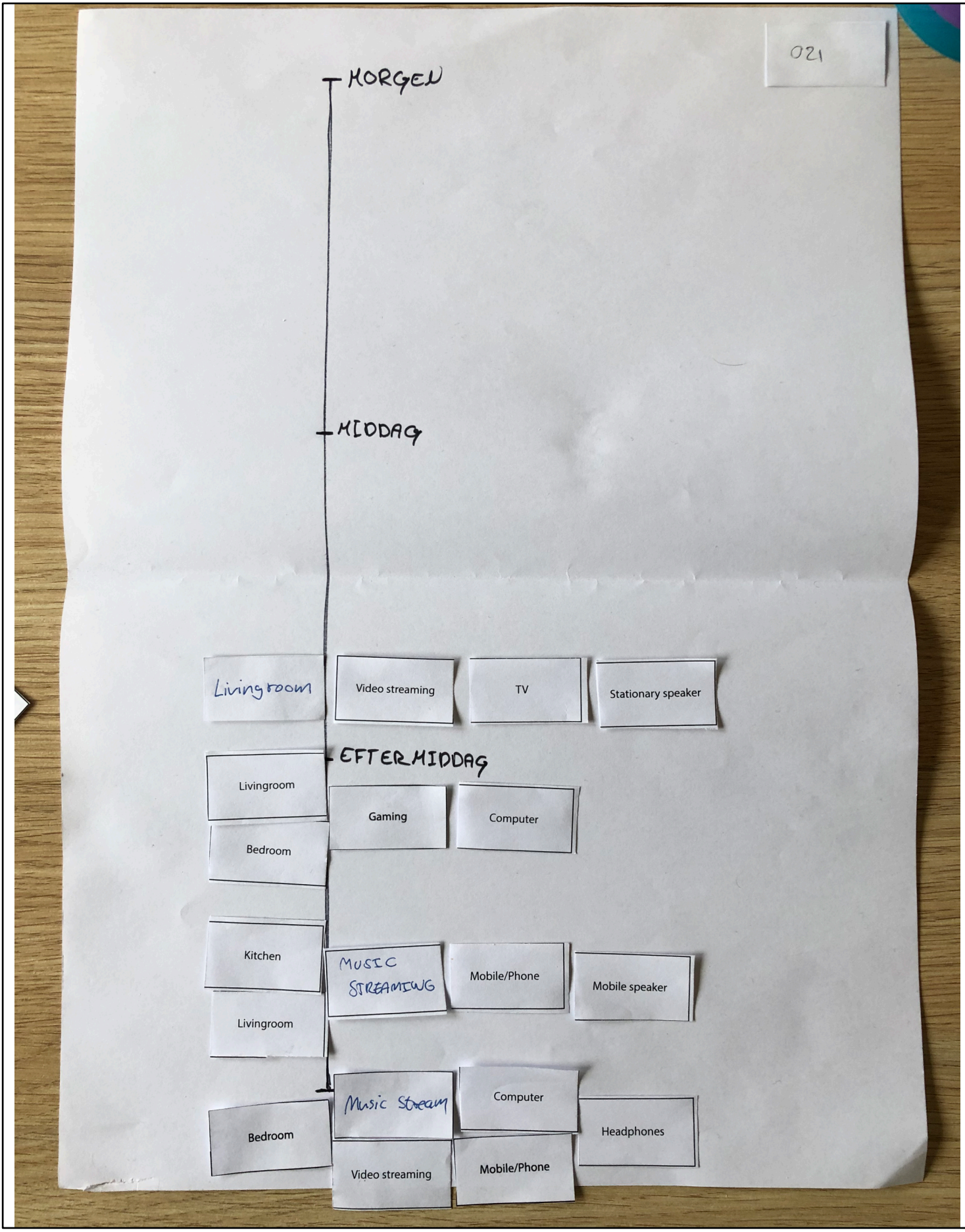
Har en playstation, men spiller ikke rigtig på den, mest lillebror.

Hører musik med far når de laver mad sammen, på bluetooth højtaler, fars playliste. Bruger den også hvis de eks. hænger tøj op

Hører nogle gange musik på telefon eller computer med høretelefoner, enten spotify eller youtube.

Nogle gange videoer, men mest musik.

Ser nogle gange egne serier fra Netflix på computer, bruger mest headset, men skruer ned for ikke at forstyrre ellers.


021
MORGEN
MIDDAG
Livingroom
Video streaming
TV
Stationary speaker
EFTERMIDDAG
Livingroom
Gaming
Computer
Bedroom
Kitchen
MUSIC STREAMING
Mobile/Phone
Mobile speaker
Livingroom
Music Stream
Computer
Bedroom
Headphones
Video streaming
Mobile/Phone

28. **Youth Club (6)**

Worksheet no.: 022
Date: 02/03/2020
Nr. 022
Alder: 12 år
Køn: Dreng
Beskæftigelse: Folkeskole
Bosted: Forældres hus
Samboende: Forældre
Noter: (Spørg til enhed/indhold)
Iphone 7.

Tjekker Snapchat og instagram om morgenen.

Spiser bare morgenmad uden lyd med familien.

Spiller fortnite eller CS på computer når han kommer hjem fra skole. 1½ time - 2 timer med headset, inde på værelset

Ser nogle gange TV (viaplay serier med chromecast) efter de har spist, fjernsynets integreret højtaler inde på værelset

Ser nogle fortnite på youtube, på én skærm mens han spiller på den anden skærm.

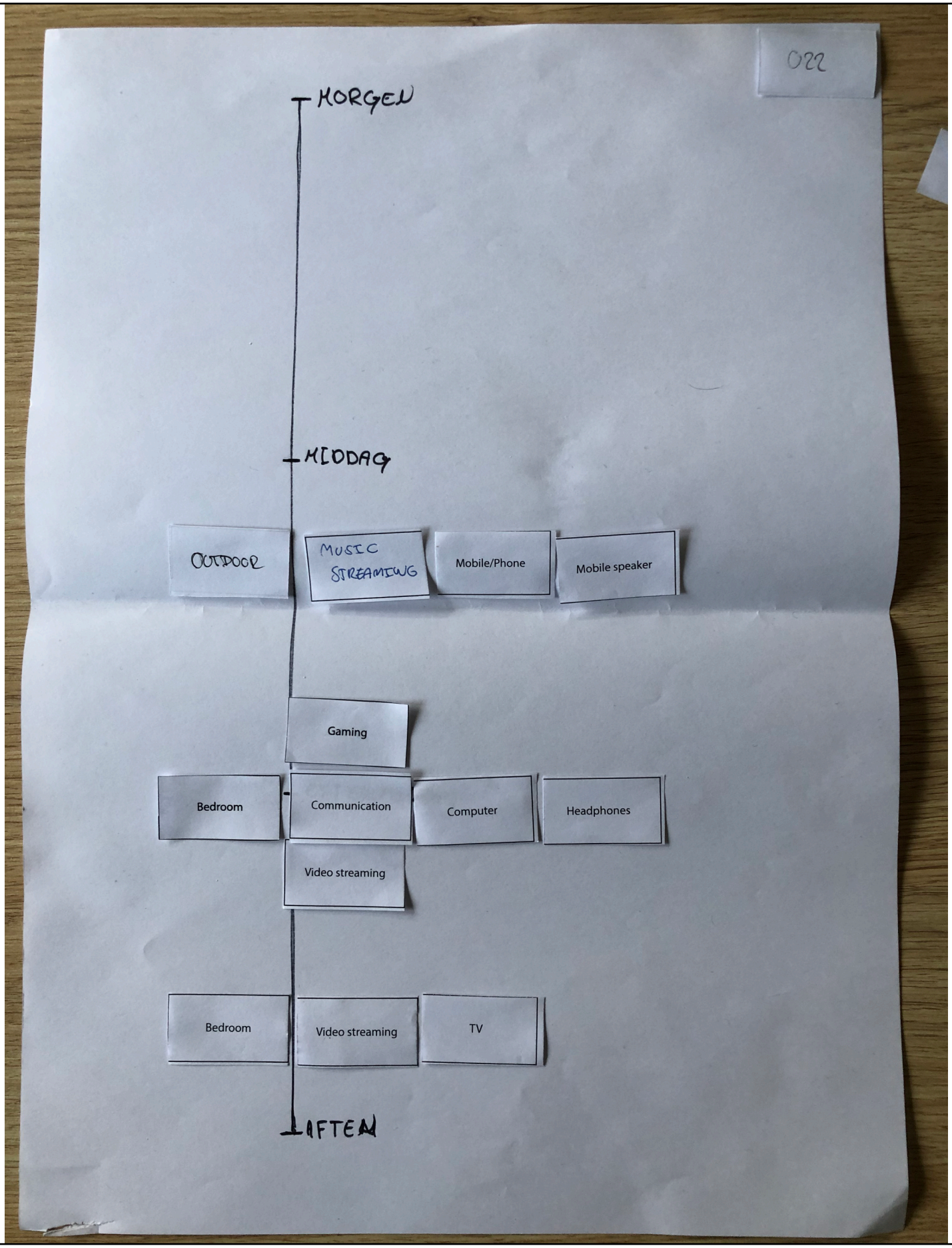
Må ikke bruge skærme en time inden han skal sove.

Havde en playstation på et tidspunkt men solgte den.

Når han ude og spille fodbold og basketball med venner, nogle gange har nogen af dem taget en højtaler med.

Bruger computer (Chromebook) til at spille i frikvarteret, kun om fredagen.

Har en bluetooth højtaler, men bruger den ikke - den er ikke særlig god så telefonen er lige så god.


022
MORGEN
MIDDAG
OUTDOOR
MUSIC STREAMING
Mobile/Phone
Mobile speaker
Gaming
Bedroom
Communication
Computer
Headphones
Video streaming
Bedroom
Video streaming
TV
AFTEN

29. **Youth Club - Comparison chart**

Room	Device	Column	Column3	No.	Case	Column	Column7	C
Bathroom	Mobile	+	Mobile speaker	1	17		Musik streaming	
Livingroom	Phone	+	Mobile speaker	1	21		Music streaming	
	Phone			1	18			
	Phone	+	Headphones	2	17 + 20		Music streaming	
	Tablet			2	17 + 19			
	Tv			3	17 + 18 + 20			
	TV	+	Stationary speakers	2	19 + 21			
	Computer	+	Headphones	1	20			
	Computer			3	18 + 19 + 21			
	Console	+	TV	1	19			
						Total		
Bedroom	Phone			3	18 + 19 + 20			
	Phone	+	Headphones	2	17 + 21		Music streaming	
	Tablet			2	17 + 19			
	Computer			3	19 + 20 + 21			
	Computer	+	Headphones	2	21 + 22		Music streaming	
	Cd player	+	Stationary speaker	1	19		Music CD	
	Tape recorder			1	19		Tape	
	Phone	+	Mobile speaker	1	20		Music streaming	
	TV			1	22			
						Total		
Kitchen	Stationary speaker			2	19 + 20		Music streaming	
	Mobile speaker			1	21		Music streaming	
Outdoor	Mobile	+	Mobile speaker	3	17 + 20 + 22		Music streaming	

Colu	Column9	Colur	Column12	Column13	Column15	Column	Column17	Column18	Column19	Column20
1										
1										
					Tik Tok	1	Private	1		
1	Video streaming	2					Private	2		
	Video streaming	2	Gaming	1			Private	2		
	Video streaming	3			Flow TV	1			Shared	3
	Video streaming	2							Shared	2
	Video streaming	1					Private	1		
	Video streaming	1	Gaming	2			Private	3		
			Gaming	1			Private	1		
3		11		4						
	Video streaming	2			Tik Tok	1				
2	Video streaming	2								
	Video streaming	2	Gaming	1						
	Video streaming	1	Gaming	2						
1	Video streaming	2	Gaming	1						
1										
1										
1										
	Video streaming	1								
6		10		4						
2										
1										
3										B

30. **Interwiew - Taewoong Lee**

Sound zones (Interview Taewoong Lee, Audio Analysis Lab @ AAU)

Imagine two sound sources, 1 being a music track, and 2 being a video.

The technology works with the following terms:

Dark Zones: Areas where there is little to no sound produced,

Bright Zones: Listening area, in the setup x used as example, the bright zone was approx. 20cm in diameter, enough to fit a person's head.

The sound zone technology is able to playback the two sources in their own bright zone, so that the user will only be able to hear the source playing in the given zone.

This is done using filtering (based upon techniques from speech enhancement) for each of the speakers in the array, that removes the other zones source sound.

The technology is suited for situations where you know the exact location of the user, due to the relation between bright zones and speaker array geometry. To move the bright zones around, a modification of the speaker system geometry is required. Furthermore, the system geometry is affected by the room within which it is placed.

The technology seems to be in a very early stage, and no companies have dared to commercialise it yet.

31. **Competing products**

Competitor analysis

Objective:
The objective of this worksheet is to find and analyse competing products for the four concept directions, to gain insight into the status of the market which the concept is aiming for. The analysis will be based on the use case and context of the concepts, described previously.

Data:

Soundwall

VP's:
- Divide large open spaces into smaller more intimate sections
- Dampen noise and increase the acoustic atmosphere of larger rooms.
- Blends in with the interior
- Increased convenience from No-phone-needed interface.
- Doesn't take up surface space on tables or bookshelves

Functionality:
- Castors for mobility
- Modular system for linking multiple panels
- Wifi speaker connectivity

Beosound shape
https://www.bang-olufsen.com/en/speakers/beosound-shape

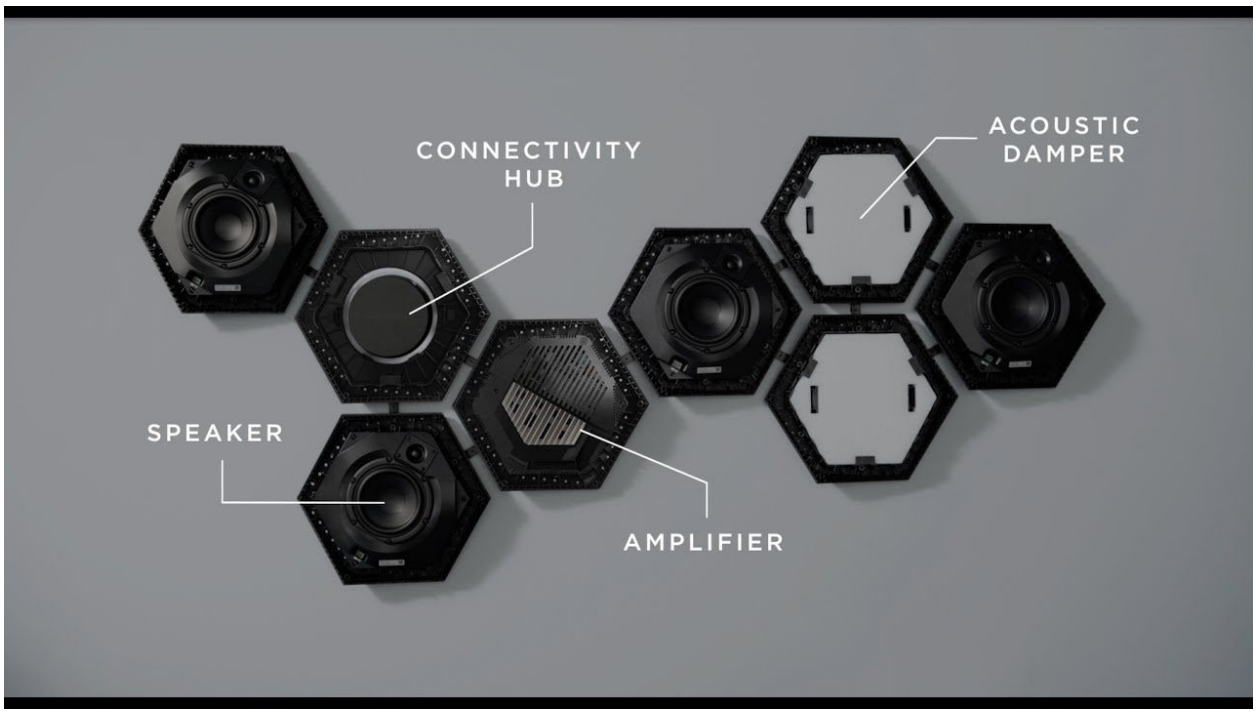
VP's:
- Dampen noise and increase the acoustic atmosphere of larger rooms.
- Blends in with the interior
- Customization (Build it yourself)
- Doesn't take up surface space on tables or bookshelves

Functionality:
- Modular system
- Acoustic panels increase room acoustics
- Wallmounted
- Wifi speaker connectivity

Do's:
- Customization
- Wifi connectivity
- Wall Mounting

Don’t:

- Needs cables running down the wall, or cables preinstalled in the wall. (Inconvenient setup scenario)
  Kræver håndværker / advanced tools til at installerer produktet.



Magnepan 1.7:
http://www.magnepan.com/model_17

VP’s:

- Blends in with the interior
- Divide large open spaces into smaller more intimate sections
- Somewhat increased acoustics in room
- Doesn't take up surface space on tables or bookshelves

Functionality:

- Panel speaker (passive)

Lacking:

- Convenience. Target at HiFi enthusiasts

Comparison:
The Magne pan 1.7 is a HiFi speaker, dressed as a room divider. The 1.7 requires an external amplifier to drive them, and the convenience factor is therefore decided by the choice of amplifier, rather than the speakers themselves. The speakers could function as stationary room dividers, as they have no castors or other mobility features. The acoustics of a room might be

slightly improved, on the basis of the size of the product, breaking up soundwaves.

Mangler vi en undersøgelse omkring hvad god rumakustik indebærer, nu når vi forsøger at forbedre det i nyere huse? Måske det kan være i kontekst analysen, hvorfor moderne huse har dårligere akustik etc.

Beoplay A9
https://www.bang-olufsen.com/da/hoejttalere/beoplay-a9

VP's:
- Blends in with the interior
- Doesn't take up surface space on tables or bookshelves
- Customization -> Adding to longevity of product

Functionality:
- Wifi speaker connectivity

Comparison:
A product with a high convenience factor, but lacks the 'no-phone-needed' interaction features. Blends into the existing interior with its large cloth covered disc shaped body, and chair like legs. Has most of the modern connectivity features, such as Airplay 2 and Google Cast.

Speaker nightstand

https://www.urbanoutfitters.com/shop/victrola-bluetooth-speaker-table

VP's:
- Blends in with the interior
- Doesn't take up surface space on tables or bookshelves

Functionality:
- Power delivery for external devices
- Bluetooth connection

Lacking:
- Wifi connectivity

Comparision:

Loftwall weave
https://loftwall.com/wp-content/uploads/2019/12/Loftwall_Weave_Black_Frame_Casters.jpg

VP’s:

- Blends in with the interior
- Divide large open spaces into smaller more intimate sections
- Dampen noise and increase the acoustic atmosphere of larger rooms.

Functionality:

- Castors for mobility

Lacking:

- Speaker functionality

Vitrola Credenza
https://victrola.com/collections/furniture/products/victrola-woodland-bluetooth-speaker-credenza-espresso

VP’s

- Blends in with the interior
- Doesn't take up surface space on tables or bookshelves

Functionality:

- Bluetooth connectivity
- Storage space + Surface space

Lacking:

- Wifi connectivity
- Non-mobile

Sonos PLAYBAR
https://www.hifiklubben.dk/streaming/sonos/sonos-playbar-soundbartradlos-hojtaler/

VP’s

- Upgrading poor TV sound
- Seamless TV integration, no additional remote

Functionality:

- Wifi speaker connectivity
- Two mounting options

Do’s:

- Seamless TV integration
- Wifi connectivity

Lacking:

- Tied to the TV

Sum-up:
Many products are working towards camouflaging into the modern home, with taking shape, or shape ques from existing furniture. This is indicating a shifting market trend, where we are moving away from small decorative pieces, placed upon sideboards or bookcases, and into a place where the speakers themselves become these furniture pieces.

Potential features;
- Seamless TV integration
- Mobile capabilities
- Customization options, to adapt to different interior styles
    - Possibility to update colorway to increase longevity of product

Concept 2: Speaker lamp

VP:
- Skjult højttaler, møbel, Potentiel WAF (camoo)
- Lys

- **Convenience:**
    - Den bliver installeret i et stationært miljø
    - Tager ikke plads på køkkenbordet (begrænset plads i forvejen)
    - Tænd musikken sammen med lyset (Remote)

USP:
- Optager ikke bord plads,
- No-phone needed interaction
- Does not take up a power plug, which is limited in number in the kitchen.
- Fast plads

Ikea symfonisk

https://www.ikea.com/dk/da/p/symfonisk-bordlampe-med-wi-fi-hojttaler-hvid-30435157/

VP's
- Hidden speaker - Lamp

Functionality:
- Room adaption - uses the phone to tune the speaker
- Wifi speaker - Apple Airplay 2

- Play/pause and volume control
- Stereo pair

Dont's
- No bluetooth
- Phone needed
- Doesn't work with trådfri +56
- Takes up table space

Comparison:

The ikea Symfonisk lamp is very similar in the feature set of the concept. It plays music through the ecosystem found in the sonos and apple family, and is somewhat independent of the phone. It does however not feature the convenience aspect and semantic value of turning on a preset as you would with the light, and the user needs to use the phone to "start" the streaming.
It takes up tabletop space, and is not compatible with their existing smart lighting series. The ikea lamp focuses on fitting into the aesthetics of the current interior trends.

Possible features:

- Compatible with ikea trådfri or philips hue
- Preset buttons

LED lightbulb speaker:

https://www.amazon.co.uk/dp/B00QMDTNDO?psc=1&slotNum=15&th=1&linkCode=g14&imprToken=Nm4tc-JP74SnsX8DUdyUqQ&creativeASIN=B00PNU8J46&tag=uknewground-21

VP's
- Installs into any lamp
- Hidden speaker

Functionality:
- Bluetooth speaker

Don'ts:
- Wifi Connection
- Phone needed
- Small speaker, not suitable for larger rooms

Comparison:

The lightbulbs compare to the lamp as they aim to turn any lamp into a speaker. They connect to the phone via bluetooth meaning the user needs to use their phone to connect to the speaker. The use case of the bulbs is properly bedside lamps or small rooms.

- Greater sound for larger rooms

Rack light with speaker:

https://store.beforward.jp/detail/Audio/Audio-Speakers/PA13795334/

VP's

- Speaker hidden into a lamp

Functionality:

- Controlled by remote - Not wall outlet
- Bluetooth connection

Dont's

- Wifi connection
- Phone needed

Comparison:

The product features many of the same values as the concept, as its a speaker integrated into a ceiling lamp. It connects to the phone via bluetooth, meaning the user needs to use their phone to use the product. It comes with a remote to control it instead of the wall outlet.

Sum-up

The found products each feature some of the proposed values and features of the concept.

Possible features:

- No phone needed
- Wifi integration
- Integration with current smarthome light solutions

Our concept fits quite well as a merge of Ikea's symfonisk and the rack-of-light with speaker, as the concept combines the quality of home-life trends, hidden speaker and loft hanging lamp.

Concept 3: Headphone / Dock

Functionality:

- Use the headphones as you would use any other headphone.
- Use the speaker as an amplifier for the audio drivers, integrated in the headphone, in order to turn them into speaker headphones.
- Use the speaker as a subwoofer for the low frequencies.

VPs:

- Seamless transition from headphone to speaker and vice versa, allowing the user to accommodate the different social contexts the user moves in between.
- Portability - A speaker meant for diverse contexts whether they are at home or on the road.
- A charging base for headphones, have them charged and ready to go.

Existing competing products:

The Motorola sphere

https://www.ebay.com/itm/Motorola-Sphere-True-Wireless-COMBO-Speaker-Headphone-With-Mic-100-Portable-/193303792479

Functionality:

- Use the headphones as you would use any other headphone.
- Put them on the speaker to transition to speaker audio.
- Use the speaker as a subwoofer for the low frequencies.
- Charge headphones while on the speaker.
- Needs power cable for the speaker

VPs:

- Seamless transition from headphone to speaker and vice versa, allowing the user to accommodate the different social contexts the user moves in between.
- A charging base for headphones.

Comparison:

The Motorola sphere is more or less an exact example of the concept in regards to both valuepropersitions and functionalities, with the exception that the drivers from the headphones aren't amplified by the speaker and used for speaker sound.
The speaker is unlike concept 3 not mobile, in the sense that you can carry it along for outdoor contexts as well.

The human headphones:

https://humanheadphones.com/

Functionality:

- Use the headphones as you would use in-ears headphones - no hanger between the two earmuffs.
- Combine the two ear muffs in order to turn them into a small mobile speaker.

VPs:

- Seamless transition from headphone to speaker and vice versa, allowing the user to accommodate the different social contexts the user moves in between.
- Very compact speaker and headphone, pocket sized.

Comparison:

The human headphones share the same valuepropersition in regard to the transition from headphone to speaker, the device is however way more compact as it doesn't include an external speaker/amplifier. This also means that the speaker functionality is very limited, given that it relies solely on the drivers and power built in the muffs.

Conclusion:

There aren't many concepts that combine the headphone and speaker into a synergetic product. However the motorola sphere is pretty much a 1 to 1 product of concept 3. Given that this is the only example of such a combination of devices there may be room for a competitive alternative to this.

We don’t know the sales figures for the Motorola sphere, however the none of us had heard of it before the research, and there are few reviews of it found online, indicating that this concept either hasn’t had it’s breakthrough yet or that it simply misses the target audience it tries to hit.

Concept 4: Phone stand

Functionality:

- Mobile device stand, place your device of choice (Phone or tablet) on the stand when playing music/videos.
- QI charging the device while on stand.
- Connect to the speaker by close distance BT.
- Portable - battery powered as well as plug-in

VPs:

- Seamless transition in audio between phone and mobile speaker, by placing and removing phone from stand.
- Charging station for device, while playing music/videos.
- Centered sound to the device playing from

AZPEN D100 Qi Wireless Charger Bluetooth 4.0 HiFi Speaker

https://www.gearbest.com/power-banks/pp_553837.html

Functionality:

- Mobile device stand, place your device of choice (Phone or tablet) on the stand when playing music/videos.
- QI charging the device while on stand.
- Bluetooth connection - pair your device to the speaker.
- In-built microphone for calls
- Handsfree interface
- Portable - battery powered as well as plug-in

VPs:

- Charging station for device, while playing music/videos.
- Centered sound to the device playing from
- Multifunctionality

Comparison:

Shares the same functionalities in regard to the stand and charging function and valuepropersitions, along with the multi functionality. It does include a microphone and handsfree interface, which adds to the functionality in comparison Concept 4. It lacks the seamless transition in placing and removing phone for connect/disconnect to speaker.

MoonSonata 3-in-1 Qi Wireless Charger with Bluetooth Speaker

https://www.rice-power.com/product/Moon-Sonata-Qi-Wireless-Charger-Bluetooth-Speaker

Functionality:

- Phone stand, place phone on the stand while playing music/videos.
- QI charging the device while on stand.
- Bluetooth connection - pair your device to the speaker.
- Needs a power plug-in

VPs:

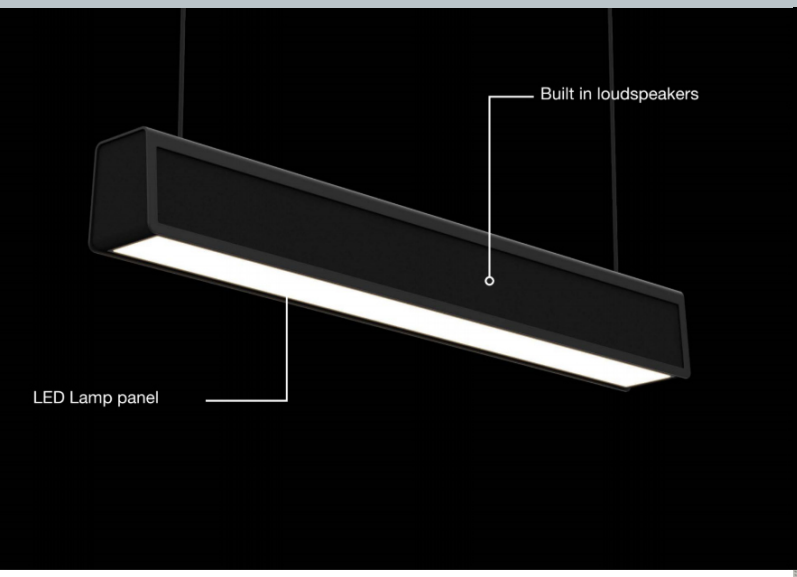
- Charging station for device, while playing music/videos.
- Centered sound to the device playing from
- Multifunctionality

Comparison: Shares the same functionalities in regard to the stand and charging function and valuepropersitions, along with the multi functionality. It doesn't support devices in multiple sizes and the phone is placed in front of the speaker, which automatically interferes with the volume. It lacks the seamless transition in placing and removing phone for connect/disconnect to speaker.

Conclusion:

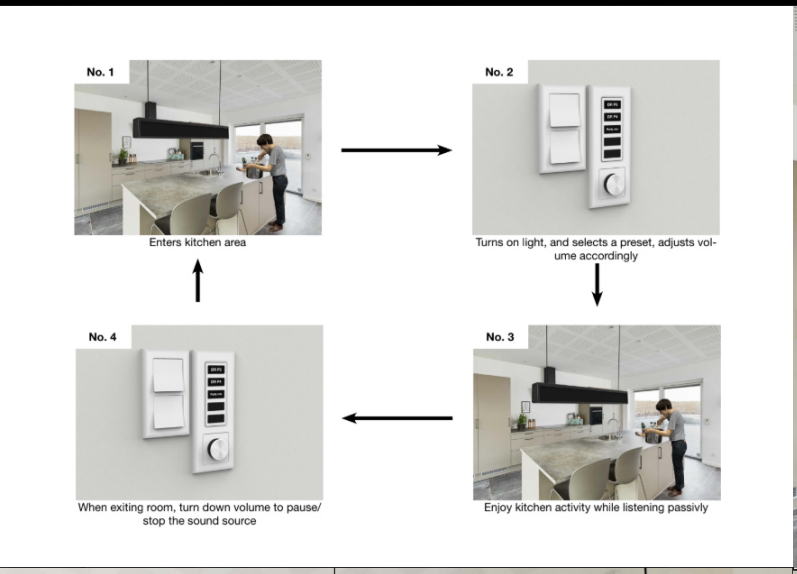
The two analyzed products are merely two of many competing products that more or less fulfills the same need in its multifunctionality of being both a stand, charger and speaker for your device. They both miss the ease-of-use in placing and removing devices to connect and disconnect from speakers, which could be an entry in valuepropersitions into this product segment. However, given the amount of similar concepts, there's a lower chance that the product will stand out enough, to get a hold of the target audience.

32. **User Probe Slides**





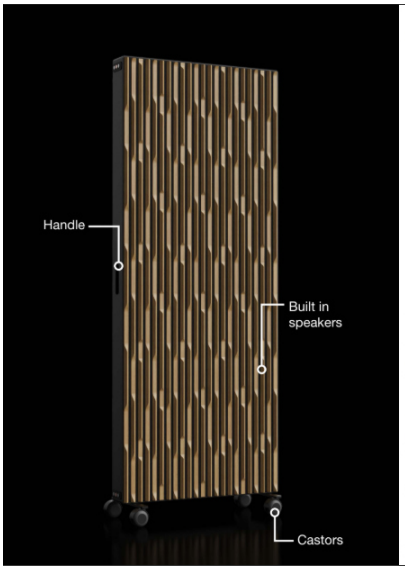


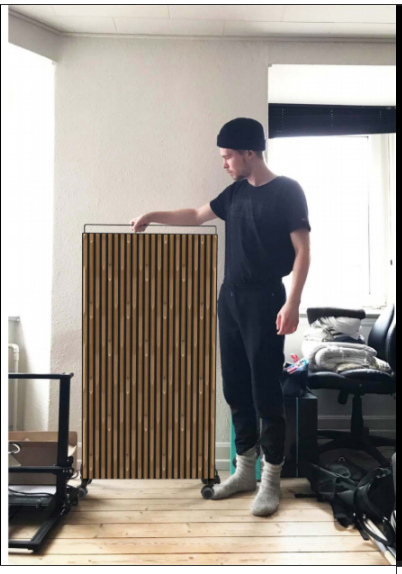


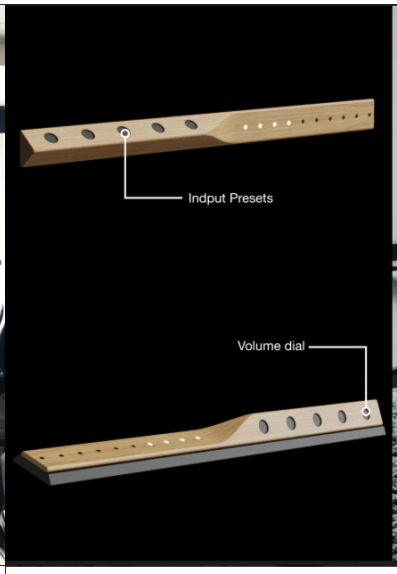








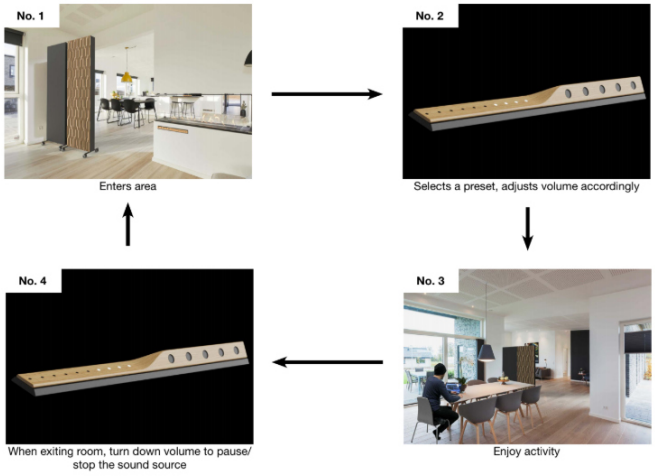






Use Contexts







33. **User probe (1)**

Worksheet no.: 15
Date: 27/3/2020
Responsible:
Deadline:

Activity:
Objective:
Spørg indtil familiesituation
Spørg indtil nuværende lyd
Forklar koncept / brugssituation!

Feedback på VP
Kan du genkende behovet / problemet?
Hvis produktet fandtes, kunne du så forestille dig at købe det? Hvorfor / hvorfor ikke?

Feedback på Æstetik
Eksperiment/data:
User 1: Peter Pilgaard , start 50'er år
Familie: Par, to hjemmeboende børn 14 & 18 år.
Lydsystemer: (højtalere setups, køkken, stue)

Generelt:
Vandret højtaler, ligner en skænk / bænk, som man kan stille nips på, men hoved funktionaliteten var egentlig højtaler (Hvad nu hvis jeg var et møbel - højtaler).

Viser køkken alrum, køkken og bryggers på tablet,
Han vil gerne vise, at det er meget åbent,
De har sat en skillevæg op imellem stue og køkken alrummet. Hvis de skulle lave den om, havde de lavet den større.
Store børn, 14,18 år, de forsvinder bare ind på værelset, så ser man ikke dem

Huset har også akustiklofter, og dem er de glade for.
Har Sonos 5 i køkkenet, Sonos 1 på det store badeværelse, men den bliver ikke brugt så meget. Ungerne har selv en JBL boombox et eller andet, som kan spille højt. Når de har svømmeklubben på besøg, skændes de om hvem der skal sætte musik på (sonos 5?)
Kom fra en lejlighed der havde stofa, hvor de brugte COAX kabler, så det var der fokus på,
men så fik de netværkskabler i stedet på anbefaling af elektrikeren.
Har lige fået waoo, har haft yousee i mange år, nu har de mere stabilt wifi, og det virker bedre.

Concept 1 - Akustisk rumdeler:
Han syntes 'skærmen' giver god mening, i forlængelse af skillevæg,

Højttaleren ser fed ud! Mega eksklusiv ud, med lamellerne.

Trekant vægmonteret, om det er en eller flere, (kunne godt være noget?)
Kan se fordelen med at paneler er vægmonteret, så de ikke skal stå på noget.

Havde drømt om surround sound i stuen, ville bruge trådløse højttalere, men de skal jo stadigvæk have strøm. Det skal jo gerne tænkes ind når man bygger huset faktisk.

Vi viser ikke, at der jo så skal være stik bag højttalerne på væg, hvor der så ville hænge et kabel.

Giver mening at sætte mobil højtaler ('skærmen') ved en stikkontakt der sidder lavt, men der vil den hængende være træls, fordi man skal have det hængende.

Dynaudio burde komme mere ud til byggefirmaer. Højtalere idag er noget andet end det var før i tiden. Bør anbefale en bestemt stik placering, som understøtter højttalere og tv.

Concept 2 - Lamp Speaker:
Kan sagtens se pointen med at det er træls at en højttaler optager et stik i køkkenet,
har sonos stående på reol i køkken, et sted hvor der originalt var planlagt et tv, som gav et stik. Ellers havde den stået for enden af køkken bordplade, og optaget et stik der.

Har langbord i stuen, med strømskinne i loft, hvor man kan justerer. sådan et par lyd lamper i skinnen ville være super, lyd i hele huset.

Ser lighed imellem philips hue, og dette, hvor man både kan styre på telefon, men også har en fysisk kontakt. Han tror vi har ret i, at man ikke kun gider kunne styre på telefonen, syntes det er træls at man altid skal bruge telefon på hans sonos. De der små ekstra steps er lidt irriterende. (Måske derfor den på badeværelset ikke bliver brugt?)

Ideen med et lille kontaktpanel (remoten) giver mening, men viser bekymring for forøget pris. Måske kontakten kunne være et tilkøb, så prisen ikke stikker af.

Viser bekymringer for vibrationer i noget der er hængende. Han er maskiningeniør. Jonas nævner et absorberende kabel som løsning.

Konceptet med at putte lyd i dagligdags ting, som man ikke ser er smart.

Vi er langt ovre gulvhøjttaler i stuen, som skulle være flotte, men det var de jo ikke
Sonos og andre wifi højtalere er jo smarte nok, men står i vejen og optager strømstik.

Kiggede på at få custom install da de byggede, men pengene rendte ud i byggeprojektet. Ville gerne have højtalere væk fra de normale placeringer. Konen går slet ikke op i det, han syntes selv det er fedt med god lyd. Konen syntes ikke det skal kunne ses. Skjulte højttalere er ikke så mandligt, så han syntes det er lidt feminint, men så igen, så er det ret fedt at det er 'usynligt' (hvor kommer lyden fra, det er sgu fra lampen du')

Afterthoughts:
Han kan se fiduser i rigtig mange af tingene, og syntes at begge er spændende. Især det med lamperne, men syntes at det er knapt så meget dynaudio måske. Frygter at lamperne jo er noget man udskifter en gang imellem, og så skal man jo også skifte højtalere. Måske modularitet kunne være en løsning. en lampe del, og en højtaler del. Nævner 'disse tider hvor man skal genanvende'. Synes vi har tænkt ud af boksen, alligevel noget fra en 'lydmand' en der kender markedet.

convenience - stealth

34. **User probe (2)**

Worksheet no.: 16
Date: 27/3/2020
Responsible:
Deadline:

Activity:
Objective:
Spørg indtil familiesituation

Spørg indtil nuværende lyd

Forklar koncept / brugssituation!

Feedback på VP
Kan du genkende behovet / problemet?
Hvis produktet fandtes, kunne du så forestille dig at købe det? Hvorfor / hvorfor ikke?

Feedback på Æstetik

Eksperiment/data:
User 2: Michael 40ish
Familie: Kæreste og 2 børn (2år & 10år)
Lydsystemer: Sonos i alle rum og garage, var begyndt at skifte til harman kardons, godt tilfreds med funktionalitet i sonos. Synes det er designmæssigt kedeligt og kedeligt at det er lidt mainstream.
Lidt mange penge at skifte, hvis det skal skiftes i alle rum.
1x playbar - 2x sonos play 1 + sub i stue
2x play 1 + sub i køkken
2x play 1 i garage

Generelt:

Concept 1 - Akustisk rumdeler:
Rigtig rart kunne skærme en lille smule af, særligt når der er andre børn, de har selv en stor åben stue og køkken alrum, som er åbent det meste af tiden.

selv med akustikloft, er der ret lydt, så et akustik panel kunne være en god ide
kan godt lide de væghængte paneler, har kigget på beosound shapes.

Kunne godt finde på at overveje de her produkter. kan rigtig godt lide det designmæssige, mangler i sonos.

Feature Mæssigt: bruger selv en fast playliste eller radio og skrue op/ned funktion. savner lidt at kunne gøre de mest basale ting uden at skulle have telefonen på sig.

prisleje (væghængte): 10-20.000 kr. (Dyrere end sonos - billigere end B&Os)

Concept 2 - Lamp Speaker:
Synes den er vildt interessant. de har ikke nogle lamper over spisebord da de har mange spots.
rigtig praktisk og pænt.
gør meget ved rummet, alternativet er mange "klatter på rummet" det pynter ikke.
Kan rigtig godt lide det med lamperne.
Synes det er en fin ide med remoten, det kunne sagtens passe ind.
Kan bedre lide den end skillevæggen.
Selv hvis han ikke noget kendte noget til, ville han overveje det.
Er sikke på at mange af dem der bor i området vil overveje det. - de fleste er gået sonos vejen, det er det nemme valg. Sonos er plastikagtigt.
Prisleje: 5-10.000 kr. højere end det bliver det svært at sælge det.

Afterthoughts:

35. **Music 5 Deconstruction**

Worksheet no.: **23**
Date:
Responsible:
Deadline:

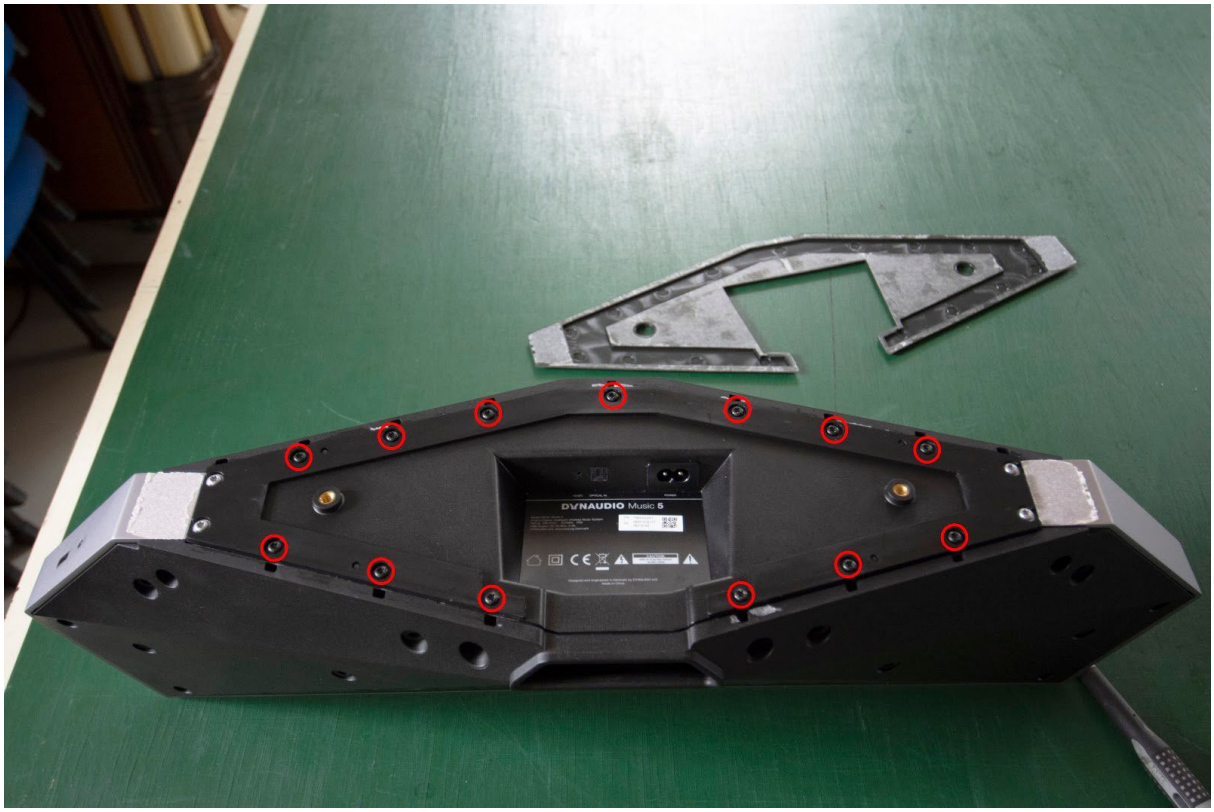
Activity:
Deconstruct a Dynaudio Music 5,

Objective:
To gain a better understanding of what goes into constructing a mainstream-level loudspeaker, specifically at Dynaudio, it was decided to deconstruct one of their existing mainstream-level products. Dynaudio provided the group with a Music 5, which lies with in their entrylevel mainstream products.

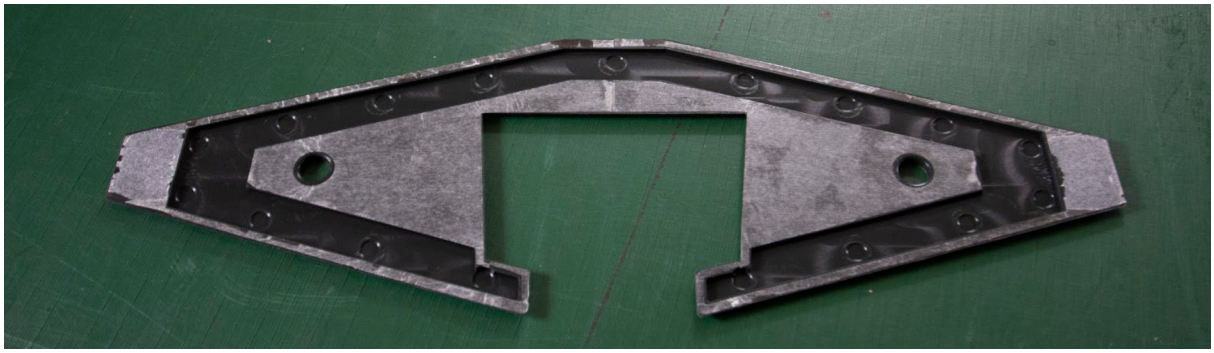
Experiment/data:
Sketch, storyboard, diagrams, photo of mock-up, renderings etc. incl. explanatory comments, analysis, evaluation.

Cabinet construction:
It has a front/back construction, that is kept assembled with 10 M?x?? screws (Fig1.) inserted from the back,





Along with the screws in the back, the bottom plate has 14 screws (Fig2) that keep it attached to both front and back cabinet. The screws are hidden beneath a rubber pad that is attached with double sided tape (Fig3).





Removing all the screws allows us to remove the buttom and backpannel, to reveal the internals. The internal components consist of:

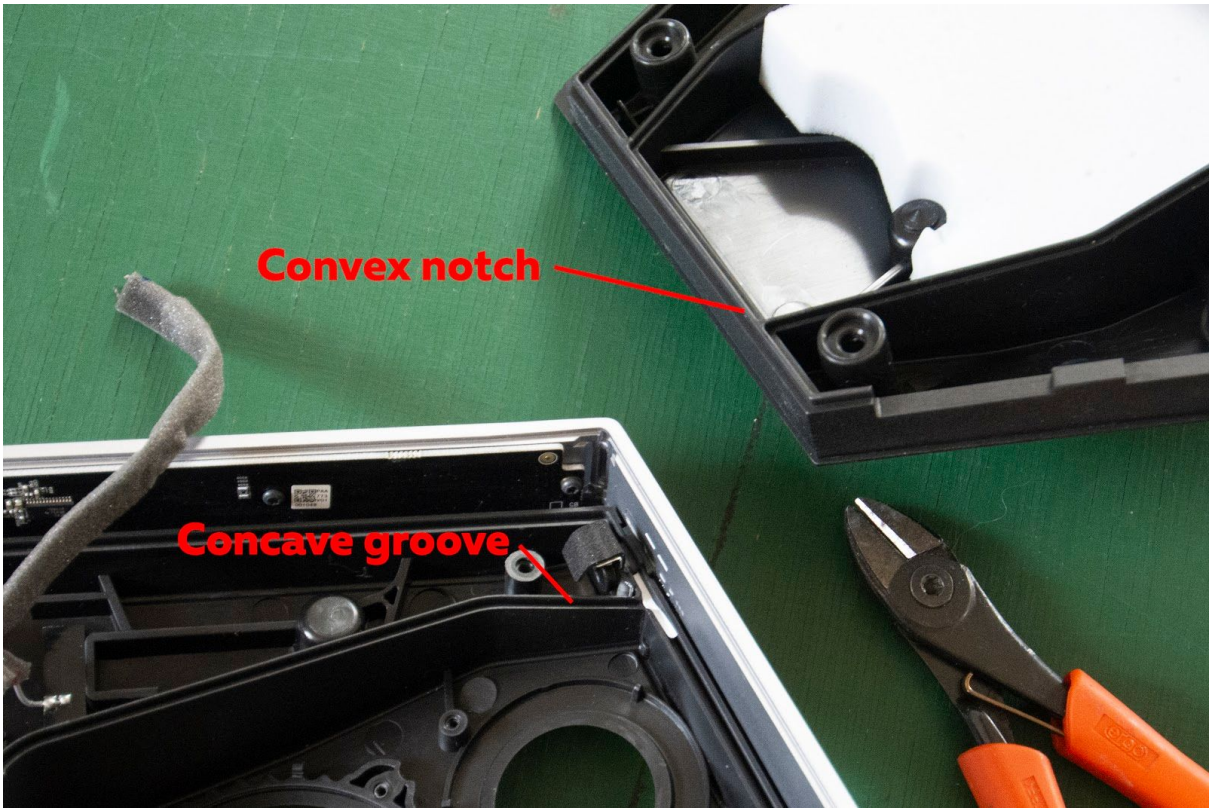
- Two Tweeters
- Two Midrange drivers
- One woofer
- Powerboard
- Mainboard + Amplifier comboboard
- Indputboard for USB and AUX.

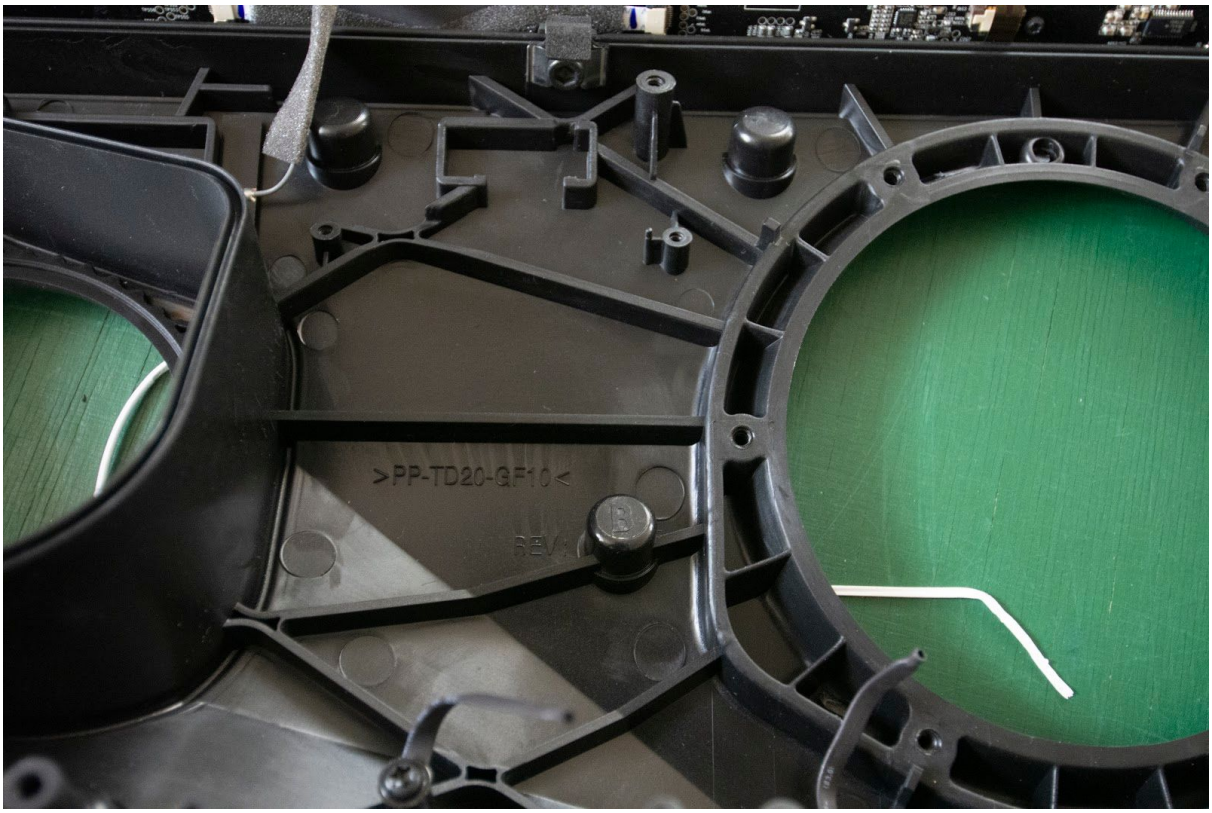
It also reveals that the drives are seperated into three seperat cabinets:

- Cabinet 1 and 2 which is for the midrange and tweeter. The tweeter has its own closed off backchamber, so the volume will not affect its performance, and the volume of the tweeter should be deducted when calculating the volume of this cabinet.
- Cabinet 3 which houses all the electronics + the woofer. This cabinet it ported.



To ensure a good seal between the back and front part of the cabinet, a small gasket has been used, to fill out the the concave side of the groove.





The cabinet front and back seems to be moulded in PP TD20 GF10, a polymer commonly used to produce housings in the automotive industry as well as consumer electronics.
https://xmkeyuan.en.alibaba.com/product/62464951914-210239394/Virgin_PP_Gf10_Td20_Reinforced_With_20_Gf_talcum_Polypropylene_Td20_pp_granules.html

https://matmatch.com/materials/mbas051-polypropylene-reinforced-with-20-talcum-pp-t20-

Density	1.04-1.06 g/cm^3
Elastic modulus	2-2.8 GPa
Elongation	10-50%
syntes det er nogle lidt lumske tal,	undersøg yderligere hvis der skal simuleres

Mounting facrib grills



Each fabric grill has 14 moulded tabs, that fit into rubber grommits found in the corresponding cabinet half.



Mounting drivers

- Drivers are hardmounted to the front cabinets with screws:
    - 2 for the tweeter
    - 4 for the midrange
    - 8 for the woofer

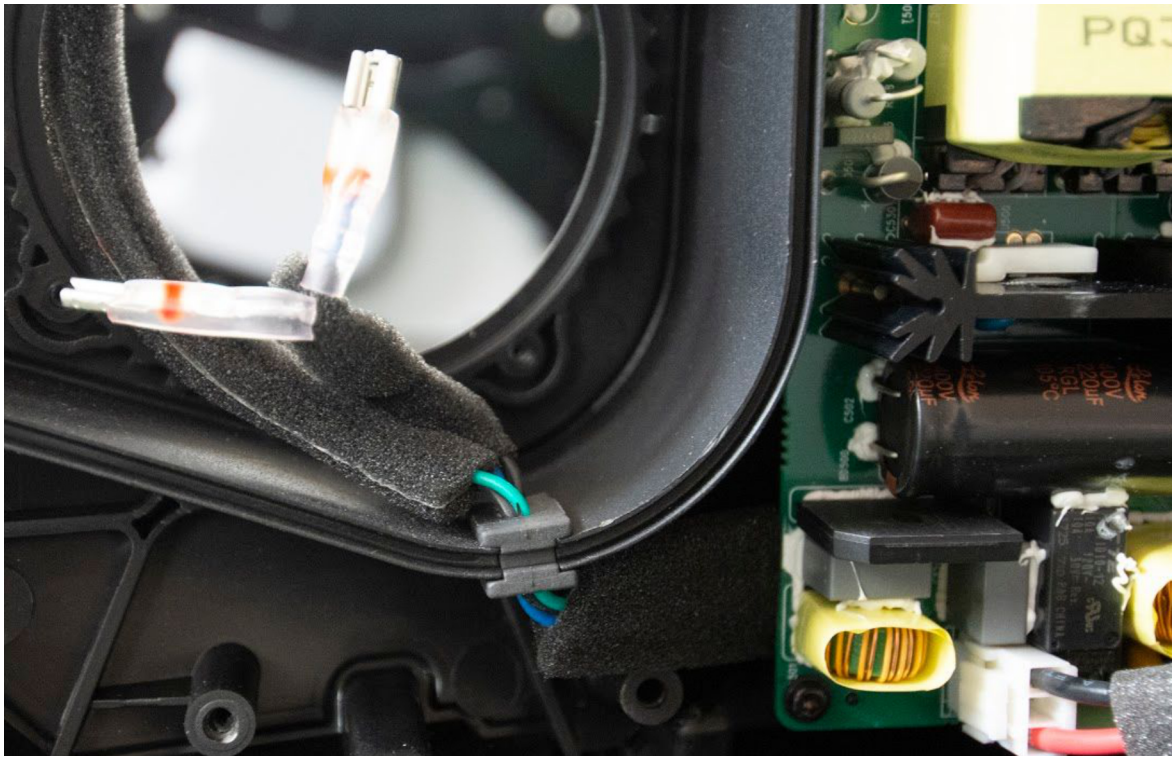
- The front of each driverbasket is covered with a thin layer of foam, to ensure a tigh seal.



- Cableties are placed between screws and cabinet to ensure neat cable routing.



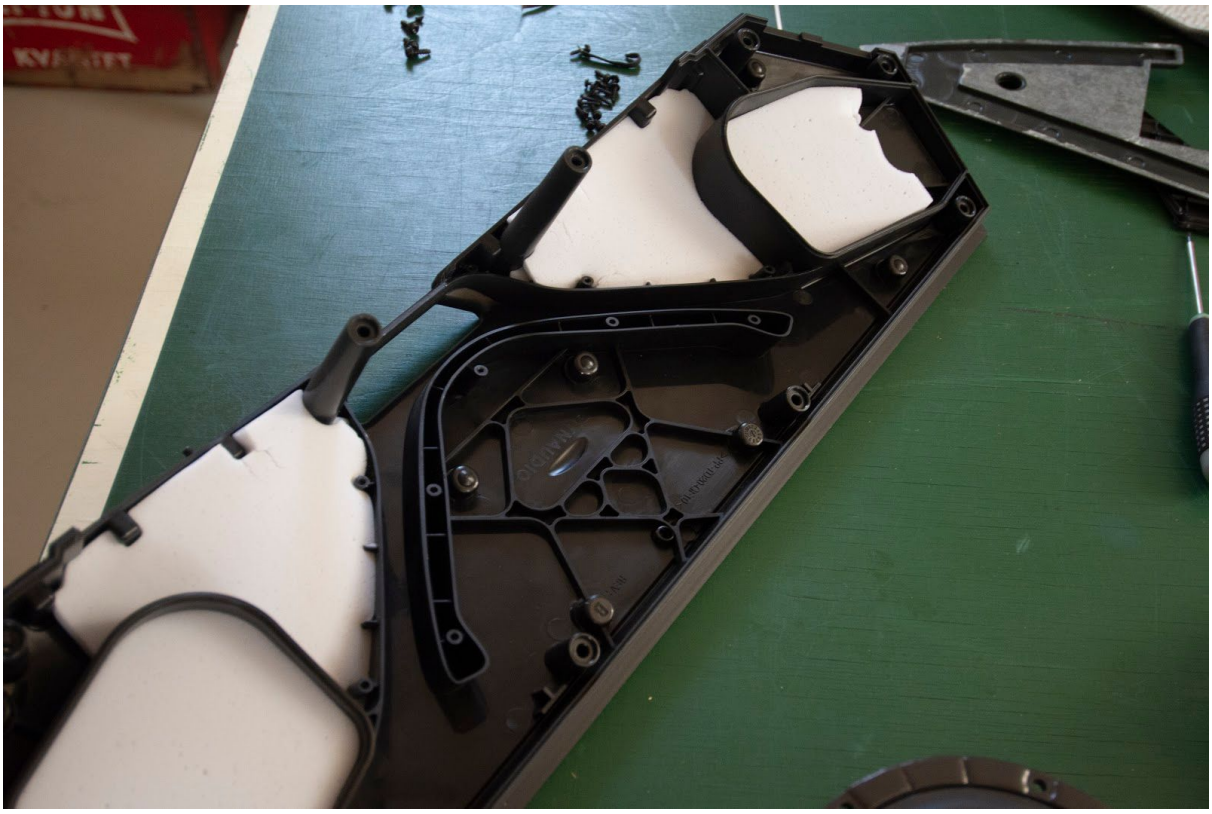
- For cable pass throughs, a rubber grommit has been used, which inherits the concave groove, to house the gasketing material.

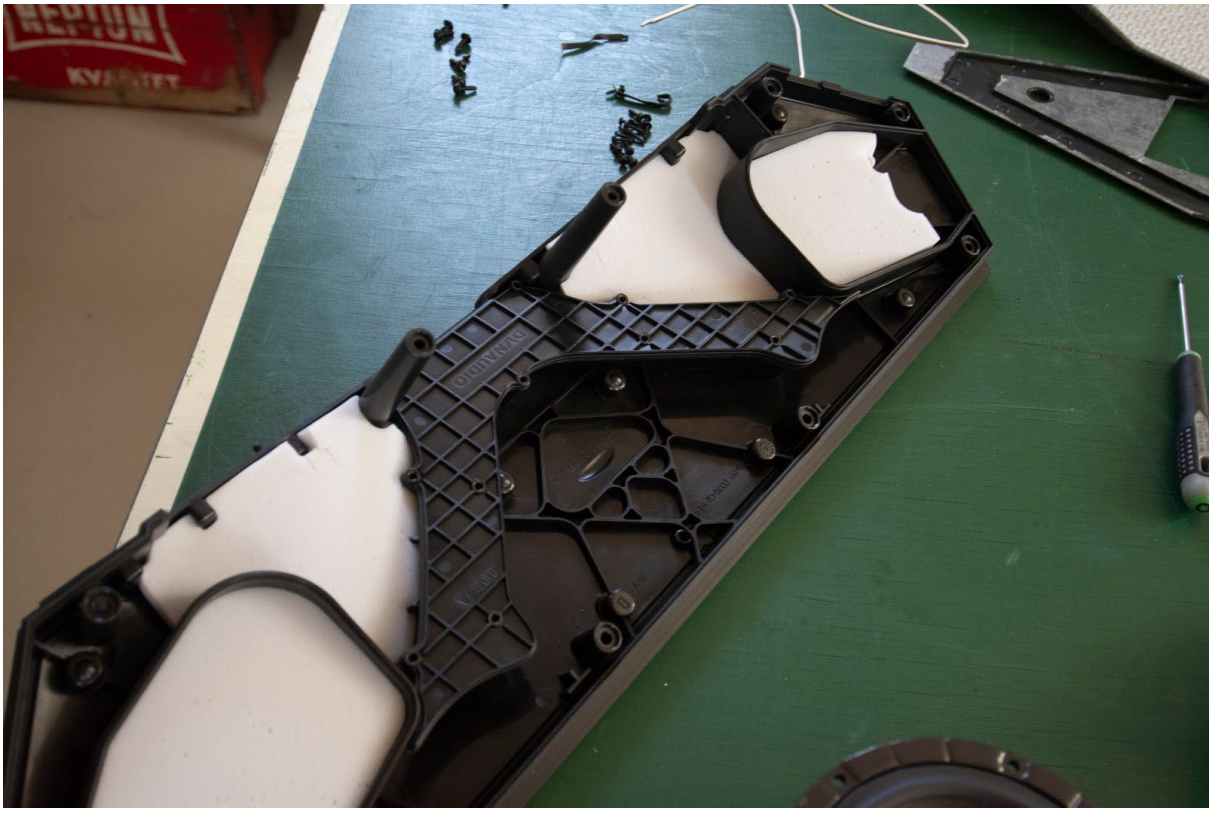


Bassport

Due to the cabinet being injection moulded, creating hollow cavities was not an option. Such a cavity is needed to get the port effect required from a bassport. This was solved blocking off part of the cabinet with an internal plate that is secured with 11 screws. The backside has

rubber moulded onto it, ensuring a tight seal once it it thightend down.





Front and back grill

- Mesh density changes, at tweeter. Is fairly dense. Specify holesize and distance.

General

Part	Weight in grams
Midrange	90
Tweeter	120.7
Woofer	1079
Power board	281.5
Combo board	320
Front cabinet	769
Back cabinet	895
Bassport plate	110.7
Bottom cabinet	257.5
Rubberpad for bottom cab	169.3
Aluframe	442
Front grill	256
Back grill	339.5
Total (Cables excluded)	5241

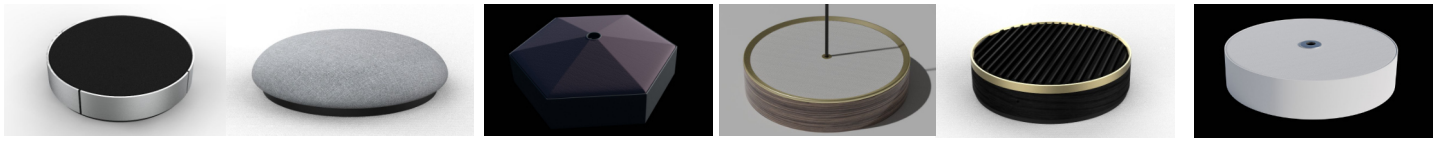
Evaluation:
Summarise and evaluation. Did the activity meet the objectives and to what extent? How did you evaluate? external feedback? calculations? validity of the result?

- Polypropylene can be used for the cabinet.
    - Front to back construction could be used. Most important thing is that the cabinets are sealed where the two parts meet.
- The rubber grommet mounting system could be useful for mounting external lampshades.
- Volumes for Cabinets, provided by Dynaudio:
    - 4,5 liters for the woofer, ported. (Music 5)
    - 3,9 liters for the woofer, sealed. (Music 3)
    - 0.5 liters for the midrange, sealed.
    - Tweeter doesn't care.

36. **Aesthetical variations**

Selected slides from the presentation of
aesthetic variations - to Malthe





1. 2. 3. 4. 5. 6.



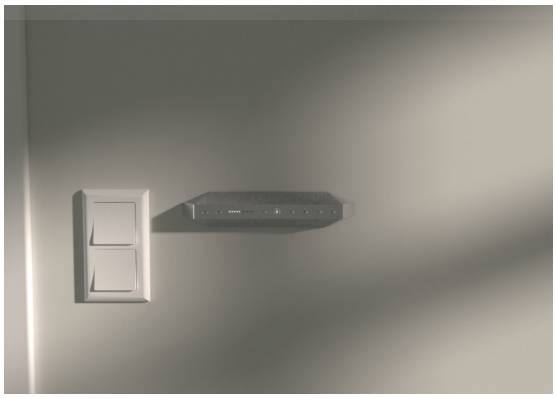


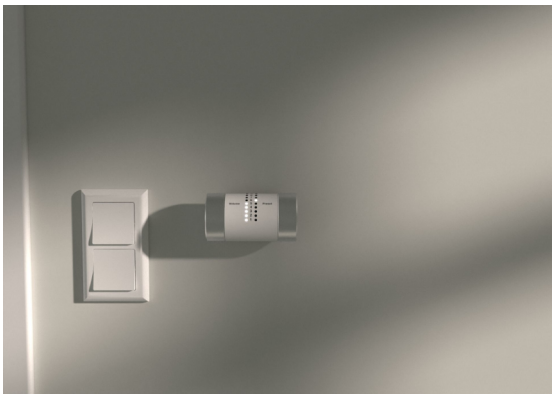


1.



2.







3.



4.



5.



37. **Acoustics Interview**

In order to verify the acoustic properties and expected performance of the system, we got a meeting with DynaudiosSeniorAcousticsdesigner,StephenJ.Entwistle(SJE)

Notes:

Is it feasible?

- Thinks it's a really good idea, very practical, and quite elegant in its simplicity (BAUHAUS).

The acoustics: The step between the edge of the canopy, won't be too much of an issue.

Control by lightswitch:

Would want to leave it powered on all the time. Quite often there's a permanent live terminal.

Practical note, would have 4 terminals, for ease of installation. The terminals he would have 4 terminals:
A permanent live wire
a switch live wire for the lamp
A neutral you need for the circuit
and an earth terminal.

If those terminals are accessible, it would be easy for an installer to install
If there isn't a permanent live in the output it's rather easy to retro install one.

Power supply

Need to fit in the power supply, doesn't see the need for a battery.
In relations to PCB.
The plug is the size of the power supply we need. There needs to be certain distances between electrical components. Meaning it would take up more space than their volume.
Having 10 mms around the components would provide the needed safety distance and it would pass the electrical tests as well.

Spreading lens

The spreading lens is all sort of a compromise, we don't need that because of the drivers and their placement. (Beosound 1 has its tweeter hidden, so it NEEDS the spreader. We use the waveguide instead).

The Grill

Instead of a fabric grill we could consider a metallic grill, fabric has bad acoustic performance. Perforated metallic grills are better, as seen in CI. Very thin perforated metal grill, they use a thin cloth layer, and that doesn't make it any worse, only visible when you're directly underneath it.

Cabinet Volume

Would leave the chamber for midrange completely open as in the music 1. DSP (digital signal processing) can compensate for the drivers placement.. May need the chamber to be a bit bigger.

The more open you make the grill, the more preferable it is to make the surface black as well so the drivers can't be seen.

Decoupling from ceiling
Coupling and decoupling becomes very complex, much easier to hard-couple.
Use a gasket. A material that compresses easily (Soft rubber or hard foam)

Performance:
We either need a large driver that doesn't move very far or a small driver that does move far (as in the music 1). (Volume of air moved can be done in those two ways)

Magnet-system can be placed all the way up against the backface.
Maximum extent of the midrange: will get us all the 3D data from the music 1. The grill is already in the right distance in that model.
If we want room correction we would need a microphone, a small hole (2-3mm) in the side of the cylinder.

Interface for setup
Include a button on the front of the speaker (Behind the grill) for putting it into wi-fi pairing mode. And then everything else can be done on the phone.

Wireless subwoofer on the wall:
What we could do, look at music 7 and just use the woofers from that. What we can do on the app is that we can group the speakers together and that would provide the base. Would need to modify the app but it's basically an option already.

An external sub extension is possible, but requires small changes in the app.

Prototyping would see if he can get us a Music 1 that we can dismantle for components.

What is it we are adjusting with the DSP to compensate for cabinet volume?
How do we shape the waveguide?
In a private home use case, where spreading the sound is required.
In a Restaurant use case, where focusing sound directly underneath is required.

38. Connecter

	Max height mm	Max width mm	Min voltage	min amperage		
Product	30	40	220	10		
Connector type	Height	Width	Max Voltage	Max Amperage		
Banana plug	40	10	5000	15		
WAGO plug	76	34.6	250	25		
WAGO terminal	13.1	4	600	10		
RS connecter	?	?	500	40		
RS connecter 2	?	?	250	16		
measurements taken from CAD model			power is a regular power outlet spec			
https://www.digikey.dk/htmldatasheets/production/1032668/0/0/1/1325-5230-5406-6546-series-datasheet.html						
https://www.wago.com/global/pluggable-connectors/plug/p/770-113						
https://www.wago.com/dk/pcb-terminal-blocks-and-pluggable-connectors/smd-printklemme/p/2060-451_998-404						
https://uk.rs-online.com/web/p/compact-power-connectors/1805379/						
https://docs.rs-online.com/0418/0900766b8167371e.pdf						

39. **Ikea remote**

Due to the inputs on the IKEA Trådfri remote, it is deemed to be suitable as a size reference for the circuitboard needed in the remote system for the product. To collected the dimensional data it is essential to deconstruct a Trådfri remote.

Objective

The IKEA Trådfri remote is part of IKEAs smart lighting system, that allows the user to control the intensity and color of a selected group of lightbulbs REF.[https://www.ikea.com/dk/da/cat/smart-belysning-36812/].

The IKEA Trådfri remote has three functions;

1. Adjust intensity of lights in the group
2. Change the color preset
3. Turn light group on/off

The remote operates via the Zigbee platform, REF.**[https://www.ikea.com/dk/da/customer-service/product-support/smart-lighting/sadan-bruger-du-smart-belysning-pub53d86412]** which is a network meshing standard, that allows multiple smarthome products to communicate and connect. Due to the mesh nature of the technology, the more Zigbee products you have, the more stable it is, as all the devices in the mesh can be used forward data packages to further placed ones. REF. **[https://zigbeealliance.org/solution/zigbee/].**

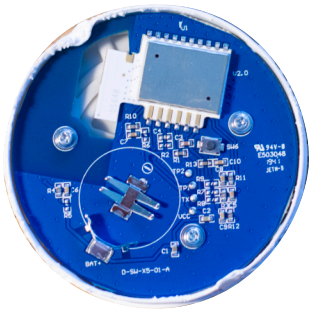
The device is assembled with four snapfits and a bead of silicone [Illu. 5]. There is a flexible piece of plastic that actuates the connection button on the back of the devices PCB [Ill. 3].

The board itself measures xmm In diameter, and is 2mm tall, without the battery, and x mm with. The battery used is a x V model xx.











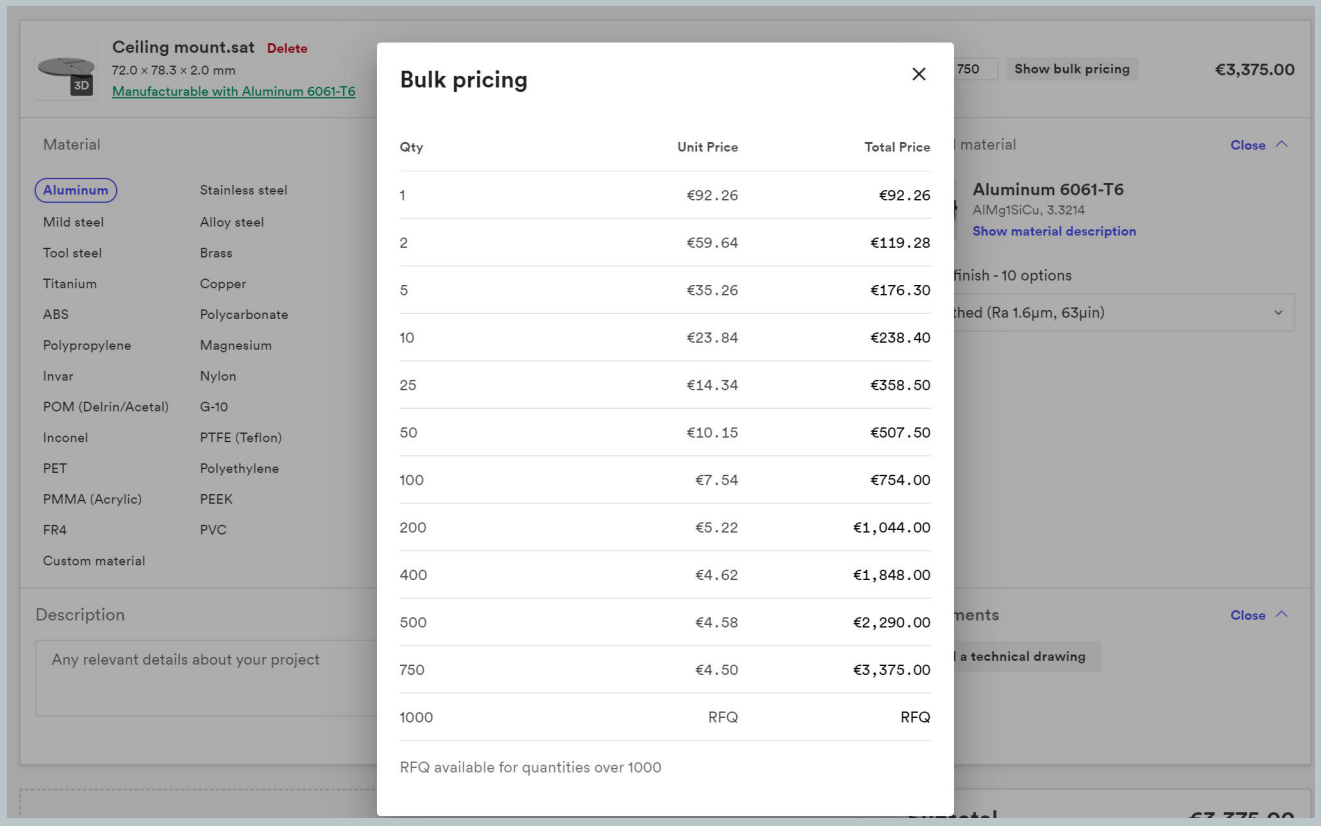
Conclusion

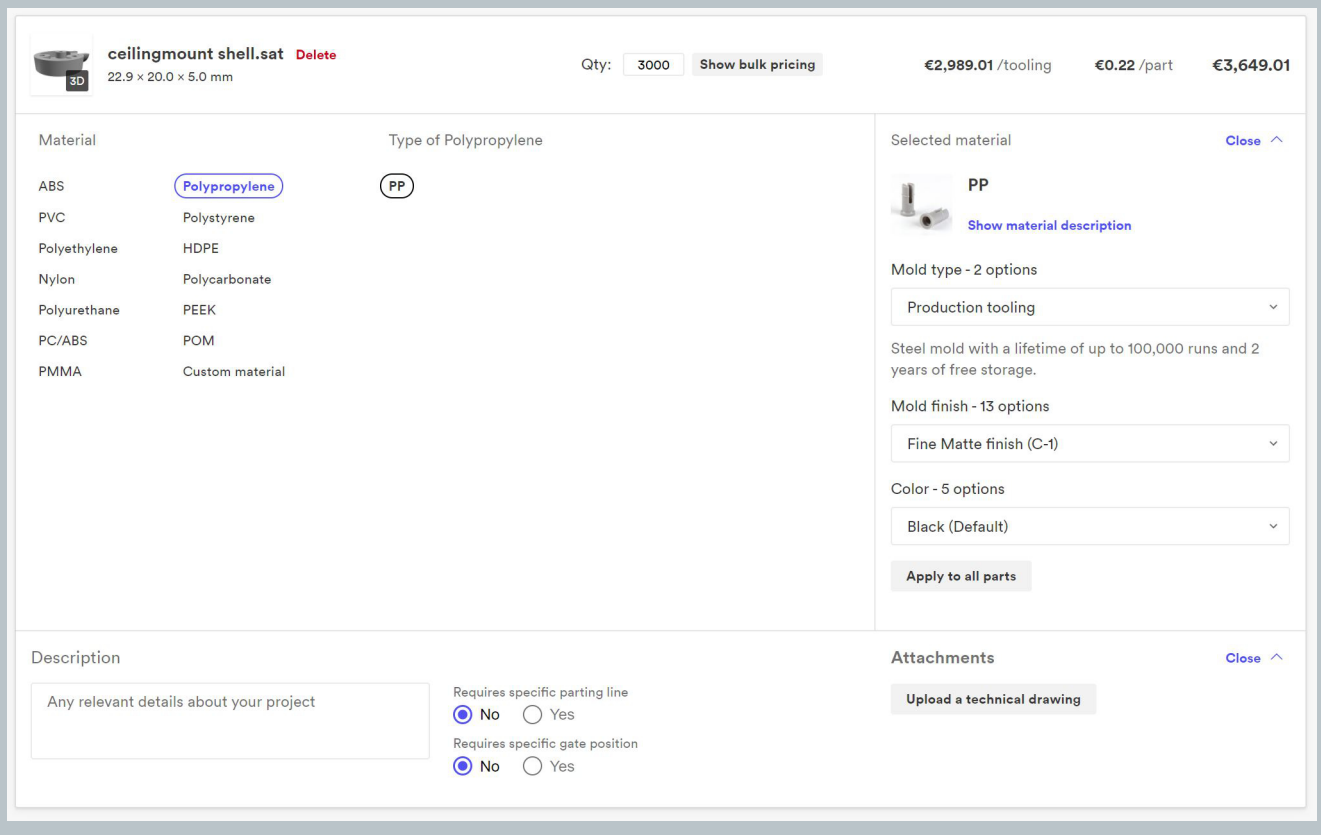
As the inputs needed for the product remote is the same or less than the IKEA trådfri, the volume of the PCB Is assumed as the needed volume in the product remote. Due to the lacking interface on the IKEA unit, a larger battery might be needed for the product remote.

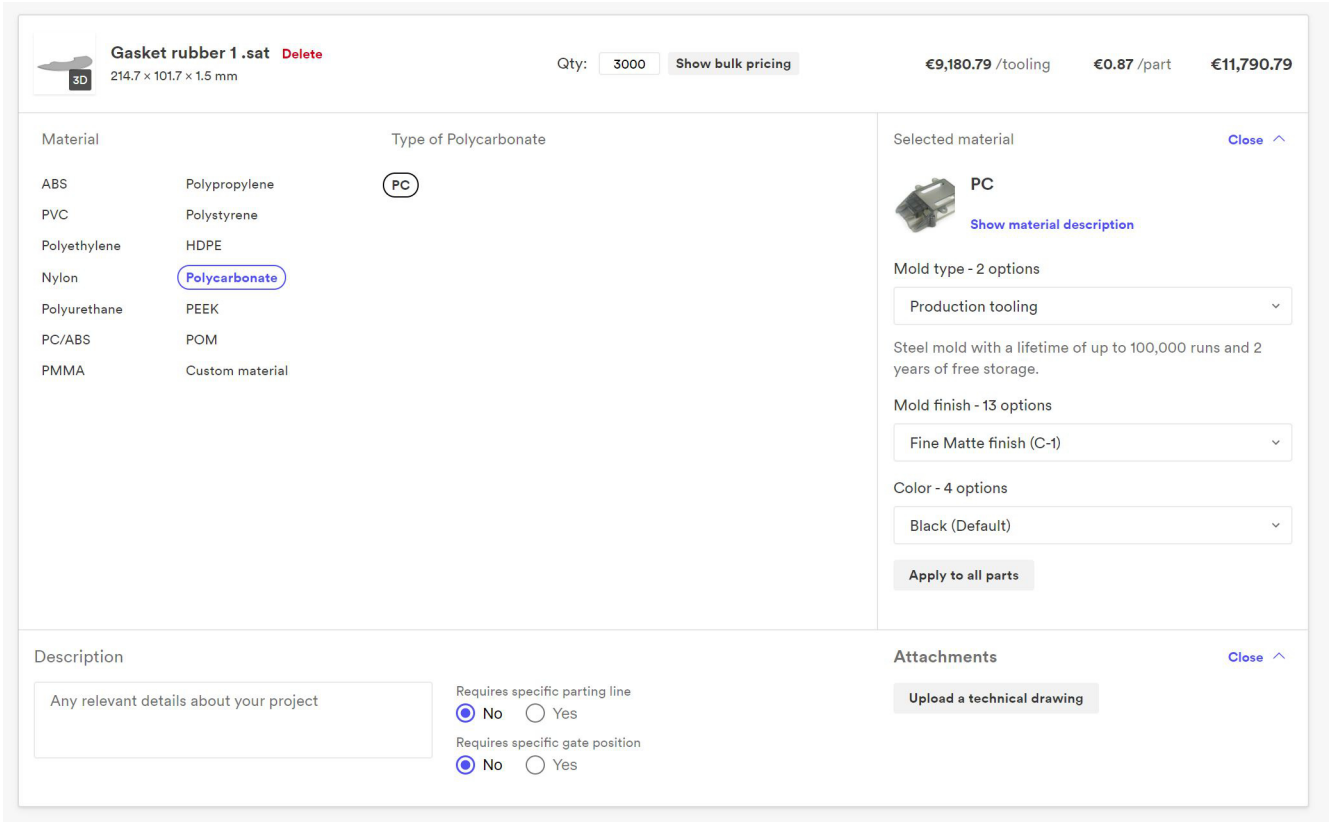
Remote PCB dimensions are defined

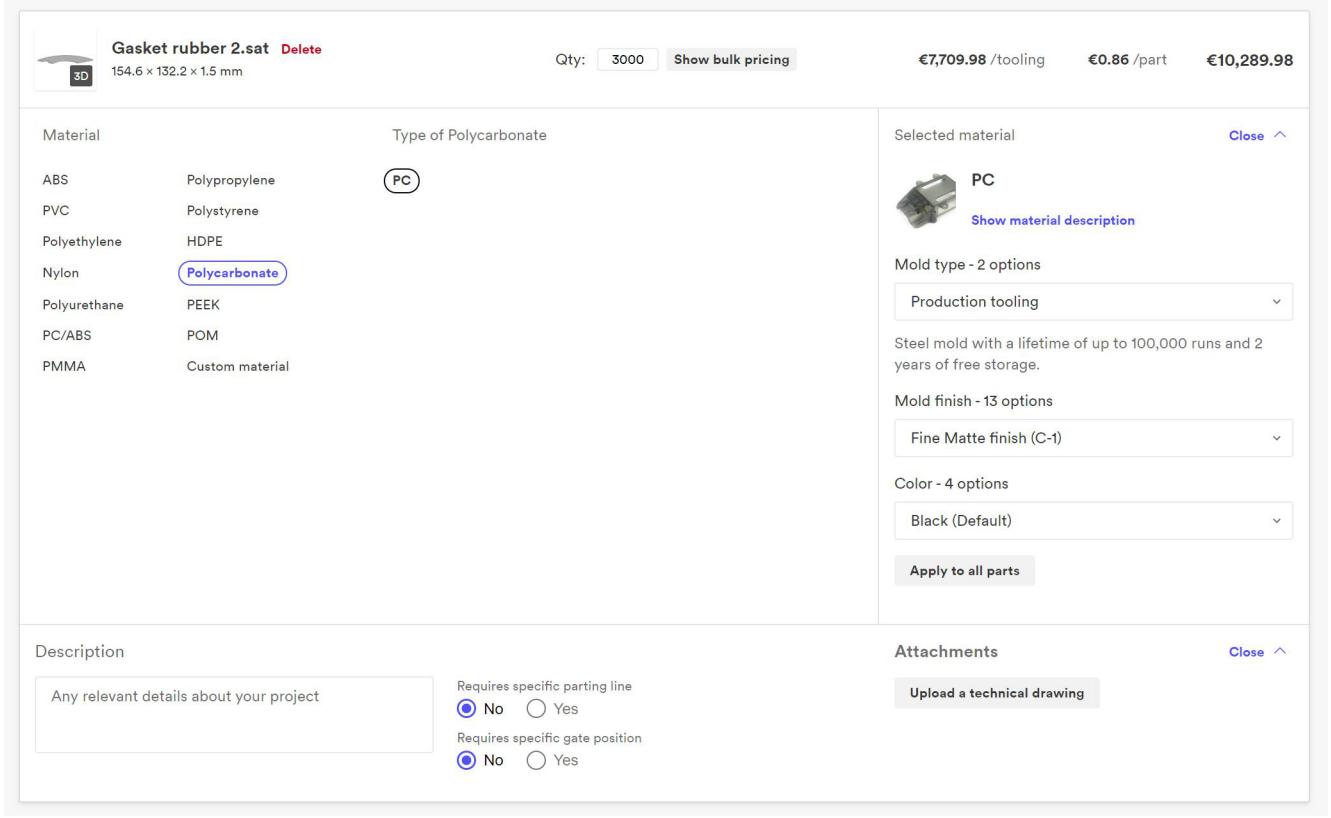
Speaker needs to be able to connect to the speaker with Zigbee

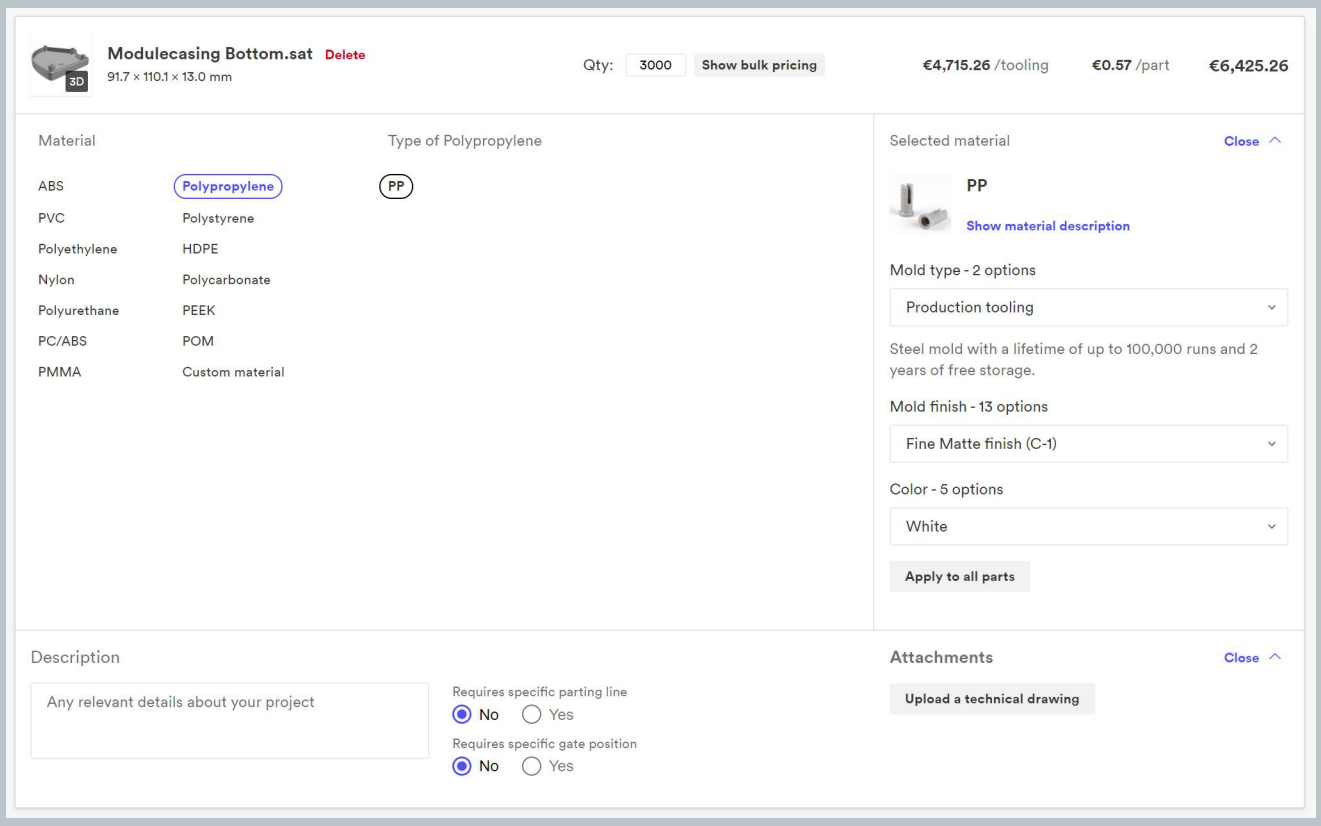
40. Canopy Production Quotes

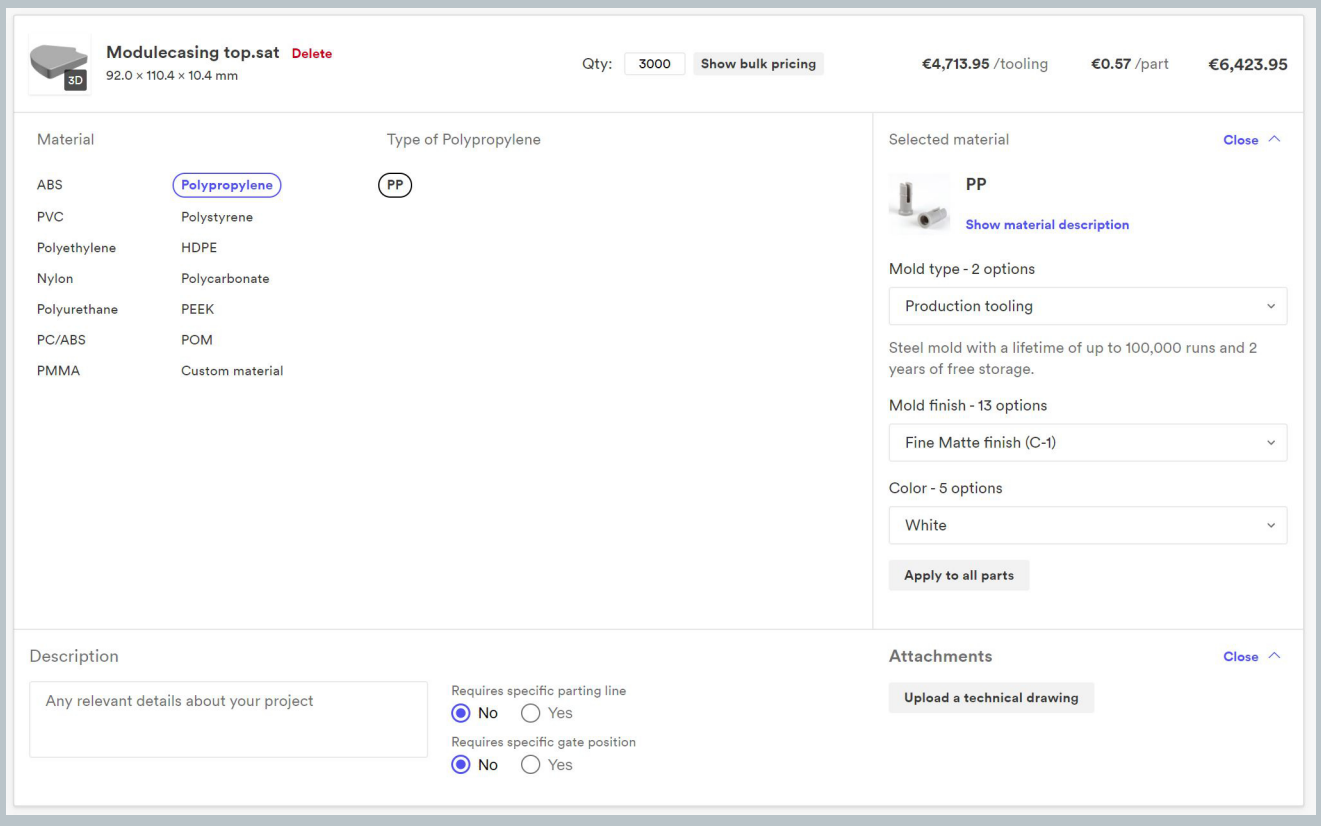


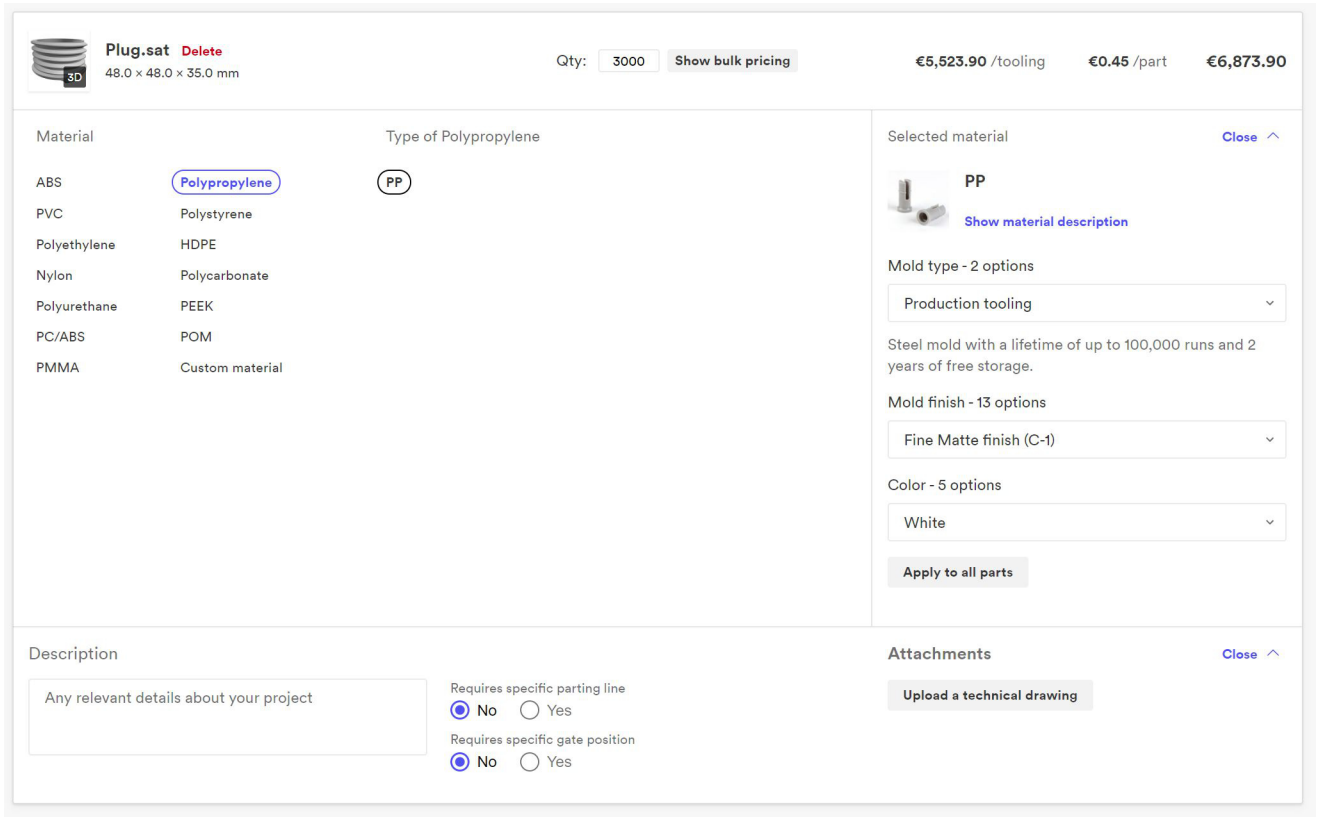


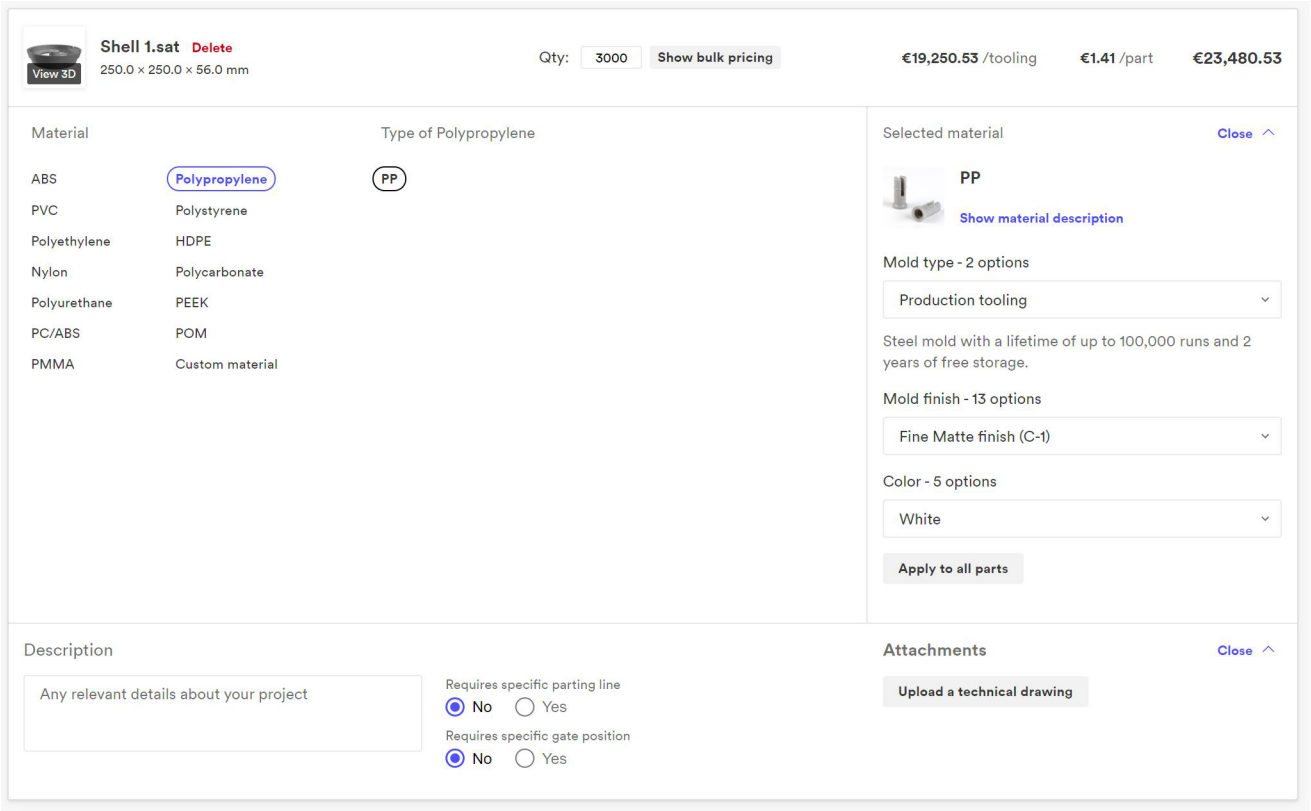

Gasket rubber 1 .sat Delete
214.7 × 101.7 × 1.5 mm
Qty: 3000 Show bulk pricing
€9,180.79 /tooling
€0.87 /part
€11,790.79
Material
Type of Polycarbonate
ABS
Polypropylene
PC
PVC
Polystyrene
Polyethylene
HDPE
Nylon
Polycarbonate
Polyurethane
PEEK
PC/ABS
POM
PMMA
Custom material
Selected material
Close
PC
Show material description
Mold type - 2 options
Production tooling
Steel mold with a lifetime of up to 100,000 runs and 2 years of free storage.
Mold finish - 13 options
Fine Matte finish (C-1)
Color - 4 options
Black (Default)
Apply to all parts
Description
Any relevant details about your project
Requires specific parting line
No
Yes
Requires specific gate position
No
Yes
Attachments
Close
Upload a technical drawing

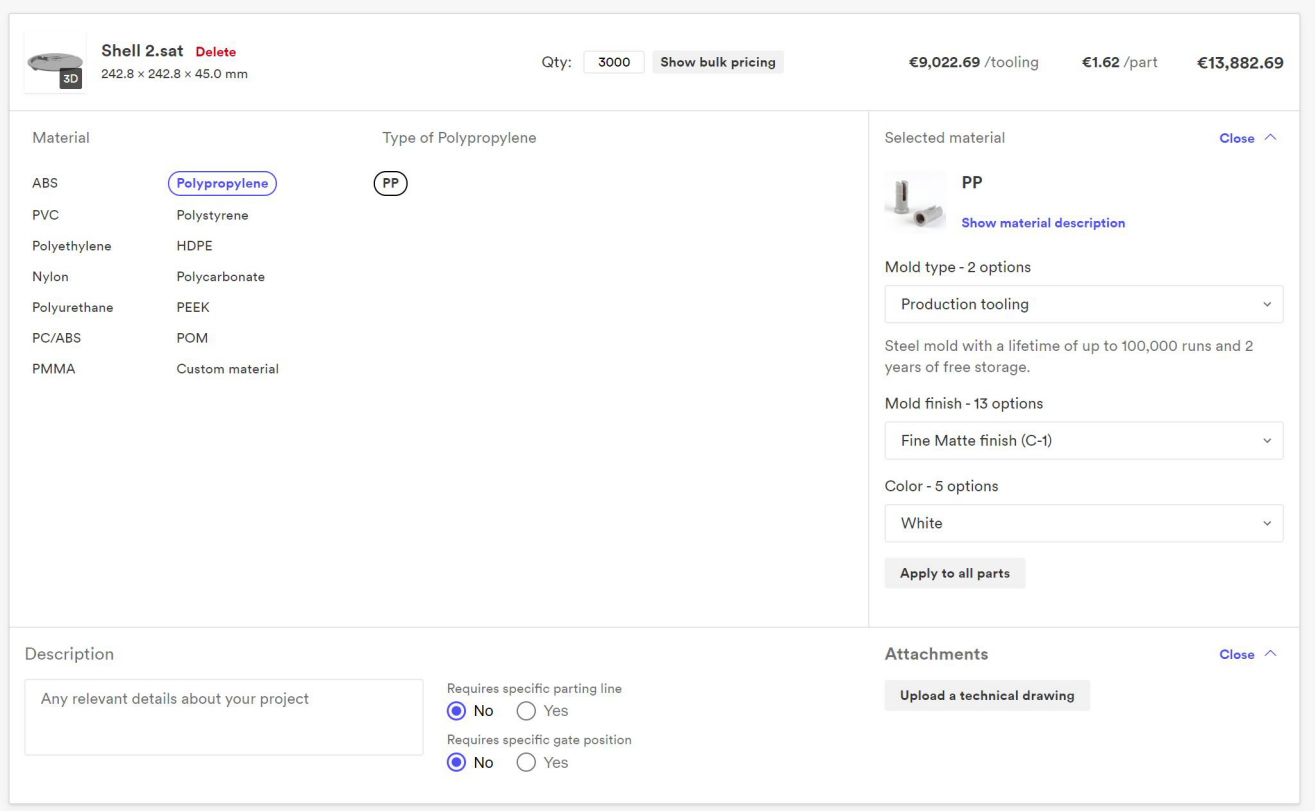

Gasket rubber 2.sat Delete
154.6 × 132.2 × 1.5 mm
Qty: 3000 Show bulk pricing
€7,709.98 /tooling
€0.86 /part
€10,289.98
Material
Type of Polycarbonate
ABS
Polypropylene
PC
PVC
Polystyrene
Polyethylene
HDPE
Nylon
Polycarbonate
Polyurethane
PEEK
PC/ABS
POM
PMMA
Custom material
Selected material
Close
PC
Show material description
Mold type - 2 options
Production tooling
Steel mold with a lifetime of up to 100,000 runs and 2 years of free storage.
Mold finish - 13 options
Fine Matte finish (C-1)
Color - 4 options
Black (Default)
Apply to all parts
Description
Any relevant details about your project
Requires specific parting line
No
Yes
Requires specific gate position
No
Yes
Attachments
Close
Upload a technical drawing


Modulecasing Bottom.sat Delete
91.7 × 110.1 × 13.0 mm
Qty: 3000 Show bulk pricing
€4,715.26 /tooling €0.57 /part €6,425.26
Material
Type of Polypropylene
ABS Polypropylene
PVC Polystyrene
Polyethylene HDPE
Nylon Polycarbonate
Polyurethane PEEK
PC/ABS POM
PMMA Custom material
PP
Selected material Close
PP
Show material description
Mold type - 2 options
Production tooling
Steel mold with a lifetime of up to 100,000 runs and 2 years of free storage.
Mold finish - 13 options
Fine Matte finish (C-1)
Color - 5 options
White
Apply to all parts
Description
Any relevant details about your project
Requires specific parting line
No Yes
Requires specific gate position
No Yes
Attachments Close
Upload a technical drawing

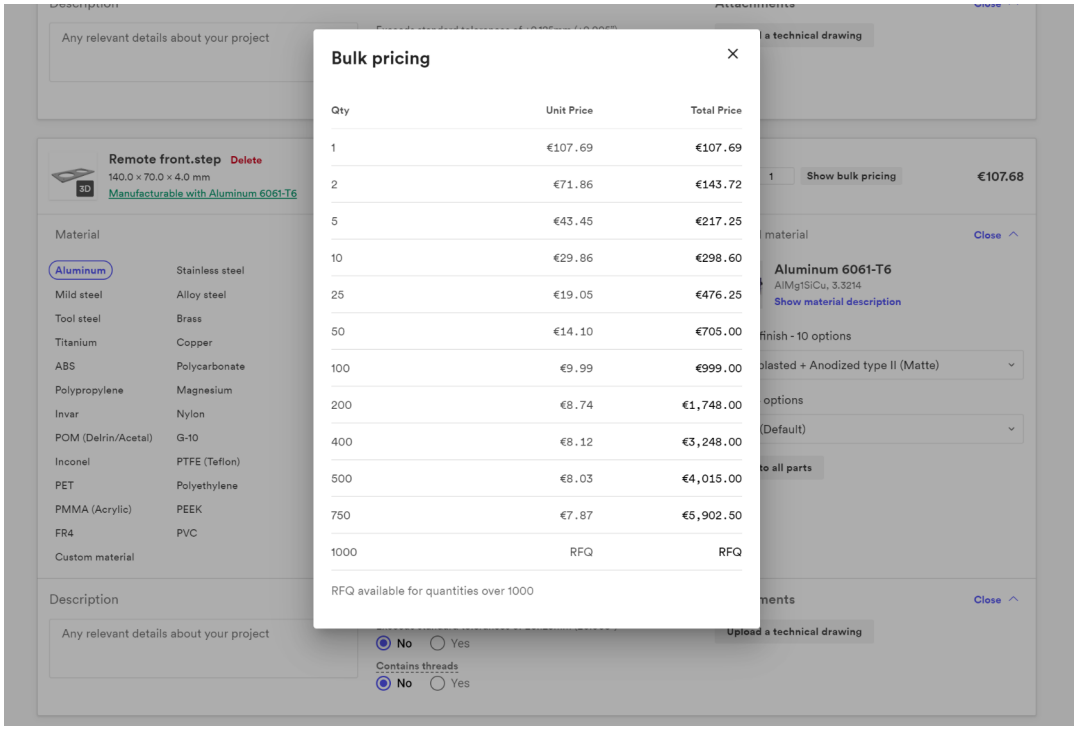

Modulecasing top.sat Delete
92.0 × 110.4 × 10.4 mm
Qty: 3000 Show bulk pricing
€4,713.95 /tooling €0.57 /part €6,423.95
Material
Type of Polypropylene
ABS Polypropylene
PVC Polystyrene
Polyethylene HDPE
Nylon Polycarbonate
Polyurethane PEEK
PC/ABS POM
PMMA Custom material
PP
Selected material Close
PP
Show material description
Mold type - 2 options
Production tooling
Steel mold with a lifetime of up to 100,000 runs and 2 years of free storage.
Mold finish - 13 options
Fine Matte finish (C-1)
Color - 5 options
White
Apply to all parts
Description
Any relevant details about your project
Requires specific parting line
No Yes
Requires specific gate position
No Yes
Attachments Close
Upload a technical drawing

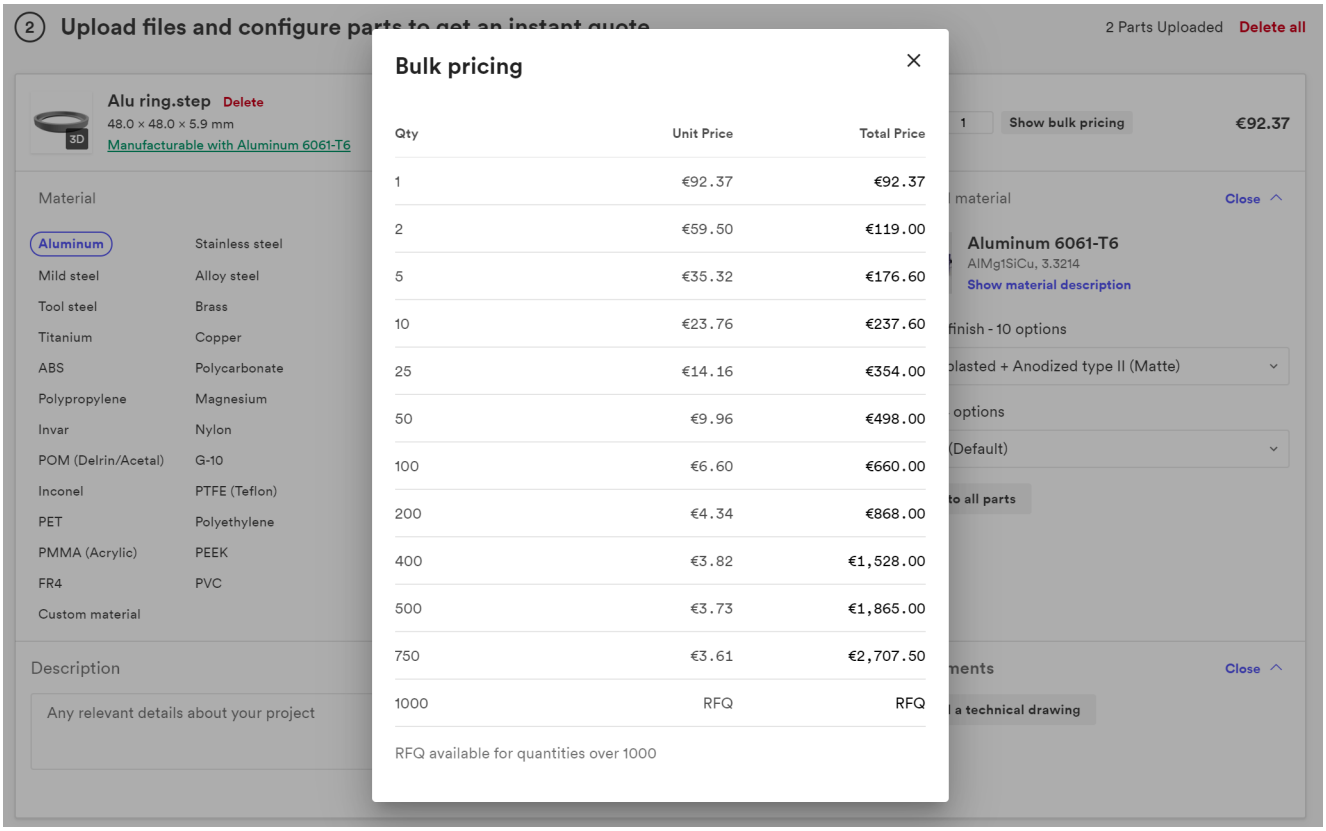

Plug.sat Delete
48.0 × 48.0 × 35.0 mm
Qty: 3000 Show bulk pricing
€5,523.90 /tooling €0.45 /part €6,873.90
Material
Type of Polypropylene
ABS Polypropylene PP
PVC Polystyrene
Polyethylene HDPE
Nylon Polycarbonate
Polyurethane PEEK
PC/ABS POM
PMMA Custom material
Selected material Close
PP
Show material description
Mold type - 2 options
Production tooling
Steel mold with a lifetime of up to 100,000 runs and 2 years of free storage.
Mold finish - 13 options
Fine Matte finish (C-1)
Color - 5 options
White
Apply to all parts
Description
Any relevant details about your project
Requires specific parting line
No Yes
Requires specific gate position
No Yes
Attachments Close
Upload a technical drawing

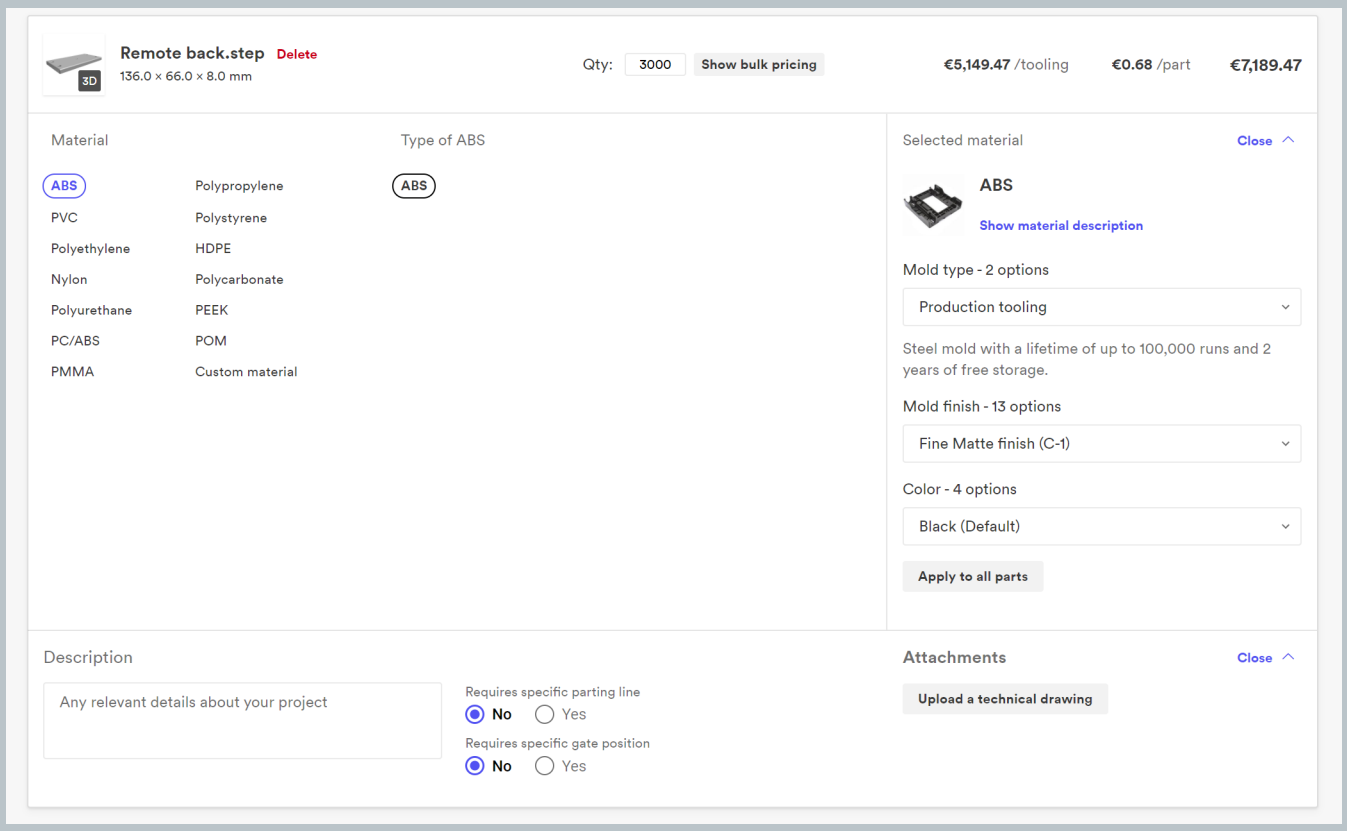

Shell 1.sat Delete
250.0 × 250.0 × 56.0 mm
View 3D
Qty: 3000 Show bulk pricing
€19,250.53 /tooling €1.41 /part €23,480.53
Material
Type of Polypropylene
ABS Polypropylene PP
PVC Polystyrene
Polyethylene HDPE
Nylon Polycarbonate
Polyurethane PEEK
PC/ABS POM
PMMA Custom material
Selected material Close
PP
Show material description
Mold type - 2 options
Production tooling
Steel mold with a lifetime of up to 100,000 runs and 2 years of free storage.
Mold finish - 13 options
Fine Matte finish (C-1)
Color - 5 options
White
Apply to all parts
Description
Any relevant details about your project
Requires specific parting line
No Yes
Requires specific gate position
No Yes
Attachments Close
Upload a technical drawing

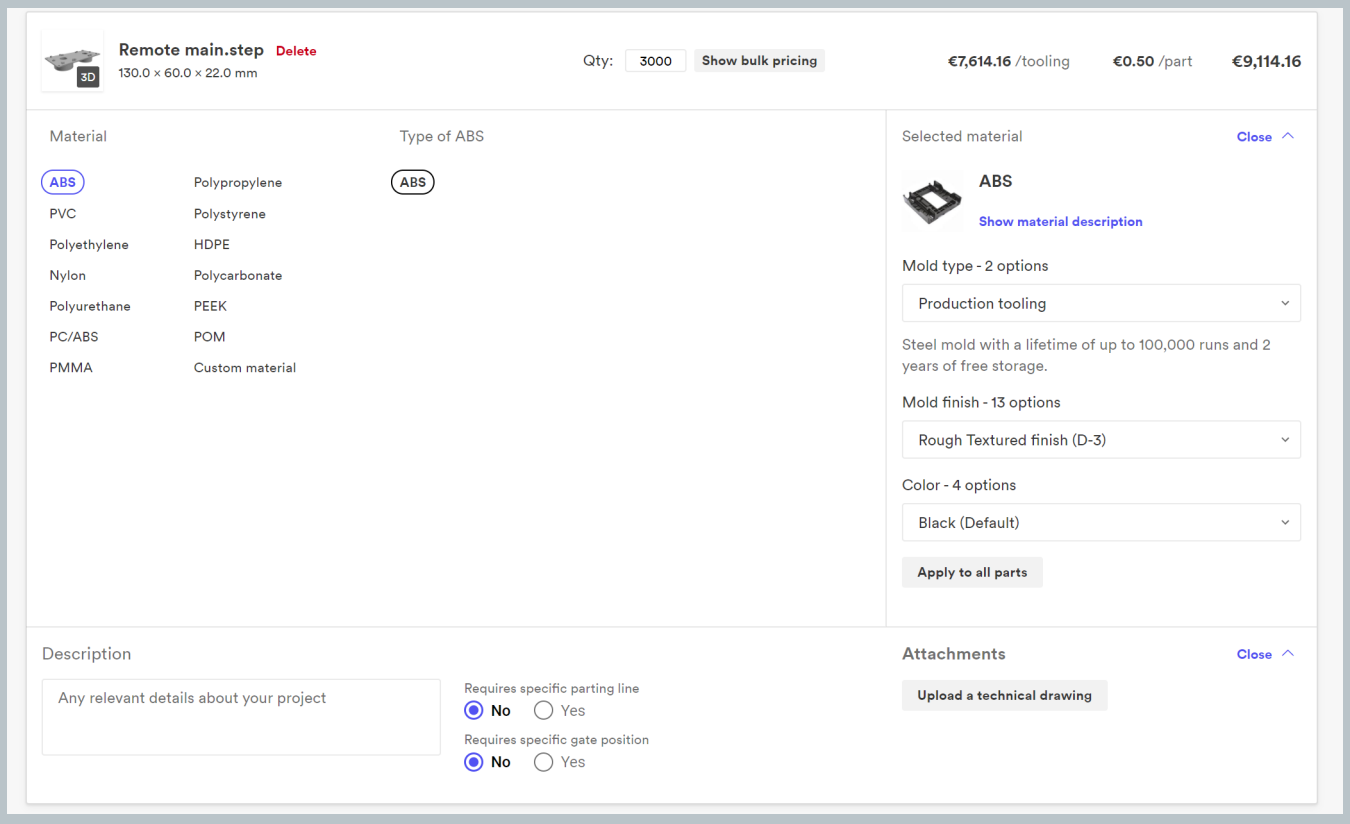

Shell 2.sat Delete
242.8 × 242.8 × 45.0 mm
Qty: 3000 Show bulk pricing
€9,022.69 /tooling
€1.62 /part
€13,882.69
Material
Type of Polypropylene
ABS
Polypropylene
PP
PVC
Polystyrene
Polyethylene
HDPE
Nylon
Polycarbonate
Polyurethane
PEEK
PC/ABS
POM
PMMA
Custom material
Selected material
Close
PP
Show material description
Mold type - 2 options
Production tooling
Steel mold with a lifetime of up to 100,000 runs and 2 years of free storage.
Mold finish - 13 options
Fine Matte finish (C-1)
Color - 5 options
White
Apply to all parts
Description
Any relevant details about your project
Requires specific parting line
No
Yes
Requires specific gate position
No
Yes
Attachments
Close
Upload a technical drawing

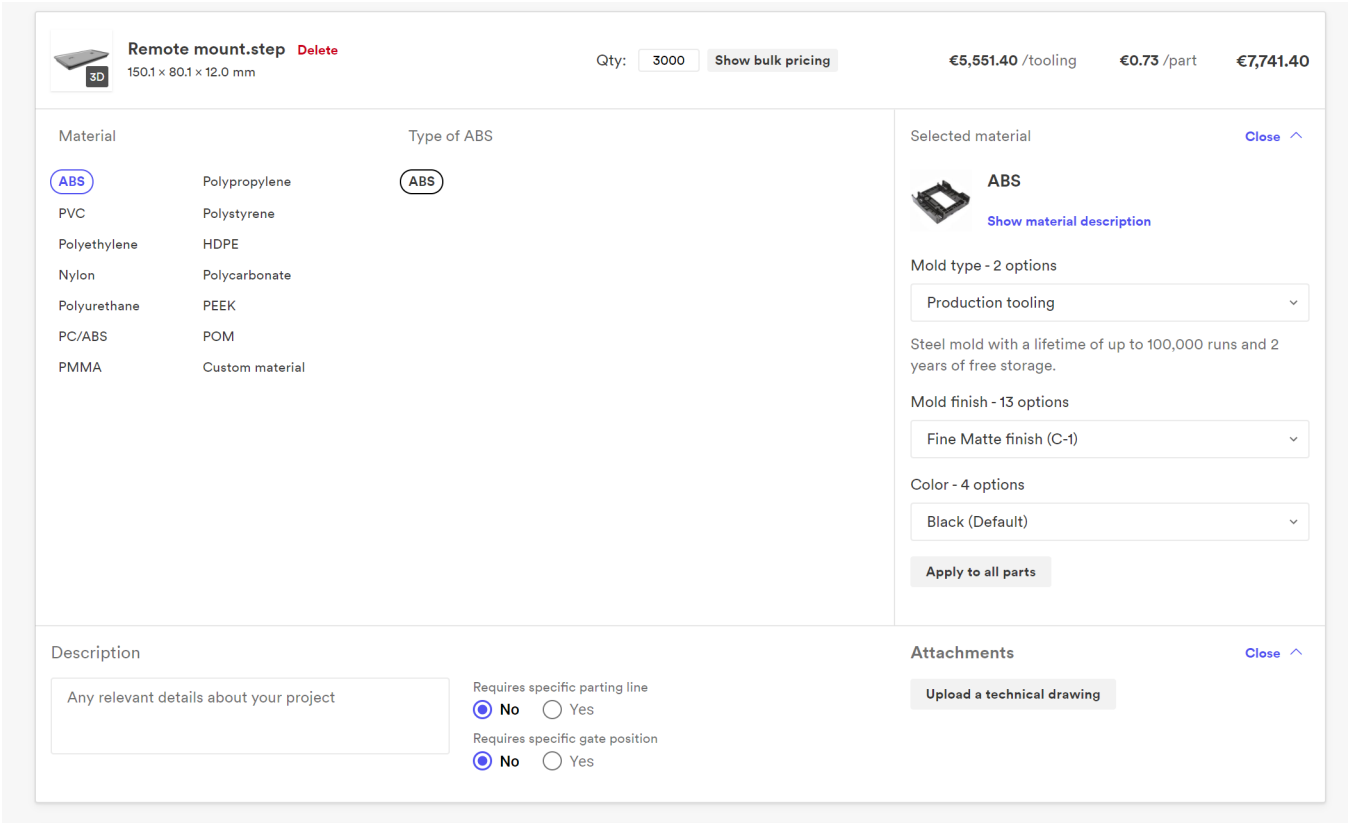
41. Remote Production quotes

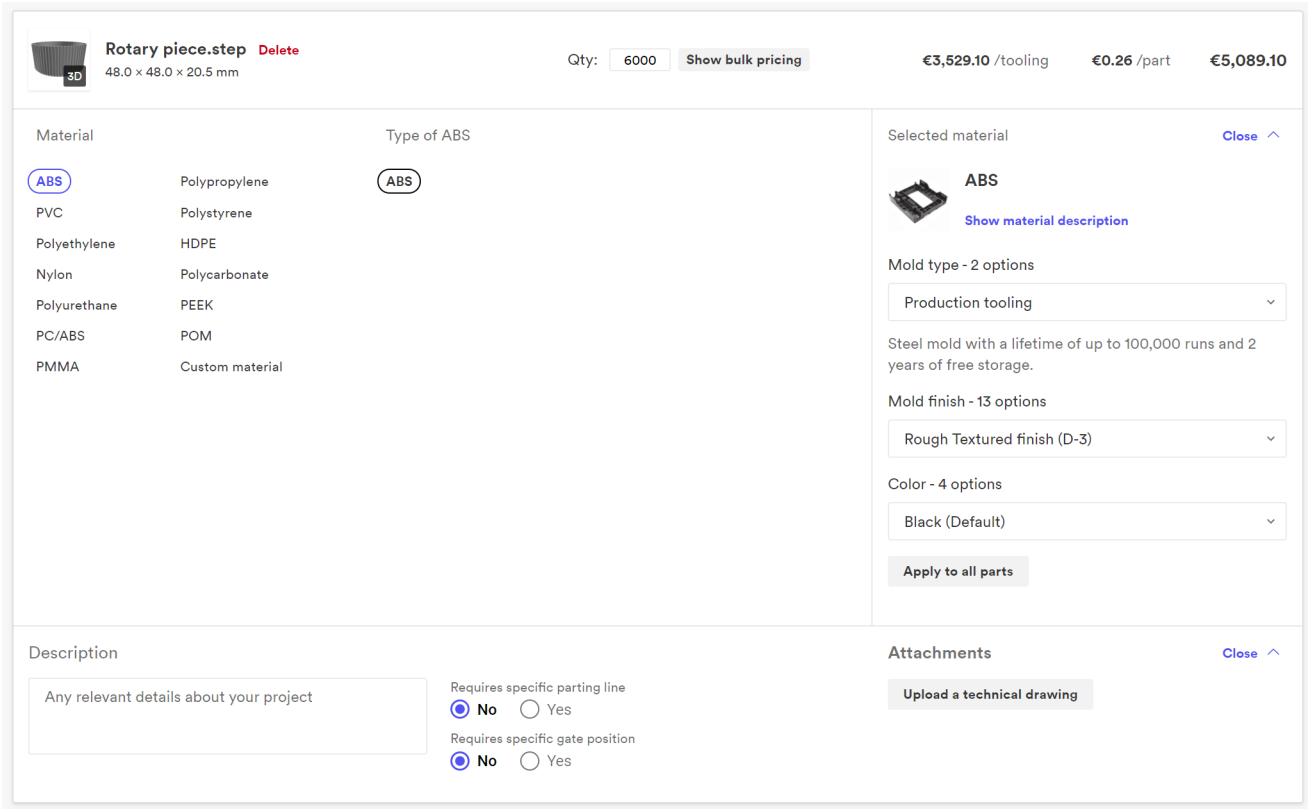


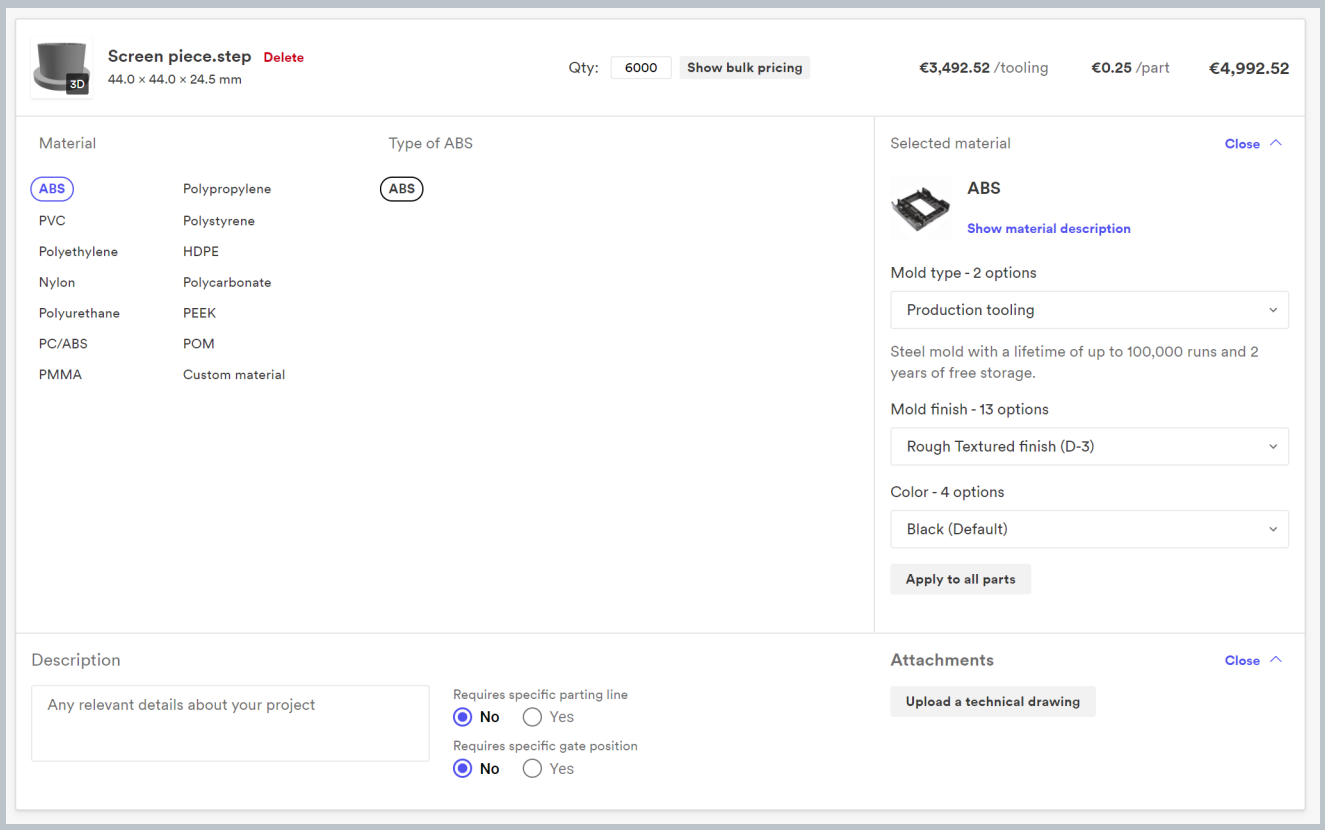



Remote back.step
Delete
136.0 × 66.0 × 8.0 mm
Qty: 3000
Show bulk pricing
€5,149.47 /tooling
€0.68 /part
€7,189.47
Material
Type of ABS
ABS
PVC
Polyethylene
Nylon
Polyurethane
PC/ABS
PMMA
Polypropylene
Polystyrene
HDPE
Polycarbonate
PEEK
POM
Custom material
ABS
Selected material
Close
ABS
Show material description
Mold type - 2 options
Production tooling
Steel mold with a lifetime of up to 100,000 runs and 2 years of free storage.
Mold finish - 13 options
Fine Matte finish (C-1)
Color - 4 options
Black (Default)
Apply to all parts
Description
Any relevant details about your project
Requires specific parting line
No
Yes
Requires specific gate position
No
Yes
Attachments
Close
Upload a technical drawing


Remote main.step
Delete
130.0 × 60.0 × 22.0 mm
Qty: 3000
Show bulk pricing
€7,614.16 /tooling
€0.50 /part
€9,114.16
Material
Type of ABS
ABS
PVC
Polyethylene
Nylon
Polyurethane
PC/ABS
PMMA
Polypropylene
Polystyrene
HDPE
Polycarbonate
PEEK
POM
Custom material
ABS
Selected material
Close
ABS
Show material description
Mold type - 2 options
Production tooling
Steel mold with a lifetime of up to 100,000 runs and 2 years of free storage.
Mold finish - 13 options
Rough Textured finish (D-3)
Color - 4 options
Black (Default)
Apply to all parts
Description
Any relevant details about your project
Requires specific parting line
No
Yes
Requires specific gate position
No
Yes
Attachments
Close
Upload a technical drawing


Remote mount.step Delete
150.1 × 80.1 × 12.0 mm
Qty: 3000 Show bulk pricing
€5,551.40 /tooling €0.73 /part €7,741.40
Material
Type of ABS
ABS
PVC
Polyethylene
Nylon
Polyurethane
PC/ABS
PMMA
Polypropylene
Polystyrene
HDPE
Polycarbonate
PEEK
POM
Custom material
ABS
Selected material
Close
ABS
Show material description
Mold type - 2 options
Production tooling
Steel mold with a lifetime of up to 100,000 runs and 2 years of free storage.
Mold finish - 13 options
Fine Matte finish (C-1)
Color - 4 options
Black (Default)
Apply to all parts
Description
Any relevant details about your project
Requires specific parting line
No
Yes
Requires specific gate position
No
Yes
Attachments
Close
Upload a technical drawing


Rotary piece.step Delete
48.0 × 48.0 × 20.5 mm
Qty: 6000 Show bulk pricing
€3,529.10 /tooling €0.26 /part €5,089.10
Material
Type of ABS
ABS
PVC
Polyethylene
Nylon
Polyurethane
PC/ABS
PMMA
Polypropylene
Polystyrene
HDPE
Polycarbonate
PEEK
POM
Custom material
ABS
Selected material
Close
ABS
Show material description
Mold type - 2 options
Production tooling
Steel mold with a lifetime of up to 100,000 runs and 2 years of free storage.
Mold finish - 13 options
Rough Textured finish (D-3)
Color - 4 options
Black (Default)
Apply to all parts
Description
Any relevant details about your project
Requires specific parting line
No
Yes
Requires specific gate position
No
Yes
Attachments
Close
Upload a technical drawing


Screen piece.step Delete
44.0 × 44.0 × 24.5 mm
Qty: 6000 Show bulk pricing
€3,492.52 /tooling
€0.25 /part
€4,992.52
Material
Type of ABS
ABS
PVC
Polyethylene
Nylon
Polyurethane
PC/ABS
PMMA
Polypropylene
Polystyrene
HDPE
Polycarbonate
PEEK
POM
Custom material
ABS
Selected material
Close
ABS
Show material description
Mold type - 2 options
Production tooling
Steel mold with a lifetime of up to 100,000 runs and 2 years of free storage.
Mold finish - 13 options
Rough Textured finish (D-3)
Color - 4 options
Black (Default)
Apply to all parts
Description
Any relevant details about your project
Requires specific parting line
No
Yes
Requires specific gate position
No
Yes
Attachments
Close
Upload a technical drawing

42. Businessplan Canopy

Production price

Retailer	ODM price	1,042.05 kr.	
	Constribution margin (Dynaudio)	677.34 kr.	65.00%
	Sales price (At Dynaudio plant)	1,719.39 kr.	
	Constribution Retail	687.76 kr.	40.00%
	Retail price (excl. VAT)	2,407.14 kr.	
	VAT	601.79 kr.	25.00%
	Retail price (incl. VAT	3,008.93 kr.	

Tooling Cost

Tooling	Cost (Euro)
Shell 1	€19,250.00
Shell 2	€9,022.00
Plug	€5,523.00
Modulecasing Bot	€4,715.00
Modulecasing Top	€4,715.00
Ceiling mount shell	€2,389.00
Rubber gasket	€9,180.00
Rubber gasket 2	€7,709.00
Grill est	€9,000.00
Total	€71,503.00
in DKK	539,847.65 kr.

Initial investment

Project cost	Price EUR	PCS	Cost EUR
Tooling	€71,503.00	€1.00	€71,503.00
Acoustic eng. hours	€40.00	€300.00	€12,000.00
HW dev hours	€40.00	€500.00	€20,000.00
Traveling	€12,500.00	€1.00	€12,500.00
Certification	€200,000.00	€1.00	€200,000.00
Prototyping	€40,000.00	€1.00	€40,000.00

Business case speakers (Retail)			
Decrease	100%	90.00%	80.00%
	Year 1	Year 2	Year 3
Units sold	6,250.00	5625	4500
Sales price (Factory)	1,719.39 kr.	1,719.39 kr.	1,719.39 kr.
Production cost	-1,042.05 kr.	-1,042.05 kr.	-1,042.05 kr.
Turn over	10,746,181.88 kr	9,671,563.69 kr.	7,737,250.95 kr.
Variable cost	-6,512,837.50 kr.	-5,861,553.75 kr.	-4,689,243.00 kr.
Contribution margin	4,233,344.38 kr.	3,810,009.94 kr.	3,048,007.95 kr.
Investment	-2,687,822.65 kr.	1,545,521.73 kr.	5,355,531.66 kr.
Remaining	1,545,521.73 kr.	5,355,531.66 kr.	8,403,539.61 kr.

43. Upgrade Module Business plan

Cost - Investment

Remote	Part	pcs	price pr pcs	price	in dkk						
	Alu ring	2	€3.61	€7.22	54.51 kr.		Remote	Tooling	price		
	Alu front	1	€7.87	€7.87	59.42 kr.			Back	€5,150.00		
	Back	1	€0.68	€0.68	5.13 kr.			Main	€7,614.00		
	Main	1	€0.50	€0.50	3.78 kr.			Mount	€5,551.00		
	Mount	1	€0.73	€0.73	5.51 kr.			Rotary piece	€3,529.00		
	Rotary	2	€0.26	€0.52	3.93 kr.	142.09 kr.		Screen piece	€3,492.00		
	Screen piece	2	€0.25	€0.50	3.78 kr.			Total	€25,336.00		
	E-ink screen	2	€5.66	€11.32	85.49 kr.			12			
	PCB	1	€5.00	€5.00	37.75 kr.	127.01 kr.					
	screws	1	€1.30	€1.30	9.82 kr.						
	labour	1	€3.25	€3.25	24.54 kr.						
	Packaging	1	€4.55	€4.55	34.35 kr.			in dkk	in euro	est price for PCB 1/3	
	Total			€43.44	327.99 kr.		ikea remote	120	15.6	5.2	
							https://www.ikea.com/dk/da/p/tradfri-fjernb		PCB price		
	ODM margin			€10.86	82.00 kr.	25%					
	Price at ODM			€54.30	409.99 kr.						
	Contribution margin (Dynaudio)			€21.72	164.00 kr.	40%			REMOTE		
	Price at Dynaudio Plant			€76.03	573.99 kr.				Electronics	123.24 kr.	
	Contribution margin (Retail)			€30.41	229.60 kr.	40%			Mechanical	145.87 kr.	
	Retail price (Excl. VAT)			€106.44	803.59 kr.				Labour	24.54 kr.	
	VAT			€26.61	200.90 kr.	25%			Packaging	34.35 kr.	
	Retail price (Incl. VAT)			€133.04	1,004.48 kr.				ODM margin	82.00 kr.	
									Total	409.99 kr.	
	https://www.aliexpress.com/item/32818722275.html?spm=a2g0o.cart.0.0.44a33c00qSBuyH&mp=1										
	$12.16	79.04 kr.	€10.28								
	https://www.alibaba.com/product-detail/Low-Price-3-9-122-Segments_62434411607.html?spm=a2700.7724857.normalList.93.22cf50ccC1jZdc										
	$6.70	43.55 kr.	€5.66								

Business case Remote			
Decrease	100%	90.00%	80.00%
	Year 1	Year 2	Year 3
Units sold	3125	2813	2250
Sales price (Factory)	573.99 kr.	573.99 kr.	573.99 kr.
Production cost	-409.99 kr.	-409.99 kr.	-409.99 kr.
Turn over	1,793,720.74 kr.	1,614,348.67 kr.	1,291,478.93 kr.
Variable cost	-1,281,229.10 kr.	-1,153,106.19 kr.	-922,484.95 kr.
Contribution margin	512,491.64 kr.	461,242.48 kr.	368,993.98 kr.
Investment	-4,123,332.84 kr.	-3,610,841.20 kr.	-3,149,598.72 kr.
Remaining	-3,610,841.20 kr.	-3,149,598.72 kr.	-2,780,604.74 kr.

44. Remote Business plan

Component price

Electronics	378.64 kr.
Mechanical	234.20 kr.
Labour	105.60 kr.
Packaging	115.20 kr.
ODM margin	208.41 kr.
Total	1,042.05 kr.

Cost

Upgrade module	Component	Price	
	Mainboard	7.51 kr.	
	Case	30.00 kr.	
	Screws + Magnets	5	
	Labour	25	
	Packagin	25	
	ODM margin 25%	23.13 kr.	
	ODM price	115.63 kr.	
	Contribution margin (Dynaudio)	346.90 kr.	300.00%
	Sales prices at Dynaudio Plant	462.54 kr.	
	Contribution margin Retail	185.01 kr.	40%
	Retail price (excl. VAT)	647.55 kr.	
	VAT	161.89 kr.	25%
	Retail price (incl. VAT)	809.44 kr.	

Business case Upgrade modules			
Decrease	100%	90.00%	80.00%
	Year 1	Year 2	Year 3
Units sold	1563	1406	1125
Sales price (Factory)	462.54 kr.	462.54 kr.	462.54 kr.
Production cost	115.63 kr.	115.63 kr.	115.63 kr.
Turn over	722,712.50 kr.	650,441.25 kr.	520,353.00 kr.
Variable cost	180,678.13 kr.	162,610.31 kr.	130,088.25 kr.
Contribution margin	903,390.63 kr.	813,051.56 kr.	650,441.25 kr.
Investment	-200,000.00 kr.	703,390.63 kr.	1,516,442.19 kr.
Remaining	703,390.63 kr.	1,516,442.19 kr.	2,166,883.44 kr.

DYNAUDIO

Ambient 1

Technical Drawings

Msc-ID 04, Group 1
Aalborg University 2020

Jonas Bennedbæk Knudsen
Marcus Heinrich Abrahamsen
Casper Mohr

0.1 Title Page

Title:
Sound of the Future

Project:
Msc-ID04, Aalborg University

Project Start:
03.02.2020

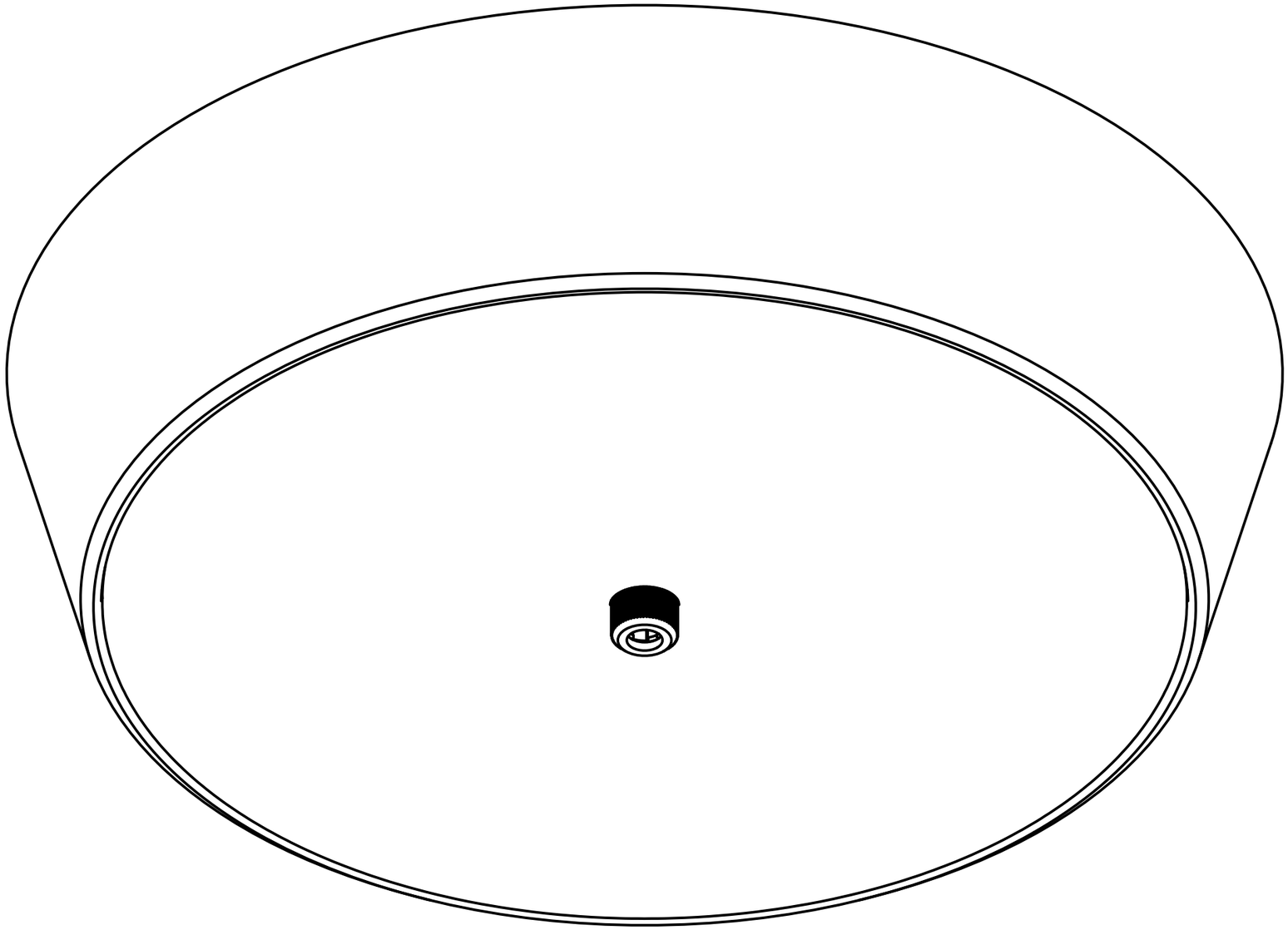
Submission:
03.06.2020

Team-Members:
Jonas Bennedbæk Knudsen
Marcus Heinrich Abrahamsen
Casper Mohr

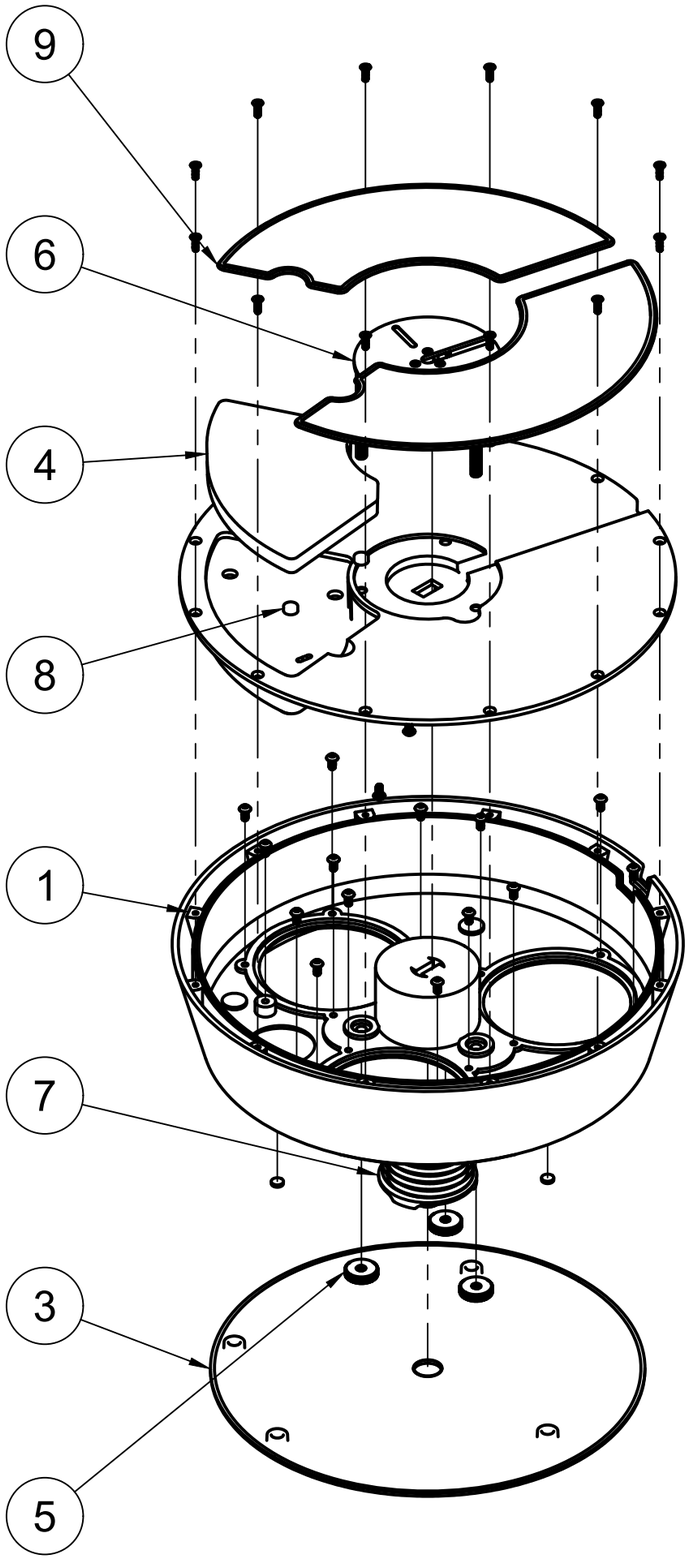
Main Supervisor:
Christian Tollestrup

Technical Supervisor:
Michael Skipper Andersen

Pages:
6



Dept.	Technical reference	Created by	Approved by
		Marcus Abrahamsen 02-06-2020	
		Document type	Document status
		Title: Ambient 1 - Perspective	DWG No.
			Rev. / Date of issue / Sheet: 1/6



Parts List				
Item	Qty	Part Number	Description	Material
1	1	Top Shell		PP-TD20-GF10
2	1	Back Shell		PP-TD20-GF10
3	1	Grill		Steel
4	1	Modulecasing		PP-TD20-GF10
5	3	Thumbnut		Steel
6	1	Ceiling mount		Brass
7	1	Plug		PP-TD20-GF10
8	4	Magnet		Steel
9	1	Rubber Gasket		Steel

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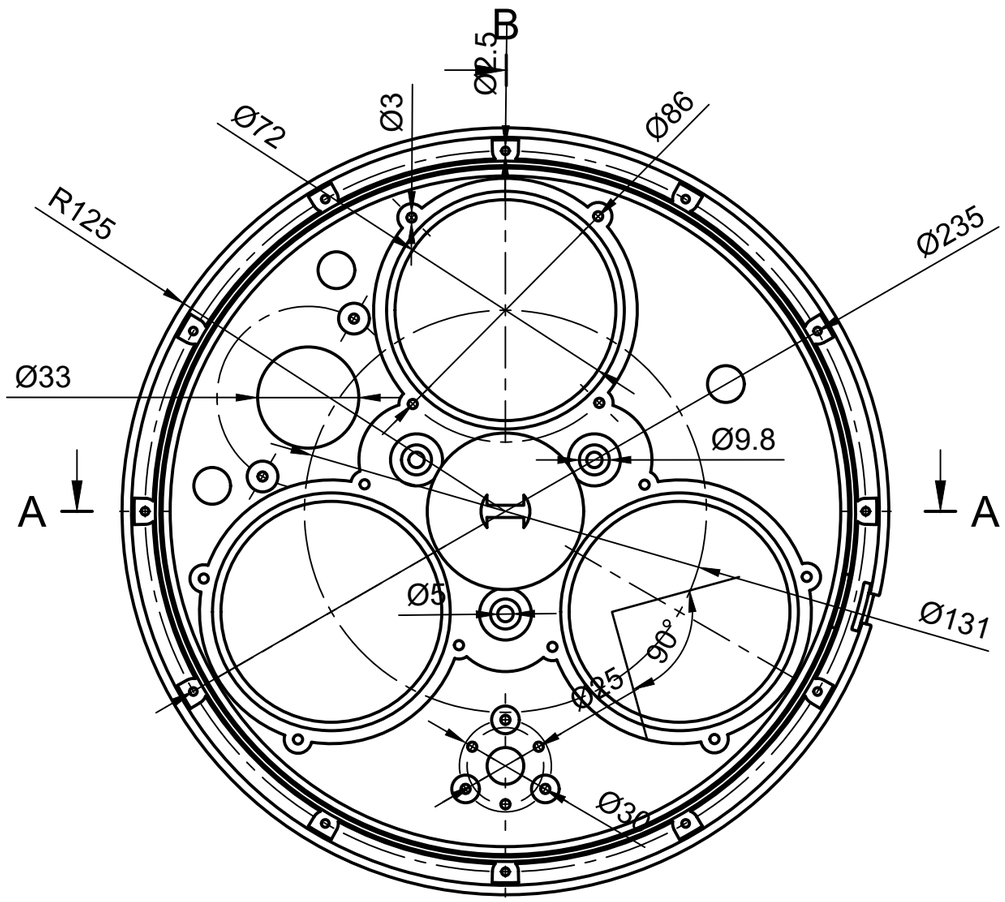
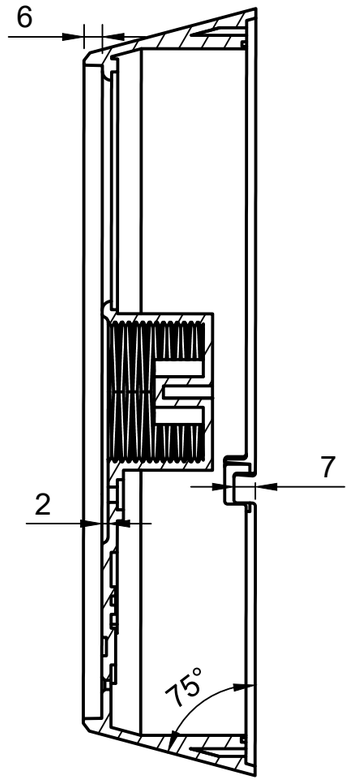
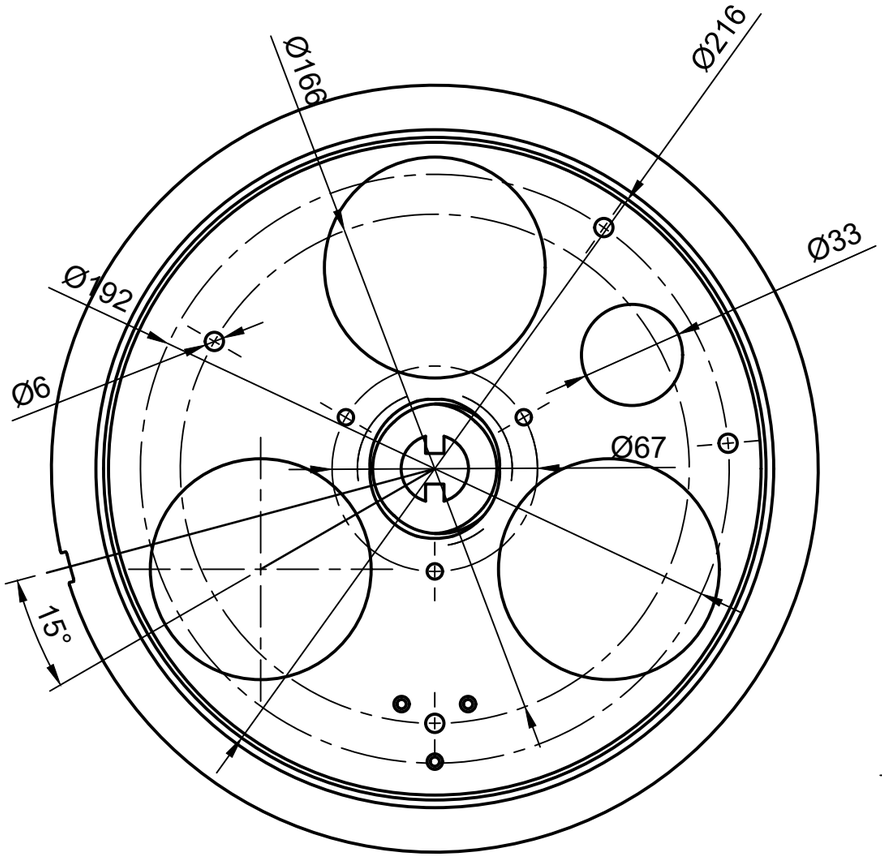
Scale: 1:3		Document type	Document status
		Title: Ambient 1 - Exploded	DWG No.
			Rev. / Date of issue / Sheet: 2/6







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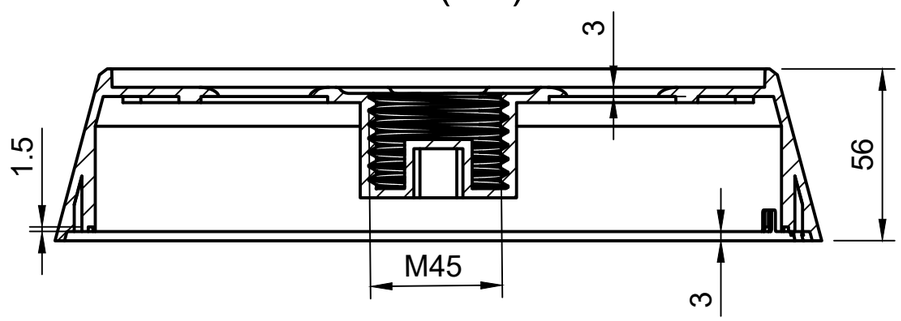
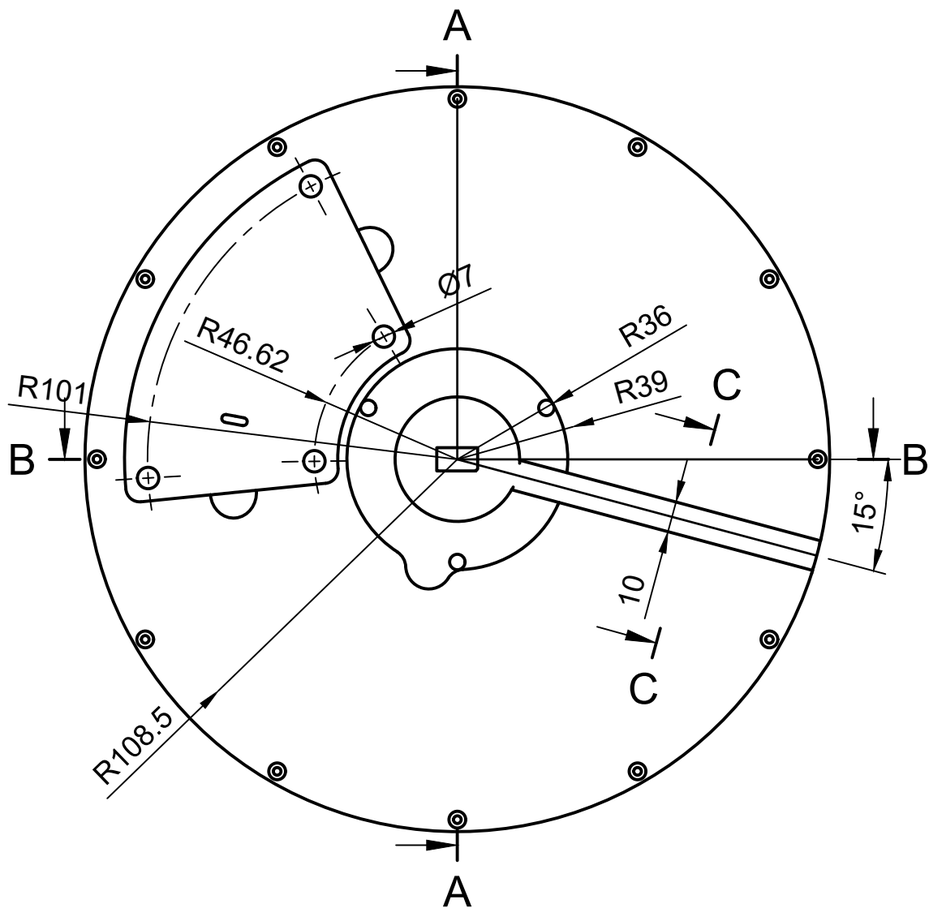
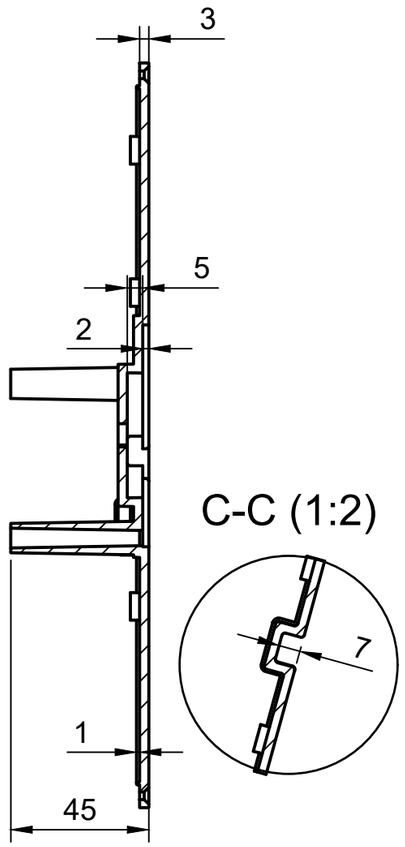


Dept.	Technical reference	Created by	Approved by
		Marcus Abrahamsen 02-06-2020	
Scale		Document type	Document status
1:2		Title: 1 - Top Shell	DWG No.
			Rev. / Date of issue / Sheet: 3/6

A-A (1:2)





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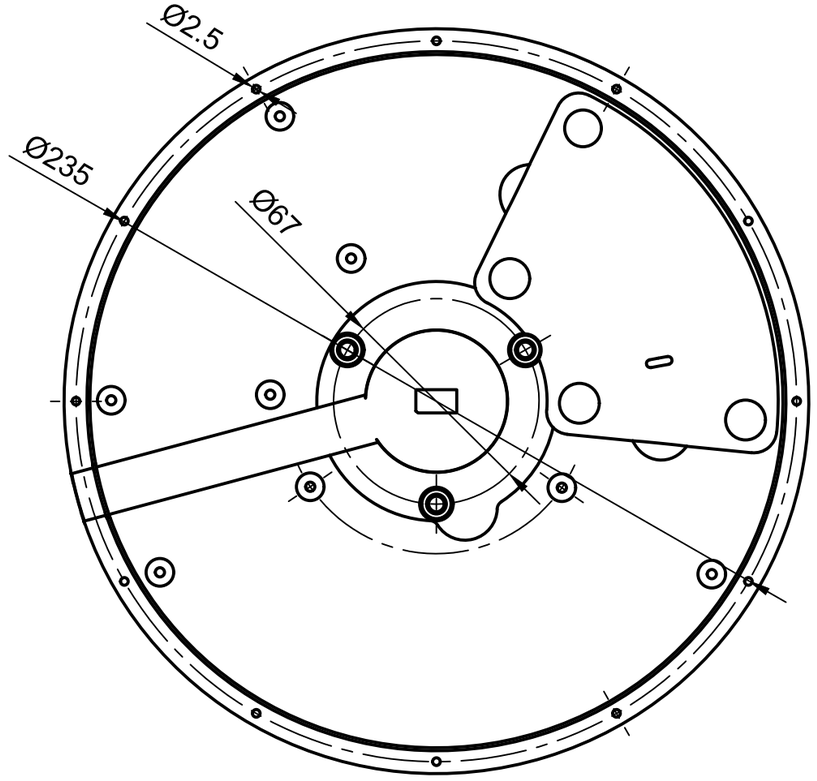

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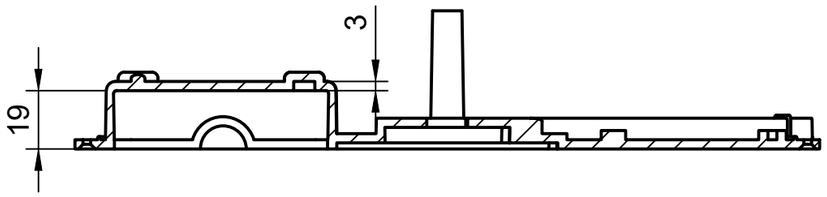
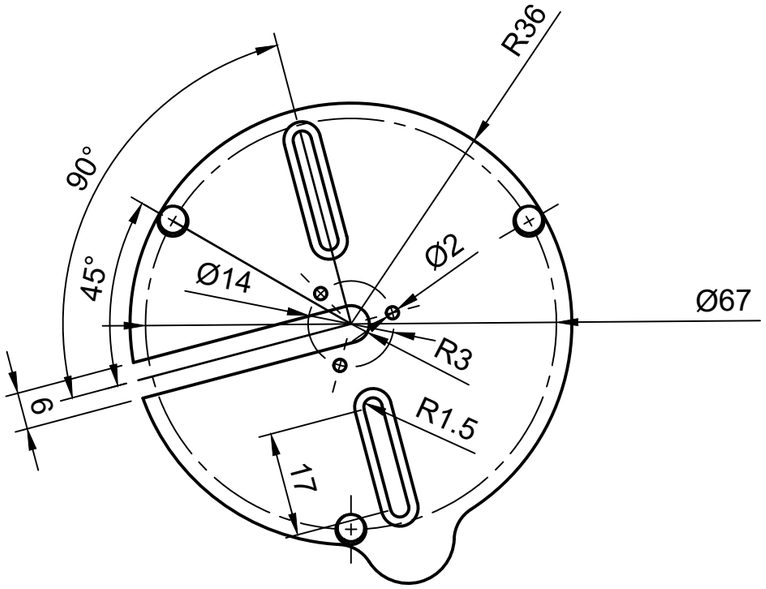
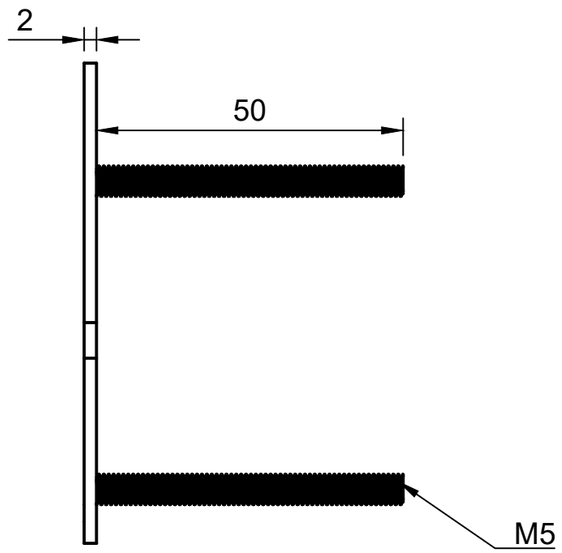
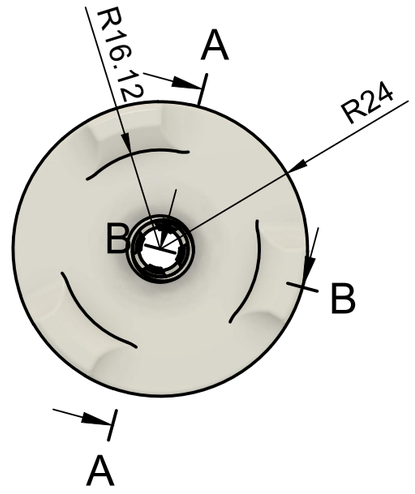


Dept.	Technical reference	Created by	Approved by
		Marcus Abrahamsen 02-06-2020	
Scale 1:2		Document type	Document status
		Title: 2 - Back Shell	DWG No.: 4
			Rev. / Date of issue / Sheet: 4/6





Dept.	Technical reference	Created by Marcus Abrahamsen 02-06-2020	Approved by
Scale 1:1		Document type	Document status
		Title 6 - Celing Mount	DWG No.
			Rev. / Date of issue / Sheet 5/6



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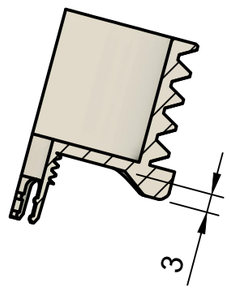

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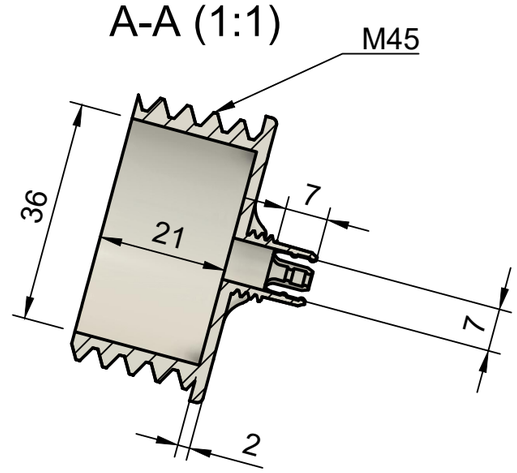

Dept.	Technical reference	Created by Marcus Abrahamsen 02-06-2020	Approved by
Scale 1:1		Document type	Document status
		Title 7 - Plug	DWG No.
			Rev. / Date of issue / Sheet 6/6