DESIGN FOR our future

TU Delft

# IDE Master Graduation

## Project team, Procedural checks and personal Project brief

This document contains the agreements made between student and supervisory team about the student's IDE Master Graduation Project. This document can also include the involvement of an external organisation, however, it does not cover any legal employment relationship that the student and the client (might) agree upon. Next to that, this document facilitates the required procedural checks. In this document:

- The student defines the team, what he/she is going to do/deliver and how that will come about.
- SSC E&SA (Shared Service Center, Education & Student Affairs) reports on the student's registration and study progress.
- IDE's Board of Examiners confirms if the student is allowed to start the Graduation Project.

**USE ADOBE ACROBAT READER TO OPEN, EDIT AND SAVE THIS DOCUMENT**

Download again and reopen in case you tried other software, such as Preview (Mac) or a webbrowser.

### STUDENT DATA & MASTER PROGRAMME

Save this form according the format "IDE Master Graduation Project Brief_familyname_firstname_studentnumber_dd-mm-yyyy".
Complete all blue parts of the form and include the approved Project Brief in your Graduation Report as Appendix 1 !

family name: Gerritsen
initials: P. given name: Pepijn
student number: [redacted]
street & no.:
zipcode & city:
country:
phone:
email:

Your master programme (only select the options that apply to you):

IDE master(s): ★ IPD ○ DfI ○ SPD
2nd non-IDE master:
individual programme: - - (give date of approval)
honours programme: ○ Honours Programme Master
specialisation / annotation: ○ Medisign
○ Tech. in Sustainable Design
○ Entrepeneurship

### SUPERVISORY TEAM

Fill in the required data for the supervisory team members. Please check the instructions on the right !

** chair: Rene van Egmond dept. / section: HCD
** mentor: Stefan Persaud dept. / section: SDE
2nd mentor: Eric van Duin
organisation: Dutch & Dutch
city: Rotterdam country: Netherlands

comments (optional)

Chair should request the IDE Board of Examiners for approval of a non-IDE mentor, including a motivation letter and c.v.

Second mentor only applies in case the assignment is hosted by an external organisation.

Ensure a heterogeneous team. In case you wish to include two team members from the same section, please explain why.

**Procedural Checks** - IDE Master Graduation

TU Delft

## APPROVAL PROJECT BRIEF

To be filled in by the chair of the supervisory team.

chair Rene van Egmond date 24 - 11 - 21 signature

## CHECK STUDY PROGRESS

To be filled in by the SSC E&SA (Shared Service Center, Education & Student Affairs), after approval of the project brief by the Chair.
The study progress will be checked for a 2nd time just before the green light meeting.

Master electives no. of EC accumulated in total: 36 EC

Of which, taking the conditional requirements into account, can be part of the exam programme 30 EC

List of electives obtained before the third semester without approval of the BoE

★ YES all 1st year master courses passed

NO missing 1st year master courses are:

name C. van der Bunt date 29 - 11 - 2021 signature

## FORMAL APPROVAL GRADUATION PROJECT

To be filled in by the Board of Examiners of IDE TU Delft. Please check the supervisory team and study the parts of the brief marked **.
Next, please assess, (dis)approve and sign this Project Brief, by using the criteria below.

- Does the project fit within the (MSc)-programme of the student (taking into account, if described, the activities done next to the obligatory MSc specific courses)?
- Is the level of the project challenging enough for a MSc IDE graduating student?
- Is the project expected to be doable within 100 working days/20 weeks ?
- Does the composition of the supervisory team comply with the regulations and fit the assignment ?

Content: V APPROVED NOT APPROVED

Procedure: V APPROVED NOT APPROVED

comments

name Monique von Morgen date 6/12/2021- signature MvM



Initials & Name P. Gerritsen Student number 460030

Title of Project Embodiment Design of the new Dutch & Dutch loudspeaker

# Embodiment Design of the new Dutch & Dutch loudspeaker

project title

Please state the title of your graduation project (above) and the start date and end date (below). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.

start date 21 - 10 - 2021 25 - 03 - 2021 end date

## INTRODUCTION **

Please describe, the context of your project, and address the main stakeholders (interests) within this context in a concise yet complete manner. Who are involved, what do they value and how do they currently operate within the given context? What are the main opportunities and limitations you are currently aware of (cultural- and social norms, resources (time, money,...), technology, ...).

Dutch & Dutch is a company focused on making and selling innovative high end audio products. The company was founded in 2014 and currently has one product on the market; the '8C' loudspeaker. (See figure 1) The 'C' in 8C stands for Cardioid, this refers to the horizontal radiation pattern of the produced soundwaves. The soundwaves are canceled out at the back of the speaker by anti-sound that escapes the cabinets trough the side vents of the speaker, this leads to the cardioid radiation pattern. The cardioid pattern is shown in figure 2 where 0 degrees corresponds to the usual listening position. The anti-sound is derived from the back of the mid frequency driver and is -per definition- 180 degrees out of phase compared to the waves produced at the front of the driver unit making it suited for noise cancelation at the back of the speaker. This energy from the back of the driver can escape the cabinet and is not absorbed/damped as is the case in most speakers. Therefore, the enclosure will also vibrate way less than is usually the case. The main benefit of the cardioid radiation pattern is that it minimizes the reflections against the wall that is behind the speaker. By eliminating these unwanted reflections, the sound characteristics are much less dependent on the physical properties of the room and the speaker's placement within the room, which is a huge benefit causing the speakers to sound at their best in almost anyone's living room or recording studio without having to use room treatment.

Dutch & Dutch is currently producing and selling 8C but they want to expand their product portfolio. Their customers want something which is even better sounding, especially at lower frequencies and higher volumes. Therefore Dutch & Dutch has made a physically bigger prototype which elaborates on the cardioid sound pattern that makes Dutch & Dutch speakers unique. Sound-wise the prototype shows potential, but just a box that produces nice sound will not sell easily. It should be made into an actual product which does not only sound good, but can also be produced in certain amounts, is profitable, easy-to use and looks as good as it sounds. This is where I come in.

The product will be high-end and the biggest limitation for me will be to completely understand the demands for a product with this specific market position. Regarding sound quality, build quality and costs, this product will have to be far above what I have encountered in design projects so far. All aspects must reflect the high-end nature of this product and becoming involved with potential users will be key to understanding what is necessary to turn the product into a success. Time will always be a constraint for a design project, but with the right scope and expectation management, it should not become a problem. I also do not think that knowledge and resources will become a constraint of the project, as both are widely available from my supervisors, Dutch & Dutch and the TU Delft.

space available for images / figures on next page

introduction (continued): space for images

image / figure 1: Dutch & Dutch 8C with matching stand

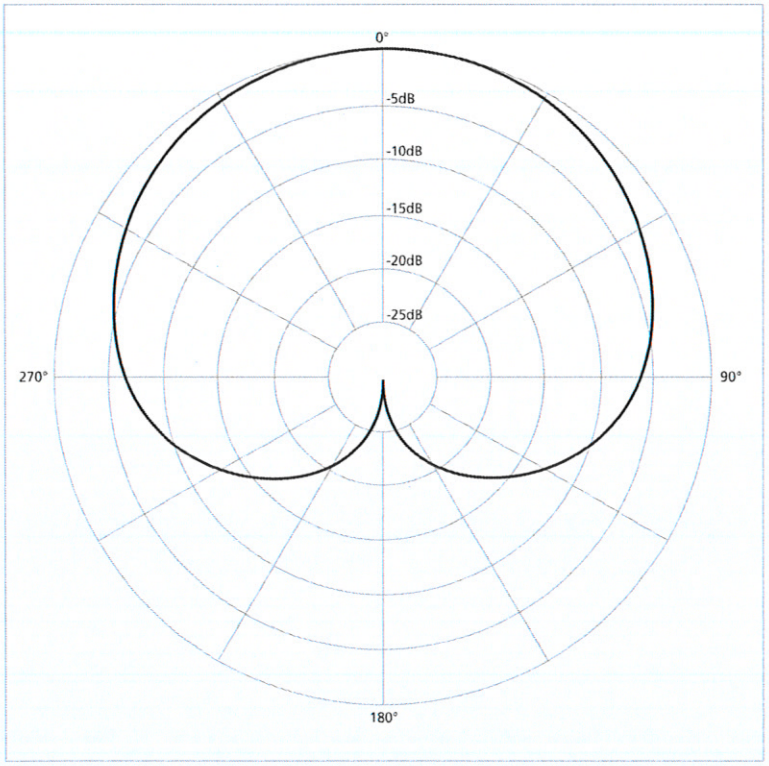



image / figure 2: Top view of Cardioid sound pattern, waves are phased out at the speakers' backside



Initials & Name P. Gerritsen Student number 460030

Title of Project Embodiment Design of the new Dutch & Dutch loudspeaker

## PROBLEM DEFINITION **

Limit and define the scope and solution space of your project to one that is manageable within one Master Graduation Project of 30 EC (= 20 full time weeks or 100 working days) and clearly indicate what issue(s) should be addressed in this project.

The new product should be a step-up from the current 8C, delivering even better performance and a more spectacular design. Acoustically, there is room for improvement in the lower frequency region. Currently the mid-driver produces frequencies from 100Hz to 2000Hz and especially at loud volumes this causes problems. the speaker distorts at a higher volume level as it is pushed to its mechanical boundaries. An extra driver will be added to deal with frequencies between 100 and 200Hz. Furthermore the 8C implements the cardioid character only for the mid-range frequencies, this should also become the case for the lowest frequencies in order to improve the sound experience for the user.

implementing these acoustical requirements will lead to even more driver units and a physically bigger product. However, it should still fit within a domestic environment and delivering an aesthetical design is the other important aspect of the project. Designing the looks is more than just nice drawing and renders, my design should be detailed enough to convince Dutch & dutch to source parts and assemble the design.

## ASSIGNMENT **

State in 2 or 3 sentences what you are going to research, design, create and / or generate, that will solve (part of) the issue(s) pointed out in "problem definition". Then illustrate this assignment by indicating what kind of solution you expect and / or aim to deliver, for instance: a product, a product-service combination, a strategy illustrated through product or product-service combination ideas, ... . In case of a Specialisation and/or Annotation, make sure the assignment reflects this/these.

Embodiment design of the next Dutch & Dutch loudspeaker.

I will make the design for a new loudspeaker for Dutch & Dutch. I will deliver a report which will elaborate on the looks, the materials and the functionality of the product. It will describe the materials and parts used, the production and assembly method and working principles. Furthermore, I expect to deliver a CAD model of the design, a BoM with cost price, renderings of how the product should look like and a prototype that will come close to the actual looks of the design. This final prototype should also produce sound with a cardioid pattern from the lowest frequencies (15Hz) upwards to the tweeter crossover frequencies (2000Hz). It should mimic the intended sound but as acoustical optimization is out of the scope of this project, my prototype cannot have the market-ready sound qualities yet.

The market introduction and exact branding will not be researched, only recommendations based on findings during the project will be made regarding marketing and future vision of the product. The software features of the product will just like the amplifier, power supply, DSP and DAC be determined by Dutch & Dutch. it will be included in the design but will not be optimized through research, it is out of the scope for this project and Dutch & Dutch will provide these parts of the design.



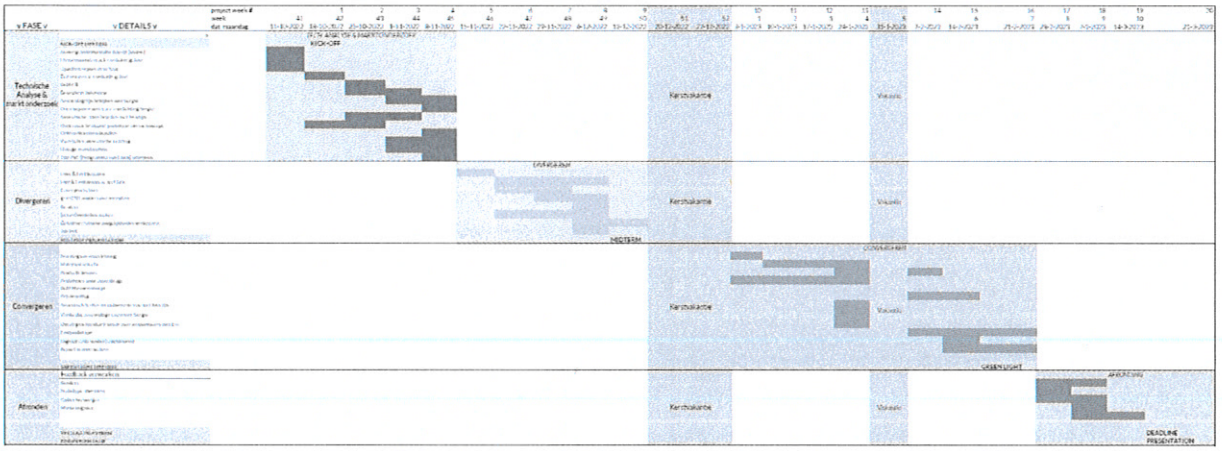
Initials & Name P. Gerritsen Student number 460030

Title of Project Embodiment Design of the new Dutch & Dutch loudspeaker

## PLANNING AND APPROACH **

Include a Gantt Chart (replace the example below - more examples can be found in Manual 2) that shows the different phases of your project, deliverables you have in mind, meetings, and how you plan to spend your time. Please note that all activities should fit within the given net time of 30 EC = 20 full time weeks or 100 working days, and your planning should include a kick-off meeting, mid-term meeting, green light meeting and graduation ceremony. Illustrate your Gantt Chart by, for instance, explaining your approach, and please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any, for instance because of holidays or parallel activities.

start date 21 - 10 - 2021 25 - 3 - 2021 end date




(See appendix at the end of this document for enlarged image)
The project will start with analyzing the current 8C speaker and its working principles. I will start with looking into the literature, together with listening to the 8C's and the latest prototype of the new concept. Also discussions/interviews with Martijn (acoustical designer at D&D), Eric (Product developer) and Sergio (software and logistics) will be useful to extract the company's knowledge to my advantage. (dis)Assembling the current 8C speaker will also be interesting to get to know the whole assembly process and all parts needed to make the speaker. To get an even better idea of the context, I will visit a reseller for an interview to get a better understanding of the selling process and consumer.

This necessary background research will result in a first version of a program of requirements. Next, the creative phase can start and I will determine the direction regarding look & feel by identifying the current position of Dutch & Dutch related to competitors. In this phase I also want to speak to current owners of Dutch & Dutch speakers. This will lead to multiple sub-concepts, which will offer different directions regarding aesthetics, used materials and functionality. These concepts I will present at the midterm presentation. The next phase will be about choosing the best (sub-) concepts and developing one final embodiment concept. Using prototypes, I will make choices regarding materials, appearance and assembly of the speaker and my goal is to end with a prototype that communicates my ideas regarding aesthetics and acoustical design of the product. Choices made during the project should be verified by the experts from Dutch & Dutch who helped me set out the boundaries/requirements in the first place. It should be clear which materials and parts are used, how the design can be produced/assembled and what the cost price will be.

## MOTIVATION AND PERSONAL AMBITIONS

Explain why you set up this project, what competences you want to prove and learn. For example: acquired competences from your MSc programme, the elective semester, extra-curricular activities (etc.) and point out the competences you have yet developed. Optionally, describe which personal learning ambitions you explicitly want to address in this project, on top of the learning objectives of the Graduation Project, such as: in depth knowledge a on specific subject, broadening your competences or experimenting with a specific tool and/or methodology, ... . Stick to no more than five ambitions.

I always had a passion for music and have played the guitar since I was about 10 years old. The last few years, this interest became broader and I also became fascinated by sound reproduction. I started to look into the electronics of amplifiers and the working principle of loudspeakers. As I have been eager to dive into these subjects in my spare time, the idea arose to also look into the possibilities within audio design during my study. During the Masters I did not have a good chance to dive into the world of audio design and my graduation project seemed like a good opportunity. With this project, my main ambition is to see whether the world of audio design could be something for me during my professional career. Furthermore, I want to experience building speaker (prototypes) that are designed using advanced theoretical models and I also want to push myself to deliver a final design that is further embodied than any other of my projects so far.

Personally, this project is successful when the end result is a product that is as close to market-ready as I could get it within the 20 weeks given. Most favourably I want the product I design to be market-ready the day I graduate but as Industrial Designer I must be realistic about my capabilities and the time given. I have never designed a product that has been sold right after the deadline of my project and 20 weeks will simply not be enough to accomplish this. However, I want the project to be the fundamentals of the product that will eventually hit the market. My research and design choices should lead to the enthusiasm of Dutch & Dutch, their customers and myself. I want to freeze as many design aspects as possible in order to make my product proposal a concrete and realistic one. Most important for me is that the things which I will accomplish in the upcoming twenty weeks, are convincing enough to proceed with my design after graduation.

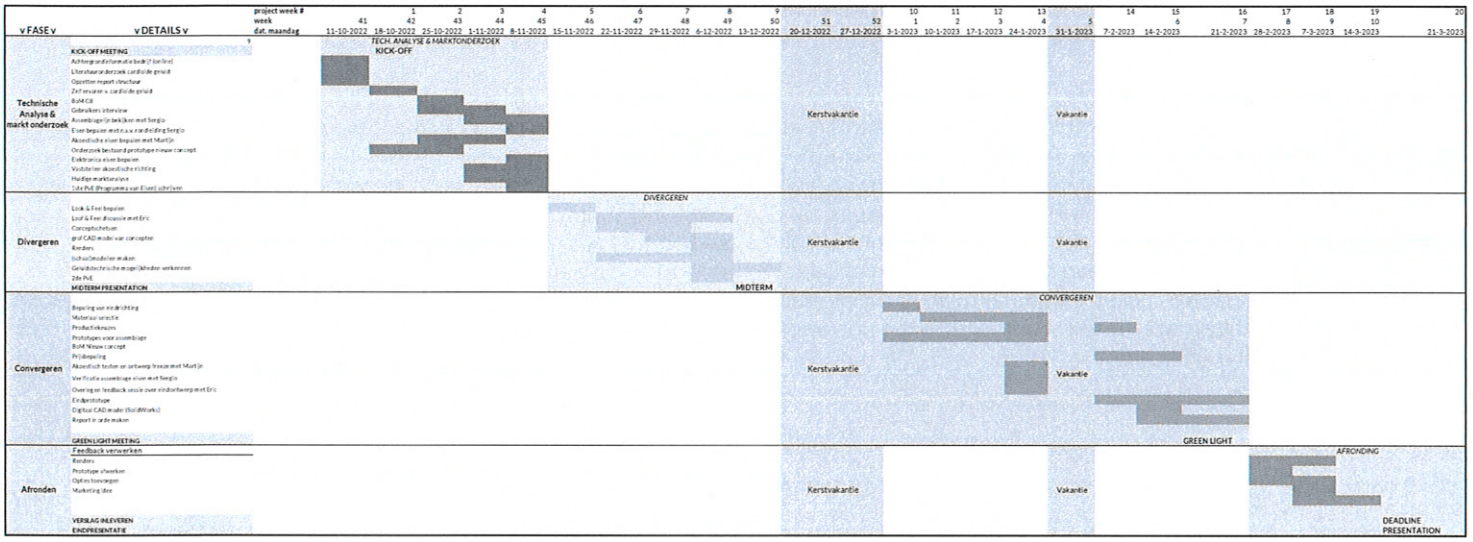
## FINAL COMMENTS

In case your project brief needs final comments, please add any information you think is relevant.



Initials & Name P. Gerritsen Student number 460030

Title of Project Embodiment Design of the new Dutch & Dutch loudspeaker


v FASE v
v DETAILS v
project week #
week
dat. maandag
11-10-2022
18-10-2022
25-10-2022
1-11-2022
8-11-2022
15-11-2022
22-11-2022
29-11-2022
6-12-2022
13-12-2022
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31-1-2023
7-2-2023
14-2-2023
21-2-2023
28-2-2023
7-3-2023
14-3-2023
21-3-2023
TECH. ANALYSE & MARKTONDERZOEK
KICK-OFF
Technische Analyse & markt onderzoek
KICK-OFF MEETING
Achtergrondinformatie bedrijf (online)
Literatuuronderzoek cardiologie gerelateerd
Opzetten report-structuur
Zelf ervaren v. cardiologie gerelateerd
BoM CB
Gebruikers interview
Assemblage/je bekijken met Sergio
Eisen bepalen met o.a.v. cardioloog Sergio
Akoestische eisen bepalen met Martijn
Onderzoek bestaand prototype nieuw concept
Elektronica eisen bepalen
Vaststellen akoestische richting
Huidige marktanalyse
1de PvE (Programma van Eisen) schrijven
MIDTERM PRESENTATION
Kerstvakantie
Vakantie
DIVERGEREN
Divergeren
Look & Feel bepalen
Look & Feel discussie met Eric
Conceptschetsen
grof CAD model van concepten
Renders
Schuimmodellen maken
Geluidstechnische mogelijkheden verkennen
2de PvE
MIDTERM
CONVERGEREN
Convergeren
Bepaling van eindrichting
Materiaal selectie
Productieknepen
Prototypes voor assemblage
BoM Nieuw concept
Prijsbepaling
Akoestisch testen or ontwerp toegemet Martijn
Vier fiscale assemblage eisen met Sergio
Overleg en feedback sessie over eindontwerp met Eric
Eindprototype
Digitaal CAD model (SolidWorks)
Report in orde maken
GREEN LIGHT MEETING
GREEN LIGHT
AFRONDING
Afronden
Feedback verwerken
Renders
Prototype afwerken
Opties toevoegen
Marketing doe
VERSLAG INLEVEREN
EINDPRESENTATIE
DEADLINE PRESENTATION