

UX RESEARCH INTERNSHIP

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Author: Nijs Bouman



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Nijs Lucas Jan Bouman



Student Industrial Design (B.Sc.)
Student number: 1264915
Department of Industrial Design
Eindhoven University of Technology
n.l.j.bouman@student.tue.nl
www.tue.nl/en
Groene Loper 3
5612 AE Eindhoven, The Netherlands

UX Design Research Intern
BEMS ID: 3293146
DS&A Research & Rapid Development
Boeing Global Services | Jeppesen GmbH
nijs.bouman@jeppesen.com
www.boeing.com | www.jeppesen.com
Frankfurter Straße 233
63263 Neu-Isenburg, Germany

Teacher Coach:
Dr. ir. Bart Hengeveld

Company Coach:
Andreas Godehart, M.Sc.

In loving memory of

Tony Hughes

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Table of Contents

List of Figures.....	6
List of Tables.....	6
List of Abbreviations.....	7
Acknowledgements.....	9
Summary.....	10
1. Introduction.....	12
2. Company Description.....	16
2.1 The Organization Boeing.....	16
2.2 The Department DS&A in Frankfurt.....	20
3. Internship Goals.....	31
4. Activities & Projects.....	35
5. Results & Outcomes.....	41
5.1 Learning Outcomes.....	41
5.2 Reflection Internship Goals.....	44
5.3 What Do Others Think?.....	48
Epilogue.....	51
References.....	52
Appendices.....	54
Appendix A: Approved Internship Plan.....	54
Appendix B: Personal Development Plan (July 2019).....	56
Appendix C: Company Coach Evaluation Form.....	59
Appendix D: Personal Reflection.....	61
Appendix E: Master Plan.....	63
Appendix F: Letter of Recommendation.....	68
Appendix G: Feedback from Team Members.....	69

List of Figures

Figure 1: focus areas; desirability (user), viability (business), feasibility (technical)	13
Figure 2: organogram of Boeing in relation to Jeppesen.....	17
Figure 3: management in relation to our team. NB: some full names are left out to maintain privacy.....	18
Figure 4: departments of Boeing Global Services.....	19
Figure 5: interior and exterior of DS&A lab near Frankfurt	20
Figure 6: The Elements of User Experience (a website is used as an example).....	21
Figure 7: visualization of team composition for different locations and stages.....	22
Figure 8: people I work with on a weekly basis	23
Figure 9: the R&D pipeline; each gate is one step closer to market entry	24
Figure 10: breakdown of pre-gate 0 phase.....	25
Figure 11: phase-gate process at BGS DS&A	26
Figure 12: the DS&A Frankfurt lab has an open-plan design.....	28
Figure 13: screenshot of Trello, the tool we use to keep track of tasks.	35
Figure 14: initial wireframe of digital solution for product idea.....	38
Figure 15: slides from UX research workshop	39
Figure 16: design-centric management, prioritizing design & financial performance	43
Figure 17: persona template I created to improve internal UX communication.....	46
Figure 18: three iterations of the 'dashboard' (confidential)	47
Figure 19: Attitude, Skill, and Knowledge: (ASK) a New Model for Design Education.....	49
Figure 20: competency development during internship	62
Figure 21: overview of possible career paths	63

List of Tables

Table 1: internship goals arranged from global to more specific	31
Table 2: central activities during the internship, grouped by area of expertise.....	36
Table 3: recurring events.....	37
Table 4: internship goals arranged from global to more specific	45
Table 5: working for Boeing, pros & cons.....	65

List of Abbreviations

ADAHRS	Air Data Attitude Heading Reference System
AR&PC	Advanced Research & Product Concepts
B&E	Business & Entrepreneurship
B2B	Business-to-Business
B2C	Business-to-Consumer
B2T	Business-to-Technical
BA	Business Aviation (market segment)
BGS	Boeing Global Services (corporate entity)
C&A	Creativity & Aesthetics
CI	Confidence Interval (statistics)
ConOps	Concept of Operations (communication of proposed system)
DevOps	Software Development & Operations
DRP	Design Research Processes
DS&A	Digital Solutions & Analytics, department of BGS
EASA	European Aviation Safety Agency
EDM	Engine Data Monitor
EFB	Electronic Flight Bag
EH&S	Environment, Health & Safety
FAA	Federal Aviation Administration (USA)
FBO	Fixed-Base Operator (aeronautical service provider)
GA	General Aviation (market segment)
GEM	Graphic Engine Monitor
GmbH	Limited Liability Company (German legal entity)
IP	Intellectual Property
IPT	Information Processes & Technology
JTBD	Jobs To Be Done, framework for user research
M&A	Mergers & Acquisitions (market research)
MBA	Master of Business Administration
MCAS	Maneuvering Characteristics Augmentation System (B737 MAX)
MD&C	Math, Data & Computing
MRO	Maintenance, Repair & Overhaul
MVP	Minimum Viable Product
NPV	Net Present Value (Discounted Cash Flow)
OEM	Original Equipment Manufacturer
PI	Product Increment (scrum)
PI&V	Professional Identity & Vision
PO	Product Owner (scrum)
R&RD	Research & Rapid Development (division of DS&A)
ROI	Return On Investment
RtD	Research through Design
SAFe	Scaled Agile Framework
SLiM	Solution Lifecycle Management

SME	Subject-Matter Expert
SQA	Software Quality Assurance
T&R	Technology & Realization
TAM	Total Addressable Market
U&S	User & Society
UXD	User Experience Design

Acknowledgements

I specifically would like to acknowledge and extend my sincere thanks for my team, tutor, coach, colleagues, and supervisors who supported me during this internship. Thanks to you I was able to develop myself, learn from our projects, and reflect upon my work. Next to that, being fully integrated in the team helped me to achieve a valuable and true work experience.

Andreas	Company Coach, UX researcher
Anna	Tutor, UX researcher
Helena	HR, recruiter
Hilna	Team member, mechanical engineer
Miriam	Team member, computer scientist
Nico	Research manager
Valentin	Team member, research intern

Anna has supported me throughout the internship, helped me to achieve my professional goals, and made sure we had a good time in the process. It was a pleasure working with you.

A sincere thank you to all people involved.

Summary

This report details a 15-week internship at Jeppesen GmbH in Neu-Isenburg, Germany. Jeppesen is a Boeing subsidiary. I joined the *Digital Solutions & Analytics (DS&A) Frankfurt* lab.

The DS&A lab works with a so-called pipeline. The pipeline consists of different gates. The initial research phase is called 'pre-gate 0'. During this phase, inter alia, an MVP¹ and a ConOps² are developed. Based on the MVP and other gate criteria, a product idea is evaluated.

During my internship, our team conducted 'pre-gate 0' research. This exploratory kind of research focusses on the feasibility, viability, and desirability of a product idea. Our multidisciplinary team presented our findings on a weekly basis to the 'product owner'. During these 'PO updates', we received feedback from the product owner and our research manager.

The research teams are self-managing, allowing for flexible and rapid research. As a result, I was able to further develop multiple areas of expertise, including User & Society, Business & Entrepreneurship, Creativity & Aesthetics, and Technology & Realization. Anna (my tutor) facilitated our team processes and my personal development. The design process we committed to is in accordance with scrum, an agile framework for software development. The DS&A lab uses other frameworks as well, such as Lean, SAFe, and Kanban. Seeing and experiencing how these frameworks are applied in a professional environment, has taught me a great deal.

In order to keep track of our progress and manage tasks, we used an online tool called 'Trello'. In combination with Trello, our team scheduled daily scrum (standup) meetings, and weekly slide review meetings for PO updates. Anna and I also scheduled weekly tutor meetings, to discuss my goals and progress. Finally, Andreas (company coach), Anna, and I scheduled weekly UX design meetings, discussing UX specific matters.

In addition to the main project, I worked on other projects as well, including two workshops on UX design research, and external presentation preparations for a university and a conference.

During this external learning activity I have further developed myself as a designer, and crucially, I now have the know-how to more confidently participate in, and manage (small) R&D projects. One of my internship goals is to familiarize myself with the inner workings of a large cooperation such as Boeing, and to apply my insights to my professional and entrepreneurial development. To this end, I have written a 'master plan', which is included in the appendix (page 63).

¹ Minimum Viable Product

² Concept of Operations (communication of proposed system)



1. INTRODUCTION



1. Introduction

Personal note

From August 1st, 2019 to November 14th, 2019, I had the privilege and pleasure of joining a team of dedicated researchers from the Jeppesen *Digital Solutions & Analytics (DS&A) Frankfurt* Division, which is part of Boeing Global Services (BGS). Within this division, my team is part of the *Research & Rapid Development (R&RD)* cluster. During the course of the internship, I collected my experiences and insights, which I present and explain through this report.

My Company Coach is Andreas Godehart, who holds a master's degree in Industrial Design and has over 10 years of experience in the field of Industrial Design. Additionally, Anna Zielinska is tutoring me within our project team. Anna is a cognitive psychologist who has specialized in UX research. Other team members include Hilna Sahle (aerospace engineer), Valentin Kantchev, and Miriam Cornel (computer scientist).

Our team focuses on 'pre-gate 0' research. This early-stage research aims to evaluate the feasibility, viability, and desirability (focus areas) of a product idea. We present our findings on a weekly basis to the 'product owner' (PO), who works from the Denver offices (USA). During these 'PO updates', we receive feedback from the PO and our manager (Nico Zimmer). Next to that, every six weeks a PI (Product Increment) review is carried out. A PI review is preceded by a sprint, a time-boxed effort supported by a breakdown of the work required to reach the sprint's goal.³ The entire 'pre-gate 0' research phase usually includes three sprints. However, a project can be discontinued ('killed') at any point, should the acquired findings indicate insufficient support of either one of the three focus areas. It is stressed that the goal of this research phase is not to develop a product, but rather to establish a fair assessment of the product idea with respect to the focus areas (Figure 1). At the end of the project, the PO decides whether the product idea continues through 'gate 0', while taking the advice of the project team into account.

Every employee can propose a new product idea, and submit this idea in order to be evaluated by a 'pre-gate 0' research team, such as our team. The product idea should also be in line with Boeing's strategy and vision.⁴ Most of the time, a manager submits an idea, and becomes the PO.

Our 'pre-gate 0' team consists of researchers with varying backgrounds, such as Aerospace Engineering, Computer Sciences, Business Administration, and Cognitive Psychology. All teams are mostly self-managing and cross-functional, following an agile software development

³ (Cooper, 2016)

⁴ (The Boeing Company, 2019)

approach: scrum.⁵ This approach allows for flexible and rapid research. As a result, I am able to develop multiple areas of expertise, including User & Society, Business & Entrepreneurship, Creativity & Aesthetics, and Technology & Realization. Within our team, Anna is our ‘facilitator’, taking care of administrative tasks and making sure our team follows the design process principles. Additionally, Anna helps me with achieving my internship goals.

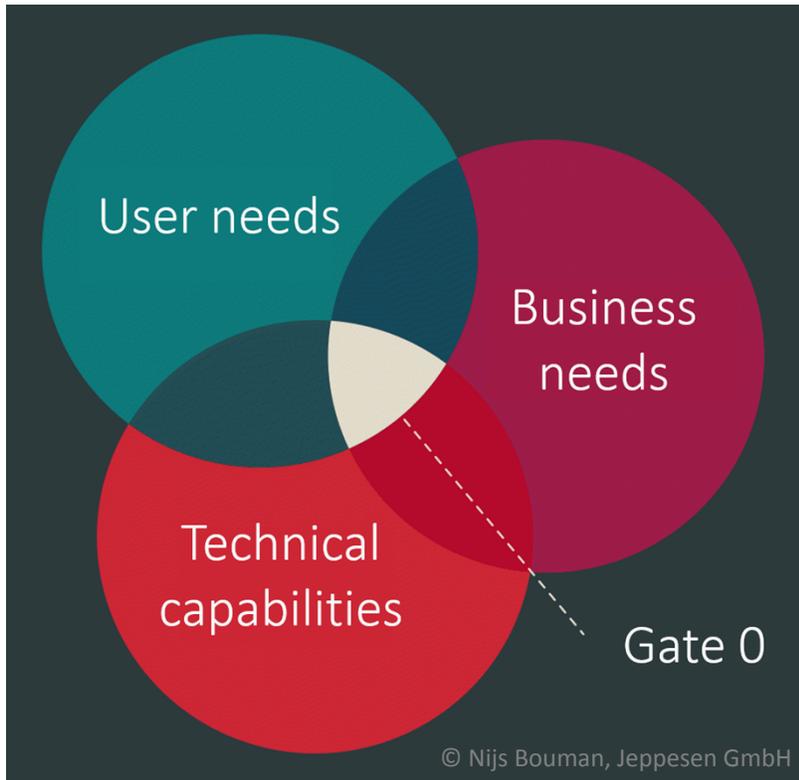


Figure 1: focus areas; desirability (user), viability (business), feasibility (technical)

The design process is in accordance with scrum, an agile framework for software development. Within the lab, other frameworks are used as well, such as Lean⁶, SAFe⁷, Kanban⁸, and Cooper’s phase-gate process⁹. I am able to apply these frameworks and gain first-hand experience.

Just like the team itself, my role within the team is cross-functional as well, with an emphasis on UX Design Research and Industrial Design. For example, I have conducted user interviews, market research, technical tests, and I have developed personas, JTBD’s, empathy maps, wireframes, digital prototypes, and more.

⁵ (Schwaber, 2002)

⁶ (Poppendieck, 2003)

⁷ (Scaled Agile, Inc, 2019)

⁸ (Ohno, 1988)

⁹ (Cooper, 2016)

Next to the main project, I have worked on a UX research evangelism project, promoting and educating UX research to other researchers within the research cluster. Additionally, I helped Anna with preparing presentations for external audiences at a German university (EBS Business School)¹⁰ and an aviation conference.

¹⁰ (EBS Universität für Wirtschaft und Recht, 2019)



2. COMPANY DESCRIPTION

2.1 The Organization Boeing

2.2 The Department DS&A in Frankfurt



2. Company Description

2.1 The Organization Boeing

The Boeing Company is a multinational corporation that develops, manufactures, and sells aircraft, rockets, satellites, communication technologies, missiles, and supporting services. The company's corporate headquarters are based in Chicago (Illinois), USA, while its main manufacturing facilities are located near Seattle (Washington), USA. Boeing is the largest global aerospace manufacturer. Boeing's stock is listed on the Dow Jones Industrial Average Index (New York Stock Exchange). The company ranks 24th on the "Fortune 500" list (2018),¹¹ and 19th on the "World's Most Admired Companies" list (2018).¹²

Boeing was founded by William Boeing in 1916. The company is currently led by President, chairman, and CEO Dennis Muilenburg (October 2019), who oversees the three corporate divisions: Boeing Commercial Airplanes (BCA); Boeing Defense, Space & Security (BDS); and Boeing Global Services (BGS). Stan Deal holds the position of CEO of Boeing Global Services and its subsidiaries, including Jeppesen (Figure 2). The entire company employs 153,000 people worldwide.¹³

In the news

At the time of this writing (October 2019), Boeing faces large problems with its Boeing 737 MAX aircraft. Within five months, two crashes occurred, killing 346 people.

According to Boeing, malfunctioning MCAS software is the cause of these crashes.¹⁴ In March 2019, all Boeing 737 MAX aircraft were grounded indefinitely by the FAA and EASA. As a result, the company is losing billions of US dollars, caused by financial claims (damages), and cancelled orders. The company and its responsible directors face criminal charges for negligence.¹⁵

Jeppesen, a subsidiary of The Boeing Company, is an American company specialized in navigational information management, operations planning and logistics, flight planning products, and aerospace software. Jeppesen has offices in locations around the world, including Neu-Isenburg, near Frankfurt am Main (Germany). Its headquarters are located in Denver (Colorado), USA. Jeppesen employs 3,200 people worldwide.¹⁶

¹¹ (Fortune, 2018)

¹² (Fortune, 2018)

¹³ (Boeing, 2019)

¹⁴ (Maneuvering Characteristics Augmentation System, 2019)

¹⁵ (Boeing 737 MAX groundings, 2019)

¹⁶ (Jeppesen, 2019)

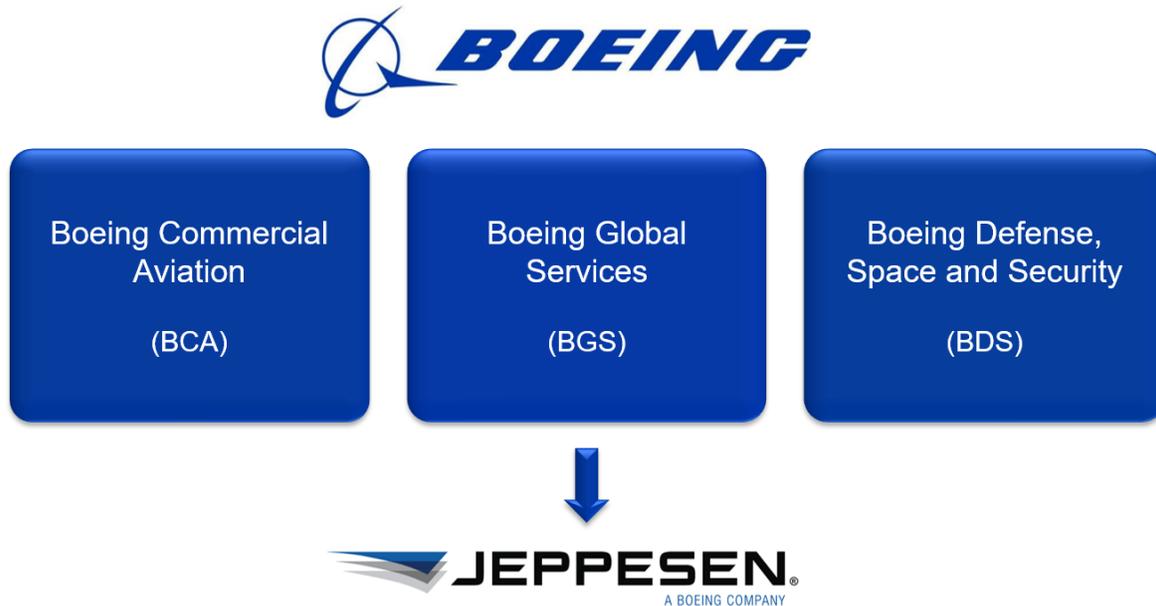


Figure 2: organogram of Boeing in relation to Jeppesen

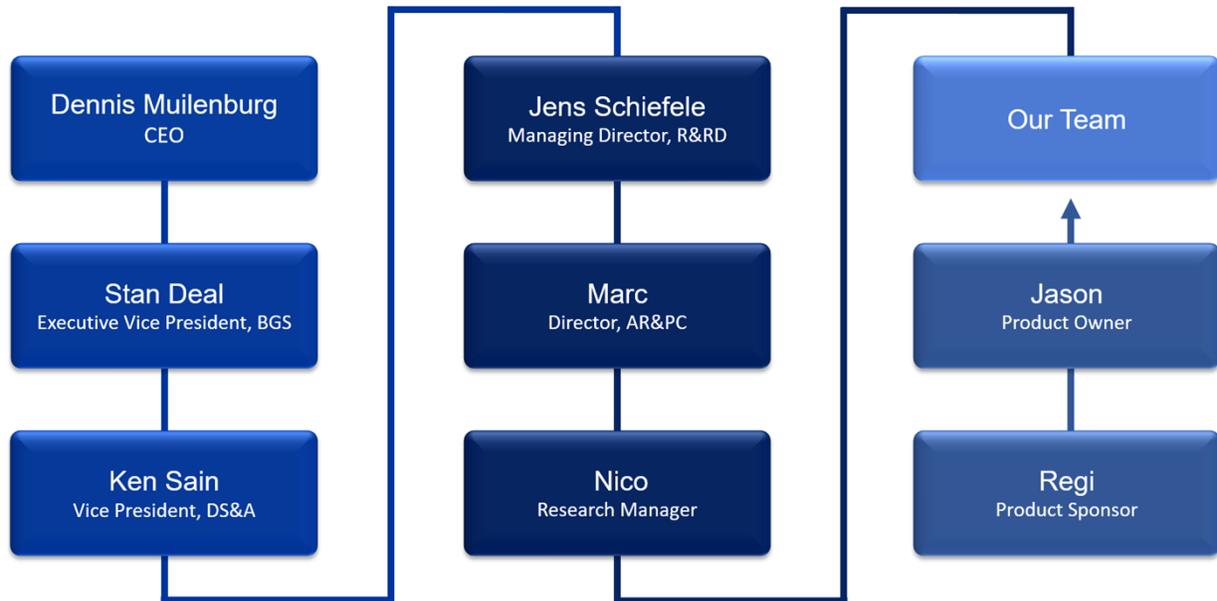
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In 2000, Jeppesen was acquired by The Boeing Company for 1.5 billion US dollars.^{17,18} As of 2019, Jeppesen is fully being integrated into Boeing Global Services. Although the brand 'Jeppesen' is maintained, all of Jeppesen's activities are integrated into BGS, specifically the DS&A department of BGS. This department is overseen by Ken Sain, Vice President of DS&A (Figure 3).¹⁹

¹⁷ (Jeppesen, 2019)

¹⁸ (The Boeing Company, 2000)

¹⁹ (Executive Biography of Ken Sain)



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Figure 3: management in relation to our team. NB: some full names are left out to maintain privacy.

A project is managed on different levels, with different stakeholders. Figure 3 demonstrates how the corporate leadership from Boeing (left column), and managers from Jeppesen (middle column) relate to our team. Next to this management, external stakeholders are included in the right column. The PO is project-specific, as well as the product sponsor.

Jeppesen is part of the DS&A department of BGS. Next to DS&A, BGS also includes other departments, such as Engineering & Maintenance, Supply Chain, and Customer Support (Figure 4), as well as companies such as Foreflight, Aerdata, ILS, CDG, and Aviall.²⁰

²⁰ (The Boeing Company, 2019)



Engineering & Maintenance



Supply Chain



Training & Professional Services



24/7 Customer Support



Digital Solutions & Analytics



Government Services

Figure 4: departments of Boeing Global Services

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To summarize, our project team is part of the R&RD²¹ cluster, which is part of the DS&A Frankfurt lab in Neu-Isenburg. This original Jeppesen facility is currently being integrated into the DS&A department, which on its part is one of the six departments of Boeing Global Services (BGS), one of the three main corporate entities of The Boeing Company.

²¹ Research & Rapid Development

2.2 The Department DS&A in Frankfurt

The Neu-Isenburg (Frankfurt am Main) offices consist of two buildings, of which a former printing facility. This building now houses the *Digital Solutions & Analytics (DS&A) Frankfurt* lab (Figure 5). The lab focusses on Digital Aviation Research & Rapid Development.

Under the direction of Dr. Jens Schiefele, Managing Director of Digital Aviation Research & Rapid Development, a team of approximately 70 researchers, software developers, engineers, and market analysts work in an open-plan lab (former printing facility) of Jeppesen GmbH, now part of Boeing Global Services (BGS).



Figure 5: interior and exterior of DS&A lab near Frankfurt

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Types of research activities at DS&A

To understand the scope of the UX research conducted by pre-gate 0 teams (such as our team), it is helpful to break down different layers of User Experience, as visualized in Figure 6. This visualization was first presented in the book *The Elements of User Experience*.²² Typical UX research in this early phase includes defining the strategy and the scope of a product idea, which relate to the focus areas (e.g. desirability).²³ The next step is to establish requirements for an MVP. To this end, market research, user interviews, and technical tests are carried out, as well as prototyping and feedback sessions.

When a project is advanced through gate 0, a new team, with new UX designers, works on the project, increasingly focusing on the more concrete aspects of UX design.

²² (Garrett, 2002)

²³ Feasibility, viability, and desirability

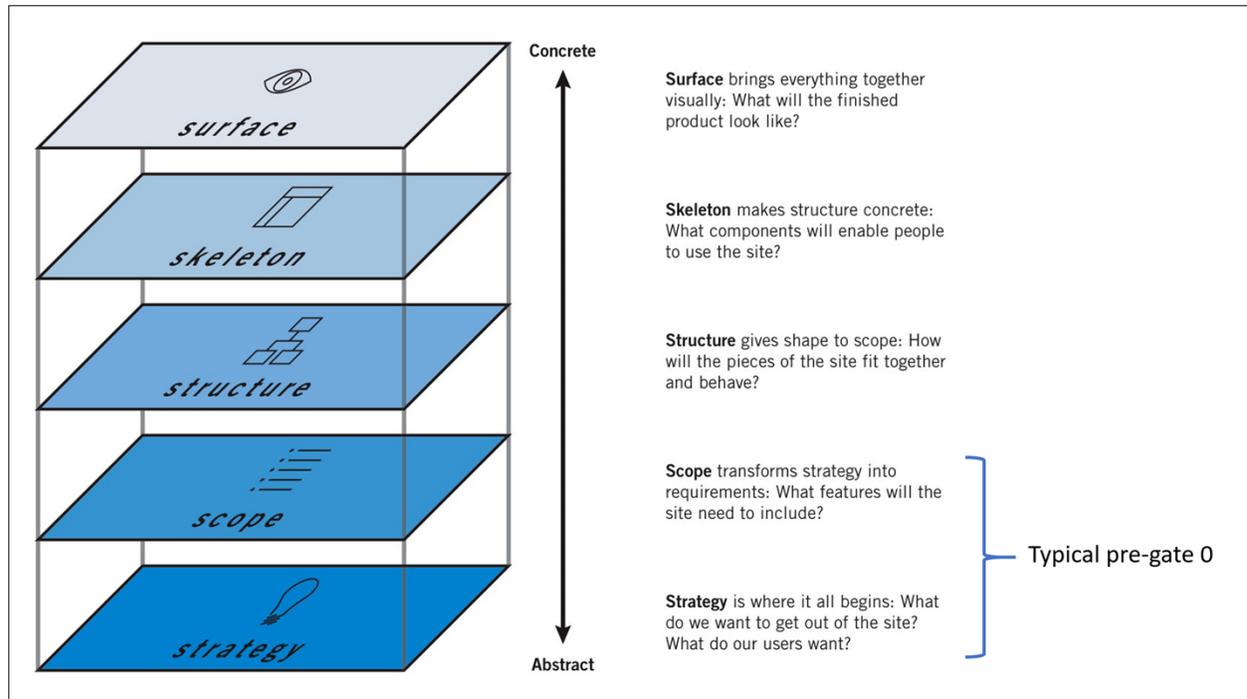


Figure 6: The Elements of User Experience (a website is used as an example)

© J. J. Garrett

Although all R&D teams are self-managing, their size and composition varies based on the stage of the project. The closer a project comes to gate 5, the more developers are involved, and the less researchers. Typical team compositions are visualized in Figure 7. The Gdansk office (Poland) mainly focusses on software development, while the Denver (USA) and Frankfurt offices focus more on research, as well as development.

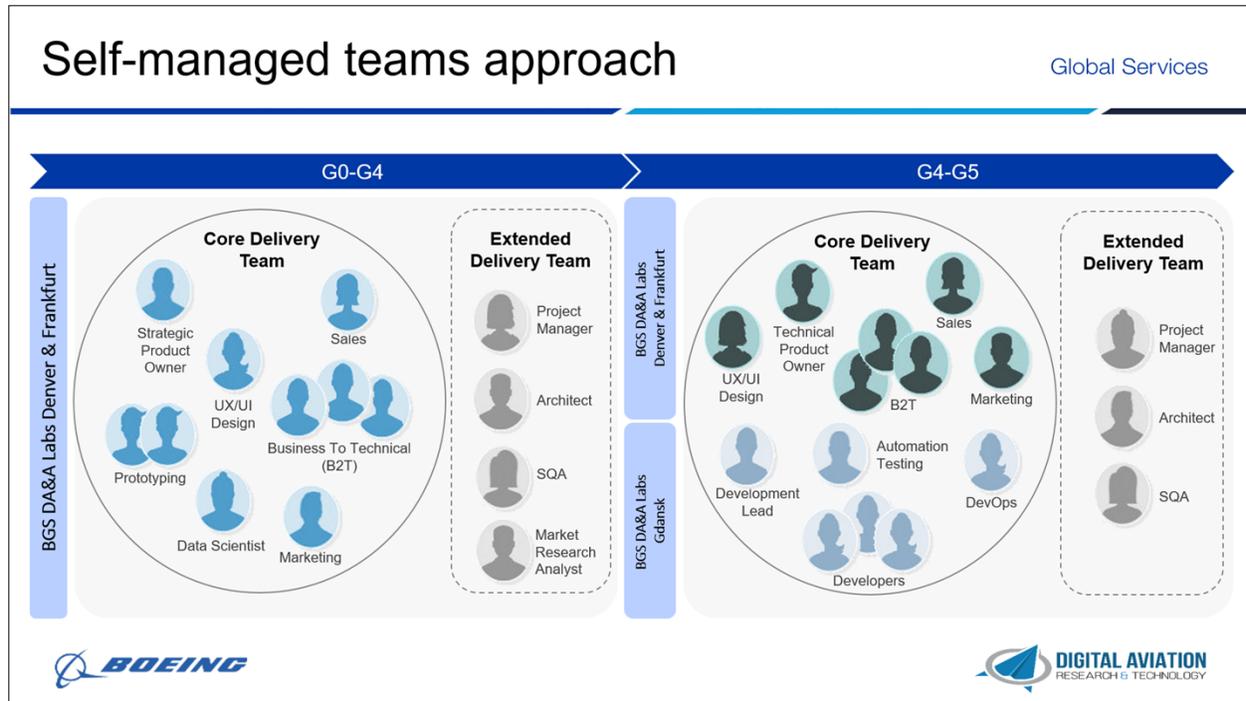


Figure 7: visualization of team composition for different locations and stages

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Our project team consists of six researchers with varying backgrounds. In our specific case (Figure 8), the team consists of two people with a UX background (Anna and me), a computer scientist, two aerospace engineers, and a business analyst (based in Denver, dark blue). Next to that we are free to ask for help from research colleagues if the team seeks additional expertise.

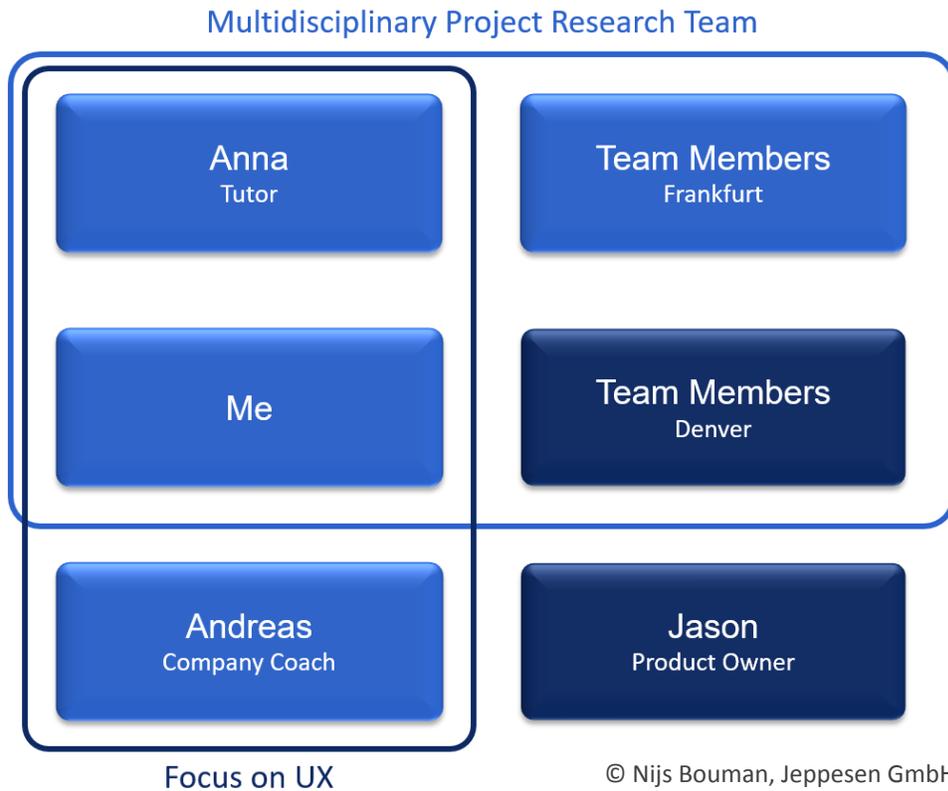


Figure 8: people I work with on a weekly basis



Figure 9: the R&D pipeline; each gate is one step closer to market entry

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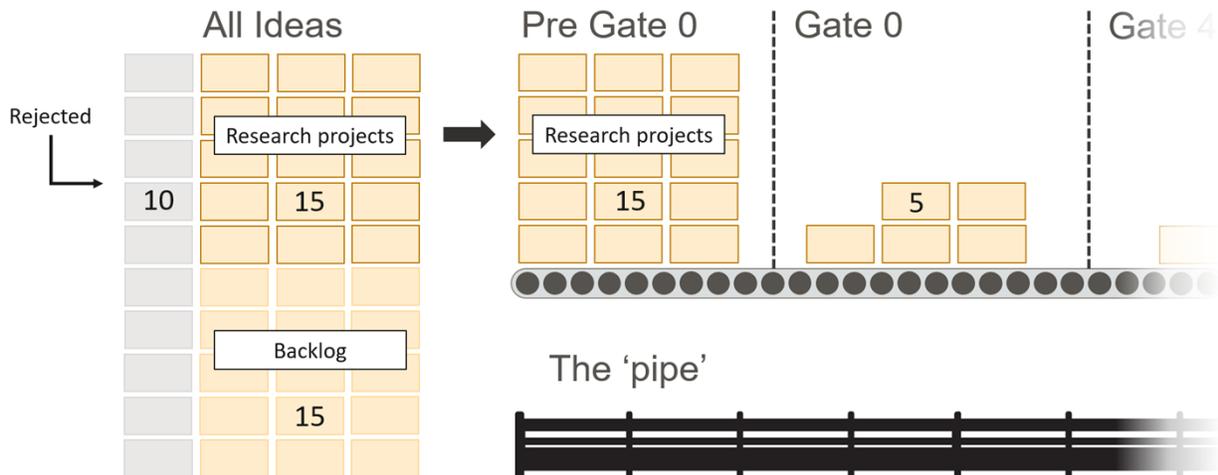
As discussed in the introduction, the DS&A Frankfurt lab works with a so-called pipeline, as shown in Figure 9. The pipeline consists of different gates and phases. The initial research phase is called 'pre-gate 0'. Our team works on a pre-gate 0 project. During this phase, an MVP is developed. Based on this MVP and other gate criteria (e.g. ROI²⁴, TAM²⁵, IP²⁶), the project is evaluated.

Figure 10 breaks down this 'pre-gate 0' phase in more depth. Of all forty yearly initial product ideas, ten are not considered at all. These ideas for instance have already been looked into before, or do not comply with the corporate strategy. The remaining thirty ideas enter the backlog, of which half actually become a research project.

²⁴ Return On Investment

²⁵ Total Addressable Market

²⁶ Intellectual Property



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Figure 10: breakdown of pre-gate 0 phase

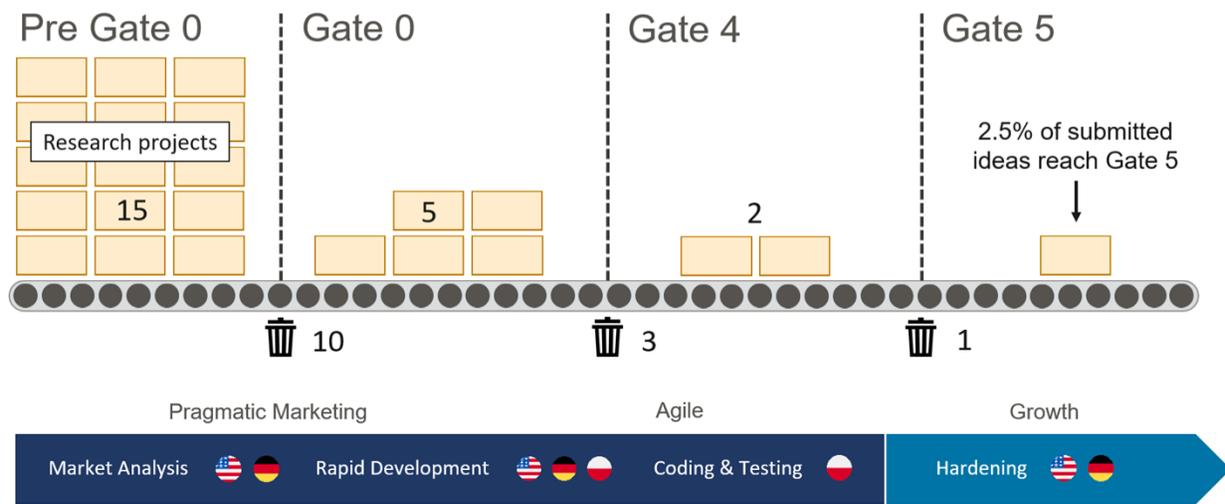
If a project advances through gate 0 (one third of the time), the MVP and ConOps (inter alia) are handed over to a new team (called the 'pipe'), which is going to further develop the product. Three pipes work in parallel at the DS&A lab in Frankfurt.

A project is re-evaluated at each gate. The majority of the projects is rejected ('killed') at some point. However, both a 'go' and a 'kill' are celebrated. Eventually only 2.5 percent of the initial product ideas successfully go through all gates, becoming more and more mature in the process. The final stage is called 'hardening'. In this phase the product becomes ready for market entry. SQA²⁷ plays an important role in this phase.²⁸

The described phase-gate process takes place at three locations: Denver (USA), Neu-Isenburg (Germany), and Gdansk (Poland). The process is graphically visualized in Figure 11.

²⁷ Software Quality Insurance

²⁸ (Cooper, 2016)



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Figure 11: phase-gate process at BGS DS&A

The following phases, with respective gates, can be identified:

0. Exploratory research (our focus)
1. Scoping
2. Build business case
3. Development
4. Testing and validation
5. Launch

At each point, all three focus areas²⁹ are involved, but at each successive phase, the R&D costs increase. Therefore, it is important to kill a project when necessary. However, one should avoid killing promising projects for obvious reasons. To help making this decision, the following guidelines are established:

- **Must meet** (checklist - yes/no)
 - Strategic alignment (fits business unit strategy)
 - Reasonable likelihood of technical feasibility
 - Meet EH&S policies
 - Positive return versus risk
- **Should meet** (scored on 0-10 scale)
 - Strategic
 - Degree to which projects aligns with business unit strategy
 - Strategic importance
 - Product advantage
 - Unique benefits

²⁹ Feasibility, viability, and desirability

- Meets customer needs better than existing or competing product
- Value for money
- Market attractiveness
 - Market size
 - Market growth
 - Competitive situation
- Synergies (leverages core competencies)
 - Marketing synergies
 - Technological synergies
 - Manufacturing / processing synergies
- Technical feasibility
 - Technical gap
 - Complexity
 - Technical uncertainty
- Operational viability
 - Go to market
 - Sales, marketing, and billing
 - Support and operation
- Risk versus return
 - Expected profitability (e.g., net present value)
 - Return (e.g., internal rate of return)
 - Payback period
 - Certainty of return

This list is retrieved from Wikipedia.³⁰ A similar list is used by Jeppesen.

A gate can lead to one of five possible verdicts:

- Go (next phase)
- Kill (discontinue)
- Hold (time is not right)
- Recycle (context is not right)
- Conditional go (further R&D is to be done before continuing)

At the end of a phase (when metaphorically knocking on the gate), the PO and managers eventually decide the *destiny* of the product idea. This is done during a special event: the ‘shark tank’. The sharks assess a project based on criteria which vary between gates. For pre-gate 0 projects, the following criteria have the most importance: Value Proposition, Competitive Analysis, and Customer Identification. These are evaluated by means of an MVP, ConOps, and more. For research teams, these criteria are managed in an expectation matrix (determined in advance).

³⁰ (Cooper, 2016)

To complete this part of the report, I will now describe some general observations of the lab.



Figure 12: the DS&A Frankfurt lab has an open-plan design

© Jeppesen GmbH

The open-plan design of the DS&A lab (Figure 12) helps to stimulate collaboration between different teams. The hierarchy is relatively flat (in contrast to the rest of Boeing), which helps to feed more thoughts and ideas into R&D.

Team members are not located next to each other, because the team compositions change periodically, based on the duration of the project (after three six-week sprints for pre-gate 0). Therefore, the colleague sitting next to you might work on another project, at another stage of the 'pipeline' as well. So people with different backgrounds, seniority, and focus are all mixed in the open-plan lab.

Although the DS&A lab focusses on digital solutions, good software support is not always taken care of, potentially limiting creativity. For example, no Adobe or CAD software was provided to our team.

As discussed, good product proposals should focus on the user needs, business needs, and technical possibilities. However, decision-making within the DS&A lab sometimes tends to lean towards business needs, at the expense of user needs. This is based on my experiences with

pre-gate 0 research. Perhaps more user-specific R&D is conducted at a later stage down the pipeline.

That said, the overall structure of the department supports innovation and creativity, and the atmosphere and work environment also match this observation.



3. INTERNSHIP GOALS



3. Internship Goals

Before the start of the internship, I defined five internship goals, based on my professional identity and interests (Table 1). The first two goals are global, since I think this internship is a great opportunity to work on career-oriented aspects of becoming a good designer. The last three goals more closely relate to an expertise area, i.e. applying the theory I learned at the TU/e in a professional context. For every goal I have also defined a success criterion. Throughout the duration of the internship, I am keeping track of the status of the goals, making sure that I maintain focused on these goals.

Note: outcomes in chapter 5 (page 40)

This section merely describes the internship goals, as well as the motivation behind the goals, and the predefined success criteria. In chapter 5. Results & Outcomes, I discuss the outcomes of these goals in relation to my learning insights.

Goal	Success criterion	Status
Expanding my professional network	Letter of recommendation from supervisor	Completed
Work experience at multinational	Planning for applying insights to career / businesses	Completed
UX research in a professional context	Conducting user interviews with multiple end-users	Completed
Improving prototyping skills	Making prototypes (1+) in the most relevant medium	Completed
Improving aesthetic design skills	Designing for external presentations	Completed

Table 1: internship goals arranged from global to more specific

PJ³¹ B&E U&S T&R C&A

I want to obtain work experience in an international context, since I am interested in pursuing an international career after graduating. This was also one of the factors to choose for an internship at Boeing in the first place. I currently co-own three small businesses: a holiday apartment rental business, web design bureau, and media start-up. Together with my friends and colleagues, we work on expanding these business opportunities. Therefore, I would like to gather insights and experiences within a large company, such as Boeing, to learn from the people working there, and to see how projects are managed on a larger scale. Additionally, an international company fits my interests well, since there are a lot of business opportunities outside of the Netherlands. I hope to expand my professional network through this internship opportunity, while working on becoming an Industrial Designer in the process.

³¹ Professional Identity: goals, networking, organizing, management, professional relations, etc.

Expanding my network

Expanding my professional network, getting to know people from other countries. A letter of recommendation will help to continue pursuing this goal, even after the internship.

The reason I choose to pursue this goal, is because in my experience as an entrepreneur, the importance of a good network becomes very clear. Having the right connections is crucial, since the best work is teamwork, and you will need help from others sooner or later. In general, people are willing to help you, especially when you can help them as well. Of course, knowing the right people can help with job opportunities as well.

This goal allows me to become a better networker, by not only expanding my network, but also diversifying my network. This goal is specifically targeted towards people in the industry who have resources that could benefit me in the future. I am going to meet new people both inside and outside the company.

A success criterion for this goal is to receive a letter of recommendation from Boeing, preferably from my direct supervisor or manager. This letter will be a valuable asset for my CV as well.

Work experience at multinational

Getting to know the ins and outs of a large international company, learning how these companies operate, and how projects are managed (Business & Entrepreneurship).

I would like to grow my businesses, become a better entrepreneur, and build a strong team. Part of this is scalability and internationalization. I would therefore like to learn why Boeing is such a successful company and how they manage projects. Of course, not all elements of Boeing are directly applicable to my situation, but team and project management for example are processes I want to experience first-hand.

Based on the insights I gather during this internship, I am going to write a 'master plan' (page 63) for my personal business opportunities and career. This master plan is going to describe the direction I want my companies to go, and how I am going to achieve this. This plan might also include parts of Boeing that I do not like. The plan will include a project management section, as well as a personal career plan.

UX research in a professional context & improving prototyping skills

Improving my knowledge in the field of User Experience design, by (1) conducting user interviews, (2) making interactive prototypes, and (3) practicing aesthetic designing.

User interviews with multiple end users (preferably by means of my own prototype), will help with practicing understanding the user, and translating their needs into design solutions (User & Society). Also, I will learn how to interact with the user in a professional context.

Prototypes in any medium allow you to iterate more easily, not only by evaluating your prototype and associated design decisions, but also by discussing your prototype with colleagues and triggering new ideas in the process. Therefore, I am going to make at least one prototype (in the most relevant medium), and further develop a product idea using these three aspects of why prototyping is useful. Furthermore, my prototyping skills (Technology & Realization) will be sharpened by more practice time.

Aesthetic designing

In line with the above mentioned, a fitting aesthetic (Creativity & Aesthetics) for deliverables helps to bring across a design, obtaining more accurate feedback, and hopefully triggering more thoughts from potential users. Therefore, I would like to focus on both functionality and aesthetics while developing product ideas. The aesthetics of the prototype should be of a high enough quality to be used for an external presentation.

Note: MD&C

I am going to address the remaining expertise area, 'Math, Data and Computing', not specifically in relation to an internship goal, but through electives, the FBP³², and through the activities I do for my businesses. However, during the internship I have analyzed many datasets, using extrapolation, CI³³ improvements, and error analysis, but I don't consider these activities to be part of my core development, because no predefined goal relates to this expertise area.

³² Final Bachelor Project

³³ Confidence Interval



4. ACTIVITIES & PROJECTS



4. Activities & Projects

For managing our research tasks, we use an online tool called 'Trello' (Figure 13),³⁴ which is commonly used by agile (software) teams. All major tasks are identified at the beginning of the project. This is the 'backlog'. During the project, tasks are broken down and added to 'to do', based on the stage the project is at. To keep track of progress, tasks are placed in either 'to do', 'doing', or 'done'. All tasks have a title, description, checklist, and participants. This tool has already proven to be useful, and I will try to incorporate it in future projects as well. Because all tasks are visible at a glance, it is easier to prioritize tasks if necessary. Next to that, the overview can give a high-level indication of the progress of the project. One downside of this approach is that it introduces one extra step to your workflow.

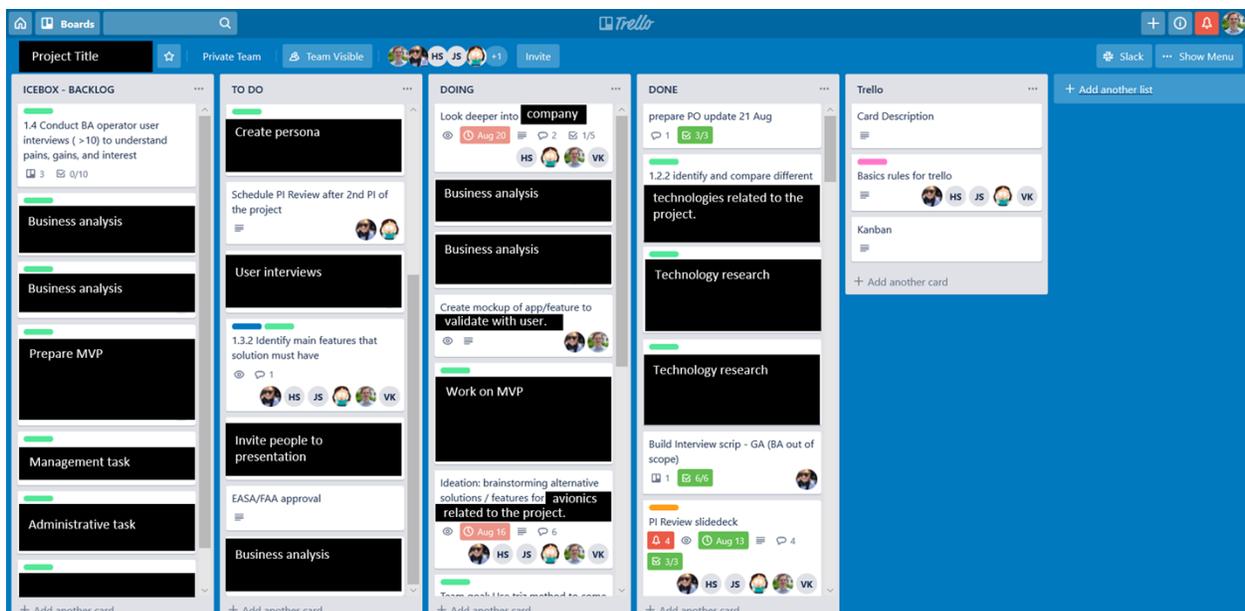


Figure 13: screenshot of Trello, the tool we use to keep track of tasks.

NB: project details are replaced with descriptive labels.

In Table 2, all main activities during the internship are grouped by area of expertise. These activities are retrieved from the Trello board cards with me listed as a participant, but other project activities are included as well. Because of the multidisciplinary nature of the research, it wasn't difficult to obtain experience in multiple areas of expertise.

³⁴ (Atlassian)

PI	DRP	B&E	U&S	T&R	C&A	MD&C
Attend weekly jour fixe meetings	Study frameworks & theory behind scrum, agile, lean, Cooper, SLiM, etc.	Explore project specific market (GA piston engine)	Read book: <i>Interviewing Users</i> , Steve Portigal.	Create mockup of app/feature (wireframe)	Visualize concepts for companion app	Identify relevant parameters for EDM's (GEM's)
Attend daily scrum standups	Use Triz to come up with IP proposals	Competitor analysis	UX guerrilla testing with wireframe (app)	Explore EASA/FAA approval process	Prepare 2 min. video to demonstrate project	Index GA compatible aircraft in Europe and Illinois
Attend weekly all-staff meetings	Brainstorm to identify roadblocks for customer engagement	Partner and M&A analysis	Read summary: <i>Validating Product Ideas</i> , Tomer Sharon.	Initial research into avionics and connectivity	Simplify visual of gate process using conveyor belt analogy	Extrapolate GA compatible aircraft sample
Attend weekly tutor, and UX meetings	Identify main features that solution must have (MVP)	Look deeper into specific competitor (avionics)	Read book: <i>Observing the User Experience</i> , Elizabeth Goodman et al.	Workshop on IPR's in relation to NDA's	Style presentation slides for university keynote	Attend GDPR for 'newbies' meeting
Watch quarterly BGS keynote	Ideation: alternative solutions for GEM/avionics	Visualize leadership structure BGS	Conduct GA operator user interviews	Patent novelty search (prior art)	Completely redesign slides for conference keynote	Study connectivity standards for avionics
Attend UX research breakfasts	Market assumptions evaluation, methodology	Workshop on finance and forecasting	Identify deficiencies in current UI	Implement feedback wireframe	Weekly ideation sessions	
Prepare whiteboard presentation for visit CEO/CPO DS&A	Cluster and interpret interview notes	Multi-tier business strategy	Persona with JTBD and pain points	Attend weekly UX meetings from DevOps		
Present UX research workshops	Review weekly slide deck for PO updates	Read summary: <i>Value Proposition Design</i> , Strategyzer.	Visit flight schools for field testing	IP one-pagers (2x), diagrams, classification		
Internal invitation for workshops			External invitation for interviews	Study/draft ConOps & B2T/hand-off document		

Table 2: central activities during the internship, grouped by area of expertise

Meetings are managed by Outlook Calendar. At the TU/e, we use Outlook Calendar as well, and I think it is a helpful tool. Plugins enable connecting WebEx (video calls) to meetings, as well as room reservations. In Table 3 all recurring events are listed and color-coded by expertise area.

Event	Attendees	Frequency
10:10:10 (standup)	DS&A Lab Frankfurt (70+)	Daily
Market research (standup)	Project team (6)	Daily
Scrum (standup)	Project team (6)	Weekly
Jour Fixe	Pre-gate 0 research teams (15+)	Weekly
UX Design	Anna, Andreas, me (3)	Weekly
Slide review for PO update	Project team (6)	Weekly
All-staff meeting	DS&A Lab Frankfurt (70+)	Weekly
PO update	Project team, PO, manager (8+)	Weekly
PI review	Project team, PO, manager (8+)	Every six weeks (sprint)
Triz ideation	Project team (6)	Weekly, for three weeks
Tutor meeting	Anna, me (2)	Weekly
UX sharing meeting	UX designers (6+)	Monthly
User interviews	Anna, me (2)	3-6 times a month
BGS all-employee	All staff, BGS (23,000+)	Quarterly
Jeppesen all-employee	All staff, Jeppesen (3,200+)	Quarterly

Table 3: recurring events

PI³⁵ B&E U&S T&R C&A

The recurring meetings have different goals, and they somewhat align with the areas of expertise, making it easier for me to distribute my effort and time among these areas.

³⁵ Professional Identity: goals, networking, organizing, management, professional relations, etc.

As part of the exploratory research into the product idea, I created a digital wireframe, using online software called Proto.io.³⁶ This online application turned out to be really helpful, as it offers an online library of UI elements, making it easier to focus on the structure, rather than the form. For the same reason, I didn't change any default colors, fonts and the like. The final wireframe consists of five different screens (with sub screens), which demonstrate a possible UI for the JTBD's³⁷ related to our project (Figure 14). The prototype is fully interactive, and can be loaded onto a smartphone. The prototype not only allowed the team to discuss an app solution in more depth, but it also helped me to make quick design decisions while designing. Part of this is thanks to the software being very agile, allowing for quick adjustments and experimenting with different UI elements. The interactive wireframe was also shown to the PO. He said that he likes the workflow. Based on new insights from user interviews, additional functionality was added later (support for fleet management and status overview).

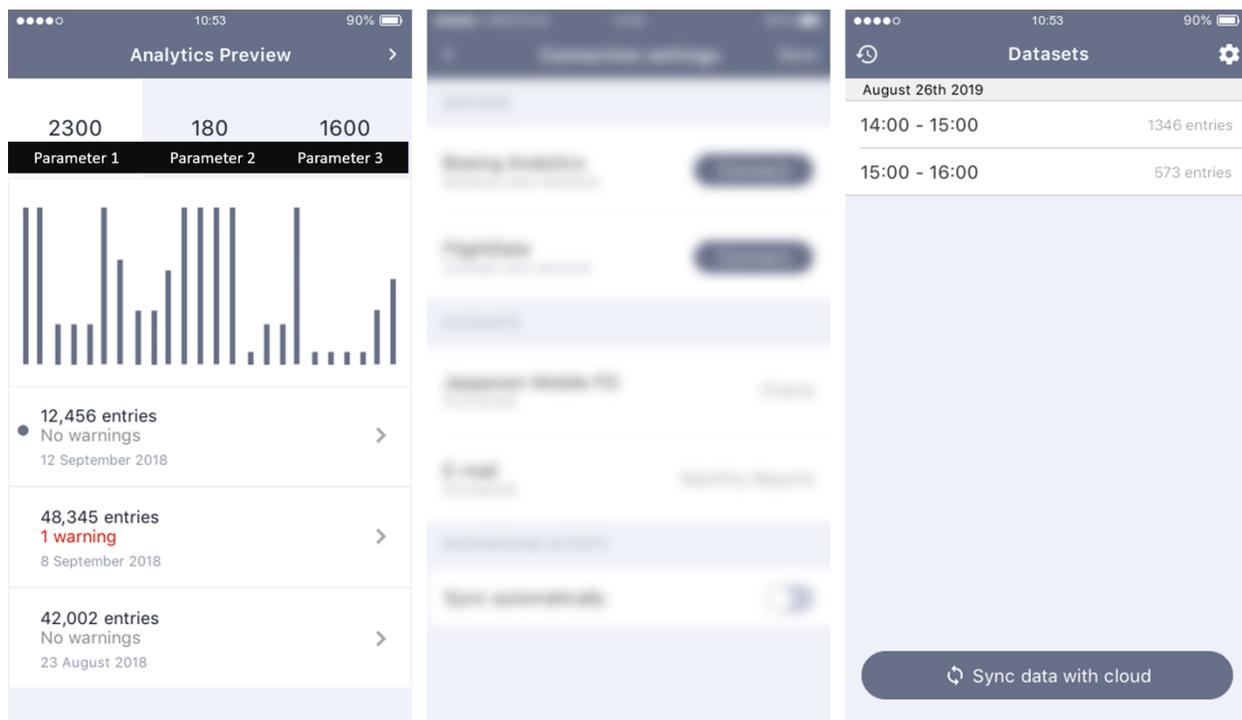


Figure 14: initial wireframe of digital solution for product idea

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In the future we should try to include the user at an even earlier stage, because some inconsistencies were leading to new ones. If we were able to identify those inconsistencies earlier, we would have saved some time and work.

³⁶ (Proto.io)

³⁷ Jobs To Be Done

Eventually, the prototype went through four iterations. The final iteration was the result of the feedback we acquired during the Guerrilla UX testing.³⁸

Next to the main project, I also worked on three presentations: slides for a keynote speech at a German university (EBS Business School) by Anna, slides for a conference, and a two-part workshop on UX research by Andreas, Anna, and me. Two slides of the last presentation can be found in Figure 15. I prepared the presentation, and presented parts of this presentation, which gave me the opportunity to teach other researchers about some design theory taught at Eindhoven University of Technology, such as affordance and feedback principles.



Figure 15: slides from UX research workshop

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Being involved in a research project which focusses on General Aviation (GA) fixed-wing piston aircraft, makes you understand the complexity and fragmentation of the market. Whereas Commercial Aviation is dominated by two companies (the duopoly of Boeing and Airbus), other aviation markets, such as GA, BA³⁹, MA⁴⁰, are much more fragmented. The range of customers is very divers, because flights schools and clubs are involved, as well as helicopters, business jet, and turboprop aircraft. Sizing specific submarkets can therefore be very difficult

A very systematic approach is thus required to tackle this problem. Only by sampling the right parts of the market, and covering the market in accordance with the Pareto principle, you will be able to identify the true size of the market, as a derivative of the Total Addressable Market (TAM).

Next to determining market sizing and segmentation, another element of market research involves possible M&A⁴¹ opportunities, which should be identified in an early stage, to avoid unnecessary R&D costs. We had multiple meetings with possible partners.

³⁸ (Babich, 2017)

³⁹ Business Aviation

⁴⁰ Military Aviation

⁴¹ Mergers & Acquisitions



5. RESULTS & OUTCOMES



5. Results & Outcomes

The project-related results & outcomes are subject to confidentiality. Therefore, this section focusses on learning outcomes, research artefacts, and the way our team presented the results. Next to that, I will discuss my internship goals.

5.1 Learning Outcomes

Throughout this report, I have already reflected upon my project contributions, as well as expressed some personal points of improvement for future projects. I will now summarize my learning outcomes.

Working closely together in a multi-disciplinary team is something I enjoy, and that contributes to the quality of the exploratory research the team conducts. With the different personal perspectives, we were able to identify the best solutions, and possible points of improvement. I've learned a lot from my teammates, who proved to be very knowledgeable, creative, and fun to work with. I am impressed by the work they do, and the research outcomes we generated. However, estimating the market size proved to be more difficult than expected. Perhaps because we didn't have the right expertise in the team, or maybe because of the nature of the GA market, which is very fragmented and informal. Conducting market research was very interesting to be involved in, but it is not something I would continue pursuing to become better at, because I think my skills and interests better align with other fields, such as feasibility research, prototyping, and market strategy research.

I obtained first-hand experience with a variety of new tools and methods, which I will try to incorporate in future projects as well when appropriate. These tools and methods include the Gate-phase process framework, Trello task management, standups (scrum), JTBD's, empathy maps, Pareto market sizing, Guerrilla UX testing, Triz Ideation, Proto.io wireframes, NPV⁴² financial forecasting (using Excel), and drafting IP proposals.

Although the DS&A lab focusses on digital solutions, no Adobe⁴³ or CAD⁴⁴ software was provided to our team. At the end this wasn't a big problem, but it can be argued that it would be better for creativity to have access to those tools as well. The lab actively seeks for improvements, by means of user employee surveys, staff meetings, and more. The biggest pain point remains the internal digital infrastructure. Resources are all over the place, and the documentation that is required to handoff a project to other teams is outdated. Access to customers is difficult. Fortunately, efforts are made to improve this. I will discuss more of the corporate culture in the Master Plan (page 63).

⁴² Net Present Value: a method for evaluating and comparing research projects by forecasting discounted cash flows.

⁴³ E.g. Photoshop, Illustrator or InDesign

⁴⁴ Computer-aided Design

It is not difficult to relate my development during the last two years at the TU/e to my work experience at Jeppesen. Both the way of thinking and tools at Jeppesen closely match what I have been taught. Of course, there are some key differences. The notion and importance of aesthetic designing (as a method) is not something that the research cluster of the DS&A lab is familiar with, although some team members have a background in Industrial Design. This is not to say that the company doesn't develop aesthetic products. Some of the digital solutions which enter the market are very aesthetic (visually) and well-developed, but the look and feel seems to be more of an afterthought than a fundamental part of the R&D process. At the same time, the way different stakeholders interact with each other, and how goals and expectations are managed, is much better taken care of than what you would normally see with TU/e student and research projects. Communication is very systematic (i.e. German), open and unambiguous. Research teams have much freedom in terms of using their resources, but expectations are very clear. At the end of the project the researchers need to justify their recommendations with sound evidence.

Of course it builds your confidence when you see that your colleagues use the tools and methods that you are familiar with, such as Arduino electronics, personas, business model canvases, and wireframes, but the most valuable asset you possess as a designer, especially in larger R&D environments, is your ability to analyze and breakdown problems and opportunities, and use your set of design and engineering tools to come up with the right tailored solutions, using your creative way of thinking (design thinking).

With regard to my professional behavior, I feel more confident participating meetings, contributing to discussions, expressing concerns, and asking colleagues for help. During the internship my team also helped me to understand the inner workings of the company, and shared tips to come across professionally to stakeholders and management. For example, when parts of your research don't add up, but crucial to continue your effort, what should you do? Especially in market research, educated guesses are key. The so-called Pareto Principle tells you that you should manage your efforts efficiently. It states that 80% of the outcomes are the result of 20% of the causes. This means for instance that your estimations will be reasonably accurate, as soon as the market share you are trying to quantify approaches a constant.⁴⁵

When assessing your research efforts, managers are looking for inconsistencies. Try to convey your genuine effort to ensure that your research is thorough and complete, and they will be more satisfied with your work.

⁴⁵ (An Analysis for Unreplicated Fractional Factorials, 1986)

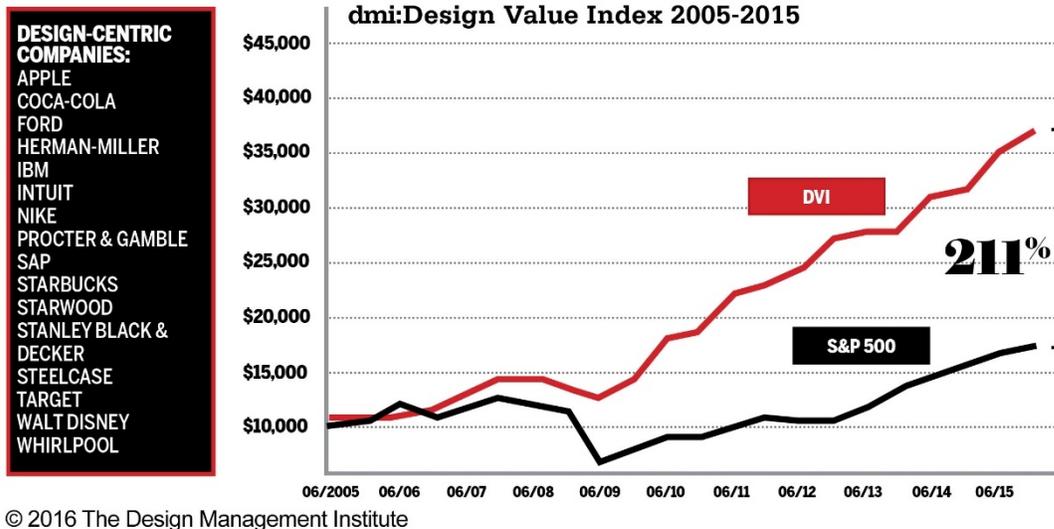


Figure 16: design-centric management, prioritizing design & financial performance

As my company coach, Andreas, pointed out to me, Boeing is originally an engineering company. Now that it also enters markets where (software) companies with a focus on consumer electronics dominate (Google, Honeywell, and Garmin), it needs to rethink its approach to R&D. Rather than the traditional technocratic, business dictated strategies, Boeing must centralize design to stay competitive in these highly competitive markets. Figure 16 demonstrates how design-centric companies outperform the S&P 500. On Boeing's executive biographies page,⁴⁶ the word 'design' doesn't occur once in any of the position titles. This clearly demonstrates that Boeing's leadership fails to identify the importance of design as a cornerstone of the company's future strategy. I therefore argue that it's time to appoint a Chief Design Officer, recognizing the importance of design.

Research through Design (RtD) entails using design processes as a method of doing research. Although the lab definitely has talented people with a very deep understanding of design, I didn't come across many examples of projects where RtD was used extensively. Design by researchers is mostly considered to be a tool to communicate and verify (with customers), and not as much as a method on its own. Again, I believe that this is the result of ignorance or a misunderstanding of what design means. Too many managers still consider design to be about 'making things pretty'. This is also one of the reasons why Anna, Andreas and I prepared two workshops on UX design research, to increase awareness.

Strength of visuals

Another learning outcome relates to visualizing research processes. A visual can describe a complex system more accurately and clearly than a thousand words. When you have the opportunity to visualize a problem, solution, use case, idea, system etc., go for it. Visuals are

⁴⁶ (The Boeing Company, 2019)

helpful in many ways. Visuals are beneficial in the following ways (based on my internship experience):

- Increase understanding while visualizing
- Improve creativity (stimulates different parts of the brain)
- Help to identify possible problems and solutions
- Help to check for completeness
- Allow for easy sharing and collaborating
- Keep track of progress
- Increase probability of success

5.2 Reflection Internship Goals

In Table 4 my internship goals are once again included. Thanks to Anna's help I was able to pursue all of them. With regard to the first goal, the success criterion was met. I have included the letter of recommendation in the appendix (page 68). Part of this goal was also to meet people from different cultures and backgrounds, which I did in both a professional and personal environment. I met other students who were also new in Frankfurt, many of them are from other parts of Germany, and the other half comes from different parts of the world (mostly Asia). At the office, over a third of the staff is international as well, mostly from Europe and the USA. I also met a few c-level⁴⁷ executives from international companies as well. Part of our research was to identify possible partnerships. When we mentioned that we are researchers from Boeing exploring different partnerships options, companies were happy to schedule a call for you with their CEO. We were most of the time actually more interested in the technologies, which a technical specialist could have told us more about, but commonly the team was pointed towards a c-level manager.

Additionally, I added many professional relations to my LinkedIn Account, which hopefully allows me to contact the right people in case in need professional help. I also received some job offers, although my career interest is currently turned off.

The master plan (page 63) details my insights and experiences related to the second internship goal.

⁴⁷ The highest-level executives in senior management who usually have titles beginning with "chief" and ending with "officer", including CEO, CFO, and COO, but also chairman, president, and executive vice president are included.

Goal	Success criterion	Status
Expanding my professional network	Letter of recommendation from supervisor	Completed
Work experience at multinational	Planning for applying insights to career / businesses	Completed
UX research in a professional context	Conducting user interviews with multiple end-users	Completed
Improving prototyping skills	Making prototypes (1+) in the most relevant medium	Completed
Improving aesthetic design skills	Designing for external presentations	Completed

Table 4: internship goals arranged from global to more specific

PI⁴⁸ B&E U&S T&R C&A

We conducted nine user interviews (with pilots and flight school managers), five Guerrilla UX tests, and three field trips to flight schools. All of which contributed to our understanding of the target customer, their JTBD's and pain points. In the process of creating the persona, I also designed a new persona template (Figure 17). Conducting many interviews, Guerrilla UX tests, and surveys, while defining personas accordingly, helped me to understand our different user groups.

In terms of C&A, I have refined my creative process, by using many different tools I was not familiar with before, such as Trello, empathy maps, and flow charts. Prototyping a new app in multiple iterations has helped me with my hands-on T&R skills. During our market research, we faced many problems, including inconsistencies in datasets, and missing numbers overall. We used different data analytics techniques to overcome these problems, including a confidence interval (CI) approach to map our sample to the entire market, as well as a ratio approach to determine technical compatibility of aircraft fleets around the world. Extrapolating these numbers introduced some practical challenges, since our datasets were not formatted the way we wanted. We pushed Excel's capabilities to be able to bring the numbers together and consolidate our hypothesis.

⁴⁸ Professional Identity: goals, networking, organizing, management, professional relations, etc.

Name Surname
Global Services



Use fictional portrait image

ABOUT

Age:
Family:
Nationality:
Education:
Work:

PROFILE

Describe your user. Consider characteristics and behaviors that are relevant in the context of your project. Keep it to the point. The goal is to empathize with the user.

MOTIVATION & GOALS

Briefly describe the motivations of your user, and the resulting goals (if any).

JOBS TO BE DONE

Describe the jobs your user wants to get done in relation to your project. Consider the user's needs on a higher level. Forget about what tools the user might use.

PAIN POINTS

Consider problems, difficulties & struggles your user might encounter while carrying out the JTBD. These pain points might not be obvious, since the user is used to them.

ENVIRONMENT

Briefly describe the user's environment: friends, family colleagues, lifestyle, and/or patterns.

"Include a quote of your user that is relevant in the context of your project. This quote defines your user's attitude towards a certain aspect of your use case."



Figure 17: persona template I created to improve internal UX communication

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Figure 17 shows a template I made to improve the internal UX communication between different teams (research and development). We shared this template to all teams involved, which will allow the teams to be more consistent with persona creation, and save time, because the teams now only have to focus on the content. The lay-out is designed to match the BGS corporate style.

With regard to the fourth goal, I conducted three full-cycle iterations of our app prototype, based on two rounds of customer feedback, including five user tests. As our customer persona matured based on new pieces of information, we continuously updated the app prototype accordingly. Referring to my elaboration of the fourth goal, "Prototypes in any medium allow you to iterate more easily, not only by evaluating your prototype and associated design decisions, but also by discussing your prototype with colleagues and triggering new ideas in the process," I am now going to check whether I have addressed these three reasons why prototyping is useful. I was able to iterate on the initial prototype, and it helped to show the prototype in the meetings with our manager, because I was then 'forced' to reevaluate my design decisions while preparing the meeting. Our manager frequently questioned reasoning and argumentation, which I believe was helpful. Anna also helped me in this process, questioning my design decisions in a constructive way.

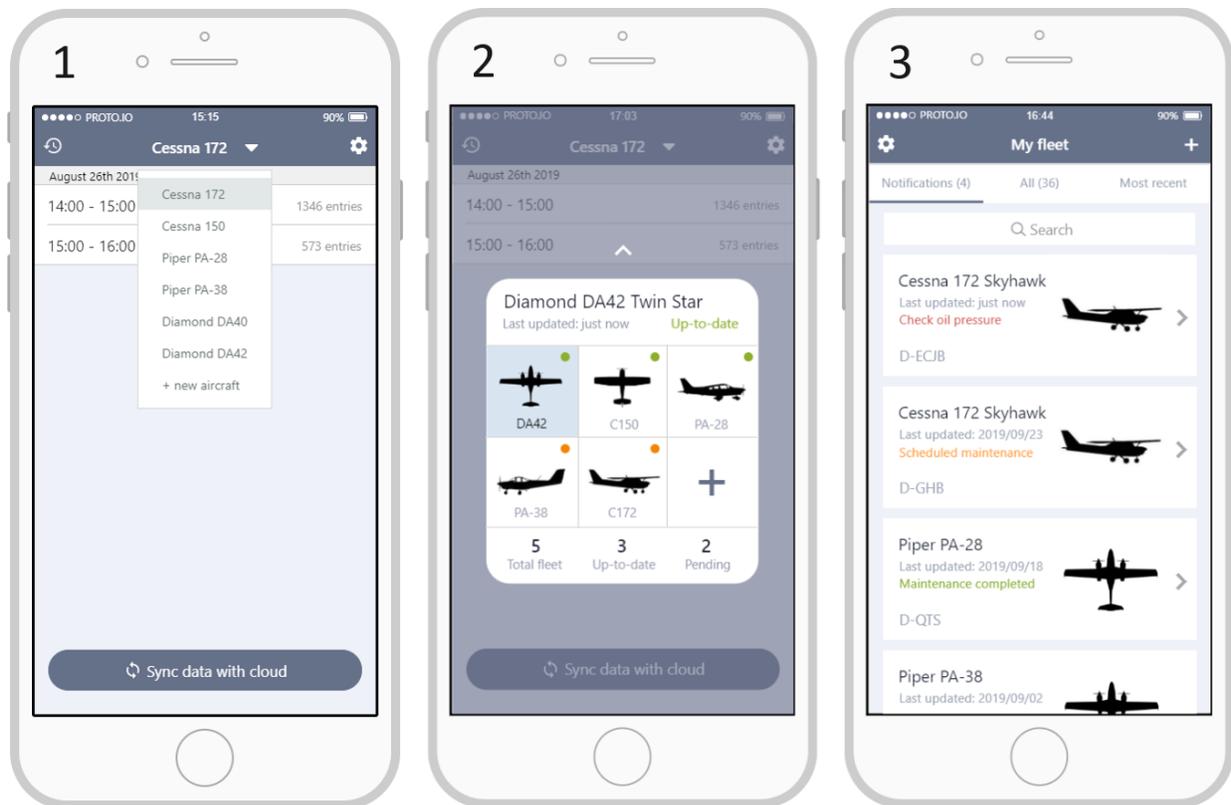


Figure 18: three iterations of the 'dashboard' (confidential)

© Jeppesen GmbH

Figure 18 shows three iterations of the 'dashboard', based on feedback Anna gave me. Additional adjustments were made after the UX guerrilla tests. I could not have come up with the third iteration, if I hadn't reflected upon my design decisions in the previous iterations.

Additional findings of the UX guerrilla tests include (summary):

- Onboarding makes the user feel 'safe'
- Users like the implementation of common iOS UI elements
- Settings menu affects all aircraft according to users (correct)

To address the last goal (aesthetic designing for external audience), I prepared two external presentations for the EBS University, and an aviation conference, presented by my tutor Anna. In the last weeks, the research team also prepared a presentation for Brett Burgess, the new Chief Product Officer at DS&A, as well Ken Sain, the CEO of DS&A.⁴⁹ I helped to prepare the presentation artefacts to demonstrate the research activities. We moved away from a traditional PowerPoint presentation, and used a whiteboard instead, with tangible props to visualize some of the processes in the lab. Finally, although not targeted towards an external

⁴⁹ (The Boeing Company, 2019)

audience, I also prepared two UX workshops with Anna and Andreas, and created a three-minute video to explain our research findings to other researchers.

5.3 What Do Others Think?

In the section I present my efforts to improve myself based on the feedback of others. The whole internship felt like a true work experience, where my colleagues treated me as a full team member, while at the same time helped me with my learning goals. I learned a lot from my team. They gave feedback on my work, and I was encouraged to actively participate in meetings. Anna has introduced me to new UX methods I was not familiar with before, such as JTBD's, and UX Guerilla tests. She also steered me a bit to put additional focus on certain aspects of the research project. Overall, I believe she is happy with the way I work, which is independent and communicative. Based on the way my team responded to my ideas, I think they have come to trust me and believe in my ability to add value to the project. Although most of the time the most guidance was provided by other team members, in some circumstances I steered the project as well, which I believe was appreciated.

One of my team members gave me the following hand-written compliment:

"Nijs, I am really impressed by the work you do here. You have exceeded all my expectations and it will be a great loss for the team when you are not around anymore. You need to come back eventually."

- Miriam, team member (computer scientist)

Our manager left the following note with regard to the UX research workshops on my desk:

"Nijs, excellent training (UX) – well done – thank you for the effort."

- Nico, research manager



Figure 19: Attitude, Skill, and Knowledge: (ASK) a New Model for Design Education

The ASK model for design education (Figure 19) suggests breaking down the abilities of a design professional into three ingredients: Attitude, Skills, and Knowledge.⁵⁰ In addition to the competencies as discussed earlier, it is important to possess the right attitude, skills, and knowledge with respect to a certain design challenge as well. Therefore, I have asked my direct team members (Hilna, Miriam) to provide me with feedback through a feedback form, which we then discussed (page 69).

From these discussions I've derived the follow insights.

My team members have expressed confidence and trust in me, value my communication skills, and fast learning capabilities. I received positive feedback from different sides, which I of course appreciated. I also appreciated the team's effort to give accurate feedback. The following was said with regard to improving myself.

My aviation knowledge is sufficient to do the work successfully, but I can improve myself if I increase my knowledge in this area. More experience in the industry will help me with achieving this, or for example by following aviation-related courses, e.g. at the TU Delft.

Although I am open-minded, and able to critically reflect upon my work and myself according to the team, I have to be aware of the fact that it is okay to say that you don't know the answer completely, instead of telling what you do know, and how you approached the problem. This was something my tutor (psychologist) noticed, and although she thinks it's not a problem, it can be helpful to approach answering a question differently sometimes. It can be valuable to

⁵⁰ (Bakarman, 2011)

answer a question by explaining what you know and how you know it, but it is sometimes even better to answer it by telling the plans you have made to get to know more.

Other feedback from the team included that they were positively surprised by the quality of the prototypes and video (“really standing out”), and my ability to integrate in the team.

Epilogue

I am convinced that this internship and those who coached me have made a distinct impact in assuring my continuation in the field of R&D. The internship was carefully organized, scheduled, and tasks were delegated with consideration of my personal goals. I consider the internship to be successful, and I would like to once again extend my thanks to those involved.

“Boeing just took \$20 billion and 10 years to improve the efficiency of their planes by 10 percent. That’s pretty lame. I have a design in mind for a vertical liftoff supersonic jet that would be a really big improvement.”

- Elon Musk

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Appendices

Appendix A: Approved Internship Plan

FORMAL APPROVAL INTERNSHIP



Student Nijs Lucas Jan Bouman **Date** 02/07/2019
Teacher coach Dr. ir. Bart Hengeveld
Period activity September – December (August – November) February - June

Personal Development Plan for formal approval	Does the choice of the learning activity align with the Professional Identity and Vision development of the student and are his/her choices well-argued?	Yes No additional feedback
	Does the learning activity contribute to the development of the student?	Yes No additional feedback
	Does the chosen learning activity contribute to a balanced development in the Bachelor program of Industrial Design?	Yes We discussed your expertise profile and you we agreed that you seemed to be on course.
	Are the goals well formulated?	Yes You improved your goal descriptions very well. They are realistic and workable.

Complete the aspects only for the chosen learning activity:

Internship (worth 25 ECTS) (requisites: P1, P2, P3)	Does the company profile align with the <u>requirements for internships</u> ?	Okay [Additional feedback.]
	<ul style="list-style-type: none"> ❖ <i>Doing an internship at one-man businesses is not allowed, unless the company owner is currently teaching at the Department of Industrial Design, Eindhoven University of Technology.</i> ❖ <i>The company must support development in several expertise areas.</i> 	
	Does the company coach align with the <u>guidelines for internships</u> ?	Okay [Additional feedback.]
	<ul style="list-style-type: none"> ❖ <i>The company coach must hold a MSc. degree in (Industrial) Design or has at least 10 years of professional experience as a designer.</i> 	
	Can the student work on a clearly framed design project or tasks?	Okay The design team Nijs will be joining is focused on experience design in the aviation context. The design work is generally homogeneous and despite the design assignment not being settled on yet, it is quite predictable what Nijs will be working on.
	Personal Development Goals (minimum 1 - to include on Assessment form as well)*: <ul style="list-style-type: none"> ❖ Expanding my network: letter of recommendation from supervisor ❖ International experience and large company: shaping a masterplan for own businesses based on experiences ❖ Making at least one prototype in the most relevant medium *Discuss goals and positive and negative points in the coach meeting to guide how the student can develop expertise areas that might not be covered within the internship. The same goals will be included in the assessment form at the end of the internship.	User test with multiple end users, translating professional needs into design solutions Aesthetic designing: suitable for external presentations

Exchange (worth 25 ECTS) (requisites: 100 ECTS when the student leaves on exchange)	Name Exchange University and Department	[Name exchange university and department]
--	---	---

Minor (worth 25 ECTS) (requisites: BoE approval for free minor)	Minor at Department of Industrial Design at University of Twente; or at the Department Industrial Design Engineering at Delft University of Technology. (No other departments at these Universities or other Universities in the Netherlands are allowed without permission of the BoE.)	[Name University and Department where Minor is done.] [Elective], [Elective], [Elective], [Elective], [Elective]
	Minor at a University elsewhere in the Netherlands	[Name University and Department where Minor is done.] [Elective], [Elective], [Elective], [Elective], [Elective]

Electives (worth 25 ECTS)	What are the chosen electives? <i>In case a student chooses to do more than 15 ECTS worth of electives outside of the Department of Industrial Design, the student needs, next to the formal approval of the coach, to file a request to the Board of Examiners.</i>	[Elective], [Elective], [Elective], [Elective], [Elective] [Generations before 2015-2016 choose 6 electives, later generations choose 5 electives]
----------------------------------	---	---

More information:
This form needs to be completed and signed by the teacher coach. In case of an internship as activity, the student has to add their personal development plan plus this form signed by the teacher coach to the appendix of their internship report. In case of an exchange, the student needs to deliver (a copy of) this form to the International Office at the Department of ID.

Approval

The personal development plan and chosen learning activity are approved by the coach**:

Okay

[When the answer above is no, please explain why.]

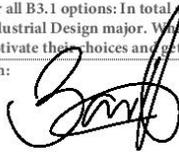
**Provided the request is granted/supported by the BoE.

Please note:

- For exchange and activities that take places abroad it is strongly advised to consult the exchange coordinator for arranging insurance and because there might be opportunities for receiving a scholarship. Please be aware that exchange students need to be nominated by the exchange coordinator.
- For an internships it is strongly advised to contact Annalisa Franco (Internship Coordinator) for arranging your internship details.
- For all B3.1 options: In total students are allowed to choose a maximum of 45 ECTS of courses outside the Industrial Design Department next to the Industrial Design major. When they would like to choose more than 15 ECTS of electives outside the Industrial Design department, they have to motivate their choices and get approval of the Board of Examiners (next to the formal approval of the coach per this formal approval form).

Teacher Coach:

Signature:


More information:

This form needs to be completed and signed by the teacher coach. In case of an internship as activity, the student has to add their personal development plan plus this form signed by the teacher coach to the appendix of their internship report. In case of an exchange, the student needs to deliver (a copy of) this form to the International Office at the Department of ID.

Appendix B: Personal Development Plan (July 2019)

PDP Internship 2019

N.L.J. Bouman | 1264915
Eindhoven University of Technology
Industrial Design

Company description

Jeppesen (part of The Boeing Company) is an American company specialized in navigational information management, operations planning and logistics, flight planning products and aerospace software. Jeppesen has offices in locations around the world, including Neusenburg, near Frankfurt. Jeppesen employs 3,200 people worldwide.¹

Starting and ending date

01-08-2019 to 15-11-2019

Company coach

Not yet determined. I have asked about the possibility to have a coach that meets the requirements as described in the *internships company prerequisites* document on the university's website. According to the hiring manager, this is no problem.

Assignment

Helping a research team with an Industrial Design related project on navigation systems, but also becoming part of this team myself. The project is orientated towards User Experience design. The work includes individual projects as well. Jeppesen is familiar with the department of Industrial Design and takes the learning values into account.

Goals of my internship

I want to obtain experience in an international context, since I am interested in pursuing an international career after graduating. I currently co-own three small businesses, namely a holiday apartment rental business, web design bureau, and media start-up. Together with my friends and colleagues, we work on expanding these businesses. Therefore, I would like to obtain knowledge within a large company, such as Boeing, to learn from the people working there. An international company fits my interests well, since most of the customers I currently serve are international as well. I hope that I can expand my professional network through this internship opportunity, while working on becoming an Industrial Designer in the process.

¹ Wikipedia contributors. (2019, June 19). Jeppesen. Retrieved June 21, 2019, from <https://en.wikipedia.org/wiki/Jeppesen>

I have defined the following goals, based on my motivation. The first two goals are soft goals, since I think this internship is a great opportunity to work on these social aspects of becoming a great designer. The last three goals relate to an expertise area, i.e. applying the theory I learned in a professional context.

Expanding my network

Expanding my (international) network, getting to know people from other countries.

The reason I choose to pursue this goal, is because in my experience as an entrepreneur, the importance of a good network becomes very clear. Having the right connections is crucial, since the best work is done in a team.

This goal will allow me to become a better networker, by not only **expanding** my network, but also **diversifying** my network. This goal is specifically targeted at **people in the industry who have resources** that could benefit me in the future. I am going to meet new people both **inside** the company, but also on **company events**.

A success criterion for this goal is to arrange a **letter of recommendation** from Boeing, preferably from my direct supervisor. This letter will be a valuable asset for my CV.

Getting to know an international company

Experiencing all aspects of a large international company, getting to learn how these companies work (**Business and Entrepreneurship**).

I would like to grow my businesses, become a better entrepreneur and build a strong team. Part of this is scalability and internationalization. I would like to learn why Boeing is such a successful company and how they work for international clients. Of course, not all elements of Boeing are directly applicable to my situation, but team management for example is something I want to learn from.

Based on the experience I obtain during this internship; I am going to make a **master plan for my own businesses**. This masterplan describes the direction I want my companies to head, and how I am going to achieve this. This might also include parts of Boeing that I do not like. This plan will include a scalability element, as well as a plan to attract international clients and customers.

User experience design in a professional context

Improving my knowledge in the field of User Experience design, by (1) making prototypes, (2) conducting user tests, and (3) practicing designing an aesthetic experience, fitting the users' needs.

Prototypes in any medium allow you to iterate more easily, not only by **evaluating** your prototype, but also by **discussing** your prototype with colleagues and **triggering new ideas** in the process. Therefore, I am going to make **at least one prototype** (in the most relevant medium), and improving the design using **all three aspects** of why prototypes are useful.

Furthermore, my prototyping skills (**Technology and Realization**) will be sharpened by more practice time.

Additionally, **user test with multiple end users** (preferably by means of my own prototype), will help with practicing understanding the user, and translating their needs into design solutions (**User and Society**). Also, I will learn how to interact with the user in a professional context.

In line with the above mentioned, a fitting aesthetic (**Creativity and Aesthetics**) for the prototypes helps to bring across the design, obtaining more accurate feedback, and hopefully triggering more thoughts from potential users. Therefore, I would like to focus on both functions and its aesthetics. The aesthetics of the prototype should be of a **high enough quality to use for external presentation** of the design.

I am going to address the remaining expertise area, **Math, Data and Computing**, not during this internship, but by electives and the work I do for my businesses.

Appendix C: Company Coach Evaluation Form

Company coach evaluation form

Internship



Student	Nijs Lucas Jan Bouman		
Company	Jeppesen, a Boeing Company		
Company coach	Andreas Godehart	Tutor	Anna Zielinska
Position	Researcher	Position	Researcher
Period	<input checked="" type="checkbox"/> August / November	<input type="checkbox"/> February / June	
Total weeks	15 weeks full-time		

Overall Competence of Chosen Design field	Assignment	Nijs' main tasks: <ul style="list-style-type: none"> o An early prototype of the companion mobile app o Analyze and design user work-flow in the context of main hardware product o Usability tests using mockup o Support and run discovery research interview o Analyze interview data and create a persona o Support in creating and hosting "UX Workshops" for Research team
	Design and research processes	The organization is following SLIM gate stage process and incorporating SAFE agile methodologies. The research team is self-managed, which means can decide on process, methods, and methodologies as long as deliver what is expected. There is no one process team is following.
	Assignment deliverables	Nijs was delivering his tasks on time, often before the deadline always high-quality deliverables.
Scientific and Professional Skills	Presenting	Nijs was not hesitant to present the results of his work with a team or during stakeholders meeting. His style of presentation is good and visual slides prepared were always high quality. He could improve his presenting skills by considering the audience needs and knowledge - try to avoid profession-specific terms or buzz words and, if needed, adding short introduction before starting technical part. <input type="checkbox"/> Not applicable / unable to judge
	Reporting	[Provide a qualitative account of the reporting skills of the student] <input checked="" type="checkbox"/> Not applicable / unable to judge
	Organizing and planning	Nijs demonstrated good planning skills and had no issues with delivering on time. He also never demonstrated any issues in working in a lean work environment with constant change and uncertainty. He blended into the self-managing team and acted as expected in a creative way deciding often on his own tasks.
	Reflecting	[Provide a qualitative account of the student's critical and/or reflective attitude] <input checked="" type="checkbox"/> Not applicable / unable to judge
	Cooperating	In our organization, we work in a very open environment and teams are "self-managed" - that means team members are deciding together on tasks and tasks to ensure they will provide high-quality outcomes. Nijs didn't have any issues with joining this style of work and to become an equal team member. He participated in all team activities and get along good. In meeting with project stakeholders he was taking part in the discussion.
Vision and Identity	Professional Identity	Nijs had a chance to practice his design skills with preparing mockups of a digital app and testing it with users. He also had a chance to learn how to understand the market and segment it. He was constantly challenged with

More information: ID.internshipcoordinator@tue.nl

Version 1.1

		different tasks, requiring different skills. I believe he learned and gain new skills and also had a chance to practice what he learned at the university. <input type="checkbox"/> Not applicable / unable to judge
	Vision	[To what extent did the internship contribute to a critical reflection of the student's vision of their work/role and/or of the work field?] <input checked="" type="checkbox"/> Not applicable / unable to judge
Contribution and Development	How do you consider the specific contributions of the student within the internship assignment:	Above average [*If best 10%, please provide a benchmark of why the students is among the best 10% of your interns]
	Provide an indication of the development the student has made throughout the internship, independently of the results:	Above average [*If best 10%, please provide a benchmark of why the students is among the best 10% of your interns]
Feedback	[Additional feedback]	

Email address Anna Zielinska: anna.zielinska@jeppesen.com, Andreas Godehart andreas.godehart@jeppesen.com

Physical address Frankfurter Strasse 233, 63263 Neu-Isenburg, Germany

Telephone number Anna Zielinska +49 6102 50 8469

Date 11 /11/2019

Signature
Company coach

Signature
Tutor

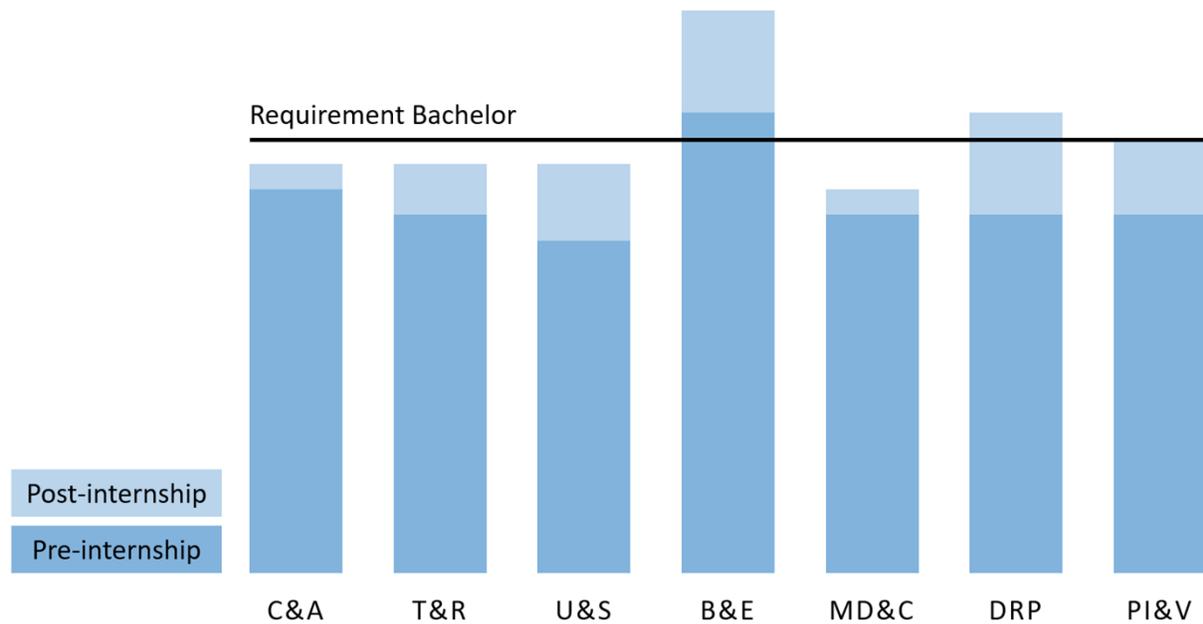
Appendix D: Personal Reflection

This internship has taught me a lot, both in relation to my development as a designer, as well as my professional identity, while it has simultaneously been a valuable life experience. In this section, I will reflection upon my personal and professional development, and relate this to my goals, growth in competency areas, and learning outcomes. To conclude this section, I will look back on my years at the TU Eindhoven, and take a look into the future.

Figure 20 demonstrates the effect of the internship on my competency development (quantitative estimation). The most significant improvements are in the field of Business & Entrepreneurship (B&E), and Design Research Processes (DRP). I have added a horizontal line to indicate what I think would be considered a good level of competence at the end of my Bachelor. As can be seen, B&E and DRP already surpass this level. A point of self-critique should be that my development in the field of B&E suggests a lack of focus to evenly develop different competencies, since the aimed level had already been reached before the start of the internship. This is partly due to my personal interests in this field indeed, but largely the result of the emphasis on market research as a part of the exploratory research during the internship project, which I wasn't aware of in advance.

I have made significant steps in the DRP domain, as the exploratory research projects focus heavily on methodology, frameworks (scrum, agile), and the phase-gate process.

With regard to my PI&V, I now have a better picture of what type of designer I want to become, and how I can achieve this (masterplan, page 63), although I still consider my PI&V work in progress. I am not sure if I ever completely understand my PI&V, and I consider it one of my weakest points as a designer. When comparing myself with other students, some of whom have a specific passion, I would say I am not a typical design student. My interests heavily lean towards entrepreneurship, and product development in relation to business viability. At the same time, I care about customers, and can feel personally attacked when a customer doesn't like a product or idea. All of these personal observations are difficult for me to put into one consistent PI&V, and also makes me wonder how much my identity as a designer coincides with my non-professional identity. Defining my PI&V therefore feels like a much broader, and more spiritual quest than what I initially believed. I cannot give a definitive description of my PI&V at this point, which I believe already is a step in the right direction, since I recognize my difficulties with this topic.



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Figure 20: competency development during internship

I will bridge the differences between the required level and my current level during the coming (and final) semester. To make sure I will reach (and surpass) the required levels, I will closely consider my personal estimations in Figure 20 during the selection of my final bachelor project (FBP).

Final Bachelor Project

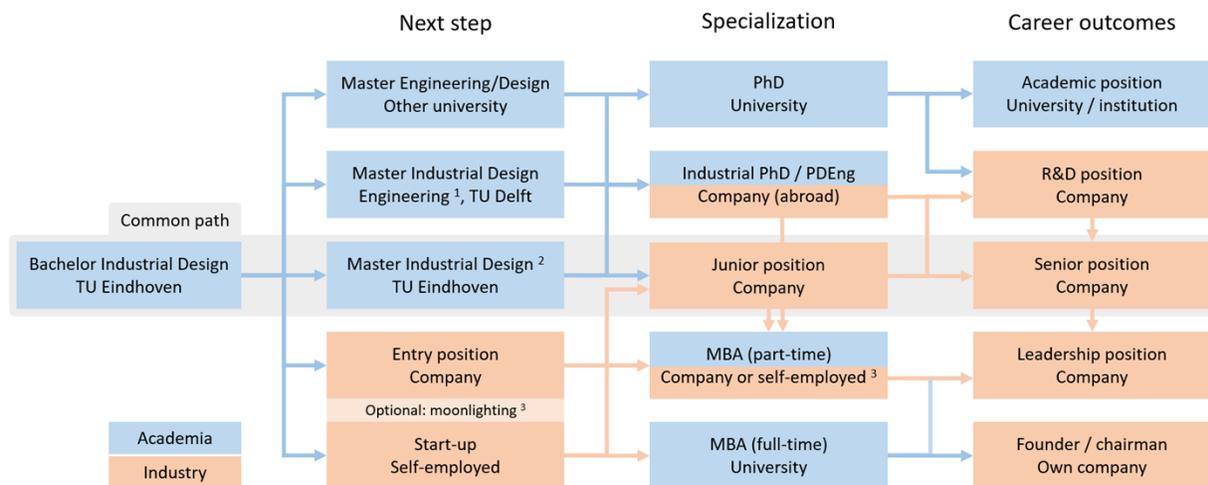
In the second semester of my last bachelor year (B3.2), I will do my FBP. Based on Figure 20 and my personal preferences I have listed my top three project squads:

1. Designing for Growing Systems in the home (DFP003)
2. Future Mobility (DFP006)
3. Seamless Interaction Design for Professionals (DFP005)

The first squad's main expertise areas are MD&C, C&A, and T&R, which nicely align with my intended competency development.

Appendix E: Master Plan

Figure 21 shows a diagram that illustrates different possible career paths, based on the insights I obtained during the internship. I have spoken to colleagues about career opportunities over dinner, and they gave me some valuable insights. Rather than solely focusing on entrepreneurial opportunities as the second goal suggests, I've also included possible educational and employment considerations. In grey, the most common path is indicated, i.e. pursuing a master's degree at the same university, finding an entry job, and developing your career from there on. In order to make sure that I take the right next step, I have to consider other possible options as well, which result in different career plans. For the career outcomes I considered a 7 to 15-year outlook. The goal of this master plan is not yet to lay out my path, but rather to better understand different possibilities and outcomes, in relation to my vision and professional identity. Breaking down different steps helps to see what education and experience could be beneficial for certain career objectives. In the course of the coming months (until May 2019, the deadline for registration for higher education), I hope to refine my initial PI&V,⁵¹ so that this can guide me in making my decision. It is also important to reevaluate your plan from time to time, since conditions or preferences might change over time.



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Figure 21: overview of possible career paths

¹ The following programs are offered: Design for Interaction, Integrated Product Design, and Strategic Product Design.

² The following tracks are offered: Design Leadership and Entrepreneurship; Research, Design and Development; and Constructive Design Research.

³ To have a second job in addition to your main job; common start-up financial structure.

⁵¹ Professional Identity & Vision

Post-internship remarks

I've received feedback from my PI&V tutor that career paths are not as linear as I depicted in Figure 21, e.g. after doing a master at the TU/e you can also start your own company. Also, the most common path becomes less and less common according to my tutor. It's good to look at all options and see what fits me best, regardless of what other people do of course. Anyway, during my FBP I hope to get a better picture of what kinds of designs I like to work on, because this is still not clear to me. Another question that remains unanswered, is in what kind of industry would I like to work? In order to answer this, I have to do at least one more internship to be able to compare.

Now that an overview of career options is established, I will explore the self-employment option in more depth, specifically what I can learn from Boeing being a successful enterprise.

Based on my internship experiences, I can tell that Boeing has created a healthy corporate culture, at least at the department I work for. Employee feedback is sought for actively, and communicated with the teams. The management also tries to convert this feedback into structural improvements. Research project outcomes, either 'positive' or 'negative' (discontinue project), are celebrated, and personal contributions are acknowledged. The following was communicated by Dr. Jens Schiefele, Managing Director of Digital Aviation Research & Rapid Development, after the employee survey:

"Good: Team oriented, trust in your managers, exciting projects, love the rapid change of projects.

Take a look at: too stove piped/politics, lack of focus on customers, not enough customer access, lack of ability to travel, lack of clear vision."

This seems to be accurate, and in line with my experiences in the lab as well. I endorse the criticism on lack of customer access, since this is something our team ran into as well.

Boeing in general is a very risk-averse company, which suits the aviation industry, as well as my personal preferences. Although I am not afraid to make risky decisions, I would rather compromise a bit of profitability, to avoid potential trouble in the future. This is also something I experienced running my businesses. I am a type of person who wants to be (feel) in control. If this is not the case, this can lead to personal stress. Therefore, I should try to take my personal traits into account when choosing what responsibilities I want to take on, and what responsibilities I want to source out. This is analogous to how Boeing operates. It has predefined rules with respect to partnering with other companies. Boeing knows what it is good at, which is large scale engineering. In order to enter new markets, it much rather partners with, or acquires companies, than investing in expensive in-house projects outside its traditional market. This is Boeing's approach to entrepreneurial ambidexterity, which is a fancy

phrase for leveraging existing product portfolios, while keeping an eye on new market opportunities.

Another insight relates to critically looking at your return on investment in relation to time. One of the companies I am involved in, PMG v.o.f., aims to find solutions for the increasingly polarized Dutch media landscape. Although the solution/concept we propose seems to address this problem effectively, I didn't realize that you can only tell so confidently if you have multiple concepts with multiple outlooks to be able to compare. Therefore, I will start a discussion to try to explore more options before we go forward, and focus more on estimations of the respective Net Present Values (NPV), rather than inaccurate assumptions for market capture. Estimated market capture is not a good benchmark in my opinion, because it doesn't account for risk, real market sizing, and pricing. Some methods I learned during the internship, will definitely come in useful for estimating the NPV.

Schiefele also identified the stove-piped character of Boeing (i.e. comprised of information silos),⁵² which is not a good thing. This is a common phenomenon which occurs when merging companies, but I don't think learning more about M&A strategy is relevant for my situation anytime soon.

In terms of project management, I am much more confident than I was at the start of the internship. I now have the tools and know-how to effectively run small projects. I still didn't figure out a way to effectively upscale business activities, since this was not part of the scope of the internship project, and heavily depends on the type of industry. This is one crucial piece of entrepreneurship I would therefore like to address during a future internship or work experience. However, there is no set 'recipe' for upscaling business activities, and I should not try to simplify this aspect of entrepreneurship.

Pros	Cons
Good career perspective and opportunities	Bureaucracy
Many resources and much expertise	Internal power politics
Well-known	Disconnected teams
Interesting industry	Hierarchy
Many teams and departments	Little power as employee
International	Strongly focused on ROI
Innovative	R&D mostly located outside Netherlands
People with different backgrounds	Mostly B2B
Industry-leading	No significant growth (Boeing is too large)
Growing market	Controversial military activities
Visionary	Controversial environmental concerns
Products with a real impact	Controversial safety assurance policy ⁵³

Table 5: working for Boeing, pros & cons

⁵² (Information Silo, 2019)

⁵³ (Boeing 737 MAX groundings, 2019)

Table 5 lists factors to take into account when choosing to work for Boeing. Like any company, working for Boeing has pros and cons. The biggest downside of Boeing in my opinion is that it is very hard to put your personal vision and beliefs into practice, since many projects come with predefined expectations, regulations and bureaucracy. Also, Boeing is so big (higher operational revenue than the GDP of most countries), that it can feel like you are just a small cog in this enormous operation. This is also one of the reasons why starting my own business is appealing to me. Another thing to note is that Boeing is very hierarchical, with many layers of management, up to eight layers (intern to CEO).

Taking into account the previous downsides, I believe that Boeing is a nice company to work for, especially at the start of your career. Boeing has much to offer. Its operations are fascinating. The American corporate culture, especially with the German flavor in Frankfurt, fits my personality well (risk-averse, structural). I can definitely see myself working in a similar environment in the future.

Boeing values

Boeing identifies the following values:

- Integrity
- Quality
- Safety
- Diversity & inclusion
- Trust & respect
- Corporate citizen
- Stakeholder success

Employees are reminded of those values. Although it may not present any concrete benefit to list seemingly random values, I think that values can help an entrepreneur to make consistent decisions, and provide guidance to stakeholders. Therefore, I should also think of values I want to adhere to, when continuing any entrepreneurial activities. In addition to values, I would also like to develop my personal business guidelines, which will help me to make better business decisions. One guideline for example should be that business should not affect your personal well-being, because this can result in you getting too emotionally attached to your work, resulting in wrong judgments and personal interference.

Personal remark on diversity & inclusion

Diversity is an important topic. However, I don't believe in diversity as an end goal, which is commonly the approach to diversity by many organizations these days, pushed by politics (e.g. by means of quota). I believe that diversity is a strength, because it exposes a team to different perspectives, which improves decision making. This will

inevitably result in better company performance, as shown by many studies.^{54, 55} Therefore, you should not enforce quota, as this will communicate the exact opposite: diversity is artificial and cannot stand on its own. I believe in giving everyone an equal opportunity, regardless of social background, gender or ethnicity. We should abstain from advantaging or disadvantaging anyone based on anything else than their individual qualities. As soon as you introduce quota, thus excluding or disadvantaging a group of people, you ignore inherent differences between people and oversimplify a problem by artificially grouping a set of people based on an attribute that doesn't relate to true (ideological) diversity, but rather relates to superficial diversity. This approach is short-sighted, and unacademic, also since you ignore what we have come to agree upon in modern society: unconditional equal treatment of individuals (article 1 of the Dutch Constitution).

*This personal remark is the result of a conversation I had with my team, and is a response to the recent decision by the TU Eindhoven to only open vacancies to women.*⁵⁶

Boeing behaviors:

- Lead with courage and passion
- Make customer priorities our own
- Invest in our team and empower each other
- Win with speed, agility and scale
- Collaborate with candor and honesty
- Reach higher, embrace change and learn from failure
- Deliver results with excellence – Live the Enduring Values

Business Imperative:

“Deliver Superior Value to Customers, Employees, Shareholders, Communities and Partners.”⁵⁷

I believe that Boeing intentionally listed customers and employees before shareholders. This is a trend amongst many companies, which have come to believe that shareholders are not the main stakeholder anymore.

⁵⁴ (Siciliano, 1996)

⁵⁵ (Mahadeo, 2012)

⁵⁶ (NOS, 2019)

⁵⁷ (The Boeing Company, 2019)

Appendix F: Letter of Recommendation

Not available yet – Jeppesen is currently processing the letter of recommendation

Appendix G: Feedback from Team Members

Feedback form: Miriam Cornel

Points for improvement

What competencies could the student further develop in relation to the internship project?

I think you already have a lot of competencies! In relation to our project, maybe some background in aviation related topics

How can the student best improve these competencies?

This is out of your control, but once a year we have an aviation basics course (which was unfortunately already over when you started)

Recommendations

What are the student's strongest skills or qualities in relation to the internship project?

You are a really fast learner, and a good communicator

Accomplishments

What are the student's most significant accomplishments in relation to the internship project?

You did a lot... most significant probably the demonstrator and the video, this was really standing out. But additionally, you were truly a part of this team, and contributed to all those little things that had to be done

Comments

Is there anything else you would like to share?

You did an amazing job and we will miss you!

Thank you for filling out this feedback form!