Towards Sustainable Behaviour in Winter Sports: a Product-Service System Design for Modular Snowboard Boots.

Master Thesis

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July 2021 TU Delft

DEELUXE

TU Delft

Towards Sustainable Behaviour in Winter Sports: a Product-Service System Design for Modular Snowboard Boots.
Graduation Project

Master Thesis
Design for Interaction
Industrial Design Engineering
Delft University of Technology

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Acknowledgement

Dear reader,

This report represents the end of an era for me as an industrial design student in Delft. I hereby present you, "Towards Sustainable Behaviour in Winter Sports: a Product-Service System Design for Modular Snowboard Boots". A manifestation of the gained knowledge and skill throughout the years, combined with a passion of mine, snowboarding. During the last five months, my perspective has shifted from being a user to a researcher and designer. Never before did I observe the snowboarding culture and people so closely. It has been a challenge to step away from what is known to me as a snowboarder and keep an open mind to the experiences of others. I have experienced first hand how connecting with users can bring joy and devotion into a project.

Moreover, collaborating with Deeluxe, the involved snowboard boot company, has been an absolute pleasure. I would like to thank them for showing interest and giving me the opportunity to work on this topic. A special thank you to Max Meinhardt, Deeluxe's Product Manager, for being a consistent supporting and teaching force throughout the project. I really enjoyed working together.

This project would not have been the same without the support of Sander and Marieke, my TU Delft chair and mentor. Thank you for humanizing a project under the dehumanizing circumstances of the pandemic. Thank you for the effort, time and energy you put into coaching me. You are both an inspiration to me and I am honored to have you as my mentors.

I am grateful for every person who participated in the interviews as well as in the co-creation session. The project has been sparked by the input and insights provided through these events.

Finally I want to thank my family and friends for all the conversations, input and for feeding me in times of need. This would not have been possible without you.

I hope that my enthusiasm for this project is reflected in the report.
So, enjoy reading!

Nadine Haagmans
July 2021
Den Haag

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"The current research aims to extend approaches of user-centred design/inclusive design to demonstrate that sustainable products can be designed, which are inherently desirable to consumers who would not ordinarily purchase them based on their conformity with environmental/sustainable qualities alone." (Carey et al., 2019)

Summary

A modular product-service system approach has the potential to facilitate behaviour change within the snowboard boot context. The circular design strategy proposed in this report, including the 6 circular design principles, navigates the process of creating a product-service system aiming to maintain a products' value throughout its lifetime. With a special focus on Design for Attachment and Trust, Design for Durability and Design for Adaptability and Upgradability. Once a product-service system has been established for a while, Attachment and Trust help estimate future consumer behaviour within the service. For snowboard boots in particular, Durability is defined as the main angle on sustainability to approach this project. The environmental impact of this product over a certain period is reduced by prolonging the lifetime of the product. When the value attached to a product by the user, slowly decreases over time, Adapting and/or Upgrading a product potentially renews the product value for the user. This is especially true for the functional and emotional values. This increased product value is complementary to product retention and thus longevity, the ultimate goal.

What motivates users to buy certain snowboard boots depends on the type of user. A beginner has more ignorance and a lack of knowledge to overcome in their purchase decisions , resulting in a price and comfort based purchase. While an experienced snowboarder demands certain qualities or features. The different types of snowboarders are captured in four personas, including their level of investment, attitude and behaviour on the slopes. Snowboarders can identify with different personas over time, as people's needs, abilities or interests develop over time. The created lookup table regarding persona shifting can be utilised to inspire user centered design while designing the product service system. The table further elaborates on the user's perspective during persona shifting, including the user's these changes, the adaptable and upgradable aspects of the product service system should include:

- the level of comfort
- the stiffness or firmness
- the tightening mechanism
- appearance

Sustainability is viewed differently among the participants of the qualitative user research. The various sustainable attitudes are independent from the snowboarder personas, which have been created from the user research data. Additionally, one's sustainable attitude is not necessarily linked to sustainable actions. Therefore, the designed sustainable, alternative product-service interaction should be superior to the current standard to avoid relying solely on benefits regarding sustainability. By doing so, an attempt is made to get both sustainable and non-sustainably behaving people on board.

A market positioning analysis shows the opportunity to approach sustainability from a durability point of view. Deeluxe currently has a basis of a repair- and replaceability focussed product offering, so the transition to enter a modular system seems to be within reach compared to other brands. Deeluxe could be a pioneer in this field and potentially gain greater visibility and grow as a company, while establishing a more sustainable way of product handling.
A modular product-service system is proposed including a service set-up, a product-service system vision and a product possibility that could enhance product longevity and stimulate the intended durable and modular behaviour. The service proposal includes the offering of separate product parts and a take-back system for repair or refurbishing of used products. The user is introduced to a different product interaction from the start, to trigger a mindset that thinks

the ease and benefits that comes with the service, the user is invited to think about their personal development as a snowboarder. *Do they challenge themselves to become better? Are different product qualities demanded if so?* and *Do they want to explore different terrains?* The threshold for trying different terrains might be lower when only one boot part has to be switched to support the rider properly.

This product-service system represents freedom, growth, and sustainability without compromise. The boots are high end and high performance, the user is investing in their future, without spending too much.

The current standard of snowboard boots has been, re-thought, revised and redesigned in a modular fashion to prepare them for a more circular future. A possible product, the Exo-Flex, has been designed in a way that enables the user to alter the stiffness of the boot to their desires. By creating that possibility, the functional value imposed on the boots can be increased throughout a product's lifetime. Enabling the increase of a value that deteriorates over time, stimulates product retention thus creating product longevity.
The Exo-Flex is especially designed for the All-in snowboarder persona, who enjoy freestyle snowboarding in the park. A form study concerning leg ergonomics and the specific movements required in snowboarding have defined the shape-design of the Exo-Flex. The main function of this prototype is to evaluate the design dimensions, demonstrate the intended use and evaluate the ease of use. The materials, the actual stiffness and structure still have to be designed and defined.

1 Introduction

Before snowboarding and sustainability can be connected, an introduction to both topics seems appropriate.

The Snowboarding Culture
Snowboarding is a sport and a recreational activity at the same time. It is adventurous and connects snowboarders with nature and each other. Snowboarders tend to express themselves through their clothing as well as their riding style. Some boarders prefer speed and riding in deep powder, others live for doing tricks on obstacles in the snowpark. Various snowboarding events take place throughout the year, from competitions to gear testing-days where riders can try out new items of the snowboard gear companies. Overall, snowboarders love to talk about snowboarding, especially if it is a common ground with others. Excitement builds throughout the year, which sometimes results in gatherings to prepare the snowboards together before the upcoming season or holiday. Snowboarding and all sideline activities are a mixture of individual development and social connection (Hebert, 2014).

Sustainability as part of a Culture
Snowboarding is, just like surfing, a boardsport with a strong connection to nature. Part of the motivation behind this master thesis is the notable difference in cultures, that lies in the created awareness for sustainability. No claim is made that snowboarders are not environmentally conscious, actions in the surf context seem to have greater visibility. For instance, awareness about the polluted ocean was created by well marketed Ocean Clean-Up (Slat, 2021) and initiatives like beach clean-ups are organized by volunteers around the globe (Goodnet, 2014). Caring for nature seems to have found its way into surf culture. There is a mutual understanding between surfers to bring any encountered plastic piece back to shore and dispose of it properly. Even though surfboards are not sustainably made, they are incredibly repairable. The need to repair a surfboard is not a matter of if, but when. Therefore, this need is incorporated into the mindset of the surfers.

Protect Our Winters is an example of environmental initiative existing in the snowboarding scene, who demand change by tackling policies and creating awareness. However, the angle of this thesis is from the boarders mindset and habits, rather than a big organisation. Snowboarding finds its origin in snow surfing, so now, maybe sustainable behaviour within the snowboard culture can learn once again from its surfing predecessors?

1.1 An Introduction to Deeluxe

Deeluxe is an Austrian based snowboard boots company that has been pioneering in hard and soft snowboard boots since 1996. The first pair of soft snowboard boots made by them can be seen in figure 1, next to a frequent model that was made especially for their team riders (professional sponsored snowboarders). Starting with the very first pair, Deeluxe converts the feeling of skateboarding into their snowboard boots. Aiming to recreate that sense of control and down to earth feeling, they utilize typical skateboard shoe characteristics, like thinner soles and a soft, comfortable fit. Their product offering ranges from these freestyle series to adventure series and more, see figure 4. This chapter contains information about snowboard boots, the target group of Deeluxe, sustainable intentions and their perceived position on the market, from a sustainability point of view.

Figure 1 - Deeluxe's first soft boots from 1996 and one of their 2020 models.

Figure 2 - An annotated image appointing snowboard boot parts and features.

1.1.1 Snowboard Boots

Snowboard boots are used to protect and support the feet while snowboarding. They come in different styles and colours to potentially match the snowboarder's look. This project focuses on soft boots (as opposed to hard boots), various parts are highlighted in figure 2. Collectively, these parts work to fit well, keep the feet warm, keep any water out and provide a certain level of support/stiffness. The complete lacing system, powerstrap, handle and heel harness are interactive product parts, as they are actively handled when boots are put on. The insole and sole serve more passive functionalities, like supporting the foot throughout the day or damping impact movement from the user. The flex window allows users to walk more comfortably, whereas the backstay influences the ability to flex.

1.1.2 Target Group

Deeluxe offers a wide range of boot series, suitable for a variety of terrains. The freestyle series includes the highest number of models and therefore is considered to be part of Deeluxe's main target group. Overall, this group is aged between 20-35. In addition to Austrians, Deeluxe targets international snowboarders by distributing their products globally and by inviting international individuals into their team. It is common practice to use professional snowboarders to create awareness about a brand or innovation in the snowboard industry. Figure 3 shows the sponsored snowboarders that are part of the Deeluxe team. The visual presentation of these people reflects the image that Deeluxe wants their target group to identify with.

Figure 3 - Deeluxe team riders.

PRODUKTE / TECHNOLOGY

ADVENTURE SERIES
ALL MOUNTAIN SERIES
PRECISION SERIES
EVOLUTION SERIES
FREESTYLE SERIES
KIDS SERIES
WOMEN SERIES
AFTERHOUR SERIES
ALPINE SERIES
ACCESSORIES ALPINE
SOFTGOODS

Figure 4 - Deeluxe snowboard boots categories.

1.1.3 Deeluxe and Sustainability

Sustainability can be approached from many angles. From the use of renewable energy, low-emission transportation, zero-waste production and eco-friendly packaging to providing durable and/or repairable products to facilitate sustainable behaviour on the consumer side. Deeluxe is interested in exploring ways to become more sustainable as a company. As can be seen in figure 5, the company stopped using plastic in packaging, they are shifting from transport by ship to train and the design department is exploring various soft boot designs using recycled materials. However, within these experiments, the boots did not comply with the requirements and therefore failed the test so far. Consequently, Deeluxe is looking for additional and alternative approaches which lead to this master thesis project.

Figure 5 - Current sustainable efforts by Deeluxe.

1.2 Research Set-up

This chapter describes what problem drives this project, followed by an explanatory assignment formulation, including some of the challenges that will be encountered throughout the process. The main research questions and some sub-questions are stated afterwards, followed by an overview of the research methods that have been used.

1.2.1 Problem Statement

The winter sports industry is lagging behind when it comes to sustainability. Occasionally renewable energy sources are used to power parts of the ski resorts or factories, but overall the industry could be more considerate when it comes to the environment. Winter sports gear and apparel have their share in the environmental footprint of the industry (Oatman, 2016). Yet more importantly, the user-product interaction throughout the product life-time influences the impact of a product on the environment considerably. Little is known about users' behaviour and motivation for a more sustainable alternative concerning their snowboard gear.

(Schneekanone in aktion im skigebiet, 2020)

Generally, current construction of snowboard boots has not drastically changed over the last 20 years across all the different brands. Certainly, progress has been made, but at a slow pace. The current boot designs provided by snowboard boot companies are not suitable for recycling, nor is a service offered that facilitates a life prolonging act for the user. Only a few brands offer spare parts to stimulate product retention, yet only to a certain extent, see appendix B for an overview.

Snowboard boots and the corresponding product-service systems, are not meeting their full potential when it comes to repairability and upgradability. This project explores the opportunity to connect behavioural change (both of the company and the users) in favour of sustainability to a new kind of snowboard boot.

1.2.2 The Assignment

The assignment given by Deeluxe was to rethink the concept of snowboard boots, so that a sustainable solution can be identified and explored. Rethinking the concept includes how snowboard boots are used throughout their lifetime, how they are constructed and what they mean to their users.
Deeluxe is looking for an innovative new boot design that facilitates the users needs, as the start of a new concept for further design innovations.

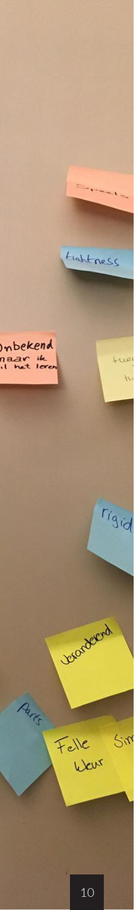
Challenges:
The current snowboard boots, and the corresponding user-product interactions are designed for a linear, 'cradle to grave', lifetime. Meaning that design for behavioural change is essential, which is by definition a challenge. Sustainable thinking needs to find roots within the snowboard culture, something that will not be established by this project alone, though it can help in initiating new ways of approaching sustainable performance products.
Since sustainability is a hot topic, political correctness of participants in the user research should be prevented. What people say and what they actually do is not always corresponding.
A fair amount of knowledge needs to be internalized in order to be able to design (a part of) snowboard boots. This project houses design challenges within both master directions, *Design for Interaction* and *Integrated Product Design*, which is simultaneously a personal motivation to pursue it.

1.2.3 Research Questions

Both literature and user research are performed in an attempt to answer the following research questions:

What sustainable strategy fits the snowboard boots context best?
- *What motivates users to choose a sustainable snowboard boot?*

How is sustainable behaviour stimulated amoung different types of users?
- *Who are the different types of users?*
- *What do snowboard boots mean to them?*
- *What does sustainability mean to them and how do they act?*



1.2.4 Research Methods

The double diamond model (Design Council, 2005) discloses the research and design process that has taken place throughout this project. Which means that knowledge is gained about the product, its context and users by repeatedly diverging and converging. The first diamond mainly concerns research to design the right thing, the second diamond focuses on ideation, to design things right. Sustainable user and consumer behaviour theories and strategies are reviewed in the literature research (*chapter 2 Sustainable Thinking*), resulting in insights for further concept development. Contextmapping techniques are used to perform a qualitative research study (*chapter 3 User Research*) that explores different types of users and possible solution spaces. The outcomes of this first diamond are input for the second diamond, where they function as input for the ideation phase. The product-service system that results from this phase is elaborated on in both *subchapter 4.1 Sustainable Service Proposal* and *subchapter 4.4 Future Product Possibility*.

The second diamond was kicked off with a creative facilitated brainstorm session with a resource group of 5 participants. Various design directions were explored during this co-creation session. Further ideation included both individual and dual brainwriting sessions with M. Meinhardt, product manager of Deeluxe. At last, a form evaluation of the designed product is conducted with apprentice physiotherapist and experienced snowboard instructor H. van Gerben. The emerging product-service system solution is further explored by creating user scenarios (*subchapter 4.2 User Scenario*) and a service mind map (*subchapter 4.1 Sustainable Service Proposal*). The entire project has been an iterative process, while new knowledge is gained, insights, ideas and conclusions are defined and redefined repeatedly.

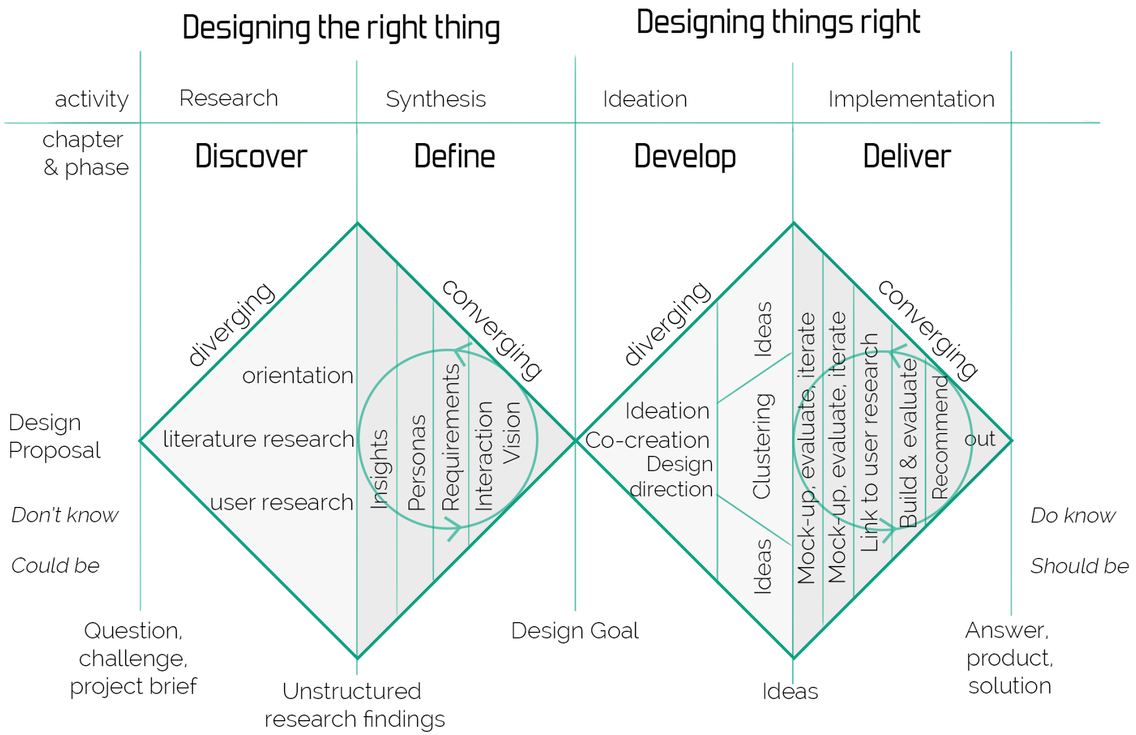


Figure 6 - Double Diamond Model including information linked to this project. (Design Council, 2005)

2 Sustainable Thinking

Both literature and user research are performed in an attempt to answer the following research questions:

What sustainable strategy fits the snowboard boots context best?
What motivates users to choose a sustainable snowboard boot?

All kinds of strategies exist to make a product or service more sustainable. However, what strategy suits a product best, is dependent on multiple factors. Literature discusses factors concerning stimulation of product retention, approaches aiming towards environmental-impact reduction during the products lifetime and the influence of product category on sustainable behaviour.

2.1 Consumer Behaviour Analysis on Product Retention

The objective of this subchapter is to apply consumer behaviour related theories in the design process to generate concrete results for the new snowboard boot concept. This behaviour is related to purchasing, caring, maintaining, retaining or replacing a performance gear product like snowboard boots. Discussed strategies could potentially stimulate sustainable behaviour and product retention.

2.1.1 Product Values

Users evaluate products in terms of emotional, functional, social, epistemic and conditional values (Sheth et al., 1991) (figure 7). These values can change over time as the needs of the user might change or as the product slowly deteriorates (van den Berge et al., 2021). All five types of product values influence the replacement behaviour to a certain degree. The more users value their products, the more likely they are to retain and maintain their product (van Nes & Cramer, 2006).

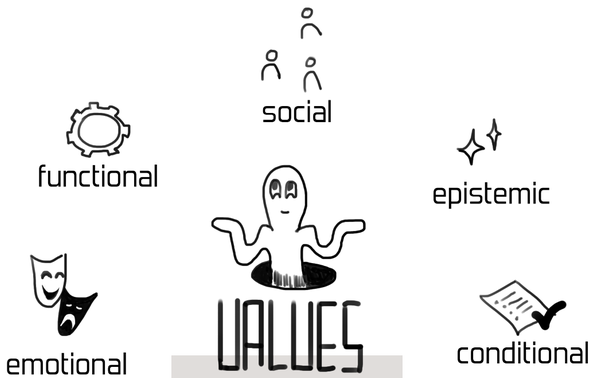


Figure 7 - Product values.

Snowboard boots can be categorized into a performance focussed product category. For this type of product, the functional value of the product is rated as the most influential value for product retention or replacement behaviour (Van den Berge et al., 2021). Multiple functional aspects of the product like the fit, the flexibility, the type of tightening system and so on, create functional value by facilitating a smooth, pleasant, fun, riding experience. The functional value decreases when parts of the boot malfunction. Postponed degradation of the functional value could therefore stimulate product retention. This could be achieved through the design strategy of design for upgradability by making the product easier to repair or replace.

The emotional value of a product can include memories and self expression amongst others (Schifferstein & Zwartkruis-Pelgrim, 2008) (Mugge et al., 2008).
Self-expression through snowboard boots could be related to the colour or style of a boot, possibly personalisable. Emotional value through memories seems harder to create, because memories are circumstantial and personal. Though, the qualitative user research in *chapter 3*, shows that the favourite snowboarding memory recalled by the majority of the participants included a bluebird sky, a fresh layer of snow and compagnions to share this experience with. A useful shared memory that serves as inspiration in later design stages.
Group affiliation through a product creates both social and emotional value to a product, as group affiliation is also a form of self-expression (Mugge R., 2017) (Schifferstein et al., 2008). Therefore, this will be taken into account in the design stage of the project, see *chapter 4*.
The epistemic value of a product concerns the need or curiousity for novelty or new features. Van den Berge *et al.* (2021) mentions that epistemic value could be created through upgradability, although knowledge on the extent of this value is lacking and should be tested. The same applies to conditional values, "research could focus on what conditions could stimulate the consumer to retain products" (van den Berge *et al.*, 2021).

2.1.2 Applicable Conclusions

Introducing personilizability of both appearance as well as functionality to the new boot design, could enhance both the functional and emotional values bestowed upon the product. Extending that personalizability into upgradability could incorporate the facilitation of a sustainable behaviour that caters to the users' vision on sustainability. With the enhancement of both emotional- and social values, product longevity can be stimulated. Which raises the following question:

What visions on sustainability do people have?

2.2 The Product's Sustainability Angle

The sustainable approach of the product is reviewed in this subchapter. Snowboard boots impact the environment mainly in the manufacturing and shipping stage and at the end of their life as non-reusable or non-recyclable waste. Their impact is low during the period of use, because no energy is consumed directly by the product. The main environmental impact of snowboard boots is therefore reduced over time, by prolonging its lifetime. An attempt is made to explain this principle by visualizing the effect in figure 8. Someone who has owned the same pair of boots for 4 years, only consumes 1/4th of the materials, energy and emissions compared to someone that buys new boots every year for a period of 4 years.

A system enabling product longevity often requires a redesign, which can be done from a circular economy perspective (Bakker et al, 2014). Within the framework that circular economy provides, product values can be sustained throughout their lifetime. Bakker's book, Products that Last defines six product lifetime prolonging design strategies that work separately or combined.

1. Design for Attachment and Trust
2. Design for Durability
3. Design for Standardization and Compatibility
4. Design for Ease of Maintenance and Repair
5. Design for Adaptability and Upgradability
6. Design for Dis- and Reassembly

According to MacArthur (2017), a circular economy is *"Looking beyond the current take-make-waste extractive industrial model, a circular economy aims to redefine growth, focusing on positive society-wide benefits. It entails gradually decoupling economic activity from the consumption of finite resources, and designing waste out of the system. Underpinned by a transition to renewable energy sources, the circular model builds economic, natural, and social capital. It is based on three principles: Design out waste and pollution, Keep products and materials in use and Regenerate natural systems"*

2.2.1 Applicable Conclusions

The following three strategies are defined as most suitable as main focus strategies for the continuation of the project: 1) '*Design for Attachment and Trust*' is an obvious strategy to use, regardless of the current sustainability perspective. Brand loyal, returning customers stimulate a company's wealth; 2) '*Design for Durability*', an essential strategy for performance products like snowboard boots. The boots function under tough conditions, so they should be durable to resist that. In addition, snowboard boots are relatively expensive items that one needs for snowboarding, user research in *subchapter 3.8 Concluding User Research* says that users have a certain lifetime expectation that the product needs to meet; 3)The strategy '*Design for Adaptability and Upgradability*' aids the need for an increase in emotional and functional value. Both a change in functionalities as well as appearance could be facilitated in later stages of the product lifetime, which on their turn, possibly stimulate product retention on the user behaviour side of the spectrum.

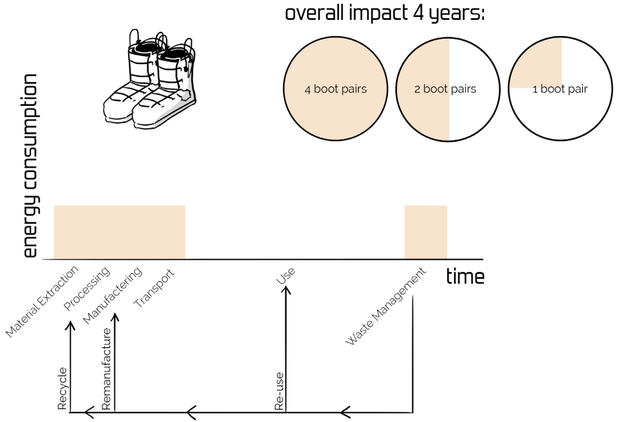


Figure 8 - An illustration of a reduced environmental impact over the years.

2.3 Sustainable Behaviour

Consumers have all kinds of sustainable attitudes and behaviours, which can vary depending on the user and the relevant product. Moreover, sustainable beliefs do not necessarily lead to sustainable behaviour (Auger & Devinney, 2006). O'Rourke & Ringer (2015) list a range of contributing factors that intervene between sustainable preferences and purchasing decisions.

- *a lack of credible information on environmental and social performance of products*
- *consumers' "willful ignorance" about product ethicality*
- *negative beliefs about the quality and performance of "greener" products*
- *brand loyalties that inhibit change*
- *skepticism about corporate claims regarding product and supply-chain sustainability*
- *skepticism about the impact that an individual consumer can make*

According to Carey et al. (2019) the application of design methods to only target attitudinal change is not sufficient to create lasting sustainability in product design as it is not how the consumer thinks about the respective product but how they use it (108).

2.3.1 Applicable Conclusions

Deeluxe is in the position to provide their customers with credible information by taking on a transparent position, and by sharing what has already been done, what they will do and what still needs to be done.

Negative beliefs about the quality and performance of "greener" products could influence the acceptance of sustainable snowboard boots as well, for instance if they would be made from alternative, let's say recycled, materials. However, a way to overcome this belief could be to start with revisiting and redesigning product use over time, by offering a service that prolongs product lifetime without changing the performance. Both the design strategies *'Design for Maintenance and Repair'* and '*Design for Adaptability and Upgradability*' could facilitate this.
Changing the system and way people use, adapt and upgrade products over time could potentially function as a means to alter these negative beliefs. This alternative approach to changing materials, could potentially ease people's mind on change for the better and pave a way for acceptance of the use of environmentally friendly materials in performance designs.

2.4 Concluding Sustainable Thinking

What sustainable strategy fits the snowboard boots context best?

The approach chosen for this master thesis is to tackle sustainability from a behavioural and durability point of view. These aspects fit within the context of the masters study program and match Deeluxe's desire for product-service system innovations. Increased product value is complementary to product retention and thus longevity. The design strategies from the circular economy repertoire (1, 2 and 5 in particular) facilitate an increase in emotional and functional value. Therefore, they provide a suitable base for further design development.

1. Design for Attachment and Trust
2. Design for Durability
3. Design for Standardization and Compatibility
4. Design for Ease of Maintenance and Repair
5. Design for Adaptability and Upgradability
6. Design for Dis- and Reassembly

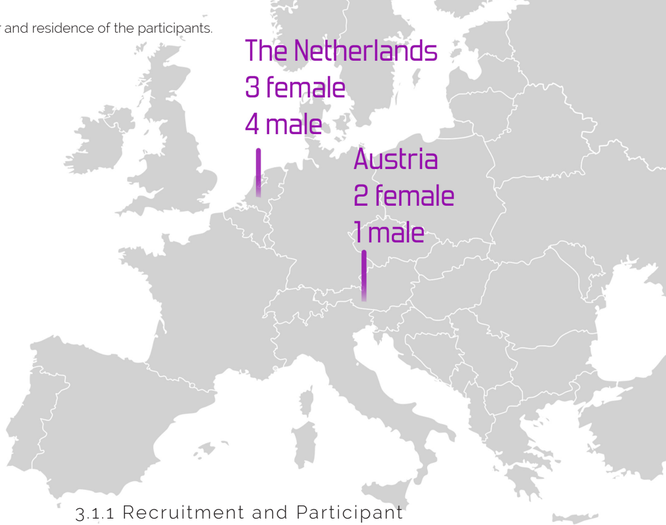
What motivates users to choose an alternative sustainable snowboard boot?

The product-service system should not rely on being sustainable, instead it should offer users a product-service interaction that is better than the current standard to get non-sustainability people on board. Which raises the following questions for the user research:

What user needs are linked to snowboarding?
What do users select their snowboard boots on?

On top of that, Deeluxe should take on a transparent and reflective attitude (and communicate accordingly) to stimulate sustainable credibility.

Figure 9 - The number, gender and residence of the participants.



3 User Research

Qualitative user research, in this case referred to as context mapping, is discussed in this chapter, followed by the analysis of the research data which is finally translated into informative user archetypes (also referred to as personas). The user research methods used throughout this chapter, are derived from the Convivial Toolbox (Sanders & Stappers, 2013). In addition, opportunities to create added value to a snowboard boots product-service system are identified. The resulting product-service system proposal is discussed in the next chapter, *chapter 4*.

3.1 Context Mapping

The context of snowboard boots is mapped and analysed to gain a deeper understanding of the underlying motivations users might have to make certain product related choices throughout its lifetime. For this qualitative research, 10 users have been involved in this process to get a representative image of their behaviour and experiences. The participants completed a booklet with assignments, later referred to as sensitizing materials, and an interview.

The goal of this phase is to identify key needs, wishes and motivations concerning product use. The following research questions lead the research:

What are the types of snowboarders?
What user needs/attitudes/behaviours are linked to snowboarding?
What do users select their snowboard boots on?
What does sustainability mean to them and how do they act?

The generated insights are translated into different personas, alongside various conclusions that influence the design direction.

3.1.1 Recruitment and Participant Requirements

A total of 10 participants have been recruited for this research project. This number includes 8 intermediate snowboarders and 2 professional snowboarders, aged between 20 and 35 years old. The participants are required to own snowboard boots and the participants are divided equally on gender to gain a broad perspective on behaviour, needs and attitudes. 7 participants have been recruited in the Netherlands, 3 from Austria, including one professional and one former professional (figure 9). The choice has been made to exclude beginning snowboarders from participating in the interviews. It is preferred to talk to intermediate snowboarders that have put in time and effort in buying snowboard boots before, to get a rich image of what they have been going through over time. However, a beginners' perspective is established by asking these experienced participants to recall past decisions and values and discuss how these might have changed over time.

3.2 Sensitizing Materials

Sensitizing material, in this case a digital booklet with short assignments, is generally used to provoke the research participants to think about the topic at hand, before an interview is conducted. By using sensitizing materials, the participant is enabled to take the conversation to the next level and think, act and provide answers beyond the obvious.
Both time and various stimuli are important factors that help participants to access their latent knowledge (what they actually know, feel and dream).

Sensitizing material, in this case a digital booklet with short assignments, is generally used to provoke the research participants to think about the topic at hand, before an interview is conducted. Both time and various stimuli are important factors that help participants to access their latent knowledge (what they actually know, feel and dream, instead of what they do, think and act on). By using sensitizing materials, the participant is enabled to take the conversation to the next level and think, act and provide answers beyond the obvious.
Another method used while constructing the assignments, is the path of expression seen in figure 10. The assignments in the booklet are organized according to this path, they relate to steps 1-4 as shown in this figure. This specific order of present, past, future helps the participants to access latent knowledge and express their views during the interviews.

The booklet consists of 5 relatively simple, creative assignments, which are meant to be filled in one day after another. Therefore, they start with the first exercise at least 5 days prior to the interview. The first two days focus on their current situation, the next two days on the past and the last day on the future. Figure 11 some exercises from the sensizing booklet, see Appendix A for the complete booklet.

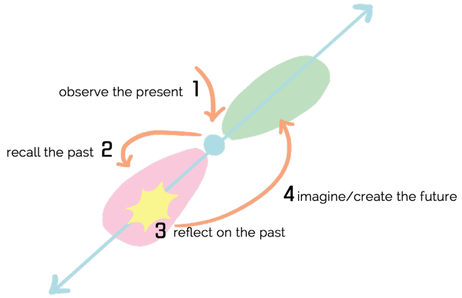


Figure 10 - Visualisation of the interview tool 'path of expression' (Sanders & Stappers, 2013).

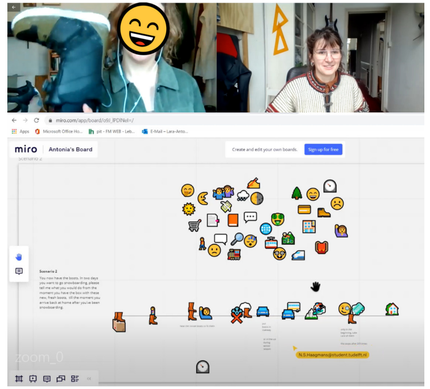
Figure 11 - Examples of filled out assignments from the booklet.

3.3 Interviews

A one hour interview is conducted with each participant, after he/his received and filled out his/her personal sensitizing material. The interviews were held online using Zoom as a meeting-platform and Miro (an online collaboration whiteboard) for collaboration during scenario exercises, as can be seen in figure 12. Every participant consented to record and transcribe the meeting for further analyses. The order of the interview questions have been arranged according to the Path of Expression (Sanders & Stappers, 2013), to achieve an open atmosphere and insightful conversation with the participant.

The goal of the interview is to discover the users perspectives and experiences concerning the selecting, using, caring and disposing of snowboard boots. In addition, their attitudes towards personalized products, their conception of sustainability and sustainable behaviour are questioned. Multiple focus areas for the ideation-phase of the new snowboard boot concept are identified from the insights and conclusions from the qualitative research analyses.

Figure 12 - A screenshot of an interview, where the participant works on a use scenario of their snowboard boots in various moments throughout the lifetime of the product.



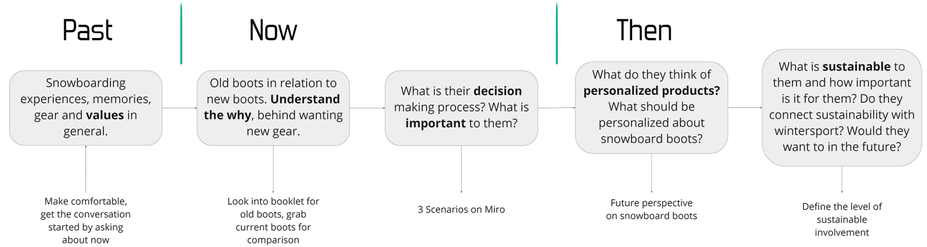


Figure 13 - Interview set-up using the 'path of expression' method by recalling memories, asking about the current situation and using these to gain access to future dreams..

3.4 Data Analysis

A large amount of qualitative data is generated by the filled out sensitizing booklets, the interviews and their corresponding transcripts. Raw user data is interpreted and translated into insights. The insights of each participant are labelled, so they can be traced back to their original quote. Online collaboration platform Miro has been used to organize and cluster all the insights. Figure 14 is a zoomed out screenshot of the first phase of this process, the next section focuses on how these insights are translated into concrete outcomes.

Figure 14 - Annotated screenshot of the data analysis process on the online collaboration platform Miro: https://miro.com/app/board/o9J_lPWIPLA=/

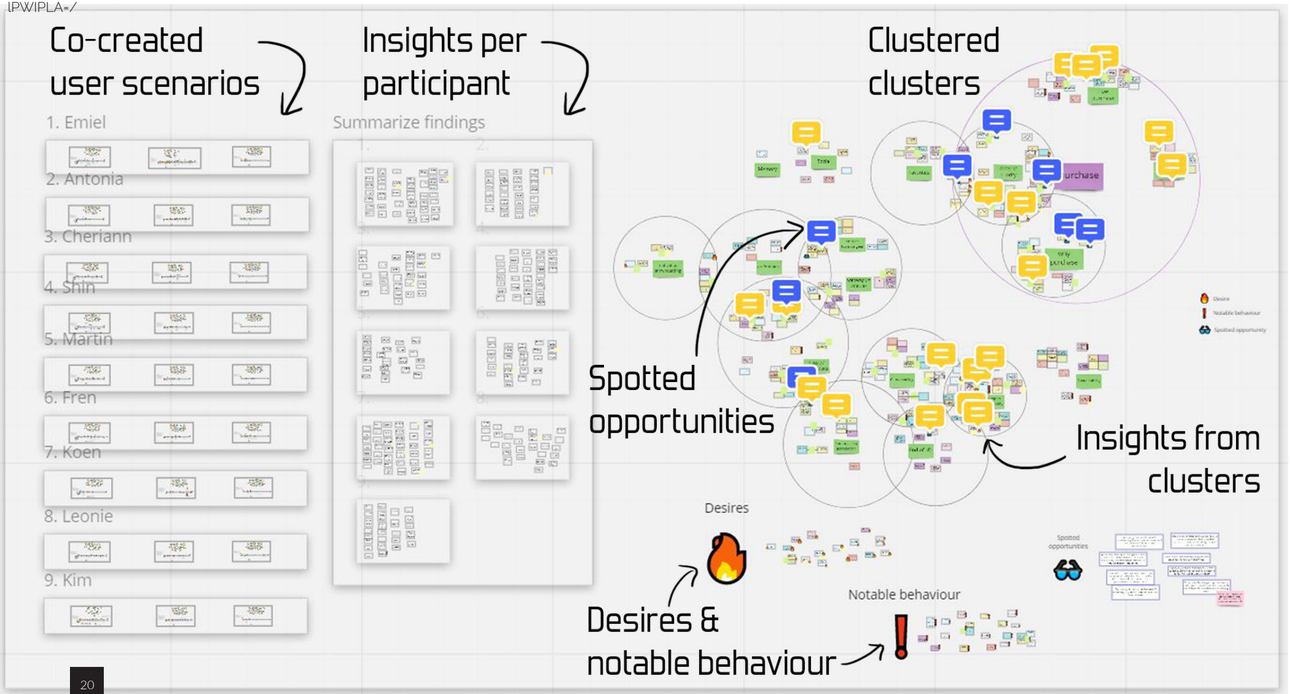


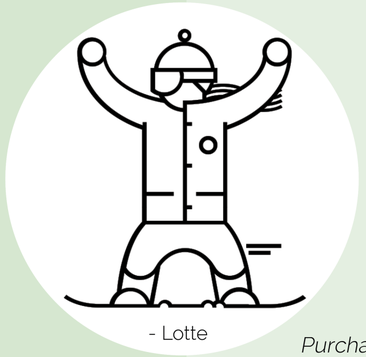
Figure 15 - Persona framework based on attitude and user behaviour.

3.5 User Personas

Personas are created to gain a broader perspective on the different types of users involved. This perspective is helpful throughout the design process, so the product-service system design is aimed at specific user needs.

A framework including user behaviour and attitude has been established from analyzing the clusters and insights, see figure 15. The position of a persona on the vertical axis shows the attitude they generally have towards the quality and pricing of snowboard boots. The position of a persona on the horizontal axis shows the drive of the rider in terms of time invested in the sport.
Experience is gained and skills are developed when practising the sport more often, with that, users' mindset, motivation and needs can change. Therefore, it is possible that a snowboarder matches with a different persona over time.

Holiday Fanatic



- Lotte

"When I'm in the store. Well, price doesn't really matter to me. The most important one for me is the way they fit and the qualities. Because, I think it's more important that they fit well, than that they are cheap. I think, if in that moment, I see what I like and they fit well, and the looks are also good. Yeah, then I will buy them."

The Holiday Fanatics are intermediate snowboarders who occasionally go to the mountains for a week of snowboarding. They are certain of their annual plans, so investing in their own gear seems like a logical step. The investment in new gear is in some cases compaired with the yearly expenses for renting gear, so they expect their gear to last at least for a few years to come. Whether they prefer purchasing or renting gear also depends on their means of travel and other factors.

How the user acquired her/his boots

Purchase (first or second hand)
Rent

Lifetime

40-100 days in the snow.
or 4-10 years

Design opportunities specifically for Holiday Fanatics

There is a gap in knowledge concerning the desired features of snowboard boot linked to the skillset of a person. In other words, effort is required from the Holiday Fanatics to get to know their needs and how these needs are satisfied with certain gear. The concepts and service provided by Deeluxe should therefore help educate the users on how to identify and satisfy their needs.

Opportunity: Provide repairable and accessible spare parts to prolong the lifetime of their boots. Because of the infrequent annual use, the boots are likely to break only when the warranty period ended.

Purchase focus

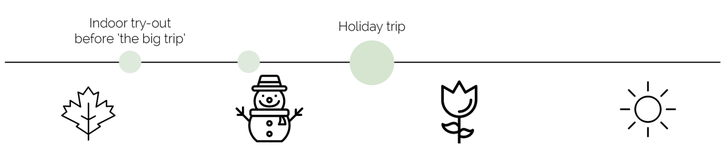
Fit
Ease of Use
Feeling Supported
Comfort
Tightening System Preference

Reasons to discard boots

The boots break post warranty.
(tightening system, holes, no longer waterproof)
Unfixable by user.
Need for new features.
Wish for different design.
(possible because of the long life expectancy)

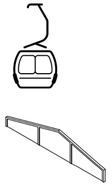
This timeline displays what a typical year for an intermediate tourist would look like, based on Dutch research participants. The timeline can look different for an intermediate snowboarder that lives near a resort, depending on the level of investment (time and money) of the boarder.

Annual activity

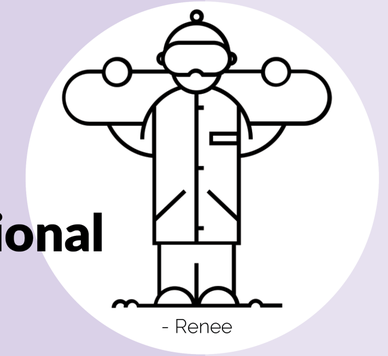


Location

resort
park
"off piste"
indoor



Professional Rider



- Renee

"Sometimes I wear a helmet and I always need protection because I destroyed both knees with snowboarding. So they are like, impact protection."

The Professional Riders are on top of their game. They are likely to have multiple sponsors and a fanbase that can vary in size. Multiple activities keep the riders busy, they either train for or take part in a contest, shoot footage for (short) movies and clips, get their photos taken while doing their thing and could have some promotional duties for the gear. Not all professionals can make a living simply by snowboarding all the time, so there are still differences in needs and behaviour within this overview.

How the user acquired her/his boots

Sponsored gift

Lifetime

40-100 days in the snow.
a season or part of a season

Design opportunities specifically for Professional Riders

Use professionals to educate and help consumers to spread the knowledge about maintaining and adjusting boots. Next to that, they could help consumers to identify and satisfy their needs.

Opportunity: Help injured professional riders to customize their boots for optimal support, to show the potential of a modular boot.

Purchase focus

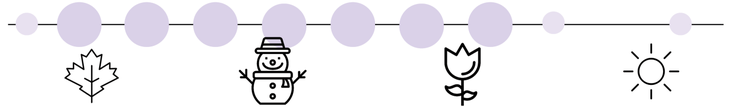
Flex
Fit
Feeling Supported

Reasons to discard boots

The boots underperform.
Fit feels too loose.
The boots break.
(tightening system, holes, no longer waterproof)

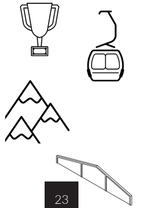
This timeline displays what a year could look like for a Professional Rider. It is not unlikely that they travel the world to spend as much time on the mountain as possible. Her/his activities can vary depending on the conditions and upcoming contests. There is a variety of types of pro snowboarders, the needs for a pro park-rider and a pro boardercrosser can differ for instance.

Annual activity

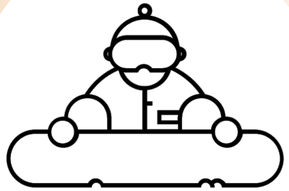


Location

resort
park
street
back country
touring
boardercross
indoor



Stoked Beginner



- Jerry

"There is not really something I am unsatisfied with when it comes to my boots. They seem to be a bit loose. But that's my fault because I bought them in 40 instead of 38, but they were cheap."

The Stoked Beginners just started snowboarding with a good mood and perseverance. They need to gather quite some gear to be able to practise the sport of snowboarding. Besides, the new boarders might be unsure about their future plans yet. Depending on those factors, they either borrow, rent or buy their own gear when they start snowboarding.

How the user acquired her/his boots

Purchase *(first or second hand)*
Rent
Borrow

Purchase focus

Comfort
Ease of Use
Fit

Design opportunities specific for beginners

Their purchase decisions can include taking growth into account beforehand. Upgradability is something that beginners could benefit from. A boot would have a longer lifetime with the same user, if the user is able to change the boot to her/his liking, once her/his skills are improved.

Opportunity: Target beginners for buying their own liners, so they no longer have to experience hygienic troubles when renting boots and can build their boots from there.

Lifetime

20-30 days in the snow.
or 2-3 years

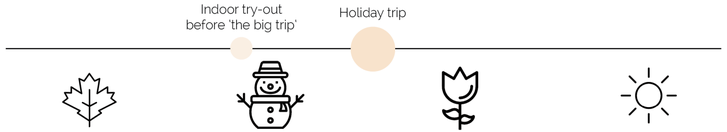
This estimate is based on the time it takes until a snowboarder becomes an intermediate snowboarder. The boarder might desire stiffer boots and could be looking for something new.

Reasons to discard boots

Outgrow them skill-wise.
Need for new features.
The boots break.
(tightening system, holes, no longer waterproof)
Wish for different design.

This timeline displays what a typical year for a (tourist) beginner would look like. It is possible that the user would choose to visit the indoor slopes a few times before going to the resort in a foreign country. The timeline can look different for a dedicated beginner that lives near a resort, depending on the level of investment (time and money) of the boarder.

Annual activity



Location

Resort
Indoor

All-in Boarder

- Charlie

"So also, you see the last couple of years, there are all these innovations in snowboarding, like, now we have clothing with electronics in it. Or we have goggles with head up displays. And I'm like, Okay, do you really want that? Like, for me the gear should allow you to be on the mountain having fun enjoying yourself? But it shouldn't draw the attention, like the best gear is the gear that you probably don't notice you're using because it's also natural and because it's not about the gear. It's about having fun outdoors with friends."

The All-in Boarders are all-round enthusiasts. They organize their life in favour of grabbing as many opportunities as possible to go snowboarding. The foreign boarders might go abroad to work and snowboard in a resort, or visit the indoor slopes on a weekly basis. The boarders who are locals or live close to resorts, visit the slopes also on a weekly basis in an ideal situation. Independently from their demographic background, they might become a teacher, work for travel companies to escort tourists, hang out in the park, or go touring with friends.

How the user acquired her/his boots

Purchase *(likely firsthand)*

Purchase focus

Stiffness
Fit
Feeling Supported
Comfort

Design opportunities specifically for Holiday Fanatics

The concepts and service provided by Deeluxe should be designed for repairability, compatibility and upgradability in an accessible and affordable way. Once this is accomplished, a pair of boots will not be declared total loss, only because of a broken tightening system.

Opportunity: Provide accessible and easy to replace parts, so upgrading the flex-rate of a boot is possible. The user might want different properties for different terrains they are riding, or simply want to prolong the lifetime of their boots by reinforcing its overall stiffness.

Lifetime

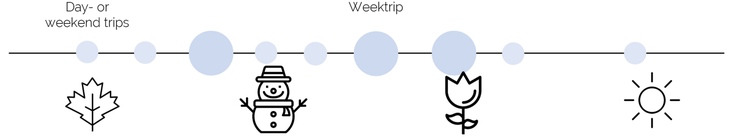
40-100 days in the snow.
or 1-2 years

Reasons to discard boots

The boots break.
(tightening system, holes, no longer waterproof)
Unfixable by user.
Fixing by company takes too long.
Need for new features.

This timeline displays what a typical year for an intermediate tourist would look like, based on Dutch research participants. They learn about their needs and desires over the years by experience and conversations with like-minded people, they therefore have less trouble picking suiting gear.

Annual activity



Location

resort
park
street
back country
touring
boardercross
indoor

3.6 Dynamic User Personas

Snowboarders are likely able to fit themselves into one of the personas at a certain moment in time. With time, change is inevitable. User needs and behaviour change over time while the product slowly deteriorates in various ways. Someone like Jerry, a *Stoked Beginner*, is likely to grow into a *Holiday Fanatic* or an *All-in Boarder*. Even a *Professional Rider* once entered the playing field as a beginner. Just like an *All-in Boarder* might shift to a *Holiday Fanatic*, for example because of an injury or change of interest.

A transition in terrain preference is not uncommon, based on experiences of the participants, an interest in freestyle (park riding) arises at an earlier age compared to the development of a sincere interest in freeriding (off-piste) with its required safety measures. This displays the changing norms and values involved with personal growth.

An increase in income can influence the consumer's purchasing behaviour, for instance in the demanded product quality after a period of time. A sponsored participant mentioned a change in the threshold of boots support. Once she had annual access to new boots, a higher quality became the standard compared to her earlier time as *All-in Boarder.*

An overview of possible attitudes, focus points and purchasing behaviour is made in table 1, based on topics discussed in the interviews. It can be noted that a shift from a *Professional Rider* towards an *All-in Boarder* is excluded from the table, simply because no such data was required during the interviews. This does not mean that a shift between those types is impossible, it is simply recommended to still gather this data in the future for a more complete overview. The same applied to a more in-depth representation of the remaining personas.

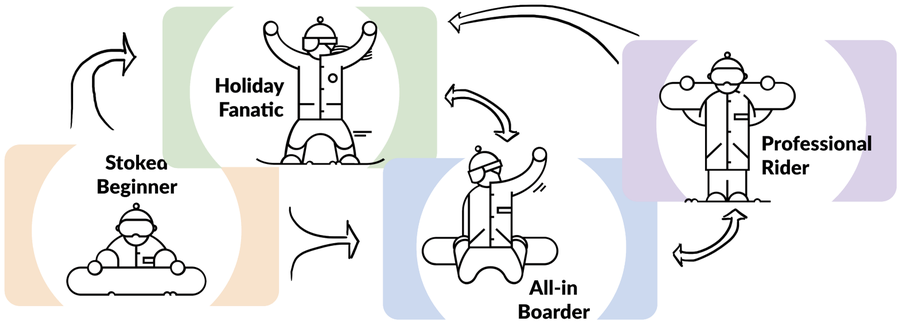


Figure 16 - Persona shifting possibiilities visualized.

Persona Shift	*Attitude*	*Focus*	*Purchase Behaviour*
Non snowboarder → Stoked Beginner	Is concentrated on gathering their gear. Curious, excited and possibly tense. Ready to form an attitude towards snowboarding as an activity.	Demands something on their feet.	Hesitant to invest, eager to borrow or rent something.
Stoked Beginner → Holiday Fanatic	Looking for a comfortable quick and easy match, might be still a bit ignorant about what they want. Sees it as a recreational activity.	Demands a certain level of comfort.	Is okay with investing because of enthusiasm and seeing it as an investment for the years to come.
Holiday Fanatic → All-in Boarder	Needs become more clear to them, so they are learning about what type of gear suits these needs best. They develop a style preference and are familiar with various brands out there.	Demands certain features and quality.	Builds and improves their set-up bit by bit, towards a composition that satisfies the image/package they want to create. Develops a dislike for loosening fit and reduced support/stiffness. Likely to look for deals.
All-in Boarder → Sponsored Rider	Possible open attitude towards new types of boots, since trying and getting them is a low effort and no costs.	Expects renewal and demands a certain level of quality.	Standard for the required state of their gear is likely to go up, because of the accessibility to new, good quality gear. Gear is passed on or sold second hand.
All-in Boarder → Holiday Fanatic	A nostalgic attitude is developed towards certain brands or products. Reduced push in needing everything to be perfect.	Demands properly working gear.	Buys new gear only when needed, the hype is irregular and so is their purchase behaviour.

Table 1 - Elaborated persona shifts.

3.6.1 Applicable Conclusions

Snowboarders expect, demand and desire different things depending on their level of commitment to the sport, on their terrain preferences, on their budget and their changing norms and values. A product-service system should aid the shifting desires of the user over time to prolong the lifetime of a product. The product service concept should support modularity towards the following aspects of snowboard boots to aid shifting desires of the user over time:

- the level of comfort
- the stiffness or firmness
- the tightening mechanism
- appearance

3.7 User Visions on Sustainability

Sustainable choices and actions within the lives of the participants are captured, by asking them to share their own sustainable object(s) with an explanation in the sensitizing booklets. Figure 17 shows an overview with these images alongside associated words. An attempt is made to find a correlation between the type of snowboarder(personas) and sustainable mindsets, it can not be found within these results. What sustainability means to people and how they act upon those thoughts differ per person and per moment, therefore the decision was made to exclude the perspective on sustainability into the personas.
This exclusion is not likely to influence the design much because it has been stated in earlier conclusions that the product-service system should be designed to strengthen the value imposed upon the product.

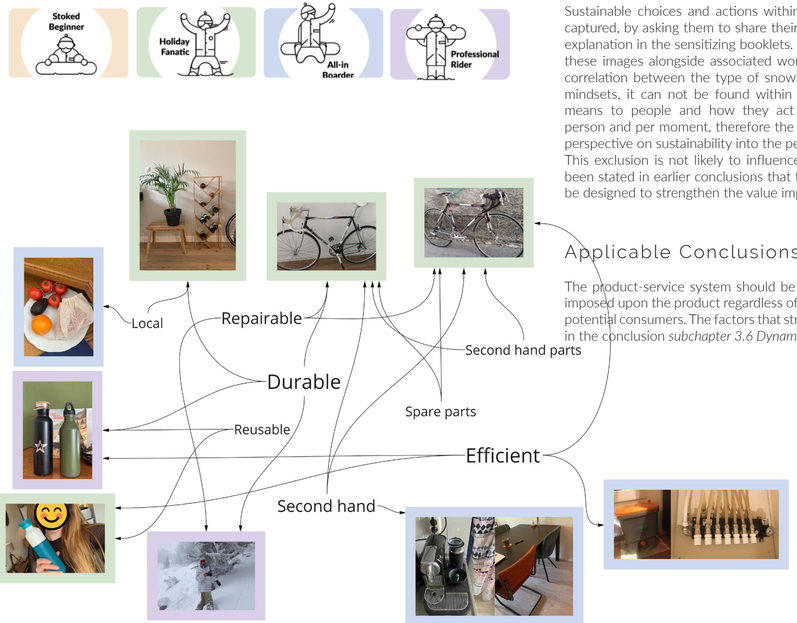


Figure 17 - Wordweb connecting images from the sensitizing booklets to what is perceived as sustainable by the participants.

Applicable Conclusions

The product-service system should be designed to strengthen the value imposed upon the product regardless of the different sustainable beliefs of potential consumers. The factors that strengthen the factors are mentioned in the conclusion *subchapter 3.6 Dynamic User Personas.*

3.8 Concluding User Research

The following conclusions are based on various insights from the interviews. They are divided into service and product related conclusions. The insights are traceable to their original quote, by the added code on the back of each conclusion:
[number of the participant_first letter of their name_transcript page of the quote]. The transcripts are handed over to Deeluxe and will not be included into the appendix because of the size (+-270 additional pages).

Product related conclusions

- The concepts and service provided by Deeluxe should be designed for repairability, compatibility and upgradability in an accessible and affordable way. (1.E.p34, 4.S.p8, 6.F.p21, 9.K.p25, 5.M.p12)
- The boot concepts should have the option to easily change/ replace the tightening system. (9.K.p25, 5.M.p12, 7.K.p10, 6.F.p9, 9.K.p7, 1.E.p4, 8.L.p5, 2.A.p10)
- The boot concepts should have the option to update the flex of the boot. (4.S.p7, 5.M.p10, 8.L.p10)
- One pair of boots, suitable for all terrains is desired. (7.K.p14, 5.M.p12, 9.K.p15, 2.A.p14)

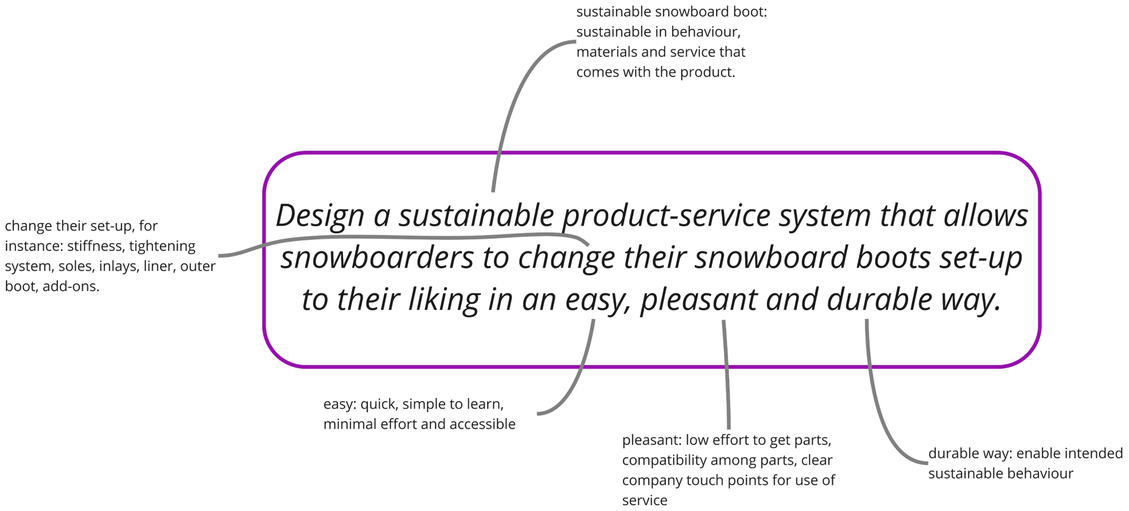
Service related conclusions

- Help the consumer to overcome any overwhelmed feeling related to making choices that could be associated with personalized or custom products. (4.S.p18)
- The concepts and service provided by Deeluxe should help educate the users on how to identify and satisfy their needs and to avoid misjudgment of their own feet. (1.E.p19, 7.K.p8)
- The timing of content that educates users on and invites them to behave sustainably is crucial for a successful intervention. The first few weeks after purchasing new boots has been identified as a phase where the user is still eager to learn about their new product and product care. (2. A.p16, 1. E.p28)
- The user experience of the boot throughout the period of use, should be beneficial in the first place, the sustainable aspects of the product should be a nice bonus. (7.K.p20, 1.E.p38)
- The sustainable impact of the new concept should be communicated extensively, for instance the impact of prolonging the life-time of a product instead of buying new ones, in order to make the sustainable aspect of a boot relevant for the consumer. Take note that this information is additional, and not the main selling point of the boot. - transparency (1.E.p37, 3.C.p19, 9.K.p27, 7.K.p23)
- Include consumers with a lower budget or a low investment attitude (like beginners) by providing second hand/refurbished parts. (2.A.p9)
- The service provided by Deeluxe should take care of the end-of-life of broken product (parts) and gain knowledge for design/ service improvements in this process. (1.E.p39)

Additionally, the product service concept should facilitate the shifting desires of the user over time. Therefore the following product aspects should support modularity in design:

- the level of comfort
- the stiffness or firmness
- the tightening mechanism
- appearance

3.8.1 Design Goal



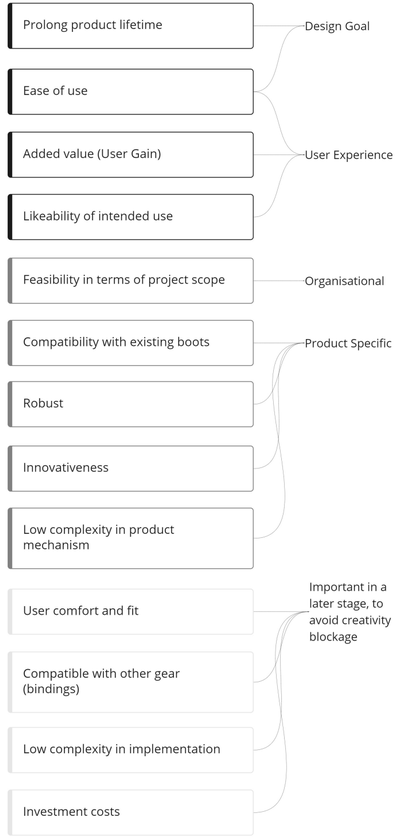


Figure 18 - Limited list of requirements, fitting within the project scope.

3.8.2 List of Requirements

Design requirements are formulated, as a result of both literature and user research. The concepts that emerge from the ideation phase, the second diamond (figure 6), eventually need to meet these requirements. The requirements in figure 18 are listed according to their importance and relevance for this project and they are ranked in collaboration with Deeluxe. The first four requirements are connected to the design goal and the user experience of the product, and so on.

The first listed requirement is the prolonged product lifetime, which reduces the environmental impact of snowboard boots over the years. This requirement is followed up by *Ease of use*, to lower the threshold for users to try the new snowboard boot product-service system. The product should *Add value* to the users' experience, the sustainable aspect would be a consequence of using the product as intended. As mentioned earlier, sustainability should not be the main selling point because of a common presumption that sustainable high performance products could be of a lesser quality than the alternative (O'Rourke & Ringer, 2015). A sustainability oriented product-service system is only as successful as its execution, therefore the *Likeability of intended use* is considered an important requirement.

4 The Modular Product-Service System Design

The second diamond starts off with the design stage of the project, the goal of this diamond is to come to a solution. Knowledge gained throughout the research process is translated into a product-service system concept. A sustainable service proposal, a supporting user scenario and an evaluating market positioning analysis are discussed in this chapter. These are followed by a future product possibility as part of the service, including information about the design process and visual representations of the product, the Exo-Flex.

4.1 Sustainable Service Proposal

A sustainable product-service system can be realized by applying the research insights and utilizing the modular potential of a snowboard boot. The service features a modular product offering and the facilitation of repairing, replacing and upgrading snowboard boots resulting in a new way of thinking about purchasing. In the new design, products are offered in separate parts to stimulate replacement behaviour of broken parts as well as stimulate product retention for the parts that remain functioning. Just offering separate ports does not reduce waste, so waste and environmental impact can be reduced over time. *Chapter 4.4.2* introduces the Exo-Flex, a design for a new part that further expands the modularity of the product offering. Drawing on customizability, the Exo-Flex has the potential to strengthen the values imposed upon the user experience throughout the entire product-service system.

The Service

A broad display of the key aspects of the proposed service and how they interrelate can be found in figure 19. The service intervenes in various stages throughout the lifetime of the parts. The end of life is taken into account from the very beginning. The parts are designed using the circular economy principles, making it easier to restore or change the value of a part at the end of its life. Users can get acquainted with the modular principle from the start, because both sets and parts are offered equally visible. Moreover, a modular product offering could be financially attractive for consumers who are given the opportunity to evaluate their consuming behaviour from that moment on into the near future.

The integration of nudges and reminders into the service could be used to stimulate users to return broken parts to appointed repair locations. For example customers could be nudged to return broken parts with the purchase of a replacement. The replacement parts could be delivered in reusable packaging with a return label, asking the customer to return the old part free of charge. The transport costs could already be included in the price to avoid disappointment from the users.

Providing this service will require support structures within Deeluxe that it currently does not have. Facilitating the service could be done by setting-up a dedicated repair- and refurbish-team, to perform the physical work and/or managing the responsibilities of outsourcing labour. Due to the international nature of Deeluxe's clientele, it may

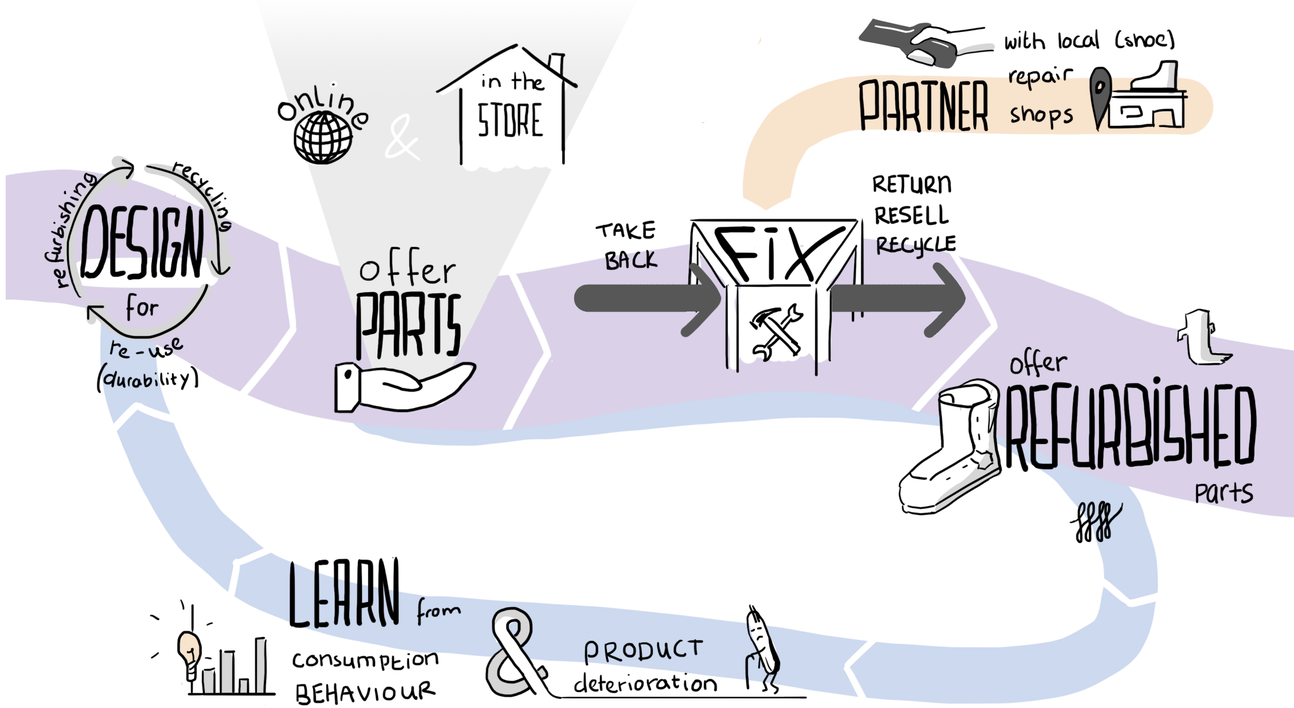


Figure 19 - Service proposal visualised.

be more beneficial to forge a network of existing, local (shoe) repair shops to cooperate and provide repair services more locally. With a return and repair system in place, Deeluxe is able to offer quick and more sustainable service to the customer by avoiding additional shipping.
Not all parts of a boot are equal in their repair and refurbishability, which should already be taken into account during the design stage of product development. For instance, liners might not be that suitable because of hygienic reasons. Reclamation of their product at the end of life stage comes with the possibility of collecting data about the lifetime, wear and tear of each product. With this knowledge Deeluxe has the opportunity to learn about product deterioration and use.

Maybe products wear differently depending on someone's snowboarding stance, or maybe asymmetrically stiffened boots would be the next innovation lurking around the corner? The part-specific product sales also show more detailed information about the customer, for instance by the number of parts sold on the left or right foot, or about what parts seem to be replaced or switched most. This new information can add to further detail the user profiles or even potentially identify new ones along the way.

This concept is designed to create extra product value for the user and bypass any negative user behaviour influences of products solely marketed on their sustainable value. However, it is far from detailed and requires more time for design development and evaluation.

Challenges

- Deeluxe should set-up a repair and refurbish team, to either perform the physical work, or to function as a team to forge a network of existing, local (shoe) repair shops that want to enter into cooperation.
- Current boot model designs should be revised to see if the design can be altered to a more suitable version.

4.2 User Scenario

A story of an enthusiastic girl named Nina is shared to help the reader envision what a modular product-service system could mean for the user. Her needs change alongside her growing experience. Thus, she develops a better sense of the desired performance of her gear. Many variations of this scenario are possible, including different persona shifts and purchase routines (shop versus webshop). It is encouraged to explore other scenarios in the future, to help foresee any service problems beforehand. The following user scenario demonstrates some user benefits, user-service interactions, a persona shift and the possible added value of the Exo-Flex.

Nina is a stoked beginner, she is having fun snowboarding in the sun with friends.

At one point the tubes break out of the second hand boots she got from a friend.

She is looking up if it is fixable. Her warranty period expired last year.

She wants to continue boarding asap, so she wants to buy new boots.

A pair with accessible spare parts and good service is essential. The Deeluxe website caught her attention.

The boots arrived, let's go!

She is back to having a good time without worrying about her gear.

The website guides her to the right boots, through the option menu. She feels ensured and inspired by the new way of maintaining her set-up. She is investing in her future by thinking ahead, and so is Deeluxe, because the brand loyalty is likely to grow.

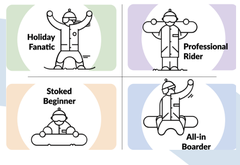
PERSONA SHIFT!

Four christmas holidays of snowboarding later. Nina would like to have new liners, as her current ones feel sloppy and smell bad.

She recalls Deeluxe's website and visits it for a new liner.

She now has a better idea of what she would like, and chooses a fitting liner for her boarding style.

She would like her boots to provide more support, since they loosened up over time.



Now that she is a more experienced rider, it is easier for her to decide on what exo-flex rate would fit her needs better.

She installs the new parts into her outer boot shells.

They feel like NEW!

Nina is extremely satisfied with her earlier decision to choose for Deeluxe and their modular way product-service model.

4.3 Market Positioning

Whereas other companies focus on many different elements within the snowboard industry (such as bindings, snowboards and apparel), Deeluxe specializes in snowboard boots only. They are determined to keep playing their part in the snowboard boot market, by taking on new projects and striving for innovation. A market analysis is performed to analyse the potential of the product-service system concept within the current snowboard boots market.
The analysis shown in figure 20, uses modularity as a base and a way to reflect on the position of a company, sustainability (thus durability) wise.

Figure 20 - Market positioning framework based on price and modularity.

The modularity of a product offering represents the level of repairability, replaceability and/or upgradability of a product. The durability factor is increased by these elements because they work in favour of prolonging a product's lifetime. The position of a brand on the vertical axis of the framework is determined by the number of different parts offered on the brands' website. The price category represents the least expensive models of each brand, so a comparison can be made with fewer variables. The data corresponding to figure 20 can be found in table 3 in Appendix B.
The framework presents an opportunity within this sustainability segment of the market.

The icons indicate the sustainable efforts of a company that are communicated to their customers. Burton, Salomon and Vans have a web page dedicated to their sustainability goals and approaches, including their energy consumption, packaging, materials of concern, sustainable materials and their ethical policy. On top of that, Burton and Vans acknowledge the value of used products and offer a pass along service where they redistribute or refurbish gear or apparel to new owners to prolong the lifetime of products. However, Burton, Salomon nor Vans mention any sustainability efforts specifically towards snowboard boots. Deeluxe does not have a sustainability dedicated web page, although their lifetime prolonging TPS shield (for tongue reinforcement) is mentioned in snowboard gear review website whitelines.com.

The opportunity space presented in the market positioning map is not far from the current Deeluxe product offering. The modular service is a way to push forward and grab the presented opportunity.
Deeluxe could gain greater visibility and grow as a company, while establishing a more sustainable way of product handling.

4.4 Future Product Possibility

This chapter is mainly about the ideation phase for product designs. The final product design of this project is presented, right after an introduction of the used design methods (*subchapter 4.4.1*). This design, the Exo-Flex, is merely a future product possibility. It is an example of how a product design could enhance a modular purchase and use system (*subchapter 4.4.2*). Knowledge is gained about the human body(*subchapter 4.4.3*) and snowboard movements of the lower leg (*subchapter 4.4.4*), before design choices are made. In an attempt to structure the detailing of the final concept, it was split up in 3 sections, A, B and C (*subchapter 4.4.5*). Finally a prototype is made for demonstrational purposes, showing the intended use of the product *(subchapter 4.4.6)*.

4.4.1 Design Methods

The design methods used in this stage of the process disclose the second diamond of the double diamond model. This process includes diverging, iterative designing, converging and detailing. It was kicked off with a creative group brainstorm session, followed by individual iterations and brainwriting sessions. Sketches and mock-ups have been continuous tools for idea generation, iteration and detailing. Concepts were evaluated using Harris Profiles and Minnoyes Decision Tool. Computer 3D models have been made using Solid Works, KeyShot is used as a rendering program. The prototypes of the final model of this project are 3D printed.

Co-Creation Session

The objective of the facilitated creative session was to evoke inspiration and diverge on concept directions and ideas. Used techniques are from the book Road Map for Creative Problem Solving Techniques (Heijne & van der Meer, 2019). The group of people participating in the creative problem solving session, now referred to as the resource group, consisted of 5 people with different educational

Figure 21 - Creative Session, during the *Random Objects* brianstorm.

as the resource group, consisted of 5 people with different educational backgrounds and snowboard experiences, displayed in table 2. The used brainstorming techniques were *Random Objects* and Force Fitting, more about this session can be found in Appendix C.

Participant	*Professional Background*	*Matching Persona*
1	Biomechanical Engineering	Stoked Beginner
2	Industrial Ecology	Holiday Fanatic
3	Physiotherapy	All-in Boarder
4	Integrated Product Design	Non-snowboarder
5	Mortages Advisor	Holiday Fanatic

Table 2 - Creative session participants and background.

Mock-Ups and Sketching

Product ideas are iterated and explored by making sketches and mock-ups. Especially fast 3D prototyping like the mock-ups helped to improve concepts, because it provided insight into the actual context of use.

Figure 22 - 5 images taken throughout the ideation process.

3D Modelling

A screenshot of one of the earlier concepts is shown in figure 23, the latest version of the Exo-Flex is seen in figure 24.

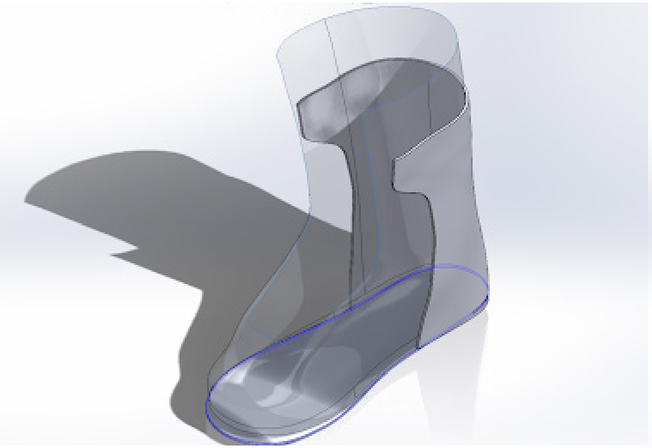


Figure 23 - SolidWork screenshot from an earlier concept.

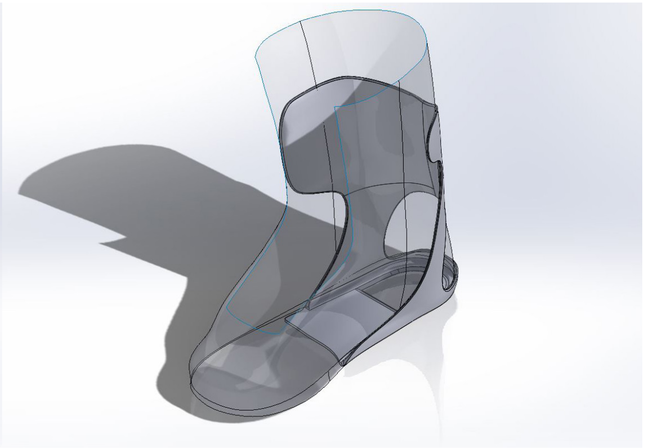


Figure 24 - SolidWorks screenshot from the latest Exo-Flex version.

4.4.2 The Exo-Flex

The Exo-Flex is a new product part of snowboard boots, inspired on insights from conversations with users and Deeluxe, its form is based on an analysis of the human body, body movements and a consultation with an apprentice physiotherapist.
The product provides stiffness to a snowboard boot and is inserted into the outer boot and the harness, and around the liner (figure 26). The heel harness compresses the liner around the users' foot and leg when tightened, the Exo-Flex utilizes this act because of its position in between the heel harness and the liner.
The product facilitates personal growth (and thus persona shifting)

Figure 25 - A render of the Exo-Flex.

Figure 26 - The placement of the Exo-Flex within the snowboard boot.

by easing the process of changing the stiffness of snowboard boots. Sloppy feeling boots can be upgraded by replacing the Exo-Flex, so the feeling of support and stiffness is restored. The user is completely capable of changing or replacing the parts, therefore it also simplifies the process of the lifetime extension of a pair of snowboard boots.
Furthermore, the Exo-Flex has the potential to be made from a recycled or recyclable material. The design of existing outer boots can be revised, because required stiffness comes from the Exo-Flex. Redesigning the outer boots is important because currently plastic parts are sewn and glued into the fabrics, prohibiting the possibility to recycle the fabrics. It is recommended to explore the use of materials further on, just like the exact structure or pattern to properly distribute stiffness and flexibility of the product.

The *All-in Boarder*, an earlier defined persona, is used as a reference user for making design choices throughout this ideation process. The *All-in Boarder* is freestyle focussed and suits the target group of Deeluxe well. Eventually multiple versions of the Exo-Flex should be available, so a variety of stiffness level and directional support is available to the user. In case the user desires a different stiffness, only the Exo-Flex has to be replaced, instead of the entire pair of boots. Figure 28 shows how the personas value different aspects of snowboard boots, values that can be utilized to better their product-service system experience. Minnoyes decision tool can help to make a decision on what concept fits the target group best, but it can also function as an evaluation tool, to test and iterate designs to fit the needs of the intended user better.

Price
In this diagram, price means how much boots are allowed to cost. The reasoning behind the placement of this factor on the diagram differs per persona. *Holiday Fanatics* seem to hold onto their snowboard boots for a longer period (an estimated 4-10 years), buying boots is therefore seen as an investment which leads to a willingness to pay a bit more. *Stoked Beginners* need a lot of gear at once, so to keep starting this new hobby affordable, boots should not be too expensive. First of all, *Professional Riders* are likely to be sponsored so they do not mind riding the most expensive models. Secondly, having good gear is important for their career, so if an expensive model seems to be what they need, they are motivated even more to accomplish their professional goals. *All-in Boarders* spend a lot of

Performance
The performance factor is linked to the value a user attaches to certain product features, like the flexrate or special hiking soles. There seems to be a correlation here: having more snowboarding experience means their ability to define what they want and need is better and thus they demand a higher level of performance from their gear (*Professional Rider* and *All-in Boarder*). Both a *Stoked Beginner* and *Holiday Fanatic*, are not invested in the sport as much yet, so usually they are not even aware of all the differences in designs, and how a well-considerate decision could enhance their skill level.

Fitting
The actual fit as well as the process of putting on the boots is meant by the term fitting, this also includes the way a boot is tightened. For example, a Boa tightening system (see figure 27), is very easy and quick in use, yet it is a bit harder to tweak the tightness throughout different places of the boots. Beginners might not even notice how the tweaking could benefit them, while they do have a pleasant experience because of the ease of use. *Holiday Fanatics* see snowboarding as a recreational activity, therefore they are prone to easy and quick systems.

Figure 27 - Boot with 2 BOA systems on the left and a partial BOA system combined with traditional lacing on the left.

Figure 28 - Minnoyes Decision Tool applied to the four snowboarder personas, demonstrating what aspects are deemed important for that specific persona.

4.4.3 The Human Body

An analysis of the human body and the complementary snowboard movements is performed in collaboration with experienced snowboard instructor and apprentice physiotherapist H. van Gerven. The insights are listed in relevance to the corresponding design section..

Section A: The Calf Muscles
The superficial lower leg muscles, the gastrocnemius and soleus, should not be hindered by the design. The plantar flexion is driven by the gastrocnemius muscle, and dorsiflexion is directed by the soleus muscle (see figure 29). Plantarflexion is mostly prevented during snowboarding because the feet are strapped in the snowboard boots and bindings, the heel stays in place. However, dorsiflexion occurs when a toe-side turn is performed, combined with other muscles that help the body balance on its toes. A tensed muscle is sensitive so the design of section A should not interfere or block the muscle in any way.

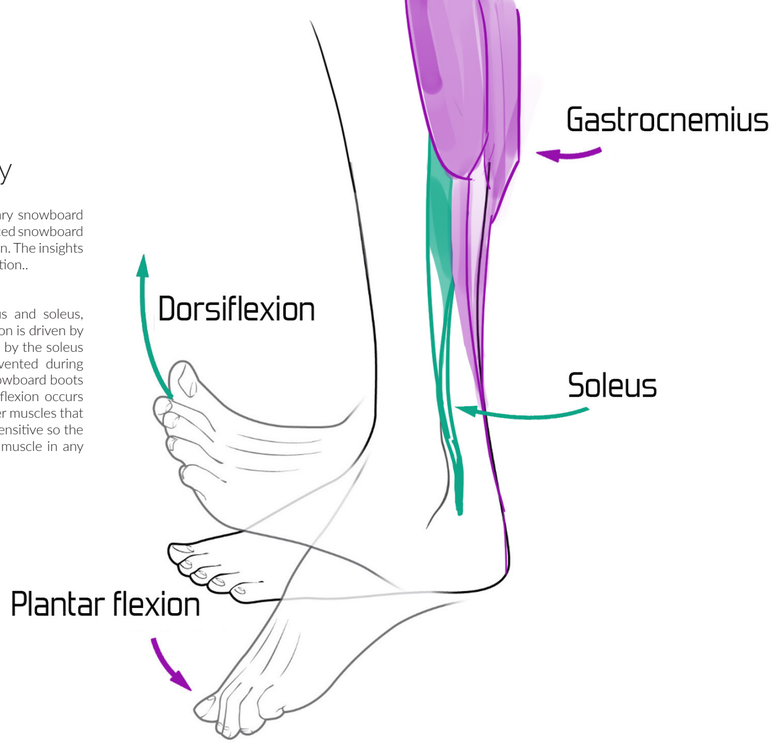


Figure 29 - Muscles and movements that need to be taken into account in the design.

Section C: The Soles of the Feet
Pressure is constantly applied on feet while snowboarding, therefore they should be supported properly without blocking force releasing movements such as the landing impact. It is often recommended at snowboard gear stores, to replace the standard insoles of snowboard boots for an insole that upholds the arch of the foot.

4.4.3 Applicable Conclusions

The opportunity is presented to include arch support in the design in section C to eliminate the necessity of buying new, reinforced insoles. As for the length of the sole of the concept, it should extend just beyond the metatarsus joints highlighted in figure 30, for balanced distribution of impact while supporting the foot muscles and bones.
To avoid pain and thus an unpleasant experience, it is important that the design does not put pressure on any protruding bones of the feet. Especially the knob on the lateral side of the midfoot, also highlighted in figure 30. To acquire optimal damping in the heel, the concept should not interfere with or block the damping structure of the outer sole.

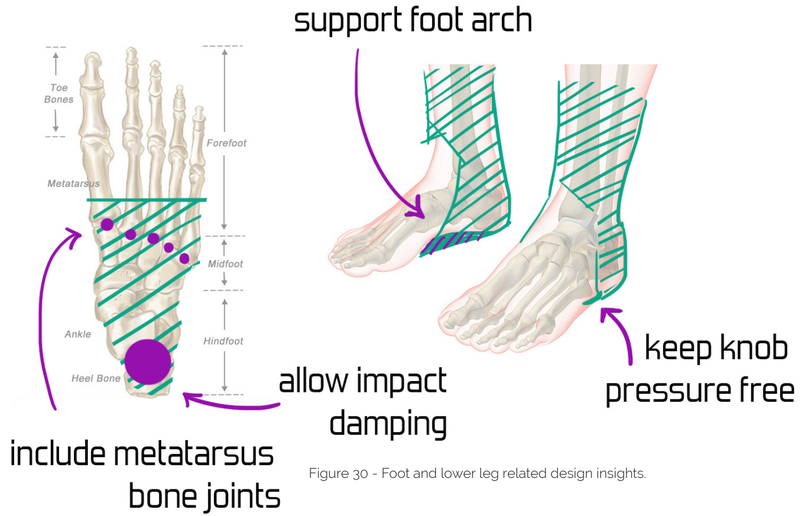


Figure 30 - Foot and lower leg related design insights.

4.4.4 Snowboard Movements

A snowboard boot is a high performance product. It has to function under applied pressure, while providing support, and in cold and wet weather conditions. Carving is a high speed, high power activity, responsive (thus stiff) gear allows the user to preserve control in these circumstances (see figure 31). These movements possibly create the most extreme positions in which the gear has to support the user. A for- and backward movement from the foot and lower leg occurs when shifting from the toe-edge to the heel-edge of the snowboard. While doing so, the front knee moves in the medial and lateral direction of the body, depending on the turn, creating a momentum on the boots. Figure 32 demonstrates the lower leg movement and weight shifting while performing both toe- and heelside turns.

The snowboard boots and bindings provide a higher level of support towards the back, as opposed to the frontal movement. However, during this frontal movement (toeside turn) the internal muscles of the lower leg and the big toe provide stability and power to perform the turn. Knee rotation and weight shifting play a bigger role during the heelside turn, since the lower leg muscles are in a different position and provide less power here.

Figure 31 - A snowboarder carving on the slopes, demonstrating the body movements during a toeside and heelside turn.

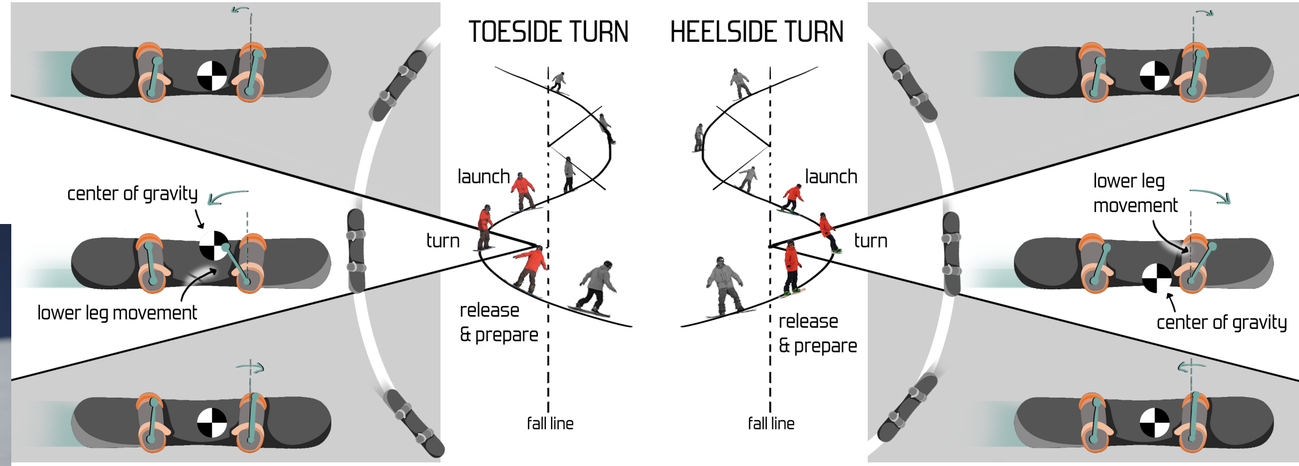


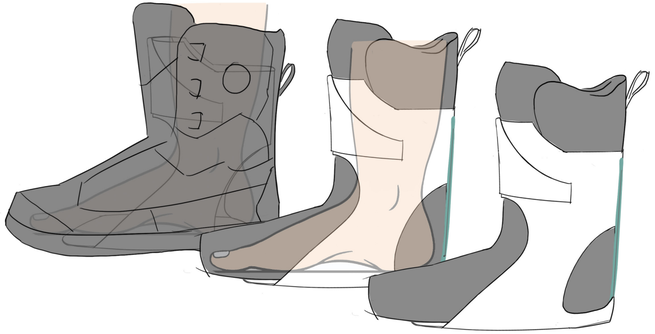
Figure 32 - Explanation of movement and weight shifting during a toeside and heelside turn.

Figure 33 demonstrates how freestyle snowboarders occasionally position their feet in unusual positions. Their feet move forward, backward, sideways or twist depending on the trick they are performing. In general freestyle snowboarders prefer to have freedom in their movement, creating an interesting trade off between flexibility and feeling supported. A stiffer boot can be desired when approaching bigger obstacles for more control, instead of flexibility.

Applicable Conclusions

Freedom is desired in the medial direction of the lower leg, whereas support is desired on the frontal-lateral side.

Figure 33 - Riding the rail (Nosova, 2018).



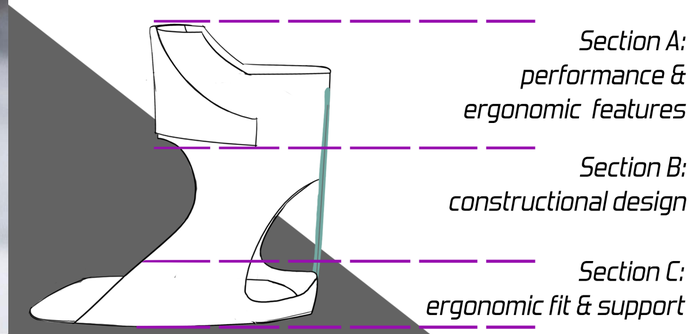


Figure 34 - Divided design sections A, B and C.

4.4.5 Design Choices

The made design choices are divided into 3 sections in order to go into detail more easily (figure 34). Section A and C are based on both ergonomics and performance aspects. Section B requires a stiffness and form study. The complete design should be tested and iterated before being a full-fledged product.

Section A

A form study is performed using a Deeluxe liner with painter's tape as a tool for 3D mock-ups and sketches (figure 35). The form study is led by the following design choices:

- Provide more support on the lateral side of the lower calf to increase stability in lateral movements *(subchapter 4.4.4 Snowboard Movements)*.
- Provide freedom for movement on the medial side of the lower calf to allow inward movements, desired for freestyle snowboarding.
- The surface of the part touching the calf-area should not create a pressure point. To avoid this, the designs have a significant area to spread the load.
- The medial side of the calf muscle gastrocnemius is likely to extend further down than the lateral side. To avoid pressure on the medial side of the gastrocnemius, the design choice has been made to avoid any material to reach too high, or have a hard edge. An extreme example of the asymmetry of the calf muscles is shown in figure 39.

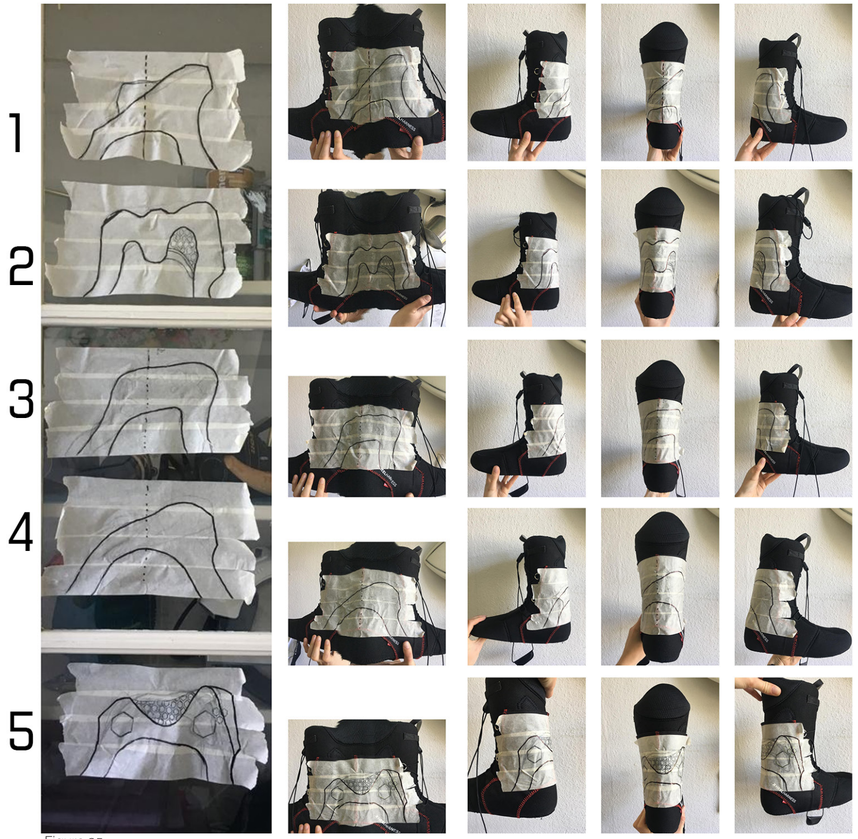


Figure 35 -

The 5th form (figure 35) is considered most suitable in terms of ergonomics, performance and style. The flexible material helps to divide pressure on the calf muscles which is an ergonomic advantage over the other forms. Furthermore, the hexagons match the Deeluxe form language. Hexagon shapes appear in some of their outer soles models, for instance the Skate Flex Sole in figure 36, as well as in the side panels of various snowboard boots such as the Deeluxe ID model in figure 37.

Figure 36 - Deeluxe's Skate Flex Sole

Figure 37 - Deeluxe's hexagon-shaped flex window

Figure 38 - Sideview from the design of Section A.

Figure 39 - Extreme contoured calf muscles (Ultra Body Sculpt, 2021).

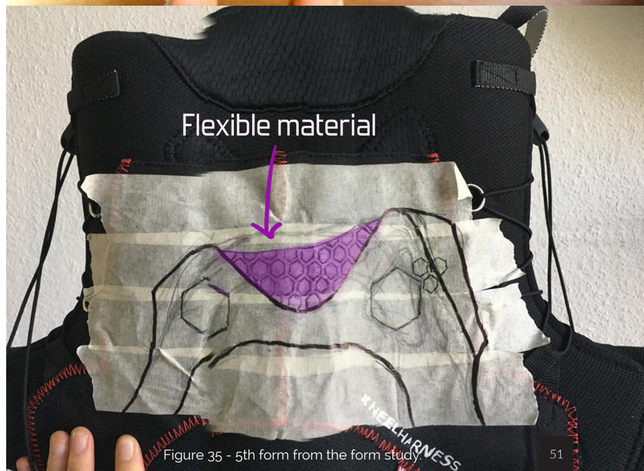


Figure 35 - 5th form from the form study.

Section B

The main functions of Section B are to provide stiffness and connect section A and C together. Only minimal deformation is allowed, the part most certainly should not break. Shape constructions, preloads and material optimizations need to be researched extensively to let the design function properly under snowboarding circumstances. These aspects are not included into the project scope and are therefore recommended to research hereafter. For now, a temporary simple shape has been chosen, so the concept comes together in a design.

Figure 40 - Aspects to take into account when designing section B.

Section C

Design choices:

- Provide more support on the lateral side of the foot to increase stability in lateral movements.
- Provide support for the foot-arch and a heel cup/hold, to provide a better ergonomic fit without needing specialized insoles.
- The surface of the part touching the foot-arch should not create a pressure point. To avoid this, the designs have a significant area to spread the load.
- The part should integrate with the harness, therefore this area under the foot is kept free of material as much as possible.
- The outer sole of snowboard boots is made to damp the body on impact. The design should facilitate this damping and not hinder it. The area underneath the heel should therefore be free.

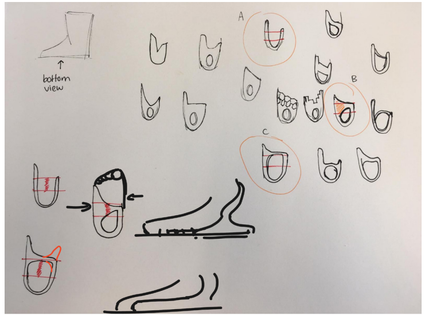


Figure 41 - Some form study sketches from the design process.

Figure 42 - Render showing the shape of the sole (excluding the foot arch support).

4.4.6 Prototype

A prototype is made for demonstrational purposes, to evaluate the size, shape and the ease of use. It is 3D printed, using a Creality Ender 3 Pro printer.

The earlier mentioned desired ergonomic foot-arch support, is not yet implemented into this prototype, simply because of limitations in the 3D modelling capabilities within the set time for this project. It would be interesting to test how this external foot support feels, and if it actually eliminates the need for additional, advanced insoles. Advanced insoles are currently being purchased by snowboard boot consumers, alternately creating extra waste because the new, under qualified standard insoles are immediately replaced and disposed of.

Figure 43 - The demonstrational Exo-Flex 3D print.

Product Evaluation Based on the Prototype

The dimensions used in the 3D model match with the already existing 3D model of a liner from Deeluxe. These dimensions should be revised for future design iterations, since the angle of the Exo-Flex model slightly varies with the actual liner, resulting in excess space at the back end of the heel.
The harness design could be optimized functionally and esthetically. Direct attachment of the harness to the liner should be avoided (see the top of the liner in figure 44), since it opposes a modular product system. Deeluxe has a variety of liners that do not have this attachment (figure 45). Nonetheless, it should be simple to lift or remove the harness to aid an easy installment of the Exo-Flex.
The placement of the Exo-Flex in between the harness and liner is essential for achieving a certain feeling of support. Therefore a nudge should be in place to ensure that the Exo-Flex is placed correctly. An easy installment process is key and misuse should be avoided at all times. It could prompt a negative experience, which forstalls sustainable behaviour, and thus prevents a reduction in environmental impact.
Additionally, the harness could be resized for aesthetic purposes, to avoid the Exo-Flex sticking out (figure 44). The design of the harness could nudge users in using the product as intended.

It would be interesting to do a user test, in which the ease of use and intuitiveness of this new way of handling snowboard boots could be tested. The results would provide insights into what comes natural to them and what part or interaction is unclear or unpleasant, design improvements can be made accordingly.

Figure 44 - The Exo-Flex positioned in its intended location.

Figure 45 - The Thermo Flex Primium Liner, with an independent harness.

5 Conclusions & Discussion

The design goal and the research questions are revised to conclude this report. This first section concludes, the context specific meaning of the elements that comprise the design goal. The design goal is annotated with these elements. Please keep in mind that the product-service system designed in this project sets a new approach in motion, but is still far from complete.

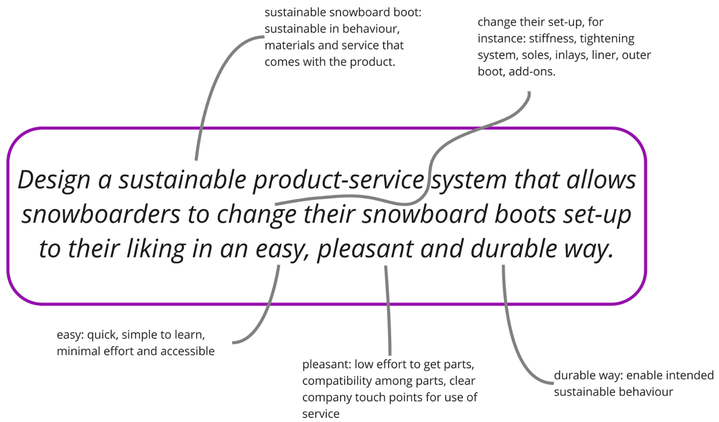


Figure 45 - Mountain landscape panorama (WallUp, 2016)

Sustainable
The proposed product-service system facilitates durable, sustainable behaviour without compromising the user's needs. The sustainable aspect can be found in the way the system enables product retention and upgradability, rather than in the change of materials.
The service stimulates product retention from the users side, and repairs and refurbishments on the company's sides. Retention is stimulated by the adaptable and upgradable qualities of the product-service, especially the adaptability of the comfort, stiffness, tightening systems and appearance.

To confirm whether this system is more sustainable than the current situation, it needs to be evaluated. The service has the potential to become a more sustainable alternative because fewer complete boot sets would need to be consumed over a period of time, thus saving material and energy in production. However, if and how users act upon the service defines whether or not the product-service system is more sustainable, the implementation and its evaluation are outside the scope of this report.

Change their set-up
The set-up of the snowboard boots can be altered by interchanging parts. The Exo-Flex and the already existing TPS Shield enable a change of stiffness and areas of support. Comfort can be altered by using a different liner and/ or thermoforming the liner. The appearance of the boots and the tightening systems can be altered by changing the outer boot, or even add-on straps. The changing of one's set-up is facilitated by the offering of separate product parts. Complete set-ups still need to be offered to help less experienced snowboarders to start somewhere.

Replacing broken product parts should be more attractive than buying a new pair of boots. Therefore the price of the parts should be considered carefully.

Easy
In the new product-service system, snowboard boots are offered in both sets and parts. Both the act of changing boot parts itself, as well as the perceived ease of using the service need to be simple. The ease of changing the parts has not been tested in this project, see chapter 6 - Recommendations for further comment. The perceived ease depends on the consumer's knowledge regarding their own needs and about snowboard boots in general. In other words, composing a boot set-up is likely to be easier for an experienced rider than for a beginner. Therefore, offering complete boot sets helps the user to take the plunge, while preventing an overwhelming feeling that is possibly caused by all part options.

The entire system of adapting or upgrading snowboard boots from parts, could profit from revising the designs from the existing snowboard boot parts. Compatibility amongst parts could be ensured by doing so, which increases the ease of use and required user effort.

Pleasant
The threshold to acquire product parts should be low making these parts both accessible and affordable. With Deeluxe's current distribution network, the products should be accessible and could be acquired with minimal effort.

The relation between Deeluxe and their distributors is personal and 'family like', according to Meinhardt. Switching to a modular product offering will take time and can be challenging, but is certainly a possibility. A pleasant product-service system experience also includes enjoyable interactions with the company. What an enjoyable interaction is, is not tackled in this project. However, the user touch points in the service should be designed accordingly, to avoid a loss of customers.

Durable
Durability is established through the design of the boots as well as the user's behaviour with a product. Whether the user behaves as intended is difficult to foresee. Unintended behaviour would be purchasing separate products more frequently than necessary, with the risk to reverse the environmental impact. Intentionally the user only replaces something that is broken, or owns two parts that serve different use-purposes (soft vs. stiff). Instead of two completely different boot pairs.

It is recommended to develop a system that stimulates intended behaviour. A possibility could be a system that positively reinforces users that had their product for a certain period of time or a certain amount of used times. Though this could stimulate users to hold on to something a tad longer, for others it could also imply that a product needs to be replaced even though it still functions properly. These examples show the risks and trickiness of designing for behavioural change. It would be ignorant to believe that unintended behaviour can be ruled out immediately and completely, regardless the overall impact of the designed intervention should be positive. A lot of knowledge can be gained when a product-service of this sort is implemented, Deeluxe should keep an open attitude and learn and adapt accordingly.

Concluding the research questions

What sustainable strategy fits the snowboard boots context best?
A modular product-service system, focussing on product longevity rather than solely on sustainable materials.

What motivates users to choose a sustainable snowboard boot?
Users demand certain qualities or features from their snowboard boots, which are now referred to as needs. Boots are chosen on how well they meet the user's needs. The importance of a certain need,varies depending on the type of user. The new snowboard boot design should benefit the user in terms of these needs and sustainability should be a nice occurrence.

How is sustainable behaviour stimulated among different types of users?
Users view sustainability differently, no correlation can be found between the established personas and specific sustainable beliefs.

The *Stoked Beginner, Holiday Fanatic* and *All-in Boarder* seem more likely to utilize the product-service system, thus perform sustainable behaviour. This assumption is based on their potential to grow and on their attitudes towards what they demand from their boots.

Who are the different types of users?
Four personas have been identified, a *Stoked Beginner, Holiday Fanatic, All-in Boarder* and *Professional Rider*. These personas are based on the experience of the rider, their needs, terrains and level of investment in the sport.

These personas cover a big group of people, but more personas could be made. Especially among different types of tourists and different types of locals. It is suggested to evaluate if the possible impact of having these personas is enough for a significant result.

What do snowboard boots mean to them?
Snowboard boots are viewed on one hand as trophies/sentimental items that represent the user's hobby and on the other as utensils. Snowboard boots as sentimental objects become utensils once the snowboarder has been practicing the sport for years. Sentimental-boots are sometimes stored in-sight, like a trophy, whereas utensil-boots are likely to be tucked away in a cupboard. Snowboard boots allow the user to do what they love, snowboarding. Purchasing snowboard boots is not as exciting as purchasing a new snowboard. Boots should therefore fit and perform well, while lasting very long. So the user can focus on picking snowboards for fun rather than getting annoyed by worrying about snowboard boots. Either way, users link snowboard boots to pleasant snowboarding memories and holidays.

At last, the design of new parts of an upgradable product is limited to the dimensions or connection mechanisms of the main product. For example, a Lego piece always needs to have small cylinders channels to be able to connect to other pieces, which is an easy starting point for the design of a new part as well as a limitation or a challenge. The first design of a modular snowboard boot concept should therefore be tested thoroughly and the design should be optimized before it is approved as an upgradable base or product. A strategy could be to connect every part to the boot independently, so without relying on a connection with another part.

Figure 46 - Snowboard boots as modular product-service system.

6 Recommendations

As discussed, Deeluxe currently does not have the infrastructure or support systems that are required to set up the proposed system. Their journey towards a more sustainable product offering is only just starting, therefore this section focuses on the present knowledge gaps that need to be filled in order to initialize this journey.

The conducted user research and literature studies regarding design for behaviour change both highlight the difficulty of facilitating change. The ease-of-use of a new product or system is absolutely crucial to its potential success. Further research and particularly testing with Deeluxe"s customers is therefore pivotal in the continuation of the design process. Optimizing this user experience should be tested throughout all elements of the service, from purchasing to return to ensure a competitive ease of use. Starting off with testing the perceived user advantages, including ease of use, to the modular product offering and the Exo-Flex itself. Regarding the actual benefits of the interchangeable stiffness brought by the Exo-Flex, Deeluxe has the advantage of a dedicated team of professional riders. This team of long-time snowboarders with specific demands of their gear can be utilized to test the performance of the product.

Moreover, the actual impact of the proposed system relies heavily on the actualization of the intended user behaviour. Measuring the willingness of customer participation should therefore be an integral part of maintaining and adapting the service while it grows over time. Just like the proposal itself, developing and running it as a company will not be a linear process. With each reclaimed product and each replaced part, Deeluxe can and should learn and adapt to make the changes required from the customer as accessible and easy as possible. As this way of working may be different from current operations, this may call for a more (exo) flexible mindset and procedure.

A slightly more future recommendation, based on market research, is one for Deeluxe to look into a potential collaboration in the snowboard boot rent sector. The advantages of having a more standard outer shoe with interchangeable performance elements are easy to see for this large and profitable sector. Making it easier to offer gear to a wide range of customers. Gear is used more intensely by numerous different users throughout a season and part replacements could potentially stretch that period. A collaboration in the renting sector could prove to be interesting for Deeluxe not only for their large numbers but also for their market share. As especially the Stoked Beginners and Holiday Fanatics are likely to rent their snowboard gear, they could familiarize themselves with the brand and their modular offering prior to making any purchasing decision on their own. Any step in this direction would obviously require much more analysis and investigation into possibilities, but as its potential aligns well with the vision on modularity, which makes it worth mentioning.

Figure 47 - Possibility of inclusiveness in future vision.

Finally it is worth mentioning that this modular product offering is incredibly inclusive for users with special needs (for instance for those who have only one leg, or those who have 2 different foot sizes). Deeluxe could be a pioneer in inclusive sports design, making snowboard boot(s) accessible, affordable and match perfectly, while avoiding premature waste, for example, of unused left boots. This area is rather unexplored within this project, the purpose of mentioning it solely to inspire others and show the power of modular design in the ability to add personal value to a product, whoever the user may be.

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Figure 48 - Max Meinhardt and myself in Austria, while testing various Deeluxe boot models.